Economics of low-cost housing

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Abstract: Owning a home called one's own is the ultimate dream of everyone. Unaffordable house costs are associated with increased market prices of ordinary Portland cement. The economic effects of low-cost housing using blended Portland cement with duo pozzolan without compromising the key properties of cement were investigated. Pre-experimental design and snowball sampling of 112 cement brand dealers and analysis were employed. The driving force was to conserve the key properties while reducing the cost of Portland cement. It was advantageous to use P-N/RHA 10/20% optimum with Portland cement in ternary materials. The replacement of conventional cement with 10% to 40% of rice husk ash lowered the expected market prices of both brands in comparison to FACF and FACC. Findings showed that RHA is the best for replacement with OPC. It is therefore concluded that RHA should be used in replacement with OPC due to its level limits of 10%–40%.

Keywords: low-cost housing; affordable house; blended Portland cement; pre-experimental; snowball; rice husk ash; RHA; OPC; FACC; FACF; expected market prices; expected savings; income level.

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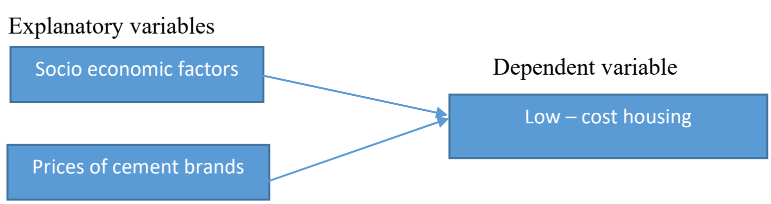
1 Introduction

Owning a home that can truly be called one's own is the ultimate dream of almost everyone (Hassan et al., 2022). Nurlaelah (2021) observed that funding and human factors are the root causes of waste in the house construction process in low-cost housing. On the other hand, Kunwar and Chander (2022) argue that the economics of low-cost housing is impacted by household income, household size, and irregular employment for household members for their livelihood. Moreover, low, medium, and high-cost housing technologies are meant for all income levels, especially low-income earners to access adequate and affordable quality shelters in their geographical location (Gambo et al., 2021; Liu and Ong, 2021). Furthermore, Lee and Kang (2022) realised that migrations driven by increased housing costs in towns and cities increase commuting time and distance to the peripherals of city centres. Similarly, Nwankwor (2021) believes that the benefits of traditional experience and technical advances by adapting existing relevant building standards will result in high-quality, low-cost, sustainable, environmentally, and health-friendly houses in emerging economies. Consequently, the reduction of house costs is one of the solutions to achieving housing affordability levels (Hassan et al., 2021).

Oyebisi et al. (2021) concerted achievements of private developers in the use of hydraform blocks as walling materials for low-cost building construction have yielded limited success. Consequently, Odoyi and Riekkinen (2022) argue that the existence of housing policy strategically in emerging economies does not translate to affordable housing development and housing affordability for low-income earners, but its implementation of strategies promotes affordable housing development. But, Hassan et al. (2022) argue the implementation of low-housing policy strategies with rising real estate prices is caused by increased market prices of ordinary Portland cement (OPC) and loan repayment periods being a paradox to the low-income earners worldwide and Tanzania in particular (Asuquo and Ogwueleka, 2019). Thus, the present study investigated how low-cost housing can be achieved for the poor while the OPC market prices are increasing. Thus, low-cost housing is influenced by socioeconomic and the prices of inputs.

Figure 1 Factors influencing low-cost housing (see online version for colours)



Socio-economic factors including household size, household income, irregular employment, and geographical location (Kunwar and Chander, 2022; Gambo et al., 2021; Liu and Ong, 2021) affect the accessibility and affordability of low-cost housing. Thus, the effects of low-cost housing are associated with the movement of market prices of cement brands and related construction inputs (Hassan et al., 2022).

2 Statement of the problem

Different needs and affordability of low-cost housing are influenced by demographic background, finance, location, dwelling features, and superstitious belief (Hassan et al., 2021). Although, the engagement of public-private partnership (PPP) in affordable low housing costs, insecurity and inequality can be achieved for the low-income earners (Schulders, 2022). Lack of PPP in place in emerging economies results in the use of low-grade materials in the construction of low-cost buildings which deteriorates soon (Lekan et al., 2021). Regardless that government policies have a significant influence on affordable housing delivery for low-income civil servants (Adejumo and Rukwaro, 2021). As a result, construction waste is associated with resource use problems of cement and concrete that contribute to the generation of construction waste by low-income earners (Patil and Manjarekar, 2021).

Consequently, cement and concrete demand in Tanzania increases with exceptionally high prices ranging from \$6.52 to \$6.95 and even higher for a 50 kg bag for most regions (ACI 232.IR-12, 2012). It is assumed that other variables such as the availability of other cement inputs and transportation are held constant. Thus, the replacement of cement with RHA from 10%, 20%, 30%, to 40% with 0% as a control (Akande et al., 2011) is anticipated to have social benefits in low-cost housing for low-income earners (Hassan et al., 2022). The wholesale price of cement per ton in Tanzania is increasing with high prices ranging from \$104.35 to \$130.43 and from \$113.04 to \$139.13 per ton and even higher for class 32.5N/R and 42.5N/R brands, respectively (Msinjili and Schmidt, 2014; NCC Report, 2019). The market price range is high for the poor to afford low-cost housing (Msinjili and Schmidt, 2014).

However, the replacement of OPC with alternative cheap resources while other factors are kept constant to lower market prices of both brands of cement without affecting its strength is a logical solution (Nwankwor, 2021; Msinjili and Schmidt, 2014). Replacement of OPC with fly ash (Akande et al., 2011; Sajedi, 2012) and RHA [SS-EN 196-3:2005+A1:2008 (E), 2015] without loss of its strength is viable. Thus cement (OPC) replacement with rice husk ash (RHA) remains the solution so as to reduce the cost of construction (ACI 232.IR-12, 2012; Tam, 2011). As a result, the improvement of the living conditions of the population living in dilapidated houses through the construction of affordable housing is inevitable (Shodmonovna and Qizi, 2021). Thus, the objective of this study was to assess the trend of market prices for cement brands in Mbeya City as the central input for low-cost housing from: Dangote Industry Tanzania; Tanga Cement Plc; Mbeya Cement Company Limited; and Tanzania Portland Cement Limited. This study, therefore, investigated the existing retail and whole prices of cement brands in the market under the consideration of achieving low-cost housing using alternative materials in Tanzania.

3 Research methodology

3.1 Study location

This study was conducted on the whole and retail cement dealers from the cement manufacturing companies which float its product in Mbeya City. Data collected were supplemented by visiting the websites of cement factories.

3.2 Research design

The present study employed pre-experimental as it involves only one round of observation with no random assignment to groups of cement dealers visited (Saunders et al., 2009). Research questions on cement brands about the trend of market prices called for exploratory knowledge. An exploratory approach is used to investigate what the population of interest perceives as helpful in their enterprises (Leavy, 2017). Thus, this approach represents detailed information in terms of characteristics, data collection, and analysis as a reverse system from exploratory sequential design (Creswell, 2014) as it explores an area where little is known.

3.3 Sampling plan and data collection

The snowballing technique sampling was employed (Leavy, 2017; Saunders et al., 2009). This relied on the human factor to provide information to further the sampling process in which one dealer after another was visited by recording the current market prices. Therefore, the researcher had contact with one case after another thus further new cases were identified and stopped when 112 business dealers as a sample size were achieved within a distance of 30 kilometres. Accordingly, cases needed to answer research questions were weighed against the resources (time and monetary) availability and method employed (Leavy, 2017). As there are no hard-and-fast rules for sample size, therefore, the sample size was computed to address research questions using the formula (Saunders et al., 2009):

$$n = \left(\frac{Z}{e}\right)^2 \cdot pq \tag{1}$$

where

n	sample size with the assumed attrition rate of 10%
Z	standard normal deviation (1.96)
e	tolerance limit (0.05)
p	the proportionate in the target population of cement dealers (0.1)
$q = (1 - p)$	the proportionate not belonging to the cement dealers
N	assumed population of cement dealers (400) in the location within the diameter of 30 km.

Thus

$$n = \left(\frac{Z}{e}\right)^2 \cdot pq = \left(\frac{1.96}{0.05}\right)^2 (0.1)(0.9) = 138$$

Then, the minimum adjusted sample size (Saunders et al., 2009) was computed so as to reduce the time in data collection using the formula:

$$nf = \frac{(n)}{1 + \left(\frac{n}{N}\right)} \quad (2)$$

where *nf* = adjusted sample size; *n* = sample size (138); *N* = assumed population (400).

So

$$nf = \frac{(n)}{1 + \left(\frac{n}{N}\right)} = \left(\frac{138}{1 + \frac{138}{400}}\right) = 102$$

Non-response rate/attrition rate of participants was taken into consideration as 10% of the minimum sample size. Therefore, the sample size of 112 participants was valuable to contribute to new learning of cement dealers in Mbeya City within a diameter of 30 kilometres.

3.4 Data analysis

Market prices for cement collected were recorded in the SPSS V 20 and MS-Excel 2013. The descriptive approach was employed to portray an accurate profile of dealers/ shopkeepers and events. Analysed data were presented in frequencies, percentages, and histograms for gender, age, education level, and nature of employment shop keepers/ dealers were presented. Thus, descriptive statistics was thought of as a precursor to an explanation.

4 Research findings

4.1 Demographic information of participants

Findings in Figure 2 showed that 50.9% and 49.1% of respondents were male and female, respectively. Results indicate that majority of cement brand participants were male. The slight differences between them could be attributed to the nature of activities in dealing with customers.

Research findings in Figure 3 showed that 93 of cement brand dealers were aged between 21–29 years followed by 3.6% aged between 30-38 years while 0.9% of the rest did not mention their age. The majority (93.6%) of participants were aged between 21–29 years. Because this age category is comprised of youth productive economic age.

Study findings in Figure 4 showed that 49.1% and 33.0% of participants had attained form four and form six education levels accordingly while 17.9% were diploma holders. The majority (46.4%) of participants were form four leavers. Results indicate that participants with low education levels are risk takers so to optimise opportunities available for their livelihoods.

Figure 2 Gender of participants (see online version for colours)

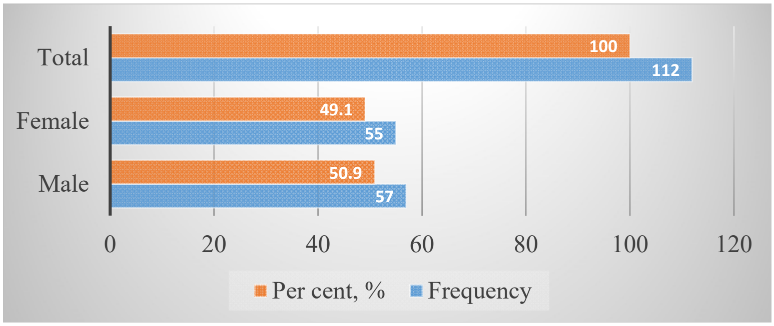


Figure 3 Age categories of participants (see online version for colours)

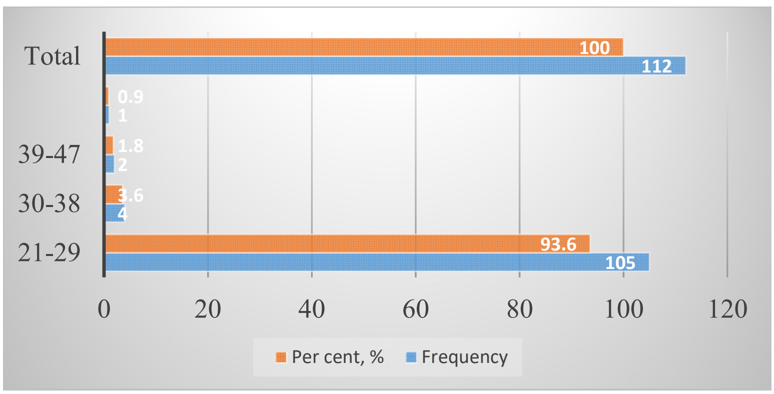
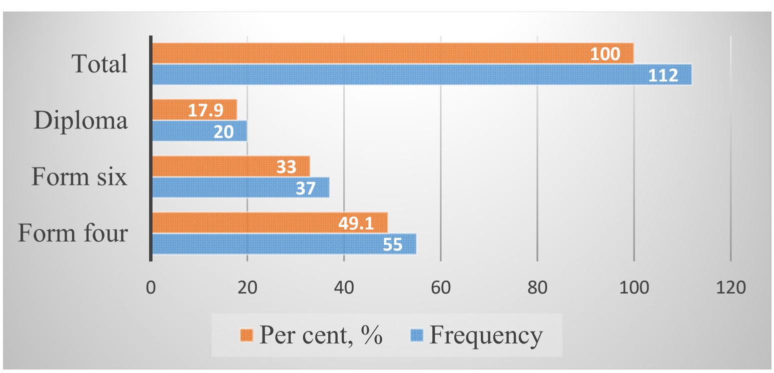
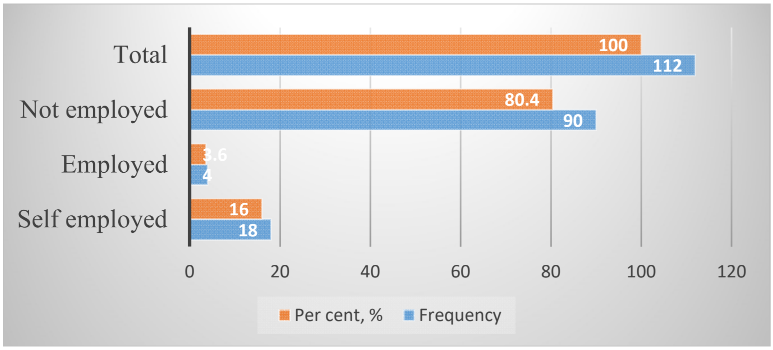


Figure 4 Education level of participants (see online version for colours)



Research findings in Figure 5 showed that 80.4% and 3.6% of participants were not employed and employed, respectively while 16% were self-employed. The self-employed shopkeepers owned cement brand outlets while the unemployed were temporarily looking for daily cakes by assisting cement dealers on a part-time support basis.

Figure 5 Occupation of participants (see online version for colours)

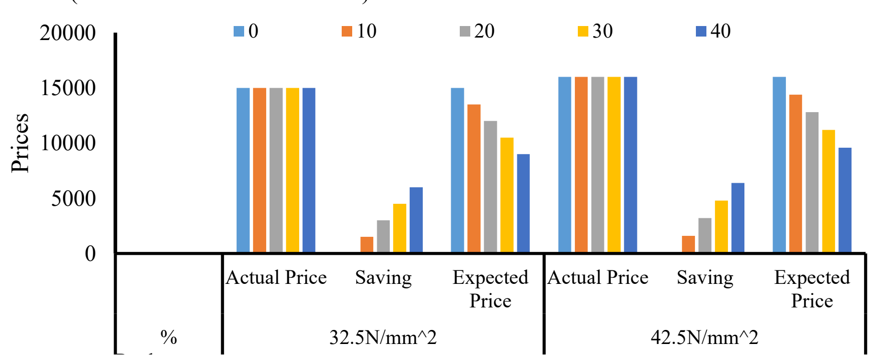


4.2 Market trends of cement brand prices versus replacement of OPC with RHA

Findings in Figure 6 showed that replacement of convention cement with RHA had a diminishing marginal cost in production as well as declining market prices for both 32.5 N/mm^2 and 42.5 N/mm^2 cement brands. Results suggested that a decline in prices of cement led to an increase in consumers' savings as payments and income levels consequently more cement demand. Findings concur with Tang et al. (2022) and Baker et al. (2020) increase in consumers' income increases consumption along their broad choices enhanced by liquidity.

As a result, increased consumption of cement for low-cost housing improves the well-being of the poor (Brown and Gathergood, 2020). Therefore, the replacement of conventional cement at the given percentages of RHA leads to increased income and improved well-being of consumers due to the low cost of cement as it enhances purchasing power.

Figure 6 Trend of actual market prices of cement brands and expected prices and savings (see online version for colours)



4.3 Market trends of cement brand prices versus replacement of OPC with fly ash and RHA

Results in Figures 7, 8, and 9 showed that replaced OPC with fly ash class F (FACF), Fly ash class C (FACC), and RHA to the limited levels of 15–25%, 15–40%, and 0–40%, respectively [Sajedi, 2012; Rein and Thorstensen, 2014; SS-EN 196-3:2005+A1:2008 (E), 2015] had positive economic effects on decreased expected market price as well as increased expected savings per ton for both brands of cement. Findings suggest that as replacement of OPC with FACF, FACC, and RHA as cheap alternative resources makes the consumers of cement rich through savings from the reduced market price of cement Figures 6–8. As a result, the poor afford low-cost housing consequently improving social well-being (Brown and Gathergood, 2020). Moreover, customers will enjoy diversified consumption patterns from saved income while achieving the same satisfaction level by maintaining customer loyalty while manufacturers win customers' interest (Sanny and Daulay, 2022; Cecily, 2022; Suhartatik and Ellitan, 2022).

Figure 7 Trend of actual market price, expected price, and savings per ton after replacement of OPC with FACF (see online version for colours)

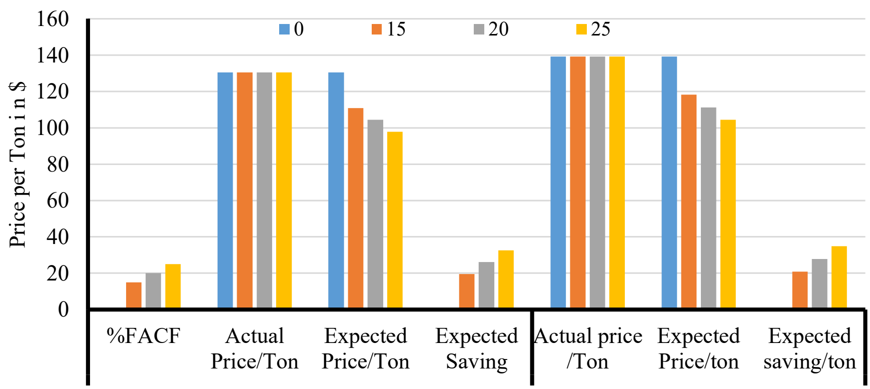
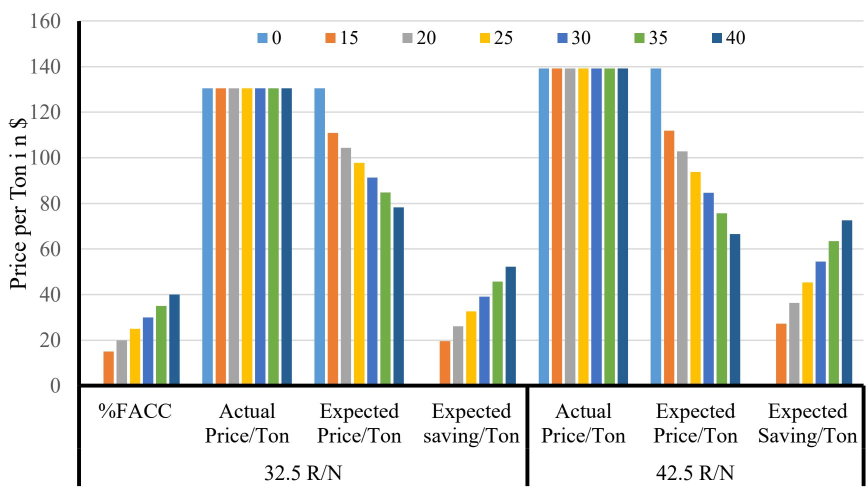


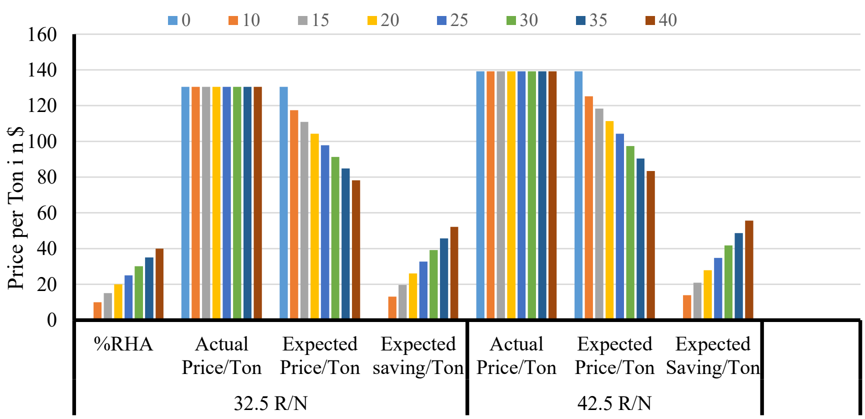
Figure 8 Trend of actual market price, expected price and savings per ton after replacement of OPC with FACC (see online version for colours)



5 Conclusions and recommendation

Findings showed that the replacement of convention cement with 10% to 40% of RHA lowered the expected market prices of both brands in comparison to FACF and FACC; thus highest expected consumers' savings and income levels were followed by FACF then FACC. It is therefore concluded that RHA has higher advantages over FACF and FACC. At the managerial level, it is therefore recommended that local governments should optimise the use of RHA so as to cut down costs associated with the movement of cement brands' prices as its demand will decline consequently obeying the price theory. Furthermore, it is recommended that RHA should be used in replacement with OPC due to its optimal limit levels of 10%–40% than FACF and FACC as it enhances more savings by consumers of OPC hence low-cost housing.

Figure 9 Trend of actual market price, expected price and savings per ton after replacement of OPC with RHA (see online version for colours)



References

ACI 232.1R-12(2012) *Report on the Use of Raw or Processed Natural Pozzolans in Concrete*.

Adejumo, I.A. and Rukwaro, R.W. (2021) 'Affordable housing policy for the low-income civil servants in Jos City, Nigeria', *Africa Habitat Review Journal*, Vol. 15, No. 1, pp.2175–2184.

Akande, J.M., Arum, C. and Omosogbe, F.M. (2011) 'Determination of the pozzolanic properties of Olotu marine clay and its potentials for cement production', *Mater. Sci. Appl.*, Vol. 2, No. 1, pp.53–58, DOI: 10.4236/msa.2011.21008.

Asuquo, C.F. and Ogwueleka, A.C. (2019) 'Identification of key macroeconomic variables for forecasting housing construction costs in Nigeria', *International Journal of Sustainable Real Estate and Construction Economics*, Vol. l, No. 3, pp.261–272 [online] https://doi.org/10.1504/IJSRECE.2019.097679.

Baker, S.R., Farrokhnia, R., Meyer, S., Pagel, M. and Yannelis, C. (2020) 'Income, liquidity, and the consumption response to the 2020 economic stimulus payments', *SSRN Electron. J.*, No. 27097, DOI: 10.2139/ssrn.3587894.

Brown, G.D.A. and Gathergood, J. (2020) 'Consumption changes, not income changes, predict changes in subjective well-being', *Soc. Psychol. Personal. Sci.*, Vol. 11, No. 1, pp.64–73, DOI: 10.1177/1948550619835215.

Cecily, S. (2022) 'Factors influencing customer satisfaction as well as internal processes: a research study', Vol. 4, No. 1, pp.250–255.

Creswell, J.W. (2014) *Research Design: Qualitative, Quantitative, and Mixed Methods Approach*, SAGE Publications Ltd, UK.

Gambo, M.J., Kunya, S.U., Ishiyaku, B., Ashen, M.J. and Dzasu, W.E. (2021) 'Relationship between housing finance institutional contexts and financial contexts to housing ownership by low-income earners in Bauchi LGA, Nigeria', *International Journal of Housing Markets and Analysis*, Vol. 15, No. 3, pp.653–669, DOI: 10.1108/IJHMA-03-2021-0032.

Hassan, M.M., Ahmad, N. and Hashim, A.H. (2021) 'Factors influencing housing purchase decision', *International Journal of Academic Research in Business and Social Sciences*, Vol. 11, No. 7, pp.429–443.

Hassan, M.M., Hashim, A.H. and Ahmad, N. (2022) 'Opportunities in housing property for young and first-time homebuyer in Malaysia', *International of Academic Research in Business and Social Sciences*, Vol. 12, No. 1, pp.942–955.

Kunwar, R.P. and Chander, S. (2022) 'Factors affecting housing affordability in Ethiopia', *Journal of Tianjin University Science and Technology*, Vol. 55, No. 4, pp.62–74, DOI: 10.17605/OSF.IO/3C98B.

Leavy, P. (2017) *Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based and Community-Based Participatory Research Approaches*, The Guilford Press, New York, London.

Lee, C. and Kang, E. (2022) 'Generation uphill: housing cost, migration, and commuting time of the young in South Korea', *Seoul Journal of Economics*, Vol. 35, No. 1, pp.1–31, DOI: 10.22904/sje.2022.35.1.001.

Lekan, A., Oluwaseun, O., Judith, E., Emetere, M.E. and Dashe, C. (2021) 'Maintenance culture of residents in some selected low-cost housing estate in Lagos State', *Earth and Environmental Science*, Vol. 665, p.12074, DOI: 10.1088/1755-1315/665/1/012074.

Liu, J. and Ong, H.Y. (2021) 'Can Malaysia's national affordable housing policy guarantee housing affordability of low-income households?', *Sustainability*, Vol. 3, pp.1–19 [online] https://doi.org/10.3390/su13168841.

Msinjili, N.S. and Schmidt, W. (2014) 'Rice husk ash as a constituent material for low-cost housing in Africa', *Cem. Trend*, November, pp.44–46.

NCC Report (2019) *National Construction Council (NCC) Baraza La Taifa La Ujenzi Report*, Review of Technical Audits Reports on Road Projects, August.

Nurlaelah, S. (2021) *Analysis Waste Proses Pembangunan Perumahan Sederhana (Low Cost Housing) Menggunakan Root Cause Analysis (RCA)*, Jakarta, India.

Nwankwor, N.A. (2021) 'An advocacy for blending traditional practices with technological developments to build capacity in providing quality low-cost earth buildings for rural housing and IDP rehabilitation in Nigeria', *International Journal of Innovative Science and Research Technology*, Vol. 6, No. 8, pp.801–806.

Odoyi, E.J. and Riekkinen, K. (2022) 'Housing policy: an analysis of public housing policy strategies for low-income earners in Nigeria', *Sustainability*, Vol. 14, No. 4, pp.1–27.

Oyebisi, S., Ede, A., Afolayan, O., Oladeji, S., Oniemayin, B. and Lazarus, J. (2021) 'Assessing the low-cost buildings in Nigeria using hydraform blocks as walling materials: the journey so far', *Conference Series: Materials Science and Engineering*, Vol. 1036, p.12044.

Patil, S. and Manjarekar, A. (2021) 'Low-cost housing by reclamation of waste material and its evaluation', *International Research Journal of Engineering and Technology*, Vol. 8, No. 1, pp.775–791.

Rein, T. and Thorstensen, P. (2014) 'Inconsistencies in the pozzolanic strength activity index (SAI) for silica fume according to EN and ASTM', DOI: 10.1617/s11527-014-0457-6.

Sajedi, F. (2012) 'Effect of curing regime and temperature on the compressive strength of cement-slag mortars', DOI: 10.1016/j.conbuildmat.2012.06.036.

Sanny, A. and Daulay, M.T. (2022) 'Analysis of factors affecting consumer satisfaction at H&M Medan', Vol. 3, No. 3, pp.112–116.

Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research Methods for Business Students*, 5th ed., Prentice Hall, England.

Schulders, M. (2022) 'The provision of affordable housing via public-private partnerships in Poland', *International Journal of Public Administration, Management and Economic Development*, Vol. 7, No. 1, pp.56–64.

Shodmonovna, F.S. and Qizi, Y.S.A. (2021) 'Impact of affordable housing construction and housing and communal services on the welfare of the population by typical projects', *Journal of Contemporary Issues in Business and Government*, Vol. 27, No. 2, pp.4069–4073.

SS-EN 196-3:2005+A1:2008 (E) (2015) *Method of Testing Cement – Part 3: Determination of Setting Times and Soundness*, No. 123867.

Suhartatik, A. and Ellitan, L. (2022) 'Increasing customer satisfaction through brand experience, brand equity, and customer commitment', *Int. J. Res.*, Vol. 9, No. 1, pp.8–15.

Tam, V.W.Y. (2011) 'Cost-effectiveness low-cost housing technologies in construction', *The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction, Procedia Engineering*, Elsevier, Vol. 14, pp.156–160.

Tang, C., Kogid, M., Alin, J. and Dollery, B. (2022) 'Modelling sectoral energy consumption in Malaysia: assessing the asymmetric effects', Vol. 14, No. 3, pp.1–17.