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DEVELOPING ECO-CITIES THROUGH ECO-COMMITMENT, ECO-OPPORTUNITY, ECO-INNOVATION, SOCIAL CAPITAL, AND URBAN FARMING SUSTAINABILITY

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Abstract

Eco-city aims to reduce the negative environmental impact of community and city activities while increasing social and economic welfare. Urban farming is promoted to improve food access and sustainability. Problems regarding low commitment, lack of innovation, and inability to take advantage of urban farming opportunities as a sustainable solution. Eco-friendly urban farming opportunities face limited land and a lack of social support. To develop eco-cities, this research aims to determine the relationship between eco-commitment, eco-opportunity, eco-innovation, social capital, and urban farming sustainability. This research was conducted in five Indonesian cities using survey, interview, and observation methods with 150 respondents. The model was compiled using a structural equation model and analyzed using the partial least squares method. This study has seven conclusions that can be summarized as follows: in the context of eco-city development, eco-commitment, eco-innovation, and eco-opportunity have a positive and significant influence on social capital, which in turn contributes positively and significantly to the sustainability of urban farming.

***Keywords**: eco-cities urban farming sustainability, eco-commitment, eco-innovation, eco-opportunity, social capital*

INTRODUCTION

Eco-cities are cities that are created and operated in a manner that is sustainable for the environment both during construction and day-to-day operations. Eco-cities are communities that work to reduce their negative impact on the natural world while enhancing the social and financial well-being of those living there. Regarding agriculture in the city, eco-cities promote secure farming practices and make it simpler for people to acquire nutritious food. By bringing food production and consumption closer together, urban farming can help reduce carbon emissions and help the earth stay healthy. Opportunities for creative urban farming to increase food production and boost social welfare are also presented by eco-cities (Bibri, 2021; Glaros et al., 2022; Li & Zhuang, 2022; Nicholls et al., 2020; Shrestha, 2021).

People, including urban farmers, are unaware of how crucial it is to protect the environment and practise sustainable farming, which is a major barrier to developing eco-cities. Farmers who make their homes in urban areas are uniquely positioned to safeguard the planet and promote sustainable development. Farmers concerned about the environment can be key in popularising sustainable farming methods. However, sustainable farming can be challenging due to economic and societal factors. Sustainable farming practices can only be adopted by farmers with access to cutting-edge information and tools, as well as widespread support and engagement from the general public (Elahi et al., 2022; Ioannis et al., 2019; Säumel et al., 2019; Wu et al., 2020).

An "eco-opportunity" is a business chance that arises due to efforts to find solutions that address both financial and ecological concerns. Eco-opportunity is difficult since it involves huge investments and assistance from the government, commercial sector, and society. Urban farming is one of the eco-opportunities that can be both a chance and a challenge for creating eco-cities. Urban farming offers cheaper organic food and new economic prospects in cities. However, urban farming can encounter problems such as restricted land, unsupported urban planning rules, and limited resources and technologies. Policies, investment, and education on urban farming practices can assist eco-cities in establishing urban farming (Cohen, 2020; Fan et al., 2021;

Guleria & Kaur, 2022; O'Manique et al., 2021; Spataru et al., 2020).

Eco-innovation is also a key part of making eco-cities a reality. Innovation among urban farmers can be a chance to make farming more environmentally friendly and get more people involved. However, constraints on available funds and technological options might make progress slow. Farmers require investment, markets, knowledge, and new technologies to innovate and execute sustainable farming practices. Environmental and sustainable agriculture programs can work better when farmers, governments, the business sector, and communities work together well. However, this progress should be open to everyone, including urban farmers who may not have easy access to cutting-edge farming tools and knowledge (Bibri, 2020; Hardman et al., 2022; Siegner et al., 2019; Watts et al., 2021).

Social capital is also key to making eco-cities happen, especially in urban farming. Social capital can help get more people involved in environmental programs and sustainable farms. Social capital's challenges in accommodating urban farmers' commitments, opportunities, and environmental innovations in sustainable urban farming and eco-cities include building trust and mobilizing resources to achieve common goals. Furthermore, land, water, and capital availability discrepancies can compound social and economic inequalities within urban farming communities. Sustainable urban farming is essential for urban ecology, but first, cities must increase public knowledge and dedication to sustainability (Keough & Ghitter, 2019; Kingsley et al., 2020; Ma et al., 2019; Shi et al., 2021; Yoshida et al., 2019).

Researchers want to find out how to make sustainable eco-cities by focusing on eco-commitment (ECM), eco-innovation (ECI), eco-opportunity (EOP), social capital (SC), and urban farming sustainability (UFS). The aim is to develop a conceptual framework that incorporates those concepts and tests their influence on sustainable city development. This study aims to determine the effect of ECM, ECI, and EOP on UFS mediated by SC. This research has novelty by proposing a comprehensive approach to developing eco-cities. This research covers ECM, ECI, EOP, SC, and UFS to strengthen key aspects in developing environmentally friendly cities. This holistic approach provides a promising new outlook for achieving sustainability and community engagement in building greener cities.

METHODOLOGY

Basic Method. This research uses the basic method of case studies to identify the relationship between ECM, ECI, EOP, SC, and UFS variables in the development of eco-cities. The case study method was used in this study because the researcher wanted to gain a deep understanding of eco-cities development, including the challenges and opportunities faced and the factors that influence its success.

Research location determination method. The location of the study was determined purposively in five cities, namely Jakarta, Bandung, Semarang, Surabaya, and Yogyakarta. This method is used to obtain data from major cities in Indonesia that have problems related to developing eco-cities and implementing sustainability concepts.

Sampling method. Researchers used a combination of purposive and simple random sampling. Through the purposive sampling method, researchers can choose research locations with certain characteristics to be studied, such as big cities in Indonesia that have problems developing eco-cities and implementing sustainability concepts. In this study, the research sample was set with 30 respondents in each selected city, so the total research sample was 150. Furthermore, researchers used a simple random sampling method to randomly select a sample from each city's relevant population. The number of samples selected in each city, as many as 30 respondents, is expected to provide sufficient and valid representation for each city studied.

Research Model. The following is a model used to examine the relationship between ECM, ECI, EOP, SC, and UFS:

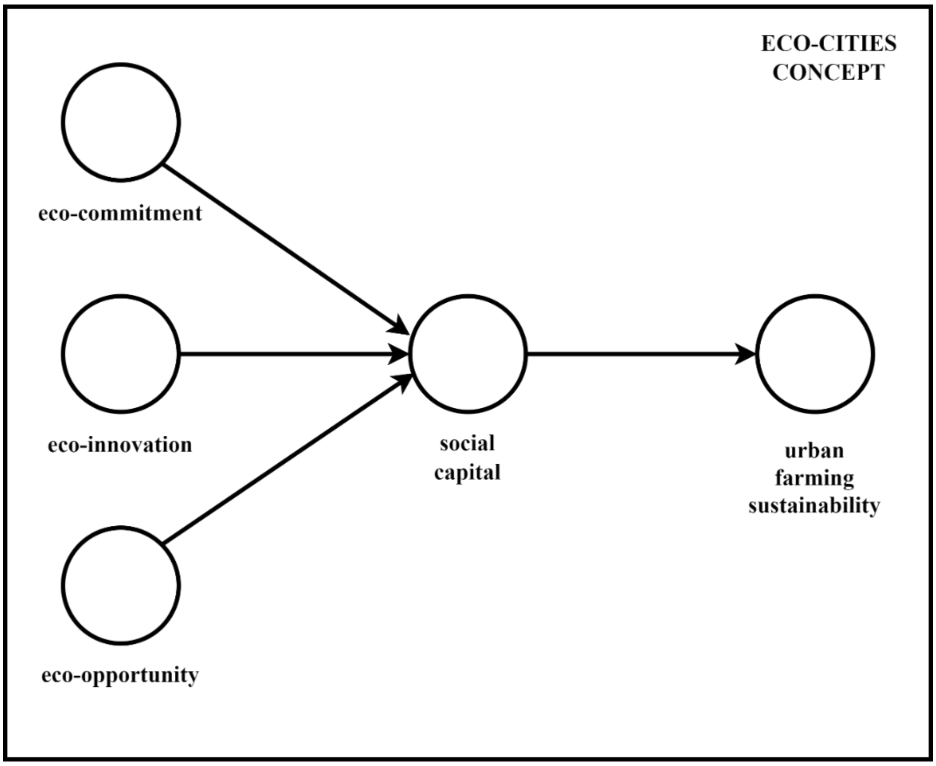

Figure 1. Model of the relationship between ECM, ECI, EOP, SC, and UFS

This study describes the relationship model between ECM, ECI, EOP, SC, and UFS using the structural equation model (SEM). SEM allows researchers to measure and model the relationship between latent and measurable variables (Brown et al., 2020). In SEM, relationship models can be depicted as diagrams that visualize the relationship between variables and the direction of their influence. In this study, researchers used SEM to model the relationship between ECM, ECI, EOP, SC, and UFS indicators in developing ecological cities. They tested hypotheses about the relationship between variables in the model.

After establishing the variables in the study, the next step is to compile indicators for each variable. Indicators are used to measure variables in research by identifying certain aspects of those variables that can be measured and observed. The indicators in this study are compiled through questionnaires that respondents will fill out. The questions in the questionnaire are based on the constituent theory and are designed to measure desired constructs. These indicators must be valid and reliable in research (Sarstedt & Cheah, 2019).

The preparation of indicators aims to formulate problems and strategies for developing eco-cities. These indicators will help researchers measure and understand ECM, ECI, EOP, SC, and UFS. Thus, indicators can provide deeper insight into the characteristics and challenges of eco-cities development and assist in formulating strategies to improve environmental sustainability in such cities.

Table 1. Variables and indicators of the relationship between ECM, ECI, EOP, SC, and UFS

Variable	Indicator	Explanation
Eco-commitment (ECM)	ECM1	Commitment to the use of environmentally friendly cultivation techniques (Valley & Wittman, 2019)
	ECM2	Commitment to saving water (Valizadeh et al., 2020)
	ECM3	Commitment to good waste management (Mir et al., 2021)
Eco-innovation (ECI)	ECI1	Innovation in the use of green technology (hydroponics, drip irrigation, aquaponics, verticulture) (Surya et al., 2020)
	ECI2	Water conservation innovations (wastewater management and water saving) (Radini et al., 2021)

	ECI3	Waste management innovations (such as vermicomposting technology) (Ahmed et al., 2019)
Eco-opportunity (EOP)	EOP1	Organic farming business opportunities (Grasswitz, 2019)
	EOP2	Opportunities for the emergence of urban farming and organic farming regulations (Skar et al., 2019)
	EOP3	Opportunities for the promotion of urban farming and organic farming (Follmann et al., 2021)
Social Capital (SC)	SC1	Networking (Christensen et al., 2018)
	SC2	Trust (Saptutyningsih et al., 2020)
	SC3	Social norms (Tiraieyari et al., 2019)
	SC4	Social responsibility (Azunre et al., 2019)
Urban Farming Sustainability (UFS)	TS1	Increasing the number of people in sustainable urban farming activities (McDougall et al., 2018)
	TS2	Increased crop diversity in urban farming development areas (Armanda et al., 2019)
	TS3	Increased number of education and training programs for communities involved in urban farming (Breuste, 2021)
	TS4	Increased stakeholder involvement (community, university, private sector) (C. Wang et al., 2020)

Data Collection Methods. This study used three data collection methods: surveys, interviews with questionnaire guides, and observation (Alam, 2020). The survey method was used to obtain answers to respondents' perceptions and attitudes towards the development of eco-cities. Interviews with questionnaire guides were used to obtain supporting information on respondents' characteristics and indicators of ECM, ECI, EOP, SC, and UFS. Meanwhile, observation is used to compare the concept of eco-city development with the real conditions in each selected city. By combining these three methods, researchers can obtain complete and accurate data on factors that influence the development of ecological cities and analyze the relationship between indicators.

Data Analysis Methods. In this study, the data analysis method used to examine the relationship between ECM, ECI, EOP, SC, and UFS is the structural equation model (SEM). SEM is a multivariate statistical technique that analyses relationships between latent or unmeasured variables (Purwanto & Sudargini, 2021). In SEM, researchers model the relationship between latent and measurable observational variables (Gimeno-Arias et al., 2021). Using SEM, researchers can test hypotheses about relationships between variables in the model and measure the strength of relationships between those variables (J. Hair & Alamer, 2022). This study used SEM to examine the relationship between ECM, ECI, EOP, SC, and UFS indicators in the development of eco-cities.

Hypothesis Development. Preparing research hypotheses aims to identify the relationship between the variables studied and answer the research objectives. In this case, researchers will formulate hypotheses based on previous theories and research to explain how the variables studied relate to and affect each other (Groenland & Dana, 2020). This hypothesis will be tested using appropriate statistical methods to provide answers to research objectives and contributions to the development of eco-cities. The following are the hypotheses used in the study:

H1: Eco-commitment affects social capital
H2: Eco-innovation affects social capital
H3: Eco-opportunity affects social capital
H4: Social capital influences urban farming sustainability
H5: Eco-commitment influences urban farming sustainability mediated by social capital
H6: Eco-innovation affects urban farming sustainability mediated by social capital
H7: Eco-opportunity affects urban farming sustainability mediated by social capital

RESULTS AND DISCUSSIONS

The initial analysis stage examines the relationship between ECM, ECI, EOP, SC, and UFS using the Partial Least Squares (PLS) algorithm. This method tests the relationship between variables and provides an idea of the strength of the relationship between variables (Hair et al., 2019). From the results of PLS analysis, researchers can determine which variables have the greatest influence in influencing other variables and find important factors in the development of eco-cities. This analysis will help researchers test hypotheses and devise recommendations for sustainable eco-cities development. The following are the results of the algorithm PLS test:

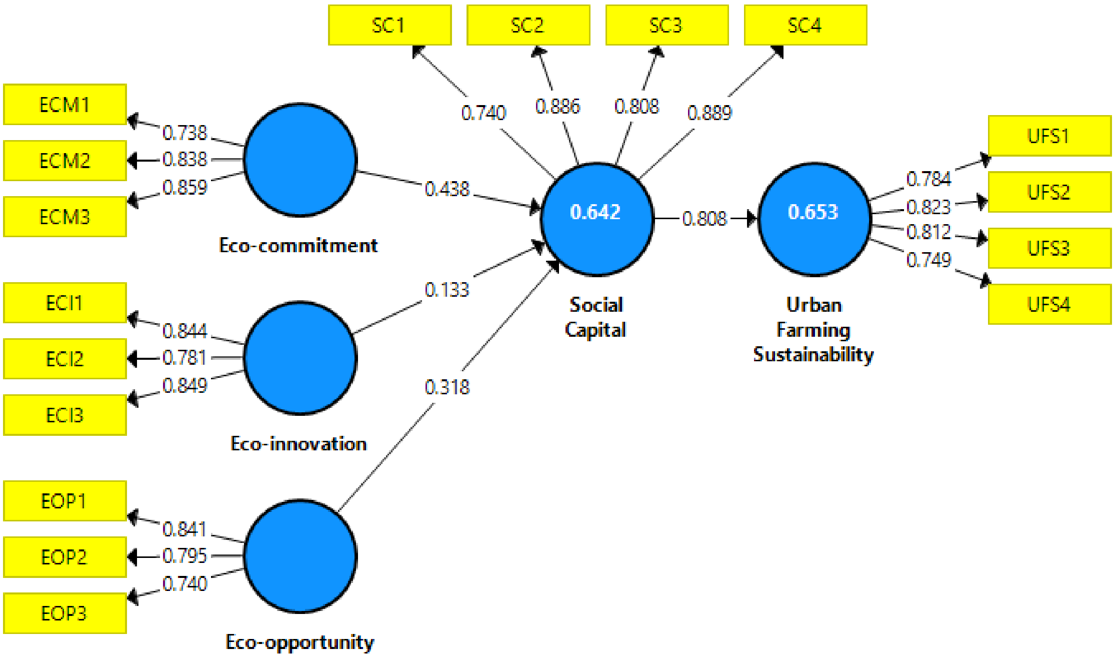

Figure 2. PLS algorithm results from the relationship between ECM, ECI, EOP, SC, and UFS

Based on Figure 2 of the PLS algorithm results, if a variable has an outer loading value above 0.7, Then the variable significantly influences other variables. In this study, the variables ECM, ECI, EOP, SC, and UFS all have outer loading values above 0.7, so it can be said that the variables measured have a strong relationship with the construct described by the PLS model. Outer loading measures how much variation of a variable is described by factors or constructs in the PLS model. Suppose the outer loading is more than 0.7. In that case, it indicates that the construct measured by that variable explains significant variance and can therefore be considered an important variable in the PLS model (Hair et al., 2020). This result shows that ECM, ECI, EOP, SC, and UFS are important in developing eco-cities.

Table 2. Reliability and construct validity tests of ECM, ECI, EOP, SC, and UFS

Var.	Indicator	Cross Loading					CA	rho_A	CR	AVE	R^2
		ECM	ECI	EOP	SC	UFS					
ECM	ECM1	**0.738**	0.658	0.605	0.487	0.525	0.745	0.768	0.854	0.662	-
	ECM2	**0.838**	0.708	0.536	0.629	0.581					
	ECM3	**0.859**	0.647	0.458	0.692	0.775					
ECI	ECI1	0.764	**0.844**	0.602	0.581	0.598	0.765	0.764	0.865	0.681	-
	ECI2	0.566	**0.781**	0.405	0.592	0.593					
	ECI3	0.699	**0.849**	0.689	0.582	0.720					
EOP	EOP1	0.516	0.447	**0.841**	0.469	0.454	0.707	0.702	0.835	0.629	-
	EOP2	0.483	0.469	**0.795**	0.512	0.538					
	EOP3	0.513	0.665	**0.740**	0.623	0.632					

SC	SC1	0.482	0.379	0.456	**0.740**	0.514	0.852	0.867	0.900	0.693	**0.642**
	SC2	0.645	0.602	0.674	**0.886**	0.709					
	SC3	0.694	0.728	0.645	**0.808**	0.642					
	SC4	0.654	0.609	0.503	**0.889**	0.793					
UFS	UFS1	0.612	0.701	0.564	0.511	**0.784**	0.805	0.826	0.871	0.628	**0.653**
	UFS2	0.649	0.617	0.671	0.802	**0.823**					
	UFS3	0.669	0.708	0.539	0.599	**0.812**					
	UFS4	0.544	0.439	0.408	0.583	**0.749**					

Source: Data processing output

Based on the analysis results, if the value of cross-loading, Cronbach's Alpha (CA), Rho_A, and Composite Reliability (CR) exceed 0.7, the measured variable is reliable and has a good consistency. This value means that the indicators used in measuring the variables of ECM, ECI, EOP, SC, and UFS are reliable and provide consistent results. This value provides confidence that these variables can be used validly in further analysis and to support research findings (Richter et al., 2020). Based on the results of the analysis, if the value of Average Variance Extracted (AVE) exceeds the 0.5 mark, it indicates that the measured construct has a fairly high variance, and most of the variation in those indicators can be explained by the construct being measured. With an AVE value above 0.5, it can be concluded that the measurement of ECM, ECI, EOP, SC, and UFS is quite good and reliable in this study. Based on the results of the analysis, if the R2 value (coefficient of determination) of the PLS test is in the range between 0.33 to 0.67, this indicates a moderate relationship between the variables studied. This R2 value indicates that between 64.2% and 65.3% of the variability in the dependent variable can be explained by the independent variable in the model. In the context of this study, a moderate R2 value shows that ECM, ECI, EOP, SC, and UFS significantly influence the development of eco-cities. However, there are still other factors that also play a role.

Table 3. The direct and indirect effect path for hypothesis testing ECM, ECI, EOP, SC, and UFS

Variable Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Sig.
Direct effect						
H1: ECM → SC	0.438	0.434	0.084	5.239	0.000	***
H2: ECI → SC	0.133	0.135	0.067	1.991	0.047	**
H3: EOP → SC	0.318	0.324	0.056	5.632	0.000	***
H4: SC → UFS	0.808	0.809	0.031	25.836	0.000	***
Indirect effect						
H5: ECM → SC → UFS	0.354	0.352	0.073	4.838	0.000	***
H6: ECI → SC → UFS	0.107	0.109	0.053	2.009	0.045	**
H7: EOP → SC → UFS	0.257	0.262	0.046	5.646	0.000	***

Source: Data processing output

3.1. Eco-commitment affects social capital

Table 3 illustrates the significant positive impact of eco-commitment on social capital, rooted in environmentally conscious cultivation techniques, water conservation, and effective waste management. Such commitment reflects social responsibility and environmental awareness, reducing negative ecological effects through organic fertilizers and natural pest control. Xie et al. (2023) study reveal that eco-committed farmers engage in knowledge-sharing networks, linking environmental dedication with social ties. Water conservation and optimized irrigation contribute to human and ecosystem water needs, fostering trust and collaboration among farmers, according to Chaudhuri et al. (2020). Similarly, proficient waste management, involving waste sorting and recycling, curbs pollution and establishes positive social networks. Homogenous commitment to sustainable practices creates strong social bonds, encouraging environmentally responsible behaviors and forming social norms. This commitment also instills societal trust and reputation, propelling cooperative interactions among diverse entities. Skaalsveen et al. (2020) confirm that committed farmers forge robust networks for knowledge exchange, support, and norm sharing.

3.2. Eco-innovation affects social capital

Table 3 highlights the significant positive influence of eco-innovation on social capital, facilitated by green technologies like hydroponics, drip irrigation, aquaponics, verticulture, water conservation, and waste management innovations, including vermicomposting. These innovations impact various aspects of social contexts, including networks, beliefs, norms, and social responsibility. Chai et al. (2022) research emphasizes that adopting green tech shapes environmental norms, generating support for eco-protection actions. Green technology fosters knowledge-sharing and experience exchange among communities interested in sustainability, promoting collaboration and idea-sharing through networks. This technology bolsters trust among environmentally engaged community members, building a foundation of mutual reliability, as Sodiq et al. (2019) demonstrated in their study of community gardens. Additionally, widespread green tech adoption transforms social norms surrounding environmental management, elevating eco-friendly practices to a socially responsible status. This shift compels individuals and groups to participate, forming a vital cornerstone for more sustainable social contexts, as indicated by Hoek et al. (2021) research on urban farming community activities and their impact on environmental norms through green technology and sustainable practices.

3.3. Eco-opportunity affects social capital

Table 3 indicates that eco-opportunity significantly and positively influences social capital. Organic farming business prospects attract entrepreneurs and investors due to potential profits. Organic produce meets consumer demand for healthy, sustainable items, especially as health and environmentally-conscious consumers seek pesticide-free products. Nakandala & Lau's (2019) research highlights the profitable potential of urban organic farming, appealing to health-conscious consumers and capitalizing on limited space and low transportation costs. Effective promotions and educational campaigns shift perceptions and instill confidence in organic products, driven by changing social norms and heightened health and sustainability awareness, as Mendez et al. (2021) noted. Furthermore, organic farming's social responsibility aspect fosters community trust and stakeholder relationships D. Wang & Li (2022), promoting participation, trust-building, and relationship cultivation among organic farming initiatives.

3.4. Social capital affects urban farming sustainability

Table 3 underscores social capital's significant and positive influence on urban farming sustainability. Collaborative networks among communities, universities, and the private sector facilitate the exchange of knowledge, resource, and support, enhancing sustainable agricultural practices. Such exchanges lead to better practices, stronger community capacity, and motivational legitimacy, contributing to environmental sustainability and community well-being. Weidner et al. (2019) study highlights the pivotal role of these networks in promoting urban agriculture sustainability, fostering participation, and improving food systems' sustainability. Trust among stakeholders cultivates cooperation, enabling effective information sharing, problem-solving, innovation, and policy implementation. Joffre et al. (2020) emphasize that stakeholder trust drives successful cooperation, bolstering sustainable urban farming practices and collaboration. Positive social norms and guiding behavior deemed appropriate play a crucial role. When these norms favor sustainability practices, communities adopt them, creating environmentally friendly agricultural landscapes.

Adnan et al. (2019) demonstrate that such norms increase participation and behavioral change, fostering sustainability. Furthermore, social responsibility sparks community commitment, motivating participation in creating better communities through sustainable farming practices, reinforcing local food production, and enhancing food security, according to Filippini et al. (2019).

3.5. Eco-commitment affects urban farming sustainability mediated by social capital

Table 3 emphasizes the significant positive impact of eco-commitment on urban farming sustainability, influenced by mediated social capital. Environmental dedication, encompassing eco-friendly cultivation techniques, water conservation, and waste management, forms a cornerstone for environmentally responsible agricultural practices, mitigating pollution and soil damage. High commitment correlates with urban farming's sustainability and stable yields, as van Delden et al. (2021) assert. Community participation in sustainable urban farming activities also contributes significantly, fostering awareness of organic food production and reducing commercial food production's environmental footprint, as highlighted by Steenkamp et al. (2021). Diverse plant development enhances resilience by reducing dependency on a single crop, while education and training programs improve agricultural knowledge and practices, augmenting land productivity and environmental quality, as evidenced by Siebrecht's (2020) research. Additionally, stakeholder engagement, involving communities, universities, and the private sector, is pivotal for program success, providing resources, expertise, and support, as Kubanza & Simatele (2019) conclude, reinforcing the symbiotic relationship between urban communities and sustainable agriculture.

3.6. Eco-innovation affects urban farming sustainability mediated by social capital

Table 3 highlights the significant positive impact of eco-innovation on urban farming sustainability, mediated by social capital. Green technologies like hydroponics, drip irrigation, aquaponics, verticulture, water conservation, and waste management innovations, including vermicomposting, play a crucial role in fostering environmentally friendly urban agriculture. Broad et al. (2021) study underscore that eco-friendly hydroponic technology increases public interest and participation in urban farming by providing convenience in limited urban spaces, emphasizing the trust in technology. These technologies contribute to enhanced plant diversity, allowing efficient cultivation of various crops even in constrained urban environments, as Surya et al. (2020) noted. Additionally, adopting green tech, water conservation innovations, and waste management facilitates community education and training, empowering individuals to learn sustainable agricultural practices directly. Mason & Ahmad's (2023) research reveals that aquaponics, an integrated fish and plant farming system, improves education programs, offering hands-on learning experiences in efficient gardening, fish rearing, and sustainable agriculture principles.

3.7. Eco-opportunity affects urban farming sustainability mediated by social capital

Table 3 underscores eco-opportunity's significant and positive influence on urban farming sustainability, mediated by social capital. The flourishing prospects within organic urban farming, driven by business growth, supportive regulations, and effective promotions, enhance the sector's appeal. Increasing demand for organic products aligns with regulatory certainty, while impactful promotion raises public awareness about the benefits of organic farming. This scenario translates into heightened community engagement in sustainable urban farming, as evidenced by Winkler et al. (2019) study. Stakeholder involvement, spanning communities, universities, and the private sector, expands urban farming participation, fostering strong networks for knowledge-sharing and support. Universities contribute vital knowledge and resources, while the private sector bolsters innovation and business potential. Active involvement further diversifies plant cultivation and extends community education and training programs, as indicated by Gómez-Villarino & Ruiz-Garcia's (2021) research, building trust, networks, and collaborative growth within organic farming practices.

CONCLUSIONS

In the context of eco-cities development, eco-commitment, eco-innovation, and eco-opportunity have a positive and significant influence on social capital, contributing positively and significantly to the sustainability of urban farming. More specifically, eco-commitment, eco-innovation, and eco-opportunity affect urban farming sustainability through social capital mediation. Thus, efforts and innovations made in maintaining ecological commitments, implementing sustainable innovations, and utilizing ecological opportunities will support the sustainability of urban farming by involving and building strong social capital. The recommendation from the results of this study for the development of eco-cities is to integrate environmental, social, and economic aspects. In terms of the environment, commitment, innovation, and ecological opportunities that support environmental sustainability are needed. In the social aspect, building strong social capital through community participation and collaboration among important stakeholders. On the economic aspect, sustainable technology and infrastructure investment must be supported to ensure economic success in eco-cities. Policy implications that can be put forward are the importance of supporting and encouraging eco-commitment, sustainable innovation, and utilizing ecological opportunities in urban farming by developing strong social capital. Policies should address these factors by providing education and training, facilitating collaboration between governments, communities, and the private sector, and encouraging investment in technology and infrastructure that supports sustainable practices in urban farming. Thus, urban farming sustainability can be achieved through utilizing ecological potential and building inclusive and sustainable social capital. A limitation of this study is that it focuses on the direct relationship between ECM, ECI, EOP, SC, and UFS without considering other factors that might influence it. Further research can expand the scope by considering additional variables such as economic, political, and cultural factors that can affect the sustainability of urban farming. In addition, future research could also delve deeper into mediation mechanisms and identify more effective policy strategies to promote sustainable urban farming growth.

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