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Green Warehousing Practices in the Philippines

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Abstract

Green practice is a worldwide policy and everybody is concerned with sustainable development. This study assessed the green warehousing (GWH) practices in the Philippines and its sustainability dimensions. It utilized a quantitative descriptive-survey approach with questionnaire for data collection. The sample consists of 48 warehouses with warehouse managers as respondents. Statistical tests used were frequency and percentage, mean and standard deviation, Kruskal-Wallis H-Test, and Mann-Whitney U-Test. Results showed most of participating warehouses are located in Parañaque, corporate-owned, small enterprises, operating for 15 years or less, with less than 100 employees, and private. Results further revealed that GWH practices on inventory management and operations were almost always practiced while those on facility design, layout, mechanical handling equipment, staff, and warehouse management system (WMS) were often practiced. Environment, social, and economic GWH practices are also often practiced. Top GWH practices are mostly economic and some social while bottom GWH practices are mostly environmental. Significant differences on GWH practices were found on inventory management, staff, WMS, and social dimension when grouped to location; on WMS when grouped to operation years; and on facility design, environment, and social dimension when grouped to nature of service. These findings may guide warehouse managers in enhancing their GWH practices as they gear towards attaining sustainability in support to the United Nation's Sustainable Development Goals.

Keywords: green practices; sustainable development; sustainable warehousing; warehouse management

INTRODUCTION

Green practices for all types of organization had become a worldwide policy issue. Sustainability is now sought in all types of businesses due to demands of the society to care for environment [1]. Sustainability in operations of business necessitates the interdependence of environment, economic, and social dimensions [2]. Green principles are put into action in all processes and green practices are implemented in all phases of supply chain [3].

Of international significance is green supply chain management as it represents a fundamental organizational philosophy of gaining profit and market share while reducing negative environmental impacts [4]. To be more competitive in the increasing socially responsible world, the three sustainability dimensions namely environment, economic, and social has to be integrated [5].

Businesses make their supply chains greener since there is also a growing interest among consumers to patronage environment-friendly products [6]. Implementing green practices in supply chain phases makes multiple ways for innovation and improvement plus a greener environment [3]. With the whole supply chain going green, businesses can sustain themselves in the competitive market [1].

Greening and sustainable development is also very important in logistics [7]. The purpose of green logistics is to lessen the negative environmental effects of its processes [3], which are very vital for sustainable ventures, interconnecting environment, economic, and social dimensions [7].

In competitive logistics, green approaches have gained research interest but the element of warehousing, which is an essential part of logistics and supply chain, is less researched [8]. Green warehousing has great potential to attain sustainable development but little research had been done [9]. It is still considered a relatively new greening approach [10] and the literature still lacks case studies and empirical data [11]. This is despite the assumption that green initiative in warehousing is a likely strategy for sustainable environment and supply chain [12].

From mere storage and distribution of products, warehousing has developed to also provide assembly, manufacturing, and other value-added services [13]. As a storage facility and center for distribution and logistics service, a warehouse is utilized for many functions [9]. A green warehouse is one that synchronizes its organizational, technological, economic and social functions and its care for the environment [14].

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A sustainable warehousing company considers the economic factors and the social and environmental effects that take place in the warehouse and its surroundings [2]. Green warehousing is a central part of the sustainable supply chain operations [5]. However, the development of a green warehouse is very demanding since the equilibrium among environment, economic, and social aspects must be sustained [14].

Moreover, researches in green warehousing address two of the 17 United Nation's Sustainable Development Goals (SDGs). In particular, GWH studies may contribute to the attainment of SDG 9 (Industry, Innovation and Infrastructure) and SDG 12 (Responsible Consumption and Production). Among the targets for Goal 9 are developing quality, reliable, sustainable and resilient infrastructure, and retrofitting industries to make them sustainable with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes [15]. For Goal 12, the targets include substantially reducing waste generation through prevention, reduction, recycling and reuse, and encouraging companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle [15].

These global goals lead to an increase of studies evaluating sustainability initiatives for warehouses [16]. Some of the sustainability measures and practices adopted in warehouse include energy efficiency [16-20], green infrastructure [16, 21], waste reduction [16, 22], employees' training [16, 23], and sustainable work culture [16, 24-26]. There is also a surge of interests in these green initiatives in Southeast Asia. For instance, Indonesian researchers have conducted studies on green warehouse performance [5, 27], green supply chain [28-34], green logistics [35, 36], green procurement [36, 37], and green transportation [37].

It is imperative to develop sustainability performance measures, and identify best practices [13]. In connection thereto, a theoretical study [9] developed a model for sustainable warehousing with eight constructs namely, warehouse facility design, warehouse layout, inventory management, mechanical handling equipment, warehouse staff, warehouse operations, onsite facilities, and warehouse management system.

Using the above-mentioned constructs, this study assessed the green warehousing practices of participating warehouses from three selected areas in the Philippines. To be more specific, the following were the objectives of this study:

1. To determine the profile of warehouses in terms of location, business ownership, size of enterprise, operation years, number of employees, and nature of service;
2. To assess the occurrence of green warehousing practices as regards warehouse facility design, warehouse layout, inventory management, mechanical handling equipment, warehouse staff, warehouse operations, and warehouse management system;
3. To determine differences on green warehousing constructs and sustainability dimensions when grouped according to warehouse profile categories; and
4. To compare the green warehousing practices as regards environment, social and economic dimensions of sustainability.

RESEARCH METHODS

This study is a quantitative descriptive research using survey approach. The respondents are 48 warehouse managers from 48 different warehouses. The warehouses are from three purposively selected areas in the Philippines: the first is Batangas City, which is where the Port of Batangas is located; the second is Parañaque City, which is very proximate to the Port of Manila; and the third is the Lipa City – Tanauan City area, two cities that are along the major thoroughfare when traveling from the Port of Batangas to the Port of Manila. It was aimed to solicit responses from at least 60 warehouses but due to a variety of reasons, only 48 were able to participate.

A combination of face to face and virtual administration of questionnaire was conducted. The respondent warehouse managers were well-informed about the objectives of the study and they were assured that the information gathered from the survey will be treated collectively, with utmost confidentiality, and for research purposes only. All the answered questionnaires gathered from the respondents were found to be usable for tabulation and statistical tests.

The first part of the questionnaire consists of items that are intended to typify the participating warehouses as to their location, ownership, size, operation years, number of employees, and nature of service. The second part of the questionnaire consists of 30 green warehousing practices [9]. A four-point Likert scale was used and the computed mean was interpreted in terms of occurrence of practice from "almost never" to "almost always" as given in Table 1.

Table 1. Scoring and Interpretation

Response	Mean	Occurrence of Practice
4	3.50 – 4.00	Almost Always
3	2.50 – 3.49	Often
2	1.50 – 2.49	Seldom
1	1.00 – 1.49	Almost Never

From the original eight sustainable warehousing constructs [9], the 30 green warehousing (GWH) practices were distributed into only seven constructs, excluding onsite facilities. This is due to concerns on reliability or internal consistency of items. The four items of onsite facilities were transferred to other constructs. One item goes to warehouse facility design and the other three to warehouse staff. The number of items and Cronbach's alpha for each GWH construct, the total GWH, and the sustainability dimensions are given in Table 2.

Table 2. Reliability Coefficients

GWH Constructs	Items	Alpha
Warehouse Facility Design	8	.81
Warehouse Layout	4	.80
Inventory Management	2	.80
Mechanical Handling Equipment	3	.85
Warehouse Staff	7	.65
Warehouse Operations	4	.90
Warehouse Management System	2	.71
Total GWH	*30*	*.89*
Sustainability	**Items**	**Alpha**
Environment	14	.85
Social	16	.80
Economic	25	.85

Investments in sustainable warehousing can generate good economic value and carry out social and environmental responsibilities [9]. Of the 30 GWH practices, 14 have impact on environment, 16 on social and 25 on economic dimension of sustainability. In addition, there are 6 items that have impact on all the three dimensions, 13 items have dual and 11 have single impact magnitude. Also, 19 items have impact on more than one dimension of sustainability.

Based on the objectives of the study, the following null hypotheses were formulated and tested:

Ho_1: There is no significant difference on GWH constructs when grouped according to warehouse profile categories.

Ho_2: There is no significant difference on the dimensions of sustainability when grouped according to warehouse profile categories.

Kruskal-Wallis H-test was used to test the above hypotheses, particularly the differences when grouped according to location, business ownership and size of enterprise. Mann-Whitney U-test was also used for the above hypotheses but particularly the differences when grouped according to operation years, number of employees, and nature of service. Frequency and percentage were used to typify the participating warehouses. Mean and standard deviation (SD) were used to assess the occurrence of GWH practices. Mean was also used to compare the practices with regard to the three dimensions of sustainability, and to compare the assessments of the different groups of respondents who were grouped base on the profile of their warehouses.

RESULTS AND DISCUSSION

Table 3 presents the profile of participating warehouses in the Philippines. As shown in the table, most warehouses are from Parañaque and categorized as small enterprises.

Table 3. Profile of Participating Warehouses

Profile Variable	Category	Frequency	Percent
Location	Batangas City	13	27.1
	Lipa-Tanauan	15	31.3
	Parañaque	20	41.7
Business Ownership	Sole Proprietorship	10	20.8
	Partnership	3	6.3
	Corporation	35	72.9
Size of Enterprise	Micro	13	27.1
	Small	16	33.3
	Medium	8	16.7
	Large	11	22.9
Operation Years	15 years or below	25	52.1
	More than 15 years	23	47.9
Number of Employees	Less than 100 employees	35	72.9
	100 employees or more	13	27.1
Nature of Service	Private	38	79.2
	Public	10	20.8

Moreover, a great majority of these warehouses are corporate-owned, with less than 100 employees, and have private services or not open for public use. Furthermore, a little more than half of the warehouses are relatively new with not more than 15 years in operation.

Table 4 presents the assessment on GWH practices adopted by warehouses as regards warehouse facility design. All the eight practices have impact on environment, six on economic, and four on social dimension of sustainability.

Table 4. GWH Practices on Warehouse Facility Design

Practices	Mean	SD	Interpretation
1. Use of renewable energy (En, Ec)	2.52	1.24	Often
2. Use of sunlight (En, Ec)	2.33	1.12	Seldom
3. Efficient use of artificial lighting (En, S, Ec)	2.94	1.04	Often
4. Control of temperature to save energy (En, Ec)	3.13	.98	Often
5. Water conservation (En, S, Ec)	2.65	1.21	Often
6. Use of noise reduction techniques (En, S)	2.92	1.27	Often
7. Biodiversity enhancement of surroundings (En	3.08	1.11	Often
8. Use of recycling facility to minimize waste (En, Ec)	3.33	.86	Often
Warehouse Facility Design	*2.86*	*.73*	*Often*

Note: En – Environment, S – Social, Ec – Economic

Results show that GWH on warehouse facility design is often practiced by the participating warehouses. Practices on minimizing waste through the use of recycling facility and conserving energy by controlling temperature that requires least amount of energy were more evident than the other practices with maximizing the use of sunlight having the least or being only seldom practiced. Similarly, a previous study [12] found optimizing energy and minimizing waste as the major green initiatives of warehouses. Moreover, allowing source of natural lighting through the use of energy efficient thermal control glass reduced electricity consumption [16, 19, 21]. Findings implied that improvement on warehouse facility design should focus on the maximum use of sunlight and renewable energy.

Table 5 presents the assessment on GWH practices adopted by warehouses as regards warehouse layout. All the four practices have impact on economic, one on social, and none on environmental dimension of sustainability.

Results show that GWH on warehouse layout is often practiced by the participating warehouses although three out of four practices are almost always practiced. Warehouses have great concerns on layout that maximizes operations, provides efficient workflow pattern, and minimizes traveling distance although the design of passageways was not at its best. A previous study [2] also found warehouse utilization, as an essential economic factor in warehousing business. Another study [10] stated that by identifying flexible layouts, the minimization of energy due to material handling activities can also be achieved. Findings implied that improvement on warehouse layout should focus on designing passageways that will minimize congestion.

Table 5. GWH Practices on Warehouse Layout

Practices	Mean	SD	Interpretation
1. Layout minimizes traveling distance (Ec)	3.54	.77	Almost Always
2. Storage system maximizes operations (Ec)	3.58	.74	Almost Always
3. Passageways minimize congestion (S, Ec)	3.21	.97	Often
4. Efficient workflow pattern (Ec)	3.58	.71	Almost Always
Warehouse Layout	*3.48*	*.63*	*Often*

Note: En – Environment, S – Social, Ec – Economic

Table 6 presents the assessment on GWH practices adopted by warehouses as regards inventory management. The two practices have impact on economic dimension of sustainability.

Table 6. GWH Practices on Inventory Management

Practices	Mean	SD	Interpretation
1. Optimization of inventory level (Ec)	3.71	.68	Almost Always
2. Accuracy of inventory record (Ec)	3.81	.57	Almost Always
Inventory Management	*3.76*	*.57*	*Almost Always*

Note: En – Environment, S – Social, Ec – Economic

Results show that GWH on inventory management is almost always practiced by the participating warehouses. The accuracy of inventory record and optimization of inventory levels that may result to avoidance of obsolescence and lost sales had been prioritized by warehouses. It was also observed in a previous study [2] that warehouse inventory is vital in a sustainable warehouse economic model. Moreover, calculation of the data accuracy of the level of goods in the warehouse is needed to minimize errors in inventory [5].

Table 7 presents the assessment on GWH practices adopted by warehouses as regards mechanical handling equipment (MHE). All the three practices have impact on environment, two on economic, and one on social dimension of sustainability.

Table 7. GWH Practices on Mechanical Handling Equipment

Practices	Mean	SD	Interpretation
1. Use of environment friendly energy for MHE (En)	2.79	1.25	Often
2. Regular maintenance of MHE (En, Ec)	3.23	1.08	Often
3. Fuel-efficient operations of MHE (En, S, Ec)	3.15	1.13	Often
Mechanical Handling Equipment	*3.06*	*1.02*	*Often*

Note: En – Environment, S – Social, Ec – Economic

Results show that GWH on MHE is often practiced by the participating warehouses. It was also shown that the primary concern is on the regular maintenance and servicing of MHEs. However, the use of MHE with environment-friendly energy source should also be given importance in future development. In relation to this, a study [4] suggested the evaluation of all aspects of energy related to the use of MHE. Another study [10] clearly manifested that energy consumption is significant for MHE in both economic and environmental perspectives.

Table 8 presents the assessment on GWH practices adopted by warehouses as regards warehouse staff. All the seven practices have impact on social, five on economic, and one on environmental dimension of sustainability.

Table 8. GWH Practices on Warehouse Staff

Practices	Mean	SD	Interpretation
1. Policy for work-life balance of warehouse staff (S, Ec)	3.65	.73	Almost Always
2. Counter-balancing disruption to natural body clocks (S, Ec)	2.58	1.05	Often
3. Provision of technical and soft-skill training (S, Ec)	3.31	.83	Often
4. Occupational health and safety standards (S, Ec)	3.60	.71	Almost Always
5. Provision of welfare facilities (S)	3.73	.45	Almost Always
6. Fully equipped medical or emergency room (S)	3.08	1.15	Often
7. Use of cross-docking for operational efficiency (En, S, Ec)	3.00	.97	Often
Warehouse Staff	*3.28*	*.49*	*Often*

Note: En – Environment, S – Social, Ec – Economic

Results show that GWH on warehouse staff is often practiced by the participating warehouses. However, three out of seven practices are almost always practiced. Practices on warehouse staff that were given more concerns by the warehouses are the provision of welfare facilities, policy to ensure the employees' work-life balance, and occupational health and safety standards. The least priority given is on counter-balancing the disruptions to natural body clocks. As such, future development should include the design of shift roster for employees' health and welfare.

Related thereto, a previous study [2] established that warehouse employees' job satisfaction is imperative and the management should appropriately address the factors affecting job satisfaction such as working hours, training, and support. Moreover, regular training about sustainable practices results to improved outputs [16, 23] while building sustainable work culture promotes employee motivation [16, 24, 25]. A green approach also enhances the health of the employees [8].

Table 9 presents the assessment on GWH practices adopted by warehouses as regards warehouse operations. All the four practices have impact on economic, one on social, and none on environmental dimension of sustainability.

Table 9. GWH Practices on Warehouse Operations

Practices	Mean	SD	Interpretation
1. Efficient inbound processes (Ec)	3.60	.77	Almost Always
2. Maximum utilization of storage space (Ec)	3.63	.76	Almost Always
3. Minimum picker's traveling time (S, Ec)	3.67	.66	Almost Always
4. Efficient outbound processes (Ec)	3.75	.60	Almost Always
Warehouse Operations	*3.66*	*.62*	*Almost Always*

Note: En – Environment, S – Social, Ec – Economic

Results show that GWH on warehouse operations is almost always practiced by the participating warehouses. It was shown that warehouses prioritize practices that optimize the efficiency of inbound, storage, picking, and outbound processes. A previous study [4] also observed that warehouses adopt different types of order picking system but the most common is the picker-to-part order picking system that allows pickers to travel along the passageways to retrieve or stock the items specified in the picking list.

Table 10 presents the assessment on GWH practices adopted by warehouses as regards warehouse management system (WMS). The two practices have impact on the environment, social and economic dimensions of sustainability.

Table 10. GWH Practices on Warehouse Management System

Practices	Mean	SD	Interpretation
1. Implementing a reliable WMS to measure performance (En, S, Ec)	3.29	.82	Often
2. Developing future strategy to improve sustainability performance (En, S, Ec)	3.46	.92	Often
Warehouse Management System	*3.38*	*.77*	*Often*

Note: En – Environment, S – Social, Ec – Economic

Results show that GWH on WMS is often practiced by the participating warehouses. However, the warehouses give slight priority to the development of a future strategy over the implementation of their WMS. Relative to this, a study [12] stated that warehouse technology efficiency is a condition for green technologies and the reduction on the efficiency of warehouse technology use is unacceptable from logistics perspective. In addition, the automated warehousing solutions can be improved by the estimation of warehouse environmental impact [38].

Table 11 and Figure 1 summarize the assessments on GWH practices. As shown, GWH had been generally often practiced by the participating warehouses.

Table 11. Green Warehousing Practices

Components	Mean	SD	Interpretation
Warehouse Facility Design (WFD)	2.86	.73	Often
Warehouse Layout (WL)	3.48	.63	Often
Inventory Management (IM)	3.76	.57	Almost Always
Mechanical Handling Equipment (MHE)	3.06	1.02	Often
Warehouse Staff (WS)	3.28	.49	Often
Warehouse Operations (WO)	3.66	.62	Almost Always
Warehouse Management System (WMS	3.38	.77	Often
Total GWH	*3.26*	*.45*	*Often*

Results further show that warehouses gave higher priorities on GWH practices regarding inventory management and warehouse operations and lesser priorities on GWH practices regarding MHE and warehouse facility design. Findings implied that improvement on green warehousing should be more on the development of facility design, MHE, staff, and WMS.

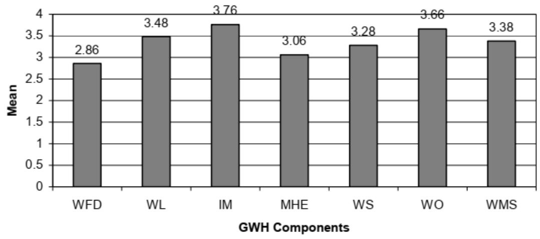

Figure 1. GWH Practices

A study [9] showed the diversity of areas affected by warehouse operations from the warehouse itself to the local environment and society. Another study [8] stated that green warehousing practices is not exclusively for environment but also for economic and societal benefits both on the micro and macro level.

Table 12 and Figure 2 summarize the assessments on GWH practices that have impact on sustainability dimensions.

Table 12. Dimensions of Sustainability

Dimensions	Mean	SD	Interpretation
Environment	2.96	.66	Often
Social	3.23	.47	Often
Economic	3.29	.42	Often

Results show that GWH practices concerning environment were less often practiced than those concerning social and economic dimensions of sustainability. Hence, future improvement on GWH has to focus more on environmental concerns.

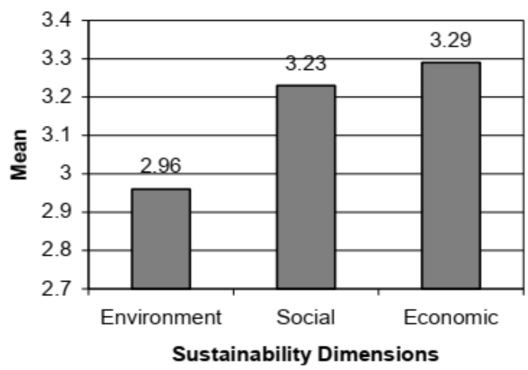

Figure 2. GWH Sustainability Dimensions

A related study [10] also found moderate GWH initiatives and recommended continuous adoption for industry and environmental benefits. Another study [1] found that green initiatives contributed to environmental protection and reduced costs. In contrast, sustainability concepts have not been implemented in operational processes of most industries in Indonesia, particularly warehouses [5]. GWH practices can be further developed by paying attention not only to the economic and operational performance but also to the environmental performance of warehousing activities [29].

The top 12 GWH practices adopted by the participating warehouses are presented in Table 13. These 12 practices have mean of 3.50 or higher, which implies that these are almost always practiced.

Table 13. Top GWH Practices

Practices	Mean	Interpretation
1. Accuracy of inventory record (Ec)	3.81	Almost Always
2. Efficient outbound processes (Ec)	3.75	Almost Always
3. Provision of welfare facilities (S)	3.73	Almost Always
4. Optimization of inventory level (Ec)	3.71	Almost Always
5. Minimum picker's traveling time (S, Ec)	3.67	Almost Always
6. Policy for work-life balance of warehouse staff (S, Ec)	3.65	Almost Always
7. Maximum utilization of storage space (Ec)	3.63	Almost Always
8. Efficient inbound processes (Ec)	3.60	Almost Always
9. Occupational health and safety standards (S, Ec)	3.60	Almost Always
10. Storage system maximizes operations (Ec)	3.58	Almost Always
11. Efficient workflow pattern (Ec)	3.58	Almost Always
12. Layout minimizes traveling distance (Ec)	3.54	Almost Always

Note: En – Environment, S – Social, Ec – Economic

As shown in the table, 11 of these practices have impact on economic dimension, four on social, and none on environment, which again implied that future development should focus on environment-related GWH practices. A similar study [2] also observed that most warehousing companies do not have much concern for the adverse effect to the environment and have a little understanding of the social consequences of business activities.

The bottom seven GWH practices adopted by the participating warehouses are presented in Table 14.

Table 14. Bottom GWH Practices

Practices	Mean	Interpretation
1. Use of sunlight (En, Ec)	2.33	Seldom
2. Use of renewable energy (En, Ec)	2.52	Often
3. Counter-balancing disruption to natural body clocks (S, Ec)	2.58	Often
4. Water conservation (En, S, Ec)	2.65	Often
5. Use of environment friendly energy for MHE (En)	2.79	Often
6. Use of noise reduction techniques (En, S)	2.92	Often
7. Efficient use of artificial lighting (En, S, Ec)	2.94	Often

Note: En – Environment, S – Social, Ec – Economic

The seven practices shown in Table 14 have mean lower than 3.00, with six of these often practiced and one seldom practiced. Further, six of these practices have impact on environment, five on economic, and four on social, and with two of these having impact on all the three dimensions of sustainability. All of these seven practices should be the primary concerns of future GWH development.

Table 15 presents the comparison on assessments of different groups of respondents on GWH practices. Results show that Batangas City and Parañaque warehouses have more frequent adoption of practices than Lipa-Tanauan warehouses. Corporation and partnership-owned warehouses have more frequent adoption of practices than those owned by sole proprietors. Large warehouses have more frequent adoption of practices than micro, small and medium size warehouses. Warehouses operating for more than 15 years have slightly higher adoption of practices than those with 15 or less years. Warehouses with 100 or more employees have more frequent adoption of practices than those with less than 100 employees. Public warehouses have more frequent adoption of practices than private warehouses.

Table 15. Comparison of Means for GWH Components

Profile	Category	WFD	WL	IM	MHE	WS	WO	WMS	Total GWH
Location	Batangas City	2.88	3.77	3.88	3.26	3.53	3.50	3.85	3.40
	Lipa-Tanauan	2.60	3.20	3.53	2.87	3.02	3.57	2.97	3.02
	Parañaque	3.04	3.50	3.85	3.07	3.31	3.84	3.38	3.35
Business Ownership	Sole Proprietorship	2.60	3.25	3.75	2.63	3.20	3.68	3.25	3.09
	Partnership	2.88	3.00	3.00	3.11	3.57	3.92	3.50	3.27
	Corporation	2.94	3.59	3.83	3.17	3.28	3.64	3.40	3.31
Size of Enterprise	Micro	2.80	3.31	3.69	2.51	3.19	3.67	3.27	3.14
	Small	2.70	3.55	3.81	3.25	3.23	3.69	3.44	3.25
	Medium	2.73	3.47	3.63	3.08	3.43	3.59	3.63	3.26
	Large	3.27	3.59	3.86	3.39	3.35	3.66	3.23	3.43
Operation Years	15 or below	2.93	3.31	3.72	2.95	3.17	3.64	3.10	3.20
	More than 15	2.79	3.66	3.80	3.17	3.40	3.68	3.67	3.33
Number of Employees	Less than 100	2.77	3.39	3.69	2.96	3.22	3.59	3.27	3.18
	100 or more	3.11	3.73	3.96	3.31	3.44	3.85	3.65	3.48
Nature of Service	Private	2.72	3.50	3.79	2.96	3.23	3.63	3.32	3.20
	Public	3.39	3.40	3.65	3.43	3.47	3.80	3.60	3.50

Note: WFD – Warehouse Facility Design, WL – Warehouse Layout, IM – Inventory Management, MHE – Mechanical Handling Equipment, WS – Warehouse Staff, WO – Warehouse Operations, Warehouse Management System

Table 16 presents the results of Kruskal-Wallis and Mann-Whitney tests and shows whether the mean differences found in the comparison of means in Table 15 are statistically significant or not.

Results show that at significance level of .05, the significant mean differences when grouped according to location were found on inventory management, warehouse staff, and WMS. Those warehouses located in Parañaque and Batangas City areas have higher adoption of practices than those located in Lipa-Tanauan area. There is also significant difference on WMS when grouped according to operation years. Warehouses operating for more than 15 years have higher adoption of practices than those operating for 15 years or less. Moreover, there is also significant difference on warehouse facility design when grouped according to nature of service. Public warehouses have higher adoption of practices than private warehouses. These findings implied that groups of warehouses with lesser adoption of GWH practices should consider improving or developing their GWH in the near future.

Table 16. Differences on GWH Practices

Grouping Variable	Value	WFD	WL	IM	MHE	WS	WO	WMS	Total GWH
Location	Chi-Square	4.029	3.709	10.621	1.653	6.244	3.125	9.890	5.097
	Sig.	.133	.157	.005	.438	.044	.210	.007	.078
Business Ownership	Chi-Square	1.811	2.158	.999	2.576	1.072	.232	.401	1.561
	Sig.	.404	.340	.607	.276	.585	.891	.818	.458
Size of Enterprise	Chi-Square	4.534	1.911	.867	3.460	1.693	.637	1.140	2.662
	Sig.	.209	.591	.833	.326	.639	.888	.767	.447
Operation Years	Mann-Whitney U	269.0	207.5	236.5	243.5	218.5	245.0	171.0	243.0
	Sig.	.702	.086	.152	.354	.151	.304	.011	.358
Number of Employees	Mann-Whitney U	171.5	154.5	177.0	179.0	177.5	183.5	171.5	148.0
	Sig.	.193	.078	.111	.251	.243	.232	.172	.065
Nature of Service	Mann-Whitney U	91.5	166.5	185.0	162.5	131.5	185.0	165.0	118.5
	Sig.	.012	.534	.863	.476	.135	.882	.504	.069

Note: WFD – Warehouse Facility Design, WL – Warehouse Layout, IM – Inventory Management, MHE – Mechanical Handling Equipment, WS – Warehouse Staff, WO – Warehouse Operations, Warehouse Management System

Table 17 presents the comparison on the assessments of different groups of respondents on the sustainable warehousing practices with regard to its impact on the three dimensions of sustainability. Results show that warehouses from Batangas City and Parañaque areas have more frequent adoption of environment, social and economic GWH practices than those from

Lipa-Tanauan area. Partnership and corporate-owned warehouses also have more frequent adoption of practices in all three dimensions than those owned by sole proprietors. Large warehouses have more frequent adoption of practices in the three dimensions than micro, small and medium size warehouses. Warehouses operating for more than 15 years have slightly higher adoption of environment, social and economic GWH practices than those with 15 or less years. Warehouses with 100 or more employees have more frequent adoption of practices in all dimensions than those with less than 100 employees. Public warehouses have more frequent adoption of practices in all three dimensions than private warehouses.

Table 17. Comparison of Means for Dimensions of Sustainability

Profile	Category	Env	Soc	Eco
Location	Batangas City	3.11	3.47	3.42
	Lipa-Tanauan	2.67	2.95	3.11
	Parañaque	3.08	3.29	3.34
Business Ownership	Sole Proprietorship	2.72	3.03	3.18
	Partnership	3.05	3.35	3.24
	Corporation	3.02	3.28	3.33
Size of Enterprise	Micro	2.75	3.12	3.20
	Small	2.94	3.23	3.27
	Medium	2.91	3.27	3.26
	Large	3.27	3.34	3.45
Operation Years	15 or below	2.94	3.15	3.23
	More than 15	2.99	3.32	3.35
Number of Employees	Less than 100	2.87	3.15	3.22
	100 or more	3.20	3.44	3.47
Nature of Service	Private	2.83	3.16	3.24
	Public	3.44	3.50	3.47

Note: Env – Environment, Soc – Social, Eco – Economic

Kruskal-Wallis and Mann-Whitney tests were also used to test whether the mean differences shown in the comparison of means in Table 17 are statistically significant or not and the results are presented in Table 18.

Results show that at significance level of .05, there is significant difference on social dimension when grouped according to location. Those warehouses located in Parañaque and Batangas City areas have higher adoption of social GWH practices than those located in Lipa-Tanauan area. There is also significant difference on environment and social GWH practices when grouped according to nature of service. Public warehouses have higher adoption of both environment and social GWH practices than private warehouses. The findings again implied that groups of warehouses with lesser adoption of social and environment GWH practices should consider improving or developing their GWH in the near future.

Table 18. Differences on Dimensions of Sustainability

Grouping Variable	Value	Env	Soc	Eco
Location	Chi-Square	4.367	8.101	4.257
	Sig.	.113	.017	.119
Business Ownership	Chi-Square	2.069	2.385	.856
	Sig.	.355	.304	.652
Size of Enterprise	Chi-Square	4.764	1.584	1.898
	Sig.	.190	.663	.594
Operation Years	Mann-Whitney U	274.5	234.0	244.0
	Sig.	.788	.269	.369
Number of Employees	Mann-Whitney U	170.0	149.5	151.0
	Sig.	.182	.070	.076
Nature of Service	Mann-Whitney U	83.5	111.0	131.0
	Sig.	.007	.045	.134

Note: Env – Environment, Soc – Social, Eco – Economic

CONCLUSION

Most of the participating warehouses are located in Parañaque area, corporate-owned, categorize as small enterprise, operating for 15 years or less, with less than 100 employees, and private in nature. In general, the GWH practices on inventory management and warehouse operations were almost always practiced while those on facility design, layout, MHE, warehouse staff, and WMS were often practiced. The environment, social, and economic GWH practices were also generally often practiced. Furthermore, the top GWH practices were mostly economic and some social while the bottom GWH practices were mostly environmental. Significant differences on GWH practices were found on inventory management, warehouse staff, WMS, and social dimension of sustainability when grouped according to location; on WMS when grouped according to operation years; and on facility design, environment, and social dimensions of sustainability when grouped according to nature of service.

This study had attained its purpose and deemed relevant as it is one of the very few studies on GWH practices in a developing country. On a larger context, the results of this study may guide warehouse managers in enhancing their GWH practices as they gear towards attaining sustainability in support to the United Nation's Sustainable Development Goals. However, since this study was limited only to purposively selected areas and with a relatively small number of participating warehouses, no generalization of results can be made. Hence, further studies are deemed necessary. Future similar studies may consider a wider geographic area of study and with larger samples that are randomly selected. Further analysis on the GWH constructs may also be conducted.

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