

## Unlocking Organic Agroindustry Employee Eco-Innovation: Role of Green Product Knowledge and Green Transformational Leadership

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Article Info	Abstract
<p><b>Received</b> : 2023-05-01 <b>Accepted</b> : 2023-06-10 <b>Published</b> : 2023-10-16</p> <p><b>Key words:</b> green knowledge; green transformational leadership; eco-innovation, agroindustry; organic food</p>	<p>The problem to be answered in this study is whether green product knowledge (GPK) affects eco-innovation through the mediation of green transformational leadership (GTL) in the processed organic food agroindustry. This research is vital because processed organic food is one of the solutions to provide healthy food products for the community and has a broad impact on environmental sustainability through environmentally friendly production practices. The basic research method is an explanatory case study; the data collection technique uses the interview method by distributing 175 questionnaires to 35 agroindustry MSMEs of processed organic food products. Only 150 questionnaires are filled in to be analyzed further, and data analysis uses partial least square. Based on the research results, the first finding is that GPK positively and significantly affects GTL. The second finding is that GPK positively and significantly affects eco-innovation in the processed organic food agroindustry (EI). The third finding is that GTL positively and significantly affects EI. The fourth finding is that GPK positively and significantly affects EI mediated by GTL.</p>

### INTRODUCTION

Indonesia's organic food MSMEs are growing. Organic food demand contributes to this agroindustry. MSMEs in the agroindustry that produce organic food face challenges related to green knowledge and innovation of environmentally friendly products to meet the market's demands. Many agroindustry MSMEs lack organic food production and processing knowledge. This lack may decrease product quality and market competitiveness (Demirel & Kesidou, 2019; Suswadi et al., 2022).

Due to obstacles, green knowledge is insufficient. To meet market demand, agroindustry MSMEs need enough organic raw materials. Due to the scarcity of organic raw materials, agroindustry MSMEs must find reliable sources. Second, agro-industrial MSMEs must know how to make safe, high-quality processed organic food. Organic and food safety regulations must be met during manufacture. Third, a recognized organization must certify agroindustry MSMEs producing processed organic food. They must be prepared to spend time and money on organic certification. The fourth, intense market rivalry, demands agroindustry SMEs to create processed organic food with higher added value than competing items. Agro-industrial SMEs must innovate and understand market requirements to compete (Baker et al., 2020; Karali & Shah, 2022).

Green transformational leadership helps employees innovate organic processed food. Green transformational leadership may help employees realize how organic processed food production affects the environment and create suitable adjustments. Employees may not grasp environmental and sustainability challenges and how organic processed foods might assist. Leaders who desire to innovate and develop green products may be affected by a culture that

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does not favor change and a hierarchical structure. Leaders must then employ resources efficiently to create environmentally friendly and high-performance goods. Leaders must influence workforce behavior and habits to generate green products. Leaders must educate, train, and communicate to raise staff awareness. Green transformational leaders may inspire staff to make greener, higher-performing organic processed food products and improve the environment (Deng et al., 2022; Wijayasundara et al., 2022).

Eco-innovation promotes sustainable organic processed food production. This innovation reduces production costs by improving technology, the environment, and raw materials. Eco-innovation can boost the supply of safe, high-quality organic processed food. This idea can increase well-being by producing community-building jobs (Rabadán et al., 2019; Rowan et al., 2022).

Insufficient green knowledge can limit organic processed food product development. A lack of information about green materials, technology, and production methods might hamper green product development. Organic processed food is more expensive to develop. High-performance, eco-friendly green products can be hampered by budget constraints. Eco-innovation of organic processed foods is difficult to locate skilled and experienced workers. Unskilled Employees can hinder green product innovation. Uncertain or shifting rules can hinder green product development and marketing. Companies may struggle to develop green products without government or other backing. Organic processed food marketing takes a distinct approach (Ben Amara & Chen, 2022; Gupta et al., 2020; Hallstedt et al., 2020; Hansmann et al., 2020; Jia et al., 2022; Mukonza & Swarts, 2020; Ncube et al., 2023).

Companies need good marketing strategies to reach customers and get the word out about green products. These problems can be fixed with GPK and GTL. Leaders can motivate workers to make organic processed foods that are better for the earth and do their jobs better. Green information also helps companies make new products that suit the environment well. This study aims to find out how green knowledge, green transformational leadership, and eco-product innovation are related in the organic food agro-industry so that suggestions can be made to improve eco-innovation in the sector.

## **LITERATURE REVIEW**

### **Theoretical basis**

#### **Green Product Knowledge Theory**

Green knowledge theory is a concept that emphasizes the importance of understanding a product's life cycle from production to disposal. It focuses on sustainable product and technology development, considering social and environmental aspects in business planning. This theory highlights the significance of minimizing negative impacts while maximizing economic and social benefits throughout a product's life cycle. GPK theory recognizes hidden environmental and social costs in production and consumption, promoting sustainability and responsibility in product manufacture, distribution, and use. Additionally, it calls for an economic paradigm shift to integrate environmental and social considerations into economic decision-making, bringing the economy closer to the environment (Alhawari et al., 2021; Chen et al., 2022; Vendrell-Herrero et al., 2022).

#### **Green Transformational Leadership Theory**

Green transformational leadership theory is a leadership approach comprising vision, skills, encouragement, and attention to rewards that emphasizes clear vision and practical leadership skills in achieving green objectives. GTL must prioritize green values in every business decision, including transparency, social responsibility, and

environmental impact. Leaders must demonstrate commitment to these values, involve team members in decision-making, and motivate them to innovate and create better green solutions. GTL involves innovative and collaborative efforts to create a positive environmental impact while addressing complex and dynamic challenges. Green leaders must understand changing environmental challenges, make informed decisions, and inspire team members to participate in green actions and promote green values (Awan et al., 2023; Riva et al., 2021; Suswadi et al., 2022).

### **Product Eco-Innovation Theory**

Eco-innovation involves balancing environmental, social, and economic aspects to develop environmentally friendly products with a systemic approach. It considers the impact of products on the environment and society by using recycled materials and reducing waste. This approach creates products that are more in balance with nature, efficient in resource use and encourages innovative thinking in product design while meeting consumer needs. Companies can develop economically sustainable products by understanding consumer preferences for green products. Eco-innovation seeks systemically sustainable solutions through collaboration between companies, governments, and civil society, benefitting all parties and the environment (Galván-Vela et al., 2023; Triguero et al., 2023).

### **Previous Research**

Several studies have investigated the relationship between green product knowledge (GPK), green transformational leadership (GTL), and environmental performance. Wang et al. (2019) found that GPK encourages green purchase intention, emphasizing green trust, perceived consumer effectiveness, and perceived price. Ahmad et al. (2022) revealed that GTL has a significant direct and positive relationship with green product and process innovation, mediated by green dynamic capabilities. Mansoor et al. (2021) showed that GTL can mediate the relationship between green management initiatives and green creativity. Begum et al. (2021) found that GTL significantly influences green thinking, creative engagement processes, and innovation, which are mediated by green thinking and creative engagement processes. Riva et al. (2021) discovered that managers' green knowledge and GTL positively influence green creativity and environmental performance, with green creativity mediating the relationship between these factors. These studies provide insights into developing marketing strategies, generating green innovations, and promoting green initiatives suitable for organizations.

### **Hypothesis Development**

#### **The Effect of Green Product Knowledge on Green Transformational Leadership**

Knowledge and understanding of green raw materials, technologies, products, and regulations can significantly benefit GTL in selecting and using resources efficiently, promoting environmentally friendly practices, and reducing the environmental impact. This knowledge enables GTL to select energy-efficient and environmentally friendly technologies, reduce environmental impact during production, and comply with relevant legal and environmental requirements. Promoting green products and increasing consumer awareness strengthens GTL's commitment to sustainability and propels companies towards green transformation, leading to better green products and increased business growth. These abilities encourage sustainable business practices and promote a cleaner environment for all (Cui et al., 2023; Kusi et al., 2021; X. Sun et al., 2022).

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From the explanation above, it can be concluded that production employees' GPK and GTL are essential in promoting sustainable business practices in production environments. Production employees who understand green products can quickly adopt sustainable business practices. GTL will help create a sustainable organizational culture and promote sustainable business practices in every part of the organization. Based on the description above, the hypotheses that can be built are:

H1: Green product knowledge influences green transformational leadership

### **The Effect of Green Product Knowledge on Eco-Innovation of Processed Organic Food**

Employees must understand green raw materials to find ways to use them efficiently and responsibly in manufacturing. Green technology knowledge can also help find energy-efficient, environmentally friendly solutions. Understanding the 3Rs to reduce environmental effects is also crucial. Understanding this helps employees optimize material reuse and recycling to reduce environmental impacts. Green product benefits help employees create more sustainable products, raise consumer awareness, and inspire innovation. Understanding environmental legislation allows compliance and optimal utilization of natural resources. Finally, green product promotion boosts product development, company image, and consumer awareness of sustainable products (Ikram, 2022; Irawan, 2023; Qu et al., 2022).

Employees' knowledge, awareness, and skills about green products, environmental regulations, green technology, and strategies to reduce environmental effects can stimulate eco-innovation in the organic food agroindustry. Eco-innovation can optimize natural resources, reduce greenhouse gas emissions, and reduce industrial waste while meeting market needs for ecologically friendly products. EI research is necessary to generate sustainable products and reduce industrial pollution. Based on the description above, the hypotheses that can be built are:

H2: Knowledge of green products influences the eco-innovation of processed organic food

### **The Effect of Green Transformational Leadership on Processed Organic Food Eco-innovation**

Eco-innovation (EI) and sustainable green product creation require leadership. Leadership can inspire the team to innovate and contribute to EI. Leaders with an established mission and solid social responsibility may ensure that sustainable ideals are continuously applied throughout the firm, driving employees to innovate. They can also promote environmental consciousness by setting an example and teaching personnel about sustainability. Leadership may inspire eco-innovation by offering employees direction, encouragement, and innovation opportunities. Good leadership and communication can foster employee involvement in EI development. Good leadership can inspire employees to enhance environmental performance, achieve sustainable goals, and build strong internal and external collaborations (Arruda et al., 2022; Olivier & Hölscher, 2023).

Eco-innovation and sustainable development in the processed organic food agroindustry depends on leadership. Leadership can drive people to raise environmental awareness, create a green organizational culture, improve communication and collaboration, and boost environmental performance. Leadership may also build stakeholder relationships to benefit society and the environment. These initiatives allow

the processed organic food agroindustry to evolve while ensuring product quality and sustainable development. Based on the description above, the hypotheses that can be built are:

H3: Green transformational leadership influences the eco-innovation of processed organic food

### **Effect of Green Product Knowledge on Eco-Innovation of Processed Organic Foods Mediated by Green Transformational Leadership**

Strong GPK can help the processed organic food agroindustry generate eco-friendly innovations through GTL. Sustainable solutions can help this collaboration adapt to environmental changes. It improves product quality, society, and the environment. Mediating GTL can make businesses more environmentally friendly and boost product value. GTL leaders may inspire innovation and sustainability. This alliance can also promote economic sustainability by manufacturing environmentally friendly products that suit market needs, improve industry image, and increase consumer loyalty (Larbi-Siaw et al., 2023; Sánchez-García et al., 2023).

GTL increases GPK and EI. GTL helps create a workplace that fosters eco-friendly knowledge and creativity. GTL may boost GPK and EI, encourage sustainable business practices, reduce environmental impacts, and increase organizational and societal value. Integrating comprehensive eco-friendly ideas can help create a more sustainable and healthy industry. GTL can support sustainable development by encouraging environmental innovation and improving stakeholder communication. GTL can help leaders and stakeholders enhance the environment and society by developing GPK and EI. Based on the description above, the hypotheses that can be built are:

H4: Knowledge of green products influences eco-innovation of processed organic food mediated by green transformational leadership

Based on the explanation above, a research model can be drawn as follows:

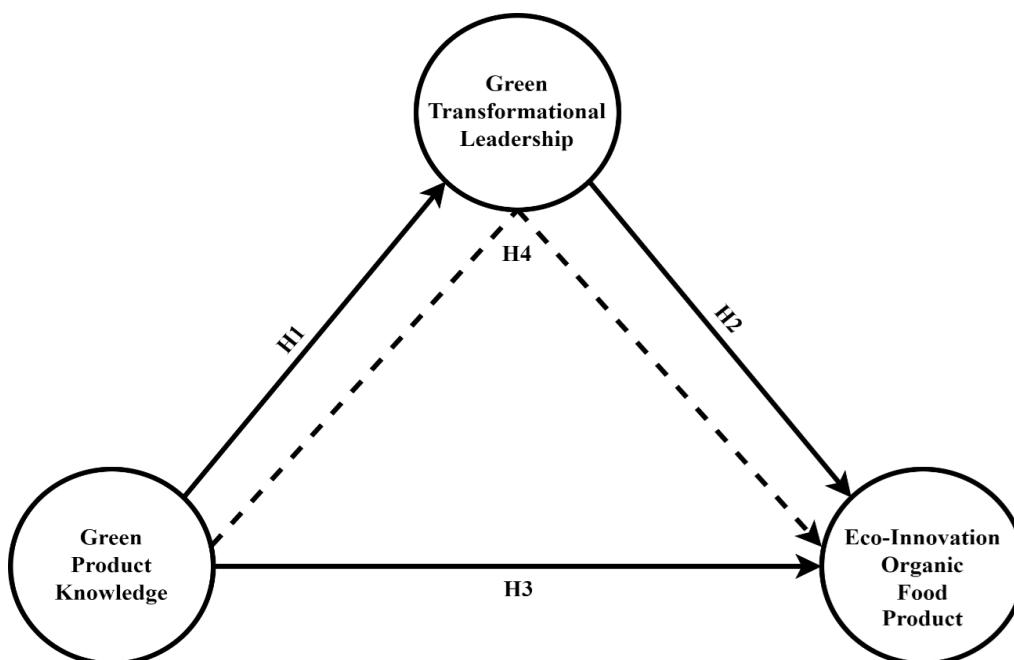


Figure 1. Research model of the relationship between GPK, GPL, and EI  
*Source: Developed by the authors, 2023*

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## METHOD

### Basic research methods

The basic method used in this research is a case study and explanatory. The case study method is used to study phenomena in authentic contexts, such as green production and management practices in the processed organic food agroindustry. Meanwhile, the explanatory method examines the causal relationship between the variables studied (Park et al., 2020), such as the relationship between GPK, GTL, and EI. Combining the two methods in this study can provide a more complete and in-depth picture of the relationship between GPK, GTL, and EI.

### Location and sample determination

The population studied were agro-industrial micro and small organic food production company employees in the former Surakarta Residency, Central Java, Indonesia (Surakarta, Boyolali, Sukoharjo, Karanganyar, Wonogiri, Sragen, and Klaten). Our team distributed 175 questionnaires to 35 MSME agroindustry of processed organic food products, then only 150 questionnaires were filled in for further analysis.

### Method of collecting data

This research uses interviews with production managers and personnel, direct field observations, and green management documentation. Researchers interviewed production managers and staff to understand the company's green management methods better. Field observation can also give a more accurate image of the company's practices. This research can use company sustainability reports, internal policies and procedures, and environmental certifications or awards. Combining these three data collection approaches should yield thorough findings on green management practices in these firms and helpful recommendations for green agroindustry sustainability.

### Operational Definition of Variables and Indicators

#### Green product knowledge

GPK is employees' understanding of materials used in green production, their environmental benefits, and ways to reduce their negative environmental impact. GPK includes employees' knowledge of raw materials used in production, green technologies used to process these raw materials, and ways to reduce waste and pollution (N. Wang et al., 2022). GPK includes employee understanding of the green products produced, the materials used in production, and how to promote green products to consumers (Zameer et al., 2020). Indicators of GPK variables include:

Table 1. Indicators of green product knowledge variables

No	Indicators	Explanation
1	GPK1	<b>Understanding of green raw materials.</b> Employees understand the raw materials used in green products, such as organic or recycled materials (Maynard <i>et al.</i> , 2020).
2	GPK2	<b>Knowledge of green technology.</b> Employees understand green technologies used in green products, such as waste treatment technologies or renewable energy production technologies (Chisholm <i>et al.</i> , 2021).
3	GPK3	<b>Understanding of the benefits of green products.</b>

		Employees understand the benefits of green products, such as reducing negative environmental impacts or improving people's quality of life (Felber & Hagelberg, 2020).
4	GPK4	<b>Knowledge of how to reduce environmental impact.</b> Employees understand ways to reduce the environmental impact of green production, such as using organic raw materials or environmentally friendly waste treatment (Ikram, 2022).
5	GPK5	<b>Awareness about the importance of green products.</b> Employees are aware of the importance of green products for the sustainability of the environment and society (Malik <i>et al.</i> , 2020).
6	GPK6	<b>Knowledge of environmental regulation.</b> Employees understand applicable environmental regulations, such as emission or waste treatment standards, and ensure that green production meets these requirements (Zimon <i>et al.</i> , 2019).
7	GPK7	<b>Ability to promote green products.</b> Employees can promote green products to consumers by explaining the benefits of green products and their positive impact on the environment (Y. Sun & Wang, 2019).

Source: Research indicator (2023)

### Green transformational leadership

GTL in the agroindustry business involves environmentally conscious leaders who inspire and motivate employees to innovate in sustainable practices, prioritize social and environmental responsibility, and develop environmentally friendly products. These green transformational leaders foster an organizational culture that values sustainability and employ creative thinking to enhance the company's competitiveness and long-term viability. Collaboration, employee participation, and evaluating environmental impacts are critical aspects of effective GTL in the agroindustry (Begum *et al.*, 2021; Farrukh *et al.*, 2022; Zhu *et al.*, 2022). Indicators of GTL variables include:

**Table 2.** Indicators of green transformational leadership variables

No	Indicators	Explanation
1	GTL1	<b>Continuous product innovation and development.</b> GTL in the agroindustry must be able to encourage innovation and product development that is more environmentally friendly, such as the use of organic raw materials or the application of more efficient and sustainable agricultural technologies (Ncube <i>et al.</i> , 2023).
2	GTL2	<b>Increased environmental awareness.</b> GTL in the agroindustry should be able to increase environmental awareness among employees and promote more sustainable business practices, such as reducing waste and saving energy (Awan <i>et al.</i> , 2023).
3	GTL3	<b>High employee engagement.</b> GTL in the agroindustry must be able to involve employees in sustainable programs, such as developing environmentally friendly products and reducing externality (Farooq <i>et al.</i> , 2022).
4	GTL4	<b>An organizational culture that supports sustainable development.</b> GTL in the agroindustry must build an organizational culture supporting product development and more sustainable business practices (Mansoor <i>et al.</i> , 2021).

5	GTL5	<b>Effective communication.</b> GTL in the agroindustry must be able to communicate with employees and customers about the company's goals and sustainable practices (Kusi <i>et al.</i> , 2021).
6	GTL6	<b>Improved environmental performance.</b> GTL in the agroindustry must improve the company's environmental performance by reducing carbon emissions, saving energy, and reducing waste (Sun <i>et al.</i> , 2022).
7	GTL7	<b>Strong collaboration and partnership.</b> GTL in the agroindustry must build solid collaborations and partnerships with customers, suppliers, and local communities to promote more sustainable business practices (Fontoura & Coelho, 2022).

Source: Research indicators (2023)

### Eco-innovation of processed organic food

Eco-innovation in agroindustry refers to developing or applying new and improved organic processed food products and practices that offer environmental and economic benefits. It involves utilizing organic materials and environmentally friendly technologies to reduce negative environmental impacts while promoting agricultural sustainability. Eco-innovation aims to create products, services, and processes that are environmentally friendly and economically advantageous (Larbi-Siaw *et al.*, 2023; Nikolova-Alexieva *et al.*, 2022; Woźniak & Woźniak, 2021). Indicators of EI variables include:

Table 3. Indicators of the variable eco-innovation of organic food products

No	Indicators	Explanation
1	EI1	<b>The number of new organic processed food products introduced to the market in a given period.</b> This indicator measures employee productivity in creating organic processed food products that are new and different from similar products already on the market (Nguyen <i>et al.</i> , 2019).
2	EI2	<b>Increased efficiency of resource use in the production process.</b> This indicator is used to measure employee productivity in using more efficient technology and practices to produce organic processed food products (van der Werf <i>et al.</i> , 2020).
3	EI3	<b>Increased percentage of organic raw materials used in the production process.</b> This indicator is used to measure employee productivity in increasing the use of organic raw materials in production, which can improve the environmental impact of food production (Maffia <i>et al.</i> , 2020).
4	EI4	<b>Increased percentage of waste recycled or reused in the production process.</b> This indicator is used to measure employee productivity in increasing the reuse and recycling of waste generated in the production process, thereby reducing the environmental impact of food production (Kowalski <i>et al.</i> , 2023).
5	EI5	<b>Percentage of organic processed food products produced with organic certification.</b> This indicator measures employee productivity in obtaining organic certification for processed food products, which can improve product quality and increase consumer confidence (Ladwein & Romero, 2021).



- 6 EI6 **The level of employee participation in training programs and the development of environmentally friendly technologies and practices.**  
This indicator measures employee productivity in improving their skills and knowledge in adopting more environmentally friendly technologies and practices (Ikram *et al.*, 2021).
- 7 EI7 **The level of consumer satisfaction with the processed organic food products produced.**  
This indicator measures employee productivity in creating better organic processed food products and meeting consumer needs to increase business competitiveness (Pei *et al.*, 2020).

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Source: Research indicators (2023)

### Data Analysis

This study uses partial least square (PLS) data analysis techniques to analyze the relationship between GPK, GTL, and EI. PLS data analysis techniques are used to examine the relationship between the dependent variable (eco-innovation) and the independent variable (GPK and GTL) simultaneously. In addition, PLS can also be used to process multivariate and complex data, taking into account the relationship between related variables. Researchers can measure and model the relationships between these variables more accurately and effectively using PLS techniques. The method of measuring the goodness of fit in the hypothesized model can be done by referring to several parameters, one of which is using Cross-loading, Cronbach's Alpha (CA), rho\_A, Composite Reliability (CR), Average Variance Extracted (AVE), and R Square values. Here is an explanation of each parameter:

Table 4. Test type, critical value, and description

Test Type / Value	Value	Description
Cross-loading	If $\geq 0.7$	Constructs have high validity and reliability
Cronbach's Alpha (CA)	If $\geq 0.7$	Higher levels of coherence and consistency among items within a construct
rho_A	If $\geq 0.7$	The construct accurately measures the latent construct, so it is reliable
Composite Reliability (CR)	If $\geq 0.7$	The construct's items accurately and reliably measure the latent construct
Average Variance Extracted (AVE)	If $\geq 0.5$	Observed variables measure latent constructs reliably and effectively
R Square	If $\geq 0.6$	The independent variables effectively explain the variance in the dependent variable.

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Source: (Hamid & Anwar, 2019)

Researchers use the above parameters to determine the accuracy of the hypothesized model. A good model must meet the requirements of the above values and have a high R Square. A high R Square indicates that the model's independent variable can explain the dependent variable's variability. However, besides R Square, the researchers also had to examine other parameters such as Cronbach's Alpha value, Composite Reliability, Average Variance Extracted, cross-loading, and rho\_A. All these parameters must be considered simultaneously to ensure the reliability and validity of the hypothesized model.

### RESULT

Partial least square (PLS) modeling can be used to analyze the linkages between GPK, GTL, and EI. The PLS method is a statistical technique that can effectively test the relationship between many variables. PLS Algorithm is a multivariate analysis method used to analyze the relationship between predictor variables and response variables in structural models reflected in the following figure:

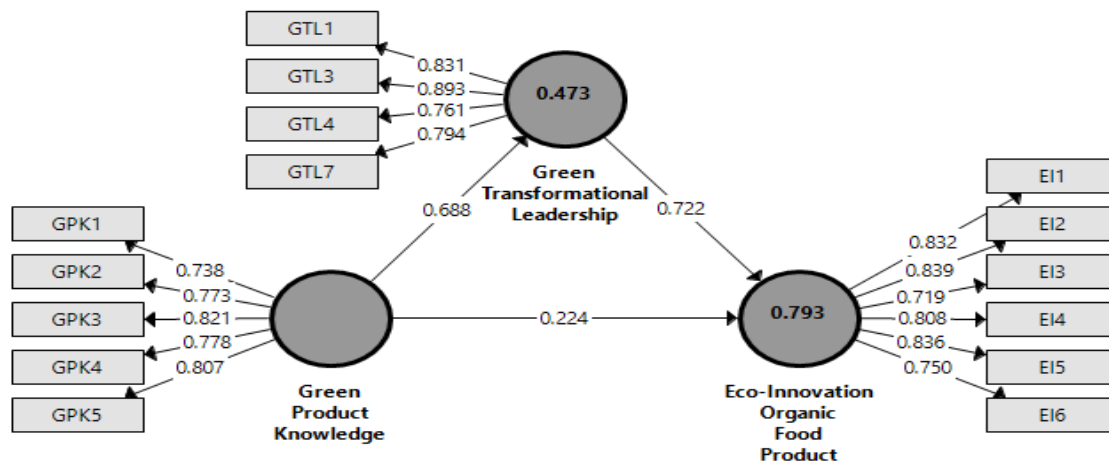


Figure 2. Model the relationship between GPK, GTL, and EI

The GPK6 and GPK7 indicators of the GPK, GPL2, GTL5, and GTL6 variables of the GTL variable, and EI7 of the eco-innovation organic food product variable, can be considered invalid because the value is below 0.7. The value 0.7 is often used as a threshold value or cutoff point in measuring the validity of an indicator or instrument. The knowledge indicator on environmental regulation (GPK6) cannot always be used to measure the impact on eco-innovation. Eco-innovation includes new technologies, eco-friendly product design, and environmental impact reduction, while environmental regulation only considers legal and policy aspects in a limited environment. The ability to promote green products indicator (GPK7) focuses more on the ability of individuals or organizations to promote green products effectively and attractively to consumers. In contrast, the knowledge indicator of green products focuses more on understanding the characteristics and benefits of green products.

The GTL2 indication examines a manager's ability to raise environmental awareness and engage staff in sustainability programs, whereas the GTL indicator measures transformational leadership that creates sustainable cultural change. The GTL5 indicator gauges managers' ability to communicate about sustainable practices, not eco-innovation. GTL6 highlights corporations' environmental aims, including lowering carbon emissions, energy, and trash, but these reductions do not always lead to environmental advances. Such efforts may produce green technologies or eco-friendly products but may only save costs. According to EI7, employee productivity, and competitiveness are vital to corporate success but do not represent employee eco-innovation. Consider other measures like staff innovation or energy efficiency improvements for a more accurate picture. Thus, eco-innovation products and services should be developed holistically.

Table 5. Reliability and construct validity tests of GPK, GTL, and EI variables

Var.	Ind.	Cross Loading			CA	rho_A	CR	AVE	R <sup>2</sup>
		GPK	GTL	EI					
GPK	GPK1	0.738	0.357	0.448	0.846	0.862	0.888	0.615	-
	GPK2	0.773	0.523	0.461					

	<b>GPK3</b>	<b>0.821</b>	0.412	0.493					
	<b>GPK4</b>	<b>0.778</b>	0.653	0.626					
	<b>GPK5</b>	<b>0.807</b>	0.642	0.705					
<b>GTL</b>	<b>GTL1</b>	0.579	<b>0.831</b>	0.665	<b>0.838</b>	<b>0.841</b>	<b>0.892</b>	<b>0.675</b>	<b>0.473</b>
	<b>GTL2</b>	0.626	<b>0.893</b>	0.748					
	<b>GTL3</b>	0.548	<b>0.761</b>	0.783					
	<b>GTL4</b>	0.496	<b>0.794</b>	0.669					
<b>EI</b>	<b>EI1</b>	0.609	0.761	<b>0.832</b>	<b>0.886</b>	<b>0.890</b>	<b>0.913</b>	<b>0.638</b>	<b>0.793</b>
	<b>EI2</b>	0.618	0.660	<b>0.839</b>					
	<b>EI3</b>	0.534	0.546	<b>0.719</b>					
	<b>EI4</b>	0.463	0.757	<b>0.808</b>					
	<b>EI5</b>	0.744	0.646	<b>0.836</b>					
	<b>EI6</b>	0.486	0.788	<b>0.750</b>					

Source: Data processing output

Cross-loading is a technique in confirmatory factor analysis that examines how well indicators in research align with the factors they are intended to measure. In this analysis, cross-loading values above 0.7 indicate that the selected indicators correspond to the expected factors and can be considered valid. On the other hand, indicators with low cross-loading values are excluded from the analysis as they do not significantly contribute to the measured factor. The reliability of the indicators is assessed using Cronbach's Alpha (CA) value, which should be above 0.7 for them to be deemed reliable and valid. CA measures the consistency between indicators within a single factor or variable, serving as an internal reliability measure. Another measure, Rho\_A, indicates the strength of the relationship between observed constructs in the constructed structural model. A high Rho\_A value suggests a significant impact between the constructs, emphasizing the importance of considering both constructs when formulating strategies or policies. Composite Reliability (CR) values above 0.7 indicate good reliability of structural models developed using the PLS-SEM method.

Additionally, Average Variance Extracted (AVE) values above 0.5 demonstrate sufficient convergent validity of the observed constructs in the structural models. A higher AVE value implies a substantial similarity in variance for the latent variables or indicators used to measure the constructs, making them suitable as measurement tools. The R square value for GTL of 0.473 indicates that the variables observed in the structural model can explain 47.3% of the variation in dependent variables used in the analysis. The model's power is moderate if the R square value is between 0.33 and 0.67. The R square value for EI of 0.793 indicates that the variables observed in the structural model can explain 79.3% of the variation in dependent variables used in the analysis. The model's power is high if the R square value exceeds 0.67.

**Table 6.** The direct and indirect effect path for hypothesis testing

Variable	Original Sample (O)	T Statistics	P Values	Sig.
<i>Direct effect</i>				
H1: GPK → GTL	0.688	17.041	<b>0.000</b>	<b>***</b>
H2: GPK → EI	0.244	4.236	<b>0.000</b>	<b>***</b>
H3: GTL → EI	0.722	16.654	<b>0.000</b>	<b>***</b>
<i>Indirect effect</i>				

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H4: GPK → GTL → EI	0.496	12.369	<b>0.000</b> ***
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Source: Data processing output

Significance level: \*\*\*= 99%; \*\*= 95%; \*= 90%; ns = not significant

## DISCUSSION

### **The Effect of Green Product Knowledge on Green Transformational Leadership**

Based on Table 6, the first hypothesis is accepted that GPK has a significant and positive effect on GTL. Employee GPK and GTL are closely linked in the agro-processed organic food industry. GPK refers to an employee's understanding of environmentally friendly products and technologies, which can help improve production efficiency and increase customer satisfaction. Meanwhile, GTL is based on a leader's understanding of green practices and sustainability goals, which can motivate and guide employees in introducing innovations and environmentally friendly practices in the business. Combining GPK and GTL can increase employee engagement in developing green products and implementing green practices in production. This approach can improve production efficiency, reduce negative environmental impacts, and create more environmentally friendly products. Therefore, leaders need to have sufficient knowledge of green products to become more sensitive to the environmental impact of their business activities and motivate employees towards eco-innovation.

### **The Influence of Green Product Knowledge on Eco-Innovation of Processed Organic Food**

Based on Table 6, the second hypothesis is accepted that knowledge of green products significantly and positively affects the eco-innovation of processed organic foods. This hypothesis implies that the greater the knowledge employees of the processed organic food agroindustry have about green products, the more likely they are to develop eco-innovations. The findings from various studies indicate that knowledge, understanding, and awareness of green products and technologies significantly impact the eco-innovation of employees in the agro-processed organic food industry. When employees are more knowledgeable about green products, such as raw materials and technologies, they are more likely to develop eco-innovations. This knowledge empowers employees to generate innovative ideas that are environmentally friendly, leading to the introduction of new organic processed food products and an increase in the use of organic raw materials. Understanding the benefits of green products also plays a crucial role in improving resource efficiency, increasing the percentage of organic certification, and promoting waste recycling or reuse in the production process.

Furthermore, awareness of the importance of green products stimulates demand for sustainable and environmentally friendly processed organic food, prompting companies to enhance their production practices and meet consumer expectations. Consequently, initiatives such as providing environmental technology training and fostering awareness among employees contribute to the overall sustainability and competitiveness of the agro-processed organic food industry. These findings highlight the significance of continuous education and training programs to cultivate employee knowledge and awareness, ultimately driving eco-innovation and sustainable practices within the industry.

### **The Effect of Green Transformational Leadership on Eco-innovation of Processed Organic Food**

Based on Table 6, the third hypothesis is that GTL significantly and positively affects processed organic food eco-innovation. This potential implies that the greater the chance of a leader implementing a GTL style in an organization or company, it can increase the likelihood of creating environmentally-friendly innovations in producing processed organic foods. The findings from multiple studies highlight the significant role of leadership in driving eco-

innovation and sustainable practices within the processed organic food agroindustry. Effective leadership positively impacts employee eco-innovation by encouraging continuous product development and innovation. Leaders play a crucial role in improving resource efficiency, optimizing the use of organic raw materials, and promoting waste recycling. They also motivate employees to participate in environmental technology training, fostering the development of environmentally friendly products and contributing to sustainable economic growth.

Furthermore, strong leadership promotes employee engagement, creating a company culture that values environmental sustainability. This results in increased resource efficiency, a higher percentage of organic raw materials used, waste recycling, and certified products. The support of leaders in fostering organizational resources that support sustainable development empowers employees to utilize organic raw materials, recycle waste, and obtain environmentally friendly certifications. Collaboration and partnerships facilitated by leaders also enhance resource efficiency, organic raw material utilization, and employee participation in training programs. These efforts contribute to introducing new organic processed food products, reducing production waste, and increasing profitability. Overall, effective leadership in the processed organic food agroindustry drives eco-innovation, enhances product quality, and promotes the industry's sustainability.

### **The Influence of Green Product Knowledge on Eco-innovation of Processed Organic Food Mediated Green Transformational Leadership**

Based on Table 6, the fourth hypothesis is accepted that employees' GPK has a significant and positive effect on processed organic food eco-innovation mediated by GTL. In the fourth hypothesis, employees' knowledge of green products will be assumed to affect their ability to create environmentally friendly innovations, especially in developing processed organic food products. The role of GTL is an essential mediator in the relationship between employees' knowledge and awareness of GPK and eco-innovation in the processed organic food agroindustry. Strong leadership with high environmental awareness can strengthen the connection between employees' GPK and eco-innovation, encouraging them to care more about the environment. Employees' understanding of the benefits of green products plays a crucial role in promoting eco-innovation and sustainable product development in the agroindustry. This understanding motivates employees to engage in eco-friendly practices, leading to resource efficiency, increased use of organic raw materials, waste recycling, and certified organic processed food production. Leadership, employee engagement, organizational culture, and collaboration are all vital factors in fostering eco-innovation and sustainability.

GTL mediation affects eco-innovation through green technology and raw material knowledge. Employees who understand green technology and environmental impact can find inventive ways to produce organic processed food, efficient resource use, waste recycling, and certified products. Awareness of green products fosters eco-innovation, affecting resource efficiency, organic raw material use, trash recycling, and organic processed food production. Eco-innovation requires sustainable leadership and corporate culture. Knowledge, awareness, leadership, employee involvement, teamwork, and supporting culture lead to sustainable practices and increased company performance in the processed organic food agroindustry.

## **CONCLUSION AND SUGGESTION**

### **Conclusion**

The relationship between employees' GPK and GTL is significant in the processed organic food agroindustry. Higher GPK positively influences GTL, which drives EI and improves production efficiency while maintaining environmental sustainability. Employees with a comprehensive understanding of green products contribute to efficient and effective environmentally friendly

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production processes, higher product quality, and increased customer satisfaction. This knowledge also influences leaders in motivating employees to develop green products and practices, enhancing the overall business. Moreover, employees' knowledge of green products directly impacts their eco-innovation level. Understanding green raw materials leads to new organic processed food products, increased use of organic raw materials in production, improved market competitiveness, and fulfilled consumer demand for environmentally friendly products. Knowledge of green technologies increases the percentage of organic raw materials used and encourages employee participation in eco-friendly training programs. In the same way, knowing about the benefits of green goods makes better use of resources, increases the number of certified organic products, and makes it easier to recycle waste during production. Leaders play a crucial role in promoting collaboration and partnerships, improving resource efficiency, using organic raw materials, and employee participation in training for environmental technology. This way of working together leads to more new organic processed food products, less waste during production, and a larger share of certified goods. In the processed organic food agroindustry, eco-innovation is helped by workers' knowledge of green goods. GTL mediates this relationship. Key things that drive eco-innovation are strong leadership, employee engagement, a supportive corporate culture, and collaboration. Support from the government in the form of policies that make it easier to handle licenses and encourage sustainable development is also crucial for the industry to grow and stick to higher environmental standards. Sustainable eco-innovation requires cooperation between the government, business owners, and employees. Policy support, environmental awareness, and innovative business practices all help create an atmosphere good for eco-innovation and society.

### **Suggestion**

Future research should focus on improving the significance of six indicators not considered in this study. Continuous training and information technology are recommended to enhance knowledge about green production and products among employees and leaders in the processed organic food industry. Technologies like videos, online presentations, and e-learning modules can strengthen training programs and ensure easy accessibility for employees. Research areas to explore include increasing employee knowledge about environmental regulations, training programs for promoting green products, leadership activities to increase environmental awareness, effective communication by leaders, using social media for promotion, improving environmental performance, and measuring consumer satisfaction with processed organic food products. Investigating these areas can provide valuable insights to enhance environmental practices, marketing strategies, and customer satisfaction in the processed organic food agroindustry.

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