



Research Article

INVESTIGATION OF IRANIAN RESIDENTIAL BUILDINGS WITH SUSTAINABLE ARCHITECTURE IN HOT AND DRY AREAS

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Abstract

The culture and knowledge of the residents and users of the building is one of the most important and influential factors in the formation of the form and space of architecture and its interior design. Since the degree of attachment of users and residents to the space and environment in residential buildings is much more than other uses, and also because the sense of ownership and freedom of action of residential building users is higher than other buildings and spaces, so the importance and role of culture in design and the development of residential spaces will be doubled. The aim of this study is to analyze and explain the aspects of culture and its influence on the interior design of traditional Iranian dwellings in hot and dry climates. The research method of this article is analytical-descriptive.

Keywords: Culture, Interior architecture, Hot and dry climate, Housing

Araştırma Makalesi

İRAN'DA SÜRDÜRÜLEBİLİR MİMARİ YAKLAŞIMLI KONUT BİNALARININ SICAK VE KURAK ALANLARDA İNCELENMESİ

Özet

Mimarinin ve yapının iç tasarımının biçim ve mekânının oluşumunda önemli ve etkili faktörlerden biri de kullanıcılarının kültürüdür. Konut alanında, kullanıcıların mekânla olan bağlantılarının miktarı diğer kullanımlara göre çok daha fazla olduğu gibi, konut mekânı kullanıcılarının da sahiplik duygusu ve hareket özgürlüğü diğer mekanlara göre daha fazla olduğundan, konut mekânının önemi ve rolü daha fazladır. konut alanlarına sahip olma ve geliştirme kültürü iki katına çıkacaktır. Bu çalışmanın amacı, sıcak ve kuru iklimlerde

geleneksel İran konutlarının iç mimarisine kültürünü ve etkisini analiz etmek ve açıklamaktır. Bu makalenin araştırma yöntemi analitik-tanımlayıcıdır.

Anahtar Kelimeler: Kültür, İç mimari, Sıcak ve kuru iklim, Konut

1. INTRODUCTION

Throughout history, people have always tried to adapt to their environment in order to create a safe habitat and thus create suitable conditions for their survival. In fact, geographical and climatic conditions play a direct role in shaping this habitat. Traditional Iranian architecture, both residential and non-residential, as well as a combination of both, has unique features that meet the climatic needs of each region by considering the aesthetic aspects and environmental protection (Erfani, Parvandi, and Heidari, 2020).

Given that the traditional architecture of Iran has strong and productive stability and support in various aspects, these features can be used to plan, design, and generalize the contemporary living environment. In this context, we have tried to first deal with the issue of sustainable development and sustainable architecture to familiarize ourselves with the views of some of the greats of this discussion, and then take a look at Iranian traditional architecture and the elements and spaces used in it as a source of inspiration and a model.

From time immemorial, people have needed artificial environments to control climatic factors and create comfortable conditions. In other words, at every stage of social life, people first consider climatic factors when building a shelter (Ural, Maniöglu, 2005).

Traditional Iranian houses are designed with the understanding that the task of protecting environmental resources with ecological sensitivity in roof and facade systems is to provide solutions that are compatible with the landscape and create a comfortable interior (Arkushkon, 2016).

It is important to note that in arid architecture, much attention has been paid to the angle of the sun. In a way that by separating the spaces inside the house, it has brought better energy savings. In such a way that they separated the hot and cold atmosphere inside the house. Of course, it should be noted that the highest heat in summer was on the roof and east walls of the building (due to the direction of the house)

Climate is one of the pillars of traditional Iranian architecture. In this type of design, the main source of energy is solar energy and building design methods are based on the direct absorption of solar energy. The purpose of climate design is to create optimal conditions and comfort inside and minimize costs. In this article, the study and research method and the library data collection method have been used.

Sustainable and environmentally friendly architecture is one of the main goals that human beings have considered as the final model of all their activities to create a better life. For this reason, turning to greener architecture is a good idea for the main purpose of architecture in our time (Watson, Laboratory, 2014).

Green architecture also has environmental, social, and economic benefits. From an environmental point of view, it can be pointed out that this style of architecture reduces

pollution, preserves natural resources, and prevents environmental degradation. Economically, it reduces the costs that building managers have to pay for water and energy consumption and improves their efficiency in using their facilities (Thomas, 2009).

The purpose of this study is to focus on clean energy by considering the rich features of indigenous architecture to achieve appropriate design solutions and sustainable architectural goals, the important features of which are focused on the climate and nature of the region and its protection and use. Natural energy to achieve a more comfortable life.

By examining the factors of sustainability in the houses of ancient Iran in hot and dry climates, we obtain an example of sustainable architecture that can be used in the design of modern buildings.

"Sustainable design is a type of design that aims to meet today's needs without compromising the resources of future generations. It should be noted that sustainable design should be able to take into account social and economic sustainability as well as energy consumption and environmental impacts of buildings and cities" (Sajjadi Ghaem Maghami, Purdihimi and Zarghami, 1390).

A noteworthy point about the artistic roots of Iranian architectural works is clearly engaged so that in every corner and city and every climate of this land can be seen architectural works specific to that region. Culture and architecture have had a close relationship for a long time, so it has created different architectural styles. And this issue has created principles that were formed according to the geographical location of that region. Hence, the architecture in areas that did not have a balanced climate has undergone fundamental and innovative changes. For example, architecture in hot and dry areas is a separate branch and creates its own unique principles and techniques. This style of construction requires attention to the things that are considered creative innovations of architecture emerges.

2. SUSTAINABLE DEVELOPMENT

The main goal of sustainable development is to secure basic needs, improve and raise the standard of living for all, preserve and provide ecosystems, and create a safer and happier future. Sustainable development is a process in which economic, financial, trade, energy, agricultural, industrial, and other policies are designed to lead to economically, socially and environmentally sustainable development, the concept of which is to invest. Enough in education, health, population, and energy, so that there is no social debt for future generations. In conclusion, sustainable development is a comprehensive concept and relates to all aspects of human life, and the implementation of sustainable development models requires fundamental changes in national and international policies (Soflaei, 2004).

Sustainable architecture requires a multidimensional and interdisciplinary study with different perspectives (Tatar, 2013). In sustainable architecture, strategies, components, and technologies have been developed to reduce environmental impacts and increase spatial comfort and quality. These include, but are not limited to, the following items.

- Daylight use,
- Indoor air quality,
- Passive solar energy use,

- Natural ventilation,
- Effective use of energy,
- Effective energy use at every stage of the design process,
- To minimize construction waste,
- Water conservation,
- Evaluation of whether the building complies with the targets and criteria in terms of energy design strategies and energy performance during the operational efficiency, design and construction stages,
- Solid waste management,
- Renewable energy use,
- Use of the natural landscape,
- Land conservation (McLennan, 2004).

The breadth of the scope of work in the name of sustainability, the multiplicity of existing concepts, the importance of ordering among the principles, and the high regional differences are some of the firsts that force the designer to find the truth. The common purpose of studies in sustainability is to examine from an architectural point of view, to protect and maintain natural energy resources by evaluating sustainability in terms of the natural environment. (Çigan & Yamaçlı, 2020). Traditional Iranian architecture shows the special interest of Iranians in the correct and effective use of renewable energy in ancient times, to do this very simple but effective methods were used in any climate based on climatic conditions. In this respect, we can name the traditional buildings based on Iran's natural energy resources, which provide maximum sunlight in winter and maximum shade in summer, to provide natural ventilation and comfort to their residents.

In the past, houses were affected by climate, culture, etc. It used to be shaped according to nature, but today the forms are used in Iranian architecture without considering the climatic conditions and harmony with nature and the environment, and because they have interesting forms that simply imitate. This has resulted in the destruction of nature and the failure to meet functional needs and the absence of a sustainable and flexible building form to reduce the consumption of non-renewable energy resources (Sajjadzadeh et al., 2015). For this reason, it is necessary to examine the architectural works of the past in order to reach the desired architecture in society.

2.1. Formation of architecture and texture of cities and villages in hot and dry areas

The architecture of dry and hot areas is a kind of design and architecture that by observing its principles, life in these areas becomes possible and easy, and also has caused principles in the construction of houses in these areas.

The oldest case of architecture is to build a house because man needed shelter after coming out of the cave. In the houses that were built later, the residents did not feel uncomfortable. In the house where the woman or child lived, there should be a lot of variety so that they do not feel tired.

Even in the Qajar period, the time of the decline of Iranian architecture, very good houses were built. Of course, today they make mistakes, for example; The toilet was far away or it was difficult to use the kitchen in winter, the toilet was made outside the living room or the kitchen was a place where the housewife could work easily and no one could see her (Pirnia, 2013).

If we examine the cities and villages of this climate, we come to the conclusion that climatic factors in the structure of cities, the design and architecture of these areas have rationally shaped, and over the millennia, solutions have been found that have amazing aspects. The main problem of people with the scorching sun is the great heat and high temperature during the day and low temperature at night. Storms and dust are characteristic of all hot and dry regions of the world.

One of the valuable solutions in response to all this misfortune was the original form of cities in this castle climate. Together and close together they minimized their climatic and social problems. The composition of a small castle town in hot, dry, and desert areas looks like this (Tavassoli, 1975).

3. COMPOSITION OF THE HOUSE IN HOT AND DRY CLIMATE

3.1. Courtyards

Iranian architects separated the building from the outside world by arranging parts of the building around one or more courtyards. Introverted houses act like a paradise in the heart of the desert in hot and dry climates. In such a way that the direction of the yard is obtained by drawing the geometry of the rectangles enclosed in a regular hexagon. In the northern part of the garden, there are sunrooms that can be used in all seasons. In the shady southern part is the summer area. In the east, facing the intense sun of the west, are located less important places and barns and screens. These rooms receive more light from the ceiling and have fewer doors and holes. One of the interests of Iranians in building a house is to create a connection between the space and the outside. Openness, vastness, and unobstructed view are part of Iranian nature, even today (Pirnia, 2009).

3.2. Summer residence

In order to be safe from the hot summer afternoons, an area was built on the southern front behind the qibla, which was called summer residence and is known among the people as Nisar and cold. The summer residence was always in the shade because its back is facing the sun. It is a word that in some traditional dialects of Iran refers to a region that its back is to the sun (shadow) or more precisely it can be said that it is an area in the house that receives less sunlight.

3.3. Winter residence

The winter quarters facing the qibla, which is located on the north side, were exposed to radiation and sun in winter to enjoy the natural heat of the sun. This room is also called Panj Dari or Tehrani which was sunny and the largest winter room. Tehrani had two small rooms with windows and a kitchen next to them.

3.4. Panam

Panam is another important issue considered in the construction of houses. Panam means insulation or barrier for something to pass from one body to another. Panam is very important in architecture. In traditional Iranian architecture, all buildings have double-walled roofs. The general logic is the same when it comes to making two folds of apartments and curved roofs. In both cases, people have tried not only to lighten the ceiling but also to prevent the transfer of heat from the outside to the inside.



(a)

(b)

Figure 1. One of the methods to prevent the penetration of heat and cold in old buildings has been the use of this technique in the construction of roofs. This is a figure of Panam in Barghan village - Karaj city - Alborz province. Source: Authors.

3.5. Orsi

The Orsi was also made of small pieces to prevent heat. This element later took a different shape, and on top of it, there is either a semicircular or quadrangular element. The sedari (three gates) was also built so that the sun could not penetrate them directly. Overhead lighting is another way to prevent direct sunlight in some rooms. The ancient architects believed that there was enough sun outside the house and did not think it necessary to have it in the same way in the rooms of the house. In the oldest houses, whether large noble houses or small houses in the countryside and in the city, some of the light was taken from the ceiling. In addition, this type of lighting in combination with the soft color of the walls and ceiling of the rooms creates a good calm. In more complete houses, where private life is nicely separated from public life, the elements are interior, exterior, roof, yard and garden, hallways, porches, etc. All these elements were sorted by size (Bloughi, Yousefi tazakor, 2017)



(a)

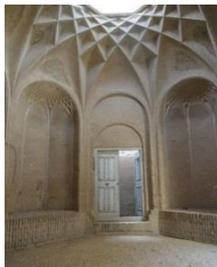
(b)

Figure 2. In the past, these windows were a combination of wood and glass, which prevented direct sunlight from entering and reduced its intensity (Source: www.orosihotel.com)

In terms of meaning and concept, the word Orsi is a compound word that means a window that moves upwards (to open and close the window) and is such that it usually covers the entire wall, from ceiling to floor. In fact, this window has several advantages that can be mentioned; Beauty and providing light inside the house - Reducing the intensity of light - Creative use of different colors - Also the geometric shapes of the windows give an artistic effect to the house - In general, it can be said that this type of window is used for two reasons: beauty and efficiency.

3.6. Hashti

A hashti is something that comes from inside the house and is the only place connected to the outside of the house. This winding room and the corridors that led to the inner and outer courtyards prevented strangers from entering the home. Creating breaks, spatial division, and waiting for space are some of the interesting functions of this element. To enter the different rooms, including party rooms and interior rooms, they have to go through winding corridors. In the houses of different cities such as Yazd, Shiraz, Isfahan, Kerman, etc., the courtyard functioned as a small garden (Pirnia, 2013).



(a)



(b)

Figure 3. In some Hashti, there is an opening in the ceiling that directs light inwards - It also connected the alley with a short or long corridor which the space inside the Hashti defined the property (Source: www.vaziri-semnani.ir)

3.7. Windows and shutters

In hot and dry climates, the number of windows and the area of buildings are minimized to prevent the penetration of reflected rays from the surrounding ground. For this purpose, windows are placed in the upper parts of the walls (Tahabaz, 2018). The use of colored glass, on the one hand, controls the light and intensity of radiation and, on the other hand, gives beauty.

4. BUILDING FORM IN HOT AND DRY CLIMATE

In these areas, due to winter conditions, the shape of the building can be expanded along the east-west axis. But due to summer conditions, buildings must be compact and cubic. In any case, by cutting a part of this cube and filling the resulting cavity with shadows (wall shadows, trees, ivy, etc.) and cooled air by evaporating water on the surface of grass, tree leaves, ponds,

and fountains, the space is relatively well created in the building. Therefore, the general plan of the building in these areas is inward (Kasmaei, 2005).

5. GREEN SPACE IN HOT AND DRY AREAS

In desert areas, the amount of revegetation depends on the amount of water and access to it. In hot and dry climates, greenery is very effective in the microclimates around the building for the following reasons;

1. effectively reduce direct solar radiation and its reflection
2. shade walls, windows, and courtyard areas
3. reduce dust around the building
4. reduce the speed of adverse winds around the building
5. concentrate wind flow and increase its speed in the desired direction
6. increase humidity in dry climates
7. reduce the temperature around the building.

The ability of plants to compensate for temperature fluctuations is an important factor in controlling solar energy. Soils in shady areas (away from sunlight) absorb heat much faster. The moisture of the plants reduces the heat and therefore the greened areas and some parts of the building remain cold longer during the day (Soflaei, 2004).

6. FEATURES OF INDIGENOUS ARCHITECTURE IN HOT AND DRY REGIONS OF IRAN AND MOROCCO

6.1. Plans

Plans are dense and compact, thus minimizing the external surfaces of the building relative to its volume. The amount of heat exchange in summer and winter is minimized and the maximum possible shade is created on the surfaces. Due to the winter conditions of these areas, the building form can be extended along the east-west axis, but summer conditions dictate the compactness of the building and it is necessary to have a cubic shape. In any case, by cutting a part of this cube and filling the cavity created by shade (wall shade, tree, ivy, etc.) and the air-cooled by evaporation of water from the surface of grass, tree leaves, pond, and fountain, a relatively favorable climate can be created in the building. The plan of the building can be freely around this inner garden, thus the general plan of the building in these areas is directed inwards.

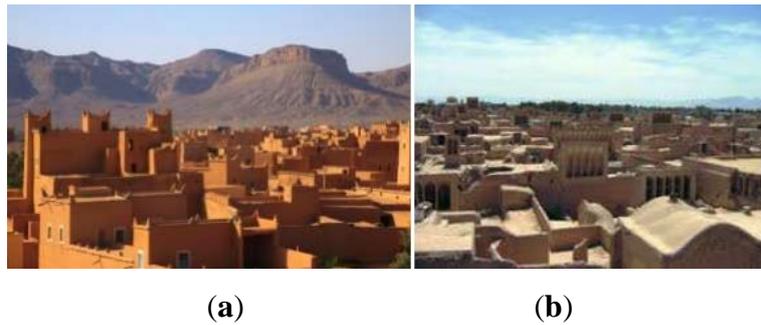


Figure 4. (a) Ouarzazate city (Source: <https://tripinmorocco.com/hollywood-africa-ouarzazate-city>) (b) Yazd city (Source: Heidari, 2012)

Ouarzazate

The plans are dense and compact, and all houses have three common external walls to prevent the exterior from being exposed to heat. Certainly, the cool air collected in these shady spaces is drawn to the yard by heat transfer and then penetrates into the houses, causing the houses to cool during the day.

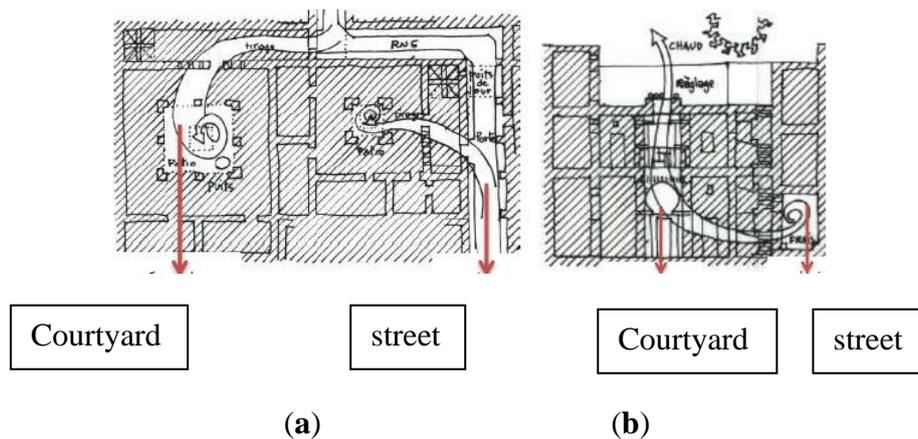


Figure 5. (a) Plan of a building in the city of Ouarzazate (Source: Nasiri, 2007) (b) Section of a building in the city of Ouarzazate (Source: Nasiri,2007)

6.2. passages

Yazd

To avoid sunlight, east and west passages are constructed as much as possible. Narrow passages with high walls on both sides of the passage are completely covered with shade in the hot afternoon and summer. In order to prevent the flow of air and the penetration of acute air conditions around the texture of the passages, winding and narrow passages are usually added to the density and compactness of the adjacent buildings.

Ouarzazate

The passages are very narrow with high walls on both sides of the passage and sometimes covered.



Figure 6. (a) Passage from the city of Ouarzazate (Source: <https://www.alamy.com/stock-photo/ouarzazate-morocco-street.html>) (b) Passage from the city of Yazd (Source: Heidari, 2012)

6.3. Materials

Yazd

The materials used in the walls are mainly clay and mud. The clay mud and soil have a high heat capacity.

Ouarzazate

Like the city of Yazd, the materials used in the walls are mainly clay and mud.

6.4. Facing

Yazd

Surfaces and facades are chosen in light colors to absorb less heat from the sun, and the facades and surfaces are polished and bright to reflect more sunlight. Most of the buildings in this city are spread horizontally.

Ouarzazate

Like the city of Yazd, surfaces and facades are selected in light colors. But in this city, most of the buildings do not have basements and were built in layers on the ground. In summer,

residents live during the day, at the bottom, and at night, at the top, and in the cold months, and vice versa.

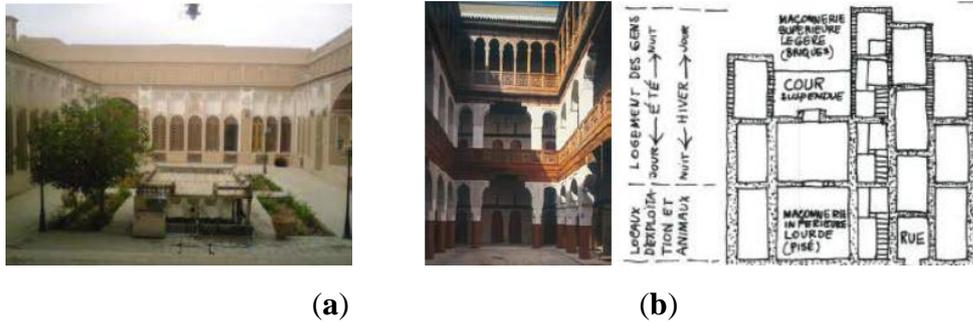


Figure 7. (a) Building facade in Yazd city (Source: Heidari, 2012) (b) Building facade in the city of Ouarzazate (Source: Nasiri,2007)

6.5. Courtyard

Yazd

Homes with central courtyards and enclosures are the most desirable composition and form for moderating acute climatic conditions, especially in hot and dry desert areas. The rooms open to the central courtyard, thus protecting them from the summer heat and winter cold, and from wind, sand, and storm.

Ouarzazate

The central courtyard creates seclusion away from the outside area for residents. Adjusting the air by creating a small garden in the central courtyard to place the rooms toward the central courtyard causes proper ventilation.

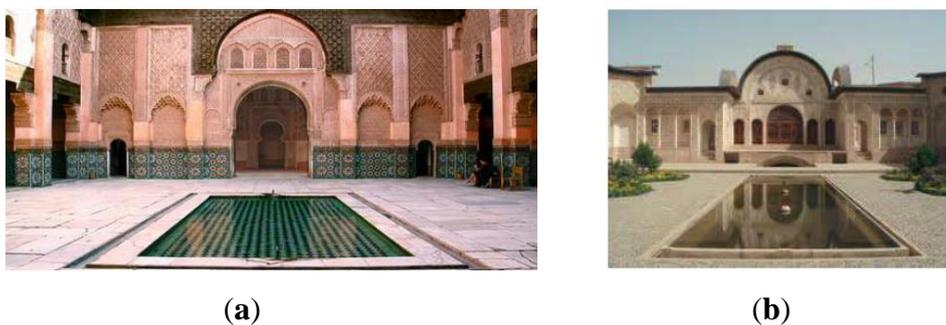


Figure 7. (a) Central courtyard in Ouarzazate (Source: <https://inspiredcitizen.com/where-to-stay-in-fes-morocco-riad-maison-bleue/>) (b) Central courtyard in Yazd (Source: Heidari, 2012)

7. CONCLUSIONS AND RECOMMENDATIONS

Smart climate architecture in hot and dry regions has created arrangements that are compatible with what is now called sustainable architecture. Awnings for regulating indoor temperature, use of waterfalls, trees, and garden pits for humidity, adaptation to the environment as a windbreak for air conditioning, and countless other things are mentioned. If we compare the principles of sustainable architecture with traditional Iranian architecture, we find that traditional Iranian architecture, by considering all the features of sustainability, has been able to overcome its environmental problems and pay attention to sustainable architecture. Traditional Iranian architecture provides comfort and a logical design of the climate. Traditional Iranian architecture is a manifestation of comfort and logical design in the climate. Traditional Iranian buildings, both architecturally and structurally, are built on natural energy sources. These buildings are designed to provide maximum sunlight in winter and maximum shade in summer to use natural ventilation to provide comfort to residents. Therefore, traditional Iranian architecture can be considered a suitable model for the sustainability of Iranian architecture. Architects of the past not only used natural resources to improve human comfort but also the construction techniques and materials of these buildings made them resistant to natural disasters. Panama, Orsay, windbreaks, gardens, central courtyards, windows, shutters, etc. are all still valuable and unique models for inspiration and use by researchers, designers, and architects looking for sustainability concepts. It seems that the people who created these elements in the past were more concerned with the people and had a much stronger understanding of the components around them. Instead of finding ambitious ways to overcome nature, their architecture has sought peaceful coexistence with nature. But they have not neglected the permanence and vitality of their works. The study of the traditional architecture of historic houses shows how this architecture has made the most use of renewable, cheap, and clean energy and the least efficiency of non-renewable, polluting, and expensive energy (which is one of the most important goals of sustainable development). The design of these traditional houses has reduced the need for fossil fuels and caused less damage to the environment, so they are examples of sustainable architecture. The findings of this study and similar studies can help policymakers consider these strategies for both future architectural policies and urban design to reduce building footprints and environmental impacts.

In any case, returning to traditional architecture and paying attention to its concepts, which are rooted in the rich culture of these two lands (Iran and Morocco) can solve many problems such as energy crises, environmental degradation, etc. It has brought many to governments and the international community. Of course, this return means restoring these principles and synchronizing them with new technology and the needs of today's societies, not merely imitating the architectural principles of the past, which will result in nothing but stagnation.

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