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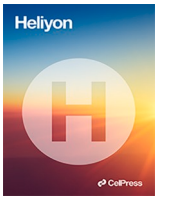

Community participation as a premise for *hangwurian* city development in North Central Nigeria

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ABSTRACT

The Hangwurian City Development Model evolved to create a linkage within the concepts of environmental awareness, urban governance, and management. Others are sustainable urban development, urban liveability, and inclusive physical development. These were measured from various indicators ranging from population, environmental knowledge, economic prosperity, quality of life, and safety. The research sorts the critical objective of analysing the significant level of the indicator variables'; and determine the predictive relevance of the indicator variables. The exploratory research employed the partial least square using SmartPLS to evaluate the variables, collecting quantitative data through the open data tool kit from three selected cities of Lokoja, Minna, and Lafia in North-Central Nigeria. The research sampled 399 respondents across the cities randomly selected amongst residents aged 18 years and more reliably targeted household heads as the unit of measurement is the household. The research findings show that most of the examined variables have Cronbach's Alpha above 0.7, and most of the retained variables have a significant value of greater or equal to 0.7. The average variance of the indicators where very substantial as most were within the 0.5 to 0.6 band. Most of the evaluated indicators have a significant performance index of between 50 and 65 %. The research recommended that this model be applied as a procedural model to guide city development at a regional scale. Hence, it was concluded that for city development to occur and evolve without ills which Hangwurian city development stands for, it must be viewed from the path linkage and significance of environment, governance, sustainability, liveability, and inclusion.

1. Introduction

The ideological linkage between environmental awareness and urban governance is measured from environmental knowledge and motivation/value as indicators for environmental awareness. In contrast, population management, family planning, credit facilities, information flow, amongst others taken as indicators of urban governance. These indicators when effectively synthesised, hold power to balance the tide of development flow amongst the triad of Sustainable urban development measured on the tripod of economic prosperity, social cohesion, and environmental consideration. Urban Liveability is measured through the quality of life of residents, creating liveable communities and enhancing place-shaping while, not neglecting the need for inclusion on all components within the city system. Inclusion was measured from the periscope of creation of safe living, working, playing urban environment, building

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resilient infrastructure, and ensuring equity/justice amongst the various elements of the urban system.

The environmental movement has developed a sustainable development paradigm. In line with its objectives, one must ensure that current needs are met without sacrificing the potential for future generations. Sustainable infrastructure development incorporates the principles of sustainable development. National governments have adopted it as an agenda in recent years, which has impacted global growth. Environmental limits are a necessary component of sustainable growth. However, governments around the world have emphasised the need to meeting everyone's fundamental necessities through the sustainable development agenda, regardless of wealth. Boswell and Hawker [1] define sustainable development as fulfilling four goals simultaneously: appropriate protection of the environment and resource conservation; social advancement that respects the needs of everyone; and safe and stable economic growth that supports employment. [2], concept of sustainable development is one of the most significant contributions of the twentieth century. The most comprehensive definition of sustainable development considers economic, environmental, and social equity [3–5]. Infrastructure is necessary. It is often regarded as the physical assets that serve a country, region, or territory, such as transportation and communication infrastructure, power plants, and schools [6]. Administrative management is one example of a non-physical aspect of infrastructure.

For anything to be long-lasting, it must be able to survive certain circumstances. Environmentally and economically sustainable infrastructure is commonly referred to as sustainable infrastructure [6]. The term "sustainability" does not have an "all-inclusive" definition. Combining the phrases "sustainability" with "growth," you might get a broader sense of the concept. However [7], believe that development is a matter of enhancing the material well-being of all people, but they reject the idea that progress is pluralistic. Infrastructure development is critical in every civilisation and should be supported possible. Making infrastructure sustainable means improving how it is constructed to meet people's current needs and decreasing its environmental impact in the future. To maintain economic growth, policymakers must build infrastructure according to green policies.

The "Movement for Democracy, Justice, and Sustainability" push for policy reform based on community input. Public participation is key to fair representation and economic development in a modern metropolitan region [1,8,9]. If a neighbourhood group is active in planning and implementing a community strategy, it is more likely to develop an effective plan that successfully represents community members' needs, expectations, and ambitions [10–12]. The unrepresented voices of traditionally voiceless communities are crucial to achieving equality, efficiency, and sustainability. However, low, and oppressed groups' involvement is frequently stifled in a politically consolidated society where collective input often amounts to little more than tokenism. Therefore, is it necessary to involve the poor and minorities in the central bureaucratic and political structures programs, hence the clamour for Citizen Engagement or participation in infrastructure provision and conceptualisation of development?'

Research shows that community involvement in urban planning can bring together facts, experience, and skills to improve outcomes [13–15]. It can achieve participants' mutual learning and personal growth [14,15], generate consensus on policies, and increase implementation [15]. By targeting implementation and planning challenges, the participation of critical stakeholders enhances the accuracy and renders it more democratic [16]. However, in developing countries like Nigeria in sub-Saharan Africa, influential politicians, senior bureaucrats, and professional planners are dominated by planning processes concerned with predetermined priorities, targets, time frames, and short-term economic goals. Public associations are invited to speak without considering their members' interests and wishes. Participation is a mechanism in which stakeholders are interested in development decisions and decisions that concern them. If the disadvantaged are permitted to help create services to better their lives, they will miss any action's potential future benefits. Ofoku [17] defines involvement as participating actively but not necessarily in community decisions, awareness of local issues, attendance at public meetings, and related efforts to influence proposed initiatives through individual and group acts, membership in organisations, and committees' financial contributions toward community programs.

Participation in the community refers to how citizens can influence state policies. Changing the power dynamics in tourism planning and development requires community stakeholders [18]. The city's daily economic and social life does not revolve solely around tourism [19]. Many people do not realise how vital their city or neighbourhood is. Policy scholars turn to community involvement in their research to gain access to community leadership, citizenship, and organisation [20]. With eight rungs that depend on the source, this widely debated metaphor distinguishes between different levels of engagement, from authoritarian consultation to collective citizen power. The public has a right to be informed about any development activities that impact directly on their lives and participate in the decision-making process that directly impacts their daily lives and places of employment. A more flexible framework for meeting the diverse needs of the community's members would be created with the involvement of people from various interest groups [21].

Social-environmental metrics are no longer sufficient for city officials and planners. The ability of a city's residents to coexist in harmony within its confines is a crucial component of urban liveability. The idea remains an exclusive philosophy without a thorough examination of a shared experience of struggle or knowledge. Critics of urban liveability point out that the term has been used primarily to describe the city's situation rather than the quality of life [22,23]. Despite their importance, governance and citizenry issues are frequently left out of the public conversation. The lack of public discussion on the importance of a place's liveability and how it affects the political climate. Study after study has shown that the state and local governments' lack of communication and inability to incorporate urban poor residents' perspectives has not been beneficial to the city's urban poor [24–26].

[27] noted that liveability is associated with the wishes and contentment of an individual or group of individuals with living in each environment. There is no uniform definition of "liveability" [28]. Living in a particular location directly impacts how people define what it means to have a good quality of life. Vine's philosophy of everyday life is used to interpret the concept of "liveability." Due to an emphasis on individualism, democracy, and the nuclear family, Australia has seen a deterioration in its place-based culture in recent years [29]. However, social division and segregation, consumerism, and the rise of a postmodern community, as well as increased physical and social mobility, a more comprehensive range of job opportunities, educational opportunities, and housing options, have

all occurred because of technological advancements today [30].

In the wake of these technological advancements, it has become more accessible for people to build support networks [31]. They have been chipping away at the spatial foundation of the community, which was established over time through meaningful interactions with the immediate surroundings [32]. Because of this, according to Ref. [33], a "place for community" has been lost. So, what does this mean for the planning and implementation of liveable communities? The ability of a city to support human habitation has a significant impact on urban quality of life. [2], presentation included quantitative and subjective indexes of urban liveability, which he discussed. Depending on the individual's needs, these categories may include geographic location, size, and domain specialisations.

Depending on the context in which "community engagement" has been used, the term has a different meaning. All four of these terms are used interchangeably in the literature as synonyms for community participation which is a term that has been around for a long time [34,35]. Furthermore, concepts like social inclusion include community involvement in their definitions [36]. Participation, involvement, and integration all fall under community engagement. People take on a greater sense of personal and societal accountability when they get involved in their local communities [37–39].

Fundamental rights and concepts underpin requests for services. As stated in Article 27 of the Universal Declaration of Human Rights and Article 25 of the International Covenant on Civil and Political Rights, citizens can participate in public affairs and decision-making processes [40]. When problems are viewed as "violations," they are no longer "problems" but rather "violations," which are neither inevitable nor acceptable [41].

A centralised governance system with over concentration of authority at a centre often harms civic engagement and public life as a result excessive central power [42,43]. As a result of colonial rule, communities in emerging countries could not participate in decision-making, but the infrastructure was still restricted. Because the colonial administration was far away, there were early rallies and activities for human rights even before the Universal Declaration of Human Rights was created. A further consequence of the 'professionalisation' of infrastructure construction was the separation of the project from the local community through the employment of project managers, architects, and other professionals. Civil engineers and architects considered communities ill-equipped to participate meaningfully, distancing themselves from them. While professionalisation aimed to improve infrastructure, it excluded input from those who would use that infrastructure [44]. Increased demand for services and a higher standard of living are two benefits that might result from community involvement in infrastructure development. Citizens' culture, acceptability, and overall perception are strongly influenced by the ties they form due to their involvement in their social and civic affairs [45,46]. For this reason, a new paradigm shift in urban thinking is needed to bring about a city free of worries by examining the complex interconnections and tensions between these disparate concepts, concepts such as sustainable consumption patterns, equitable access to the city, and equity within the city.

This research sort to promote a development paradigm which is cities without worries also known as the *Hangwurian City Development (HCD)*. A new paradigm in urban development which acknowledges the variations and strengths in a particular environment to promote its unique development. Fig. 1 depicts a path connectivity map of the *Hangwurian Model*. The term *Hangwurian* is derived from *Hangwelani a Venda word in South Africa* which means 'Forgiveness'. The idea of this novel concept is to evolve urban development model that is devoid of acrimonies and the various urban worries inherent in the city system in Africa. The basic idea is to ensure that urban development is conceptualised in line with the strength, weaknesses, opportunities, and threats inherent in the environment which is under development focus. The development path of the *Hangwurian Model* is shown in Fig. 1. This paradigm change is the driving force behind the *Hangwurian city*, which aims to create a city free of ills through three key metrics. It is a city where everyone has equal access to the city's natural and artificial resources, ensuring that no one's space is violated by a regulated consumption pattern for urban resources in natural and man-made forms [47]. Consumption patterns, access to the urban environment, and social fairness.

Africa's cities can benefit from a paradigm shift in development focus which argues that policymakers and urban gatekeepers—promote development at a reasonable pace of resource availability while increasing development acceptability, which are points of tension in the African city system [48]. This study aims to evaluate the HCD paradigm in north-central Nigeria. Among the research's most important goals are to examine the significance levels of various indicator variables, determine the predictive value of various indicators, and determine the importance-performance index of HCD's evolved variables.

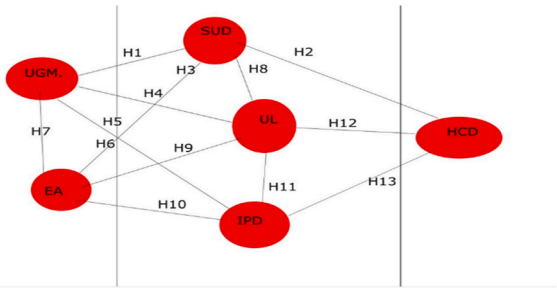

Fig. 1. *Hangwurian* city development path diagram.
Source: Author's Simulation

2. Methodology

This study involves collection of necessary data and the proposition of model for the analysis of the Hangwurian city development plan. The data was collected in the three purposively selected cities in North Central Nigeria because of their similarities of being the state capital and seat of government. The capital cities in Africa always enjoy huge government investment at the detriments of other parts of the state. This research employs a quantitative research approach through a simple random sampling method to obtain primary research data through questionnaire survey and administration.

The data for the study was obtained through two sources. The primary data was obtained through physical observation to see the development over time in the selected cities. Also, there was administration of questionnaire to different urban infrastructure used for the study (Health facilities, educational facilities, Recreational facilities, Commercial facilities, Transportation facilities and Security facilities). The secondary data was obtained from secondary sources such as journal articles, textbooks, internet materials, government documents and gazettes and other relevant materials.

The sample frame for the research was obtained from the Nigerian National Population Census figure of 1991. The Census figure was adopted because of the period of research that span between 2001 and 2020. Despite that the Census was conducted in 2006, it does not fit in into the first 10 years of the study. The figure was then projected by 3.2 annual growth rate (National Population Commission [NPC] [49]). The household population was estimated at 6 people per household which form the basis for the population of the study area as presented in Table 1.

The total number of samples was obtained through formula of

$$Ss = \frac{N}{1 + N(e)^2}$$

Where N is the total Population.

e is the exponential a (0.05)

The total sample for the study is therefore 399 households which are distributed based on the proportion of the population as shown in Table 2.

The analysis of the sample size based on equal proportionality indicated that 174, 166 and 59 questionnaires were administered in each of the state respectively. Systematic random sampling was adopted for the study to be able to obtain necessary data from all section of the selected cities. The cities were divided into different sections based on the known delineation of the cities politically.

Further analysis was carried out using Hangwurian City Development Plan. The model aimed to create a criterion for measuring sustainability capacities of cities. This model assume that cities can be devoid of ills through key metrics. The model opined that a city supposed to be where everyone has equal access to the city's natural and man-made resources, ensuring that no one's space is violated by a regulated consumption pattern for urban resources in both natural and man-made forms [47]. Consumption patterns, access to the urban environment, and social fairness define what it means to live in Hangwurian city. It is a Venda name for "city without worries or acrimonies." Africa's cities can benefit from a paradigm shift in development focus that focuses on the policymakers and urban gatekeepers—promote development at a reasonable pace of resource availability while increasing development acceptability, which are points of tension in the African city system [48]. This study aims to evaluate the HCD paradigm in north-central Nigeria. Among the research's most important goals are to examine the significance levels of various indicator variables, determine the predictive value of various indicators, and determine the importance-performance index of HCD's evolved variables.

2.1. Hangwurian City Model assumptions

This model is set to achieve developments in the city premised on six (6) essential assumptions:

i. City development must emanate from the prism of environmental awareness and urban governance and management;
ii. Environmental awareness is measured through environmental knowledge, motivations, and value;
iii. Urban governance and management must be measured from the prism of Credit facilities, population management, family planning, hospital network system;
iv. There must be a balance between sustainable development, urban liveability, and inclusive physical development;

Table 1
Sample frame structure for the research.

S/No	STATE	CITY	1991 Census Figure	Projected Population 1991–2001	Projected Population 2002–2012	Projected Population 2013–2019	Number of Households = total population/6
1	Nasarawa	Lafia	240,656	329,756	451,845	563,315	93,996
2	Niger	Minna	230,169	315,387	432143	538748	89,791
3	Kogi	Lokoja	82,483	113,018	154,857	193,060	32,177
	Total		**553, 308**	**758,161**	**1,038,845**	**1,295,123**	**215,964**

Source: Author's modification of 1991 census figure, 2022

Table 2
Sample Size for the study.

City	Household Population	Proportion	Sample Size
Lafia	93,996	43.5	174
Minna	89,791	41.6	166
Lokoja	32,177	14.9	59
Total	**215,964**	**100.0**	**399**

Source: Author's Estimate

v. The three concepts must be measured through economic prosperity, environmental considerations, and social cohesion for sustainable urban development; liveable communities, quality of life, and place-shaping for urban liveability; and for inclusive physical development indicators for measurement must be safety, resilience, and equity/justice; and
vi. The New order (Hangwurian Model) must be measured from indicators of consumption patterns, access to the city, and equity.

2.2. Hangwurian City Model measurement

The Hangwurian City Model Measurement **was** determined using Exploratory Factor Analysis. The Factor Analysis was used to determine the indicators of city's sustainability. The Factor Analysis retained variables for the six (6) latent variables in the model include: Urban Liveability (URL), Sustainable Urban Development (SUD), Inclusive Physical Development (IPD), Environmental Awareness (EA), Urban Governance (UMG), and Hangwurian City Development (HCD). For URL construct, fifteen indicators were retained; ten were identified for SUD, and sixteen were retained for IPD. Also, eleven indicators were retained for EA, twenty-two indicators were retained for urban management and governance, and fourteen indicators were retained for HCD. The following criteria must be examined when evaluating the measurement model based on the PLS results: Indicators of reliability, convergent and discriminant validity, convergent and convergent validity, and internal consistency.

The analysis of the Cronbach's Alpha Level of 0.7 was attained by nearly all the indicators. This exploratory study, which relied on factor loading squared agrees with the study of [50]. This is presented in Appendix I. The significance levels were higher than 0.4, which was considered the minimum for this type of exploratory research [51]. A composite reliability value for latent components ranging from 0.824 to 0.925 exceeded the model's acceptable cut-off of 0.70 for individual internal consistency. Thus, the measurement model's composite items had a high internal consistency. When evaluating the model's convergent validity, AVE found values greater than or equal to 0.5, as shown in Table 2, which concur with the positions of [52].

2.3. Data analysis and results

Utilising SmartPLS version 3.0 software, the theoretical paths described in this research [53] are investigated based on PLS analysis results. In this section PLS (a structural equation modelling technique) can be used to find standard regression coefficients for the paths connecting components [54]. PLS can show formative and reflective latent variables with the least-squares estimate technique, making it ideal for this study [55]. Because it is a component-based method, the sample size and residual distributions are only limited [56,57].

Researchers can conduct simultaneous modelling and evaluation of structural models using PLS-SEM [57]. This research being an exploratory study means putting various theories to the test, which is a critical measure in developing a new paradigm and helping to identify the impact of common biases on the adopted approach to a problem [58]. Researchers have widely adopted this method [57, 59,60].

2.4. Structural model results

Before forming the reliability and validity of the construct measures, it is time to evaluate the hypotheses based on the results of the built structural model. Path coefficients were interpreted as normalised beta weights in a PLS model regression analysis. To estimate the coefficients of the paths, partial least squares regression is used to estimate. According to Refs. [60,61] noted a necessity to check the model for collinearity. There is a possibility that collinearity in these results could be construed as bias, according to Ref. [59]. As a result, to determine if there is collinearity between the constructs, we took the same approach as [60,62]. Exogenous latent variables (EA, UMG, SUD, URL, and IPD) were employed as independent variables in multiple regression to test for collinearity issues in the inner model. The dependent variable, on the other hand, was Hangwurian City Development.

3. Results of the analysis

3.1. Hangwurian Model path coefficient

Path coefficients were interpreted as normalised beta weights in a PLS model regression analysis. However, the model was examined for collinearity by Refs. [60,61] because the calculation of path coefficients is based on Partial Least Squares regressions. There is a possibility that collinearity in these results could be construed as bias, according to Ref. [59]. As a result, to determine if there is collinearity between the constructs, we took the same approach as [60,62]. Latent variable scores were used as input for

multiple regression in which the exogenous latent variables were generated as independent variables to examine collinearity issues of the inner model.

As an alternative, HCD served as the dependent variable in this experiment. Fig. 2 depicts the link between the numerous exogenous latent factors and their impact on the dependent variable HCD. We found that environmental awareness (EA), urban management and governance (UMG), as well as the city's ability to live comfortably, as well as the city's ability to develop sustainably all, had a positive and relevant impact on Hangwurian City Development (HCD) (HCD). The paths were analysed from the EA to HCD and the UMG to HCD.

It was found that the hypothesised path Access to the City (ATC) to HCD (ATC – HCD: Path = 0.925; t = 299.267; p0.000) supported the hypothesised path; consumption patterns to HCD (CSP – HCD: Path = 0.631; t = 30.621; p0.000) and the hypothesised path Equity (EQY) to HCD (EQY – HCD: Path = 0.858; t = 85.662; p0.000) also supported the hypothesised path. Fig. 2 demonstrate the hypothesised routes for Hangwurian City Development and its endogenous latent variables Appendix II. This path and its endogenous factors represent the first three theorised routes for HCD. In addition, the path coefficient, T-statistics, and *P*-value for each of the exogenous and endogenous variables are shown in the Table. Hence, all these pathways were rejected because of the path coefficients for the exogenous latent variables in North Central Nigeria that provide an alternate hypothesis to the null hypothesis.

Author's Analysis (2021)

3.2. Analysing predictive relevance (Q^2)

According to Refs. [63,64], the predictive relevance Q was used to evaluate the research model's ability to forecast. Q2 was determined via a blindfolding process. Predictive relevance is indicated by a Q2 greater than zero, while predictive relevance is indicated by an inferior Q^2 [59]. There is a low correlation between exogenous and endogenous constructs when the coefficients are 0.02, 0.15, and 0.35, respectively [59]. They explain that significant results for the coefficient of determination and medium predictive relevance provide enough statistical support to validate the model fit in Ref. [65].

Next, the predictive capacity of endogenous latent variables was investigated, with results displayed in Appendix III and Fig. 3 (see below). As reported by Ref. [57], the R2 values of the structural model are acceptable because they are greater than the recommended threshold of 10 %: Credit Facilities (CRF R2 = 94.2 %), Economic Prosperity (ECP R2 = 79.8 %), Environmental (ENV R2 = 72.5 %), Equity (EQY R2 = 73.6 %), Liveable Communities (LVC R2 = 58.8 %), Consumption Pattern (CSP R2 = 72.3 %). Table 3 and Fig. 3 list the R2 values for each endogenous variable and the accompanying predictive relevance Q^2.

3.3. Predictive relevance of the endogenous variables

As shown in Table 3, the predictive relevance of (Q^2) of the endogenous variables ranged from values 0 to values greater than >0 as benchmarked by Ref. [60] in his use of blindfolding to determine the predictive relevance of both exogenous and endogenous variables of the model construct, which was based on the blindfolding method. The result of the 17 variables considered in the Hangwurian City

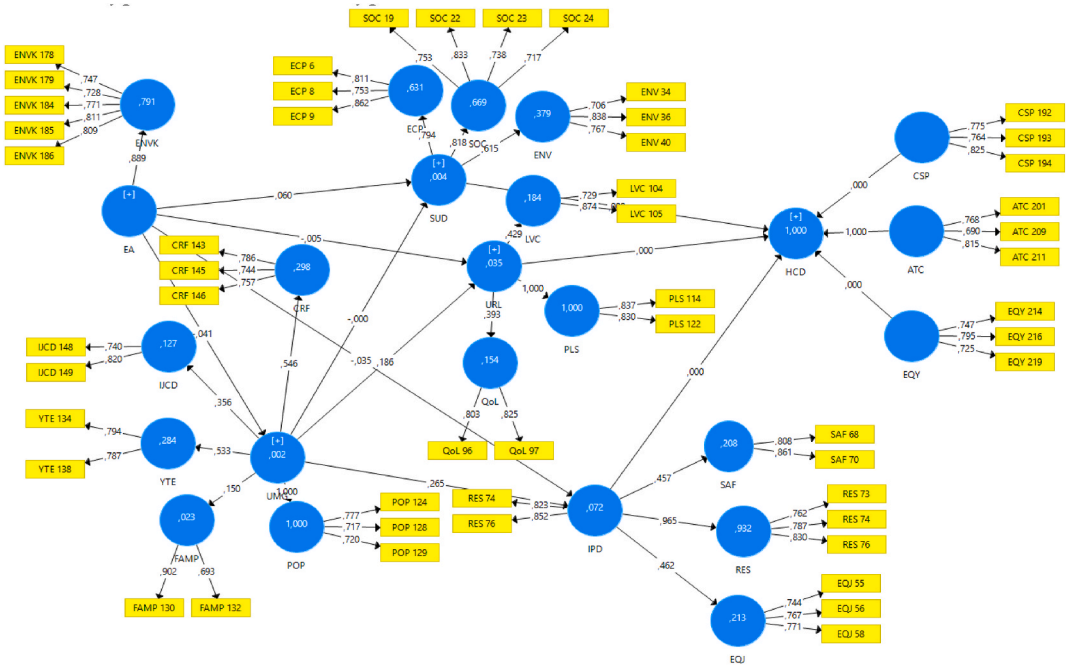

Fig. 2. Path coefficient and analysis.

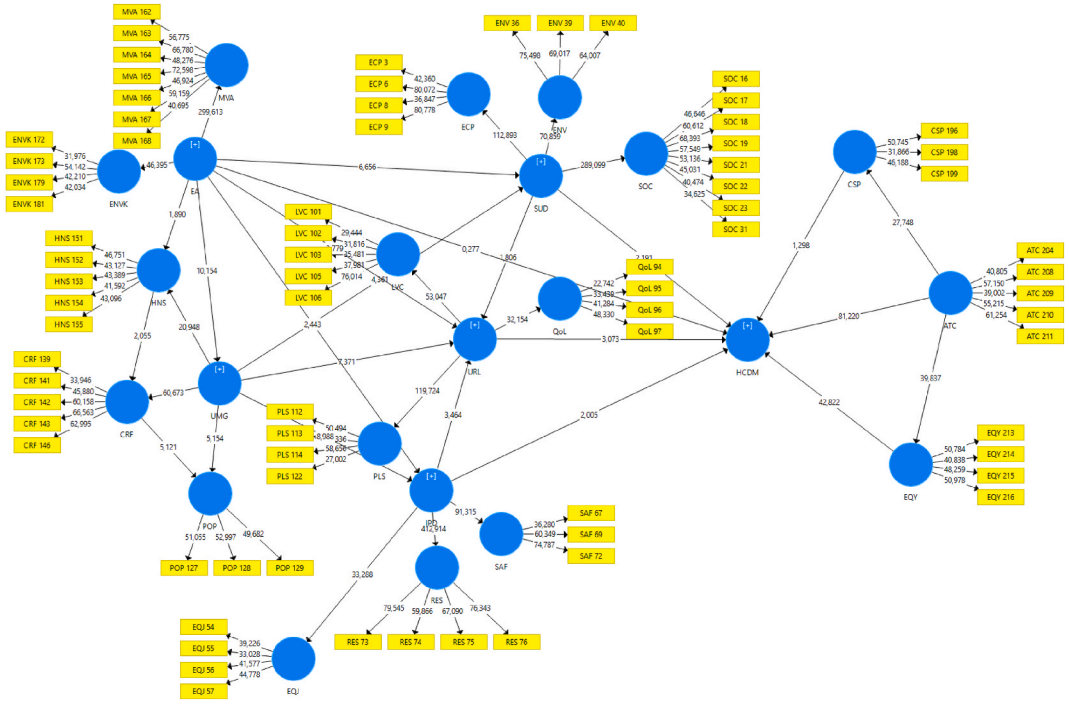

Fig. 3. Structural model analysis.
Source: Author's Analysis (2021)

Table 3
Predictive relevance analysis.

Indicator Label	R^2 Result of Coefficient of Determinant
CRF	0.942
ATC	0.911
EMVK	0.909
RES	0.907
MVA	0.903
SOC	0.900
ECP	0.798
PLS	0.751
SAF	0.739
EQY	0.736
EVT	0.725
QoL	0.625
LVC	0.588
EQJ	0.453
POP	0.403
CSP	0.399
HNS	0.309

Source: Author's Analysis, 2022

Model ranges between 0.309 and 0.942 suggesting that the model constructs' endogenous variables have predictive relevance that supports the structural model's predictive relevance. The positive values of endogenous variable predictability indicate an increase in prediction direction. Detail of the analysis is presented in Appendix III.

4. Discussion of the analysis

The predictive relevance Q^2 was used to evaluate the research model's forecasting capability, according to Duarte and Raposo [63] and Götz and Liehr-Gobbers [64]. Q^2 was determined using a blindfolded method. A Q^2 greater than zero indicates predictive relevance, whereas a Q^2lower than zero indicates predictive relevance [59]. A low level of correlation between external and internal variables is found when the respective coefficients are 0.02, 0.15, and 0.35 [59]. The questions of significance of results for the coefficient of determination and predictive relevance were evaluated on the premise of the assumptions [65]. Credit facilities are critical

components of livelihood development when analyzing the human development component of the urban space [66]. Several studies have looked at the lending rates of banks and how external lending contributes significantly to the economic viability of the urban space [8,67,68]. It is also noted as affirmed by Ref. [41] that, the lending of foreign banks exhibits a strong and positive association with the economic growth of cities, when appraising the development of emerging economic giant. This therefore indicates that credit facilities and rate of cash flow within the urban economic landscape is a very important component of urban development which gives credit to the Hangwurian development model which has one of its sub-construct as credit facilities and its availability within the urban space [22,15,and38]]. The credit facilities is also clearly related to the economic development of the city. The economic component of the city which gives credit also to the sustainable development subcomponent of the Hangwurian city development.

The indicators of economic development were also considered to be significance in their prediction of the development of the Hangwurian city [17]. [24] noted that technological changes and improved electronic communications seem, paradoxically, to be making cities more, rather than less, important. Therefore, is a strong correlation between urbanization and economic development across countries, and within-country evidence suggests that productivity rises in dense agglomerations [10]. But urban economic advantages are often offset by the perennial urban curses of crime, congestion and contagious disease [9]. The past history of the developed world suggests that these problems require more capable governments that use a combination of economic solutions [21]. Though the scope of urban challenges can make remaining rural seem attractive, agrarian poverty has typically also been quite costly [24]. It therefore follows that if the urban space will be competitive, economic development must be accelerated in order to enhance quality of life of the urban residents.

The Hangwurian model also requires articulating the goals of economic development and defining quality of life [63]. It is also indicative that the index of quality of life is substantive conception of development [57]. Additionally, the quality of life index is positively correlated with both economic prosperity and an individual's desire to reside in areas that offer higher levels of development and quality of life.

Scenario analysis can provide a more meaningful theoretical basis and decision reference for balancing economic development and ecological conservation and, therefore, has received increasing attention in urban research. For example [69], constructed several scenarios covering policy and climate change, including the one-child policy and carbon tax policy, and projected the land use distribution under various scenarios, which evaluated impacts on carbon sequestration, soil conservation, and water yields. Based on the aesthetic value and the recreation value of nature reserves [20], combine social and natural factors from the perspective of ES and select priority protected areas by comparing conservation efficiency under multiple scenarios. Medayese et al. [45] used an artificial neural network model to analyze the land use changes in the city of Minna and ecosystem service values, noting that Minna in 2029 under the current urban spatial change model will witness a more significant consumption of ecological space thereby tilting the sustainability imbalance of the urban space. This therefore gives credit to the environmental preservation and management as an indicator considered significant in the Hangwurian city development.

The co-benefits of urban liveability for the economy, social inclusion, environmental and social sustainability, and public health are now well recognized by all levels of government and these are significantly appreciated in the Hangwurian city development model [70]. Liveable communities are safe, socially cohesive and inclusive, and environmentally sustainable [3]. They have affordable housing that is linked (via public transport, walking and cycling infrastructure) to employment; education; shops and services; public open space; and social, cultural and recreational opportunities. The Hangwurian city development model assesses the availability and implementation of policies governing characteristics of cities that can contribute to creating liveable communities.

According to Ref. [71], sustainable development emerges from the natural capital aligning with the term of production as an essential factor. They created a procedure that represents critical natural capital requirements of a defined economy or population in terms of the corresponding ecologically productive areas called 'ecological footprint', i.e. [71], consider the fluxes of matter and energy into and out of any specified economy and converts them into the matching natural land and water areas needed to support those flows. Thus, ecological footprint [6] measures the area of biologically productive land and water that an individual, a population, or an activity needs to produce, all the resources they consume, and the generated waste they absorb using technology and management practices resources. The idea of environmental dimension or the ecological footprint of any development is a very critical indicator of the hangwurian development model. The model prioritizes efficient and sustainable use of the environmental resources without compromise on the environment. Contemporary socio-environmental issues such as reduced natural resource availability, biodiversity loss, soil degradation, pollution, unprecedented population growth, mass migration to cities, and urban sprawl may be linked to the consequences of an economic infinite growth paradigm on a finite planet. Despite international goals to improve spatial and environmental management, current and future developments are constantly planned without regard for biophysical growth limits.

The outcome of this research was substantially significant, as posited in earlier research. This understanding established that the indicators of the Hangwurian city development are adjudged to predict the outcome of the model on evaluation significantly. Subsequently, the predictive power and relevance of endogenous latent variables and structural model linkages were assessed [57]. found that the following R^2 values for the structural model exceeded the recommended threshold of 10 %: Credit Facilities (CRF $R^2 = 94.2$ %), Economic Prosperity (ECP $R^2 = 79.8$ %), Environmental Equity (EQY $R^2 = 73.6$ %), Liveable Communities (LVC $R^2 = 58.8$ %), and Consumption Pattern (CSP $R^2 = 72.3$ %). Therefore, the research was able to carefully compute the R^2 values, which is the predictive power of the indicators of the endogenous constructs of the model and presented.

It was found that the predictive relevance of (Q^2) ranged from zero to greater than zero. In contrast, the predictive relevance of (R^2) for exogenous latent variables was substantial [57]. From −0.013 to +0.699, the predictive relevance of endogenous model constructs supported the structural model's relevance. Endogenous variables with a positive predictive relevance value indicate an increase in the predictive relevance of endogenous model constructs.

5. Recommendations

It is clear from the study's predictive relevance Q^2 [63,64] that the research variables for the constructs and sub-constructs can indeed predict. It was shown that the predictive model Q^2 has predictive relevance greater than 0, indicating that model variables can accurately foretell model variables themselves. In keeping with the ideals of achieving urban development without worries which is the notion of the Hangwurian City, it is expedient to view these development in the following context:

- Urban development must be viewed from the stand point of environmental consumption and urban management and governance. These idea must be approached from the standpoint of environmental knowledge and environmental value, while the urban governance and management must be all encompassing involving planning from the smallest unit of the society which involves family planning for management of urban population growth which has a direct impact on the rate of environmental consumption, moderation and provision of credit facility to ensure a competitive economic space, adequate population management in terms of inflow and outflow of migrants and adequate healthcare system which provides enabling environment from proper exhibition of individual potentials and abilities.
- The Hangwurian development of the city must also consider the tripartite ideal of sustainability which must ensure that economic prosperity is assured for all citizens since it is a predictor which is also considered significant in the model, environmental protection and ensuring that the social space is harnessed not only for the human elements but also for the various species that makes up the social ecosystem for requisite balance. The second ideal for the second layer measurement of the hangwurian city is the question of urban liveability, hence, it is recommended that liveability must be placed as priority where Quality of life, liveable communities and place making which are part of the important indicators which predicts the Hangwurian city must be prioritised. Finally, these development must ensure that every elements of the social space are included for a balanced eco-system. In order to achieve these, equity/justice must be a priority for all, the city space must be modified in such a manner that it provides safety for all and also engender resilience such that infrastructure are provided which can stand the test of certain human and naturally induced disasters.

As a result of the above mentioned facts, it is advised that the model's predictive power be used to anticipate the outcome of Hangwurian city growth and its variables, as most of the indicator variables have a predictive power of above 0.35, which is large according to the literature in this area. As reported by Ref. [57]: Credit Facilities (CRF R2 = 94.2%), Economic Prosperity (ECP R2 = 79.8 %), Environmental (ENV R2 = 72.5 %), Equity (EQY R2 = 73.6 %), Liveable Communities (LVC R2 = 58.8 %), Consumption Pattern (CSP R2 = 39.9 %). According to R2, which shows that a significant number of the construct indicators of Hangwurian city development have a value greater than 10 %, it is recommended that cities in North central Nigeria develop in a way that residents consider acceptable. Such physical or infrastructure development must be viewed from moderated coherency. The predictive relevance of endogenous model constructs supported the structural model's predictive relevance; thus, many have values ranging from −0.013 to +0.699. This indicates an increase in predictive relevance for endogenous model constructs, as positive predictive relevance values for endogenous variables. Therefore, the concept is credible and recommended for North central Nigeria's physical and infrastructure development.

6. Conclusion

According to the research, using SmartPLS to construct a model for physical infrastructure development in North central Nigeria is feasible. Five variables, including urban liveability, Environmental Awareness, sustainable urban development, and Inclusive physical development, have been selected for this study. A structural equation model is now being used with the original method to understand Hangwurian city development better. Q^2 should be used to test for factor loadings' convergent and discriminant validity once the structural model is presented in the first portion of the study. According to this study, population control, environmental awareness, planning, long-term sustainability, access to credit, and economic worth are critical predictors. In the opinion of inhabitants in north central Nigeria, predictive relevance plays an integral part in creating the Hangwurian city development with relevant indicators.

Data availability

The data for this research are available and accessible on the University of KwaZulu Natal, Durban South Africa Website. As this research is a part of the UKZN research property.

CRediT authorship contribution statement

Samuel Medayese: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Hangwelani H. Magidimisha-Chipungu:** Supervision, Funding acquisition. **Lovemore Chipungu:** Writing – review & editing, Supervision.

Declaration of competing interest

I, Medayese Samuel, at this moment undertake on behalf of the authors stated in this manuscript desire to submit this article for

possible consideration for publication in your journal outlet. I wish to state that it is an original research article extracted from my Doctoral research thesis, and it is currently not under consideration by any other journal outlet.

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Appendix

Appendix 1
Model Path Analysis for Hangurian City Development in North-Central Nigeria

Latent variable	Indicators	Loadings	Indicator reliability (i.e., Factor loadings)	Composite reliability	R^2	AVE	Cronbach's Alpha
Access to the City	**ATC 204**	**0.743**	0.552	0.888	0.911	0.614	0.843
	ATC 208	**0.785**	0.616				
	ATC 209	**0.746**	0.557				
	ATC 210	**0.825**	0.681				
	ATC 211	**0.816**	0.666				
	ATC 211	**0.743**	0.552				
Credit facilities	**CRF 141**	**0.749**	0.561	0.849	0.942	0.548	0.766
	CRF 142	**0.788**	0.621				
	CRF 143	**0.830**	0.689				
	CRF 144	**0.841**	0.707				
	CRF 145	**0.833**	0.694				
Consumption Pattern	**CSP 192**	**0.787**	0.619	0.826	0.399	0.614	0.684
	CSP 193	**0.819**	0.671				
	CSP 196	**0.742**	0.551				
Economic Prosperity	**ECP 3**	**0.786**	0.618	0.882	0.798	0.653	0.822
	ECP 6	**0.857**	0.734				
	ECP 8	**0.731**	0.534				
	ECP 9	**0.852**	0.726				
	ECP 9	**0.786**	0.617				
Environment	**ENV 36**	**0.850**	0.723	0.882	0.725	0.714	0.800
	ENV 39	**0.857**	0.734				
	ENV 40	**0.827**	0.684				
Environmental Knowledge	**ENVK 169**	**0.768**	0.590	0.914	0.909	0.570	0.892
	ENVK 170	**0.750**	0.563				
	ENVK 175	**0.743**	0.552				
	ENVK 182	**0.763**	0.582				
	ENVK 185	**0.784**	0.615				
	ENVK 186	**0.804**	0.646				
	ENVK 187	**0.714**	0.510				
	ENVK 189	**0.713**	0.508				
Equity/Justice	**EQJ 54**	**0.763**	0.582	0.852	0.453	0.589	0.768
	EQJ 55	**0.769**	0.591				
	EQJ 56	**0.773**	0.598				
	EQJ 57	**0.766**	0.587				
Equity	**EQY 213**	**0.801**	0.642	0.864	0.736	0.613	0.791
	EQY 214	**0.780**	0.609				
	EQY 215	**0.789**	0.623				
	EQY 216	**0.762**	0.581				
Hospital Network Services	**HNS 151**	**0.796**	0.634	0.891	0.309	0.577	0.803
	HNS 153	**0.786**	0.618				
	HNS 154	**0.797**	0.635				
	HNS 155	**0.791**	0.626				
Liveable Communities	**LVC 102**	**0.708**	0.501	0.871	0.588	0.628	0.762
	LVC 103	**0.741**	0.549				
	LVC 105	**0.770**	0.593				
	LVC 106	**0.821**	0.674				
Motivation and Value	**MVA 162**	**0.807**	0.651	0.846	0.903	0.579	0.905
	MVA 163	**0.818**	0.669				
	MVA 164	**0.793**	0.629				
	MVA 165	**0.830**	0.689				
	MVA 166	**0.790**	0.624				
	MVA 167	**0.792**	0.627				
	MVA 168	**0.753**	0.567				

(*continued on next page*)

Appendix 1 (*continued*)

Latent variable	Indicators	Loadings	Indicator reliability (i.e., Factor loadings)	Composite reliability	R^2	AVE	Cronbach's Alpha
Place Shaping	**PLS 112**	**0.809**	0.654	0.925	0.761	0.637	0.756
	PLS 113	**0.812**	0.659				
	PLS 114	**0.835**	0.697				
Population	**POP 127**	**0.822**	0.676	0.859	0.403	0.671	0.740
	POP 128	**0.802**	0.643				
	POP 129	**0.809**	0.654				
Quality of Life	**QoL 93**	**0.837**	0.700	0.852	0.625	0.658	0.689
	QoL 96	**0.751**	0.564				
	QoL 97	**0.751**	0.564				
Building Resilience	**RES 73**	**0.837**	0.701	0.824	0.907	0.609	0.871
	RES 74	**0.751**	0.564				
	RES 75	**0.811**	0.658				
	RES 76	**0.830**	0.689				
	RES 78	**0.709**	0.503				
	RES 84	**0.695**	0.483				
Safety	**SAF 67**	**0.756**	0.572	0.903	0.739	0.609	0.724
	SAF 69	**0.817**	0.667				
	SAF 72	**0.829**	0.687				
Social	**SOC 16**	**0.766**	0.587	0.843	0.900	0.642	0.886
	SOC 17	**0.816**	0.666				
	SOC 18	**0.829**	0.687				
	SOC 19	**0.823**	0.677				
	SOC 21	**0.771**	0.594				
	SOC 22	**0.783**	0.613				

Author's Analysis (2021).

Appendix ii

Path Coefficients

Variable Label	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Decision
EA -> ENVK	0.953	0.954	0.004	255.691	**0.000**	**Supported**
EA -> HCD	−0.086	−0.086	0.035	2.439	**0.015**	**Supported**
EA -> MVA	0.950	0.951	0.004	258.618	**0.000**	**Supported**
EA -> UMG	−0.183	−0.183	0.032	5.684	**0.000**	**Supported**
HCD -> ATC	0.954	0.955	0.003	299.267	**0.000**	**Supported**
HCD -> CSP	0.631	0.634	0.021	30.621	**0.000**	**Supported**
HCD -> EQY	0.858	0.858	0.010	85.662	**0.000**	**Supported**
IPD -> EA	−0.099	−0.097	0.033	3.002	**0.003**	**Supported**
IPD -> EQJ	0.673	0.674	0.020	33.598	**0.000**	**Supported**
IPD -> RES	0.952	0.952	0.003	368.881	**0.000**	**Supported**
IPD -> SAF	0.860	0.860	0.009	92.828	**0.000**	**Supported**
IPD -> UMG	0.212	0.210	0.034	6.237	**0.000**	**Supported**
IPD -> URL	0.226	0.224	0.035	6.541	**0.000**	**Supported**
SUD -> EA	0.233	0.236	0.036	6.542	**0.000**	**Supported**
SUD -> ECP	0.893	0.893	0.008	109.702	**0.000**	**Supported**
SUD -> ENV	0.851	0.852	0.013	67.109	**0.000**	**Supported**
SUD -> SOC	0.948	0.949	0.004	253.664	**0.000**	**Supported**
SUD -> UMG	−0.097	−0.100	0.032	3.026	**0.003**	**Supported**
SUD -> URL	−0.149	−0.151	0.034	4.399	**0.000**	**Supported**
UMG -> CRF	0.971	0.971	0.002	530.053	**0.000**	**Supported**
UMG -> HCD	0.262	0.265	0.035	7.427	**0.000**	**Supported**
UMG -> HNS	0.556	0.557	0.027	20.585	**0.000**	**Supported**
UMG -> POP	0.634	0.636	0.025	25.612	**0.000**	**Supported**
URL -> EA	−0.191	−0.193	0.032	5.917	**0.000**	**Supported**
URL -> LVC	0.767	0.769	0.015	52.360	**0.000**	**Supported**
URL -> PLS	0.872	0.873	0.008	103.716	**0.000**	**Supported**
URL -> QoL	0.791	0.792	0.012	64.851	**0.000**	**Supported**
URL -> UMG	0.256	0.256	0.036	7.109	**0.000**	**Supported**

Author's Analysis (2021).

Appendix iii

Predictive Relevance Analysis

INDICATOR LABEL	RMSE	MAE	MAPE	Q^2_predict	R^2 Result of Coefficient of Determinant
ATC 204	1.052	0.849	43.202	0.015	0.911
ATC 208	1.112	0.936	49.781	0.030	
ATC 209	1.012	0.856	48.416	0.029	
ATC 210	1.065	0.904	50.400	0.031	

(*continued on next page*)

Appendix iii (*continued*)

INDICATOR LABEL	RMSE	MAE	MAPE	Q^2_predict	R^2 Result of Coefficient of Determinant
ATC 211	1.080	0.922	51.087	0.035	
CRF 141	1.134	0.917	46.782	0.082	0.942
CRF 142	1.035	0.857	49.811	0.075	
CRF 143	1.100	0.900	49.382	0.098	
CRF 144	1.107	0.918	52.287	0.083	
CRF 145	1.124	0.932	52.700	0.079	
CRF 140	1.227	1.045	44.189	0.013	
CSP 192	1.180	1.001	54.593	0.013	0.399
CSP 193	1.128	0.936	48.885	0.016	
CSP 196	1.111	0.892	45.832	0.006	
MVA 162	1.039	0.868	30.023	0.058	0.903
MVA 163	1.144	0.956	36.677	0.047	
MVA 164	1.031	0.843	29.431	0.040	
MVA 165	1.133	0.943	36.418	0.039	
MVA 166	1.142	0.954	36.202	0.026	
MVA 167	1.161	0.969	39.900	0.074	
MVA 168	1.061	0.876	31.113	0.033	
ENVK 169	1.148	0.955	38.513	0.069	0.909
ENVK 170	1.131	0.933	37.616	0.053	
ENVK 175	1.063	0.883	31.767	0.048	
ENVK 182	1.158	0.958	40.518	0.063	
ENVK 185	1.143	0.933	40.754	0.058	
ENVK 186	1.076	0.882	34.633	0.076	
ENVK 187	1.030	0.867	30.666	0.054	
ENVK 189	1.042	0.870	32.022	0.036	
ECP 3	0.834	0.622	23.763	0.448	0.798
ECP 6	0.857	0.645	26.383	0.593	
ECP 8	0.861	0.664	24.563	0.419	
ECP 9	0.828	0.632	27.309	0.618	
ENV 36	0.801	0.631	26.540	0.529	0.725
ENV 39	0.815	0.623	24.261	0.524	
ENV 40	0.765	0.584	21.806	0.496	
EQJ 54	0.953	0.760	36.639	0.236	0.453
EQJ 55	0.905	0.709	36.253	0.276	
EQJ 56	0.954	0.759	36.350	0.281	
EQJ 57	0.912	0.711	34.586	0.269	
EQY 213	1.063	0.864	44.635	0.026	0.736
EQY 214	1.039	0.839	42.029	0.013	
EQY 215	1.036	0.869	45.954	0.021	
EQY 216	1.077	0.861	43.230	0.007	
HNS 151	0.986	0.785	39.246	0.046	0.309
HNS 153	0.971	0.791	39.995	0.038	
HNS 154	0.978	0.798	39.729	0.044	
HNS 155	1.015	0.803	37.827	0.067	
LVC 102	0.980	0.801	39.481	0.017	0.588
LVC 103	1.001	0.819	41.312	0.010	
LVC 105	1.012	0.791	37.438	0.024	
LVC 106	1.058	0.877	46.981	0.039	
PLS 112	1.025	0.857	47.911	0.061	0.761
PLS 113	1.007	0.808	40.098	0.042	
PLS 114	0.981	0.804	42.525	0.043	
POP 127	1.105	0.922	49.432	0.068	0.403
POP 128	1.057	0.895	49.312	0.066	
POP 129	1.010	0.838	45.165	0.050	
QoL 93	1.071	0.886	47.538	0.058	0.625
QoL 96	0.986	0.770	37.805	0.016	
QoL 97	1.040	0.875	48.349	0.033	
RES 73	0.683	0.525	22.755	0.699	0.907
RES 74	0.649	0.488	24.565	0.607	
RES 75	0.622	0.465	22.358	0.647	
RES 76	0.695	0.544	23.147	0.657	
RES 78	0.928	0.693	32.906	0.340	
RES 84	0.876	0.690	35.364	0.325	
SAF 67	0.924	0.720	35.415	0.310	0.739
SAF 69	0.770	0.604	27.207	0.491	
SAF 72	0.694	0.540	25.371	0.598	
SOC 16	0.795	0.633	24.097	0.519	0.900
SOC 17	0.750	0.581	25.758	0.647	
SOC 18	0.736	0.564	21.283	0.602	
SOC 19	0.739	0.546	21.539	0.603	

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Appendix iii (*continued*)

INDICATOR LABEL	RMSE	MAE	MAPE	Q^2_predict	R^2 Result of Coefficient of Determinant
SOC 21	0.745	0.571	20.460	0.540	
SOC 22	0.779	0.592	22.847	0.523	

Author's Analysis (2021).

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