A Multidimensional Model on Compliance to Environmental Regulations of Covered Establishments in Davao Region, Philippines Amidst the Covid-19 Pandemic

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Abstract: - This study was conducted to develop a multi-dimensional model for compliance to environmental regulations of the covered establishments in the Davao Region, Philippines during the COVID-19 pandemic. Utilizing exploratory factor analysis, the study processed 351 responses from Pollution Control Officers and Managing Heads of Category A and Category B establishments in Davao Region through an online survey. After several rotations and based on criteria set, a total of 19 items were generated as factor structures and were categorized into six factors. The cumulative load percentage of these six factors was calculated at 47.806 which implies that these six constructs could explain approximately 47% of the total variability of compliance to environmental regulations. The quantitative data reduction revealed that during the pandemic, compliance to environmental regulations may be heightened considering the following dimensions: inter-agency collaboration in information dissemination, adaptability in environmental enforcement, observance of health protocols, accountability and leadership in environmental management, digitization in environmental capability building, and unrestricted mobility for environment-related travels.

Key Words: — ***Multidimensional model, compliance, environmental regulations, exploratory factor analysis, COVID-19 pandemic, covered establishments, Davao Region, Philippines.***

I. INTRODUCTION

Environmental laws developed in response to the several significant environmental events in the 20th century which required careful attention at the local, national, and international levels (Callan, 2017). In the Philippines, since the inception of the Environmental Code under Marcos' regime, several environmental policies had been enacted to mainstream the protection of natural resources. In fact, according to Gera (2016), the Philippines has been considered to have the most progressive environmental regulation in Southeast Asia.

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This is evident in the promulgation of several environmental laws, memorandum orders, and circulars such as the Philippine Clean Air Act, Philippine Clean Water Act, Ecological Solid Waste Management Act, Toxic Wastes and Hazardous Wastes Control Act, and the Philippine Environmental Impact Statement System, among others. But despite this, the compliance of establishments with these environmental laws remains questionable. For instance, only a few local government units execute the full implementation of ecological solid waste management (Ancheta et al., 2020) and studies revealed that many other LGUs are struggling to implement it (Geguinto, 2017). This situation is prevalent under the normal state of things. Unfortunately, by the onset of the COVID-19 pandemic crisis, more and more establishments showed complacency in environmental compliance due to the observance of health protocols. Also, the unexpected fluctuations in the generation of waste brought about by the pandemic require a dynamic and strategic response from policymakers (Sharma et al., 2020). Consequently, in response to the Covid-19 pandemic, the policymakers of many states adopted several temporary policies that suspended, delayed, or

relaxed various environmental safeguards (Mc Cury et al., 2021).

Studying the status of compliance with environmental regulations among covered establishments is crucial to the attainment of the State's principle to protect and enhance the rights of the Filipino people to a balanced and healthful environment in accord with the rhythm and harmony of nature (Gonzales, 2017). Many other studies revealed that understanding the factors that influence environmental compliance as well as the underlying reasons for environmental violations significantly relates to the creation of relevant strategies to improve the management of natural resources in the country. Machaka et al. (2016) uncovered that EIA reports in Zimbabwe contain less than 65% of the required information needed to make environmental decisions and therefore, there is a need to improve the monitoring and enforcement of compliance processes. This is supported by Weekers et al. (2021) when they suggested that law enforcement strategies should focus on reducing the negative outcomes of environmental violations. This was very relevant during the COVID-19 pandemic where environmental enforcement is hindered by the threat of viral infection among implementers and the need to abide by the health and safety protocols imposed by local governments.

Before the pandemic, which infected more than one million people throughout the world (Percival et al., 2021), covered establishments in the Philippines could easily submit quarterly and semestral reports to the DENR, apply for permits conveniently, submit samples for laboratory testing with ease, and the like. Likewise, the DENR-EMB personnel ensured full implementation of environmental regulations by reviewing submitted reports, processing permits, and clearance applications, conducting monitoring and many others. But with the limitations due to restricted mobility, quarantine protocols, and border lockdowns (Wells et al., 2020), these customary environmental compliance procedures are being challenged. No one can simply go out without the threat of being infected by the COVID-19 virus. Hence, despite the presence of environmental policies, several establishments have been reprimanded for having violated the provisions of the law (Yu, 2020). Despite this, even if measures have been put in place to ensure the protection of the environment, it can be noted that the number of violators had been consistent and varied from individual to institutional. According to Howes et al. (2017), decades of scientific monitoring indicate that the world is not closed to environmental sustainability and in many respects, the situation is getting worse. This means that non-compliance to environmental laws does not only rest on people but also on the establishments that ignore the profundity of these regulations. For instance, in the European Union, it was found that companies have poor performance in compliance with environmental aspects specifically on the emission of greenhouse gases and hazardous wastes with high levels (Habib & Bhuiyan, 2017). An effective way of bringing polluters under compliance is by imposing environmental fines to discourage them from doing the same in the future. But in Bangladesh, there are issues with the implementation of environmental regulations due to the absence of structured penalties commensurate to the reported violations (Nabil, 2018).

To sustain compliance with environmental regulations amid the limitations posed by the pandemic crisis, certain measures may be considered by implementing agencies to uphold fairness and consideration to covered establishments. In the US for example, while a substantial number of new regulations was passed to address the pandemic, many environmental policies and regulations have been relaxed or suspended since COVID-19 began to spread in the country (Kecinski et al., 2020). These acts either deregulated or weakened environmental legislation such as reducing environmental fines during the pandemic (Vale et al., 2021). But in the Philippines, the government continues to crack down the establishments which have violated applicable environmental laws even if the said establishments are greatly affected by the impact of the pandemic. A recent pronouncement by the DENR revealed that although environmental compliance in the Philippines is at stake with the onset of the COVID-19 pandemic, it should not be an excuse for dropping guard against violators of environmental laws (Cimatu, 2020). This is rather a ferocious and aggressive move because most establishments are hampered by lockdowns and quarantine protocols. There is therefore a pressing urgency to come up with strategies on how to effectively comply with the environmental laws that are both beneficial to covered establishments and concerned implementing agencies such as the DENR. This can be a landmark solution to sustaining the quality of the environment despite the threats brought about by the COVID-19 pandemic.

Further, this study is anchored on the theory of goal framing and norm-guided environmental behavior by Lindenberg and Steg (2013). This theory suggests that the values and norms of the existing scenario must guide the pro-environmental behavior of individuals and institutions. This insight emanated from the idea that in a situation where values and norms are

disrupted or changed, as in the case of the COVID-19 pandemic, a concrete policy implication is generated to promote pro-environmental behavior by revisiting the implementation of environmental laws. This is seen as a bold move to at least promote sustainable development even amid the challenges and limitation of the pandemic.

Therefore, this study was conducted to develop a model on the different dimensions that will enable the covered establishments in Davao Region to comply with environmental regulations amid the COVID-19 pandemic.

II. METHOD

2.1 Research Respondents

The respondents of this study were 351 Pollution Control Officers and Managing Heads of Category A and Category B establishments in the Philippines. According to the DENR Administrative Order 2014-02 (2014), a Category A establishment does not handle, store, or use any chemical that is listed in the Priority Chemical List (DAO 2005-27, 2005), has a small quantity generator or hazardous waste, uses air pollution source equipment that does not require stack sampling, generates less than 30 kilograms of solid wastes per day, and discharges less than 30 cubic meters of wastewater per day. On the other hand, a Category B establishment handles, store, or use chemicals that are listed in the Priority Chemical List (DAO 2005-27, 2005), especially those that are under the Chemical Control Order.

In data reduction, the number of samples required to proceed with the data processing is at least 300 as recommended by Yong and Pearce (2013). An older reference explains that in factor analysis, a sample of 100 would be poor, 200 be fair, 300 be good, 500 be very good, and 1000 or more is excellent (Williams et al (1996). Alternatively, cases to a variable ratio of 1:5 or one items in the instrument are equivalent to five respondents is considered minimum. Hence, considering the total items of 50 in the instrument, at least 250 respondents are counted as the minimum sampling frame of this study. Depending on the efficiency of the data collection, the number of respondents might reach as many as 1000 to reach the excellent description of sampling for factor analysis.

However, in this study, random sampling was used to select the target respondents. According to Bulacan (2021), there are about 800 covered establishments in Region XI. Based on Slovin's formula, 260 is the calculated and accepted sample at a 95% confidence level and a 5% margin of error.

The study was conducted in the entire Davao Region or Region XI based on geographical and political delineations. This study covered both category A and category B establishments in the region as defined in the DENR Administrative Order No. 02, s. of 2014. In Davao Region, most of the non-compliance to applicable environmental laws include operating without hazardous waste generator's ID, permit to operate air pollution source and wastewater discharge permit for waste water generation (DENR-EMB, 2021).

2.2 Materials and Instrument

This study utilized an original and researcher-made survey questionnaire which consists of fifty items extracted from the interview conducted with selected environmental management practitioners and regulators. Because of the novelty of this topic and the nature of the research design being utilized, an original instrument needs to be generated through the Delphi technique. Chalmers and Armour (2019) argue that a Delphi technique can help in the acquisition of knowledge by exploring and identifying the fundamental elements of a phenomenon. They further explained that this is a process of collecting data by throwing away a successive round of polling until such time that a consensus has been made. In the case of producing an instrument specific to this study, one question was introduced to several practitioners in environmental management with similar characteristics to the respondents of this study. However, due to the limitations of quarantine protocols posed by the government amid the COVID-19 pandemic, the conduct of the Delphi technique was done through online polling. This is a process of collecting data by distributing the Delphi question through the use of online platforms such as google forms (Torrentira, 2020).

The survey instrument was further validated by a panel of experts which consisted of four academicians and researchers. The mean score of content validation was 4.82 described as very good. This means that the items are very highly relevant to the assumed dimensions. The questionnaire was later presented to the thesis advisory committee for further review and enhancement. After complying with the comments of the panel, the survey instrument was further subjected to pilot testing with the help of 20 respondents to account for the internal consistency of the instrument. The questionnaire's Cronbach's alpha coefficient was then measured. Based on the reliability test, Cronbach's alpha coefficient for the questionnaire was 0.941 which is deemed to be acceptable.

To interpret the responses of the study participants, the following Likert-like scaling was used: 5 for 4.20 to 5.00

interval which is interpreted as highly essential, 4 for 3.40 to 4.19 interval which is interpreted as essential, 3 for 2.60 to 3.39 interval which is interpreted as somehow essential, 2 for 1.80 to 2.59 interval which is interpreted as less essential, and 1 for 1.00 to 1.79 which is interpreted as not essential.

2.3 Design and Procedure

This non-experimental quantitative research made use of empirical data expressed numerically to represent the perception or experience of the respondents without manipulating the independent variable through random assignment into a control group (Frey, 2018). As such, quantitative data were gathered, accumulated, encoded, and statistically processed to analyze and estimate the interaction of variables through a deductive process. This interaction of variables led to the likelihood of the emergence of one phenomenon or outcome. This type of research design generally aims to measure social realities that can be objectively determined.

Further, this quantitative study made use of descriptive-exploratory design to generate factors through data reduction which represented the dimensions of environmental compliance of covered establishments amid the COVID-19 pandemic crisis. According to Rahi (2017), the purpose of exploratory research design is to seek new insights and to find out what is happening which attempts to ask questions and assess a phenomenon in a new light. Van Wyk (2017) argues that an exploratory design for research is very useful when there is a high level of uncertainty and even ignorance about the research topic. Moreover, considering that a pandemic is a novel experience for the present generation, this design would be very helpful to uncover insights that will help the concerned establishments to better understand the needed modalities of complying with environmental laws despite the many restrictions being implemented at the time of quarantines.

The major objective of this exploratory research is to identify the salient factors for environmental compliance. According to Bandalos and Finney (2018), factor analysis is a multivariate statistical procedure that reduces a large number of variables into factors while establishing the underlying dimensions between measured variables and latent constructs to allow the formation of a model.

Before the pandemic, collecting data for research could be easily done through an actual survey, face-to-face interview, focus group discussion and extensive literature review. But all these became unworkable and difficult with the onset of the pandemic primarily due to quarantine restrictions and other health protocols implemented by the local governments. Hence, the researcher resorted to conduct an online survey rather than a physical survey. An online survey is a process of distributing the instrument or the questionnaire to the target respondents using online platforms.

While the personal distribution of surveys is desirable in terms of improving response rate, online distribution on the other hand is a very feasible adaptation given current restrictions (Tabaley et al., 2020).

A survey is a process by which the participants of the study personally respond to the structured questionnaire produced by the researcher. The responses are then retrieved, encoded, and analyzed to generate statistical data in the form of graphs or tables. Vaske (2019) elaborated that the data collected from surveys can result in hundreds of variables and thousands of respondents in a rigid process of data encoding in the database, running preliminary analysis to detect any missing data or potential outliers, conducting reliability and validity tests, and converting the data to generate indices of underlying concepts.

But during the COVID-19 pandemic, social distancing and quarantine protocols are strictly implemented by local governments across the globe. This poses a big challenge in the data collection through a traditional survey that requires individual interaction with a large number of respondents or participants. This is strictly prohibited during the pandemic to prevent the possible spread of the coronavirus. Hence, in the middle of these restrictions, an online survey as a technique in data collection becomes inevitable.

The distribution of electronic survey questionnaires was done without a cost by employing google forms through the services of email, messenger, Facebook, WhatsApp, and other social media accounts (Torrentira, 2020). In this way, the respondents were able to access an online survey through email specifically set up for the research (Barnes et al, 2020). Hence, amid the many restrictions on mobility during the COVID-19 pandemic, data collection through this remote online platform can be feasible, safe, and very convenient.

This study made use of Exploratory Factor Analysis (EFA) as a data reduction technique. According to Newson (2012), EFA can discover the factor structure and the number of latent constructs of a set of variables without imposing preconceived hypotheses about the nature or outcome of the underlying factor structure of a measure. This statistical tool was able to identify the principal constructs of compliance with environmental

regulations amid the COVID-19 pandemic among establishments in the Philippines. On the other hand, the Keiser Meyer Olkin or KMO Measure of Sampling Adequacy tested the magnitude of partial correlation among identified constructs while Bartlett's Test of Sphericity determined the presence or absence of identity matrix of the correlation. The latest version of the Statistical Package for Social Sciences (SPSS) was used to process the data. The data collection was conducted from July 1, 2021, to June 30, 2022.

In the conduct of this study, the researcher made sure that the highest ethical standards and guidelines set forth by the University of Mindanao Ethics Committee are being upheld. Before the survey was conducted, UMERC Certification was secured, with the numbers UMERC-2020-234. The key provisions such as voluntary participation, privacy and confidentiality, recruitment of participants, informed consent process, risks, benefits, plagiarism, fabrication, falsification, conflict of interest, deceit, permission from location, technological issues, and authorship were observed. Using the online platform through google survey, the respondents were informed that their participation in the study is the primary source of data to generate informed consent. The respondents' participation in the online survey was voluntary and if in case he or she withdraws from the study, he or she was allowed to do so. In the formulation of the items in the instrument, the researcher made sure that they are not offensive and discriminatory. The anonymity of the respondents was upheld and all information or the works of other authors were properly acknowledged. In compliance with RA 10173 or the Data Privacy Act of 2012, all data and information that were useful in the research study were kept with the strictest confidentiality. Proper authorization and consent were obtained from the sample of the study, wherein they were assured that all their rights were fully protected, specifically in handling the data such as, but not limited to their location, establishment categorization, email address, and responses to the questionnaire statements.

III. Result And Discussion

3.1 Factor Analysis

In this section, the results of the Kaiser Meyer-Olkin Measure, Bartlett's Test and Principal Component Analysis are presented. The derivation of the number of factor structures, as well as the rotated matrix of the model, is also presented using Varimax with Kaiser Normalization.

KMO and Bartlett's Test. To ensure that the construct can be tested for factor analysis, the Kaiser Meyer-Olkin Measure (KMO) of Sampling Adequacy and Bartlett's test of Sphericity were performed. It can be gleaned from Table 1 that the KMO value is .921 which is above the recommended value of .5, indicating that the sample is meritorious and adequate for factor analysis. Almalak et al. (2014) recommend that values greater than .5 are acceptable. In particular, values .5 to .7 are mediocre, values between .7 and .8 are good, values between .8 and .9 are great and values above .9 are superb.

Meanwhile, Bartlett's test was performed to check if there is a certain redundancy between the variables that can be summarized with a few factors. The results revealed that the p-value is significant ($p<.05$) indicating that the data have patterned relationships, and factorability is assumed. It was emphasized by Tabachnick and Fidel (2007) that Bartlett's Test of Sphericity should be significant for factor analysis to be suitable. With this value, factor structures can be developed.

As shown in the preliminary analysis, it can be generalized that the items in the tool are suitable and adequate for the extraction of factors, and thus ready for factor analysis.

Table.1. *KMO and Bartlett's Test*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.921
Bartlett's Test of Sphericity	Approx. Chi-Square	8180.827
	Df	1225
	Sig.	.000

3.1.1 Derivation of the Number of Factor Structure and Total Variance Explained.

The derivation of factor structure was determined through the eigenvalues of the components. As a rule of thumb, components are selected whose Eigenvalue is at least 1. Table 2 presents the number of constructs extracted, initial Eigenvalues associated with the specified constructs, the percentage of the total variance, and the cumulative percentage of each construct. After utilizing the criterion for Eigenvalue, the 50 items of the scale seem to measure eleven underlying factors because the first eleven components have an Eigenvalue of at least 1. The eleven underlying factors represent the initial multidimensional model on the compliance to environmental regulations of establishments in Davao region amid the Covid-19 pandemic.

Table.2. *Total Variance Explained*

Component	Initial Eigenvalues	Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings

	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.596	29.191	29.191	14.596	29.191	29.191	7.725	15.450	15.450
2	3.864	7.728	36.920	3.864	7.728	36.920	3.657	7.315	22.765
3	1.931	3.863	40.782	1.931	3.863	40.782	2.840	5.681	28.446
4	1.542	3.085	43.867	1.542	3.085	43.867	2.600	5.199	33.645
5	1.449	2.898	46.766	1.449	2.898	46.766	2.485	4.970	38.614
6	1.384	2.767	49.533	1.384	2.767	49.533	2.292	4.584	43.198
7	1.260	2.519	52.052	1.260	2.519	52.052	2.105	4.210	47.408
8	1.163	2.326	54.378	1.163	2.326	54.378	2.056	4.112	51.519
9	1.088	2.175	56.553	1.088	2.175	56.553	1.979	3.958	55.478
10	1.055	2.110	58.663	1.055	2.110	58.663	1.428	2.856	58.333
11	1.008	2.017	60.680	1.008	2.017	60.680	1.173	2.346	60.680
12	.954	1.907	62.587						
13	.916	1.833	64.420						
Extraction Method: Principal Component Analysis.									

3.1.2 Rotated Component Matrix.

After identifying the number of factor structures, the 50-item construct was then subjected to rotations which converged in 25 iterations based on the statistical outputs (refer to Appendix A). Table 3 shows the pattern matrix using Principal Component Analysis with a rotation method of Varimax with Kaiser Normalization. Based on the standard rule of factor analysis, items with a loading value of less than .60 should be excluded. This is supported by Field (2005) who expounded that a loading value of at least .60 is recommended and necessary to obtain the desired factors. Further, twenty-two items showed loading coefficients above .60. Of these, three items however were lone items and were not able to produce constructs; hence, they had to be eliminated from the initial grouping. On the other hand, the remaining 28 items had a loading coefficient below .60 which indicates face validity issues and low communalities. They are therefore excluded from the development of the construct. This supports Hair et al. (2010) who posited that those items having no sense and not reflective of the factor can be removed from the model. Further, Hair et al. (2010) continued that loading coefficients can be set by the researcher to select only those items that best represent the factor, and those low coefficients may not be included in the factor structure. Furthermore, Field (2005) stated that the suppression of communalities less than .60 and ordering variables by loading size will make interpretation easier because there is no need to scan the matrix to identify substantive loadings.

3.2 Rotated Component Matrix with Grouped Items

Based on the criteria set, a total of 19 items were categorized into six dimensions after undergoing two rotations, namely; inter-agency collaboration in information dissemination, adaptability in environmental enforcement, observance of health protocols, accountability and leadership in environmental management, digitization in environmental capability building, unrestricted mobility for environment-related travels. The cumulative load percentage of these six dimensions was calculated at 47.806 which implies that the six constructs could explain approximately almost half of the total variability.

These constructs and the categorized items are presented in tables and discussed with other related scientific studies. New understanding and insights that emerged from the results of the study were also discussed.

Dimension 1. Table 3 shows the seven items that fall under the first construct namely; inter-agency collaboration in information dissemination and their corresponding loading coefficients. As shown, item no. 41 garnered the highest loading coefficient of 0.798 which states that *the LGUs should coordinate with EMB and other government agencies in all environment-related activities.* The other items included in the first dimension are the following: *implementation of environmental laws should be a collaboration among LGUs, government agencies, and other private establishments* with a loading coefficient of 0.758; *associations or organizations of PCOs can help in promoting sustainable development* with a loading coefficient of 0.683; *EMB must have developed the crisis management plan that will help the PCO's comply with*

the environmental laws with a loading coefficient of 0.666; *environmental awareness should be reinforced by online platforms during this time of pandemic* with a loading coefficient of 0.66; *EMB should strategize to monitor the compliance of establishments to environmental laws despite the pandemic* with a loading coefficient of 0.659; and *communication and constant dissemination of information online should be done to update the PCO's* with a loading coefficient of 0.618.

The stated items imply a need for inter-agency collaboration in the dissemination of information relevant to instructions and memorandum orders from the Environmental Management Bureau.

It can be inferred that the pollution control officers and managing heads of covered establishments can have a better grasp of guidance on how to comply with the environmental regulations amid many restrictions and lockdowns imposed by the local government units. When the information is coursed through the agencies, easier coordination can be made. Hence, awareness of the updates of policies can be enhanced if there is a coordinated channeling of information from the department to bureaus, LGU's even to the establishments.

This finding can be corroborated in the study of Arshad (2019) which mentioned that inter-agency collaboration is important in addressing the limitations of vulnerable groups especially those who were deeply affected by the pandemic. A greater resolution can be achieved if there is collaboration and coordination among concerned agencies and establishments. Meschede (2019) further explained that coordination is important to capacitate the agencies in confronting crises. This is very true in the dissemination of the right information so that any concern in environmental compliance can be addressed despite the challenge of quarantines and lockdowns. In Indonesia, information was made widely available immediately after the first case was reported by establishing an information and data center. This prompted a well-organized and coordinated flow of information in response to the growing threat of the virus through a one-gate command system (Hizbaron, 2021).

Table.3. Items Grouped Under Inter-Agency Collaboration in Information Dissemination

Item No.	Items	Factor Coefficient	Construct
41	The LGUs should coordinate with EMB and other government agencies in all environment-related activities	0.798	Inter-agency Collaboration in Information Dissemination
42	Implementation of environmental laws should be a collaboration among LGUs, government agencies, and other private establishments	0.758	
43	Associations or organizations of PCOs can help in promoting sustainable development.	0.683	
38	EMB must have developed a crisis management plan that will help the PCOs comply with environmental laws.	0.666	
45	Environmental awareness should be reinforced by online platforms during this time of the pandemic	0.66	
40	EMB should strategize to monitor the compliance of establishments with environmental laws despite the pandemic.	0.659	
46	Communication and constant dissemination of information online should be done to update the PCOs	0.618	

Dimension 2. Table 4 shows the four items that fall under the second construct namely; adaptability in environmental enforcement and their corresponding loading coefficients. As presented, *EMB and other environmental agencies should consider waiving penalties for violations that are beyond the control of the establishments due to the pandemic* obtaining a loading coefficient of 0.716. Secondly, fees and penalties need to be adjusted because establishments are still making up for the economic impact of the quarantines and lockdowns obtained a loading coefficient of 0.699. Third, *EMB must be considerate and adjust the deadlines for submission of reports when community quarantines constrain the timely generation of data on sampling, laboratory analysis, testing, notarial services, etc.* obtained ta loading coefficient of 0.675. Finally, the last item which was stated as *EMB should consider late submissions, an extension of validity of permits and clearances due to the limitations of quarantines* obtained a loading coefficient of 0.65.

This group of items summarizes the need to reconsider the penalties being incurred by the establishments due to the violations which can be attributed to the limitations and challenges posed by the pandemic. It can be inferred that the pandemic hindered important travels that are necessary for compliance such as the acquisition or procurement of equipment and tools needed in the pollution control processes, obtaining water samples for laboratory testing and analysis, the actual processing of permits and clearances, submission of quarterly or semestral reports, and others. These scenarios are beyond the control of the establishments but if not complied with, will lead to non-compliance, therefore, a cause for violation and the imposition of penalties.

It is suggested in this study that the EMB and other agencies may adjust their violation and penalty schemes to pave way for the establishments to catch compliance despite the challenges and limitations of the pandemic. Strategies like waiving fees, extending the validity of permits, and reduction of penalties may be considered knowing that doing business amid the pandemic is very risky and ambiguous.

This narrative is not peculiar to the Philippines. In fact, in Taiwan, during the onset of the pandemic, inspectors were encouraged to waive the penalties and fines imposed on small to medium-sized enterprises that were found to have violated Taiwan's environmental laws in consideration of the impending threats of the virus (Fang, 2020). Environmental governance, therefore, needs to be returned according to the challenges of the time. In the US, after the declaration of the pandemic, the Environmental Protection Agency immediately announced that there will be a relaxation or lenience of enforcement of environmental policies in terms of submission of environmental reporting and even other violations. This is a bold move of the government so that the establishments are not penalized outright in the face of the threats of the virus (Flatt, 2020).

Table.4. Items Grouped Under Adaptability in Environmental Enforcement

Item No.	Items	Factor Coefficient	Construct
10	EMB and other environmental agencies should consider waiving penalties for violations that are beyond the control of the establishments due to the pandemic.	0.716	Adaptability in Environmental Enforcement
2	Fees and penalties need to be adjusted because establishments are still making up for the economic impact of the quarantines and lockdowns.	0.699	
5	EMB must be considerate and adjust the deadlines for submission of reports when community quarantines constrain the timely generation of data on sampling, laboratory analysis, testing, notarial services, etc.	0.675	
39	EMB should consider late submissions and extensions of the validity of permits and clearances due to the limitations of quarantines.	0.65	

Dimension 3. In Table 5, the two items that fall under the third construct are shown namely; observance of health protocols and their corresponding loading coefficients. As shown, *health protocols like wearing masks, observing social distancing, regular disinfecting, and others should not be compromised in complying with environmental requirements* obtained a loading coefficient of 0.734. Likewise, *environmental protection should not be compromised even if there are restrictive community quarantines* obtained a loading coefficient of 0.629.

In this dimension, it is very clear that health and the environment are both equally important. The sustainable development goals of the United Nations included health under social development in the equilibrium of economic development and environmental protection. This means that even if there is a pandemic, the concern for environmental protection should not be undermined while at the same time, providing mechanisms to prevent the proliferation of COVID-19. Hence, in complying with environmental laws, health protocols such as wearing face masks and face shields, social distancing, regular hand washing, and the like should be observed.

According to Shirali et al. (2020), social distancing and wearing masks are tools that seek to minimize the possible spread of infections among individuals. This is equally important with environmental compliance. While adhering to the supremacy of environmental protection, the implementers and followers of environmental laws should take seriously the need to protect themselves from being infected by the virus by observing the

right health protocols. The study of Dzisi and Dei (2020) suggested that public transport remains an area of high risk in the fight against COVID-19. It was therefore recommended to implement strict directives on the observance of health protocols such as wearing masks and physical distancing to reduce the risk of being infected by the disease.

Table.5. Items Grouped Under Observance of Health Protocols

Item No.	Items	Factor Coefficient	Construct
20	Health protocols like wearing masks, observing social distancing, regular disinfecting, and others should not be compromised in complying with environmental requirements	0.734	Observance of Health Protocols
11	Environmental protection should not be compromised even if there are restrictive community quarantines	0.629	

Dimension 4. In Table 6, the two items that fall under the fourth construct are shown namely; accountability and leadership in environmental management and their corresponding loading coefficients. As shown, *stricter monitoring of EMB on the disposal and treatment of hospital wastes that may have been infected by the coronavirus must be implemented* obtained a loading coefficient of 0.753. On the other hand, *when managers or*

owners are knowledgeable of environmental laws; it will be easy for the personnel to comply obtained a loading coefficient of 0.656.

At the height of the COVID-19 pandemic, the risk of getting infected was very high, especially for front liners. Considering the influx of patients in hospitals and other healthcare facilities, residual wastes that may have been contaminated by the virus should be disposed of appropriately following the standards of both Department of Health and the Department of Environment and Natural Resources. Hence, strict monitoring should be made so that a greater problem of community infection which may result in lockdowns may be avoided. Lockdowns usually restrict the mobility of individuals including those who need to implement environmental mandates. The concerned agencies are held accountable for the monitoring of the proper disposal of these wastes.

But the key to gaining support and command is leadership. If the managers and even owners are very knowledgeable and capacitated in dealing with environmental compliance, it will be very easy to inspire and motivate the employees such as the pollution control officers to comply with the environmental laws even amid the threats of the COVID-19 virus.

A recent study in China concluded that leadership in environmental compliance resulted in a significant decrease in emissions (Zhang et al 2018). This means that leadership is essential in pursuing responsible and sustainable environmental protection. In the words of Li et al. (2019), policy implementation is essential to the effectiveness of environmental governance. Therefore, this kind of governance requires accountability to ensure transparency and sensitivity of the implementers of environmental policies, especially amid the threats of COVID-19.

Table.6. Items Grouped Under Accountability and Leadership in Environmental Management

Item No.	Items	Factor Coefficient	Construct
15	Stricter monitoring of EMB on the disposal and treatment of hospital wastes that may have been infected by the coronavirus must be implemented.	0.753	Accountability and Leadership in Environmental Management
9	When managers or owners are knowledgeable of environmental laws, it will be easy for the personnel to comply	0.656	

Dimension 5. In Table 7, the two items that fall under the fifth construct are shown namely; digitization in environmental capacity building and their corresponding loading coefficients. As shown, *specific online environmental training will help me comply with the provisions of the environmental laws* obtained a loading coefficient of 0.759. On the other hand, *online environmental training and seminars will make us technically competent* obtained a loading coefficient of 0.684.

One very important element to raise the awareness of pollution control officers and managing heads is capability-building activities such as training, seminars, and workshops. This means that appropriate technical competencies for environmental compliance should be developed among the concerned individuals. However, given the policies on social or physical distancing and the prohibition of social gatherings due to the risk of community infection, distance learning through online or virtual training is the most efficient way to capacitate the PCOs and managing heads. This will minimize the risk of being infected while substantially complying with environmental laws.

Warner and Wager (2019) defined digital transformation as the use of the internet of things to create a seamless flow of information using digital technologies or platforms such as zoom, google meet, MS Teams, and many others. When applied to capacity building of environmental competencies, this online or virtual learning ensures that the pollution control officers and managing heads continue to get updates on how to sustainably comply with environmental mandates while reducing the risk of being infected by the virus. In this way, training or seminars do not need to be physically conducted. Webinars are therefore applauded and praised for their practicality and efficiency in the flow of knowledge in the digital age. Liang et al (2017) inferred that digital transformation adds to the competitiveness of establishments especially in making sure that the requirements set by the DENR-EMB are being complied with.

Table.7. Items Grouped Under Digitization in Environmental Capability Building

Item No.	Items	Factor Coefficient	Construct
1	Specific online environmental training will help me comply with the provisions of the environmental laws	0.759	Digitization in Environmental Capability Building
22	Online environmental training and seminars will make us technically competent	0.684	

Dimension 6. In Table 8, the two items that fall under the sixth construct are shown namely; unrestricted mobility for environment-related travels and their corresponding loading coefficients. As shown, *travel restrictions prohibit me from complying with environmental permits, clearances, and submission of reports during the pandemic* obtained a loading coefficient of 0.744 *while the long distance of travel from the establishment to the EMB office is a factor of non-compliance to environmental laws* obtained a loading coefficient of 0.683.

Lockdowns imposed by the local government units have prevented the easy flow or mobility of persons including those who need to implement environmental laws. This study suggests that the government should give due consideration to environmental frontliners who need to obtain water samples for laboratory testing and analysis, submit documents for permit and clearance issuance or renewal, attend technical conferences, conduct EIA studies, gather baseline data, and the like. These activities cannot be delayed due to the urgency and necessity of the needed results and findings. Hence, travel restrictions must be halted when the need to pass through different territories is required for environmental compliance.

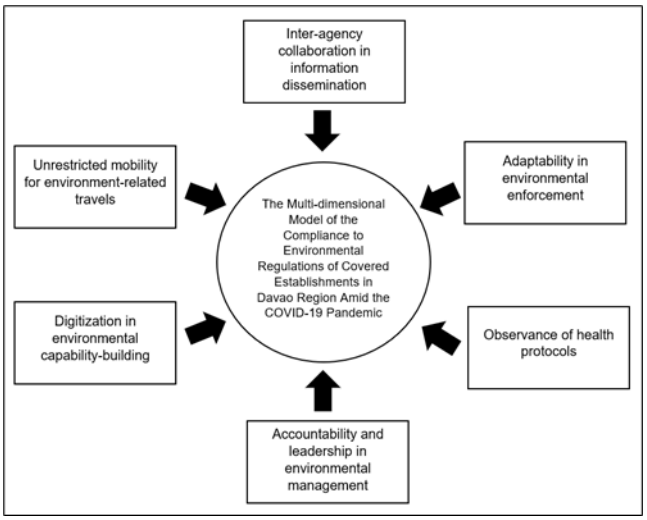
Aside from that, travel restrictions should be relaxed on the essential sectors (Di Porto et al, 2021) such as the implementers of environmental policies because they make sure that the requirements for environmental sustainability are met. They must be exempted from the travel restrictions because of the severity of outcomes that might take place if left ignored.

Table.8. Items Grouped Under Unrestricted Mobility for Environment-related Travels

Item No.	Items	Factor Coefficient	Construct
4	Travel restrictions prohibit me from complying with environmental permits, clearances, and submission of reports during the pandemic	0.744	Unrestricted Mobility for Environment-Related Travels
3	Long distance of travel from the establishment to the EMB office is a factor of non-compliance with environmental laws	0.683	

The Multidimensional Model on Compliance to Environmental Regulations of Covered Establishments in Davao Region Amid Covid-19 Pandemic

Below is the pictorial presentation of the generated factors for compliance to environmental regulations:



The Generated Multi-Dimensional Model on the Compliance to Environmental Regulations using Exploratory Factor Analysis

IV. Conclusion and Recommendation

Based on the findings of the study, it is concluded that compliance with environmental regulations at the height of the COVID-19 pandemic transcends conventional practice. Compared to pre-pandemic times, the implementation of environmental laws is stringent and painstaking. Hence, it is hereby recommended that capability-building activities through distance learning should be attended by the managing heads and pollution control officers to further boost their awareness of environmental compliance and develop resilience and adaptability in the new normal.

On the other hand, during the pandemic, there was a need to revisit the pre-existing processes due to the impact of community quarantines, lockdowns, and other local government-imposed strategies to control the spread of the COVID-19 virus. Thus, the Department of Environment and Natural Resources through the Environmental Management Bureau, should reevaluate its regulatory and implementation mechanisms to be attuned to the restriction policies of the national agencies and local government units such that the spread of the COVID-19 virus is minimized. Also, the policymakers may use the findings of the study to benchmark and secure a quantitative basis for crafting new guidelines and policies for the appropriate implementation of environmental laws amid the pandemic.

This study, therefore, suggests a multi-dimensional model of environmental compliance that can serve as a guiding principle to craft policies for painless regulation and implementation of environmental laws.

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