

# Investigating the Semantics of the Phenomenon of Ancient Roads in Iran by Emphasizing Their Formation and Development\*

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## ABSTRACT

The formation of Iran's ancient roads has been affected by various natural and human factors. Focus on these factors has led to the stabilization of a large part of ancient roads from old times up to now and has helped continue life in livable areas and led to the creation of cultural and natural heritage along those roads. In this way, ancient corridors, in addition to serving as transportation hubs, provide a wide variety of nature-based cultural and ancient opportunities; for this, measures need to be taken to manage and preserve these roads as they are inextricably linked with living areas and helping accumulate heritage sources. It is thus imperative to better understand the concept of ancient roads and their relations with the peripheral areas which incorporate natural and human geographies as the requirement for surveying the assets and advantages of those roads, before taking any protective and management measurements. In this regard, this study aimed to provide a better understanding of the factors that influence the formation, development, and stabilization of ancient roads in Iran to establish a semantic network of those roads. The study fell under qualitative research. Findings showed that throughout history, the source and destination in linking networks of ancient roads were not just important but the phenomenon of ancient roads could not be made possible only through a one-dimensional view of the physical environment. Thus, natural geography (e.g., ecological sources, environmental threats, registered documents, and the management and ownership system), human geography (e.g., cultural and social life, economic life, human needs, and threats, registered documents, environmental stimuli, and the managerial system), and geography of the road (physical aspects, travel, functions, registered documents, and the managerial system) can be regarded as the main elements constituting the semantic network of roads.

**Keywords:** Ancient Roads, Formation and Development, Natural Geography, Human Geography, Semantic Network of Roads.

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## 1. INTRODUCTION

Ancient roads still exist. In some cases, their physical evidence is entirely observed and is still used. Some roads are laid hidden beneath modern roads. Yet, some others are still ways for walking and contain some weak recesses or depressions deep inside the earth, which can hardly be determined (Forest 2007). “The route of caravans almost fades away; however, for those who are used to seek ways, they may find places wherein neither the howling of the desert’s wind nor the toll of the camels’ bells have ever penetrated amidst the commotion of cars” (Harold 2008). In the formation of early roads, only the access or link roads, arrival at the destination and the shortest roads were regarded to be important. Following the establishment of “routes” and the commencement of traffic, the travelers who moved toward the destination would pay attention to new capacities to construct their environment to meet their needs just like the civilized man who aspired to unchain himself from the shackles of livelihood and to see “life” as beyond “living” and to think of their high-end needs such as growth, spirituality, culture, and art. Gradually, the road took on a meaning beyond the linkage between the two points. Hence, not only are roads and relevant elements seen as cultural heritage in landscapes, the road manifests as a viewpoint for representing nature and the heritage built in the periphery (Grazuleviciute-Vileniske and Matijosaitiene 2010; Mansouri 2016). In this way, roads indicate critical arteries of land and serve as major factors of dynamism in societies that are directed toward cultural progress and civilizational development. Preservation of ancient roads as the preservation of legal ancient sources, which exhibit the unique and valuable characteristics of a society and serve as cultural, historical, and natural places, would simulate and strengthen experiences of cultural identity (Marriot 2010; Griffin and NRM 2005). In this connection, it is crucial to understand the phenomenon of roads to evaluate the current situation and to make policies and provide suggestions for planning and managing how to preserve the future life of ancient roads. In Iran, geographical characteristics and dimensions of livability (livelihood and bio-ecological variables) have directly influenced the formation of livable and habitable and linking areas and have thus led to different models. Cultural accumulation along these routes has produced various cultural heritage elements and values; meanwhile, road-dependent historical buildings, which are direct evidence of these cultural and historical measures, reveal the well-established stability of Iran’s ancient roads. The question raised is: “Which factors contribute to the formation and development of ancient roads? And What factors help to create a phenomenon, called “the road”?”

In sum, this study aimed to provide an inclusive and systematic framework to promote knowledge about

ancient roads and to understand the various factors that helped to form and develop this linking network, thus striving to determine the levels and components affecting the understanding of ancient roads. Understanding the elements of roads and the meaning of the phenomenon of ancient roads would reveal an effective step to preserving and managing them.

In so doing, the study first reviewed the literature related to the subject under study and then identified the factors influencing the formation, changes, development, and stability of ancient roads in Iran. Later, the study analyzed and compared the obtained results to describe the semantic network of ancient roads.

## 2. LITERATURE REVIEW

According to the literature review, various approaches have been adopted by researchers for studying and understanding roads, road landscapes, and cultural roads. Table 1 below lists relevant literature, dimensions of the road and its landscape, and finally the general levels under study. Research has shown that no uniform categorization has been used for studying the characteristics of ancient roads in the literature. However, characteristics, as found in the literature, can be generally categorized into three human, natural, and road geographies. As shown by Table 1, the aspects studied at each level in the related literature are different. It is also noteworthy that in one of the relevant sources, only the road geography received attention (Caltrans 2016), while others failed to take up the level of the geography of the road to focus on understanding the landscape (Kavian, Massoudm and Talebian 2020) and historical landscape (Islami, Nurhayati, and Gunawa 2021).

Findings from the relevant literature reveal that concerning the geography of the road all sources have studied the physical characteristics of ancient roads and the understanding of historical and ancient sites and buildings that relate to roads. Meanwhile, some other sources have not just studied the physical evidence and remnants of roads; rather, they have also investigated the history of how the roads were formed (Marriot 2010; Caltrans 2016; Durusoy 2014; Amini Sad 2013), as well as the engineering and anatomical characteristics of the roads (Marriot 2010; Caltrans 2016; Gholampour, Mansouri, and Shahcheraghi 2021). Moreover, as emphasized by the Chart on Cultural Routes (ICOMOS 2008), the role and significance of roads throughout history indicates another aspect that has received attention in a wide range of research. This aspect is in some sources exclusive to the historical significance (Marriot 2010). Yet in some others, in addition to the historical significance, the understanding of the inter-cultural significance of ancient roads (ICOMOS 2008), the understanding of cultural and economic significance (Caltrans 2016), and the role of road through social, economic, semantic and spiritual (Durusoy 2014) dimensions were examined.

The description of the landscape around the roads is yet another aspect that has a special standing in studies. In this connection, one study by Grazuleviciute-Vileniske and Matijosaitiene (2010) investigated the effects that road formation has had on the landscape and its aesthetics while paying attention to the landscape in the periphery of the road. In the meantime, another study by Gholampour, Mansouri, and Shahcheraghi (2021) has examined the effects of creating a road on regional ecology. Furthermore, the history of road planning and management in the past and the present (Marriot 2010; Durusoy 2014), travel means and provisions (Caltrans 2016), and road relation with its formation characteristics (ICOMOS 2008; Keke 2019), not to mention others, are subjects that are taken up by other studies.

According to the literature review, concerning “human geography”, a large part of research has emphasized the understanding and description of the history of the formation of human textures. In this research, under the Burra Charter on the significance of understanding historical, aesthetic, scientific, social, and spiritual values for determining cultural significance (Australia ICOMOS, 2013), investigations have been made into [human textures] from two tangible and intangible aspects, especially in the region where the road goes through. Some sources have specifically addressed the issue of human activities and human livelihood around the roads and the way they relate to route dynamism (Durusoy, 2014; Griffin NRM, 2005; Gholampour, Mansouri; Shahcheraghi, 2021; Kavian, Massoud & Talebian, 2020). Also, since the growing social life and the ever-expanding communications between various human groups have led to the expansion of roads and growing and frequent journeys have made

routes into appropriate roads (Lay 2007), it is critical to investigate the inter-cultural interactions, links, exchanges, and mobility among various social groups throughout history, with some research taking up the issue, including (Durusoy 2014; Garau, Annunziata, and Yamu 2020). Also, the study of management and planning documents (Garau, Annunziata, and Yamu 2020) is another subject that takes up human geography. The key point is that some studies have examined the values and heritage in the past and the present (Griffin NRM 2005) and the human interactions and interventions with the historical characteristics of the region (Garau, Annunziata, and Yamu 2020).

Concerning “natural geography”, most research has investigated the natural characteristics of the regions under study, including climatic, topographic, biodiversity, vegetation, and animal characteristics. Natural landscape values of the road and natural heritage diversity (Griffin NRM 2005; Garau, Annunziata, and Yam 2020; Islami, Nurhayati, and Gunawa 2021; Grazuleviciute-Vileniske and Matijosaitiene 2010), as well as the rare and unique situation of this heritage (Durusoy 2014), not to mention others, are major topics that receive attention in other research. Other topics of interest, include the conservation of natural characteristics of the region and attention to man-made natural green areas (Durusoy 2014), changes in these characteristics throughout history (Griffin NRM 2005), as well as the relationship of the elements of the heritage with other regional natural characteristics (Garau, Annunziata, and Yamu 2020) for describing the natural geography, have been examined by researchers.

**Table 1. Different Global Approaches to the Study of Road and Cultural Routes**

| No. | Title   | Source             | General Levels of the Study of Road and Sub-Components (Aspects of each Level)   |
|-----|---|--------------------|--|
| 1   | The Old Great North Road Cultural Landscape     | (Griffin NRM 2005) | <ol style="list-style-type: none"> <li>1. Human geography: Past social values, contemporary social values, popular livelihood relation with roads, local heritage, local heritage arising from human and nature interaction (cultural landscape)</li> <li>2. Natural geography: Bio-diversity, topographic diversity, evidence for environmental changes over time, and natural landscape values of roads</li> <li>3. Geography of the road: Physical remnants of ancient roads, historical sites, and buildings related to the road</li> </ol>  |
| 2   | The ICOMOS Charter on Cultural Routes           | (ICOMOS 2008)      | <ol style="list-style-type: none"> <li>1. Human geography: Describing the cultural texture of the region</li> <li>2. Natural geography: Describing the natural texture of the region</li> <li>3. Geography of the road: Physical remnants of ancient roads, tangible and intangible heritage assets related to ancient roads, the inter-cultural significance of ancient roads, describing the dynamism of ancient roads and their role of dynamism in the reciprocal transfer of cultural elements between human societies, the relation between roads and its formation characteristics</li> </ol>   |
| 3   | The Preservation Office Guide to Historic Roads | (Marriott 2010)    | <ol style="list-style-type: none"> <li>1. Geography of the road: Complete understanding of the road anatomy, road materials, and construction techniques, history of ancient road planning, horizon of view of routes to ancient roads, investigating the history and historical eras of road construction, the historical significance of roads, historical buildings related to roads</li> <li>2. Human geography: Describing characteristics of a society through which the road goes, describing the cultural landscape</li> <li>3. Natural geography: Natural characteristics of the landscape around the road: Parks, natural regions, vegetation, the rural and urban nature</li> </ol> |

| No. | Title   | Source   | General Levels of the Study of Road and Sub-Components (Aspects of each Level)   |
|-----|---|--|--|
| 4   | Cultural Heritage of Roads and Road Landscapes  | (Grazulevičiute-Vileniske and Matijošaitiene 2010) | <ol style="list-style-type: none"> <li>1. Geography of the road: Describing the physical route of the road, describing historical buildings related to ancient roads, the reason for the significance of roads throughout history, describing the historical, spiritual, and aesthetic significance of ancient roads</li> <li>2. Human geography: Characteristics of the cultural landscape of the road, describing historical buildings around the road</li> <li>3. Natural geography: Describing aesthetic, social, and ecological aspects of the natural landscape created as a result of road construction</li> </ol>  |
| 5   | From an Ancient Road to a Cultural Route  | (Durusoy 2014)                                     | <ol style="list-style-type: none"> <li>1. Geography of the road: Configuration of ancient roads, the relation between ancient roads and human livelihood, significance of roads throughout the historical era, role and function of roads throughout history socially, economically, spiritually, and semantically, describing road landscape and historical buildings related to roads, describing managerial issues related to historical roads</li> <li>2. Human geography: Social diversity and cultural interaction, inter-cultural aspects and effects, such as links, exchanges, mobility among various cultural groups, sense of identity, and past and present cultural effects, intangible elements of the environment such as traditions, customs, events, activities, uses, narratives, written documents, festivals, rites and rituals, traditional knowledge, skills, representation, values, textures, arts, colors and smells, local popular livelihood with roads</li> <li>3. Natural geography: Unique and intact natural environment, climatic characteristics, ecology, vegetation and bio-diversity, topography, status of preservation, rare and unique status, diversity and liveliness of natural elements, such as mountains, valleys, rivers as well as man-made natural green areas, and cultural landscapes, such as parks, jungles, farmlands, greenhouse areas, vineyards, parks, green roofs, single trees, monumental natural elements.</li> </ol> |
| 6   | A Historical Context and Methodology for Evaluating Trails, Roads, and Highways in California | (Caltrans 2016)                                    | <ol style="list-style-type: none"> <li>1. Geography of the road: History of routes, road engineering, and construction, travel means and provisions, road-related buildings, cultural and economic roads, and functions of roads throughout history</li> </ol>   |
| 7   | Preservation of Cultural Routes: Historic Center of Manisa                                    | (Keke 2019)  | <ol style="list-style-type: none"> <li>1. Geography of the road: Physical characteristics, road relations with the peripheral environment, historical buildings related to the road</li> <li>2. Human geography: Historical development and history of human context through which the road goes, history of spatial planning and organization, cultural assets</li> <li>3. Natural geography: Geographical characteristics of the region, including climatic topography, vegetation and animals, types of land use</li> </ol>   |
| 8   | The Multi-Method Tool 'PAST' for Evaluating Cultural Routes in Historical Cities              | (Garau, Annunziata, and Yamu 2020)                 | <ol style="list-style-type: none"> <li>1. Human geography: Describing the cultural elements of tangible and intangible heritage, the significance of cultural landscape, describing historical cores and expressing the inter-cultural significance between them, historical, aesthetic, scientific, social, and spiritual values embodied in a man-made environment, human interventions in the historical texture, management, and planning documents</li> <li>2. Natural geography: Describing highlands and natural areas, value of the natural environment as a territorial source, relations between heritage elements and regional natural characteristics</li> </ol>   |
| 9   | Landscape Planning of the Historical Tourism Route of Siak Sultanate in Siak                  | (Islami, Nurhayati, and Gunawan 2021)              | <ol style="list-style-type: none"> <li>1. Human geography: Describing the history of the region, list of tangible and intangible cultural heritage, describing the significance of cultural heritage, describing historical tourism elements</li> <li>2. Natural geography: Geographical characteristics such as the climate, topography, vegetation, land use, list of natural heritage</li> </ol>  |
| 10  | Recognizing Ancient-Historical Roads and Preserving Old Signs in the Ray to Saveh Area        | (Amini Sad 2013)                                   | <ol style="list-style-type: none"> <li>1. Geography of the road: Describing the physical route, history, and background of ancient roads in the region throughout history</li> <li>2. Human geography: Describing the background and history of the region, describing the population, race, language, religion, dialect, customs, figures, list of historical buildings</li> <li>3. Natural geography: Geographical situation, geology, water resources, regional climate</li> </ol>  |

| No. | Title   | Source  | General Levels of the Study of Road and Sub-Components (Aspects of each Level)  |
|-----|---|---|---|
| 11  | Expressing uniformity in the landscape; Presenting a new conceptual model                                   | (Kavian, Massoud, and Talebian 2020)          | 1. Human geography: Archeological characteristics, man-made structures, historical objects, describing stories, aesthetics, meanings, sense of place, memories, doctrinal symbols, spirituality, human activities, historical processes, historical events, ecological processes, human systems<br>2. Natural geography: Vegetation and natural landforms                       |
| 12  | The landscape approach in the realization of cultural tourism mediated with the cultural phenomenon of road | (Gholampour, Mansouri, and Shahcheraghi 2021) | 1. Geography of the road: Physical dimensions of the road, including the route, road parts, road-construction effects on the ecology<br>2. Human geography: Describing the human context through which the road goes, describing cultural backgrounds, describing activities, economics, and politics<br>3. Natural geography: Geology, the climate, vegetation and animal life |

Despite the aforementioned research and relevant literature that emphasizes the understanding and preservation of the landscape of ancient roads, no research, either domestic or foreign research, has ever accurately described the framework by which ancient roads can be studied. Only one study has explored the subcomponents to be addressed at any level (without expressing the way each component is described) (Durusoy 2014). In addition, as suggested by the literature review, the territorial environment, both natural and cultural, was regarded to be an inseparable part of ancient roads, with a strong link existing between ancient roads and their peripheral environmental capacities (ICOMOS 2008). In the meantime, a study by Keke (2019) has briefly mentioned the characteristics of road formation, though it is not clear how this issue has been reflected in human and natural geographies. For this, it is required to use an inclusive approach to re-read a semantic network and the nature of an ancient road corridor. According to this approach and in line with the literature review, in addition to the physical characteristics of ancient roads, the natural characteristics and the human environment characteristics, which include historical and contemporary periods, as well as attention to the factors involved in forming, developing and stabilizing roads throughout history, will be critical. For this, this study aimed to re-read the nature of ancient roads and explore the relationship between this subject and Iran's ancient roads.

### 3. METHODS

This qualitative study was divided into three parts: in the first part, i.e., the literature review, an analytical-interpretive approach was used to analyze the relevant sources. Here, the emphasis was placed on various dimensions of ancient roads whose comparison led to some general levels of roads, including physical, historical, natural, and human dimensions. In this stage, the literature related to the terms road, ancient roads, road landscape, and cultural routes were extracted from Persian and English books, which have published up until now (Persian books were taken from Elm.net database and English books from Open

Library), academic research, including theses and dissertations from 2011 to 2022, conducted in various research institutes (Persian research from Elm.net and English research from the ProQuest database), scientific and research articles from 2011 to 2022 (Persian texts from Elm.net database and English texts from Scopus), as well as relevant international charts. Having been reviewed, the sources led to 12 available references which were most related to the subject under study and the Iranian geographical environment.

In the next stage, an analytical and interpretive approach was used to determine the results taken from the literature review to better understand the formation of Iran's ancient roads and to identify the factors influencing the formation, changes, development, and stability of those roads in Iran. In this stage, relevant sources taken from searches in Persian sources, which have been published so far (e.g., books on Persian research, scientific and research articles taken from Elm.net database), were collected.

In the third stage, a descriptive-analytical approach was used to provide a more comprehensive insight into the nature of ancient roads, using data obtained from previous stages.

### 4. IDENTIFYING THE FACTORS INFLUENCING THE FORMATION, CHANGES, AND DEVELOPMENT OF IRAN'S ANCIENT ROADS

In Iran, roads served as pathways for the traffic of caravans, and vehicles, including carts and trailers, for many centuries, and were used to get travelers toward their destination and stretched until one could see (Schopfer 1992; Lotfi 1994). These roads covered different destinations, and if they ran across mountains, lagoons rivers, or any other similar obstacles, they could deviate from the main centers, with the quadruped continuing their rides on these roads without being hurried off by anyone (Wills 2004). These roads were formed completely naturally and based on the natural structure of Iran's plateau and the natural model of water and soil which was

experienced by locals, without any disturbing road-construction measures (the organic model) ever taken; in the meantime, even the architecture of the buildings related to roads and types of roads (desert and mountainous) was completely affected by nature and the climate.

#### 4.1. Factors Influencing the Formation and Development of Ancient Roads

As stated above, man has always had a mutual and systematic relation with his ecology, with change to one causing change to the other that resulted in

maintaining balance in the system. Evidence like roads, habitable areas, irrigation channels, farmlands, etc. are signs of man-environment interaction. In this interaction, in addition to the human impacts on the environment, the environment, in turn, as the human life context, leaves deep impacts on the livelihood and the cultural formation of human beings (Amirhajloo et al. 2013). According to historical and contemporary sources, the following factors have influenced the formation and development of ancient roads in Iran (Table 2).

**Table 2. Factors Influencing the Formation and Development of Ancient Roads**

| No. | Factors  | No. | Factors  | Sources                 |
|-----|--|-----|--|-------------------------|
| 1   | Geographical factors (flatness and roughness)  | 2   | Climatic factors (coldness and heat)   |                         |
| 3   | Security factors (attacks by enemies and looting of caravans)  | 4   | Amenities factors (provisions for travelers, fodder for animals, and the presence of water and prosperity)                         | (Takmil Homayoun 2022)  |
| 5   | Procurement factors (Caravans and resorts/ repair and travel equipment)  | 6   | The vastness of Iran's territories and the advantageous status of linkage with the big centers of the world's civilizations        |                         |
| 7   | The natural structure of Iran's plateau and the natural status of water and soil   | 8   | Civilizational growth and industrial power   | (Pirnia and Afsar 1991) |
| 9   | Natural amenities  | 10  | Route perspective  |                         |
| 11  | Shortness of route   | 12  | Easiness of route  |                         |
| 13  | Collective migration   | 14  | Natural barriers to traffic  | (Mahmoudian 2015)       |
| 15  | Accessible engineering and materials   | 16  | Environmental capacities (Geographical capacities)   |                         |
| 17  | Religious, doctrinal/ideological, and value motives in connection with territorial sanctity, special places and peoples' spiritual (Pilgrimage) needs. | 18  | The will of the ruling government  |                         |
| 19  | Production and industrial hubs and technological and scientific transfer   | 20  | Social, economic, and cultural transformation  | (Bazazan 2007)          |
| 21  | Means and longevity of travel time   | 22  | Attention to the easiness of traffic for meeting linking/communication needs, transportation of products, and produced items       |                         |
| 23  | The need for commerce and amassing wealth <sup>1</sup>   | 24  | Political and government factors, military campaigns (the need for short roads to deal with the nation's affairs and protect them) | (Siroux 1949)           |
| 25  | Key cities and government capitals in each historical era  |     |  |                         |
| 26  | Astronomy: Science of stars and observation of stars <sup>2</sup>  |     |  | (Bahauddin Ameli 1992)  |

#### 4.2. Factors Influencing the Changes and Displacement in the Network of Ancient Roads

The network of roads in each historical era was

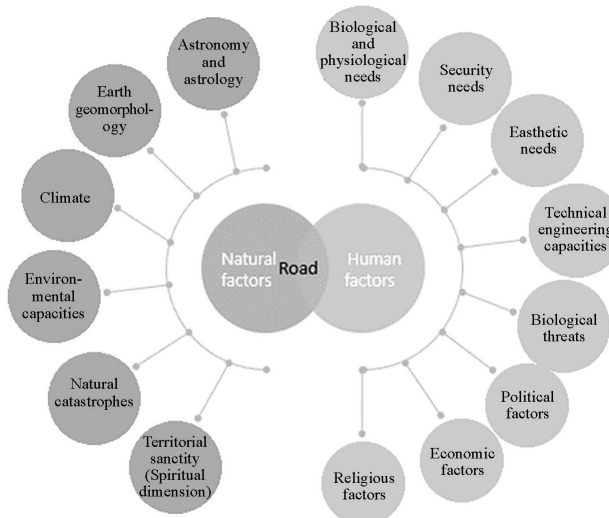
developed based on previous roads; however, some differences can be investigated (Table 3).

**Table 3. Factors Influencing the Changes and Displacement in the Network of Ancient Roads**

| No. | Factors   | No. | Factors  | Sources                         |
|-----|---|-----|--|---------------------------------|
| 1   | Changes of capital in each historical era   | 2   | Destruction of some cities, and bridges and inundation of some roads                   | (Pirnia and Afsar 1991)         |
| 3   | Some major cities getting outmoded and outdated accompanied by the construction of new cities around them |     |  |                                 |
| 4   | Natural disasters/catastrophes (flooding and droughts)  |     |  | (World Heritage Committee 1994) |
| 5   | Changing bio-ecological variables   |     |  | (Amirhajloo et al. 2013)        |
| 6   | Political events (wars, coups, campaigns, and diplomatic risks)   | 7   | Road insecurity and lack of quality (physical, hard-to-reach, and presence of bandits) | (Bazazan 2007; Ehteshami 2014)  |
| 8   | Will of the ruling government and the king  | 9   | Decline of welfare and services and amenities related to road                          |                                 |
| 10  | Prevalence of contagious diseases   |     |  |                                 |

That said, ancient roads were constructed based on natural corridors and the need to protect humans against various threats for some cultural insights

(Talebian 2016). In this connection, a more profound study of ancient roads requires a more inclusive approach to these factors (Fig. 1).



**Fig. 1. Semantic Model of the Factors Influencing the Formation, Developments, Changes, and Displacement of the Network of Ancient Roads in Iran**

### 4.3. Stability of the Network of Roads Throughout History

Despite some changes and displacement to the network of ancient roads, which were referred to earlier, the history of ancient roads in the world indicates that humans have throughout history constructed routes

for hunting, herding, and trading, with groups of explorers, migrants, pilgrims and tourists taking these routes off and on (Timothy and Boyd 2015). Numerous factors suggest that the human line of mobility and the routes of big roads have not changed that much since old times up to now (Table 4).

**Table 4. Factors Indicating the Stability of the Network of Roads Throughout History**

| No. | Factors   | No. | Factors   | Sources                 |
|-----|---|-----|---|-------------------------|
| 1   | Location of villages, oases, ancient hills, and pre-history explored settlements around current roads | 2   | Construction of new cities around old cities or at their sites after demolition                                       | (Pirnia and Afsar 1991) |
| 3   | The presence of stone carvings close to current cities  | 4   | Approximate matching of migration routes and the influx of groups of people in various eras to major traffic arteries |                         |

| No. | Factors  | No. | Factors   | Sources           |
|-----|--|-----|---|-------------------|
| 5   | Presence of tribal roads for winter and summer migration, as well as for nomads and tent dwellers  | 6   | Geographical and climatic conditions and water resources that necessitate human roads                       |                   |
| 7   | Much historical and archeological evidence related to various historical eras and the remnants of caravanserais, post offices, and on-road stations near current roads, cities, and villages.  | 8   | Special human living conditions and his motive in evolution and communication with other tribes and nations | (Mahmoudian 2015) |
| 9   | Continuation of using the buildings and structures around roads that belong to ancient eras, as well as the improvement, development, and transformation of compounds and human settlements in various historical eras, which indicate dynamism, continuation, transportation, road construction, etc. |     |   | (Ehteshami 2014)  |
| 10  | Matching of movement routes by geographers, historians, and tourists in various historical eras, as stated in history and geography books and itineraries  |     |   |                   |

As stated, understanding the factors leading to the stability of Iran’s ancient road network over time will also influence the understanding of the values and the phenomenon of ancient roads, which should be included in the semantic network of roads.

### 5. FORMATION OF THE SEMANTIC NETWORK OF ANCIENT ROADS

Controlling the limits of ancient roads and the definition of a system that would enable studying all relevant elements require a listing model that would not miss out on any aspects of the preservation and management of ancient roads. The information obtained this way, would also provide the listing of all

road-related assets and advantages based on cultural values. The analysis of dimensions extracted from sources in the literature review section, as well as the factors influencing the formation, development, and changes of ancient roads, and those indicating the stability of the network of roads throughout history reveals the natural geography, the human geography and the geography of the road as the main components constituting Iran’s semantic network of roads (Fig. 2). This categorization helps to systematically reread all studied elements in the literature review, all the characteristics upon which ancient roads were formed, developed and changed, as well as all contemporary characteristics of ancient roads and their peripheral landscapes.

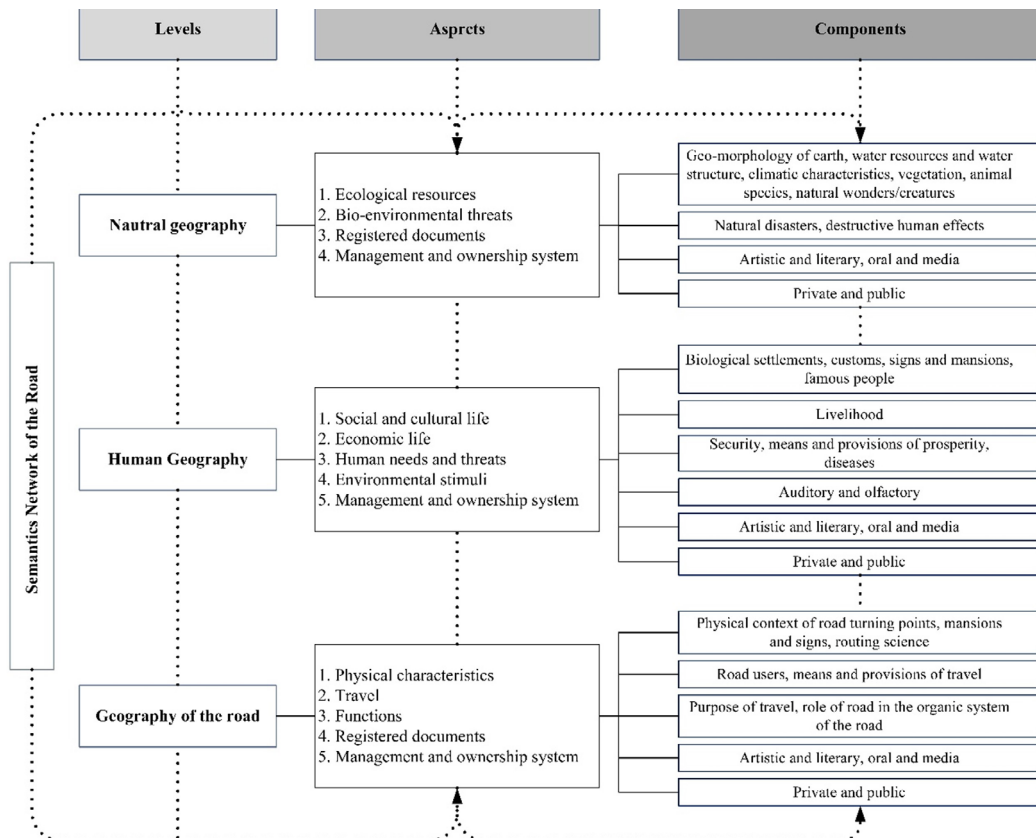


Fig. 2. Diagram of the Semantic Network of Roads

Natural geography can be investigated from the four aspects of ecological resources, bio-environmental threats, registered documents, and the management and ownership system; human geography can be investigated from the six aspects of social and cultural aspects, human needs and threats, registered documents, environmental stimuli, and the managerial system; also, the geography of the road can be investigated from the four aspects of physical characteristics, travel, functions, registered documents, and the managerial system. Various components, which can be described utilizing various

elements, will determine each of the mentioned aspects (Tables 5-7). It is thus critical to provide a structured summary of key characteristics and the status of each of the elements. This summary reveals the nature of the levels of the natural geography, human geography, and the geography of the road by reference to various databases, including written documents, visual documents, and the collection of field data, the documentation of data in the form of tables and maps to ensure the quality of data collection and to form the semantic network of roads at the three levels.

**Table 5. Hierarchy of Understanding what is Meant to be the Phenomenon of the Road (Formation of the Semantic Network of Roads) at the Natural Geography Level**

| Aspects                              |   | Ecological Resources   |
|--------------------------------------|---|--|
| Components                           | Elements  | Description  |
| Earth geo-Morphology                 | <ol style="list-style-type: none"> <li>1. Mountainous lands: mountains, rocks, bottlenecks, valleys, cliffs</li> <li>2. Flat lands (plains and plateaus)</li> <li>3. Man-made structures: Fortification (castle on mountains) and castles (on hills and land)</li> </ol>  | Name and appellation, geographical situation, forms, colors, genus, slope, vegetation, water resources (rivers and boiling springs, their origins), safety, use, valley depths, meaning association (symbolic aspects)                                 |
| Water Resources and Water Structures | <ol style="list-style-type: none"> <li>1. Natural resources: Springs, rivers, pools, headwater, underwater</li> <li>2. Man-made structures: <ul style="list-style-type: none"> <li>- Water transfer, aqueducts and waterwheel</li> <li>- Water reserves, pool and cistern</li> <li>- Water control: bridges and dams</li> </ul> </li> </ol>                         | Name and appellation, geographical situation, water volume (high and low water), origin, movement path (territories and places where water goes through and leads to), status of manmade structures, water temperature (cold or hot), use and property |
| Climatic Characteristics             | Climate characteristics in the seasons  | Temperature description, moisture, wind, rainfall (snow, rain, hails), pressure, fogs, relevant benefits   |
| Vegetation                           | <ol style="list-style-type: none"> <li>1. Jungles</li> <li>1. Grassland and pastures (for sheep, etc.)</li> <li>2. Lagoons and marshlands</li> <li>3. Land where nothing grows (Rocks, ridges, salt marshes, salt marshes, burnt-down lands without plants, and devastated lands)</li> <li>4. Mountainous and forest trees, as well as other wildflowers</li> </ol> | Name and appellations, geographical situation (where things are situated), plant names, their benefits, and properties, fruitful and fruitless, wild or planted, meaning association   |
| Animal Species                       | Birds, grazers, predators, and stingers   | Types, advantages, and disadvantages, meaning association  |
| Natural Creatures/Wonders            | <ol style="list-style-type: none"> <li>1. Power wonders of land and mountains</li> <li>2. Power wonders of vegetation and animals</li> </ol>  | Types, situation   |

| Aspects                   |   | Bio-Environmental Threats   |
|---------------------------|---|---|
| Components                | Elements  | Description   |
| Natural Disasters         | <ol style="list-style-type: none"> <li>1. Disasters (Plague, cholera, frostbite, hot wind, lightning, grasshopper pests, etc.)</li> <li>2. Land plights (earthquake, famine, flood, fire, and destruction)</li> </ol> | When and which season, to what extent, advantages and disadvantages |
| Human Destruction Effects | Changes in biophysical environments, ecosystems, biodiversity, and natural resources  | Types, direct and indirect effects, how much, losses                |

| Aspects               |  | Registered Documents   |
|-----------------------|--|--|
| Components            | Elements   | Description  |
| Artistic and literary | Collection of artistic and literary works that define the natural context and the past and contemporary historical events, including poetry, story, music, theater, paintings, sculpting, animation, drama plays, etc. | Creator of artwork, history of the creation of the artwork, and representation characteristics                                       |
| Oral                  | Collection of registered documents that define the natural context and past and contemporary historical events from an oral association aspect, including language, folklore, and any other oral background            |  |
| Media                 | Collection of media documents that define the natural context of past and contemporary historical events, including the press and advertisements, TV and radio, films, and any other media                             |  |
| Aspects               |  | Management and Ownership System  |
| Components            | Elements   | Description  |
| Public                | Management and social organizations and offices, institutes, entities  | - Responsibilities, powers, task description, plans and programs underway, planned programs for future, legal decisions and measures |
| Private               |  | - How does the ownership of natural environment components look like?  |

**Table 6. Hierarchy of Understanding the Concept of the Phenomenon of the Road (Formation of the Semantic Network of the Road) at the Human Geography Level**

| Aspects                    |   | Social-Cultural Life  |
|----------------------------|---|---|
| Components                 | Elements  | Description   |
| Living Areas (Settlements) | <ol style="list-style-type: none"> <li>1. Cities, oases, villages and farmlands</li> <li>2. Human communities</li> <li>3. Tribes and clans</li> </ol>   | <ol style="list-style-type: none"> <li>1. Name and appellation, geographical situation (where they are situated), historical era, founder of (settlements), old and new boundaries, properties, prosperity status</li> <li>2. Number of people, houses, forms and figures, heights, etc.</li> <li>3. Tribes, number of households per tribe, location of cold and warm areas,</li> <li>4. Apparent characteristics of what is revealed on the route (e.g., forms and figures, status of prosperity or destruction, materials and colors)</li> <li>5. Functions of road</li> <li>6. Meaning association</li> </ol> |
| Customs                    | <ol style="list-style-type: none"> <li>1. People's companionship with each other and with strangers</li> <li>2. Religion and language</li> <li>3. Clothing and food</li> <li>4. Living area</li> <li>5. Customs and rituals of various ceremonies, including marriage and mourning</li> </ol> | <ol style="list-style-type: none"> <li>1. Ways of companionship, customs, diligence</li> <li>2. Religion and language in the past, in the present, and the cause of changes</li> <li>3. Style of clothing and types of food in the past and present</li> <li>4. How did the place and way of living look like in the past and the present?</li> <li>5. How did and does life look?</li> </ol>   |
| Signs and Mansions         | <ol style="list-style-type: none"> <li>1. Great mansions, signs, and buildings, including mosques, bathrooms, schools, and pilgrimage sites</li> <li>2. New buildings and complexes, as well as compounds</li> </ol>  | <ol style="list-style-type: none"> <li>1. Number and types of status, situation, founder of (settlement)</li> <li>2. Apparent characteristics of what is revealed on the route (forms and figures, status of prosperity or destruction, materials and colors)</li> <li>3. Function and type of ownership</li> <li>4. Meaning association</li> </ol>   |
| Famous People              | <ol style="list-style-type: none"> <li>1. Famous traders business owners and farmland owners</li> <li>2. Old families, including scholars, mystics, philosophers, and famous figures</li> <li>3. Rulers</li> </ol>  | <ol style="list-style-type: none"> <li>1. Their names in the past and the present, live and dead, their business status, their memories, cause of their fame</li> <li>2. Their names in the past and the present, live or dead. How did they earn their living? Their memories and monuments and the cause of their fame</li> <li>3. Name, place of government, and their tribes in the nation. How was the nation ruled? How is it ruled now? Their memories, their cause of fame</li> </ol>   |

| Aspects    |   | Economic life   |
|------------|---|---|
| Components | Elements  | Description   |
| Livelihood | <ol style="list-style-type: none"> <li>1. Farming and agriculture</li> <li>2. Gardens, orchards and vegetation</li> <li>3. Cereals and corns</li> <li>4. Plants and flavors</li> <li>5. Minerals (e.g., gold, copper and silver, iron, lead. Etc.)</li> <li>6. Industry and business</li> <li>7. Owners of herds, sheep, ranch owners</li> <li>8. Commercial goods in the past</li> <li>9. Court taxes</li> <li>10. Female business and work</li> <li>11. Local handicrafts</li> <li>12. Road related livelihood</li> </ol> | <ol style="list-style-type: none"> <li>1. Place of agriculture (type of soil, earth, etc.), types of agriculture, the science of agriculture, the status of each season in the year</li> <li>2. Name and appellation, geographical situation (where they are situated?), types of plants, citrus and fruits, science of nurturing orchards and gardens</li> <li>3. What types of plants? amounts, uses, principles of raising and cultivation</li> <li>4. What types? advantages, which one is imported and exported?</li> <li>5. What types? amounts, advantages, how much is consumed, and what about the uses?</li> <li>6. What types, and places, where they are consumed, being private or not?</li> <li>7. What type, which is better? Number of shops and their status</li> <li>8. Name, place and why?</li> <li>9. What was imported or exported in the past? Which goods saw the highest demand or buyers? How were the goods traded for? (money, goods), profits and losses in the past and the present</li> <li>10. How about the taxes and their principles?</li> <li>11. Environmental relations/ what about business owners (fixed or temporary)</li> </ol> |

| Aspects              |  | Human Needs and Threats   |
|----------------------|--|---|
| Components           | Elements   | Description   |
| Security             | <ol style="list-style-type: none"> <li>1. Status of security in the past and the present</li> <li>2. Government of groups and militaries, means and tools for wars (riding, on foot, artillery, etc.)</li> </ol> | <ol style="list-style-type: none"> <li>1. Causes of security and disturbance, who caused evil? Manner of establishing security in the past and the present</li> </ol> |
| Means for Prosperity | <ol style="list-style-type: none"> <li>1. Tools and facilities required for prosperity and life</li> <li>2. Facilities required for trading and agriculture, etc.</li> </ol>                                     | What were there? What is required? What is not observed? (by people or the government)  |
| Diseases             | Fatalities or diseases related to humans   | Which disease has intensity or is prevalent? Which season sees diseases rising? How cure is made (present and present)?   |

| Aspects          |   | Environmental Stimuli       |
|------------------|---|-----------------------------|
| Components       | Elements  | Description                 |
| Auditory         | How do auditory stimuli affect the way environmental senses, feelings, and emotions are perceived?  | Related to humans or nature |
| Olfactory/ Smell | How do olfactory stimuli affect the way environmental senses, feelings, and emotions are perceived? |                             |

| Aspects               |   | Registered Documents  |
|-----------------------|---|---|
| Components            | Elements  | Description   |
| Artistic and Literary | Collection of registered documents that narrate the human environment and historical and contemporary events in it, including poetry, stories, music, theater, painting, sculpting, animation, plays, scripts, etc. |   |
| Oral                  | Collection of registered documents that define historical and contemporary events from the viewpoint of oral association, including language, folklore, and any other given oral contexts                           | Creator of artworks, date of creation of artworks, representation characteristics |
| Media                 | Collection of media documents that narrate human context and historical and contemporary events, including the press and advertisements, TV and radio, and any other given media                                    |   |

| Aspects    |   | Management and Ownership System   |
|------------|---|---|
| Components | Elements  | Description   |
| Public     | Offices and organizations, institutes, entities, and management and social bodies | Responsibilities, powers, task description, plans and programs underway, planned programs for future, legal decisions |
| Private    |   |   |

**Table 7. Hierarchy of Understanding the Concept of the Phenomenon of the Road (Formation of the Semantic Network of the Road) at the Geography of the Road Level**

| Aspects                                |  | Physical characteristics  |
|--|--|---|
| Component                              | Elements   | Description   |
| Physical Fabric or Context of the Road | 1. Main and secondary ancient roads<br>2. Main and secondary contemporary roads<br>3. Cross-section changes along the route  | 1. Types of roads (using chariots, on foot, caravans, quadruped)<br>2. Route geomorphology (mountainous, flat, and rough terrain, changed routes), form, color, material and genus, construction techniques, slope, vegetation, water resources, valley depth, route width, safety, movement speed<br>3. Meaning association (visual stimuli)<br>4. Analyzing typological differences in road landscape |
| Turning Point                          | 1. Place of establishment of major settlements, connecting nodes to roads and human settlements<br>2. Road destinations (main cities that connect via roads)             | Geographical position and cause of importance   |
| Signs and Mansions                     | 1. Signs, road-related mansions (serving buildings and their users)<br>2. Road complementary buildings (bridges, underpasses, tunnels, etc.)<br>Road-unrelated buildings | Name and appellation, geographical situation, historical and contemporary, user, status, and type of ownership  |
| Science of Routing                     | Understanding the relationship between geographical features, road routing through astrology, old tools  | -   |

| Aspects                        |   | Travel   |
|--------------------------------|---|--|
| Component                      | Elements  | Description  |
| Road Users                     | 1. Travelers<br>2. Employers<br>3. residents  | 1. Who were the travelers of this region in the past? Whether they left itineraries or not?<br>2. Which season sees the highest number of travelers? |
| Means and Provisions of Travel | Means and provisions of travel in the past and the present? (wheeled carts, quadruped, and on foot) and procurement for travel (provisions) | Manner and conditions of travel in the past and the present  |

| Aspects  |  | Functions                   |  |
|--|--|-----------------------------|--|
| Component                                      | Elements   | Description                 |  |
| Purpose of Travel/ Road Map                    | Road role, various commercial, religious, political, recreational, and entertainment dimensions  | In the past and the present |  |
| Position in the Organ-Based System of the Road | Position of the road in the hierarchy of linking roads (first, second, and third degree), role of road in the hierarchy of linking roads |                             |  |

| Aspects               |   | Registered Documents  |  |
|-----------------------|---|---|--|
| Component             | Elements  | Description   |  |
| Artistic and Literary | Collection of registered documents that narrate the human environment and historical and contemporary events in it, including poetry, stories, music, theater, painting, sculpting, animation, plays, scripts, etc. | Creator of artworks, date of creation of artworks, representation characteristics |  |
| Oral                  | Collection of registered documents that define historical and contemporary events from the viewpoint of oral association, including language, folklore, and any other given oral contexts                           |   |  |
| Media                 | Collection of media documents that narrate human context and historical and contemporary events, including the press and advertisements, TV and radio, and any other given media                                    |   |  |

| Aspects   |   | Management and Ownership System   |
|-----------|---|---|
| Component | Elements  | Description   |
| Public    | Offices and organizations, institutes, social and managerial bodies, and associations | Responsibilities, powers, task description, plans and programs underway, planned programs for future, legal decisions |
| Private   |   |   |

## 6. CONCLUSION

This study aimed to provide an understanding of the concept of ancient roads and to reread their current assets and advantages to describe a semantic network of ancient roads. One of the limitations of this study was the lack of domestic sources about the subject and the need for much time to be spent on finding foreign sources as well as translating those texts. Another limitation was the lack of previous literature on the characteristics of ancient roads in Iran; this issue was addressed by studying and analyzing historical and contemporary documents. Given the semantic network obtained from the study, in preserving and managing ancient roads, the key characteristics in studying ancient roads were generally divided into three levels “natural geography”, “human geography” and “geography of the road”. Each level can be investigated from different aspects, and various components that determine each aspect include describing various elements, studied in detailed. The details are noted in Figure 2 and Tables 5 to 7.

According to this network, as shown by the level of the natural geography, in addition to the ecological sources and the ownership and management system, referred to in the relevant sources, the study of registered documents (e.g., artistic and literary works of art, oral and media documents), which describes the natural environment and the past and contemporary historical events related to the natural geography of the region, as well as the study of bioenvironmental threats, which are reciprocally related to ancient roads’ dynamism and mobility, will be critical.

Also, as regards the human geography of ancient roads, in addition to the social-cultural and economic life and environmental stimuli, the study of human needs and threats throughout history, including how security had been established and the supply of prosperity means, as well as human settlements and various diseases, which could lead to human fatalities, will be critical due to their direct effects on road users’ security in the prosperity of ancient roads. As well, the study of the

management and ownership system of human living areas for the better understanding of stakeholders, and like the natural geography, the study of registered documents that narrate the human environment and relevant historical and contemporary events will be aspects that the network will emphasize.

The last level defined in the semantic network of ancient roads is the study of the geography of the road. Here, in addition to the study of roads’ physical characteristics and the understanding of buildings related or unrelated to roads, the understanding of turning points (place where major buildings were established, nodes connecting to peripheral rods and human settlements, road destinations (main cities that were connected via roads)) and the understanding of the science of routing ancient roads, which is based on understanding the relation between geographical features and road routing based on astrology and old tools, will be critical.

In the meantime, in addition to travel provisions, referred to in the literature review, the understanding of road (users) in the past and the present will be critical for helping understand the role and function of roads in the past and future planning. As well, in addition to describing the role and function of the road in the past and the present, the present role and position of roads in the hierarchy of linking roads need to be investigated.

In sum, the study of registered documents that narrate the road routes and historical and contemporary events of the roads, as well as the study of the management and ownership system of the roads and peripheral areas, which would lead to understanding stakeholders, will be critical.

In general, understanding this network requires us to investigate case studies while delving into this study requires us to provide more studies and conduct separate research and survey polls from the community of experts, which is beyond the scope of this study. It is thus hoped that the preservation of ancient roads would be addressed, in addition to dealing with the subject under study.

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## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

## MORAL APPROVAL

The authors commit to observe all the ethical principles of the publication of the scientific work based on the ethical principles of COPE. In case of any violation of the ethical principles, even after the publication of the article, they give the journal the right to delete the article and follow up on the matter.

## PARTICIPATION PERCENTAGE

The authors state that they have directly participated in the stages of conducting research and writing the article.

## ENDNOTE

1. The type of goods and merchandises produced in cities and villages, and in fact, the situation of these farmlands and production nodes, affected road development. For this, not only were types of products and goods parts of the commerce between nations, they were also the cause of wars that erupted in those lands.
2. Making of ancient astronomical instruments, including astrolabes, featured such applications as measuring altitude and other astronomical coordinates of such objects as the sun, the moon, and stars, calculating the altitude of the sun and stars, the time of sunrise and sunset, the hours of night and day, and determining the channels of aqueducts. Furthermore, this tool could be used for calculating the altitude of mountains and the width of rivers and other natural land features and areas that could not be surveyed; the tool could also be used for measuring the latitude and longitude of places and distances between cities (from the book *Tohfe Hatami (One Hundred Treatises on Astronomy)* by Sheikh Baha'ei), which would help provide routing, mapping and finding directions and sea destinations (Ghazni 1979; Zulfonoun and Nojoumi 1998).

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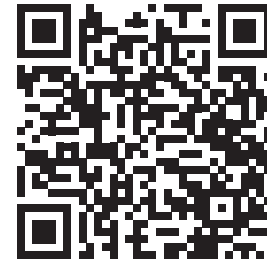
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