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A DECISION SCIENCE FRAMEWORK FOR INTEGRATING GREEN FINANCIAL TECHNOLOGY AND INCLUSION TO ENHANCE SME FINANCIAL STABILITY

UMA ESTRUTURA DE CIÊNCIA DA DECISÃO PARA INTEGRAR TECNOLOGIA FINANCEIRA VERDE E INCLUSÃO, A FIM DE AUMENTAR A ESTABILIDADE FINANCEIRA DAS PME

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Abstract
As digital finance rapidly evolves in Industry 5.0, organizations truly require a project management approach. It should effectively balance technological innovation with sustainability objectives. In response to this critical need, the present study introduces a new framework. This positions Green Financial Technology (Green FinTech) and Green Inclusion as pivotal. This helps in strengthening the financial resilience of small, and medium-sized enterprises (SMEs) in Deli Serdang, Indonesia. The study uses a quantitative approach. It draws on Structural Equation Modeling–Partial Least Squares (SEM-PLS), a quite advanced statistical tool. The data set? One thousand SMEs. The outcomes do suggest the core role of Green FinTech is quite undeniable. Notably, it widens access to digital financial services for all parties concerned. It may also improve the productivity of business operations. I find the increased use of environmentally conscious innovations fascinating too. Although Green Inclusion is showing a more subdued influence; its contribution remains really rather meaningful. It meaningfully expands the scope of equitable financing possibilities for many. Taken as a whole, these ingredients reveal digital metamorphosis executed with project initiatives

Resumo
À medida que as finanças digitais evoluem rapidamente na Indústria 5.0, as organizações precisam realmente de uma abordagem de gerenciamento de projetos. Ela deve equilibrar efetivamente a inovação tecnológica com os objetivos de sustentabilidade. Em resposta a essa necessidade crítica, o presente estudo introduz uma nova estrutura. Ela posiciona a Tecnologia Financeira Verde (Green FinTech) e a Inclusão Verde como fundamentais. Isso ajuda a fortalecer a resiliência financeira das pequenas e médias empresas (PMEs) em Deli Serdang, Indonésia. O estudo utiliza uma abordagem quantitativa. Ele se baseia na Modelagem de Equações Estruturais – Mínimos Quadrados Parciais (SEM-PLS), uma ferramenta estatística bastante avançada. O conjunto de dados? Mil PMEs. Os resultados sugerem que o papel central da Green FinTech é inegável. Notavelmente, ela amplia o acesso a serviços financeiros digitais para todas as partes envolvidas. Ela também pode melhorar a produtividade das operações comerciais. Também acho fascinante o aumento do uso de inovações ambientalmente conscientes. Embora a inclusão verde esteja mostrando uma influência mais moderada, sua contribuição continua sendo bastante significativa. Ela

can boost lasting financial gains and nurture an economic ecosystem that is more accepting. This empirical substantiation of that framework provides a notable insight to project management scholarship, yes it does. Digital finance, sustainability-centered inclusion and SME resilience link quite easily in this way, quite easily indeed. Further it presents important directives for policy experts or any other people and project chiefs, involved with newly established market contexts.

Keywords: Green Financial Technology. Green Inclusion. Financial Resilience. SMEs.

amplia significativamente o escopo das possibilidades de financiamento equitativo para muitos. Em conjunto, esses ingredientes revelam que a metamorfose digital executada com iniciativas de projetos pode .impulsionar ganhos financeiros duradouros e nutrir um ecossistema econômico mais receptivo. Essa comprovação empírica desse quadro fornece uma visão notável para os estudos sobre gerenciamento de projetos, sem dúvida. Finanças digitais, inclusão centrada na sustentabilidade e resiliência das PMEs se conectam facilmente dessa forma, com bastante facilidade, de fato. Além disso, apresenta diretrizes importantes para especialistas em políticas ou quaisquer outras pessoas e chefes de projetos envolvidos com contextos de mercado recém-estabelecidos.

Palavras-chave: *Tecnologia Financeira Verde. Inclusão Verde. Resiliência Financeira. PME.*

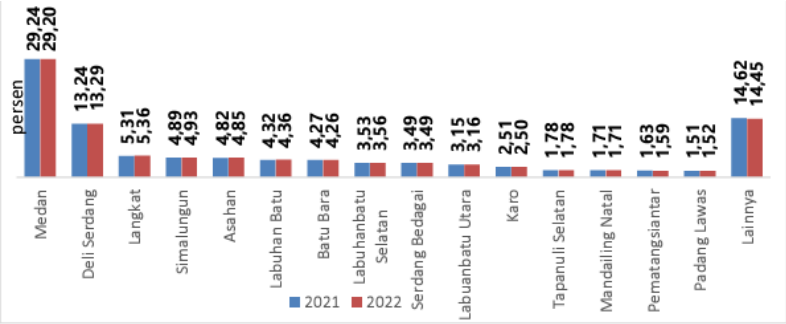
1 INTRODUCTION

In the era of the Fifth Industrial Revolution, we see digital technology greatly accelerating. This has reshaped economic and, also business dynamics, very fundamentally. Now, all sectors, need to adapt fast. This includes Small and Medium-Sized Enterprises, also known as SMEs, swiftly! Doing so, helps them remain relevant, and, sustain their competitiveness. Further they contribute effectively; to national economic growth within the evolving digital economy, it must be done. (Chinoda *et al*., 2023). SME actors, it's very true, must develop a comprehensive understanding of the principles that are basic and important. They must grasp how technological progress is ruling the financial sector; financial acumen. It can become a strategic foundation; you see for building resilient, business models (Cantero *et al*., 2024; Rahman *et al*., 2024; Gomez, 2020). These efforts are headed to adopting business practices, that are environmentally, and yes, very, very responsible as well as sustainable (Asmar *et al*., 2020; Köngeter *et al*., 2023). Such actions utilize technology, for improvement, waste and energy efficiency; optimize the utilization of nature's bounty, insuring economic endurance (Jhaa *et al*., 2024; Karyawati *et al*., 2020; Adhikari *et al*., 2023; Issa *et al*., 2024). If green financial technology, is welcomed by SMEs, their financial presentation will enhance as their economic impression lessens; efficiency of operation will rise via innovation, that is so needed and, also; quite, digital (Nagesh *et al*., 2023; Lichao *et al*.,

2024; Xi *et al*., 2023). Further SMEs are important to make equality better, to widen participation, and fair access to a greener economy too (Shen *et al*., 2021; Ding *et al*., 2024; Suhrab *et al*., 2024). Gaining better SME access, to economic wares that won't fade, and accepting methods, with social effects; those, will gain objectives; this can happen, for sure (Sun *et al*., 2022; Yang *et al*., 2024). By agreeing to become, an agent of inclusion in going green, SMEs aid the advance to greener development for economy, quite nice indeed (Tao *et al*., 2023; Bu *et al*., 2024). Through getting familiar with the green inclusion; and adapting to new green financial technology, operational strength and the, fiscal fitness increases of SMEs too (Ozturk *et al*., 2024; Nugraha *et al*., 2022). Via binding and meshing of these two viewpoints SMEs; they, gain capacity; for better fighting the coming, global hard, knocks; adapt and come out in good stead. Innovation plus, a framework: sustainable, growth and competition.

Figure 1

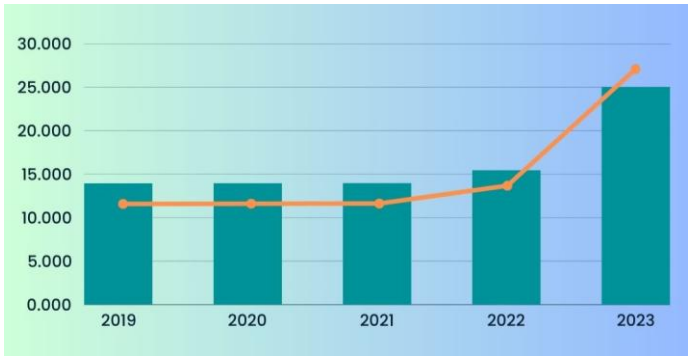
Contribution of Deli Serdang Regency's GRDP to North Sumatra's Economy in 2021-2022 (percent)



Source: https://portal.deliserdangkab.go.id/wp-content/berkas/1701070532.pdf

Figure 2

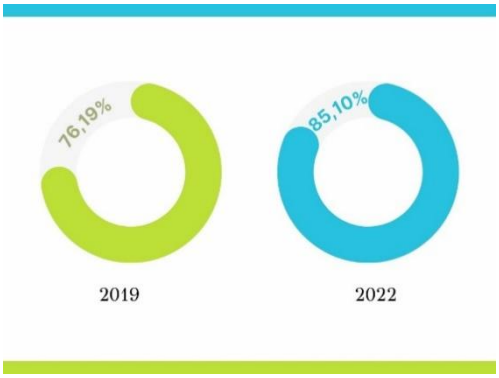
Number of MSMEs in Deli Serdang Regency



SMEs have shown consistent growth in recent years. The growth spans across many regions and cities in North Sumatra. Deli Serdang Regency is a key player. It supports the regional economic expansion. This regency strengthens the economic structure of North Sumatra. You know that Prassetyo states this in 2022. It's important, or so I believe.

Figure 3

Financial Inclusion Index



Based on the 2022 survey by the Financial Services Authority; or Otoritas Jasa Keuangan, Indonesia's financial inclusion index reached 85.10%. It did see a very notable increase from 76.19% in 2019. This means that within just three years, access to financial products did increase, with services, indicating the level of inclusion, rose a considerable 8.91% (OJK, 2019). The progress is the result of hard and continuous collaborative work. This effort included the Government, the Financial Services Authority, various ministries, other related institutions, the financial services industry, and all stakeholders, who worked persistently to boost financial inclusion across our society, (Putri, 2022; Mirdiyantika, 2023). Therefore; the development of financial technology shapes the future, which looks inclusive, innovative, also sustainable for the financial sector (Du *et al*., 2023; Babilla *et al*., 2023; Gao *et al*., 2023; Ningsi *et al*., 2022). We expect further public access expansion, with better financial products and the important services will continue, which means better and positive impact, an increased economical growth as well as improvements for overall well-being, Ningsi, 2021; Ningsi, 2024; Lubis, 2022. We note, this study's importance: it bolsters sustainable growth for Small and Medium-Sized Enterprises (SMEs) by increasing operational efficiency, decreasing environmental impact, offering greater access to financial resources for expanding the business,

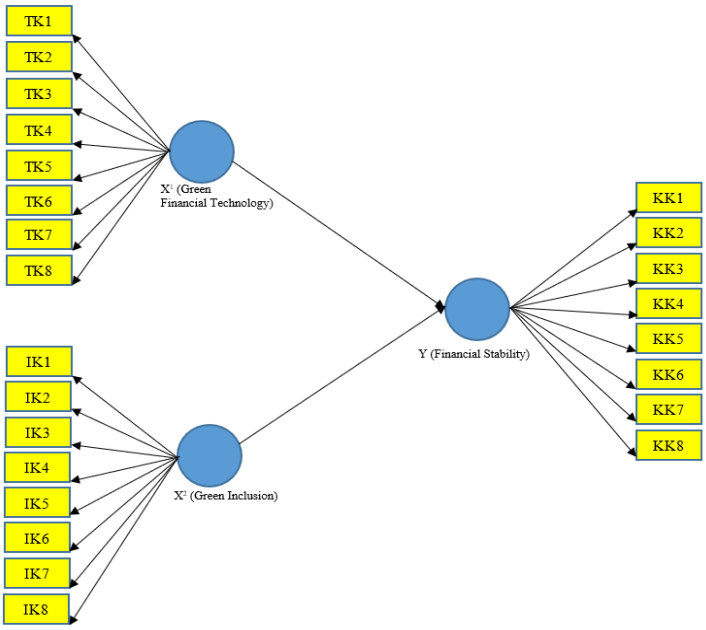
investing in environment safety practices, managing finances safely, as well as, importantly, pushing digital innovation in the SME sector. What is more, these moves do energize local economics, offering entirely new business chances alongside environmental best-practice which includes green sustainability methods, together, they show value for renewable power alongside upgrades of the waste management equipment in operation. The issue is problem-solving through focused view within three key, broad points. There is an important and notable need to improve Operational Efficiency: Application of a green Financial Technology – think of digital payment systems also think of cloud-based financial management apps which are able to trim administrative expenditure that works by simply smoothing out and thus streamline operations which are run in the office. Access to vital capital: Important; Green Inclusion can offer to expand SMEs access, offering financial resource avenues, supporting them via sustainability financial options which will sit squarely besides enviro- aims and the requirements expected for sustainable finance. A clear point needs focus – Digital Innovation: This push has implications which do not purely just sit comfortably alongside sound stability in finances alone nevertheless do give an edge with SME's long games around sustaining the current operation and the scope of that existing game. Previous research lends great support towards shaping and informing this paper's concepts which are included within, the prior work which gave valuable assistance, is shown by several experts; namely, Reisdorf *et al*. (2023) as well as Flori *et al*. (2024) and together, they pinpointed exactly how vital digital onboarding actually is within this sector of economics especially alongside inclusion from any, across, differing social classes that require, important help to improve general public's better, well running socio eco standards using some clever and smart solutions whilst at once getting a handle of the already identified problems existing with all types of modern social, inclusion programs, a team-style attitude if one can put it simply! While there, Telukdarie *et al*. (2023) went so very carefully as to add there is solid gains when they understand how finances need use new ways in a current style for using tools to access funds within growth sectors to then allow funding accessibility through poverty declines! However; there are two other boons alongside such important studies these included -Tay's and team which focused digital funds can turn into a new 'yes please' route into sound-future developments by funding all fund sectors inside new funds circles - a grand old team.

2 METHODOLOGY

This study works on the framework, and looks at model and direction. The aim is green finance and green inclusion. They will help SMEs, plus reinforce environmentally responsible practices. These will generate new solutions. The research uses purposive sampling; that's a technique that selects data based on specifics. Not all respondents meet relevant characteristics, after all. Therefore; this sampling helps pick those who fit criteria important to study goals. Primary data was gathered by questionnaires to 1,000 SMEs, in Deli Serdang Regency. The research has solid ground. There were early looks to see what was happening and careful data collecting (Purnasari, 2021). It was quite diligent, I must say. The team used Structural Equation Modeling (SEM), with Smart-PLS (Partial Least Squares). Harahap wrote about it, you see in 2020. Concept; model, and policy construction consist of particular stages: Structural Equation Modeling (SEM). For validity, each question was judged with the total score per variable. We compare a calculated coefficient to a critical r-table. Data are good for hypothesis work when the R-value exceeds the table value. And if lower, the data, it, will be deemed invalid. Acceptable question items possess a value over 0.30 ($r > 0.30$), says Janna, 2021.Instrument consistency was the key to reliability. With SPSS, the indication of accepted reliability is a Cronbach's Alpha (α) exceeding 0.6. An overview of each included variable was the work of Descriptive statistical analysis. They look at trends, as well as distribution. This gave helpful insight. Structural Equation Modeling (SEM),A causal model examines relationships among variables with SEM, using Smart-PLS. The SEM-PLS model used in this case is set as follows:

Figure 4

SEM-PLS model



The stages of data analysis above are as follows:Measurement model analysis (outer models): Construct reliability and validity; Discriminant validity; Measurement model analysis (inner models): R-Square; F-Square; Hypothesis testing, namely Direct effect; Indirect effect; total effect.

3 LITERATURE REVIEW

3.1 Financial stability

Financial stability is a state where the financial system works well. It includes financial institutions, markets, and intermediaries. This system can absorb shocks from economic issues. These issues can be domestic or global. A stable system makes sure funds flow smoothly. Credit allocation functions, as well as payment mechanisms. All these are key for economic growth, a sustainable kind. When stability decreases, the system weakens. Its ability to channel investment reduces. Also, managing risk gets hard which leads to liquidity problems. There is also, much market uncertainty. Instability can damage investor confidence. This results in capital flight, as well as less lending and weak business. The problem threatens the financial sector. Also it hurts the broader economy

which includes SMEs. These smaller companies depend on outside funds. In contrast, a stable environment helps green projects grow. It supports innovation with managed risks. Policymakers can add sustainability to financial rules. They may include these sustainable goals into investment strategies too. Financial stability becomes both, required as well as, an outcome for a sustainable shift. It prevents risk. Furthermore it builds a system supporting innovation and green goals. It also backs inclusion and environmental plans.In places such as Indonesia, stability is crucial for the economy. Banks, non-bank groups, and capital markets form an ecosystem. This is where policy shocks easily spread. An imbalance somewhere can affect other industries. Consider for example a monetary issue, or even, a credit issue. Agencies like Bank Indonesia and OJK are vital here. They maintain the system through oversight; namely macroprudential and microprudential work. Policies involving liquidity, or maybe sustainability-linked finances are all important. A balanced system encourages investments; also improving financial inclusion for every entrepreneur out there. The system must give a greater feeling of predictability for success. Researches says stable systems fund green ideas more easily. Therefore they offer financing for environmentally friendly actions. Financial stability does not mean equilibrium is important however it gives a capacity in which challenges are met, be them, financial or environmental. In the management scene; a good system would make sure that financial support be monitored, used as, well, efficiently. Financial stability further influences investment behavior particularly in green technology, too. Poor stability, can, erect barriers. It blocks access to vital funding; thereby reducing capital available; for innovative green solutions. Upfront investment are generally expensive so projects must come at an environmental cost; this investment yields; positive results down the line. But investors like to play it safe when the market's volatility is a big issue; which hinders technology development; even limiting different channels and structures in funding mechanisms.A reliable well organized system; allows public sectors to fund the project by enabling sectors to become fully operational to finance digital green innovation by building confidence in long term funding in new emerging new sustainable funding sources. It increases the flow of sustainable financing by enabling; less capital mobilization; and making funds reach projects rapidly which promotes trust and minimize costs.There is an advantage; a system of strategy enabling in this case; that stability is regarded not so much, as, a monetary objective of policy which ensures progress toward all kinds of growth; that all growth could be realized under the economic infrastructure;

an infrastructure like no other because sustainability serves an additional tool by creating the possibility that goals meet policy objectives under those conditions.

3.2 Green financial technology

Green financial technology or Green FinTech is the blend of digital innovation, also it blends sustainable financial practices. It shows the employment of technological progress—such as big data analytics, AI, blockchain, with mobile platforms—for environmentally good financial services plus products. These techs will change the regular financial zone as they help efficiency transparency, or accessibility within sustainability operations. Green FinTech fixes investment to bolster renewal power, also carbon structure schemes; round savings moves get enhanced info along with low value process. SMEs can use FinTech devices to oversee their money management well. Records are very true or marketing growth will expand by online frameworks. By tying digital funds in plus eco law is one thing helps a bridge so both sides will see what is going well; it hits goal with the business works for some. Now there may be trouble hitting targets as needed as you know. According to Afifah (2018), financial engineering offers different work arrangements. Finance gets a leg into enterprises so modern economies see and learn; plus small spots do well now also. I think this is neat. This transformation demonstrates a trade up as profits turn or innovation of cash becomes real and valuable or transformation is environment based. Green FinTech helps bolster fiscal support as pieces mix. The role of Green FinTech for financial power involves many things to look at. First off financial actions become faster. Borrowing from a bank or making information and sharing what the issue is allows someone know where risk happens so things seem obvious as what can happen plus system risk. Second it means access may happen and alternative scoring mechanisms work instead of collateral. Broader people are there and are included inside our business zone and play. As Rahardjo *et al*. (2019) tells; with digital apps SMEs get it easily also borrowing comes along because digital SMEs show boost and business along with work goes by. Green FinTech will help push low carbon things ahead as online ties connect bonds between people as projects are sustainable or stock portfolios go friendly. Now for Indonesia with their technology it shakes normal way. They even think about it! Now standard groups do. For things to do they should have law on their team. Policy support has got to be just the job. Not be too

new as people using tech will see customer power plus have a shield. Green FinTech does become financial; also governance too as plan occurs on sustainability with aims in a path or not. If you manage the things needed as tools, resources are involved by each aspect inside of cycles. From beginning to closing you will watch what needs to have resource sharing plus will notice activity happening also team members will check for good for aims so environment metrics go the right way; no big. This lets SMEs be Eco as normal fiscal duties is right to use it; nor get things done because you ought. Integration may become very swift also as markets grow or Eco trade. Further. Green FinTech builds cut down of overhead; is low cost; plus, it may cut papers along also one learns quickly. They also suggest work together which are fiscal groups and are tech to find things together. To keep pace for innovation Green FinTech makes you understand. Thus, the world benefits; even more if fiscal projects also Eco goal posts strengthen plus everyone shares in; plus, it done with cash. All this way Green Fintech is helpful but even will strengthen all inside plan also use of power of cash also business.

3.3 Green inclusion

Green inclusion is the fair participation of all economic players in sustainable financial systems. It really extends the usual concept of financial inclusion by also integrating environmental awareness. That awareness includes access to finance. It also includes credit distribution and investment practices. Green inclusion is making sure that the good things coming from sustainability-linked finance reach many. These often include micro, small, and medium enterprises especially those in marginalized areas, or maybe even underserved areas. With this approach, businesses can, in fact, use environmentally friendly production methods. They can also handle waste more effectively. Participation in renewable energy programs is now possible. Shen *et al*. (2021) and Ding *et al*. (2024) show, financial inclusion programs; should do much more than provide access to credit. The emphasis needs to be more. on changes that support sustainable habits both on a behavior level and structure level. Therefore, Green Inclusion is also a social and ecological agenda that wants everyone to benefit. In some cases it democratizes green finance. That finance then reaches all kinds of sectors, big and small. Inequality decreases in access to green funds. Also small entrepreneurs have opportunity, and they can take part in climate-conscious markets. Green inclusion helps promote a

varied range of investments, adding to financial stability, and also by reducing dangers to the economy which may come from highly focused unsustainable economic activity. A financial system includes both inclusive green ways. Then, because risks are shared by more actors, that system tends to be resilient. Economic strength is increased by getting more people involved with finances. Furthermore, demand stability, you see, is increased. Economic damage is made less impactful. Suhrab *et al*. (2024) and Sun *et al*. (2022) state, inclusive green systems, stimulate consumption. The result is responsible and constant environmental consideration in the market. Embedding green criteria into lending promotes good ethics and growth. It is possible, by embedding environmental criteria. In the long run these actions contribute positively to economies. Digital transition and, what's more institutional support are very key to implementing Green Inclusion, very well. Digital avenues can bridge information gaps which separate financial lenders with small scale debtors; banking, such as via mobile devices helps provide financial sources across bigger regions to isolated parts. Yang *et al*. (2024) and Tao *et al*. (2023) explain how. Green Inclusion needs policy from the government, but, also private funding, not only that but too; participation from civic organizations to do well. For equality and permanence policy, makers should mix inclusion principles to more complete strategies. FinTech supports continual development by linking access with constant aid such as education. When coupled with FinTech Green Inclusion offers constant aid by merging insight business innovation with financial understanding and with eco awareness. This helps support steadiness, yet at same moment also the roots necessary towards a stronger world mainly concerning places that begin from small base economies.

4 RESULTS AND DISCUSSION

4.1 Results

This section discusses the results obtained during this study.

Table 1

Descriptive Statistical Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
X1.1	100	3.00	5.00	4.1900	.59789
X1.2	100	3.00	5.00	4.1800	.68726
X1.3	100	3.00	5.00	4.0400	.60168
X1.4	100	3.00	5.00	3.7900	.59110
X1.5	100	1.00	5.00	3.9000	.54123
X1.6	100	3.00	5.00	3.8900	.52982
X1.7	100	2.00	5.00	3.8000	.61955
X1.8	100	2.00	5.00	3.8100	.59789
X2.1	100	2.00	5.00	3.7400	.67600
X2.2	100	2.00	5.00	3.7200	.65258
X2.3	100	2.00	5.00	3.8800	.53711
X2.4	100	3.00	5.00	4.1100	.58422
X2.5	100	2.00	5.00	3.6600	.63913
X2.6	100	2.00	5.00	3.8200	.62571
X2.7	100	2.00	5.00	3.8600	.56889
X2.8	100	2.00	5.00	3.8800	.57349
Y.1	100	3.00	5.00	4.2500	.55732
Y.2	100	3.00	5.00	4.1100	.66507
Y.3	100	3.00	5.00	3.9800	.60269
Y.4	100	3.00	5.00	4.0200	.58569
Y.5	100	1.00	5.00	4.0700	.65528
Y.6	100	2.00	5.00	4.0100	.68895
Y.7	100	3.00	5.00	4.0900	.45160
Y.8	100	3.00	5.00	4.1900	.50642
Valid N (listwise)	100				

Source: Data processed in 2024

For Variable X1 (Green Financial Technology), the indicator with the highest mean is X1.1, reflecting the statement that "financial technology contributes to innovation in the financial industry," with a mean value of 4.19. This indicates that most business actors agree that green financial technology fosters innovation in the financial sector. The lowest mean is observed in X1.4, "society understands digital banking systems," with a value of 3.79, suggesting limited understanding among respondents regarding digital banking mechanisms.

For Variable X2 (Green Inclusion), the highest mean value appears in X2.4, "optimal use of funds supports business sustainability," with a mean of 4.11, indicating strong agreement among respondents. Conversely, X2.5, "all business actors experience equal financial access," shows the lowest mean at 3.66, implying disagreement that financial access is evenly distributed.

For Variable Y (Financial Stability), the highest mean value (4.25) corresponds to Y.1, "building a sustainable business requires effective planning from inception to development," showing strong respondent agreement. The lowest mean (3.98) belongs to

Y.3, "sales growth results from financing through green financial technology," suggesting moderate agreement.

4.2 Convergen validity

Convergent validity was assessed using outer loading values. Indicators with outer loadings above 0.7 are considered to demonstrate good convergent validity. Values between 0.5–0.6 are acceptable (Ghozali, 2014). However, indicators below 0.5 are excluded from further analysis.:

Table 2

Outer Loading

Variable	Indicator	Outer Loading
Green Financial Technology (X1)	GFT1	0.77
	GFT2	0.74
	GFT3	0.75
	GFT4	0.51
	GFT5	0.60
	GFT6	0.51
	GFT7	0.60
	GFT8	0.51
Green Inclusion (X2)	GI1	0.47
	GI2	0.47
	GI3	0.67
	GI4	0.61
	GI5	0.52
	GI6	0.67
	GI7	0.78
	GI8	0.78
Financial Stability (Y)	FS1	0.71
	FS2	0.75
	FS3	0.75
	FS4	0.72
	FS5	0.71
	FS6	0.76
	FS7	0.70
	FS8	0.83

Source: Data processed in 2024

Based on the data presented in the table 2 above, it is evident that most indicator variables in this study exhibit outer loading values greater than 0.7, indicating a strong level of convergence with their respective constructs. However, several indicators show outer loading values below 0.7, suggesting a moderate level of association. According to Ghozali (2014), outer loading values ranging between 0.5 and 0.6 are still considered

acceptable and sufficient to meet the criteria for convergent validity. Nevertheless, the data also reveal that a few indicators have outer loading values below 0.5, indicating that not all indicators are valid or appropriate for inclusion in the measurement model. These lower values suggest that certain indicators may not effectively represent the intended construct and therefore should be reconsidered or refined in subsequent analyses to improve the reliability and validity of the model.

4.3 Discriminant validity

Discriminant validity measures the distinctiveness of each construct. The Heterotrait-Monotrait Ratio (HTMT) criterion was used, where values below 0.90 indicate adequate discriminant validity (Juliandi, 2018).

Table 3

Heretroit-Monotrait Ratio (HTMT)

	Heretroit-Monotrait Ratio (HTMT)		
	X1	X2	Y
X1			
X2			
Y	0.87	0.53	

Source: Data processed in 2024

The conclusions derived from the **Heterotrait-Monotrait Ratio (HTMT)** analysis presented in the table above are as follows:

1. For the variable **Green Financial Technology** in relation to **Financial Stability**, the HTMT value is **0.87 < 0.90**, indicating good discriminant validity. This result suggests that the construct is distinct and truly different from other constructs, confirming its uniqueness.

2. For the variable **Green Inclusion** in relation to **Financial Stability**, the HTMT value is **0.53 < 0.90**, which also demonstrates good discriminant validity, signifying that the construct is unique and not overlapping with others.

In addition to observing the **Heterotrait-Monotrait Ratio (HTMT)** values, discriminant validity can also be assessed using another approach, namely the **cross-loading method**. An indicator is considered to meet the criteria for discriminant validity if its loading value on the corresponding variable is higher than its loading values on other

variables (Ghozali, 2014). The following table presents the cross-loading values for each indicator.

Table 4

Cross Loading

Indicator	Green Financial Technology	Green Inclusion	Financial Stability
GFT1	0.77	0.33	0.64
GFT2	0.74	0.28	0.72
GFT3	0.75	0.43	0.51
GFT4	0.51	0.43	0.34
GFT5	0.60	0.54	0.41
GFT6	0.51	0.26	0.30
GFT7	0.22	0.21	0.11
GFT8	0.39	0.39	0.16
GI1	0.25	0.47	0.01
GI2	0.26	0.47	0.01
GI3	0.41	0.67	0.37
GI4	0.49	0.61	0.54
GI5	0.17	0.52	0.13
GI6	0.25	0.67	0.25
GI7	0.52	0.78	0.45
GI8	0.43	0.78	0.45
FS1	0.49	0.24	0.71
FS2	0.61	0.34	0.75
FS3	0.49	0.45	0.75
FS4	0.44	0.37	0.72
FS5	0.55	0.45	0.71
FS6	0.59	0.52	0.76
FS7	0.58	0.50	0.70
FS8	0.65	0.41	0.83

Source: Data processed in 2024

Based on the data presented in the table above, it can be observed that each indicator within the research variables exhibits the highest cross-loading value on its respective construct compared to its loadings on other constructs. These results indicate that the indicators employed in this study demonstrate strong discriminant validity, confirming that each indicator appropriately represents its designated variable.

In addition to evaluating cross-loading values, discriminant validity can also be assessed using another approach—by examining the Average Variance Extracted (AVE) value for each construct. For a model to be considered adequate, the AVE value of each construct must exceed 0.50, indicating that the construct explains more than half of the variance of its observed indicators.

Table 5

Average Variant Extracted

Variable	AVE
Green Financial Technology	0.35
Green Inclusion	0.55
Financial Stability	0.40

Source: Data processed in 2024

4.4 Composite reliability

Composite reliability values greater than 0.6 confirm internal consistency (Juliandi, 2018).

Table 6

Composite Reliability

Variable	Composite Reliability
Green Financial Technology	0.79
Green Inclusion	0.91
Financial Stability	0.84

Source: Data processed in 2024

All variables—Green Financial Technology (0.79), Green Inclusion (0.91), and Financial Stability (0.84) —exceed the minimum threshold, confirming that all constructs are reliable

4.5 Cronbach alpha

Cronbach's Alpha values above 0.7 further validate reliability (Ghozali, 2014).

Table 7

Cronbach Alpha

Variable	Cronbach Alpha
Green Financial Technology	0.71
Green Inclusion	0.88
Financial Stability	0.81

Source: Data processed in 2024

The results—Green Financial Technology (0.71), Green Inclusion (0.88), and Financial Stability (0.81) —confirm strong reliability across all constructs..

4.6 R-Square

The R-Square measures the proportion of variance in endogenous variables explained by exogenous variables. Criteria (Juliandi, 2018):

- 0.75 = Substantial
- 0.50 = Moderate
- 0.25 = Weak

Table 8

R-Square

	R-Square	R-Square Adjusted
Financial Stability	0.59	0.58

Source: Data processed in 2024

The adjusted $R^2 = 0.58$, indicating that Green Financial Technology and Green Inclusion jointly explain 58% of Financial Stability variance. Thus, the model demonstrates strong explanatory power.

4.7 F-Square

The **F^2 effect** size assesses the relative influence of each exogenous variable. According to Cohen (Juliandi, 2018): 0.02 = Small effect,,0.15 = Medium effect,,0.35 = Large effect

Table 9

F-Square

	X1	X2	Y
X1			0.30
X2			0.03
Y			

Source: Data processed in 2024

Findings show that: Green Financial Technology → Financial Stability: **0.30 (moderate to large effect).** Green Inclusion → Financial Stability: **0.03 (small effect)**.

Table 10

Direct Effect

Variable	Original Sample	Sample Mean (M)	Standart Deviation	T-Statictics (|O/STDEV)	P-Values
Green financial technology terhadap financial stability	0.54	0.58	0.13	4.10	0.00
Green inclusion terhadap financial stability	0.15	0.12	0.12	1.23	0.22

Source: Data processed in 2024.

1. Green Financial Technology → Financial Stability: β = **0.54**, p = **0.00 (<0.05)** — positive and significant.
2. Green Inclusion → Financial Stability: β = **0.15**, p = **0.22 (>0.05)** — positive but not significant.

Table 11

Total Effect

	Original Sample	P-Values
Green financial technology -> financial stability	0.62	0.00
Green inclusion -> financial stability	0.15	0.22

Source: Data processed in 2024

1. Green Financial Technology → Financial Stability: 0.62 (p = 0.00).
2. Green Inclusion → Financial Stability: 0.15 (p = 0.22).

Green Financial Technology does indeed have a stronger effect on Financial Stability than Green Inclusion.

Green Financial Technology, is truly an innovative step in the financial world; achieved through the application of modern tech made to improve accessibility, ease, and to be cost effective. Such fresh thinking permits even isolated communities access to fiscal facilities digitally; thus lowering dependence on typical bank methods. Financial Technology also helps provide funding for SMEs, or small businesses, that struggle with older, restrictive loan setups. Effective governing bodies should further aid these SMEs in expanding via environmental friendly methods giving them access to transactional credits with less red tape involved.

The upswing of SMEs adds richly to money gain, what with biz and jobs booming. Many would be biz people though find cash is tight which blocks business spread. A good

plan to knock this hurdle down is to use green including which makes sure folks get even entry to money means, investments and actions promoting green business practices. This research says Green Tech has important and proven good affect for small Deli Serdang groups keeping their wallets solid. With 0.54 path points as well as little doubt indicated through having p measured with only 0.00 showing here too this leads somewhere. This suggests usage with these tech helps with bank account. Amount reaches a value totalling point six two. With solid backup as tech promotes solid trust over things! This outcome is great- value sits nicely thanks adjusted 0.58 hinting mixed efforts with these technologies, including ones for 'greener' aims making up maybe most percentage amount changing stability suggesting good chance! Value, furthermore F measurement registers very nice value. Innovation definitely reigns supreme making those adaptable resilient too in practice especially relevant when guiding such important business strategies towards more eco choices during economic duties which matter overall showing here nicely even making banks, places like networks- even government come near since it would create fairness. Green ideas though should start slow during this phase.

Green inclusion helps out but not very significantly. The p-value sits at about 0.22 showing positive good effects too though insignificant statistically given everything in place- thus the influence seems okay- the effect from an inclusive financial presence hangs mainly since the surroundings do assist more than something specific though; a factor needs noting now here when observing projects in their running. The little f2 points only slight extra help while this inclusion doesn't outweigh the benefits as this digital part shifts for now, even banks like working closely- even country offices! What about projects with how-to ideas? Need we embed those goals too into digital classes policy design too? It then will make that framework ready in organized order. Still even a minor, great affect still shines it isn't at large driving strong SME. Project ideas must get stronger starting early though from larger greener project dreams in works really after such initial good insight too given here right too much which overall may sound though less well explained still should get through, should be simple enough.

Proven facts show these business runs should be ran a solid route leading sustainable good run. In combining tech with this fairness you may wish planning should find its area of money matters through solid number facts too to measure its run here forward- or what projects these solid group reliability brings: Point seven nine-zero- point nine one or numbers should have worth especially during reality given good sense making

business more sensible through distinct ways; each being what's made to mean well or even sound with. Bank accounts become made but through how well someone moves to a nice job- making something eco is well driven though the aim feels good as its given! It feels fair- things could have better accountability. Through running what could give great aid for banks giving some guidance for business with aid and assistance together through solid long run!

Good, fair gains means money saving drives. Digital help systems with AI means a business pays little risks! That leads to banks growing. More demanding marketplace leads great runs. That has what technology steps during all periods since things might change during it all. We could look from Plan –Do; solid assistance together here over solid bank matters so they get fair good assistance now going ahead. Solid tech might aid some projects too during assistance given here now especially being long! From how we see clear aids, banks aren't simply good enough now especially considering long!

Thinking the facts over. Green inclusiveness plays green aide on accounts; an attached scheme matters well in project-plans too or something similar now still through. To put into good solid terms fairness matters so do modern and good business making banks make smart plays forward too, its feasibility might make these policies sound sensible; given what aid gets presented its very mature even by what one makes through how they build what feels nice solid bank aids make accounts now become stable- especially given they're repeated for more eco too from more inclusiveness made to aid them both- since its where it needs to start anyway and its great especially given since banks can change here for much more over time too by all means overall right now at the end it gives ways too even overall at the overall end right as well!.

4.8 Discussion and policy implications

This study underscores the idea. Green FinTech and inclusion need project focus. You want to align tech and eco-goals. SEM-PLS analysis shows Green FinTech has real impact on stability. Green Inclusion also plays a role, but it is indirect. This means digital finance boosts efficiency and supports green finance. The results back up prior research. Studies by Du *et al*. (2023) and Babilla *et al*. (2023) showed how digital finance changes sustainability. So you see, organizing these actions via projects lets you manage, track,

and scale financial changes; SMEs in emerging areas, may gain lasting fiscal strength via project results.

In theory the current work improves project-based finance talks. It unites sustainability, access, and tech within one test model. Applying project ideas to financial change connects company progress, to actually doing green things. Rather, than view financial stability as solid the work shows it changes with project times, partners, and tests. This view lines up with Reisdorf *et al*. (2023) and Flori *et al*. (2024); both noticed digital access and project rule mattered a lot, for lasting social progress. Empirical data now supports. Financial strength for SMEs happens, when projects go well, as well as using tech, that are mutually reinforcing.

For Indonesia other, evolving nations, there is practical guidance from the results, as follows. Because Green FinTech and financial health correlate positively investment in digital structures, plus tough cyber rules, plus fixed eco-measurements become a must. Oversight groups such, as Otoritas Jasa Keuangan (OJK), they might widen their green finance ideas, to include more FinTech features as well as eco-related funding choices. Green Inclusion also matters, urging inclusive thinking about monetary rules guaranteeing SMEs entrepreneurs; run by those who may be overlooked, or women find equal options within durable finance offers. Decision makers may employ project led approaches. Plans, plus targets for assessing both economic returns as well, impact. Managers could really, deploy these project based means into planning their digital and eco friendly, strategies which is where SMEs benefit. You can’t just use tech one time; instead, see linked actions governed by sustainable guidelines. You may structure these things green finances as systems to use as digital money handling sites, software which does e-accounting; plus maybe green micro borrowing and all run under stages like begin-make plans-take action keep a check as you judge. Stages that are happening, as phases that must bring, numbers together touching savings on finance cost, slash likely odds on problems plus watch, over environmental duty to which such phases; Institutionalizes routines. This gives them more agility, shows clearer resourcing as well gains more party reliance as one views endurance. Its shows it cannot, have an obligation by external rule though one built into team project outlook and culture.

The wide scope regarding strategy also matters too as those nations put more effort to fulfill the SDGs--mostly to support SDG targets 8, plus also nine and most prominently 13. Green FinTech joined into main plans as Sustainable plans do get helped for that

changing one by more inclusive, low footprint banking structure by inclusion via the tech driven world. To face all struggles involved; both governments along with firms tech people or think tanks those who put together fundings of it. It makes sense; also givers together validated ways starting studies may lead on assessing lasting good SME plan making efforts have toward project efforts made. Therefore embedding routines those, mentioned toward money use as with plans overall does make societies overall those either near from nations all may come that banking system which builds up toward strength equity also responsible environmentally forward through finances. The **Key Policy Implications**

1. **Institutionalization of Project-Based Governance** – Integrate project management methodologies in digital finance and inclusion programs to enhance accountability and performance measurement.
2. **Regulatory Support for Green FinTech** – Develop adaptive regulatory frameworks that promote technological innovation while ensuring environmental compliance.
3. **Inclusive Financing for SMEs** – Expand digital access to sustainable financing instruments for underrepresented SME groups through targeted inclusion projects.
4. **Capacity Building and Literacy Enhancement** – Implement continuous digital literacy and project management training for SME owners to ensure sustainable adoption.

Cross-Sector Collaboration Platforms – Encourage partnerships between government, FinTech companies, and green investors to foster innovation, knowledge transfer, and financial resilience

5 CONCLUSION

This study determines, therefore, that integrating green financial technology along with green inclusion within project management frameworks really does enhance the financial resilience of SMEs. This is an interesting find. The SEM-PLS results showed that Green Financial Technology significantly improves financial stability. Green Inclusion does, too. Although it is less substantially influential. The model's adjusted R^2 value of 0.58 indicates a pretty strong explanatory power. It definitely confirms, that sustainable finance plus digital innovation strengthens SME performance together. The

research has great contributions. Theoretically; it redefines financial stability as a project-based outcome that can be achieved, via structured planning; stakeholder coordination, and continuous improvement initiatives. Practically it offers; you know, a roadmap for policymakers' financial institutions and SME managers. They may align green finance initiatives with project governance principles—ensuring, of course, that digital transformation, as well as sustainability goals are measurable and also integrated. Future studies must consider the expansion of this particular framework across different regions. Various industries may benefit from that too. Maybe the researchers will even incorporate qualitative or mixed-method approaches. Behavioral as well as cultural factors which influence the uptake of technology and inclusion, should also be captured. Maybe exploring a couple more variables might assist. Variables like, digital literacy, or even regulatory readiness, plus organizational culture, may enrich this cool model even further. To sum up this excellent analysis, this particular research establishes that project-oriented implementation regarding Green FinTech including Green Inclusion is helpful. It does this to promotes operational efficiency. Inclusive access too. You know; there is also long-term sustainability. All of those things. These findings are quite amazing! They offer, essentially, an adaptable also practical framework, for erecting and constructing a resilient as well as environmentally responsible financial ecosystem in various emerging economies.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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