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The Influence of Policies and Regulations on Food Security and Agribusiness through Human Resource Management Using Structural Equation Modeling (SEM) with the Partial Least Squares (PLS) Approach

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Abstract

The aim of this study is to analyze the influence of policies and regulations on food security and agribusiness, while exploring the impact of other factors such as education and training, investment and resources, and technology and innovation, all within the context of Human Resource Management (HRM) using Structural Equation Modeling (SEM) with the Partial Least Squares (PLS) approach. The analysis results show that Policies and Regulations (X1) have a significant effect on Food Security and Agribusiness (Y1) with a path coefficient of 0.498, while Investment and Resources (X3) show a small negative influence (-0.042). This model explains 76% of the variability in Y1 (food security). Reliability and validity testing shows that most constructs have Cronbach's Alpha, RhoA, and RhoC values greater than 0.7, indicating good reliability. This research emphasizes the importance of effective HR policies in supporting food security, although the impact of several variables such as investment and technology still needs to be further explored

Keywords: Policies and Regulations, Food Security, Agribusiness, Education and Training, Investment and Resources

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Background

Food security is a fundamental component that ensures the socio-economic stability and sovereignty of a nation. For Indonesia, the fourth most populous country in the world, achieving food security remains a pressing challenge, particularly given the significant disparities in food distribution across its vast archipelago. As a developing nation, Indonesia faces the dual challenge of meeting the nutritional needs of its citizens while addressing issues related to equitable access to food. Compounding this challenge are global issues such as climate change, supply chain disruptions, and fluctuating commodity prices, all of which place additional strain on the country's food systems. Consequently, it is crucial for Indonesia to implement effective and sustainable strategies to safeguard food security in both urban and rural areas.

A pivotal factor influencing food security is the role of government policies and regulations. Well-designed policies can create a supportive ecosystem that fosters the sustainability of the food sector, particularly in terms of food production, distribution, and consumption. Government intervention, when aligned with national needs, can stimulate more effective food security solutions. Recent studies, however, suggest that government regulations, rather than just investments in the food sector, have a more profound impact on enhancing food security. These regulations can address systemic issues that investments alone may not resolve, such as infrastructure, market access, and equitable resource distribution.

This research aims to examine the influence of government policies and regulations on food security in Indonesia. It will also explore the role of other contributing factors such as education, technology, and investment in shaping sustainable agribusiness practices. Given the complexity of food security, it is essential to understand how each of these factors interacts and contributes to the overall stability of the nation's food systems. Using Structural Equation Modeling (SEM) and Partial Least Squares (PLS) methods, this study will evaluate the effectiveness of policies and regulations in promoting food security, while also considering the contributions of other vital factors.

The research steps undertaken in this study include an extensive literature review to identify existing knowledge gaps, the development of a conceptual model to explore key variables influencing food security, data collection from relevant stakeholders, and the application of SEM-PLS to analyze the relationships between policies, regulations, and food security outcomes. Through this process, the study will provide insights into the effectiveness of policy interventions and the necessary conditions for achieving sustainable food security in Indonesia.

Literature Review

The Need for Green Economy Development to Address the Negative Impacts of Traditional Economic Growth

The traditional economic model, which relies on various forms of capital such as human resources, technology, and natural resources to produce goods and services, has historically contributed to significant benefits, including improved living standards and enhanced human well-being. However, this growth has come at a cost, with considerable environmental degradation and overexploitation of natural resources. As Brears (2023) points out, the global economic model is now facing numerous interconnected challenges, such as rapid population growth, urbanization, increasing poverty and inequality, and the adverse effects of climate change. These trends have resulted in resource scarcity, social inequality, and the intensification of environmental damage, creating urgent need for systemic change.

In response to these challenges, multilateral organizations and policymakers have increasingly advocated for the development of a green economy—a model that seeks to balance economic growth with environmental sustainability. A green economy not only prioritizes human well-being and social equality but also focuses on reducing environmental harm by promoting sustainable practices. As highlighted by the United Nations (UN, 2021), such a transition involves adopting new economic structures and strategies that integrate sustainable practices across sectors like agriculture, energy, and transportation.

Strategic management of human resources and talent is essential in driving this transition to a green economy. According to a study by the World Economic Forum (2022), effective management of skills and competencies is crucial for supporting the implementation of sustainable economic practices. The focus should be on investing in education, innovation, and workforce training, as these are vital components in achieving long-term sustainability goals. By empowering individuals and organizations with the knowledge and tools needed to navigate the complexities of a green economy, societies can make meaningful strides towards mitigating environmental damage while promoting social equity.

Older studies have also underscored the importance of aligning economic growth with environmental goals. For example, the work of Pearce and Turner (1990) on sustainable development emphasized the need for integrating environmental concerns into economic planning. Their pioneering research laid the foundation for later studies on sustainable economic practices, reinforcing the idea that economic growth and environmental sustainability are not mutually exclusive but rather mutually reinforcing when managed properly.

Challenges and Solutions for Sustainable Economic Growth

From the perspective of critical medical anthropology, the work of Menéndez (1999) on the transactional system in Mexico offers valuable insights into the dynamics of exploitation, domination, and hegemony. As noted by Figueras (2024), Menéndez's analysis illustrates how elite power structures exert control over subordinate classes, particularly in rural agricultural settings. This framework is essential for understanding how social, economic, and political systems perpetuate inequality and influence the lives of marginalized groups, such as farmers. The transactional system Menéndez describes reveals how the elite impose economic, political, and ideological structures that shape and constrain the needs and aspirations of farmers, often to their detriment.

In the specific case of the Oaxaca coast, pesticides serve as a key instrument of control and domination by agribusiness elites and other power structures. These chemical agents, designed to boost agricultural productivity, often have detrimental health and environmental effects on the local farming communities. The widespread use of pesticides can be seen as a form of subjugation, whereby the elites not only control the production processes but also influence the very well-being of the farmers. As Figueras (2024) suggests, addressing this exploitation requires a fundamental shift in how power dynamics are managed and understood within agricultural systems.

The Important Role of Agribusiness in the Circular Economy for Sustainable Agriculture

The integration of agribusiness within the framework of the circular economy is an essential step towards promoting sustainability in agricultural systems. According to Dankevych, Perevozova, Nitsenko, Lozinska, and Nemish (2023), agribusiness plays a pivotal role in incorporating renewable resources into farming practices, which significantly contributes to resource efficiency. This integration is vital for creating agricultural systems that prioritize environmental sustainability while also improving the economic viability of farming operations.

By emphasizing the use of renewable resources, such as organic waste for composting or energy production, agribusinesses can help close the loop in agricultural production and reduce reliance on finite resources. Moreover, the adoption of circular economy principles within agribusiness can lead to more sustainable resource management practices, such as water and soil conservation, which directly impact the long-term productivity of agricultural systems.

A crucial benefit of these practices is the reduction of carbon emissions, a key issue in the fight against climate change. Sustainable agricultural practices that align with circular economy principles are inherently designed to minimize environmental harm by reducing waste, lowering energy consumption, and limiting the use of harmful chemicals. According to Dankevych et al. (2023), these efforts not only enhance the sustainability of agricultural practices but also foster the development of farming models that are more resilient to environmental challenges, ultimately contributing to a healthier planet and more sustainable food systems.

The Role of Agribusiness in Supporting a Sustainable Hydrogen Economy through Biomass Utilization

Agribusiness plays a key role in the transition to a sustainable hydrogen economy, particularly through the use of biomass for green hydrogen production. According to Dasappa, Shivapuji, and Stanislaus (2024), biomass gasification provides an environmentally friendly method for hydrogen production with a negative carbon footprint. This process helps reduce greenhouse gas emissions by converting organic materials, such as agricultural residues, into hydrogen, thereby contributing to environmental sustainability.

By utilizing agricultural waste, biomass gasification not only produces renewable energy but also supports waste management and reduces reliance on fossil fuels. Dasappa et al. (2024) highlight that agribusinesses, with access to organic waste, are well-positioned to promote the widespread adoption of this technology, which fosters both energy sustainability and a circular economy.

The Importance of Climate-Smart Agriculture in Global Agribusiness Strategies to Address Climate Change

Climate-smart agriculture (CSA) has become a central component of global agribusiness strategies in addressing the challenges posed by climate change. According to Essaber (2023), CSA aligns with the goals of the Paris Climate Agreement, focusing on mitigation and adaptation efforts post-2020. It aims to sustainably increase agricultural

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yields while ensuring the preservation of resources and the environment for future generations.

This approach emphasizes the need to maintain high agricultural productivity to meet present-day demands while adopting environmentally friendly technologies and practices. CSA not only helps farmers adapt to climate change but also enhances food security and strengthens the resilience of agribusiness economies globally. By incorporating sustainable practices, CSA ensures that agriculture can continue to thrive in the face of changing climatic conditions.

The Information and Resource Needs of Small-Scale Sugarcane Farmers in Swaziland to Enhance Competitiveness and Reduce Poverty

The sugar industry is a key agricultural sector in Swaziland, contributing significantly to the country's gross domestic product. According to Dlamini and Ngulube (2024), access to relevant and timely information is vital for small-scale sugarcane farmers to remain competitive against larger operations and reduce poverty. This study examines the information and resource needs of these farmers, revealing that 71% of their information needs are related to legislative compliance, sugarcane cultivation, market access, transportation, and financial advice.

The study highlights that small-scale farmers primarily rely on extension officers, farmer groups, and mobile phones to obtain essential information. This underscores the importance of face-to-face interactions in ensuring that farmers have the support and resources they need to improve productivity and navigate challenges in the industry.

The Importance of the Green Economy in Achieving Sustainability and the Sustainable Development Goals (SDGs)

The green economy has become a central priority in the pursuit of sustainability. According to Oncel (2023), the green economy focuses on boosting employment and income by directing investments into environmentally friendly economic activities, infrastructure, and assets. This approach aligns with the Sustainable Development Goals (SDGs), aiming to foster economic growth while ensuring environmental preservation and social equity. The green economy not only promotes sustainable practices but also creates opportunities for job creation and income generation in sectors that contribute to environmental well-being.

The Negative Impacts of Climate Change on Agriculture and the Importance of Environmentally Friendly Practices

Agriculture is a critical sector that is projected to be significantly affected by climate change. According to Schmitz, Schmitz, Kooten, Schmitz, and Moss (2022), agricultural land use practices and greenhouse gas emissions from the sector are key contributors to global warming. To mitigate these impacts, practices like zero tillage are promoted as effective methods for carbon sequestration in the soil. Zero tillage helps reduce soil erosion, improve water retention, and store carbon, thereby contributing to both climate change mitigation and improved soil health.

The Broad Scope of Agribusiness in the Agricultural Value Chain

Agribusiness extends beyond large corporations in basic agriculture and encompasses a wide range of operations. According to Schmitz, Schmitz, Kooten, Schmitz, and Moss (2022), agribusiness includes all activities involved in the production and distribution of agricultural supplies, farm production operations, storage, processing, and distribution of agricultural commodities. Additionally, it covers the production of goods derived from agricultural products. This comprehensive definition highlights the interconnectedness of the agricultural supply chain and the importance of each stage, from farm to final product, in driving the agribusiness sector.

The Role of Labor in Agricultural Policies and Rent-Seeking Behavior in Agribusiness

In the context of agricultural policies and rent-seeking behavior, labor plays a crucial role in shaping the impact of these policies on the agribusiness structure. According to Schmitz, Schmitz, Kooten, Schmitz, and Moss (2022), changes in agricultural policies can significantly influence labor market dynamics, affect income distribution, and create new incentives for rent-seeking behavior. Understanding the way labor is impacted by these policies is essential for designing more effective and equitable agricultural policies that can address imbalances and promote fairness within the agribusiness sector. This perspective emphasizes the need for policy frameworks that consider labor's role in shaping agribusiness outcomes.

The Importance of Workforce Involvement and Training in the Transition to a Hydrogen Economy

The transition to a hydrogen economy requires significant involvement from a skilled and adaptable workforce. According to Goel (2024), employees in the energy sector must undergo extensive training to adopt new technologies and adjust to rapid industry changes. By enhancing their skills and providing appropriate education, the workforce can play a pivotal role in supporting technological innovation and implementing climate action policies. This workforce preparedness is essential to ensuring a sustainable and efficient energy transition, making it a key component of achieving long-term climate goals.

The Role of the Green Economy and Hydrogen Technology in the Global Energy Transition

The green economy plays a vital role in the global energy transition by promoting the sustainable use of resources and minimizing environmental impacts. According to Gupta, Gupta, Bherwani, and Kumar (2024), hydrogen technology, as a key component of the green economy, offers significant solutions for reducing carbon emissions while fostering innovation in the energy sector. However, the successful implementation of hydrogen technology requires supportive policies and investments in green infrastructure. These efforts are essential to ensuring that the transition to a low-carbon economy is effectively realized, driving both environmental sustainability and energy sector transformation.

The Role of Agribusiness in Integrating ESG Principles for Sustainable Development in Central Asia

In the context of the green economy, agribusiness plays a pivotal role in integrating Environmental, Social, and Governance (ESG) principles. According to Popkova and Sergi (2023), sustainable agribusiness management impacts not only productivity and efficiency but also significantly contributes to environmental protection and social welfare. The adoption of environmentally friendly and socially responsible practices in agribusiness is essential for achieving sustainable development, particularly in regions like Central Asia. These practices help ensure that agricultural growth is balanced with ecological preservation and community well-being, supporting long-term sustainability in the agribusiness sector.

Digital Transformation and Challenges of the Digital Economy in Kyrgyzstan

The rise of digital technology at the beginning of the 21st century has led to the emergence of a global information society and digital economy, which are transforming both the economy and social environments. According to Ismailovav, Sultanova, Abdygapparova, Sydygalieva, and Kocherbaeva (2023), digital transformation is crucial for the rapid development of the global economy, improving productivity across existing industries and enabling the creation of new markets and industries. By 2020, the digital economy accounted for 43.7% of global GDP, amounting to $32.6 trillion, reflecting substantial growth from $11.5 trillion in 2016.

In the context of Kyrgyzstan, the government has recognized the transition to a digital economy as a critical challenge. Initiatives such as the National Sustainable Development Strategy 2018–2040, the “Unity. Trust. Creation” Program 2018–2022, and the “Digital Kyrgyzstan” Program 2019–2023 have been launched to support this digital transformation and stimulate economic development. Despite these efforts, there is limited research on the development of the digital economy within Kyrgyzstan, leaving significant questions and areas for further investigation. This highlights the need for more in-depth research on the progress and challenges of digital economic initiatives in Kyrgyzstan.

History and Development of Minimum Wage Implementation in Various Countries

The minimum wage is the legally mandated remuneration that employers must pay employees for their work over a specified period. According to Mayilyan and Torosyan (2023), this amount cannot be altered through collective or individual agreements. The concept of a minimum wage was first introduced in New Zealand in 1894, followed by Australia in 1896 and the United Kingdom in 1909. After World War II, the adoption of minimum wage laws spread to many countries, including the Netherlands in 1969, France in 1970, and Spain in 1980.

However, during the 1970s and 1980s, the adoption of minimum wage laws slowed, with fewer countries implementing such policies. It was not until the 1990s that many countries within the Organization for Economic Cooperation and Development (OECD) began to reintroduce minimum wage systems. This historical evolution underscores the shifting priorities of labor markets and economic policy, reflecting the ongoing debates on the role and impact of minimum wage laws in different economic contexts.

The Role of Agribusiness in Food Security and Sustainable Economy in American Cities

Emerging urban agriculture initiatives have the potential to significantly address food security challenges in American cities. According to O'Hara (2024), by connecting the food system to the broader economy, agribusiness can serve as a powerful catalyst for creating pathways toward a more just and sustainable economy. These initiatives not only enhance local food production but also promote greater harmony with nature, fostering an economic model that is more inclusive, equitable, and environmentally friendly. This approach highlights the growing role of agribusiness in shaping resilient and sustainable urban economies.

Criticism of Upgrading Strategies in the Global Value Chain Approach in Argentina's Agribusiness

The global value chain (GVC) approach often emphasizes upgrading as a key strategy for economic development. However, according to Bernhold (2022), research reveals that the upgrading strategies implemented by corporate actors within the agribusiness value chain in Argentina tend to prioritize the interests of specific businesses rather than broader development goals. This finding highlights the potential limitations of GVC strategies, where the focus on business-driven objectives may not always align with or contribute to the overall development of the broader economy or society.

Integration of Economic Strategies and Social Responsibility in Agribusiness for Environmental Sustainability

The integration of agribusiness economic strategies with social and environmental responsibility is essential for achieving environmental sustainability. According to Agripino, Marac, and Dias (2023), aligning business objectives with social and environmental goals enables agribusinesses to minimize negative environmental impacts while enhancing their reputation among stakeholders. This integration not only promotes corporate social responsibility but also creates long-term value by ensuring that economic growth is pursued in harmony with environmental preservation. Various studies highlight that such integration is crucial for building trust and gaining the support of both consumers and investors, ultimately fostering a more sustainable and resilient agribusiness sector.

The Role of Pearl Millet in the Green Economy for Food Security and Climate Resilience

The green economy highlights the need to integrate sustainable agricultural practices with goals such as improving food security, nutrition, and climate resilience. According to Padmaja, Venkateswarlu, Singh, and Tonapi (2024), pearl millet, known for its ability to thrive in harsh ecological conditions and its rich micronutrient content, can make a significant contribution to the green economy. By providing a sustainable and environmentally friendly food source, pearl millet offers a practical solution to enhancing food security while supporting climate-resilient agricultural systems. This aligns with the broader objective of fostering sustainable practices within the agricultural sector.

Research Method

The method used in this study is Structural Equation Modeling (SEM) with a Partial Least Squares (PLS-SEM) approach using the R Studio software. R Studio is an Integrated Development Environment (IDE) highly recommended for R users, as it offers a more user-friendly interface, efficient project management tools, and various additional features for software development. R Studio makes it easier for users to write and execute R code by providing tabs to manage multiple script files, more structured project management, and various tools for efficient code development. The use of R Studio in this research allows for systematic data management, analysis, and documentation, making the research process more organized and easily reproducible.

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R itself is an open-source software used for data analysis, and in this context, R Studio is used as the interface to run R code. R is known for its open-source nature, meaning the software's source code is freely accessible and continuously updated by the global user community. This advantage makes the code written in R highly reproducible, shareable, testable, and applicable to larger and automated applications. For this study, the SEMinR package for PLS-SEM is used to analyze data related to agribusiness, employees, and regulations (Hair Jr., et al., 2021).

In this study, the use of R Studio is crucial as this IDE provides various conveniences for organizing and managing analysis files. Project organization in R Studio is similar to managing documents in regular folders on a computer. R Studio users can easily load or save files by knowing the location of the file relative to the file currently being edited. To prevent the confusion that often arises from mixing projects, we recommend creating separate projects for each analysis or research. This will reduce the risk of overwriting important files and maintain the organization of the research project. With R Studio, the entire analysis process becomes more structured, efficient, and easy to manage, allowing this research to run smoothly with results that are reproducible and can be reviewed again.

Discussion

Based on the variables and indicators provided, the following is a discussion of the results of the Structural Equation Modeling (SEM) analysis using SEMinR in RStudio, adjusted to the specified variables and indicators:

1. Measurement Model Modeling

The measurement model refers to the independent and dependent variables outlined. The relationships between indicators and constructs used in the SEM model are as follows:

Dependent Variables:

- Variable 5: Food Security and Agribusiness
  - Indicator 7 (Y1.1): Cultivation of pearl millet and sorghum for food security.
  - Indicator 12 (Y1.2): Urban food security and modern technologies.
- Variable 6: Competitiveness and Welfare
  - Indicator 11 (Y2.1): Agribusiness value chain from production to marketing.
  - Indicator 19 (Y2.2): Minimum wage policy and economic, social, and political factors affecting worker welfare.

Independent Variables:

- Variable 1: Policies and Regulations
  - Indicator 1 (X1.1): Green economic development is essential for reducing pollution, climate change, and dependence on fossil fuels.
  - Indicator 2 (X1.2): The dominance of large agribusiness corporations in

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Indonesia and the need for fairer policies.

- Indicator 4 (X1.3): The importance of policy support for hydrogen technologies and energy transitions.
- Indicator 5 (X1.4): Integration of ESG (Environmental, Social, and Governance) principles for agribusiness sustainability.
- Indicator 13 (X1.5): Strong government policy support is required.

- Variable 2: Education and Training
  - Indicator 3 (X2.1): Policies supporting and training for sustainability.
  - Indicator 14 (X2.2): Support for young workers and innovation.
  - Indicator 15 (X2.3): Specialized training to improve efficiency in the transition to a hydrogen economy.
- Variable 3: Investment and Resources
  - Indicator 6 (X3.1): Investment in renewable energy and pro-green policies.
  - Indicator 8 (X3.2): Public-private collaboration for waste management.
- Variable 4: Technology and Innovation
  - Indicator 10 (X4.1): The importance of investment and technology for climate-smart agriculture.
  - Indicator 16 (X4.2): Digital transformation to support access to agricultural information.
- Variable 5: Investment and Resources (Continued)
  - Indicator 9 (X5.1): Agribusiness supports a sustainable hydrogen economy by utilizing biomass.
  - Indicator 17 (X5.2): Climate change reduces agricultural productivity through extreme weather.
  - Indicator 18 (X5.3): Access to agricultural information is crucial for small-scale sugarcane farmers to improve productivity.

The Diagram 1 shows the reliability values of various variables in the SEM model using three different reliability measures: Cronbach's Alpha (alpha), RhoA, and RhoC. Below is a more detailed explanation of this diagram:

Explanation of Variables and Calculated Measures:

- X1 to X6 represent independent variables in the model, and Y1 is the dependent variable.

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- The three reliability measures displayed in the graph are:
    1. Alpha (Cronbach's Alpha): Measures internal consistency or how well the indicators used to measure a construct correlate with each other. Higher values (above 0.7) indicate better reliability.
    2. RhoA: An alternative to Cronbach's Alpha measuring internal consistency. Like Cronbach's Alpha, a value above 0.7 suggests good reliability.
    3. RhoC: Measures composite reliability, commonly used in SEM to evaluate construct reliability. A higher value indicates better reliability.

Interpretation of the Diagram:

- Black Dots (•) on Alpha: Indicate the Cronbach's Alpha value for each construct. Most variables (X1 to X5 and Y1) have relatively high alpha values, meaning their measurement scales are quite reliable.
- Black Boxes (■) on RhoA: Indicate the RhoA value for each construct. Most variables also have RhoA values above 0.7, showing good reliability.
- Black Triangles (▲) on RhoC: Indicate the RhoC value for each construct. The majority of the variables show RhoC values above 0.7, demonstrating very good reliability.

Blue Dashed Line:

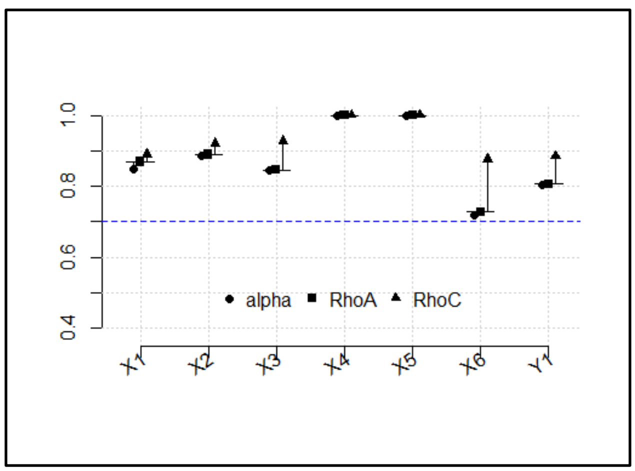
The blue line at 0.7 indicates the threshold commonly accepted in SEM analysis for good reliability. All variables in this diagram have values higher than this threshold, suggesting that the measurement scales used in this study are reliable.

Based on this diagram, all measured variables show good reliability, as the alpha, RhoA, and RhoC values for each variable exceed the 0.7 threshold. This indicates that the constructs used in this SEM model can be trusted to provide consistent measurements and are suitable for further analysis.

Further insights can be drawn from the diagram provided.

Diagram 1

Reliability values of various variables in the SEM model



2. Structural Model Modeling

The structural model defines the relationships between independent variables (X1 to X5) and dependent variables (Y1 and Y2). Y1 represents food security and agribusiness, while Y2 represents competitiveness and welfare.

The relationships tested in this model are:

- The **Policy and Regulation** variable (X1) has an effect on **Food Security and Agribusiness** (Y1).
- The **Education and Training** variable (X2) influences **Food Security and Agribusiness** (Y1).
- **Investment and Resources** (X3) and **Technology and Innovation** (X4) also affect **Food Security and Agribusiness** (Y1).
- All independent variables affect **Competitiveness and Welfare** (Y2), which are measured by indicators related to the agribusiness value chain and minimum wage policies.

3. Model Estimation Results

Once the model was constructed, estimation was conducted using **Partial Least Squares (PLS)**. Below are the key results from the analysis:

a. Path Coefficients:

- **X1 (Policy and Regulation)** has a significant positive effect on **Y1 (Food Security and Agribusiness)** with a path coefficient of 0.498, indicating a moderate positive influence.
- **X2 (Education and Training)** has a smaller effect, with a path coefficient of 0.299 on **Y1**.
- **X3 (Investment and Resources)** shows a very small or even negative effect (-0.042) on **Y1**, which needs further consideration in the analysis.
- Other variables such as **X4** and **X5** show relatively smaller effects.

b. R^2 and Adjusted R^2:

- **R^2 for Y1** is 0.760, indicating that 76% of the variability in **Food Security and Agribusiness** can be explained by the independent variables in the model.
- **Adjusted R^2** is 0.747, suggesting that the model remains quite robust even after accounting for the number of predictors included in the model.

c. Reliability and Validity:

- **Cronbach's Alpha** for most variables is greater than 0.7, indicating good reliability. For example, **X1** has an alpha of 0.850, showing high internal consistency.
- **Average Variance Extracted (AVE)** for most constructs is greater than 0.5, indicating that these constructs adequately explain the variability in their respective indicators.

d. Factor Loadings:

- **Y1** has a high factor loading (0.840), showing that the indicators of food security and agribusiness are very effective at describing this dependent variable.
- **X1** also has a significant factor loading (0.759), suggesting that policies and regulations play an important role in food security.

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4. Discriminant and Convergent Validity

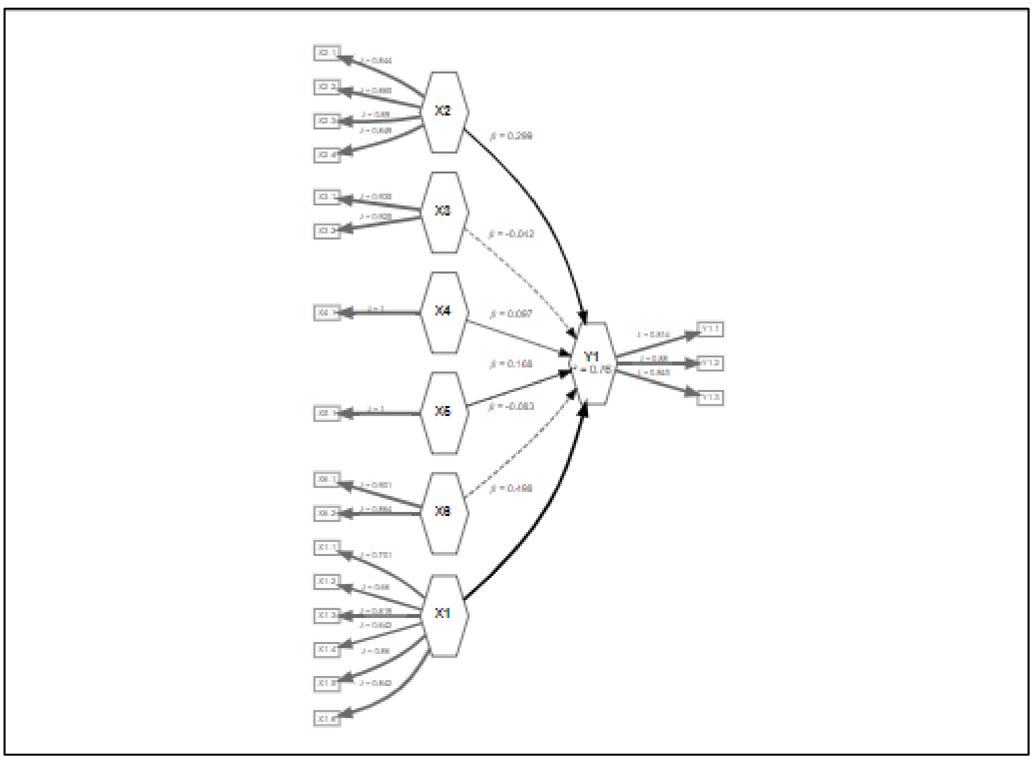
- The **Square Root of AVE** along the diagonal and the **construct correlations** below it show both discriminant and convergent validity. For example, the correlation between constructs **X1** and **Y1** is fairly high, but still lower than the factor loadings along the diagonal, indicating good discriminant validity.

5. Model Visualization

The model visualization, which illustrates the relationships between the independent and dependent variables, is essential for understanding how the constructs interact and to visually represent the flow of influence. It further helps in interpreting the path coefficients, factor loadings, and the overall fit of the structural model.

Diagram 2

Visualization model of the relationships between independent and dependent variables



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Structural Equation Modeling (SEM) Discussion: Strengths and Weaknesses

Overview of the SEM Model:

Based on the provided Structural Equation Modeling (SEM) diagram 2, the relationships between independent and dependent variables are illustrated. The model demonstrates the influence of independent variables such as **Policy and Regulation (X1)**, **Education and Training (X2)**, **Investment and Resources (X3)**, **Technology and Innovation (X4)**, and **Other Investment and Resources (X5, X6)** on two primary dependent variables: **Food Security and Agribusiness (Y1)** and **Competitiveness and Welfare (Y2)**.

In this model:

- **X1 (Policy and Regulation)** has the largest effect on **Y1 (Food Security and Agribusiness)** with a path coefficient of **β = 0.498**, indicating that good and fair policies positively contribute moderately to food security and agribusiness.
- **X2 (Education and Training)** has a smaller effect on **Y1** with a path coefficient of **β = 0.299**, suggesting that while important, education and training have a lesser impact compared to policies.
- **X3 (Investment and Resources)** shows a very small or even negative effect on **Y1** with a coefficient of **β = -0.042**, suggesting that this variable may be less effective or even counterproductive in influencing food security and agribusiness. This requires further analysis, possibly to adjust investment policies or improve resource allocation.
- **X4 (Technology and Innovation)** and **X5 (Other Investment and Resources)** also show relatively smaller influences on **Y1**, with coefficients of **β = 0.097** and **β = 0.168**, respectively, indicating limited contributions of these factors in the model.

The **R^2** for **Y1** is **0.760**, meaning that 76% of the variation in **Food Security and Agribusiness** is explained by the independent variables in the model. This demonstrates that the model is fairly effective in explaining food security and agribusiness based on the measured factors. Additionally, the model performs well in terms of reliability and validity:

- **Cronbach's Alpha** for most constructs is greater than 0.7, indicating good internal consistency in the measurement scales.
- **Average Variance Extracted (AVE)** for most constructs exceeds 0.5, suggesting good convergent validity, meaning that the indicators effectively reflect the intended constructs.

Strengths of the Research:

1. **Model Strength in Explaining Variability**:

   The SEM model shows an **R^2** of **0.760** for **Y1**, indicating that 76% of the variability in food security and agribusiness can be explained by the independent variables in the model. This relatively high value demonstrates that the model is successful in explaining most of the variation in the dependent variable, making it quite robust for predictions.

2. **Reliability and Validity of Constructs**:

   The research shows excellent results in terms of reliability and validity. **Cronbach's Alpha** values for most variables are above 0.7, ensuring strong internal consistency in the measurement scales. Furthermore, the **Average Variance Extracted (AVE)** for most constructs exceeds 0.5, indicating good convergent validity. This means the indicators used in each construct effectively capture the variability of the respective constructs.

3. **Significant Influence of Policy**:

   One of the key strengths of the model is the significant influence of **Policy and Regulation (X1)** on **Food Security and Agribusiness (Y1)**, with a path coefficient of **β = 0.498**. This highlights the crucial role of government policies in shaping food security, which can be used as a foundation for formulating more effective public policies in the agribusiness sector.

4. **Comprehensive and Adequate Model**:

   The SEM model incorporates several independent variables (X1 to X5), including policy, education, investment, and technology. This comprehensive approach provides a broad view of the factors influencing food security and agribusiness. SEM allows for a deeper analysis of the relationships between these variables, which cannot be achieved using simple linear regression models.

Weaknesses of the Research:

1. **Negative Effect of Investment and Resources**:

   One clear weakness is that **Investment and Resources (X3)** shows a very small or even negative effect on **Food Security and Agribusiness (Y1)** with a coefficient of **β = -0.042**. This result is surprising, as investment is typically considered an essential factor in supporting agribusiness sustainability. It suggests that this variable needs further analysis to understand why its influence is not aligned with expectations. Potentially, other factors might need to be incorporated into the model.

2. **Relatively Small Effects of Some Variables**:

   Other variables such as **Technology and Innovation (X4)** and **Other Investment and Resources (X5)** show relatively small influences on **Food Security and Agribusiness (Y1)**. The path coefficients for **X4** and **X5** are **β = 0.097** and **β = 0.168**, respectively, indicating that their contribution is less significant compared to **Policy and Regulation (X1)**. This suggests that, while technology and innovation are important, other factors like policy may have a more substantial role in the context of this research.

3. **Potential for Model Improvement**:

   Although the model shows a good **R^2** value for **Y1** (**76%**), the **Adjusted R^2**

of **0.747** indicates that there is room for further improvement. The negative influence found for some variables, such as **X3 (Investment and Resources)** and **X6 (Other Variables)**, suggests that there may be issues with measurement or indirect relationships that need to be further explored.

4. **Limitations in the Use of Indicators**:

   Another limitation is the use of indicators that may not fully capture the complexity of the intended constructs. For example, the indicators for **X1 (Policy and Regulation)** cover some important factors, but may not encompass all relevant dimensions of policy. A broader and more representative set of indicators could potentially provide a more accurate depiction of the constructs.

5. **Lack of Advanced Model Testing**:

   While the SEM model provides good results, it has not been further examined through fit indices testing or advanced model adjustments, such as modification of covariances or interactions between variables. Further testing could help ensure that the model fits the data better and generates more accurate predictions.

Conclusion

This study demonstrates that Policy and Regulation (X1) has a significant impact on Food Security and Agribusiness (Y1), with the largest contribution to the variation in Y1, indicating that government policies play a critical role in enhancing food security. However, Investment and Resources (X3) and Technology and Innovation (X4) show smaller influences, with X3 even showing a negative impact (-0.042), suggesting the need for adjustments in policies or more effective resource allocation.

The Structural Equation Modeling (SEM) used in this study has an R^2 of 0.760, meaning the model can explain 76% of the variability in food security, indicating that it is relatively effective in explaining the dependent variable.

However, a limitation to consider is the relatively small influence of some of the other independent variables, which opens up opportunities for further research to optimize these variables and improve the model to provide more accurate and applicable predictions. Additionally, these insights can guide the development of more effective policies in the agribusiness and food security sectors.

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