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Research Paper: Water Resource Crisis and Sustainable Rural Livelihoods: Planning at the Watershed Scale

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ABSTRACT

Purpose: The analysis of the current spatial organization of the country and its past trends reveals an unfavorable and concerning picture of population distribution and activities across the land. The unchecked continuation of this trend will exacerbate its adverse effects, leading to an intensified water resource crisis and suboptimal utilization of the land's potential and capabilities. The reality is that watersheds should serve as a foundation for national macro-planning, such as the formulation of vision documents, five-year development plans, and central decision-making processes. Each watershed has a specific capacity, and exceeding this capacity leads to the degradation of resources and the loss of the ecosystem's ability to recover. Disregarding this principle is one of the primary drivers of the formation, persistence, and deepening of the water crisis in the country, and it has also fueled regional and interprovincial disputes. Undoubtedly, rural areas in Iran play a crucial role in either preserving or depleting the ecological capacity of watersheds.

Methods: This study utilized a meta-analysis approach to analyze the content of rural sustainable livelihood plans in Iran. Subsequently, by examining successful foreign resources and experiences, sustainable livelihood indicators that could be assessed at the national level were implemented and measured.

Results: The findings of this study indicate that the primary livelihood strategies of villages in the six major watersheds of the country—namely, the Caspian Sea watershed, Lake Urmia watershed, Qara Qum watershed, Eastern Border watershed, Central Plateau watershed, and finally, the Persian Gulf and Oman Sea watershed—can be divided into two main groups: a) livelihood diversification and alternative livelihoods and b) sustainable agriculture.

Conclusion: Based on this analysis, and considering the status of livelihood assets in different watersheds and the widespread water crisis in these areas, a combination of the following models has been proposed, adapted to the conditions of each watershed: The mountainous village livelihood model, desert village livelihood model, northern coastal villages, southern coastal villages, small and remote settlements, peri-urban villages, border villages, tourism-targeted villages, low-water agriculture with an emphasis on food security, utilization of indigenous knowledge and lived experiences of rural residents, leveraging the capabilities of rural women, rural home-based businesses, and branding-based models.

Keywords:

Livelihood planning, Livelihood diversification, Sustainable agriculture, Iranian villages

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1. Introduction

Agricultural activities form the foundation of economic activities. The input-output linkages of this sector with the industrial and service sectors highlight its role in determining the stages of development. This is important because some believe that without an agricultural revolution, an industrial revolution will not occur. This development will lead to increased employment opportunities and growth in labor productivity. Agriculture is the dominant sector in rural areas and constitutes almost the entire economy in most developing countries. Agriculture contributes the most to the gross national product, provides employment for the majority of the country's population, and supplies their food. With its various functions, agriculture can contribute to overall socio-economic development, a reality that holds across nearly all developing countries (Ramazanzadeh & Hesam, 2012: 116).

An analysis of the country's economic sectors reveals the strong position of the agricultural sector in Iran's economy. This is because agriculture has managed to achieve a desirable position in Iran's economy in terms of employment generation, income provision, its share in the gross national product, meeting the consumption needs of the population, and foreign exchange earnings (Motiee Langroudi et al., 2011).

On the other hand, spatial flows, through the linkages among economic sectors, operate at the household and local economy levels, encompassing forward and backward linkages of agriculture, factory-based industry, and services, such as the production of inputs and the processing of agricultural raw materials (Rezvani, 2011). Therefore, the rural economy cannot be viewed in isolation from the rest of the country's economic and social systems. To improve the rural economy and stimulate it, as well as to raise the standard of living for rural residents, comprehensive rural development policies and programs need to be designed and implemented. These should encourage non-agricultural employment-generating and income-generating activities, as well as the expansion of rural towns, include rural residents in decision-making processes related to rural development, and ensure the implementation of social and welfare programs. In this way, with increased agricultural production, the income and living standards of rural residents will improve, and with enhanced social welfare, their health and education levels will also improve.

Historically, development policies for agricultural regions aimed at poverty alleviation have focused solely on expanding the growth and development of agricultural activity. However, it is now clear that many rural areas lack the potential to increase the income of their residents through this profession.

While some states are implementing policies to promote sustainable development, the prevalence of environmental issues is increasing on a global scale. One of the most significant challenges that will define the near future is the emerging water crisis. While some regions are experiencing the threat of flooding due to rising sea levels, drought is becoming increasingly prevalent in other areas. The utilization of water for commercial purposes is on the rise, while access to water is becoming increasingly challenging for economically disadvantaged individuals. In developing countries, approximately one-fifth of the population lacks access to adequate and clean drinking water (UN, The Sustainable Development Goals Report, 2024). This situation has a detrimental impact on the availability of clean drinking water. Furthermore, the number of individuals who are unable to maintain adequate hygiene due to a lack of water is also rising rapidly. Currently, approximately 3.6 billion people worldwide- nearly half of the global population- lack access to adequate sanitation (UNEP, 2009).

According to the results of the 2016 National Population and Housing Census, the number of inhabited villages in the country was 62,284, which has increased by 536 villages compared to 2011. Additionally, the number of villages with 20 households or 100 or more residents, defined as villages, is 39,601, which has increased by 1,335 villages compared to 2016. In total, 20,730,625 people, or 26% of the country's total population, belong to the rural community. The average share of the rural population in other parts of the world, according to global statistics in 2014, is 27% in Europe, 52% in Asia, 7% in Japan, 68% in India, and about 23% in the United Kingdom.

Additionally, 6,386,582 people, or 28% of the country's employed population, belong to the rural community. Of this, 94% of rural employment is in the private sector, and only 6% is in the public sector. From this perspective, the private sector plays a much more significant and fundamental role in strengthening rural production and employment than the government.

Based on this, a regional planning project aimed at creating sustainable employment to reduce the dependence of farmers' livelihoods on water resources was commis-

sioned by the Strategic Studies and Education Center of the Ministry of Interior in 2018.

The main research questions of this study are as follows:

1. What are the optimal livelihood strategies for farmers in agricultural watersheds?

2. How can villages be classified to promote livelihood diversification and alternative livelihoods?

2. Literature Review

Water is the single most important natural resource that is widely distributed in the natural environment (Plessis, 2017; Singh et al., 2019). Water is essential for various aspects of human health, development, and well-being (Guppy & Anderson, 2017; Plessis, 2017). Realizing the importance of water for human health and economic activity, the United Nations Sustainable Development Goal 6 targets access to water and sanitation for all people in the next 15 years (WHO, 2017). Climate change has increased incidents of extreme weather events. These changing patterns have severe effects on rural economic activities and livelihoods (Fieldsend & Kerekes, 2015; Asha & Madzivhandila, 2016; Madzivhandila & Niyimbanira, 2016). Consequently, climate change continues to pose significant threats to communities worldwide. The International Labour Organisation (2008) reports that not only does climate change impact rural economic activities and livelihoods, but it also hinder progress toward achieving the Millennium Development Goals (MDGs), a challenge that is further intensified by rising inflation, food, and other basic human commodity prices.

Furthermore, Olsen (2008) emphasizes that developing countries are the most vulnerable to the impact of climate change as they are already economically disadvantaged and financially fragile, making them less capable of responding to such challenges.

The importance of rural non-agricultural occupations becomes more apparent when we realize that these occupations provide rural residents with income, enabling them to invest in the agricultural sector. For example, a significant portion of non-agricultural occupations is somehow related to the vast expanse of agricultural food products, such as trade in fertilizers, buying and selling, and exporting fruits, and servicing agricultural machinery and equipment (Reardon et al., 2001: 396). The development of non-agricultural activities does not mean abandoning the agricultural sector. These activities are divided into two categories: one, activities that compete with the agricultural sector for labor, and the other, activities that complement the agricultural sector and are pursued during agricultural downturns (Singh, 1993: 397). An important priority proposed in the economic structure of rural societies through the adoption of a new rural development strategy is an appropriate combination of agricultural and non-agricultural activities, especially agro-processing and complementary industries (Taherkhani, 2007: 2). With this approach, based on the hypothesis of mutual linkage, which emphasizes the simultaneous growth of agricultural and non-agricultural sectors, sustainable and productive employment is expected to be achieved (Kishore, 1997: 45).

3. Methodology

3.1. Study Area

A watershed is a part of the land where all the precipitation or runoff flows to a single endpoint. Based on this definition, various natural and human features such as rivers, roads, forests, villages, and cities can be located within a watershed. The boundary of each watershed is the ridgeline of elevated terrain, meaning that if two watersheds are adjacent, their separating boundaries are the ridgelines of the elevations. Therefore, the spatial scale on which hydrological analyses are conducted is the watershed or a part of it.

According to the hydrological classifications of the Basic Studies Office of the Water Resources Management Company of Iran, the country's water resources are divided into six main watersheds: The Caspian Sea, the Persian Gulf and Oman Sea, Lake Urmia, the Central Plateau, the Eastern Border, and the Qara Qum, as well as 30 sub-watersheds.

• The main Caspian Sea watershed is divided into sub-watersheds of the Aras River, the Talesh-Anzali Lagoon rivers, the Sefidrud River, the rivers between the Sefidrud and Haraz, the Haraz River, the rivers between the Haraz and Qareh Su, the Qareh Su and Gorgan rivers, and the Atrak River.

• The Persian Gulf and Oman Sea watershed includes sub-watersheds of the western border rivers, the Karkheh River, the Karun River, the Jarahi and Zohreh rivers, the Helleh River, and small streams on both sides; the Mond River; and the closed watersheds of Karian and Khanj; the Kol and Mehran rivers; and southern streams and islands; the rivers between Bandar Abbas and Sadij; and

the southern Balochistan rivers between Sadij and the Pakistan border.

• The Lake Urmia watershed includes one sub-watershed with the same name.

• The Central Plateau watershed is also divided into sub-watersheds of the Salt Lake, Gavkhouni, Tashk, and Bakhtegan lakes; Maharloo; Abarkooh-Sirjan desert; Hamun Jazmurian; Lut desert; Central desert; Ardistan deserts; Rig-e Zarin and Siah Kuh; and the deserts of Daranjir and Saghand.

• The Eastern Border watershed includes sub-watersheds of the Petregan Salt Flat-Khaf Salt Marsh, Hamun Hirmand (Gowdzareh), and Hamun Mashkel.

• Finally, the Qara Qum watershed also includes one sub-watershed with the same name.

Approximately 73.4% of the country's total area is covered by closed or internal watersheds. Among the six main watersheds of the country, the Central Plateau watershed is the largest, spanning 824,611 km², while the Sarakhs watershed, with 44,296 km², has the smallest area. In terms of precipitation, the Persian Gulf and Oman Sea watershed receives the highest volume, with 160,702 million cubic meters, whereas the Qara Qum watershed receives the lowest, with only 10,812 million cubic meters of precipitation annually.

In the following sections, since the analysis in this study is based on the country's watersheds, the status of rural employment within the watersheds has been examined. The table below presents the average employment rate of the provinces located in each watershed in terms of overall employment, male employment, and female employment. In this section, the Central Plateau watershed, with an average of 91.88%, has the highest rural employment, while the Persian Gulf watershed, with 87.10%, has the lowest rural employment. Additionally, in terms of male and female employment rates, the Central Plateau and Qara Qum watersheds rank first, while the Persian Gulf watershed ranks last in both male and female employment categories. The distribution of employment across the country's watersheds is also shown in Figure 2.

Table 1. Characteristics of Iran's Watersheds

Watershed	Area (km²)	Precipitation (million km²)	Renewable Groundwater Resources (million m³)	Renewable Surface Water Resources (million m³)
Caspian Sea	175,060	78,496	11,317	14,847
Persian Gulf & Oman Sea	424,030	160,702	21,952	46,531
Lake Urmia	51,762	19,152	2,465	4,969
Central Plateau	824,611	134,910	17,462	10,883
Eastern Border	103,183	12,993	972	518
Qara Qum (Sarakhs)	44,296	10,812	1,040	936
Country	1,622,942	417,065	55,208	78,684

Source: Basic Studies Office, Ministry of Energy, 2018

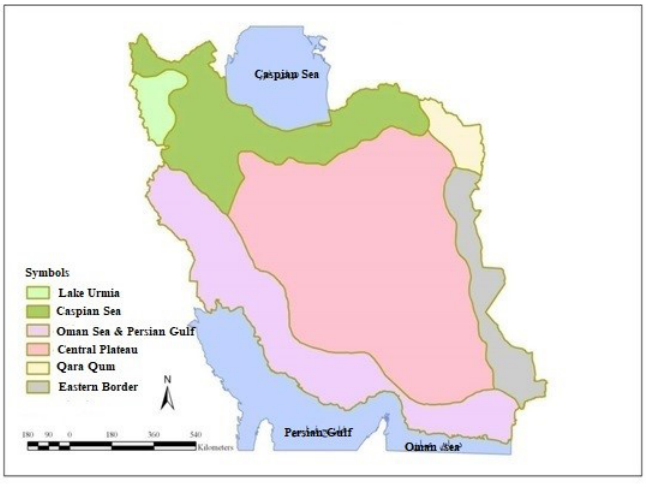

Figure 1. Location of the Main Watersheds of the country

Table 2. Summary of General Male, and Female Employment Rates in the Country's Watersheds

Row	Watershed	Rural Employment Rate	Male Employment Rate	Female Employment Rate
1	Caspian Sea	89.27	90.33	82.07
2	Lake Urmia	88.75	89.61	81.97
3	Qara Qum	90.54	91.10	85.82
4	Persian Gulf	87.10	89.15	76.39
5	Central Plateau	91.88	93.02	83.19
6	Eastern Border	89.15	90.97	80.22

Source: Research findings based on the 2016 Census

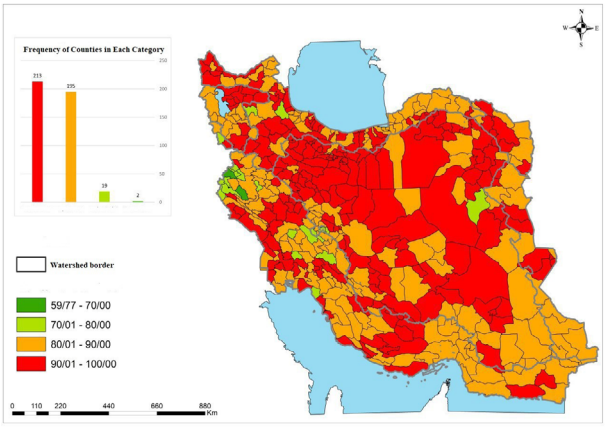

Figure 2. Status of Watersheds in Terms of Rural Employment Rate

3.2. Indicators

In this study, we first conducted a meta-analysis of domestic and international experiences in the field of sustainable rural livelihood development. Subsequently, based on the findings from the previous section and a review of reputable international sources, indicators for low-water rural livelihoods were developed. Finally, using spatial analysis of the status of these indicators at the watershed level—with the Persian Gulf and Oman Sea watersheds as an example—the groundwork for presenting an optimal model for watersheds was laid.

In this section, the status of the country's villages based on five livelihood capitals has been examined using the latest available statistics in the country.

Regarding the livelihood capitals under review, it is necessary to provide some explanations. First, efforts have been made to use the latest and most reliable data to provide an accurate and realistic picture of the current conditions in the country's villages. Not using low-credibility or outdated indicators, using at least three indicators per capital, ensuring data integration (meaning their availability for all provinces and counties in the country), maintaining data uniformity to enable comparisons between watersheds, providing data at the county level for greater accuracy, and the ability to compare conditions in different spaces within a watershed are among the most important criteria for selecting livelihood capital indicators in this study. Certainly, for each livelihood capital, other indicators could have been considered. However, many were excluded due to limitations related to one or more of the above-mentioned criteria, such as compromising data integration, uniformity, comparability, and reliability. Additionally, limited access to quality databases from relevant organizations, lack of cooperation from some institutions, and a reliance on incomplete and outdated data- despite correspondence- further constrained access to potentially valuable indicators.

Despite these challenges, presenting such an extensive set of data along with maps related to watersheds is undoubtedly an unprecedented and significant contribution, as there is no similar example in the country that examines all livelihood capitals (a multidisciplinary feature), and a review of domestic experiences—which were examined in detail in the previous chapter—confirms this claim.

In the following sections, after introducing the livelihood capitals and the sources used to measure them, the prevailing conditions in the watersheds from this perspective are examined in detail.

Table 3. Livelihood Capitals Examined in Rural Areas of the Country's Main Watersheds

References	Spatial Scale	Year	Source	Indicators	Capital
Erenstein, 2007; Buumba, 2015; Quandt, 2017; Fang et al., 2014; Su & Shang, 2012; Xu et al., 2015; Donohue & Biggs, 2015; Ansoms & McKay, 2010; Quandt, 2018	County	2016	Population and Housing Census	1- Literacy rate of the population aged 6 and above | Human Capital	Human
	County	2016	Population and Housing Census	2- Literacy rate of the population aged 6 and above with primary education	
	County	2016	Population and Housing Census	3- Literacy rate of the population aged 6 and above with university education	
	County	2016	Population and Housing Census	4- Female literacy rate	
	County	2016	Population and Housing Census	5- Active population rate	
	County	2016	Population and Housing Census	6- Dependency ratio	
	County	2015	National Statistics Center	7- Ratio of health houses to population	
	County	2015	National Statistics Center	8- Ratio of rural health centers to population	
Erenstein, 2007; Antwi-Agyei et al., 2013; Buumba, 2015; Fang et al., 2014; Thulstrup, 2015; Nguyen et al., 2015; Xu et al., 2015; Quandt, 2018; Donohue & Biggs, 2015	County	2014	Agriculture Census	1- Per capita agricultural land	Natural
	County	2014	Agriculture Census	2- Ratio of agricultural land to total land	
	County	2014	Agriculture Census	3- Per capita small livestock (sheep and goats)	
	County	2014	Agriculture Census	4- Per capita large livestock (cattle and buffalo)	
	County	2014	Agriculture Census	5- Per capita large livestock (buffalo and calves)	
	County	2014	Agriculture Census	6- Per capita large livestock (camels and calves)	
Ansoms & McKay, 2010; Ding et al., 2014; Erenstein, 2007; Quandt, 2017; Thulstrup, 2015; Nguyen et al., 2015	Province	2015	National Social Council	1- Trust in government organizations | Social Capital	Social
				2- Quality of services provided by government organizations	
				3- Performance and responsiveness of organizations	
				4- Willingness to participate and help organizations	
				5- Social lending and borrowing	
Su & Shang, 2012; Erenstein, 2007	County	2016	Population and Housing Census	1- Unemployment	Financial
				2- Access to banks	
				3- Access to rural production cooperatives	
Ansoms & McKay, 2010; Ding et al., 2014; Erenstein, 2007; Quandt, 2017; Thulstrup, 2015; Nguyen et al., 2015; Donohue & Biggs, 2015; Quandt, 2018; Antwi-Agyei et al., 2013; Donohue & Biggs, 2015	County	2015	National Statistics Center	1- Ratio of paved roads in rural areas | Physical Capital	Physical
		2014	Agriculture Census	2- Ratio of tractors to agricultural land	
		2014	Agriculture Census	3- Ratio of combine harvesters to agricultural land	
		2016	Population and Housing Census	4- Housing with two rooms	
		2016	Population and Housing Census	5- Housing size	

4. Findings

4.1. Analysis of Livelihood Capitals at the Country Level

In the following sections, all the examined indicators, as exemplified by the rural literacy rate for the population aged 6 and above, have been analyzed at the watershed and national levels.

The rural literacy rate ranges from 58.7% to 95.5% among counties, with the lowest recorded in Sarbaz County (Sistan and Baluchestan Province) and the highest in Kangān County (Bushehr Province). The national average for all counties is 78.5%.

he spatial distribution of rural literacy is highly uneven across the country. Lower literacy rates are predominantly concentrated in border and peripheral counties, particularly in the southeastern, northeastern, western, and northwestern regions. In contrast, higher literacy rates are primarily found in the central regions, although some southern counties and parts of the Caspian Sea coast also report relatively high literacy levels.

4.2. Strengths, Weaknesses, Opportunities, and Threats of the Watersheds

The country's watersheds, as an environmental-ecological classification based on climatic parameters, runoff, precipitation, elevations, and ridgelines, are recognized. Accordingly, the basis for understanding and analyzing the current situation and the criteria and models of sustainable livelihoods in rural areas in this study is the six major watersheds: The Caspian Sea, Persian Gulf and Oman Sea, Lake Urmia, Central Plateau, Eastern Border, and Qara Qum (Sarakhs) watersheds.

In this section, the strengths, weaknesses, opportunities, and threats of each of the country's watersheds are identified from the perspective of the key research topic, i.e., sustainable livelihoods in rural areas of Iran. An attempt has been made to identify the strengths and weaknesses of the watersheds based on the five capitals of sustainable livelihoods- natural, physical, social, human, and financial- through the documentation of provincial planning and other relevant sources. Additionally, the opportunities and threats of each watershed are identified based on documents, laws, regulations, and development plans, as well as the opportunities and threats of adjacent watersheds in terms of defining and establishing non-water-intensive sustainable livelihoods.

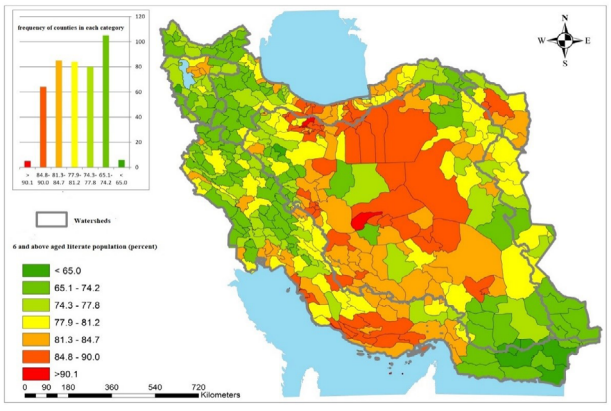

Figure 3. Spatial Distribution of Rural Literacy Rate in 2016.Drawn by the Authors, 2018

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Table 4. Descriptive Statistics of the Literacy Rate of the Population Aged 6 and Above by Watershed

Watershed	Minimum	Maximum	Mean	Standard Deviation
Caspian Sea (N=95)	65.3	89.1	77.9	5.6
Central Plateau (N=151)	64.3	93.4	80.7	5.7
Persian Gulf & Oman Sea (N=136)	58.7	95.5	77.2	5.9
Eastern Border (N=17)	65.4	81.1	74.8	5.0
Lake Urmia (N=21)	64.7	81.7	75.2	4.6
Qara Qum	74.1	87.2	80.8	4.0
Country (N=429)	58.7	95.5	78.5	6.0

Source: Authors' Calculations, 2018

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It should be emphasized that a range of statistics, charts, and maps were previously presented in this study, providing a comprehensive overview of the economic, social, natural, and human dimensions of each watershed, which shows a general picture of the status of the country's villages in the watersheds. Therefore, this section avoids repetition and instead focuses on synthesizing key findings.

Due to the lack of deep, systematic rural studies and the diversity and internal disparities within and across the six main watersheds, this section aims to highlight the most salient and widely recognized SWOT factors. For instance, indigenous knowledge is a common strength in many rural areas; however, in this study, it is emphasized only where it is particularly prominent—such as in the Zagros-inhabited rural zones of the Persian Gulf and Oman Sea watershed.

4.3. Strengths and Weaknesses of the Persian Gulf and Oman Sea Watershed

The Persian Gulf and Oman Sea watershed encompasses unique natural and ecological features, stretching from the northwest to the southern and southeastern borders of Iran. It is characterized by a dense rural population, the presence of nomadic communities with distinct social and economic roles, and numerous natural and tourism attractions, particularly in the western areas. These features, with targeted interventions and proper planning, create opportunities to expand non-agricultural or complementary agricultural rural enterprises.

Additionally, proximity to major urban centers such as Shiraz and Ahvaz provides a strong consumer market for low-water-use rural products. The region also benefits from the cultural and livelihood identity of the Zagros communities, whose economic stimulation could help preserve local traditions and lifestyles while generating income. The interdependence of nature, rural life, and livelihoods is a defining feature of this watershed, and its ecological landscapes offer strong potential for ecotourism and cultural tourism development.

Moreover, in the southern and eastern regions, proximity to the coastline and maritime activities introduces possibilities for non-agricultural enterprise development and value chain completion across various sectors.

However, this watershed also faces significant challenges. The phrase "deprivation despite high potential" aptly describes the condition of many provinces within this region. Despite its considerable assets, the watershed is hampered by factors such as:

- Limited accessibility in some areas,
- Inadequate infrastructure,
- High initial investment requirements,
- Remoteness and geographic isolation, and
- Elevated unemployment rates.

Furthermore, frequent dust storms across large portions of the watershed significantly degrade living conditions and negatively impact the quality of life in both urban and rural settlements.

4.4. Proposing an Optimal Model for Sustainable Rural Livelihoods in the Watersheds

As mentioned in previous chapters, the Persian Gulf and Oman Sea watershed has unique natural and ecological features and a great diversity in livelihoods, life, and activities, stretching from the northwestern part of the country to the southern and southeastern borders. The high settlement of the rural population, the presence of nomadic communities with specific functions, and various natural and tourism attractions have given a distinct character (especially in the western part of this watershed).

Despite these considerable strengths, this watershed faces numerous challenges, such as inaccessibility, limited infrastructure, remoteness, isolation, and high unemployment rates. Additionally, dust storms across large areas have severely affected living conditions and quality of life in many rural settlements.

Given the relatively favorable rainfall in the western and southwestern parts of the watershed, a key component of the livelihood strategy for this region should be the promotion of sustainable, low-water agriculture. Agricultural activities and their sub-sectors remain visible and vital in the rural fabric of this watershed. Furthermore, the issues of food security, production support, and economic resilience highlight the importance of focusing on sustainable agricultural development within watersheds.

The following strategies and approaches are proposed to support rational policymaking and planning for sustainable rural livelihoods in this watershed:

Table 5. Persian Gulf and Oman Sea Watershed weaknesses and strengths

Weaknesses	Strengths	Capitals
- Destruction of habitats and forests - Water transfer within the watershed - Presence of dust storms as a threat to rural settlements - Lack of water resources in the southern parts of the watershed	- Existence of suitable environmental-ecological conditions for defining and establishing sustainable livelihoods (mountains, forests, foothills) - Existence of tourism attractions (ecotourism, nature tourism, nomads, historical heritage, hot springs, snow landscapes, etc.) - Existence of suitable coasts and access to the sea as an important resource for defining sustainable livelihood activities - Existence of mineral and extraction potentials in many parts of the watershed	Natural Capital
- Lack of proper road and transportation infrastructure	-	Physical Capital
- The backwardness and remoteness of rural areas away from the center of the country	- Little investment to start a business	Financial Capital
- Rural-urban migration in the southern reaches of the watershed - Disruption of the demographic mix and productive workforce - High unemployment levels in rural areas	- Existence of Indigenous knowledge in rural areas - The existence of an active female population as a cheap labor force and the capacity for sustainable livelihoods	Human Capital
- Religious divergence (Sunni) in the southern and eastern parts of the watershed	- High degree of homogeneity in culture and way of life (ethno-tribal system) - Ethnic and linguistic diversity and a rich culture of work and production	Social Capital

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Table 6. Opportunities and Threats of the Persian Gulf and Oman Sea Watershed

Threats	Opportunities
- Dominance of water-intensive agricultural views over rural policies and planning in the watershed - Low share of rural credits from the total national credits - Lack of attention to the potential and capacities of women in sustainable livelihoods in upstream documents - Lack of attention to the potential and capacities of youth migrating from rural to urban areas to encourage activities related to sustainable livelihoods in rural areas - Lack of attention to rural life and livelihoods as a value at the macro policy and planning levels - Lack of proper policy definition in the field of tourism and rural tourism - Lack of proper policy definition in the field of agricultural production - Lack of specific authority in the rural sector and the multiplicity of decision-making and policy-making institutions - Lack of supporting and upstream documents in the field of rural economy - Lack of attention to the development of non-water-intensive rural businesses and occupations in upstream documents - Unclear share of rural employment in the macro economy and lack of appropriate targeting in development plans - Lack of an employment generation model in border areas of the country - Lack of laws and regulations supporting the rural economy and attracting investment in rural areas	- Existence of appropriate upstream laws in the field of resistance economy and national production, especially in recent development plans - Raising the issue of environmental and water resource crises at the macro policy and planning levels - Dominant view on the role of border rural settlements as guarantors of national and territorial security - Dominant view on optimal water resource management and preservation of water resources in recent years - High rate of reverse migration (migration from cities to rural areas with various motivations) in the northern parts of this watershed as an opportunity to institutionalize non-water-intensive activities - Establishment of the issue of cropping patterns at the macro policy level as a fundamental solution to preserve limited water resources - Diversity and high potential for employment generation in rural areas of the watershed - Inter-watershed water transfer as a macro policy agenda

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1. Crop Pattern Reform

Selecting a cropping pattern that aligns with each region's climatic and ecological characteristics can reduce dependence on groundwater extraction, alleviating pressure on these limited resources. Although the Ministry of Agriculture has initiated crop pattern reform programs, these must be translated into practice to produce real change.

A key policy recommendation is to reallocate subsidies—currently provided for water and electricity—towards supporting region-specific cropping patterns. This change would encourage farmers to reduce water and

energy use while improving productivity and increasing income.

2. Practical and Continuous Training

Practical and continuous training plays a significant role in empowering farmers to use water resources optimally and sustainably. The training currently provided to farmers on how to utilize water resources is short-term and not continuous. However, the farmer needs advice and guidance at all stages of planting, cultivation, and harvesting and should receive the necessary guidance step by step. Therefore, farmer training (especially in water management) should be a continuous, dynamic, and ongoing process to increase their knowledge and awareness. In this regard, it is suggested that the training programs of the Agricultural Jihad Organization specify for both farmers and officials the economic, social, and environmental consequences of the decline of aquifers and groundwater tables. Farmers need step-by-step guidance throughout the stages of planting, cultivation, and harvesting. It is essential that training becomes dynamic, continuous, and solution-oriented.

Training should include:

• Education on the economic, social, and environmental consequences of aquifer depletion,

• Field visits to successful farms,

• Use of educational media such as films, brochures, and CDs,

• Greater involvement from national media in promoting water conservation knowledge and skills among rural populations

3. Development of Greenhouse Cultivation

The performance and water consumption of greenhouse cultivation, due to the control of production factors, are significantly better compared to field cultivation. Given the climatic conditions of the country and the large number of agricultural graduates, the approach to greenhouse production is an inevitable necessity. It is suggested that the government support producers in this sector in various ways, such as providing subsidies, special facilities, assistance in exporting greenhouse products, etc.

4. Increasing Water Transfer Efficiency

"Increasing water transfer efficiency" is another influential factor in balancing groundwater resources. A significant portion of water transfer canals are earthen and unlined, and surface water enters the farms through these canals. Therefore, during the transfer process, a large amount of water is lost through evaporation and deep percolation. Upgrading these canals by lining them will reduce water loss and decrease reliance on groundwater. In this regard, it is suggested that the Agricultural Jihad Organization and regional water companies cooperate and interact to accomplish this important task.

5. Improving Irrigation Systems

Improving irrigation systems increases irrigation efficiency and can consequently reduce groundwater extraction. However, this factor has not had a significant impact on the decline of groundwater depletion. Perhaps the reason for this can be found in the fact that the development of pressurized irrigation systems, contrary to predictions, actually exacerbated the groundwater crisis. After the establishment of these systems, farmers expanded cultivation by reducing deep percolation losses, which resulted in continued water extraction from aquifers and reduced aquifer recharge. Therefore, the practical result of this policy was the continuation of water extraction from aquifers at the same rate and the expansion of cultivation by preventing deep percolation losses and aquifer recharge, which means more pressure on water resources.

6. Water Recycling

Efforts to recycle water in the production process of agricultural products will pave the way for the sustainability of water resources. Generally, two main actions are considered in this strategy: one is the use of treated wastewater in the production of some agricultural products, and the other is the construction of water recovery systems on farms to return used water to the production cycle.

7. Reducing Agricultural Product Losses

Reducing post-harvest losses increases effective production without increasing the cultivated area, easing pressure on water resources. In this regard, the interviewees suggested various solutions to reduce agricultural product losses and optimize the use of water resources. One of these solutions is "proper storage and warehousing of surplus products." The government should invest specifically in this sector by constructing suitable and standard cold storage facilities to minimize product losses. "Proper transportation of agricultural products" is another important solution, as products are exposed to

environmental factors such as heat, humidity, etc., due to inadequate packaging, reducing their nutritional value. Therefore, managing and controlling temperature during the transportation of products in the post-harvest period is one of the solutions to prevent losses.

5. Discussion

Considering the conditions of the watersheds, the following strategic recommendations are proposed, taking into account the geographical characteristics of the villages:

1. Peri-Urban Village Livelihood Strategy

In today's planning literature, the term "rural" must be considered alongside "peri-urban" to define areas that have a mix of urban and rural characteristics and cannot be clearly distinguished from each other. As a result, the outskirts of cities gradually lose their traditional form and role and become like cities, and now dependent on the development, preferences, and potential demand of urban areas.

In most developed countries, the important issue is no longer the resources used to produce products but the resources that can provide an attractive environment for living and working, offering potential for development in residence, tourism, and recreation.

Today, the new relationship between city and village is not primarily based on meeting biological needs such as food but is more based on the social demands of urban populations. The reality is that peri-urban settlements have special conditions, and their economic orientations should be aligned with both urban and rural economies.

Accordingly, the ideation, design, and establishment of any rural activity and business must consider the nearby urban center and its functions. Part of the life and death of these settlements in recent decades has been dependent on urban centers and urban development hubs as engines of development and assistance to the development of surrounding areas. The existence of spatial flows (population, capital, labor, goods, and innovation) between urban settlements and their surrounding villages indicates the intertwining and integration of their functions.

2. Tourism-Targeted Village Livelihood Strategy

The issue of rural tourism in our country has become more serious in the last one or two decades. The reality is that rural tourism in our country has mostly emerged naturally and gradually in parts of urban society, and unfortunately, this process has not been pursued in a planned and strategic manner for various reasons.

Spontaneously and naturally, parts of the urban population prefer to benefit from rural areas and rural tourism capacities. Although this desire and demand have not yet become widespread, the existing potential in the tourism sector directs audiences and visitors to rural areas.

3. Rural Home-Based Business Livelihood Strategy

One of the fundamental issues in rural development is the proper and logical use of the abilities and talents of the human resources of rural society. Today, home-based businesses are considered essential and complementary parts of the economic activities of rural households. These businesses have introduced diversity and transformation in job creation and the innovation of products or services.

Although rural home-based businesses have a long history in Iran, less attention has been paid to the dimensions and capacities of rural home-based businesses (in a targeted and planned manner). One of the suitable platforms for home-based businesses in Iran, which traditionally has the potential for several million job opportunities, is the handicraft sector. Estimates show that with more commitment and comprehensive government support and creating motivation among artists, 250 handicraft fields have the potential to create at least 5 million job opportunities per year. According to experts, Iran, along with China and India, is one of the top three handicraft hubs in the world. Handicrafts in our country, due to the relative advantages they have, still have the potential for job creation and productive investment.

4. Border Village Livelihood Strategy

Due to the centralized management system, there is a noticeable gap in development and welfare between central urbanized regions and peripheral border areas. Accordingly, border settlements, including cities and villages, should be considered in prioritization and planning, especially given their critical role in maintaining national and territorial security.

5. Low-Water Agriculture Livelihood Strategy with an Emphasis on Food Security

The agricultural sector, considering the country's water and soil potential, faces serious limitations in increas-

ing job opportunities. Therefore, its main mission should be to preserve existing job opportunities and structural transformation within the sector towards modernizing its activities and increasing productivity and efficiency, and maximizing the income of farmers and rural residents as the main producers.

Water conservation and resource balance can only be achieved through sustainable practices in agriculture, and this is only viable if farmers' livelihoods and the nation's food security are simultaneously addressed.

6. Southern Coastal Village Livelihood Strategy

Regional planning should ensure that population and activity distribution aligns with each region's economic capacity, environmental sensitivity, and strategic considerations. Ideally, if the population is proportionate to the region's resources, social justice and regional balance can be achieved in terms of access to welfare and public services.

In regions where strategic national interests require higher population levels than the local carrying capacity, new economic frameworks should be introduced. The southern coastal strip of Iran, extending along the Persian Gulf and Oman Sea, has tremendous untapped potential for national population and economic activity due to its proximity to the sea and access to open waters, which remains underutilized.

7. Mountainous Village Livelihood Strategy

Large portions of the Persian Gulf and Oman Sea watershed consist of mountainous terrain. Many rural settlements of the provinces of Ilam, Hamadan, Kurdistan, Kermanshah, Lorestan, Chaharmahal and Bakhtiari, Kohgiluyeh and Boyer-Ahmad, Khuzestan, and Fars are classified as mountainous villages. Although these settlements are in access limitations and isolation, due to the large number of this type of village and the great potential of heritage, nature, and life and livelihood, one of the livelihood strategies in this watershed should be mountainous villages. Mountainous villages, due to their pristine nature and lack of inappropriate human interventions, have remained as a heritage in the heart of nature and mountains and, in the future, will be one of the potentials for attracting tourism.

Also, the connection of this type of village to livestock production and its derived products and the specific rural-nomadic culture and mountainous livelihood, along with pristine landscapes in different seasons and wildlife and vegetation and oak forests, give a special character to this type of settlement. Defining specific activities and livelihoods for mountainous areas should be on the agenda of rural policymakers and planners.

8. Livelihood Strategy Based on Small and Remote Settlements

In general, rural areas in the country as a spatial reality are the result of the interaction of different ecological, socio-cultural, economic, political, and physical factors. The degree of unity and alignment of this reality (village) with the requirements of time can be recognized by considering the structural-functional status of settlements and their position in the settlement system of the country. One of the characteristics of rural settlements in Iran is their dispersion, multiplicity, and diversity. The dispersion of water and soil resources and climatic fluctuations in receiving rainfall and other climatic parameters such as drought, flood rains, etc., have led to the diversity and dispersion of rural settlements in the country and have given Iranian villages a point-like character and diversity in population classes (small, medium, and large settlements). Each of these settlements requires specific intervention and planning based on its territorial resources and environmental context. Accordingly, the existence of any type of settlement, including small and scattered rural settlements in this country, has its fundamental reasons. These scattered settlements have shown during their formation and life that, in many cases, they are the best and most appropriate form of adaptation to the scattered resources of the country.

9. Northern Coastal Village Livelihood Strategy

The same logic of regional balance applies to the northern coastal regions. Population and activity should correspond to the area's economic and ecological capacities. In cases where maintaining a larger population is necessary for national interests, economic support and investment should follow to ensure sustainability and equity.

10. Livelihood Strategy Based on Indigenous Knowledge and Lived Experiences of Rural Residents

Central Iranian rural areas have long been centers of indigenous knowledge and sustainable living adapted to arid climates. Traditional livelihoods—ranging from agriculture to crafts—demonstrate adaptive strategies developed over generations.

This strategy proposes reviving and updating traditional knowledge and occupations, identifying historic products and crafts, and supporting their modernization, production, and commercialization.

11. Livelihood Strategy Based on Utilizing the Capabilities of Rural Women

Gender equality is increasingly central to modern rural development. In many countries, development accelerates when both women and men participate equally. Unfortunately, stereotypical views of women's roles persist in some societies, hindering progress.

To truly advance rural development, women must be meaningfully engaged in planning and implementation. Supporting women entrepreneurs is a powerful driver for reducing rural unemployment and promoting inclusive growth.

12. Livelihood Strategy Based on Branding

Creating and promoting unique, high-quality rural products is an opportunity for rural entrepreneurs. The growing demand for organic and authentic products among urban consumers highlights the potential for branding to become a key rural development tool.

If rural businesses align their products with market preferences, rural communities will benefit from economic growth, job creation, and sustainable livelihoods.

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Conflict of Interest

The authors declared no conflicts of interest.

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