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EFFICIENCY AND PRODUCTIVITY OF DENR ENFORCEMENT UNIT IN DAVAO REGION

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Abstract

The main objective of this study is the estimation of technical efficiency and productivity of Community Environment and Natural Resource Offices (CENROs) environmental law enforcement units in the Davao Region from 2010 to 2018. The environmental law enforcement units of CENRO-Baganga, Davao Oriental, CENRO- Lupon, Davao Oriental, CENRO- Manay, Davao Oriental, CENRO- Mati, Davao Oriental, CENRO-Monkayo, Davao Oriental, CENRO-Davao City, Davao del Sur, CENRO-Digos City, Davao del Sur, CENRO-Malalag, Davao del Sur, CENRO-Maco, Compostela Valley, Province, CENRO-New Corella, Davao del Norte, and CENRO- Panabo City, Davao del Norte are evaluated. There were eight inputs for and three outputs of environmental law enforcement units that were considered in this study. Data Envelopment Analysis (DEA) was used to estimate the technical efficiencies and the Malquist Total Factor Productivity (TFP) Indices. Results showed that only seven CENROs' – CENRO-Baganga, CENRO-Davao City, CENRO-Lupon, CENRO-Malalag, CENRO-Manay, CENRO-New Corella and CENRO-Panabo City – Environmental Law Enforcing Units were operating with technical efficiency, under the VRS assumption, from 2010 to 2018. Malmquist Index Summary of Firm Means revealed that Environmental Law Enforcing Units of CENRO-New Corrella, CENRO-Davao City, CENRO-Baganga, CENRO-Panabo, CENRO-Digos City, CENRO-Manay and CENRO-Malalag were productive performers.

Keywords: Effeciency, Productivity, DENR Enforcement Unit, Davao Region

INTRODUCTION

In recent years, environmental protection in the Philippines was not delegated to a single government agency; instead, environment-related concerns were part of the directives of several agencies dealing with agriculture, natural resources, health, housing, and public works. It was only in 1964 when the National Pollution Control Commission (NPCC) was created to handle air and water pollution control in the country. In 1977, the National Environmental Protection Council (NEPC) was created as the policy-making body on matters related to the environment. On June 6, 1977, the Philippine Environmental Policy (Presidential Decree 1151) and the Philippine Environmental Code (Presidential Decree 1152) were both enacted to embody the national environmental framework. PD 1151 defines the continuing policy

of the state to develop and maintain a better quality of life for present and future generations by recognizing the right of every Filipino to a healthy environment. It was also the first environmental law to introduce the concept of Environmental Impact Assessment (EIA) in the country. PD 1152, on the other hand, defines the management policy objectives and strategies for water, air, natural resources, land, and waste management by prescribing the enforcement of environmental quality standards. In 1986, however, major institutional changes were introduced in the government structure as a result of a change in political administration – one of these was the creation of the Environmental Management Bureau (EMB) in 1987, under the Department of Environment and Natural Resources (DENR) by virtue of EO 192. The EMB assumed the regulatory functions of both the NEPC and the NPCC. The DENR has a societal goal of poverty reduction and sustainable development. While Agriculture, Agrarian Reform, Environment, and Natural Resources Sector, has a primary, sectoral goal of sustainable management of environmental and natural resources.

One of the expected major outputs of the DENR is providing appropriate and comprehensive regulations and standards to be developed, implemented, monitored, and enforced which can be indicated by systems of environmental laws, rules, and regulations that are established and monitored. Protection of the environment and good environmental management can only be attained by compliance with environmental laws. The best tool for achieving environmental compliance is effective and consistent civil and criminal enforcement of the law. Since a number of programs have already been enacted to meet the mandate of the DENR and EMB, a wide array of assessments has been conducted in several aspects of each of its implementations. In an evaluation of Israel and Lintag (2013), they found that an important problem was the delay in the availability of the mobilization fund and limited personnel for monitoring and enforcement and further suggested that more personnel and financial resources should be allotted to the working group so they can adequately perform their job. Luna (2016) recommended that enforcement of laws and protection should be given a larger prioritization while a follow-up program should be implemented with realistic goals which include skills for dispute resolution, organizing and efficient technology transfer, and clear reforestation and forest production mandate to ensure efficiency and sustainability.

METHOD

This research employed a mixed method design by considering both quantitative and qualitative approaches. Triangulation will be employed to provide compact findings. Triangulation will solidify the findings brought by an analysis of secondary data by integrating confirming or negating key informant interviews (KII) and focus group discussion (FGD) results. Primary data was collected through key informant interviews (KII) and focus group discussions (FGD). The collection of KII and FGD data was realized with the use of an approved data-gathering instrument. Secondary data would include the list of inputs and outputs throughout the administration of environmental laws by enforcing units. It will be collected from CENROs. This study employed a complete enumeration-based survey, where all members of the whole population were measured, which was often preferred for certain types of data,

solely because it was expected that it would provide complete statistical coverage over space and time of the environmental law enforcement units of the Davao Region. The use of such a technique was expected to provide robust and rigorous results in terms of estimating the efficiency and productivity of the DENR enforcement unit in the implementation of environmental laws in the Davao Region. With only 33 members of the environmental law enforcement unit, for the considered CENROs of Davao Region, thus, complete enumeration was seen as desirable and attainable for operational reasons. Complete enumeration was preferred in this case where data sources can be legally provided such as in the forms of reports, logs, or inventory, thus reducing the cost of applying this approach.

RESULTS AND DISCUSSIONS

The presentation follows a sequence based on the research questions: the inputs for environmental law enforcement; the outputs of environmental law enforcement; the estimated technical efficiency of the DENR enforcement unit; the productivity performance of the enforcement unit; and the issues and concerns confronted in the enforcement of environmental laws in the region.

Inputs for Environmental Law Enforcement Unit

This section presented the inputs used for environmental law enforcement in Davao Region based on the data gathered.

Number of Personnel. Personnel of enforcing units may include Forest Rangers, Forest Technicians, Foresters, and Development Management Officers. Based on reports collected, CENRO-Mati, Davao Oriental has the highest average annual number of personnel, 16 enforcers were attached to their environmental law enforcement unit from 2010 to 2018. This was followed by CENRO-Panabo, Davao del Norte with 14 attached enforcers, CENRO-Lupon, Davao Oriental with 13 enforcers, and CENRO-Monkayo with 12 enforcers. CENRO-Maco, CENRO-Malalag, and CENRO-New Corella have an average of 11 enforcers while CENRO-Digos City and CENRO-Manay have an average of nine attached enforces from 2010 to 2018 in their environmental law enforcement units. Lastly, the CENR-Baganga and CENRO-Davao City have an average of eight enforcers in their environmental law enforcement unit from 2010 to 2018.

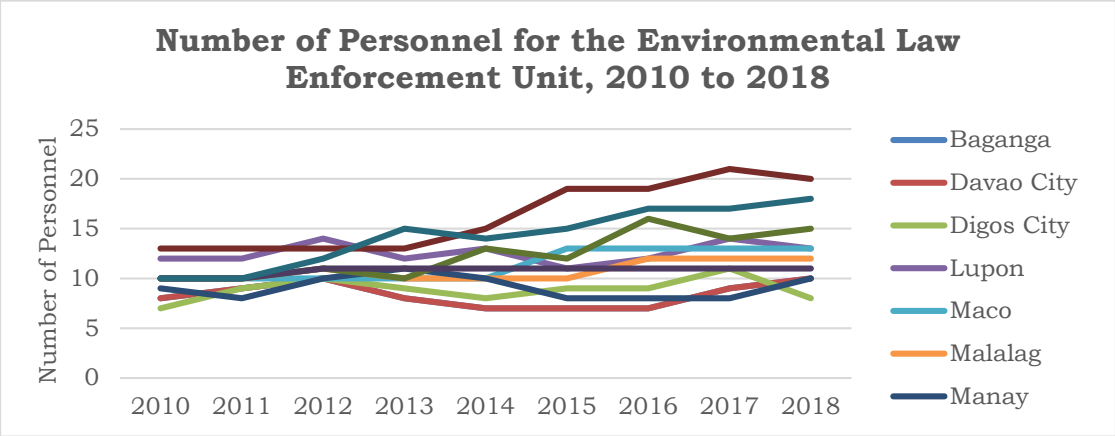

Figure 3. Number of Personnel for the Environmental Law Enforcement Unit, 2010 to 2018

Table 2. Number of Personnel, 2010-2018

CENRO	Min.	Max.	Mean	Std. Deviation
Baganga	7	10	8.33	1.22
Davao City	7	10	8.33	1.22
Digos City	7	11	8.89	1.17
Lupon	11	14	12.56	1.01
Maco	10	13	11.33	1.58
Malalag	10	12	10.78	0.97
Manay	8	11	9.11	1.17
Mati	13	21	16.22	3.46
Monkayo	10	16	12.33	2.29
New Corella	10	11	10.78	0.44
Panabo	10	18	14.22	2.99

Facilities and Equipment. Facilities and equipment of the environmental law enforcement units include, but are not limited to, computer units, hand-held monitoring equipment, communication devices, or transportation facilities. Among the CENROs considered, CENRO-New Corella has the most facilities and equipment deployed and used by their environmental law enforcement units from 2010 to 2018, on average. This is followed by CENRO-Lupon and CENRO-Monkayo with five and four facilities and equipment, respectively. The rest of the CENROs surveyed had an average of two facilities and equipment from 2010 to 2018. In addition, based on the graphical presentation of facilities and equipment from 2010 to 2018, it is evident that there is an increasing quantity of facilities and equipment since 2014.

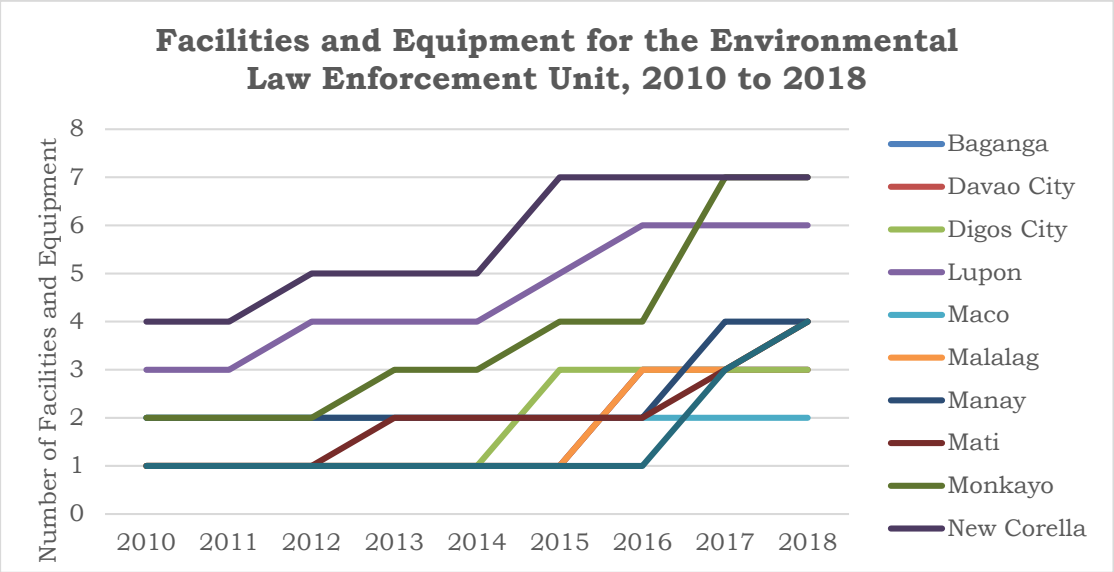

Figure 4. Facilities and Equipment for the Environmental Law Enforcement Unit, 2010 to 2018.

Table 3. Facilities and Equipment, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	1	3	1.67	1.00
Davao City	1	3	1.67	1.00
Digos City	1	3	1.89	1.05
Lupon	3	6	4.56	1.24
Maco	2	2	2.00	0.00
Malalag	1	4	1.78	1.20
Manay	2	4	2.44	0.88
Mati	1	4	2.00	1.00
Monkayo	2	7	3.78	1.99
New Corella	4	7	5.67	1.32
Panabo	1	4	1.56	1.13

Annual Budget. As to the annual budget allocated for the environmental law enforcement units, it was found the CENRO-New Corella has the highest annual budget, on average, from 2010 to 2018. Environmental law enforcement units of CENRO-Baganga, Davao City, Manay, Mati, and Monkayo are with an annual average of more than one million pesos while those of CENRO-Digos City, Lupon, Maco, Malalag, and Panabo receive less than a million annually, on the average. Referring to the trend of annual budget for these units, it was revealed that CENRO- New Corella environmental law enforcement units received a decreasing amount of annual budget from 2010 while the rest of the enforcement units under consideration followed a common trend since 2010 where an increase in annual budget was observed since 2016.

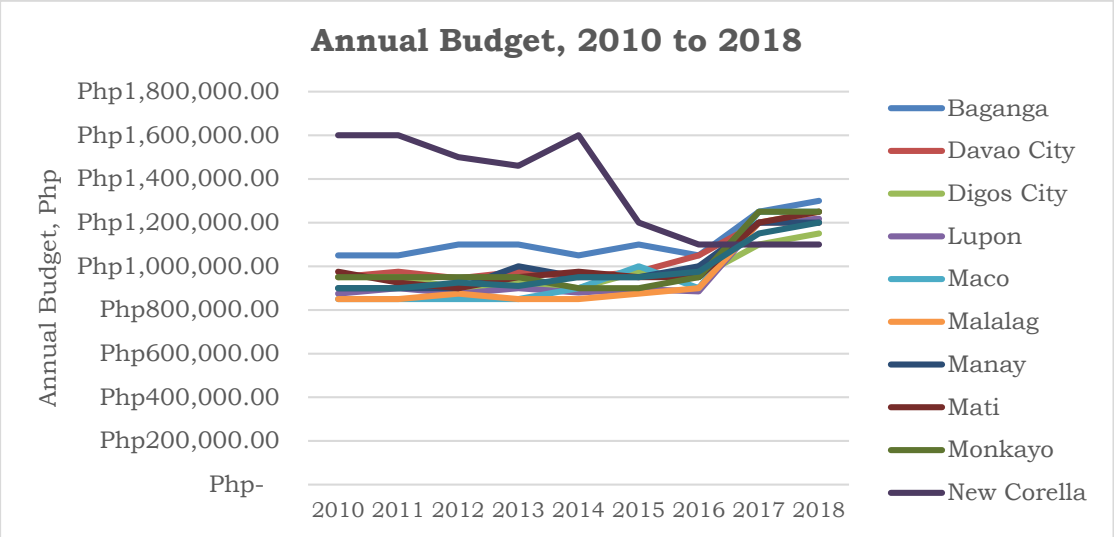

Figure 5. Annual Budget, 2010-2018

Table 4. Annual Budget, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	1,050,000.00	1,300,000.00	1,116,700.00	93,541.43
Davao City	945,000.00	1,200,000.00	1,024,400.00	104,297.00
Digos City	900,000.00	1,150,000.00	977,780.00	87,895.93
Lupon	875,000.00	1,220,000.00	958,670.00	142,324.00
Maco	850,000.00	1,250,000.00	966,670.00	167,705.00
Malalag	850,000.00	1,250,000.00	944,440.00	160,457.00
Manay	900,000.00	1,200,000.00	1,000,000.00	119,896.00
Mati	900,000.00	1,250,000.00	1,008,300.00	125,623.00
Monkayo	900,000.00	1,250,000.00	1,005,600.00	140,188.00
New Corella	1,100,000.00	1,600,000.00	1,362,200.00	232,044.00
Panabo	900,000.00	1,200,000.00	984,440.00	111,620.00

The number of Inspected and monitored Establishments. Establishments that were inspected and monitored include, but are not limited to, WPPs and lumber dealers as well as those involved in the trade of wildlife species. It was found that CENRO-New Corella enforcing units have inspected and monitored 35 establishments, on average, from 2010 to 2018 which is considered the highest number among these units. Environmental law enforcing units in CENRO-Monkayo, Maco, Digos City, and Panabo have been inspecting and monitoring also a number of 23, 18, 9, and 8 establishments, respectively, on an annual average from 2010 to 2018. CENRO-Baganga, Davao City, Lupon, Manay, and Mati enforcing units were inspecting and monitoring only one establishment from 2010 until 2018. Lastly, CENRO-Malalag environmental law enforcement units have no established WPPs and lumber dealers as well as those involved in the trade of wildlife species to inspect and monitor since 2010.

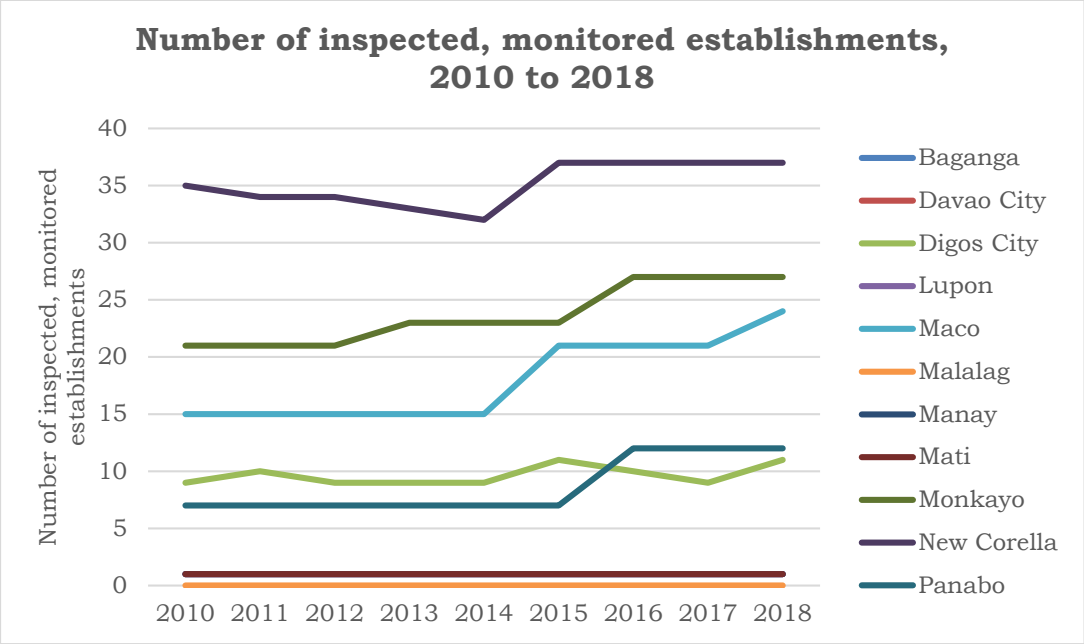

Figure 6. Number of Inspected, Monitored Establishments, 2010-2018

Table 5. Number of Inspected, Monitored Establishments, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	1	1	1.00	0.00
Davao City	1	1	1.00	0.00
Digos City	9	11	9.67	0.87
Lupon	1	1	1.00	0.00
Maco	15	24	18.00	3.67
Malalag	0	0	0.00	0.00
Manay	1	1	1.00	0.00
Mati	1	1	1.00	0.00
Monkayo	21	27	23.67	2.65
New Corella	32	37	35.11	1.96
Panabo	7	12	8.67	2.50

Number of Apprehensions. In terms of the apprehensions successfully accomplished by the environmental law enforcing units against violators, it was found that CENRO- New Corella has the highest number of apprehensions achieved from 2010 to 2018, on average. CENRO-Mati enforcing units followed the lead with 13 apprehensions while CENRO-Lupon enforcing units apprehended more than six violators since 2010. The rest of the enforcing units considered have apprehended five or fewer violators from 2010 to 2018 on average. Based on the trend, an increase in the number of apprehensions was recorded from 2011 until 2014 and was observed to increase again in 2017.

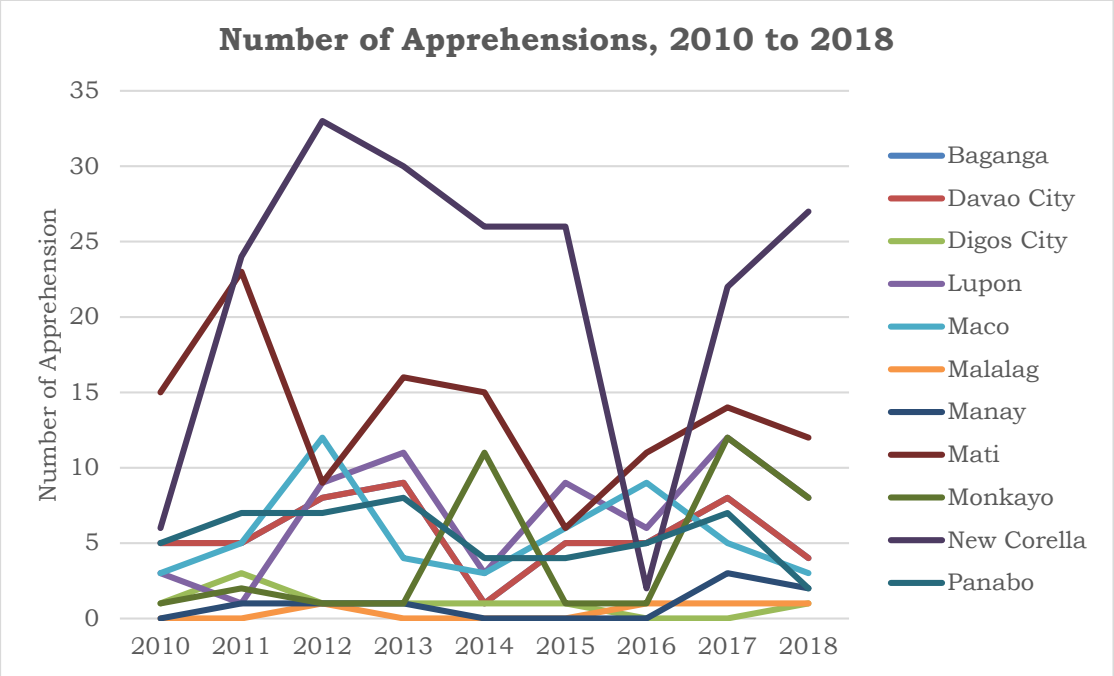

Figure 7. Number of Apprehensions, 2010-2018
Table 6. Number of Apprehensions, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	1	9	5.56	2.46
Davao City	1	9	5.56	2.46
Digos City	0	3	1.00	0.87
Lupon	1	12	6.89	3.86
Maco	3	12	5.56	3.09
Malalag	0	1	0.44	0.53
Manay	0	3	0.89	1.05
Mati	6	23	13.44	4.82
Monkayo	1	12	4.22	4.71
New Corella	2	33	21.78	10.62
Panabo	2	8	5.44	1.94

Number of Detected Environmental Violations. Aside from the apprehensions accomplished by the environmental law enforcing units, it was also observed that there are detected environmental violators as a result of their intensive inspection and monitoring. It was found that CENRO-New Corella enforcing units have the highest number of detected violators, with an average of 21 from 2010 to 2018. CENRO-Mati, Lupon and Maco enforcing units followed with 13, seven and six detected violators on the average, respectively. The rest of the environmental law enforcing units have detected five or less environmental violators since 2010 through 2018 on the average. An increase of number of detected environmental violators was reported on 2011 until 2014 and was observed again to increase in 2017 based on the data gathered on the recorded environmental violations.

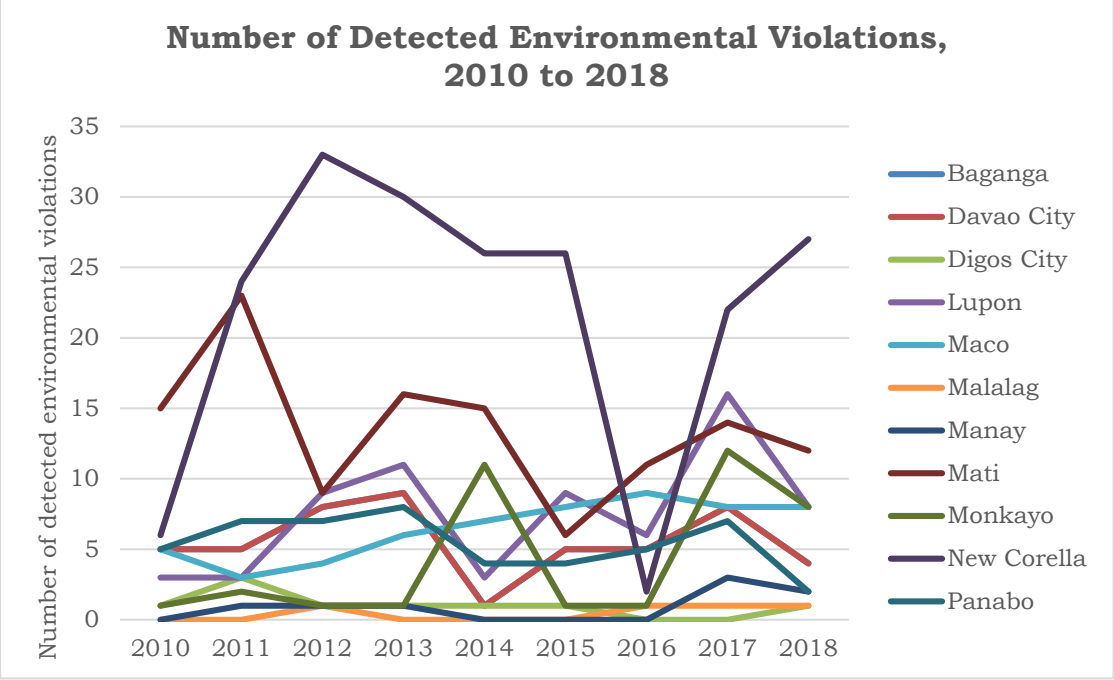

Figure 8. Number of Detected Environmental Violations, 2010-2018

Table 7. Number of detected environmental violations, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	1	9	5.56	2.46
Davao City	1	9	5.56	2.46
Digos City	0	3	1.00	0.87
Lupon	3	16	7.56	4.36
Maco	3	9	6.44	2.07
Malalag	0	1	0.44	0.53
Manay	0	3	0.89	1.05
Mati	6	23	13.44	4.82
Monkayo	1	12	4.22	4.71
New Corella	2	33	21.78	10.62
Panabo	2	8	5.44	1.94

Number of Information, Education, and Communication Campaigns Conducted. Another important input for environmental law enforcement units is the number of information and education drives that were conducted in their areas of responsibility for successful environmental protection. It was found that CENRO-New Corella environmental law enforcing units were leading the campaign among the units with 5 information and education drives conducted annually from 2010 until 2018. CENRO-Lupon and Monkayo enforcement units conducted an average of four information and education efforts annually. CENRO-Maco and Malalag conducted three education campaigns yearly while the rest of the enforcing units have conducted 2 or fewer information and education drives annually.

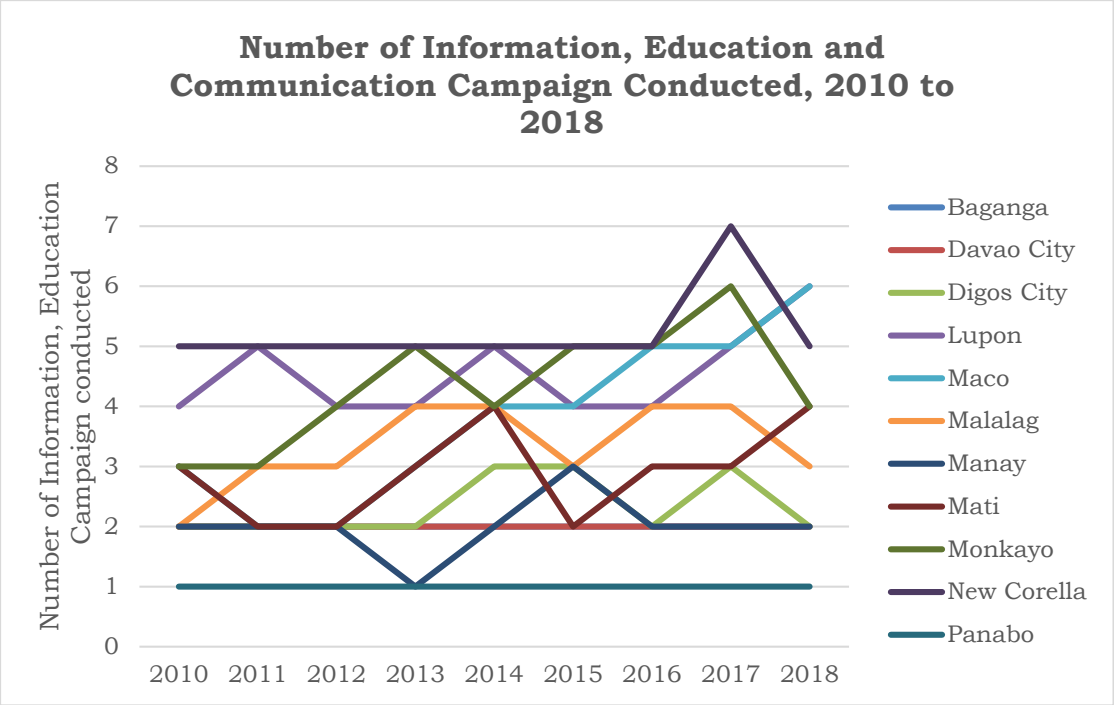

Figure 9. Number of Information, Education, and Communication Campaigns Conducted, 2010-2018.

Table 8. Number of Information, Education, and Communication Campaigns conducted, 2010-2018.

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	2	2	2.00	0.00
Davao City	2	2	2.00	0.00
Digos City	2	3	2.33	0.50
Lupon	4	6	4.56	0.73
Maco	2	6	3.78	1.39
Malalag	2	4	3.33	0.71
Manay	1	3	2.00	0.50
Mati	2	4	2.89	0.78
Monkayo	3	6	4.33	1.00
New Corella	5	7	5.22	0.67
Panabo	1	1	1.00	0.00

Number of Capacity Building Conducted. Aside from conducting information and education efforts, the environmental law enforcing units also organized capacity building for their stakeholders to enhance environmental protection and law enforcement. It was revealed that environmental law enforcing units of CENRO-Monkayo, Mati, Maco, and Digos City organized and participated in two trainings and capacity building activities annually since 2010, on average. In addition, the environmental law enforcing units of CENRO-Baganga, Davao City, Lupon, Malalag, Manay, New Corella, and Panabo organized and participated in only one training or capacity-building

activity annually from 2010 through 2018. With regard to the trend, it is evident that CENRO-New Corella is leading in solidifying the capability and aptitude of their enforcers and stakeholders when it comes to environmental protection and law enforcement.

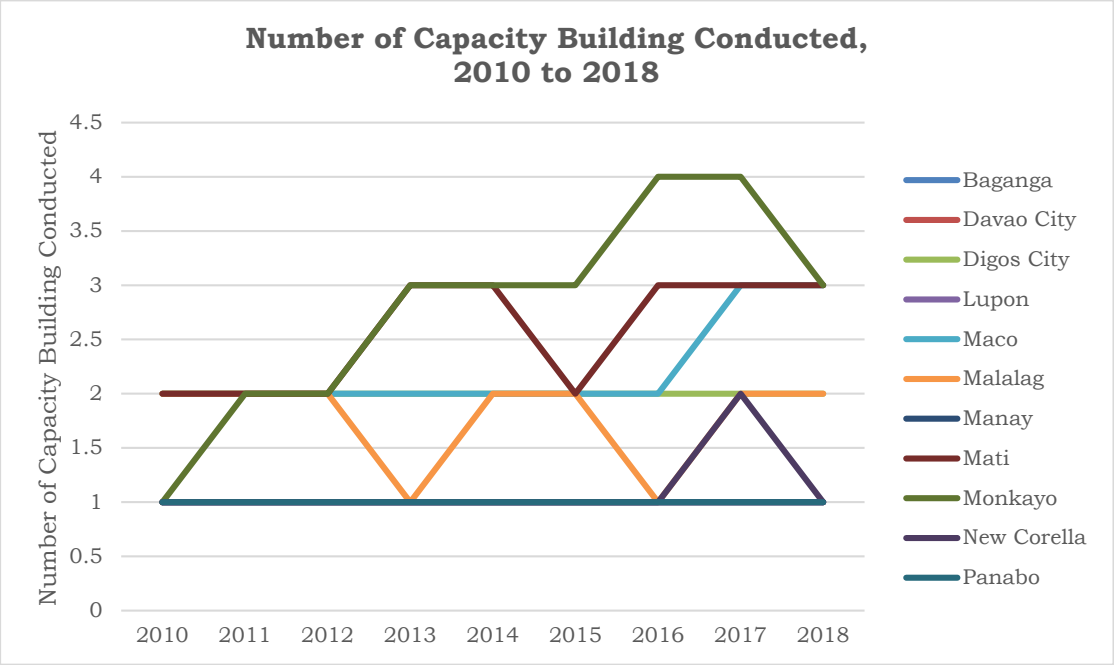

Figure 10. Number of Capacity Building Conducted, 2010-2018

Table 9. Number of Capacity Building Conducted, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	1	1	1.00	0.00
Davao City	1	1	1.00	0.00
Digos City	2	2	2.00	0.00
Lupon	1	1	1.00	0.00
Maco	2	3	2.22	0.44
Malalag	1	2	1.78	0.44
Manay	1	1	1.00	0.00
Mati	2	3	2.56	0.53
Monkayo	1	4	2.78	0.97
New Corella	1	2	1.11	0.33
Panabo	1	1	1.00	0.00

Outputs of Environmental Law Enforcement Unit

This segment provided a discussion on the output of the environmental law enforcement units of the Davao Region based on the data gathered for the study.

Number of Cases Transmitted to Court. With the detections of violators and apprehensions accomplished by the environmental law enforcers, the next step in processing violations is filing the complaint to the concerned Prosecutor's Office. When permissible, the complaint against the instituted

action committed against environmental laws is transmitted and filed in the court. Based on the findings, it was found that CENRO-New Corella transmitted an average of 6 cases of environmental violations to courts annually while CENRO-Panabo and Maco environmental law enforcement units transmitted three and two cases, respectively. The rest of these units transmitted at most one case annually except for CENRO-Digos City where no case of environmental violations was transmitted to courts from 2010 to 2018.

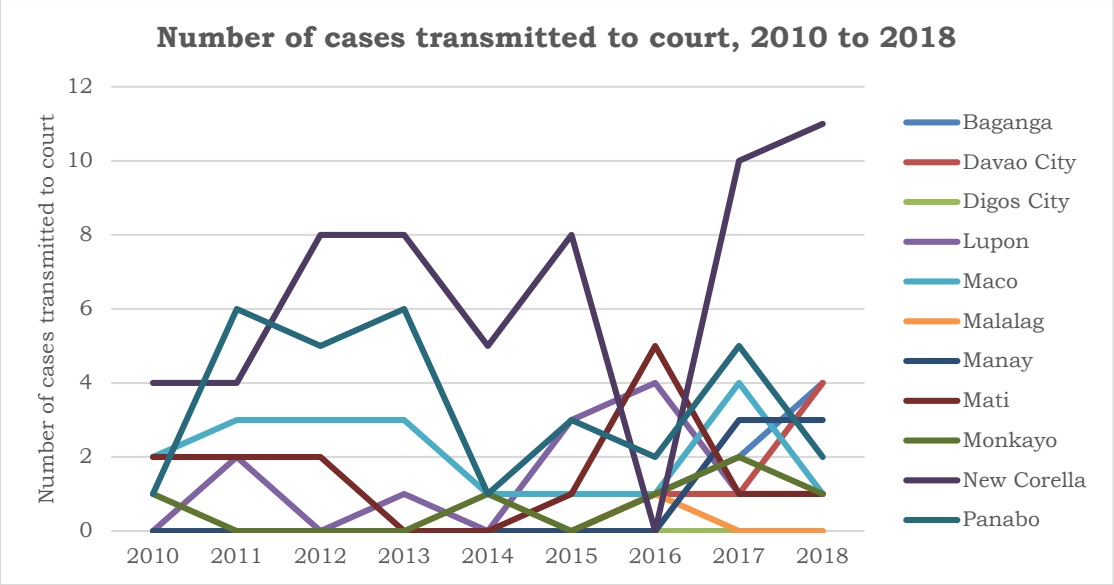

Figure 11. Number of Cases Transmitted to Court, 2010-2018

Table 10. Number of Cases Transmitted to Court, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	0	4	0.78	1.39
Davao City	0	4	0.67	1.32
Digos City	0	0	0.00	0.00
Lupon	0	4	1.33	1.41
Maco	1	4	2.11	1.17
Malalag	0	1	0.11	0.33
Manay	0	3	0.67	1.32
Mati	0	5	1.56	1.51
Monkayo	0	2	0.67	0.71
New Corella	0	11	6.44	3.47
Panabo	1	6	3.44	2.07

Number of Dismantled and/or Padlock Establishments. With the intensified conducts of monitoring and detection implemented by the environmental law enforcing units of Davao Region, one of their important outputs is the closure and the cessation of operations of establishments, such as WPPs and lumber dealers as well as those involved in the trade of wildlife species, that were environmental laws violators. Based on the data gathered, it was found that five establishments in CENRO-New Corella have been

dismantled and/or padlocked on an annual average since 2010. CENRO-Davao City and Monkayo enforcing units have an average of three establishments that were dismantled and/or padlocked, annually. Enforcers in CENRO-Baganga, Maco, and Panabo closed one establishment while those in Lupon, Malalag, Manay, and Mati have not detected or monitored any environmental laws violator establishment that were dismantled and/or padlocked since 2010.

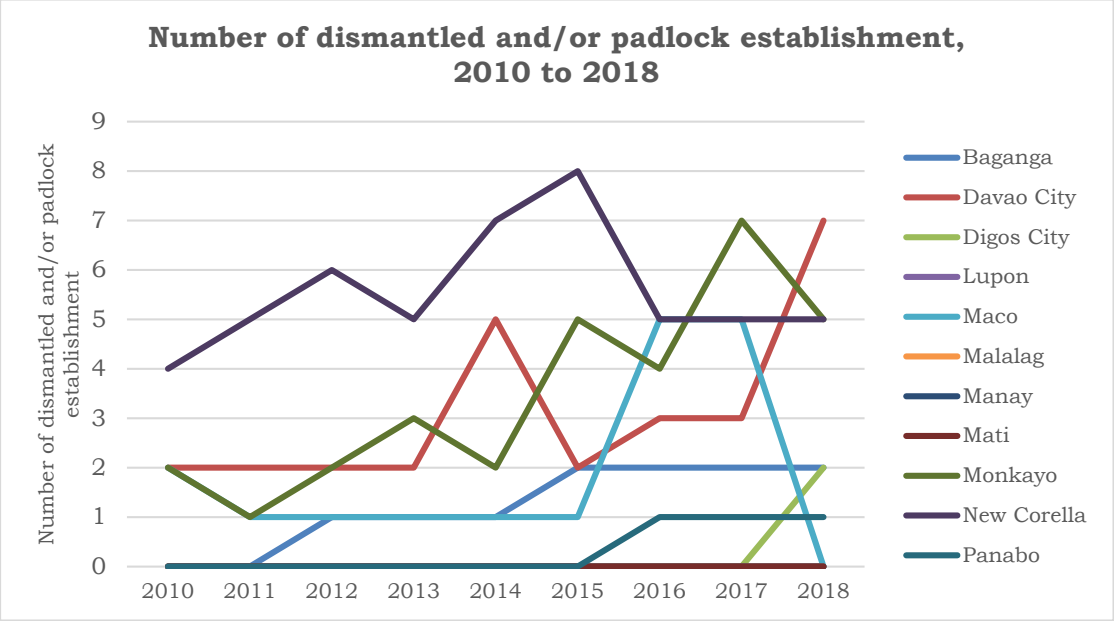

Figure 12. Number of Dismantled and/or Padlock Establishments, 2010-2018

Table 11. Number of Dismantled and/or Padlock Establishments, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	0	2	1.22	0.83
Davao City	2	7	3.11	1.76
Digos City	0	2	0.22	0.67
Lupon	0	0	0.00	0.00
Maco	0	5	1.89	1.83
Malalag	0	0	0.00	0.00
Manay	0	0	0.00	0.00
Mati	0	0	0.00	0.00
Monkayo	1	7	3.44	1.94
New Corella	4	8	5.56	1.24
Panabo	0	1	0.33	0.50

Number of Turned-over/Confiscated Wildlife. The last output of environmental law enforcing units in the Davao Region is the number of confiscated and turned/over wildlife that resulted from their intensified operation against illegal traders of environmentally protected flora and fauna. CENRO-Davao City environmental law enforcement unit takes the lead in the highest number of confiscated and turned-over wildlife with an average of 30 fauna per year from 2010 to 2018. This was followed by the CENRO- Panabo

enforcing unit with an average of seven confiscated/turned-over wildlife on an annual average since 2010. The rest of the enforcing units have four or fewer confiscated/turned over wildlife on average from 2010 to 2018.

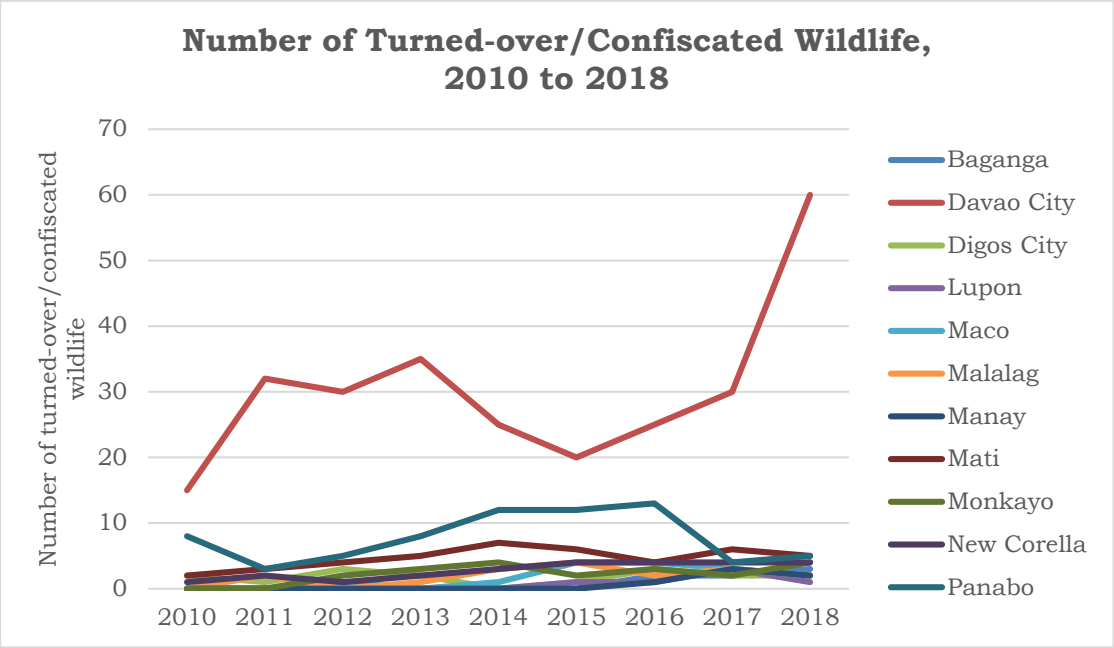

Figure 13. Number of Turned-over/Confiscated Wildlife, 2010-2018

Table 12. Number of Turned-over/Confiscated Wildlife, 2010-2018

CENRO	Minimum	Maximum	Mean	Std. Deviation
Baganga	0	3	0.78	1.20
Davao City	15	60	30.22	12.76
Digos City	0	3	1.78	0.97
Lupon	0	3	0.67	1.00
Maco	0	4	1.67	1.66
Malalag	0	4	1.89	1.36
Manay	0	3	0.67	1.12
Mati	2	7	4.67	1.58
Monkayo	0	4	2.22	1.48
New Corella	1	4	2.78	1.30
Panabo	3	13	7.78	3.80

Estimated Technical Efficiency of DENR Enforcement Unit

The technical efficiency of environmental law enforcement units was estimated in input-orientated variable returns to scale (VRS), pure technical efficiency, and data envelopment analysis model using DEAP 2.1 (Coelli, 1996). The use of the VRS specification permits the calculation of TE and it has been the most commonly used specification.

Technical Efficiency of DENR Enforcement Unit. As presented in Table 13, all of the enforcing units in 2010 are technically efficient under the

VRS model. With this, all units are able to maintain their outputs even if there is a proportional decrease in inputs.

By 2011, it was observed that the enforcement units had assumed a strong disposability of both inputs and outputs and a variable return to scale technology as evidenced by their technical efficiency score of one. Data envelopment analysis of the inputs used and outputs achieved by the enforcement unit for 2014 revealed that under the VRS assumption, 10 environmental law enforcing units have achieved technical efficiency while the CENRO-Mati unit was observed to decline further as compared to the previous year where a continued decreasing output was observed, implying scale inefficiency. These inefficiencies under the CRS assumption suggest that the enforcing units in these areas are not operating under the optimal scale. Constraints on finances or the lack of labor force to monitor or detect as well as the absence of environmental violators, thus affecting outputs, may lead to a unit not operating in an optimal scale. Scale inefficiency in this period was observed in these units.

By 2015, nine units were found to be technically efficient in terms of the VRS model while CENRO-Digos City and Maco experienced a scale inefficiency evidenced by an increase in some of the inputs while achieving a decreasing output. These changes were brought about by the variations in the optimal use of inputs where outputs achieved have increased or decreased.

From 2016 through 2017, all units were revealed to be technically efficient under the VRS assumption suggesting that all units were able to maintain their outputs even if there occurred a variation in their inputs.

Lastly, for 2018, nine units were found to be technically efficient in their operations under the VRS model. CENRO-Mati and Monkayo units are in need of increasing their input by four and seven percent, respectively, to attain the optimum scale.

Overall, environmental law enforcing units of CENROs in Baganga, Davao City, Lupon, Malalag, Manay, New Corella, and Panabo were operating with technical efficiency under the VRS assumption from 2010 through 2018. On the other hand, enforcing units of CENRO-Digos City, Maco, Mati, and Monkayo were operating with technical inefficiencies throughout the period under review. Scale inefficiency was observed in the operation of these units where constraints in finances or the lack of labor force to monitor or detect as well as the controlled/absence of environmental violators affects the delivery of outputs which lead to cause these units to be not operating in an optimal scale. The findings revealed high levels of technical efficiency indicating variable – decreasing, constant, or increasing – returns to scale. This further suggests that these units were able to maintain achieving their expected outputs despite the variations in their inputs as previously described.

Table 13. Efficiency Scores Summary (TE_{vrs}): 2010 to 2018

MENRO	2010	2011	2012	2013	2014	2015	2016	2017	2018
Baganga	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Davao City	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Digos City	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00

Lupon	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Maco	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	1.00
Malalag	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Manay	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mati	1.00	1.00	1.00	0.95	0.89	1.00	1.00	1.00	0.96
Monkayo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93
New Corella	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Panabo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mean	1.00	1.00	1.00	1.00	0.99	0.99	1.00	1.00	0.99

Output is generated through DEAP version 2.1

Productivity Performance of the Enforcement Unit

This section provided the results after analyzing the productivity performance of the environmental law enforcement units in the Davao Region employing data envelopment analysis (DEA) based Malmquist productivity index.

Data envelopment analysis revealed the geometric means from the Malmquist index summary for the Total Factor Productivity (TFP) Change from the years between 2010 and 2011 until 2017 and 2018.

The productivity scores of the environmental law enforcing units were observed to be in variation across time. Negative and positive TFP growth was displayed by all enforcing units. To illustrate, environmental law enforcing units in CENRO-Baganga, Davao City, Lupon, Maco, Malalag, Manay, Mati, and Panabo were observed to have a positive productivity growth in their second year of operations, between 2010 and 2011. However, operations of their counterparts in CENRO- Digos City, Monkayo, and New Corella, were already observed to have experienced negative productivity growth. Between these base years of operations, it was found that the most productive performer among these CENROs was CENRO-Panabo City. By examining the presented TFP scores below, variations in the productivity growth until the last year of operations considered in this study were observed. These phenomena was supported by the previously presented inputs and outputs for the environmental law enforcement units. The technical and technological efficiency changes in the maximum utilization of inputs to achieve optimum output were crucial in achieving high total factor productivity scores.

Table 14. Total Factor Productivity (TFP) Change: 2010 to 2018

CENRO	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
Baganga	1.00	0.96	1.00	1.05	0.91	0.74	1.80	1.90
Davao City	1.57	0.76	1.20	2.16	0.40	0.73	0.95	2.77
Digos City	0.56	2.67	0.92	1.01	0.97	1.05	0.90	1.02
Lupon	1.89	0.46	1.00	1.00	2.10	1.46	0.27	0.94
Maco	1.71	0.79	1.01	0.39	0.71	0.96	3.27	0.36
Malalag	1.11	0.90	1.04	1.16	1.00	0.80	1.06	0.98
Manay	1.05	0.97	1.08	0.74	0.91	1.09	1.26	1.25
Mati	1.13	1.17	0.52	1.00	1.03	3.15	0.25	0.90

Monkayo	0.60	1.75	1.00	0.33	2.58	1.00	0.36	0.73
New Corella	0.95	1.78	1.03	0.63	1.62	0.48	2.08	1.44
Panabo	3.15	0.84	1.14	0.39	1.72	0.79	1.10	0.78

Output is generated through DEAP version 2.1

Table 15 provides the geometric means of Technical Efficiency Change scores indicates the change in the quantity of output produced from constant input and also assumes that the environmental law enforcement units experience a movement closer to the frontier from year one or 2010-2011 through 2017-2018. It was revealed that five units achieved a score of one while the rest showed inefficiencies. CENRO-Monkayo needs to increase its main inputs by 19%, CENRO-Mati by 15.9%, Lupon by 15.8%, Maco by 11.7% and both CENRO-Digos City and Malalag by 4.4% to become efficient.

Technological change depicts the increase of outputs over constant inputs. It was revealed that all of the environmental law enforcing units were found to be successful in terms of technological grounds. However, the enforcing unit of CENRO-Lupon was found to be technically productive by 12.8% showing the maximum progress on the technological front.

Further decomposition of efficiency into pure technical efficiency showed that the majority of the environmental law enforcing units revealed a score of 1.000 suggesting that these units are appropriately utilizing their overall operative inputs for efficient average outputs. Other enforcing units showed negative pure technical efficiency growth, indicating inputs are not optimally utilized for achieving their outputs.

Scale efficiency change shows the increasing or decreasing returns to scale derived from the ratio of overall technical efficiency to pure technological efficiency. Most of the environmental law enforcement units were found to have variable returns to scale efficiency as indicated by a score of equal to or greater than 1.000. However, CENRO-Maco was observed to have the highest variable returns to scale inefficiency of 11.7%. Henceforth, CENRO-Maco enforcing units have either increased or decreased returns by an average of 11.7% within the period under review. Other units observed to have variable returns to scale inefficiencies are CENRO-Digos City and Malalag with both having 4.4%, CENRO-Monkayo with 0.4% and CENRO-Lupon with 0.2% scale inefficiency.

Lastly, Table 14 below presents the geometric mean of Malmquist Total Factor Productivity (TFP) change scores of the environmental law enforcement units for the period of 2010 to 2018. Environmental law enforcement units from seven CENROs exhibit positive TFP growth. Henceforth, the CENRO-New Corella enforcing unit was revealed to be the best performing environmental law enforcing unit in the Davao Region with an average of 12.3% TFP growth, which is the highest productivity index observed. This was followed by CENRO-Davao City with 11.5%, CENRO-Baganga at 11.1%, CENRO-Panabo with 4.2%, 3.2% for CENRO-Digos City, 2.9% in CENRO-Manay and Malalag with 0.1% of productivity index. Environmental law enforcement units of CENRO-Lupon, Maco, Mati, and Monkayo displayed negative TFP growth. This implies that the level of efficiency and intensity of this unit in utilizing their inputs is not producing effective results for environmental law enforcement.

Table 15. Malmquist Index Summary of Firm Means

CENRO	Technical Efficiency Change	Technological Change	Pure Technical Efficiency Change	Scale Efficiency Change	Total Factor Productivity (TFP) Change
Baganga	1.000	1.111	1.000	1.000	1.111
Davao City	1.000	1.115	1.000	1.000	1.115
Digos City	0.956	1.079	1.000	0.956	1.032
Lupon	0.842	1.128	0.841	1.002	0.950
Maco	0.883	1.013	1.000	0.883	0.894
Malalag	0.956	1.047	1.000	0.956	1.001
Manay	1.000	1.029	1.000	1.000	1.029
Mati	0.841	1.092	0.841	1.000	0.919
Monkayo	0.810	1.027	0.813	0.996	0.832
New Corella	1.000	1.123	1.000	1.000	1.123
Panabo	1.000	1.042	1.000	1.000	1.042
Mean	0.932	1.072	0.951	0.981	1.000

Output is generated through DEAP version 2.1

The Malmquist Index Summary of Annual Means provides the analysis of TFP indices of the overall environmental law enforcement unit from 2010 to 2018. It was found that in between 2010 and 2011, the productivity growth of the unit was 18.7% and declined 5.8% in 2011-2012 operations. From 2012-2013 and 2013-2014, negative productivity growth was observed. By the succeeding year, 2014-2015, a productivity growth of 12.1% was observed but a decline between 2015-2016 and 2016-2017 where a negative productivity growth was experienced. By 2017-2018, the last period under review, the productivity growth was noted to rise, implying the growth of output variables, to 4.4% which was contributed by the technical and technological change of 0.744 and 1.403 on average.

Table 16. Malmquist Index Summary of Annual Means

Year	Technical Efficiency Change	Techno-logical Change	Pure Technical Efficiency Change	Scale Efficiency Change	Total Factor Productivity (TFP) Change
2010-2011	0.816	1.455	0.912	0.894	1.187
2011-2012	1.169	0.905	1.096	1.066	1.058
2012-2013	1.047	0.932	1.000	1.047	0.976
2013-2014	0.910	0.852	0.962	0.946	0.776
2014-2015	0.964	1.163	0.940	1.026	1.121
2015-2016	0.953	1.032	1.083	0.880	0.983
2016-2017	0.920	0.993	0.843	1.091	0.914
2017-2018	0.744	1.403	0.810	0.918	1.044
Mean	0.932	1.072	0.951	0.981	1.000

Output is generated through DEAP version 2.1

Issues and Concerns in the Enforcement of Environmental Laws

This section presents the findings generated in assessing the issues and concerns in the enforcement of environmental laws utilizing the data gathered through focused group discussions (FGD) and key informant interviews (KII).

Issues and Concerns of Environmental Law Enforcement Units. The interviews and discussions were conducted to generate issues and concerns in the implementation of environmental law enforcement which was focused on the inputs needed and the expected outputs thereof. It was found that the most common issues arising are in terms of budget (13%) and facilities and equipment (13%). As provided in Table 17, key informants revealed that there is a need to increase the budget for forest protection units while transportation facility, state-of-the-art equipment, and ICT equipment are also their main necessities. Personnel, capacity building, and information and education campaigns are the next leading issues and concerns voiced by the informants. They explained that, in terms of personnel, they need to hire more foresters and enforcers who are younger to compensate for the capacity and health of the currently aging workforce. They are also in need of lawyers to assist them with all the legalities they have to undertake.

As to the capacity building and information and education campaigns, the main issue was the lack of allotment for a much higher budget so that the coverage of providing capability and education to their stakeholders could be widened. In terms of transmitting cases to the court, the informants revealed that the units need continuing training on the technicalities and legalities of the processes since many cases were dismissed at the prosecutor level only.

With regards to conducting apprehensions by the enforcing units, the informant shared that the lack of manpower to conduct such activities is the main obstacle reiterating the need to hire or install a legal team that will aid them in the legality of the process. In detecting and monitoring environmental violators, the informants disclosed that the laws in place were not fully and effectively implemented. There is also a security concern since some violators are known to be affiliated with the communist terrorist group. The conduct of inspections was hurdled by a lack of workers or transportation facilities. Dismantling and padlocking establishments were problematic at times since some enforcers were threatened by the operators. Others will continue their operations when not monitored properly while others need security in achieving the said conduct.

Lastly, other issues tackled include budget, security, or training. Some informants revealed that to effectively implement environmental law enforcement, the enforcers should be provided with firearms. Other informants are concerned about the safety of their enforcers thus the need to be compensated with a hazard pay. Others suggested the swift release of funds for the conduct of operations while some need to acquire more training on the legalities of environmental law enforcement.

Overall, the informants confide that these issues identified were the main hindrances that affect the implementation of environmental law enforcement thus creating an impact on the achievement of targeted outputs of the environmental law enforcement unit in the Davao Region.

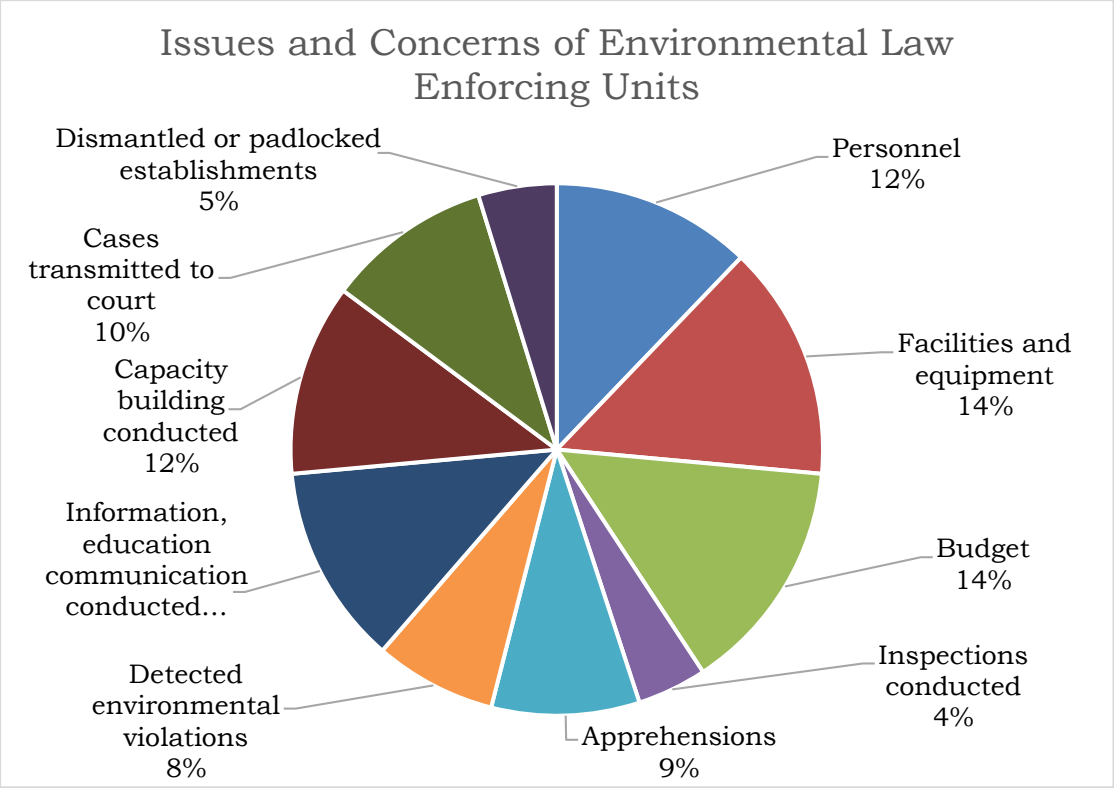

Figure 14. Issues and Concerns Confronting Environmental Law Enforcement Units

Table 17. Explanations of the Issues and Concerns of Environmental Law Enforcement Units

Issues or concerns in terms of:	**Explanations/Justifications**
Personnel	• Need additional manpower. • Lack of personnel to conduct or enforce ENR laws. • Health and capability of the personnel. • Hiring of young foresters and lawyers.
Facilities and equipment	• Need additional vehicles to be used in the hauling of apprehended forest products. • Lack of conveyance to haul the apprehended forest. • Lacked conveyance to be used in actual operations. • Addition of high-tech equipment. • Prevision of laptops and motorcycles. • Provision of firearms to forest protection officers.
Budget	• Need additional budget to be allotted to TEV and allowance of personnel. • Lack of budget. • Additional budget for forest protection unit. • To fast-track track release of the budget in terms of hauling if there is apprehension made and supposedly there were funds to be allotted as intelligence funds

Issues or	Explanations/Justifications
	that can be withdrawn immediately in case needed for operations. • Provision of hazard pay to the forest protection officers
Inspections conducted	• Out-numbered personnel. • Lack of transportation facilities.
Apprehensions	• Out-numbered personnel. • Need the help of a lawyer in filing cases against violators. • Delay of funds for payment of vehicles to be used in hauling the apprehended forest products.
Detected environmental violations	• Sometimes the detected environmental violators were members of the NPA • Through the use LAWIN system DENR can able to detect threats to the environment in real time but needs effective implantation of the law.
Information, education, and communication campaign conducted	• More budget to be allotted to IEC. • Needs more budget.
Capacity building conducted	• Needs a clear budget to be allotted in the conduct of training so that all topics to be discussed may be given to the participants. • Provision of pamphlets to be given to the participants. • More legal training to be undertaken to the forest protection officers, hazard pay will supposedly be given also to the forest protection officers who actually enforce the environmental laws.
Cases transmitted to the court	• Needs security. • The personnel of forest protection needs continuous training in terms of the technicality of filing a case. • Delay in terms of a decision given by the judge. • Dismissal of the case in the prosecutor level.
Dismantled or padlocked establishments	• Needs security for padlocking establishment. • The dismantled or padlocked establishment must be closely monitored to avoid continued operation in the absence of DENR. • Enforcers are threatened.

Perceptions on the Performance of the Environmental Laws Enforcement. Presented in Table 18 below are the results of the KIIs and FGDs with the DENR environmental law enforcing unit personnel on the performance of environmental law enforcement in the Davao Region.

The results indicated that based on the perception of informants, the reforestation program of the DENR has scored positive points on many fronts. Firstly, it was viewed as having actually improved forest cover although this was mitigated by the continued incidence of the illegal cutting of trees. On the other hand, the program was also reported to have actually reduced the illegal cutting of trees.

In terms of mitigating the impacts of climate change on the natural environment, environmental law enforcement units were seen to have actually increased and protected the flora, fauna, and tree species, raised water availability and quality, pollution control, and increased environmental awareness.

Furthermore, environmental law enforcement was seen as helping reduce social conflicts yet highly affected by the insurgency problem in several areas. The forest law enforcement unit was seen to have actually improved the coordination between the national and local branches of government.

However, on the operation side, the informants were unashamed to mention the lack of optimal inputs in terms of budget, personnel, facilities, and equipment. Also, the capacity of enforcers in terms of the legalities surrounding the implementation of environmental law enforcement was considered weak and needs attention. Due to the delays in releasing of mobilization funds with limited and under-capacitated personnel, the optimum implementation has been constrained thus partly affecting the delivery of the expected outputs from the environmental law enforcement unit.

Despite the aforementioned positive and negative perceptions, however, the informants viewed the forest law enforcement unit of the DENR in the Davao Region as being successful in attaining its objectives.

Table 18. Perceived Performance of the Environmental Law Enforcement Units

Question	Response		Explanation
	Yes (%)	No (%)	
Is the entire environmental law enforcement unit successful in attaining its stated objectives?	75.76	24.24	• With the help of partner agencies. • By actual participation of law enforcement staff and head of office. • The target derivatives were closely monitored and compiled by the end of the year
Are enforcement units adequately funded?	33.33	66.67	• But needs additional budget for the law enforcement activity. • Lack of funds from the national especially in enforcing ENR Laws • But needs more allotment intended for TEV, allowance for operational expenses.
Are the enforcement units composed of an adequate number of personnel?	36.36	63.64	• But needs additional young foresters to be assigned in FLEU. • There were personnel that were transferred from the other office • Needs additional manpower specially foresters and lawyers. • Needs new enforcers and technical employees
Are enforcement units composed of well-capacitated personnel?	48.48	51.52	• Needs follow-up training. • Needs continuous training, especially on environmental laws and protocols for filing cases. • Additional training is required.
Are enforcement units provided with adequate and suitable facilities and equipment?	15.15	84.85	• Provision of vehicles to be used in law enforcement activities. • Needs vehicles to be given to the forest protection unit • Need high-tech equipment and vehicles to be used in forest protection.

Question	Response		Explanation
Were the inspections and monitoring conducted by the enforcement units successful?	87.88	12.12	• Through regular monitoring. • Continued monitoring and inspection of registered WPPs and LDs.
Were all the apprehensions of violators done by the enforcement units effective in reducing environmental violations?	81.82	18.18	• But need training on the filling of cases. • Through IEC they were able to know the importance of protecting the natural resources • Serve them a sample, especially those violators with cases filed in court against them
Were all the apprehensions of violators done by the enforcement units properly reported and transmitted to court?	66.67	33.33	• But sometimes in the absence of the claimant the apprehension team finds it difficult to identify the culprit • If probable cause is being established after the conduct of the administrative hearing.
Did the information, education, and communication programs by the enforcement units' actually improved environmental awareness in your area?	100.00	0.00	• Through public awareness and conduct of IEC • With the active participation of partner agencies. • Through public awareness and the help of barangay officials
Were the information, education, and communication programs conducted by the enforcement units successfully applied by participants in using or interacting with natural resources?	72.73	27.27	• They were afraid of threats from illegal loggers. • Needs help from PNP AFP and DENR personnel. • Sometimes but need technical assistance from DENR.
Did the enforcement units actually help increase forest and wildlife protection in your area?	90.91	9.09	• Because there were cases filed by DENR. • Through IEC and strict implementation of environmental laws. • Through public awareness.
Did the enforcement units facilitate increased flora and fauna biodiversity in your area?	84.85	15.15	• Through public awareness. • Through regular conduct of foot patrol by using systems and technology. • Through regular monitoring and conduct of public awareness.
Did the enforcement units actually protect and/or improve water quality in your area?	78.79	21.21	• With the help of LGUs and the community • By means of IEC and involvement of BLGU. • With the help of EMB and LGU's.
Did the implementing units actually reduce the illegal cutting of trees in your area?	96.97	3.03	• Through IEC and strict implementation of environmental laws. • Strict implementation of environmental laws PD 705. • A lot of personalities have already filed a case against them.
Did the implementing units actually reduce the illegal use, transport, and sale of endangered wildlife in your area?	96.97	3.03	• Strict implementation of RA 9147. • Intensified operations and apprehension. • Through filing of cases against violators.
Did the implementing units actually reduce all forms of pollution in your	66.67	33.33	• Through community awareness and the help of BLGU. • Weak monitoring of solid waste

Question	Response		Explanation
area?			management.
Did the implementing units actually facilitate the proper waste disposal in your area?	72.73	27.27	• Through community awareness and the help of BLGU. • With the help of BLGU and LGU and the active participation of the community.
Did the enforcement units help in reducing social conflicts and improve social cohesion in your area?	81.82	18.18	• Sometimes. • Through MFPC • Maybe sometime in another way by involving them in DENR protect.
Did the units' implementation of environmental laws affect any means of insurgency in your area?	75.76	24.24	• Presence of war between government troops and the communist terrorist group, the forest protection activities will be stopped. • The presence of lawless elements can hamper enforcement activities to avoid compromising the safety of forest protection officers. • Some illegal activities or protected by lawless element.
Overall performance, effectiveness, and efficiency	71.77	28.23	• With the help of partner agencies, LGU, BLGU, and the community.

Summary

The main intention of this study was to measure or estimate the efficiency and productivity of Community Environment and Natural Resource Offices (CENROs) in the implementation of environmental laws in the Davao Region from 2010 to 2018. Specifically, its objectives were to identify the inputs for environmental law enforcement; identify the outputs of environmental law enforcement; estimate the technical efficiency of the DENR enforcement unit; estimate the productivity performance of the enforcement unit of the environmental laws; and identify issues and concerns confronted in the implementation of environmental law enforcement in Davao Region.

The researcher employed a mixed method design by considering both quantitative and qualitative approaches and used primary data gathering through survey interviews and focused group discussions and the collection of secondary data to estimate the efficiency of data envelopment analysis (DEA) and further estimated the productivity of the enforcement units using DEA-based Malmquist total factor productivity (TFP) index.

The following were the findings of the study:

Based on the secondary data collected, there eight inputs identified that were utilized for the implementation and enforcement of environmental laws in the Davao Region from 2010 to 2018 which were: the number of personnel; facilities, and equipment; annual budget; the number of inspected, monitored establishments; the number of apprehensions; the number of detected environmental violations; information, education communication conducted; and the number of the capacity building conducted. Consequently, the outputs expected from the environmental law enforcement units were: the number of cases transmitted to court; the number of dismantled in/or padlock establishments; and the number of turned-over/confiscated wildlife.

In the estimation of technical efficiency scores; it was revealed that among the CENROs observed, CENRO-Baganga, Davao City, Lupon, Malalag, Manay, New Corella, and Panabo environmental law enforcing units were operating with technical efficiency under VRS assumptions from 2010 to 2018. On the other hand, enforcing units of CENRO-Digos City, Maco, Mati, and Monkayo were operating with technical inefficiencies throughout the period under review.

In the estimation of the productivity performance of the enforcement unit of the environmental laws in Davao Region, it was found that CENRO-New Corrella was the most productive performer followed by CENRO-Davao City, Baganga, Panabo, Digos City, Manay and Malalag. Environmental Law Enforcement Units of CENRO- Lupon, Maco, Mati and Monkayo displayed negative TFP growth. Overall, the DENR implementation of environmental laws in Davao Region from 2010 to 2018 revealed that the units were productive between 2010 and 2011, 2011-2012, 2014-2015 and 2017-2018. Operation in other years were deemed to have a negative total factor productivity growth suggesting that in these periods, the units combined were not appropriately utilizing its overall operative inputs for efficient average outputs.

Furthermore, the deficiencies in facilities and equipment and budget were the leading issue in the implementation of the environmental law enforcement. Lack of personnel, budget for Information, Education and

Communication Campaign and Capacity Building conducted were the next concern that affects achievement of outputs. Overall, the environmental law enforcing unit of DENR in Davao Region was considered successful regardless of the limited operational inputs in achieving optimum output as observed.

Conclusion

In view of the findings of the study only seven CENROs' – CENRO-Baganga, CENRO-Davao City, CENRO-Lupon, CENRO-Malalag, CENRO-Manay, CENRO-New Corella and CENRO-Panabo – Environmental Law Enforcing Units were operating with technical efficiency, under the VRS assumption, from 2010 to 2018.

The Malmquist Index Summary of Firm Means revealed that Environmental Law Enforcing Units of CENRO-New Corrella, CENRO- Davao City, CENRO-Baganga, CENRO-Panabo, CENRO-Digos City, CENRO-Manay and CENRO-Malalag were productive performers as evidenced by their average TFP growth resulted from higher technical and technological change throughout the period under review.

Recommendations

The following were the recommendations drawn from the findings and conclusions of the study:

Tracking Efficiency. It is recommended that the DENR along with its CENROs should put in place measures to monitor the efficiency of their units to track the achievement of outputs whether they are operating with appropriate utilization of either constant, varied or adjusted inputs. This is to secure that the units are operating in an optimal state given with the inputs available for their disposition. Environmental law enforcement units of CENROs that are operating with inefficiencies should be assessed and assisted by the DENR in improving their work competencies rather than mandating and requiring the provision of target outputs that are problematic to achieve due to limitations thus making these units and their personnel resort to tampering reports and eventually corruption.

Improving Performance and Productivity. Criminalizing environmental offenses can be both effective and inhibitive way to achieve proper implementation of environmental law. However, at the current study, the emerging knowledge of the lack of capacity in the legalities and technicalities of the environmental laws confronting the enforcing units may also be a weakness in the overall process. To improve performance and productivity of these enforcing units, the main attention of the governing agency is required and recommended with the swift and continuing process of exacting capacity build-up for enforces. An increased outputs entails quality and excellence thus emanating productivity.

Addressing Issues and Concerns. The government should continuously support its agencies in addressing their institutional limitations to improve the achievement of targeted outputs. As observed, most issues confronting the units are operational in nature and the government has the capacity to correct these limitations. The DENR should secure the infusion of sufficient financial

and manpower resources for these units to have a better chance of attaining its objectives where enforcers can sufficiently monitor its current activities and effectively implement laws in its operations to address the problems encountered.

Future Research. Since this study was only focused on the technical efficiency of DENR's environmental law enforcing units, a research on allocative and economic efficiency is suggested to give more insight for these units. The determinants of efficiency and productivity were also unexplored and it is also recommended that other qualitative and quantitative dimensions be included in future studies.

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