

## A Conceptual Paper on the Relationship between GHRM and Pro-Environmental Behavior via Employee Empowerment

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**Abstract:** This conceptual study is based on literature reviews related to green human resource management (GHRM), employee empowerment, and pro-environmental behavior (PEB) at the workplace. Business activities in small and medium enterprises or corporations, including agriculture, will impact the ecosphere. The impact suggests the importance for organizations to focus their concerns on PEBs to reduce the negative environmental impact of their ignorance of green practices. Organizations may use GHRM to efficiently provide and execute environmentally friendly policies since it can track and impact employee environmental behavior. The present study aimed to investigate for future research whether employee empowerment mediates the relationship between the GHRM and PEB at the workplace from the perspective of the Ability-Motivation-Opportunity (AMO) Theory, specifically among agricultural companies in Malaysia. The study continued to explore the concepts, issues, and objectives through several works of literature in numerous areas. This conceptual paper signifies supplementing works of literature as a future reference for academics. The outcome of this study can offer information to agricultural companies on the ways to leverage GHRM and employee empowerment to promote PEB in the workplace.

**Keywords:** *PEB; GHRM; Empowerment; AMO Theory; Agricultural*

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### 1. Introduction and Background

The agricultural sector contributes to substantial economic growth by producing food sources, providing job opportunities, and endowing industrial raw materials (Afzal et al., 2009; Ali et al., 2017). In Malaysia, the agricultural industry contributes approximately 8.7% to the annual gross domestic (GDP) and 11.4% to the total employment (Hassan et al., 2018), making it one of the predominant sectors for socio-economic activities. Although it plays an important role in increasing crops for food security, agriculture activities have caused new issues leading to climate change (Moghaddam et al., 2020). Approximately 30% of all greenhouse gas emissions are attributable to agricultural operations, mostly due to the usage of chemical fertilizers, pesticides, and animal manure. Thus, to maintain global clients and sustain a vibrant global economy, effective management and control procedures are essential in environmental issues. According to Paille et al. (2014) and Tang et al. (2018), aligned with the concern for green practices, organizations gain their reputation and competitive advantage through sustainable environmental practices. They are aware of the significance of involving employees in attempts to improve sustainable performance through programs geared towards ensuring efficient usage of energy and reducing waste and other resources.

The research on pro-environmental behavior (PEB) in the workplace has emerged widely as most organizations are aware that green elements are their competitive advantage, especially when facing global climate change crises. In Malaysia, a serious concern exists for green practices due to the nation's poor environmental performance based on Global Environmental Performance Index. Malaysia ranked 9<sup>th</sup> in 2006, 26<sup>th</sup> in 2008, 54<sup>th</sup> in 2010, 25<sup>th</sup> in 2012 and 51<sup>st</sup> in 2014 to 75<sup>th</sup> recently in 2018. Hence, as reported by the Department of Environment (2010), the Malaysian government needs to be seriously focused on preserving the environment using numerous efforts, including the Ministry of Energy, Green Technology, and Water's (KeTTHA) promotion and funding of high-impact green technology research. The efforts were undertaken to align with one of the three themes in the 12th Malaysia Plan (2021-2025): Advancing Sustainability towards guaranteeing continuous economic growth while protecting the environment and continuing Malaysia's commitments to global targets.

Human activity is one of the main causes of climate change, and currently, an international consensus agrees that PEB must be promoted. A number of agricultural characteristics, including yield, cultivation of crops, and crop value, are changing as a result of climate change, which affects agriculture sustainability. Climate change has a variety of effects on agricultural yield, affecting both household and national food

security in diverse ways. Additionally, food security and sustainable agriculture are focal topics for innovation-related initiatives and research under the UN Sustainable Development Goals and Horizon 2020 (European Commission 2011). The significance of sustainable agriculture in agriculturally dependent countries, such as Malaysia, has been widely debated among academics. Tiraieyari and Uli (2011) pointed out that approximately 90% of Malaysia's farmers that grow food are small-scale farmers of unprofitable crops with expensive production costs, insufficient inputs, low yields, and unsatisfactory product quality.

The Malaysian government has assisted fertilizer subsidy farmers in raising their output and enhancing their revenue since the nation's agriculture strategy prioritizes higher production to attain food self-sufficiency (FAO, 2004). Endeavors to produce enough food and fiber for self-sufficiency have also resulted in Malaysia implementing an intensive agricultural system and consequently facing environmental degradation. In general, environmental behavior scores, specifically for air pollution and waste management, among Malaysians are not as high as their environmental awareness score due to the factor of convenience. Besides, PEBs are habitually performed (Staats, 2004) and are unlikely mentioned in the job description. Yuriev et al. (2018) discovered negligence of these behaviors among managers as it is not described in official documents. This finding is supported by Daily et al. (2009), who highlighted that the managerial level ignored employees' responsibility to lessen the organizations' environmental impact owing to unexpected behavior. Effective human resource management is necessary to accomplish PEB at work since it is difficult to achieve this by employing solely formal methods. According to a number of empirical studies on the disparities between environmentally friendly behavior at home and the office, the same individual recycles more regularly at home than at work. Additionally, Lo et al. (2012) demonstrated substantial discrepancies in energy-saving practices outside and inside the workplace. According to Norton et al. (2015), certain behaviors were linked to the organization, while others were connected to the individuals' qualities when related to PEB-related difficulties. According to a recent study by Faraz et al. (2021), encouraging PEB gave organizations a strategic advantage by cutting expenses, increasing income, cultivating a favorable reputation, achieving sustainability efforts, and preserving a competitive edge.

Vinojini and Arulrajah (2017) studied external and internal factors that influence PEB in the workplace, including green human resource management (GHRM). Dumont et al. (2017) researched and stated that employee behavior is influenced by the direct and indirect effects of GHRM. Thus, an individual's green behavior influences the personal value of employees towards environmental performance. Hence, this study concluded that a positive relationship exists between GHRM practices and the workplace behavior of the employees. There is a number of theories that support the notion that employees must be empowered, motivated and environmentally conscious to pursue green practices. According to the management concept known as empowerment, employees who are given the freedom to make their own choices are more likely to be emotionally involved. Employees increase their level of activity and develop a resilient spirit by being involved in worthwhile endeavors that advance the success of the company through empowerment (Elnaga & Imran, 2014). The present conceptual study examines the nexus between the GHRM practices of the Malaysian agricultural industry and employee empowerment and the effect on PEBs.

**Problem Statement:** There has been an increasing interest among practitioners and researchers in exploring the GHRM concept over the last two decades (Gilal et al., 2019). Nevertheless, studies that have focused on how to encourage staff to adopt a positive attitude and behavior to manage organizations' environmental impact and improve sustainable business operations remain limited (Dumont et al., 2017). The PEBs are considered critical employee behaviors for enhancing environmental performance within the GHRM framework (Tang et al., 2018). The PEB refers to any action related to responsible environmental behaviors to assist firms in achieving environmental sustainability (Andersson et al., 2013). As suggested in the literature, employees' roles are crucial in assisting the organization in becoming green by using PEBs (Lülfes and Hahn, 2013). Nonetheless, the relationship between GHRM and employee workplace green behavior, such as PEBs, has not yet been sufficiently studied, despite the growing academic interest in this topic (Saeed et al., 2019). Additionally, relatively few researchers have focused on the underlying mechanism behind the relationship between GHRM and PEBs. Thus, this study aims to fill up any existing gaps in the literature by first studying the direct effects of GHRM on PEBs and subsequently examining the indirect mechanisms by which GHRM may affect PEBs. In this respect, the current research intends to investigate the mediating role of employee empowerment in the relationship between GHRM and PEBs.

**Questions and Research Objectives:** The purpose of the conceptual study is to reveal the relationships between GHRM, employee empowerment, and the PEB of the agricultural industry in Malaysia. Therefore, the following research questions will be addressed:

- Is there a relationship between GHRM and PEB in the agricultural industry?
- Is there a relationship between employee empowerment and PEB in the agricultural industry?
- Is there a relationship between GHRM and employee empowerment in the agricultural industry?
- Does employee empowerment mediate the relationship between GHRM and employee PEB?

**Significance of the Research:** The present conceptual study is crucial as it potentially offers vital implications to various business leaders from the agricultural sector who desires to monitor their organizational performance constantly. The present study aims to examine the impact of GHRM on green awareness and practices among employees. In addition, the study will also investigate the mediating effect of employee empowerment between GHRM and employee PEB. The findings of these relationships could offer knowledge that benefits the agricultural sector on ways to leverage empowerment to enhance PEB among employees. Besides, the study could be crucial to policymakers entrusted with designing support mechanisms and schemes to promote the green practices of organizations. The findings of the study could also add to the existing body of literature referred to by scholars.

**The Ability-Motivation-Opportunity (AMO) Theory:** The theory of Ability-Motivation-Opportunity (AMO), as suggested by Applebaum et al. (2000), focuses on helping to select a human resource (HRM) activity that improves organizational success. According to Gerhart (2005), a good choice of HRM practice is important for the conscious development of employee skills (selection, recruiting, and training), motivation (performance-related pay), and opportunities to act (emphasis on teamwork and suggestions). Katou and Buddhwar (2010) divided HRM activities into three classes, which are HRM mechanisms affecting the desire to perform, the motivation to perform, and the ability to perform. Finally, in this vein, Rauch and Hatak (2016) systematized and specifically described and differentiated HRM activities into three distinct classes, namely skills, motivation and empowerment. Abilities enhancing HRM activities (Subramony, 2009) are aimed at increasing the level of expertise, skills, and skills within the business, thereby allowing employees to perform their job properly. This community consists of two subgroups: i) HRM practices that concentrate on expertise and are mainly task selection, and (ii) HRM practices that concentrate on information and skills development. These HRM activities can be influenced by interventions, in particular, training and coaching.

In essence, motivation-enhancing activities are designed to steer employee actions toward the goals of the company through the use of an acceptable set of rewards. These rewards include but are not limited to, performance management, compensation, motivation, and reward activities. Notably, motivation-enhancing activities vary in organizational behavior literature (Deci and Ryan, 1985), which focuses primarily on extrinsic motivation by concentrating on rewards and benefits. Empowerment-enhancing activities focus on the growth of employee autonomy, engagement in the decision-making process, and employee accountability and input mechanisms.

The theory of AMO is bound to have several implications. First, HRM activities have an indirect effect on organizational success by improving human skills and motivation and influencing the requirements for innovation, accountability, and active involvement in the life of an organization. Second, various HRM activities influence the various elements of the AMO. Some activities promote capacity, focus on motivation and are considered to affect organizational conditions. Third, HRM practice studies are viewed as the antecedents of AMO, situated at the intersection of management, psychology, sociology, and organizational behavioral theories. Fourth, AMO applies to and encompasses numerous components, including expertise, skills, experience, commitment, work satisfaction, decision-making, determination, accountability, creativity, and innovation. Researching all AMO components in one research would be incredibly difficult due to the sheer number of various AMO manifestations. Researchers concentrate on a single AMO case at a time, such as happiness, engagement, awareness, decision-making, and imagination.

## 2. Literature Review

**PEB at Workplace:** The PEB is considered one of the approaches that can be employed by organizations to reduce their adverse ecological impact. The employment of PEB is encouraged because PEB, also known as personal actions by individuals and with support from their organizations, can help to improve the environment (Blankenberg and Alhusen, 2018). Employees are considered agents of implementing organizational change regarding green initiatives and policies in many aspects (Dumont et al., 2017) because improving environmental sustainability and its success are dependent on employees' PEB (Saeed et al., 2019). Employees' PEB can be categorized into five dimensions listed below (Fatoki, 2019):

- **Conserving:** Conserving focuses on behaviors that preserve resources and avoid waste (such as recycling).
- **Avoiding harms:** Avoiding harm includes behaviors that reduce or mitigate the damage to the environment (such as pollution prevention).
- **Transforming:** Transforming focuses on changing and adapting to sustainable behavior (for instance, buying green products and renewable energy).
- **Influencing others:** Influencing others focuses on social behaviors that support sustainability (such as motivation, training, and incentives).
- **Taking initiative:** Taking initiative involves behaviors that do not support the status quo (for example, lobbying and activism).

Prior studies have empirically suggested that the ability to perform work in environmentally conscious behavior is important. Thus, organizations must crucially develop such behavior among their employees (Afsar et al., 2018; Chaudhary, 2019; Cheema et al., 2019; Fawehinmi et al., 2020). Furthermore, other literature has pointed out several benefits for organizations that practice PEB. For example, their employees will (i) promote and enhance the natural environment, which will help the long-term survival of the world and (ii) have a positive impact on financial implications in terms of reducing costs and improving financial, environmental, and social performance (Fatoki, 2019). Nonetheless, the evidence on how, why and when employees adopt these behaviors remains undiscovered or inconclusive (Dumont et al., 2017; Saeed et al., 2019; Fawehinmi et al., 2020). Therefore, based on this literature, the organizations shall put their effort and attention into the importance of PEB and their roles in green practices. Moreover, the findings in the literature drive the authors' motivation to explore PEB determinants which is also the aim of this research.

**GHRM and PEB:** The reviews of literature further suggested that organizations can utilize GHRM to effectively deliver and implement environment-friendly policies because it has the ability to measure and influence employee environment-related behavior, attitudes, knowledge, and motivation (Guziana and Dobers, 2013; Jabbour et al., 2013). In fact, past literature has stated their concerns on the effects of environmental management activities from HRM practices, which can enhance its alignment with environmental management (Jabbour et al., 2013). Globally, respect for the atmosphere drives businesses to adopt ecological HRM activities, namely climate management dimensions of HRM, to encourage sustainable occupational actions among workers. Renwick et al. (2013) defined GHRM as HRM activities that produce positive environmental results. Past studies underlined GHRM as a new approach based on various aspects, such as the development of environmentally friendly working conditions and the creation of a green workforce (Bombiak et al., 2018). Besides, GHRM officially established and implemented policies and practices that can directly influence employee behavior, guiding company personnel to engage in PEB at work. Thus, the following hypothesis has been posited.

**H1:** There is a positive influence of GHRM on PEB in the agricultural sector.

**Employee Empowerment and PEB:** The employees may feel more comfortable with a high level of empowerment provided by the leader as they gain a high sense of control. Additionally, they may perceive that the empowering behaviors are coherent with their existential values, which results in them interpreting their work as meaningful. Due to the sense of meaningfulness, empowering behaviors bring a feeling of satisfaction. Hence, employees become more committed to their organization, which motivates them to spend more time and energy in their organization. Employees can be provided with opportunities to engage in environmental management, which allows them to promote pollution reduction and recognize environmental opportunities (Renwick et al., 2013). Research has shown that employee green engagement is critical to

enhancing the efficiency of the environmental management system, such as eliminating waste and emissions at the workplace and making maximum use of resources. Renwick et al. (2013) outlined a variety of employee green communication processes from an integrated perspective. Employees can be inspired to engage in environmental management by providing green initiatives, such as writing newsletters, forming problem-solving groups, or setting up green teams (Vallaster, 2017). Encouraging green participation includes presenting staff with resources for quality development and environmental issues to be discussed. Thus, the authors suggest the following hypothesis:

**H2:** Employee empowerment in the agricultural sector relates positively to PEB.

**GHRM and Employee Empowerment:** Employees' PEB can be affected by GHRM practices through psychological mechanisms (Hameed et al., 2020; Spreitzer, 1995). Psychological green engagement and green climate in green initiatives are examples of psychological mechanisms for performance enhancement. Employees would contribute to green performance when they are empowered through GHRM practices. Thus, employees play an important role in strengthening the nexus between environmental performance and GHRM. When they feel empowered, they will present discretionary behavior, which is related to green behavior. Furthermore, employees will feel obliged to present environmental behavior if they receive some benefits from the company for green initiatives (Hameed et al., 2020). With these findings, it can be assumed that GHRM practices are related to employee empowerment. Thus, the following hypothesis has been posited.

**H3:** There is a positive relationship between GHRM with employee empowerment in the agricultural sector.

**The Mediating Effect of Employee Empowerment:** Empowerment is a motivational force that increases the self-efficiency of organizational members, including formal and informal practices of facilitating competence (Conger and Kanungo, 1988). Furthermore, most scholars emphasized empowerment as a motivational construct in promoting proactive behaviors. Employees will receive the feeling of empowerment and competency when employers offer empowerment to them, which makes them believe that they can influence their environment. Empowerment is known as an active perception of an individual work role and not a passive one, as it includes self-esteem, rewards, control and access to information. In addition, initiating and regulating actions with a positive impact on the job environment is part of the subjective process of empowerment. Moreover, a higher level of psychological empowerment is found to lead to leadership creativeness and effectiveness. The creativity of employees and their ability to influence intrinsic motivation within the organization is improved when they feel empowered. Past research has explored the mediating effect of psychological empowerment in other constructs, such as between job performance and psychological climate, affective commitment and job satisfaction, and the relationship between transactional leadership and followers' organizational identification. Therefore, the hypothesis has been posited as follows.

**H4:** Employee empowerment mediates the relationship between the GHRM and PEB of the agricultural sector in Malaysia.

### 3. Research Methodology

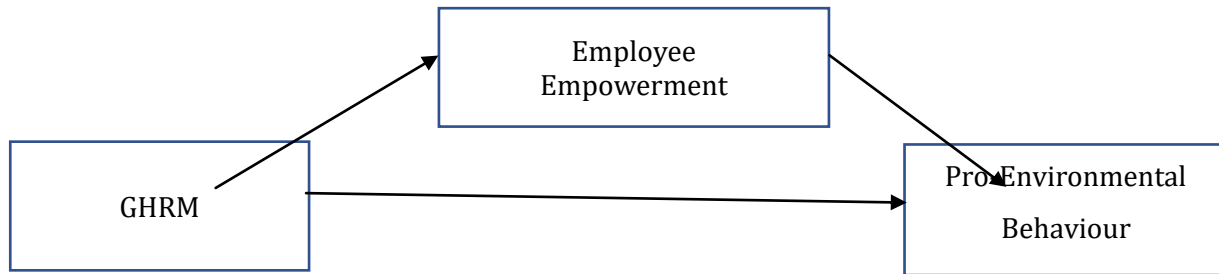
This article used an archival method based on literature reviews from journal articles, proceedings, theses and books to understand the existing studies of GHRM and PEB at the workplace to propose a conceptual framework. The keywords searched in the search engines such as Scopus, WoS and Google Scholar were "green human resource management", "pro-environmental behavior", "green behavior", "employee empowerment" and "ability-motivation-opportunity theory".

### 4. Conceptual Model Development

This conceptual study attempts to determine the relationship between GHRM and PEB and whether the relationship is mediated by employee empowerment. Studies have been undertaken on several models established by other authors. The conceptual model shown in Figure 1 is the combination study of Kularathne (2020) and Saeed et al. (2018). Kularathne (2020) investigated the effect of employee empowerment on environmental performance. On the other hand, Saeed et al. (2018) determined the relationship between GHRM and employees' PEB, which is also mediated by psychological capital from diverse industry sectors, such as the manufacturing, pharmaceutical and power industries. Therefore, as shown in Figure 1, the study proposed the following hypothesis:

- H1: There is a positive influence of GHRM and PEB on the agricultural sector.  
H2: Employee empowerment in the agricultural sector relates positively to PEB.  
H3: There is a positive relationship between GHRM with employee empowerment in the agricultural sector.  
H4: Employee empowerment mediates the relationship between the GHRM and PEB of the agricultural sector in Malaysia.

Figure 1: Proposed Research Model



## 5. Conclusion

The findings of the present study will provide a gateway to the study of the relationship between GHRM, employee empowerment, and PEB in the agriculture industry in Malaysia. Further research needs a wider range of literature to obtain insightful knowledge. This conceptual paper is expected to contribute to and supplement literature for the reference of future scholars. It serves a remarkable impact on the policymakers and owners of management in agriculture upon the full completion of the research.

## References

- Afsar, B., Cheema, S., & Javed, F. (2018). Activating employee's pro-environmental behaviors: The role of CSR, organizational identification, and environmentally specific servant leadership. *Corporate Social Responsibility and Environmental Management*, 25(5), 904–911. <https://doi.org/10.1002/csr.1506>
- Appelbaum, E., Bailey, T., Berg, P., & Kalleberg, A. (2000). *Manufacturing Advantage: Why High-Performance Work Systems Pay Off*. Ithaca, NY: Cornell University Press.
- Bombiak, E. & Marciniuk-Kluska, A. (2018). Green Human Resource Management as a Tool for the Sustainable Development of Enterprises: Polish Young Company Experience. *Sustainability*, 10(6): 1739.
- Blakenberg, A.K & Alhusen, H. (2018). On the Determinants of Pro-Environmental Behaviour-A Guide for Further Investigations. University of Goettingen, Center for European, Governance and Economic Development. <https://wwwuser.gwdg.de/~cege>
- Cheema, S., Afsar, B., & Javed, F. (2019). Employees' corporate social responsibility perceptions and organizational citizenship behaviors for the environment: The mediating roles of organizational identification and environmental orientation fit. *Corporate Social Responsibility and Environmental Management*, 7(1), 1–13. <https://doi.org/10.1002/csr.1769>
- Conger, J. A. & Kanungo, R. N. (1988). The empowerment process: Integrating theory and practice. *Acad. Manag. Rev.*, 13, 471–482.
- Dumont, J., Shen, J., & Deng, X. (2017). Effects of green HRM practices on employee workplace green behavior: The role of psychological green climate and employee green values. *Human Resource Management*, 56(4), 613–627. <https://doi.org/10.1002/hrm.21792>
- FAO. (2004). *The State of Food Insecurity in the World*.
- Fatoki, O. (2019). Hotel Employees' Pro-Environmental Behaviour: Effect of Leadership Behaviour, Institutional Support and Workplace Spirituality. *Sustainability*, 11, 4135. <https://doi.org/10.3390/su11154135>.
- Fawehinmi, O., Yusliza, M. Y., Mohamad, Z., Noor Faezah, J., & Muhammad, Z. (2020). Assessing the green behavior of academics: The role of green human resource management and environmental knowledge. *International Journal of Manpower*. <https://doi.org/10.1108/IJM-07-2019-0347>

- Gerhart, B. (2005). Human Resources and Business Performance: Findings, Unanswered Questions and Alternative Approach. *Management Review* 16(2)
- Guziana, B., & Dobers, P. (2013). How sustainability leaders communicate corporate activities of sustainable development. *Corporate Social Responsibility and Environmental Management*, 20(4), 193–204. <https://doi.org/10.1002/csr.1292>
- Hameed, Z., Khan, I.U., Islam, T., Sheikh, Z. and Naeem, R.M. (2020). Do green HRM Practices Influence employees' environmental performance? *International Journal of Manpower*, 41.
- Jabbour, C.J., Govindan, K., and Teixeira, A. and Freitas, W. (2013). Environmental management and operational performance in automotive companies in Brazil: The role of human resource management and lean manufacturing. *Journal of Cleaner Production*, 47. 129 140
- Katou, A. & Buddhwar, P. (2010). Causal Relationship between HRM Policies and organizational performance: Evidence from the Greek manufacturing sector. *European Management Journal*, 28(1)
- Kularathne, H.M.R.D. (2020). Does Green Employee Empowerment Mediate the Relationship between Green HRM and Environmental Performance? *Asian Journal of Social Science and Management Technology*
- Lulfs, R. & Hahn, R. (2013). Corporate Greening beyond formal programs, initiatives, and Systems: a conceptual model for voluntary pro-environmental Behavior of Employees. *European Management Review*, 10 83-98.
- Norton, T. & Parker, S., Zacher, H. & Ashkanasy, N. (2015). Employee Green Behavior. *Organization & Environment*, 28. 103-125
- Rauch, A. & Hatak, I. (2016). A Meta-Analysis of Different HR-Enhancing Practices and Performance of Small and Medium-Sized Firms. *Journal of Business Venturing*, 31.
- Renwick, D. W. S., Redman, T., & Maguire, S. (2013). Green human resource management: A review and research agenda. *International Journal of Management Reviews*, 15(1), 1– 14. <https://doi.org/10.1111/j.1468-2370.2011.00328.x>
- Saeed, B. Bin, Afsar, B., Hafeez, S., Khan, I., Tahir, M., & Afridi, M. A. (2018). Promoting employee's pro-environmental behavior through green human resource management practices. *Corporate Social Responsibility and Environmental Management*, 26(2), 424– 438. <https://doi.org/10.1002/csr.1694>
- Spreitzer, G. M. (1995). Psychological Empowerment in the Workplace: Dimensions, Measurement, and Validation Author (s): Gretchen M. Spreitzer Source: *The Academy of Management Journal*, 38(5), 1442-1465.
- Tang, G., Chen, Y., Jiang, Y., Paillé, P., & Jia, J. (2018). Green human resource management practices: scale development and validity. *Asia Pacific Journal of Human Resources*, 56(1), 31–55. <https://doi.org/10.1111/1744-7941.12147>
- Tiraieyari, N., & Uli, J. (2011). Sustainable Agriculture in Malaysia: Implication for Extension Workers. *Journal of American Science*, 7(8).
- Vallaster, C. (2017). Managing a company crisis through strategic corporate social responsibility: A practice-based analysis. *Corporate Social Responsibility and Environmental Management*, 24(6), 509–523
- Vinojini, M. and Arulrajah, A.A., (2017). The Pro-Environmental Behaviour of Employees in an Apparel Manufacturing Organization in Nuwara-Eliya District of Sri Lanka. *Sri Lankan Journal of Human Resource Management*, 7(1), 1–17.
- Yuriev, A., Boiral, O., Francoeur, V., & Paillé, P. (2018). Overcoming the barriers to pro-environmental behaviors in the workplace: A systematic review. *Journal of Cleaner Production*, 182, 379–394. <https://doi.org/10.1016/j.jclepro.2018.02.041>