

# Investigation of the Critical Factors Influencing Low-Cost Green Sustainable Housing Projects in Iraq

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## Article Info

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## Abstract

Iraq oil rich country is in the condition of economic chaos and confronting an intense scarcity for the low-cost housing in the capital as migration from the surrounding cities flooded where country poor economic condition has pushed the housing price hiked in cities. Therefore, this study is conducted with aims to determine critical factors affecting the affordable housing in Iraq. Quantitative study consisting close ended questionnaire of four sections cover all critical factors and randomly distributed questionnaire among the construction industry players to determine the objectives of the study. The questionnaire was translated into Arabic/local language so the every responded understand the questions, total distributed questionnaire is 175 and in response 134 received and data is analysed using SPSS software. Study findings shows that sustainable land management, easy and low interest rate loan arrangement to overcome on the financial constraints are the critical problem followed by unsteady or interpreted supply of construction materials, pricing control significantly help to keep lower the cost of affordable housing. Study also concluded that smaller size houses are no longer the key barriers of acceptance to the Iraqi community. Thus, study strongly recommend government stakeholders to develop framework and properly manage the land for housing purpose. Lastly, steady supply chain management for all the essential construction materials such as steel, technology, cement, electrical and sanitary appliance also control the pricing so low-cost housing dream of the people become true.

## Article History

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## Introduction

Iraq is confronting an intense scarcity for the low-cost housing in the capital as migration from the surrounding cities flooded to the big cities of Iraq. Internally displaced people (IDPs) and refugees to reside in sub-standard accommodation, including collective centres, tents, unfinished or abandoned buildings, informal settlements, and open air [1]. The settlement of the people informally creating barriers to the essential services and people are living in intense weather condition. Accommodation is always congested, exposing people to significant protection risks due to the lack of privacy and physical security [2]. According to the UN-Habitat [1] study published by the united nation habitant program stated that in the Iraq about 3.1 million people are internally displaced, 43% people are

renting the houses, 23% people are hosting by their families, 15% staying in the campus, 17% are in the critical shelter arrangement and about 2% population are living in informal lands. Large migration of people from the remote countries/ villages to the cities has push the governments to find alternative of affordable housing for everyone in the congested cities. Study [3] reported new housing construction in the country has increased and largest share of housing from 2000-2004 was allowed in the Baghdad as illustrated in Fig 1. To overcome the shortage of housing in Iraq, the Ministry of Planning proposed new housing projects of 1.6 million units and planned to construct with 85% investment from the private sector and 15% from the public sector, unfortunately the delayed occurred in the planning for about 5 years now and prices of housing materials hiked in the country in the result future housing has lower occupancy rate [4].

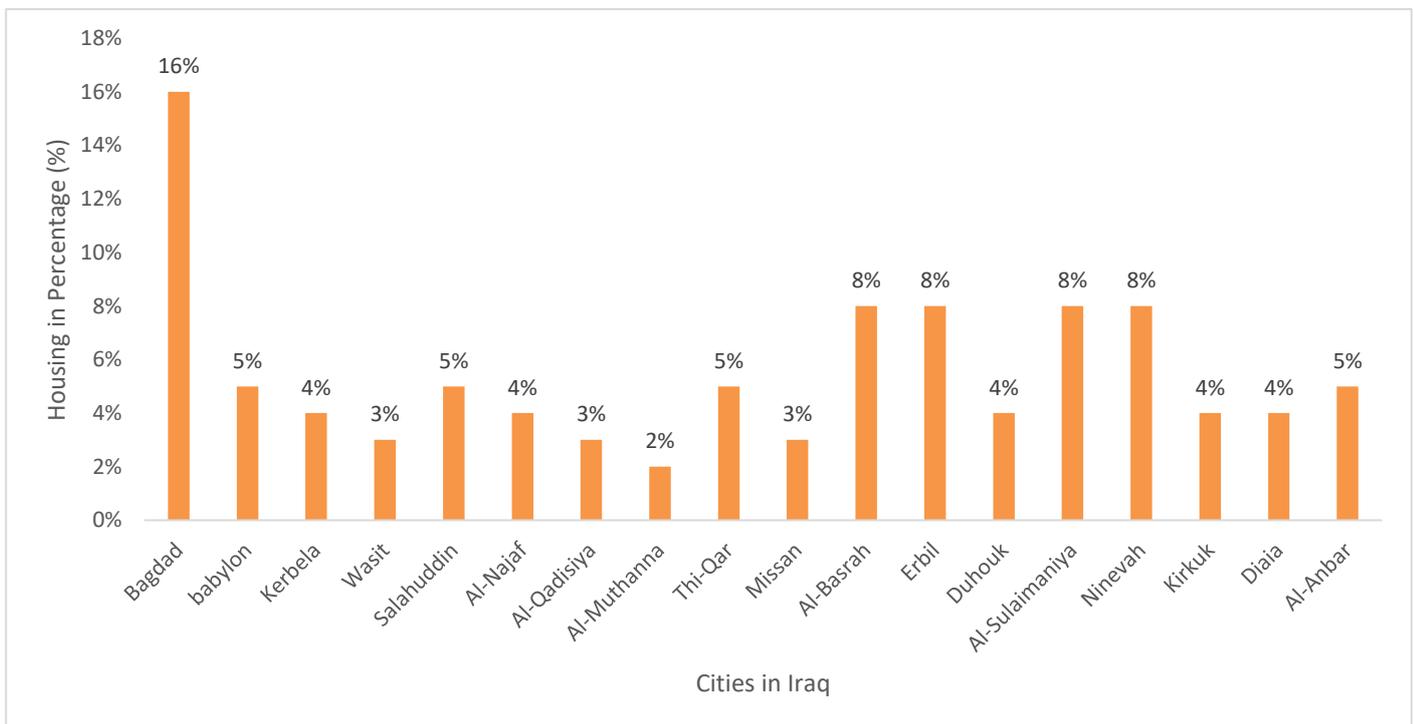


Fig.1: Housing in Iraq [3]

Residential buildings greatly linked with poverty and other social issues in human life. Intergenerational poverty reduces by increasing the economic activities and construction is considered one of the key elements to reduce the poverty [5-6]. Study of [7-9] postulated that housing poverty has adverse effect on human health, environmental and social aspects in the result crime, pollution and many other diseases spread among the poorly housing societies. Personal housing affordability factor is the potential of individual to own a house [4] is one of the important factors. The poor income, poor economic stability of the country is witnessed the high number of people living in slums are among the affecting factor.

Iraq oil rich country is in the condition of economic chaos due to the war and terror. Thus, the country is economically and socially destabilized till lack of governance in the country has raised unplanned urbanization and unbalanced utilization of natural resources of construction materials has heavily affected the environment and residential infrastructure is greatly affected in the past two decades. On other hand, high cost of the land in the urban cities of the Iraq has change the Iraqi people living

perception from the landed house to accept vertical housing projects. Availability of land for housing in communities, costs of building, land costs, labour supply and materials are among some factors contributing to the unaffordable houses other than demographic changes [10-11].

Locally available materials were traditionally used in buildings, but in the modern structure concrete, glass, brick, RCC structure has changed the trend and showing clear gap between conventional construction materials using in the housing, technology and techniques as compared to the integration of the modern techniques into the decision-making process [12]. Low-Cost housing provision should be on the high priority for Iraqi government this is largely due to the need to address historical racial inequalities, poor and mismanagement of the construction materials, poor municipal service provision and contemporary rural urban migration. Iraq is among the developing countries list suffering with the problem of housing shortage. It has become a challenging task for the government as well as private real estate sector in the kingdom to provide affordable housing to lower and medium income group families in urban areas mainly due to high demand, escalating prices and non-preference to (vertical expansion) apartments. These call for the need to address issues of low-cost housing in order to ensure the wellbeing of the society and a stable and promising future for the Iraqi citizen. This study aims to identify critical factors affecting the affordable houses in Iraq and thoroughly updates the construction materials incorporated into the decision-making processes in low-cost residential projects in Iraq and propose long-term policy for the sustainable utilization of construction materials.

## **Literature Review**

### **Housing Cost**

Scarcity of the affordable houses and low-mid income families in Iraq are incapable to afford sustainable low-cost housing because of high land and material cost. on other hand, large contribution of the private sectors in the housing development industry in Iraq is paying huge attention but unfortunately poor government policies are creating major challenges in the process of land acquisition to the construction financing, materials are the major challenging facing in the country [4]. Moreover, economic uncertainty and international firms are restricted as delays in the construction costing very high due to the instability condition, followed by land disputes, challenges in planning and development, obtaining the permit from the ministry, unemployment, poor economic condition, material shortage and high prices and instable market prices are the key challenges for the private investors in the housing sector in Iraq leading factors to the expensive housing units also barriers to the common people to afford the house [13]

Housing Cost is the prerequisite building (house or other structure) costs and building costs by alluding to the structure costs as the market cost for building work payable by a customer and the structure costs as the expenses caused by a project worker in doing work. Materials, labor, and equipment qualify as direct costs because of their physical traceability to the construction activity taken place while project and general overhead, and (perhaps) profits are indirect costs. Indirect costs are also those small costs that would be direct except that assigning them to activities is not economical did not consider profit as part of the contractor's costs.

They see it as the difference between the builders' cost and the client's price [14]. Typically, Housing prices in Denmark is divided as materials 50%, labor 30%, heavy equipment 5%, construction management and supervision absorb the other 15% [15]. Study reported that construction materials were approximately 40% of contractors' costs in multifamily housing projects though this figure

could be lower due to discounts on bulk material. Construction materials account for over half of the final cost of house building while the cost of labor account for less than third, and overheads and profit stand for the rest [16]. A contractor's construction costs are not generally known and describe them as an aggregate of the costs of materials, labor, and equipment to undertake the work and the contractor's finance, management and various site and office overheads. The contractor then charges these costs plus a margin profit to the developer [16]. At the point when the designer's expense is added then it's called the all-out expenses of the creation factors. Friedman [17] asserted that construction developers will divide the cost of the buildings as hard and soft cost where hard costs are the sums of money that are spent acquiring the site and building the dwellings. Soft costs are the amounts spent on indirect expenses related to the execution and the marketing of the project. In other words, the influencing factors affecting the cost of the housing are; Land cost, Material costs, Labor costs, Architectural and land developer cost, Government fee for Design approval Financing and Taxes etc.

### **Influencing Factors of Low-Cost Housing Selections**

#### **Materials**

Construction is incomplete without construction materials. The cost of the materials alone usually sits at about 50 % or more of the total cost of projects [18]. The factory cost for the construction materials constitutes a minor 15-35%, or even less but discrepancy is that the manufactured items are warehoused, transported, and restored before they are finally utilized at the building significantly affect the material costing in the construction industries [19]. In Iraq due to instability condition materials manufacturing industries significantly reduce the operation or closed due to security issue has drastically increased the material pricing. Therefore, the material pricing is not under the government control neither government has subsidized will significantly influence the affordability of the housing construction.

The main concern in the selection process of the construction material is to reduce the cost, however, Kishk [20] claimed construction materials should selected based on the quality of the material not on the cost, low-cost material might cause damage in the building. A poorly erected structure financially drains the client for the entirety of its existence, and while the architects have no vested interest in the structure and are not liable for its occupant's related performance, the client has an interest in minimizing long-term costs. The majority of materials perform more than one function in the construction and selection should be very practical so the single material can use for multipurpose to reduce the cost of the building [22]. The material should produce less waste as the building material is the key contributors of waste generation [18]. According to the Ashby & Johnson [22] architecture specifically will choose the material which function is more to the appearance and sensory appeal. The architecture or design engineer must have chosen the construction material locally available otherwise the cost of the building increased. In the process towards low cost building the materials information of supply chain and management is very essential [23]. The cost can be reduced by properly management and access to the real market material information.

#### **Lack of Technologies Utilization**

Under-developing countries have lack of construction technologies utilization in the construction processing, in the result manual labor cost is higher by prolonging the construction task. Hadi [23]

stressed the lack of technologies utilization in the construction industry in the Iraq is causing the cost to the developers. Recently, computer-based technologies adoption in the construction industry such as building information system (BIM) is getting popularity all over the world and such technologies will reduce the cost and schedule of the building.

### **Land acquisition and Regulation**

In Iraq numerous governments supported housing projects have been implemented for the low-income people, the projects were majorly subsidized by the government [4]

Land acquisition in the major cities is becoming the challenging and regulation is restricting them. The concept of private residency alludes to the capacity of the person to pay the taken a toll of the residential land as well as the plan and usage of the private units. The cost per square meter in horizontal housing is less than the cost per square meter in vertical housing. However, there is a trend in Iraq to establish vertical housing projects with integrated services because of the scarcity of land in urban centres [25]. The National Housing Policy in Iraq 2010-2016 performed the most important housing policies after 2003 aimed at securing housing and development of the housing sector in Iraq, identifying the housing shortage by about 2 million housing units, which examined the reality of the housing situation in Iraq and its future, including housing in urban, semi-urban and rural areas, playing the key role in providing sustainability and creating the integrated and sustainable residential neighbourhoods [26].

### **Sustainable Low-Cost Materials**

This study key focusing is the sustainable low cost or locally available construction materials for the development of low-cost housing in Iraq. The construction engineers and project developers select the building materials into three groups are the mineral materials, organic and mixture materials [27]. The demand and supply in each city and district are different so overall the pricing and major construction elements materials are discussed in this section. Housing construction materials are classified into organic materials and non-organic or mineral materials. The organic materials are renewable material and most of time locally available. The main benefit of the organic materials the availability at low cost and environmentally friendly with excellent thermal properties [28].

### **Reeds**

It is the common type of organic material highly flexible in the structure but highly flammable in nature. The agricultural plant with high silicon attracts less insects and animals with highly insulating properties. The reed is an excellent in nature and practices in the housing construction in the past especially in the countries with hot weather due to the relative durability and flexibility [29]. The durability of the reed is lower than wood and cannot be used in the modern construction. The high flammability and less durability nature discourage the reed material to use in the modern construction practice [30].

### **Wood**

The cellulose fiber nature made wood good in tension and this is also the most common organic material has been used since long time in the construction. The physical and chemical properties of the wooden material depend on the extract and the moisture content and other properties like durability,

stability, smell, color and resistance against pest and other damage [31]. The conversion of wood into a sustainable, renewable resource to be used as a main building material could be beneficial in various areas of the world.

### **Cement**

Cement is one of the main elements in the housing construction [32] and this is the reason the consumption and pricing importance is very understood. According to the findings of Hadi [24] the consumption of the key construction materials is steadily grown as the peace and stability in the country is reshaped. The consumption of cement stood for about 15 million per year and expected to reach 25 million in 2027 as the new construction projects are open [24]. Cement is largely imported from other countries as the locally produce cement could not cover the demand. The high demand has increased the price of cement which is fundamental element of the building.

### **Iron Work (Steel)**

Reinforced concrete structure is the most widely concrete structure across the world and iron/steel play an essential role in the reinforcement of the building roofing, column and beams construction is almost not possible without iron. However, steel is not locally produced so often imported from other countries costing higher and pricing will be fluctuating in Iraq directly affect the housing cost. Alternatively, the scrap steel is reutilized in the construction projects in Iraq.

### **Clay**

Excellent adhesion and bonding nature of the clay mineral has been in the use for very long time in the construction. Clay has extraordinary formability and robustness. Clay is most common and locally available construction material.

### **Brick**

Traditional houses in the past were constructed of single-story sun-dried mud bricks. The brick which is also made of clay material mixed with cementing material and will be used in the housing construction. The brick properties highly durable and stable, withstand on high load, good in thermal properties [32]. Most of the Asian and African countries are using the bricks bio-ecological materials. Modern bricks are made of cement and sand material also called block which is comparatively bigger in size than standard brick materials. The traditional brick material was easy to recycle while block material is hard due to non-humongous nature [33].

### **Alternative Sustainable Housing Concept**

The sustainability concept has become the key to the housing industry [29]. The increasing concerns about the sustainability of modern consumer lifestyles in the housing industry have led a number of professionals to seek for themselves different models of sustainable developments that are less demanding of resources. The sustainable and affordable housing provision in the populated cities is challenging [34]. The sustainability in the housing construction is about to reduce energy and resources allocation and more to renewable resources and locally sourced products, least pollution generation and recycling of the pollution and waste generated from the waste. Tied to the concern of population growth, material waste, climate change and loss of biodiversity with sustainable

development is a consideration of Low-Impact Green Housing Developments (LIGHDs). Studies on LIGHDs has determined the principal standard of economic, social and environmental sustainability as the literature shows that LIGHD concept will create green economy, biodiversity and homogeny, low carbon housing design and renewable energy production in the result low waste generation on the construction site as well residential units [34]. Low-cost housing significantly reduces the carbon emission and reduces energy consumption [35]. Low-cost housing is considerably smaller in size of the main stream housing would have some psychological barriers of acceptance to resident in the smaller house in the Iraq is the barrier. The increasing regulatory pressure to improve building standards for low-impact green developments may help to reinforce or even force mainstream professionals to implement low-cost housing models.

### Methodology

Quantitative study consisting close ended questionnaire with Likert scale of five is consisting of four (4) major portions such as affordable housing (1= very low important & 5= extremely important); Obstacles facing by Building construction causing high cost (1=Least important & 5= Extremely important); Unstable supply of construction Materials (1= very low shortage & 5= extremely shortage); sustainable alternative Factors of Affordable housing (1= strongly disagree & strongly Agree) and last section discussed. Randomly distributed questionnaire among the construction industry players and common citizen to determine the objectives of the study. The questionnaire was translated into Arabic/local language so the every responded understand the questionnaire, total distributed questionnaire is 175 and in response 134 received. The demographic questions play important role thus frequency analysis, followed with Descriptive Analysis (Mean and Std deviation) and Data Reliability Analysis (Cranach’s Alpha) using SPSS software was performed.

### Results and Analysis

#### Demographic Analysis

This section discusses the findings of the research initiated with demographic questions findings as shown in Table 1.

**Table 1: Demographic Findings (N=134)**

Items		Frequency	Percentage (%)
Qualification	Diploma	36	27
	Degree	78	58
	Master	16	12
	PhD	04	
Professional Background	Architect	15	11
	Project Manager	13	10
	Contractor	10	7.5
	Engineer	96	71.6
Working experience	Less than 5 Years	08	6
	5-10 Years	24	18

	10-15 years	25	18.5
	15-20	67	50
	More than 20 years	10	7.5
House occupancy status	Rent		20.1
	Own	27	75.4
	Government	101	1.5
	Relatives	2	1.5
	Others	2	1.5
Types of housing	Flat/Apartments	20	15
	Condominium	17	13
	Landed	97	72
Would you choose low-cost homes if you had this opportunity?	Yes	85	63.4
	No	37	27.6
	Do not Know	12	09

Table 1 findings indicated that about (58%) respondents are university graduate and holding engineering degree of about (71.6%) participants. Majorly respondents (50%) having working experience of 15-20 years and (N= 77, 57.6%) working in private sector, (N=28, 20.9%) affiliated with government section. Housing occupancy status indicated (N=101, 75.3%) owning a house followed by 20% rented and few scored livings in government houses. It is very common in Iraq people preferred staying landed houses so (N=97, 72.4%) stated living in landed houses. The respondents were inquired for the size of the building (N=102, 76.1%) reported 3-5 rooms in the house. Family size of the respondents shows (N=66, 49.3%) 5-7 people followed by (N=54, 40.3%) less than 3-4 people. Al-Shaibani & Popov [4] stated that the size of the housing depends on the family size and in Iraq commonly family size is about 5-7 people and they will prefer to build big size landed house compare to go for the vertical house. Respondents were asking how long it take to construct the house (N=54, 40.3%) shows more than 5 years to build a house. About 63.4% respondents to the question of acceptance of low-cost housing indication of the awareness and acceptance of low-cost housing is much higher.

### Data Reliability Analysis

Table 2 summarized the Cronbach ( $\alpha$ ) Coefficient of Reliability as affordable housing ( $\alpha=0.791$ ); obstacles facing by the low-cost housing ( $\alpha= 0.846$ ); unstable supply of construction material ( $\alpha= 0.685$ ) and alternative factors for the affordable housing ( $\alpha= 0.842$ ). The outcomes suggest that the Cronbach  $\alpha$  coefficient for all the variables is within the range of 0.685 to 0.848. Moreover, the aggregate Cronbach  $\alpha$  coefficient for all the variables was 0.797. According to Eisinga [36 et al., (2013) the generally accepted social science cut-off is that Cronbach's alpha should be 0.70 or higher for a set of objects to be measured in a scale. Tavakol & Dennick [37] suggested 0.70 and above is accepted coefficient of reliability. Thus, this survey data results are reliable.

**Table 2: Cronbach  $\alpha$  Coefficient of Reliability**

Variable	Cronbach $\alpha$ coefficient	Aggregate Cronbach $\alpha$ coefficient
Affordable Housing	0.791	0.791
Obstacles Building construction causing high cost	0.846	
Unstable supply of construction Materials	0.685	
Alternative Factors of Affordable housing selection	0.842	

N=134

### Descriptive Analysis (Mean and Std deviation)

#### Affordable Housing

Rating of the respondent for affordable housing factors based on Likert scale 5 where 1= extremely important and 5= very low important is shown in Table 3 and top five highly rated factors is shown in figure 1. The highly rated factor is house income (M=4.78) indicating that most of the respondents are agreed for owning affordable house income is the extremely important factor. Second extremely important factor which is also related to the financing for the housing. Loan arrangement for house financing (M=4.58) is rated the second most important factor. Interest rate on the loan (M=4.40) is rated the third most important factor. Complex banking and financial process also less incentives from the Iraqi government. The above stated three factors which are mainly dealing with housing cost, poor or complex process of loan arrangement and interest rate on the loan are rate extremely important factors.

In the follow up discussion, result shows that easy access to the public transport (M=4.39); public safety and crime rate (M=4.35). According to the respondents rating of the importance of affordable housing are not well managed irrespective of transportation and since war the safety and crime is among the top concern of the respondents for affordable housing. Over the past three decades Iraq has gone through lots of war and terror in the result crime and public safety is the major concern, thus other cost, loan and interest rate public safety and transportation is rated top factors. Construction material (M= 4.22); Access to the school/colleges/universities (M=4.17); Access to the hospital/shopping malls (M=4.13). The findings shows that house size (M=3.08) and Quality of house (M=3.88) are moderate important factor. Further, graphical chart of 4.1 indicated the top 5 extremely important.

**Table 3: Affordable housing (Descriptive Analysis)**

	N	Mean	Std. Deviation
Household income	134	4.785	.96566
Loan arrangement for house financing	134	4.522	.84911
Interest rate on loan	134	4.400	.81592
Size of the house	134	3.082	.73626
Quality of the house	134	3.880	.63317
Construction Materials	134	4.224	.70940

Access to school/ colleges/ universities	134	4.174	.67864
Access to the hospitals	134	4.138	.84429
Access to the shopping malls/business center	134	4.124	.8066
Easy access to the public transport	134	4.380	.81083
Public safety and Crime rate	134	4.358	.8897
Valid N (listwise)	134		

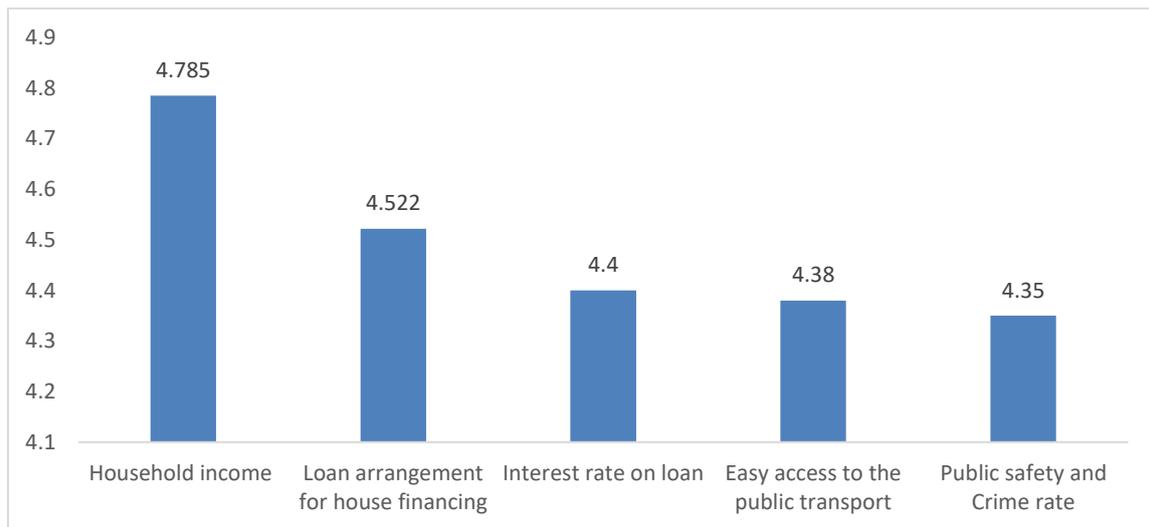


Fig. 2: Top five rated factors of important for affordable housing

### Obstacles facing by Building construction causing high cost

In this section respondents were asked to rate the important obstacles facing by affordable housing causing higher cost where 1= Least important (LI) and Extremely Important (EI). Table 4 shows the result indicated that the most top-rated obstacles facing to build house are budgeting /Financial issue (M=4.55). Second most rated obstacle is the lack of affordable land for the housing (M=4.42). The cost per square meter in horizontal housing is less than the cost per square meter in vertical housing. However, there is a trend in Iraq to establish vertical housing projects with integrated services because of the scarcity of land in urban canters. As a result of the housing units' shortage, the average construction costs per square meter increased about 22% [25]. New materials replaced traditional materials (M=4.35) is rated the third most important obstacle of the facing by the housing construction in Iraq. In the process towards low cost building the materials information of supply chain and management is very essential [22]. Concrete (RCC) construction has replaced traditional building material of wooden structure or clay housing, the new construction materials costing much higher increase overall budget of the housing are one of the obstacles highly rated. Some more, the new material is imported from other countries so supply chain management and import costing increase the budget. The cost of the materials alone usually sits at about 50 % or more of the total cost of projects [30].

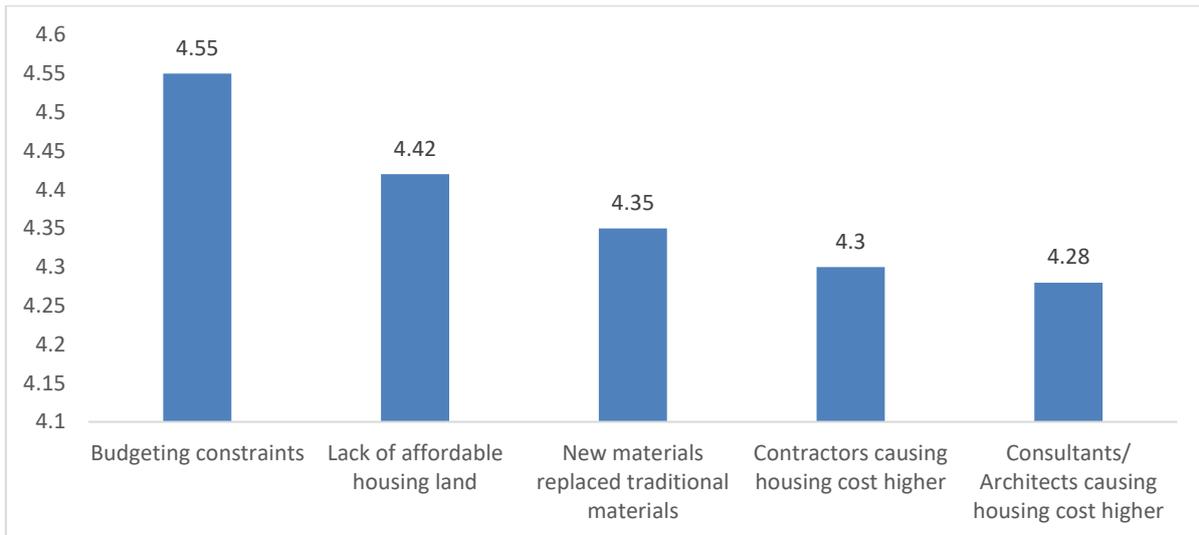
Contractor and consultants are contributing very much in the cost increasing of housing construction as rated among the top give factors (M=4.30 and M=4.28) respectively. Consultant fee

and contractor profit are also indirect costs but they very importantly contributing to increase the cost of the building. A contractor's construction costs are not generally known and describe them as an aggregate of the costs of materials, labor, and equipment to undertake the work and the contractor's finance, management and various site and office overheads. The contractor then charges these costs plus a margin profit to the developer [16].

Lack of technologies (M=4.089); Unavailability of materials (M=4.029); Materials causing cost higher (M=4.21); materials qualities and selection (M=4.16) and lack of planning and development (M=4.087) are the factors which are rated important obstacles factors towards construction of housing in Iraq. Unwillingness to change the conventional way of housing construction (M=3.29) and Lack of awareness of sustainable housing (M=3.089) are the fairly important factor rated by the respondents. Others factors such as lack of manpower (M=1.76); complex and tradition design (1.91) are considered least important factors. Fig 3 represent the five top obstacles factors.

**Table 4: obstacles facing by the housing construction**

	N	Mean	Std. Deviation
Budgeting constraints	134	4.553	.74697
Lack of manpower/Labors	134	1.768	.69276
Lack of technologies	134	4.089	.60651
Complex and traditional design	134	1.910	.60651
Unavailability of materials	134	4.029	.69304
Materials causing cost higher	134	4.211	.70081
materials qualities and selection	134	4.164	.67383
New materials replaced traditional materials	134	4.352	.73987
Lack of affordable housing land	134	4.424	.86698
Unwillingness to change the conventional way of housing construction	134	3.234	.75459
Lack of awareness of sustainable housing	134	3.089	.75057
Lack of planning and development	134	4.082	.83214
Contractors causing housing cost higher	134	4.307	.93789
Consultants/ Architects causing housing cost higher	134	4.283	.84641
Valid N (listwise)	134		



**Fig. 3: five top obstacles factors of housing construction**

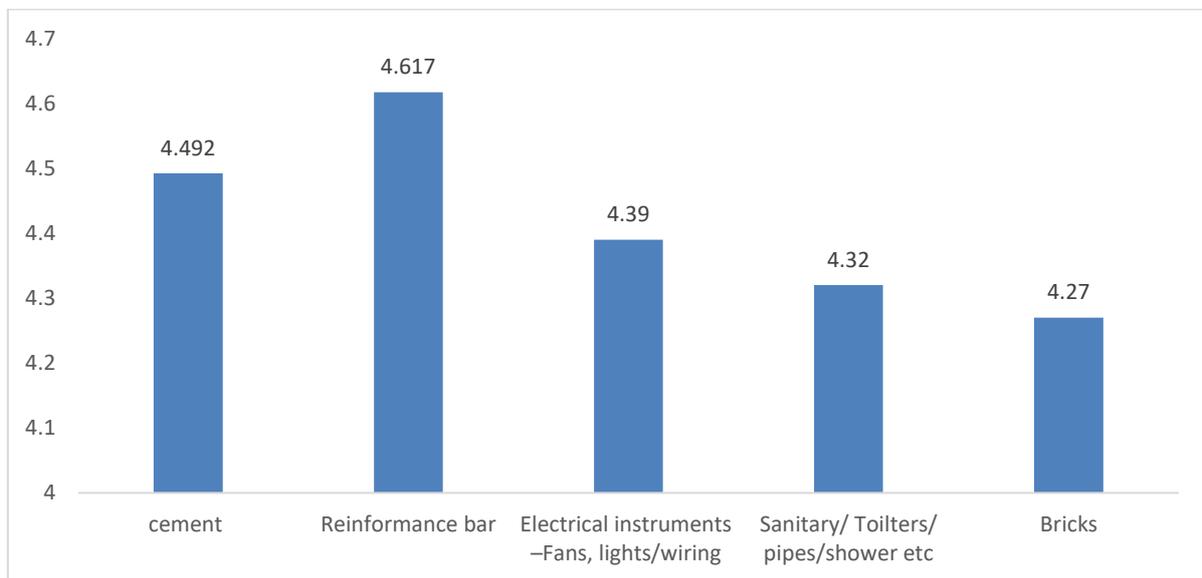
### **Unstable supply of construction Materials**

This section discuss which materials will have the highest risk of unstable supply during construction causing housing cost higher and respondents were asked to rate based on likert scale fiver where 1=very low Shortage and 5= Extremely Shortage. Previously was discussed new innovation in the construction and new materials has replaced traditional locally available materials thus supply chain for the imported material highly affecting the cost of the construction buildings in Iraq. Table 5 shows the results of the materials which shortage or unsteady supply will affect the construction process. Based on the respondent rating it is found that steel/ reinforcement Bar (M=4.61) is rated the extreme shortage or increase in the cost will affect the cost of the housing materials and affect the whole budgeting.

Cement (M=4.49) which is also locally produced is rated the second most important factor and unsteady supply would affect the housing construction or budgeting of the low-cost building. Electrical instruments –Fans, lights/wiring etc (M= 4.39); Sanitary/ Toilters/ pipes/shower etc (M=4.33) and bricks (M=4.27) are rated the top most materials if unsteady the supply chain will largely affect the housing budget and costing of the building. Vrijhoef & Koskela [38] suggested an effective measurement and government policies can maintain the supply chain and cost to affordably available. In the process towards low cost building the materials information of supply chain and management is very essential [22]. Therefore, this section is specifically discussing the supply chain of the materials majorly contributing in the housing. Some materials temporarily delay or unsteady supply might not affect the processing or overall cost of the building but the top rates are considered highly potential and necessary elements. Sand (M=4.20) concrete (4.19) and wood (M=4.09) are considerable important materials also and their unsteady supply will affect the housing cost. Tiles (M=3.55) are listed moderately important material because tiles are locally available and also their short-term supply delay would not affect the cost of the building. Fig 4.3 shows the top-rated materials which unsteady supply will highly affect the building costing, the reason those materials are imported and often shortage in the market due to government ineffective policies.

**Table 5: Material unsteady supply affecting the housing cost**

	N	Mean	Std. Deviation
Cement	134	4.492	.91353
Sand	134	4.201	.74369
Concrete/Aggregates	134	4.149	.81810
Bricks	134	4.271	.66211
Wood	134	4.029	.84016
Reinforcement Bar	134	4.617	.72983
Tiles	134	3.559	1.25962
Window/Doors/	134	4.149	.73072
Sanitary/ Toilters/ pipes/shower etc	134	4.333	1.29511
Electrical instruments –Fans, lights/wiring etc	134	4.395	.81149
Valid N (listwise)	134		



**Fig. 4: Unsteady supply of the materials would affect housing cost**

### Alternative Factors of Affordable housing

Alternative factors including the materials that will cause housing price to affordable in Iraq. Likert scale fiver were used where 1= Strongly Disagree and 5 =Strongly Agree. Land management (M=4.72) is the critical problem and properly management land will significantly reduce the building construction cost and people will be able to get lower cost land. Therefore, respondents have raked land management one of the highest alternative factors to lower the housing cost. In the previous section we have witnessed the major issue is budgeting and financing of the housing lower and easy loan payment and financing (M=4.55) respondents strongly agree is strong alternative toward alternative housing.

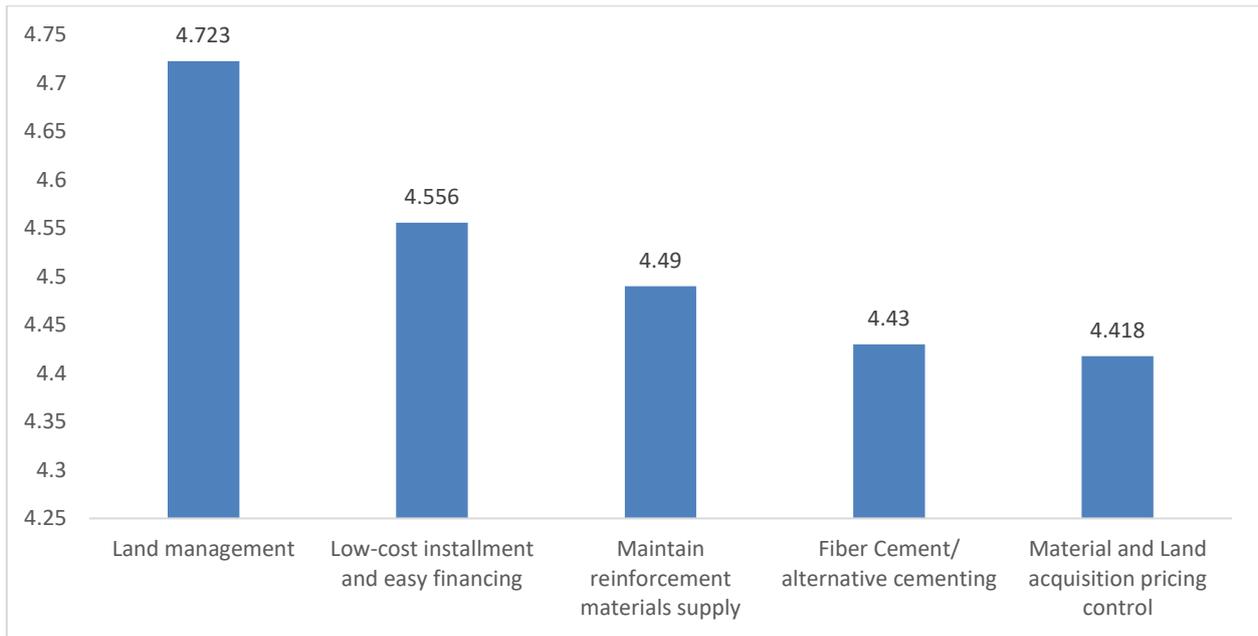
Unsteady or interpreted supply of construction materials significantly causing for the higher cost of the construction. Therefore, maintain reinforcement materials supply and fiber cement or alternative cementing material (M=4.49, M=4.43) is rated strongly agreed alternative factors for the lowering

the cost. Other than, sand, aggregate material cement and steel contributing very importantly in the construction of low-cost housing therefore, unsteady supply of these main materials is strongly suggested alternative factors for the low-cost housing. Material and Land acquisition pricing control (M=4.41) is rated among the top factor of alternative to the affordable housing. Land management and materials continues supply will significantly keep balance the costing in the result cause of the affordable housing.

Concrete blocks/Instead of conventional bricks (M= 4.38); Housing production requirement (M=4.37); Electrical and sanitary instruments steady supply (M= 4.30) and Sustainable construction for housing (M=4.22) are the alternative factors which is rated higher by the respondents and important for the low-cost housing in Iraq. Fly ash bricks (M=2.83) as an alternative factor material is disagreed by the respondents. Figure 5 shows the five top rated alternative factors for affordable housing.

**Table 5: Alternative factors for affordable housing**

	N	Mean	Std. Deviation
Bamboo	134	2.156	.79334
Concrete blocks/Instead of conventional bricks	134	4.385	.96546
Fiber Cement composites/ alternative cementing	134	4.437	1.23487
Fly ash bricks	134	2.835	1.28727
Maintain reinforcement materials supply	134	4.494	.83601
Land management	134	4.723	.59625
Housing production requirement	134	4.373	.64507
Electrical and sanitary instruments steady supply	134	4.304	.81149
Material and Land acquisition pricing control	134	4.416	.69760
Low-cost installment and easy financing	134	4.556	.77415
Reduction of water and energy consumption	134	4.119	.83211
Sustainable construction for housing	134	4.229	.79870
Window/Doors/	134	4.149	.73072
Valid N (listwise)	134		



**Fig. 5: five top rated alternative factors for affordable housing**

Table 6 shows the summary of descriptive analysis on the overall four variables of affordable housing (M=4.39, SD=0.87); obstacles facing toward low-cost housing (M=4.19; SD=0.95); unsteady material supply affecting the housing cost (M=4.010, SD=0.97); Alternative factors of affordable housing (M=4.514, SD= 0.819). Hence, the findings indicated that alternative factors of affordable housing are strongly agreed by the respondents followed by affordable housing factors are extremely important.

**Table 6: Summary of Descriptive Statistics**

	N	Mean	Std. Deviation
Affordable housing	134	4.396	.8791
Obstacle factors	134	4.195	.9588
Unsteady supply of materials	134	4.010	.9793
Alternative factor of affordable housing	134	4.514	.8187
Valid N (listwise)			

**Discussion**

The study findings indicated over the past few decades’ major conventional construction materials such as date husk, straw bale, bamboo, wooden and mud house were conventionally constructed not only in the Iraq but in the whole middle eastern Arab gulf region. The conventional materials are replaced with new materials such as mud brick has replaced with concrete block and wooden structure has replaced with steel structure or concrete structure. The reason is conventional material was not fit in the weather as well did not last for over long period of time and need higher maintenance. Concrete structures are the mostly accepted construction material all over the world recently so the new construction materials and accessories has increased the cost of the house, also unmanaged land also

double the price of the land. Therefore, this study has identified the factors causing construction cost higher.

An online survey study conducted among the Iraqi national to meet the research objectives, the respondents' profiles indicated most of the respondents are well educated by profession are engineers and very much understand and award of low-cost housing. One of the main reason people not having own house is high construction price including land price to the end product, therefore respondents said easy financing and government incentives will help lot to the people having own house and this possible by reducing material cost or sustainable land management to the national strategies for the housing by financing with low interest rate and easy instalment. Hence most of the respondents are agreed they can pay monthly instalment up to 20% of their salary.

The factors affecting demand for affordable housing are determined as per the rated by respondents is the individual household income. Since Iraq economic situation get worse in the past few decades because of the War and terror in the country, the unemployment has increased and household income has significantly dropped, thus owning a house or construction of new house is the challenging because of either low income or not sufficient saving to pay for the housing. Secondly government poor policies of financing or loan to the general public is the complex process, so study findings shows that easy loan arrangement with lower interest rate are some extremely important factors for the people to have a house or afford a house. Beddu [35] stated that biggest portion of the low-mid income families in Iraq are incapable to buy sustainable low-cost housing units offered by the private housing developers due to high interest rate and complicated investment process.

Alkhalefy [3] found that the planning task for sustainable housing in Iraq proposed by the government are –short- and long-term development in housing, implementation of new housing project with the help of public private partnership, subsidizing the construction material and financing low interest rate housing loans. According to UN-Habitat [1] in the past decades Iraqi government provide loans and subsidized interest rate to the households especially providing material below the market rate price subsidized by the government. Lombardi [39] asserted that since 1980s Iraq is facing numerous challenges of international and local conflict has negative impact on the economy leading to the significant shortage of housing in Iraq because government unable to subsidize the housing industry. The findings of this study are in the line of the previous researcher where they have identified financial inflow and higher interest rate are the main challenge for owning the house in Iraq.

Challenges faced by affordable housing which causing higher cost is determined based on respondents' opinions stated that obstacles facing to build house are budgeting /Financial issue. The country poor economy after the war which is ended in 2010 but still the foreign direct investment in the country is major dropped are the reason and key challenge toward affordable housing. Lack of affordable land for the housing and the cost per square meter in horizontal housing is less than the cost per square meter in vertical housing. However, there is a trend in Iraq to establish vertical housing projects with integrated services because of the scarcity of land in urban centers. As a result of the housing units' shortage, the average construction costs per square meter increased about 22% [25].

New materials replaced traditional materials the third most important obstacle of the facing by the housing construction in Iraq. In the process towards low cost building the materials information of supply chain and management is very essential [22]. Concrete (RCC) construction has replaced traditional building material of wooden structure or clay housing, the new construction materials costing much higher increase overall budget of the housing are one of the obstacles highly rated.

Some more, the new material is imported from other countries so supply chain management and import costing increase the budget. The cost of the materials alone usually sits at about 50 % or more of the total cost of projects [18].

Contractor and consultants are contributing very much in the cost increasing of housing construction as rated among the top give challenging causing affordable housing over costing. Consultant fee and contractor profit are also indirect costs but they very importantly contributing to increase the cost of the building. A contractor's construction costs are not generally known and describe them as an aggregate of the costs of materials, labor, and equipment to undertake the work and the contractor's finance, management and various site and office overheads. The contractor then charges these costs plus a margin profit to the developer [16].

Study found that steel/ reinforcement bar, cement, electrical and sanitary appliance which is mostly imported from the overseas are materials their shortage will significantly increase in the cost will affect the cost of the housing materials and affect the whole budgeting. Vrijhoef & Koskela [38] suggested an effective measurement and government policies can maintain the supply chain and cost to affordably available. In the process towards low cost building the materials information of supply chain and management is very essential [25]. Hence, the supply chain of the materials majorly contributing in the housing.

Some materials temporarily delay or unsteady supply might not affect the processing or overall cost of the building but the top rates are considered highly potential and necessary elements. The alternative factors including the materials that will cause housing price to affordable in Iraq has proposed to help in the strategies and polices development. The study proposed sustainable land management land management which is the critical problem and properly management land will significantly reduce the building construction cost and people will be able to get lower cost land. Government should subsidize and finance the housing materials and easy loan payment with lower interest rate. Unsteady or interpreted supply of construction materials significantly causing higher cost of the construction. Therefore, maintain reinforcement, cement and electoral appliance material supply should not interpreted in the market to maintain the cost of the material. Locally made materials prices did not much effect the overall cost of the building but the imported material supply which is complex process of supply chain management has to be addressed and should be the government strategies and policy to maintain the products.

In the analysis, study found that Iraqi respondents to this study said low-cost housing which is usually small in size does not matter for them as long as the housing area is safe and accessible to the public transport, shopping malls, schools and hospitals. This study found that smaller size houses are no longer the key barriers of acceptance to the Iraqi community. Technologies adoption in the construction industry improve the quality of work, reduce time consumption and costing however, respondent rating the technology moderately importance, manpower in Iraq is not an issue. Hadi [24] stressed the lack of technologies utilization in the construction industry in the Iraq is causing the cost to the developers.

## **Conclusion**

The research aim is to determine critical factors affecting the construction of low-cost houses in Iraq, followed by the selection of suitable construction materials and adoption of the occupants in the low-cost housing. Financial constraints due to the country poor economy is the main critical factor causing

high cost to the affordable housing, followed by the land acquisition, urbanization and poor development of the cities are causing challenge to find a land for the affordable housing is also critical factor. The poor and complex financial infrastructure for housing loan and higher interest rate discouraged people not to have a house. Biggest portion of the low-mid income families in Iraq are incapable to buy sustainable low-cost housing units offered by the private housing developers due to high interest rate and complicated investment process. In the process towards low cost building the materials information of supply chain and management is very essential. The materials imported from other countries so supply chain management and import costing increase the budget. Developer cost of contractor and consultants are another critical challenging factor of increase the low-cost housing cost, and generally contractor or consultant charges are not included in the budgeting of the building construction but there are immense charges of consultants. Sustainable land management, easy and low interest rate loan arrangement to overcome on the financial constraints are the critical problem followed by Unsteady or interpreted supply of construction materials, pricing control significantly help to keep lower the cost of affordable housing. Study also concluded that smaller size houses are no longer the key barriers of acceptance to the Iraqi community. Technologies adoption in the construction industry improve the quality of work, reduce time consumption and costing however, respondent rating the technology moderately importance, manpower in Iraq is not an issue. Moreover, low-cost housing is should be safe and easy access to the hospital, schools, and shopping malls.

### **Recommendations**

This study has some recommendations to tackle down the housing cost issues and most of the people would have minimum one house or basic need of shelter home. The critical factors are most related to the economy or financial constraint of the general public, in such cases government should develop a framework with banking institutions for the flexible housing loans schemes with low interest rate and easy repayment schedules would be helpful most of the public to own house, also government should finance development projects with long term loans. Secondly sustainable and computerized land management in the urban cities is essential these days not only for the housing but also tackling down the climate change and environmental issues, poor land management causing lots of challenges. Thus, study strongly recommend government stakeholders to develop framework and properly manage the land for housing purpose. Lastly, steady supply chain management for all the essential construction materials such as steel, technology, cement, electrical and sanitary appliance also control the pricing so low-cost housing dream of the people become true.

**Conflict of Interest:** I firmly declared there is no conflict of interest between/among the authors.

### **Compliance with ethical standards**

**Competing interests:** The authors declare that they have no competing interests.

**Ethical approval and consent to participate:** We declare that we have no human participants, human data or human issues.

**Consent for publication:** We do not have any individual person's data in any form and we give consent for publication in true letter and spirit.

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