International Journal of Agricultural Management and Development
Available online on: www.ijamad.iaurasht.ac.ir
ISSN: 2159-5852 (Print)
ISSN:2159-5860 (Online)

Gender Analysis of Medicinal Plant Cultivation from the Aspect of the Security of Livelihood Capitals

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Received: 10 Jun 2022
Accepted: 28 Aug 2023

Keywords:
Climate change, resilience, vulnerability, villagers, livelihood

ABSTRACT

Since climate change has negative consequences for agricultural production and people's livelihoods, there is an increased need for flexibility in agricultural systems. The cultivation of medicinal plants is crucial for livelihoods and water resource conservation, making it an effective strategy to achieve resilience in agricultural systems and reduce vulnerability. This study explores the effect of cultivating medicinal plants on the livelihood capitals of women and men farmers in eastern Iran. The statistical population included 7,172 farmers, with 368 selected as a sample using the Krejcie and Morgan table through stratified random sampling. Subject matter experts confirmed the study instrument's validity, and its reliability was established using Cronbach's alpha. Data were analyzed with SPSS software. Comparing the livelihood capital of women and men resulting from the cultivation of medicinal plants showed that men had higher social, human, and economic capital than women. The study's findings guide policymakers and executive managers in developing effective livelihood strategies and assist farmers in selecting activities that maximize capital and performance. Recommendations include enhancing farmers' skills, improving access to technology, and strengthening rural cooperatives to boost productivity and quality. The study urges policymakers to prioritize resource access and support agricultural communities, especially in developing countries and regions affected by climate change, to foster economic development.

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INTRODUCTION

Nowadays, one of the major challenges in human societies, especially in the rural areas of developing countries, is providing livelihoods (Shrestha et al., 2020; Su et al., 2021). The use of inappropriate methods has led to problems such as drought, water shortages (Xu et al., 2019; Momenpour et al., 2021), soil degradation, and erosion (Momenpour et al., 2018; Tsegaye, 2019). With changes in climatic conditions (Ghosh and Ghosal, 2020; Escarcha et al., 2020; Das and Mitra, 2021) and subsequent shifts in production and marketing methods, rural livelihood practices must be modified to move towards sustainability. True assistance for villagers involves transforming their livelihoods rather than providing protective aid (Sene-Harper et al., 2019). To address immediate livelihood challenges in rural areas, basic measures should be taken to develop new methods for organizing activities, diversifying jobs (Das and Mitra, 2021), and exploiting resources (Li et al., 2019) with a forward-looking approach. This is essential because today's rural communities often lack information (Imeni et al., 2020), have poor skills (Siriwardhana et al., 2019; Dragan et al., 2022), and a weak entrepreneurial culture (Zhu et al., 2019; Arellano and Reyes, 2019). To overcome these challenges, sustainable rural livelihood development must rely on the internal resources of the local community.

Currently, the dominant issues in rural development include reducing rural poverty (Guo et al., 2022; Singh and Chudasama, 2020), organizing indigenous knowledge potentials (Maunganidze, 2016), and focusing on gender issues (Barik, 2021). Poverty is one of the oldest social harms in all societies (Pemberton et al., 2017). To achieve development, it is essential to focus on villages, as the majority of the world's poor live in rural areas of developing countries (World Bank, 2008). One approach that addresses poverty and vulnerability of rural households in a human-centered way emphasizes sustainable livelihoods (Philips and Potter, 2003; Su et al., 2021; Wu et al., 2019). Human and economic development are contingent upon livelihood. Su et al. (2021) found a positive correlation between poverty alleviation measures and natural as well as social capital for sustainable livelihoods. Livelihood encompasses all activities people undertake to earn a living (Helmor and Sing, 2001). Timmermenn and Smith-Hall (2019) argued that the commercialization of medicinal plant cultivation offers a unique opportunity to boost incomes in local communities, supporting livelihood strategies and reducing the negative effects of migration. Bhat et al. (2020) found that the cultivation of medicinal plants (MPs) yielded the highest income from off-farm sources. Given climatic changes and current environmental problems, cultivating MPs is an effective option compatible with livelihood sustainability in rural areas. Sharma et al. (2020) emphasized its economic role and beneficial effect on the livelihood of rural households.

The high volume of global trade in medicinal plants (MPs) (Mohammadi and Saghaian, 2022) indicates the potential of producing MPs, which require less water and can adapt to harsh climatic conditions, to improve the livelihoods of rural households. Agriculture is the main source of support for the majority of rural families and urban populations in developing countries (Abid et al., 2015; Keiko Yamaguchi et al., 2020; Teka and Lee, 2020). Gajurel et al. (2021) examined the impact of the Ayurvedic pippali plant (Piper longum L.) on the livelihood and socio-economic development of Indian farmers. They found that, in addition to its climate compatibility, the plant's cultivation has increased farmers' income and boosted self-employment opportunities through processing and marketing products. Therefore, a plan should be made for the integrated management of natural resources and the optimal use of water and soil resources to ensure farmers' livelihoods and reduce pressure on the environment and natural resources. The cultivation and processing of MPs is a suitable option to achieve this goal.

A significant portion of Iran is classified as arid and semi-arid, characterized by harsh environmental conditions and fragile ecosystems. The deficient and uneven distribution of rainfall, frequent severe droughts, increasing temperatures, water stress, and more extreme weather events predicted for the next 50 years threaten agricultural productivity worldwide. A study examining Iran's temperature over 30 years showed an annual average rainfall decrease of about 2.1 mm, alongside an upward trend in average temperatures (Kohi et al., 2019). These climatic changes pose severe challenges, especially for the agricultural sector, due to its extensive interactions with the environment (Karimi et al., 2021).

Livelihood provision is a major challenge in human societies, particularly in rural areas of developing countries, exacerbated by issues such as drought (Pasricha and Ghosh, 2022; Nasrnia and Ashktorab, 2021), water scarcity, soil degradation, and erosion (Kangalawe and Liwenga, 2005; Abdulmalik and Zewide, 2021). Changes in climatic conditions (Wichern et al., 2019; Sujakhu et al., 2019) and production and marketing methods necessitate modifications in rural livelihood strategies towards sustainability. The primary goal of sustainable livelihoods is to utilize resources, assets, and capital in rural areas without harming the environment (Mohammadi et al., 2021; Krantz, 2001). If the sustainable livelihood approach is not implemented effectively, rural communities may resort to migration to escape difficult living conditions, leading to deserted rural settlements. South Khorasan province, for instance, faces rising unemployment in the agricultural sector (South Khorasan Agricultural Jihad Organization, 2017), resulting in issues like poverty, unemployment, migration, marginalization, income and expenditure discrepancies between urban and rural areas, and the spread of illicit businesses. These factors highlight the necessity of cultivating medicinal plants to improve rural livelihoods.

Medicinal plants (MPs) have always been vital for health and wellness in communities (Astutik et al., 2019). These natural resources have been a key source of medicinal supply for generations. Knowledge of their properties dates back beyond recorded history, and they have always had a unique connection with humans. The use of local plants for treating various diseases is well-documented, reflecting their biological and socio-cultural heritage (Mbuni et al., 2020). MPs with traditional values contribute significantly to human development and well-being in many local communities (Lerotholi et al., 2017; Nwafor et al., 2021; Astutik et al., 2019). They also foster the development of new value chains and traditional healthcare knowledge systems (Nwafor et al., 2021; Astutik et al., 2019). In this study, MPs are defined according to the World Health Organization (Dhawan, 2003), which describes them as plants whose parts contain effective substances that, without undergoing industrial processing, have beneficial therapeutic effects on the body and help treat diseases by regulating the activity of different body systems.

As reported by Egamberdieva et al. (2017), a large number of medicinal plants (MPs) have been studied for their phytochemical compounds, especially those used in the treatment or prevention of diseases. The use of plants and the general interest in herbal medicines have been increasing in recent years. The superiority of MPs and the drugs derived from them over chemical drugs has been demonstrated (Farzaneh and Carvalho, 2015; Zajíčková et al., 2020). Chemical drugs have side effects (Ding et al., 2019), leading to the removal of some from pharmacopeia as dangerous drugs. According to the World Health Organization, achieving the goal of "health for all" is impossible without herbal medicines (Zhang, 2018; WHO, 2010). Compared to chemical drugs, MPs have fewer side effects and, in some cases, no complications (Kooti et al., 2016). Their widespread use can reduce the consumption of chemical drugs (Zhu, 2020), lower the physical and psychological risks they pose to society, and decrease environmental pollution (Łuszczki et al., 2019). Reported statistics indicate that more than 70 percent of people in developing countries and remote areas rely on MPs for their primary medical needs (Jadhav et al., 2020; Jeelani et al., 2018). MPs are significant natural resources, with countries varying in the type, number, and diversity of plant species based on geographical conditions. With the identification of new MP species each year, many people are increasingly turning to these resources.

An estimated 25 percent of modern pharmaceuticals and 18 percent of the top 150 prescription drugs are plant-based (Astutik et al., 2019). The international trade in medicinal plants (MPs) and their products amounted to $60 billion in 2010 and is expected to reach $5 trillion by 2050 (Jadhav et al., 2020). In the United States, consumers spent an estimated $11.3 billion on herbs and herbal dietary supplements in 2020 (Smith et al., 2021). This reflects a growing trend, particularly in industrialized countries, to treat diseases without chemical side effects. Evidence shows that most medicinal plant materials in the world market originate from developing countries (Smith and Larson, 2003; Roosta et al., 2017).

Asian MPs account for about 50 percent of the export value and 45 percent of the global income from traditional medicines (Astutik et al., 2019; Vasisht et al., 2016). These plants are used at both the household and commercial levels. Iran, with a history of using MPs spanning over 5,000 years (Jamshidi et al., 2017), is notable in this context. Of the 18 regions identified globally for MP cultivation, 12 are in Iran. Promoting and developing MP cultivation in Iran on a large scale could support economic development, employment (Astutik et al., 2019), self-sufficiency (Herdiani and Wijaya, 2021), and the preservation of genetic reserves (Rashid et al., 2014).

According to the Ministry of Agriculture Jihad, the cultivated area of medicinal plants (MPs) in Iran was 150,000 hectares in 1996, with $450 million worth of MPs exported that year. This included $230 million from saffron, $20 million from cumin, and $200 million from other MPs. With more than 2,300 plant species in the country having medicinal, aromatic, and cosmetic properties, and about 1,750 of these species being native to Iran (National Document of MPs and Traditional Medicine, 2013), there is a unique capacity for scientific exploitation. This potential can be preserved, restored, developed, and reformed in a principled and sustainable manner. Leveraging this capacity at the national level can enhance employment in rural areas, improve villagers' income, and reduce the income disparity between urban and rural areas, thereby improving rural livelihoods.

Although only a few medicinal plants are cultivated, the majority are still gathered from the wild. The substantial demand for these products has led to over-exploitation, posing threats such as species endangerment, loss of biodiversity, adulteration of plant materials and products, and adverse effects on the ecosystem (Namdeo, 2018; Ramawat and Arora, 2021). Scientifically validated processes for preparing medicinal plants have not been sufficiently developed historically or in modern medicine. Additionally, herbal manufacturing and processing units predominantly rely on traditional methods, with minimal updates in this regard (Porwal et al., 2020).

Statistics show that the cultivated area of medicinal plants in Iran is about 261 thousand hectares, leading to the production of 463 thousand tons (Ministry of Agricultural Jihad, 2022). The marketing of herbal medicines is currently carried out by various herbal pharmaceutical companies (Afshar et al., 2022). However, the future research and policy interventions related to the production and commercialization of MPs, as well as their contribution to household economies and farmers' livelihood security, are unclear. This lack of transparency results from limited and scattered knowledge about medicinal plant production systems and usage methods, specifically related to ignoring the potential (production, use, and commercialization) of different MPs and their impact on improving farmers' income and living conditions. To address this gap and propose a future research agenda, this study examines the effect of the value of MPs on improving the welfare and livelihood of male and female farmers in eastern Iran.

Methodology

Research design

Since the results of this study may be used by various stakeholders such as managers of natural resources, rural development managers, agricultural organizations, private sectors active in the field of medicinal plants, and farmers, it is applied in terms of purpose. This research employs a quantitative approach, utilizing a survey for data collection. It adopts a cross-sectional design, focusing on a specific point in time rather than following participants over an extended period. A questionnaire was used for data collection, and a descriptive-correlational method was employed for data analysis. Therefore, the study's data and information analysis methods are both descriptive and relational.

The study area

South Khorasan province is one of the eastern provinces of Iran, characterized by a dry and semi-dry climate (Figure 1).

The average annual rainfall in the province is 133 mm, mostly occurring as torrential and non-intermittent rains. The hot season in South Khorasan is long, spanning from May to September. Due to intermittent droughts and the reduction of underground water, rural livelihoods in this province face numerous challenges, such as increased unemployment rates, reduced employment in the agricultural sector, a growing income disparity between urban and rural areas, migration, and the prevalence of illicit businesses. These issues have led to a more serious consideration of changing cultivation patterns. Since agriculture is the main source of support for the majority of rural families and urban populations in developing countries (Abid et al., 2015), measures should be taken for the integrated management of natural resources and the optimal use of water and soil resources. The cultivation of medicinal plants (MPs) can be a sustainable solution. In South Khorasan province, the area under cultivation for MPs ranks fourth, and it is third in terms of production (Gohar Shahi and Senjari, 2014), indicating significant potential. On average, out of 116,700 hectares of medicinal plant development in Iran, 26,500 hectares (equivalent to 23%) belong to South Khorasan province, which has the highest level of medicinal plant cultivation development in the country (Agricultural Jihad Statistics, 2021).

Figure 1. Location of the Study Area

tatistical population, sample, and sampling method

The statistical population of the study consisted of farmers in South Khorasan province engaged in the cultivation of medicinal plants (MPs), totaling 38,039 individuals. From this population, 368 farmers were selected as a sample using the Krejcie and Morgan (1970) table. Sampling was based on the clustering of geographical areas within South Khorasan province. The clusters included: Qahestan: Qaen, Sarayan, FerdowsBagheran: Birjand, Darmiyan, KhousfGolshan: Tabas, BeshrouyehNoh: Nehbandan, SarbishehStratified random sampling was used to select cities and the number of farmers sampled from each county: Ferdows (4,742), Birjand (1,926), Beshroieh (1,743), and Nehbandan (765).

Table 1
Farmers Cultivating MPs and Selected Samples.

County	Cluster	Population size	Sample size
Qahestan	Ferdows	4742	190
Bagheran	Birjand	1926	77
Golshan	Beshrouyeh	1743	70
Noh	Nehbandan	765	31
	Total	9176	368

Statistical Annual of South Khorasan Province (2018).

Data collection and analysis

The data required to understand the views of farmers engaged in the cultivation of medicinal plants (MPs) were collected through a questionnaire in South Khorasan province from April 2019. The survey data were gathered using a face-to-face method. A team of five individuals, familiar with the local culture, language, and customs, was employed to ensure accurate data collection. In cases where interviewees had a minimum level of education, the interview team translated the questions during the survey. Following a briefing session with the interviewers, data collection commenced. Out of 375 distributed questionnaires, seven were removed due to inappropriate and insufficient data, leaving 368 questionnaires for analysis. The data were analyzed using SPSS22 software. Data analysis was conducted in two parts:

Demographic Information: Descriptive statistics (frequency, percentage, mean, and standard deviation (SD)) were used.

Inferential Statistics: Validation and means comparison tests were employed to analyze the relationships between variables.

Research tools, validity, and reliability

In this study, data were collected using a questionnaire (Table 2) distributed among the statistical samples. The questionnaire comprised two main parts, totaling 55 questions:

Personal Characteristics: This section included nine variables: Age,Gender,Education level,Work experience,Income,Number of family members,Savings, Received facilities and, Training courses.

Independent Variables: This section focused on various forms of capital: Social capital, Economic capital, Natural capital, Physical capital and, Human capital. Responses were measured on a five-point Likert scale, ranging from “very little” to “very much.” The average of all parameters was used to determine the living conditions of the respondents.

Reliability and validity of the questionnaire: To ensure the reliability of the designed questionnaire, a preliminary study was conducted with 30 questionnaires completed by farmers engaged in planting MPs. The data were analyzed using SPSS and Smart-PLS software. Confirmatory Factor Analysis (CFA) was employed to validate the items in the research tool. Composite reliability values (CR) and Cronbach’s alpha values were used to evaluate the reliability of the constructs, with recommended threshold values above 0.70 (Hair et al., 2021).

Convergent validity: The Average Variance Extracted (AVE) criterion was used to measure convergent validity, indicating the degree of correlation of a structure with its indicators. The minimum acceptable AVE is 0.40 (Cheung et al., 2017). According to the results (Table 3), the analysis model demonstrated acceptable validity and reliability.

Table 2
Ranking of Items to Measure Farmers' Livelihood Capital.

Variable	Items	Mean*	SD	Rank	Reference
Economic capital	ECO1. Hope for a future career (stable income)	3.5	0.7	1	Abdollahzadeh et al. (2016)
	ECO 2. Providing suitable job opportunities for people in the village	3.26	0.72	2	Sojasi Ghidari et al. (2016)
	ECO 3. Creating suitable economic opportunities	3.25	0.72	3	Sojasi Ghidari et al. (2016)
	ECO 4. Access to production resources (fertilizer, seeds...)	3.22	0.67	4	Sojasi Ghidari et al. (2016)
	ECO 5. Improving income status	3.17	0.65	5	Abdollahzadeh et al. (2016)
	ECO 6. Having job security due to planting MPs (job insurance and pension)	3.16	0.66	6	Abdollahzadeh et al. (2016)
	ECO 7. Greater saving power	3.07	0.71	7	Yang et al. (2018), Zhang et al. (2019)
	ECO 8. Expansion of cultivated area	3.06	0.71	8	Quandt (2018), Shanazi and Aazami, (2018)
	ECO 9. Ability to finance educational expenses related to MPs	3.06	0.64	9	Alibigi and Mahdizadeh, (2017)
	ECO 10. Loan repayment ability	3.02	0.64	10	Sharafi et al. (2018)
	ECO 11. Having the necessary capital for the insurance of MPs	2.97	0.63	11	Nourozi and Hayati, (2015)
	ECO 12. Access to credit facilities for planting MPs	2.84	0.64	12	Jung et al. 2017), (Liu et al. 2018), (Tian & Lemos, 2018)
		Mean=3.13			
Social capital	SOC1. Participation in various village matters	3.62	0.65	1	Sojasi Ghidari et al. (2016), Alibigi and Mahdizadeh, (2017)
	SOC2. Improving communication through social networks	3.42	0.7	2	Njole, (2011)
	SOC3. Willingness to help others financially	3.35	0.7	3	Alibigi and Mahdizadeh, (2017)
	SOC4. Enhancement of trust of others in you	3.34	0.68	4	Alibigi and Mahdizadeh, (2017)
	SOC5. The level of using media to keep job information up to date	3.19	0.8	5	Jung et al. (2017), MotieeLangroodi et al. (2011)
	SOC6. Preference to start a business in the village than in the city	3.18	0.65	6	Sojasi Ghidari et al. (2016)

Social capital	SOC7. Communication of farmers with officials, experts, and agricultural promoters to obtain ideas and resources from an economic and social point of view	3.17	0.63	7	Keshavarz et al. (2017), Nourozi and Hayati, (2015
	SOC8. Willingness to stay in the village	3.09	0.65	8	Sojasi Ghidari et al. (2016) Yang et al. (2018)
	SOC9. Participation in related training courses	3.06	0.75	9	Alibigi and Mahdizadeh, (2017)
	SOC10. Preferring to live in the village environment than in the city	3.05	0.68	10	Sojasi Ghidari et al. (2016)
	SOC11. Participation in cooperatives, associations, and rural organizations	2.84	0.71	11	Sojasi Ghidari et al. (2016); Abdollahzadeh et al. (2016), Nourozi and Hayati, (2015), Motiee-Langroodi et al. (2011)
		Mean=3.53			
Natural capital	NAT1. Diversity in pharmaceutical products	3.83	0.81	1	Shanazi and Aazami, (2018), Roknedin eftekhari et al. (2014)
	NAT2. Increasing vegetation in the area	3.23	0.65	2	Quandt (2018), Shanazi and Aazami, (2018), Sharafi et al. (2018)
	NAT3. Reducing soil erosion in agricultural lands	3.19	0.69	3	(Quandt 2018)
	NAT4. Conserving pastures for the collection of MPs	3.15	069	4	Sharafi et al., (2018)
	NAT5. Improving farm soil fertility	3.14	0.65	5	Yang et al. (2018), Sojasi Ghidari et al. (2016)
	NAT6. The rate of plant growth in the ground	3.13	0.65	6	Khayyati andAazami, (2016), Liu et al. (2018)
	NAT7. Sufficient amount of water to irrigate fields and gardens	2.96	0.62	7	Abdollahzadeh et al. (2016), Sojasi Ghidari et al., (2016), Nourozi and Hayati, (2015)
		Mean=3.23			

Physical capital	PHY1. Expansion of communication routes and suitable roads	3.45	0.66	1	Abdollahzadeh et al. (2016), Sojasi Ghidari et al. (2016), Quandt (2018)
	PHY2. Suitable transport facilities for marketing	3.42	0.64	2	Nourozi and Hayati, (2015)
	PHY3. Access to agricultural machinery for planting as well as keeping MPs	3.26	0.61	3	Yang et al. (2018),) Khayyati and Aazami, 2016)
	PHY4. Access to the market for the marketing of manufactured products	3.21	0.61	4	Sojasi Ghidari et al. (2016), Nourozi and Hayati, (2015
	PHY5. Improving access to energy and fossil fuels to prevent deforestation	3.18	0.76	5	Alibigi and Mahdizadeh, (2017); Sharafi et al. (2018), MotieeLangroodi et al. (2011)
	PHY6. Convenient access to the work environment	3.13	0.83	6	Sojasi Ghidari et al. (2016)
	PHY7. Development of complementary agricultural conversion industries in the field of MPs	2.82	0.74	7	Sawari et al. (2017)
		Mean=3.21			
Human capital	HUM1. Encouraging human resources to study fields related to MPs	3.48	0.8	1	Tian et al. (2016)
	HUM2. Ability to diversify sources of income	3.21	2.28	2	Alibigi and Mahdizadeh, (2017), MotieeLangroodi et al. (2011), Ghadiri Masoum et al. (2015)
	HUM3. Acceptance of skills by villagers	3.17	0.67	3	Alibigi and Mahdizadeh, (2017), Sharafi et al. (2018)
	HUM4. Marketing ability	3.14	0.67	4	Alibigi and Mahdizadeh, (2017), MotieeLangroodi et al. (2011), Ghadiri Masoum et al. (2015)
	HUM5. Ability to teach other villagers skills related to planting MPs	3.11	0.71	5	Abdollahzadeh et al. (2016), Alibigi and Mahdizadeh, (2017), Sharafi et al. (2018), Jung et al. 2017)
	HUM6. Ability to compete with other businesses	3.05	0.65	6	Alibigi and Mahdizadeh, (2017), MotieeLangroodi et al. (2011), Ghadiri Masoum et al. (2015)

	HUM7. Ability to compete in production	3.05	0.66	7	Alibigi and Mahdizadeh, (2017), MotieeLangroodi et al. (2011)
Natural capital	HUM8. The ability to innovate in the field of MPs	2.97	0.68	8	Alibigi and Mahdizadeh, (2017), MotieeLangroodi et al. (2011), Ghadiri Masoum et al. (2015)
	HUM9. Access to innovations in the field of MPs	2.95	0.66	9	Alibigi and Mahdizadeh, (2017), MotieeLangroodi et al. (2011), Ghadiri Masoum et al. (2015)
		Mean=3.23			

Results

Descriptive statistics

Descriptive data analysis revealed that 65 percent of the respondents had three or fewer family members involved in medicinal plant cultivation. The frequency distribution of annual savings of farmers indicated that most people (362 people) had savings of less than $ 236.69 and only one person had more than $ 497.04 per year. The frequency distribution of the facilities received by farmers showed that 367 people (99.7%) received facilities for less than 78.82 dollars and only 1 person (0.2%) received facilities above $ 2366.86 . The frequency distribution of the facilities received by farmers revealed that 98.4 percent of people (362 people) received agricultural incentives less than $ 23.67 and only 0.3 percent (1 person) received agricultural incentives higher than $ 50 . Finally, almost 96 percent of them had participated in less than two training courses on planting MPs (Table 3).

Table 3
Socio-demographic Variables (n=368).

Gender	Frequency (percentage)	Mean	Mode
Male	263 (71.5)	-	Male
Female	105 (28.5)		
Age			
≤ 31	138 (37.8)	42	≤ 31
32 - 41	98 (26.9)		
42 - 50	68 (18.2)		
≥ 51	64 (17.1)		
Level of education			
Lower	201 (54.6)	-	Lower
Middle	143 (38.9)		
Upper	24 (6.5)		
Income			
€≤268	316 (85.9)	178	€≤268
€ 269 - 535	41 (11.1)		
€ 536 - 803	5 (1.4)		
€ ≥ 804	6 (1.6)		

Experience			
≤ 10	287 (78)		
11 – 20	50 (13.6)	8.59	≤ 10
21 - 30	18 (4.9)		
31 - 40	9 (2.4)		
≥ 41	4 (1.1)		

Description of the livelihood status of farmers engaged in the cultivation of MPs

To obtain a qualitative description of the livelihood variable and to classify the respondents in terms of the livelihood of farmers engaged in the cultivation of MPs, the interval of standard deviation from the mean equation (ISDM) was used. This method is one of the common options for qualitative description of research variables. In this method, the manner of converting the obtained grades into four levels is estimated as follows (Table 4) (Davis, 1971). First, the mean and standard deviation (SD) were calculated for the farmers' livelihood variables (Table 4). Then, by calculating Mean + SD, the following four parts named A (weak), B (moderate), C (good), and D (excellent) were obtained to describe these two variables. The results indicated that 15.49 percent of farmers' livelihood status was poor, 34.51 percent was average, 34.24 percent was good, and 15.76 percent was excellent (Table 4). The results of Table 3 indicate that about 75 percent of people had an average and good livelihood. This result demonstrates that the cultivation of MPs can have a positive effect on the livelihood of farmers and be a factor in improving their living conditions as well as well-being. Cultivation of MPs can be a useful and sustainable source of income for farmers. Although recent climatic changes have hurt agricultural production, due to the consumption of little water and resistance to these changes, the cultivation of MPs receives minimal impacts, and the farmers who are engaged in the cultivation of these products experience less damage. As can be seen in Table 4, 15.49 percent of farmers are at a poor level. This is because these farmers have little resilience to environmental changes, and economically, they are considered small-scale farmers with little investment in planting MPs. At the same time, 15.56 percent of the farmers had an excellent status about livelihood. Because these farmers have better facilities than others, they also have easier access to information sources, though as mentioned before, the majority of them are average (68.75%).

Table 4
Classification of Farmers' Livelihood.

A < Mean – Sd	A < 14.47	Weak	15.49%
Mean - Sd ≤ B < Mean	14.47 ≤ B < 16.25	Medium	34.51%
Mean ≤ C < Mean+ Sd	16.25 ≤ C < 18.03	Good	34.24%
Mean + Sd ≤ D	18.03 ≤ D	Excellent	15.76%

The findings of the confirmatory factor analysis

The results obtained from the CFA showed that in the measurement model, item NAT7 related to natural capital, ECO6 related to economic capital, HUM7, HUM8, and HUM9 related to human capital, PHY1, PHY2, PHY6, and PHY7 related to physical capital, and SOC1, SOC3, and SOC11 related to social capital had a factor loading of less than 0.4. These items were excluded from the confirmatory factor analysis due to the low factor loadings (Table 5).

Table 5

Results of Confirmatory Factor Analysis.

Constructs	Items	t- value	Cronbach'salpha	CR	AVE
Economic capital	ECO1	12.731	0.88	0.88	0.41
	ECO2	12.276			
	ECO3	12.360			
	ECO4	12.627			
	ECO5	12.788			
	ECO6	deleted			
	ECO7	12.326			
	ECO8	12.430			
	ECO9	12.557			
	ECO10	12.449			
	ECO11	11.995			
	ECO12	12.380			
Social capital	SOC1	deleted	0.83	0.84	0.42
	SOC2	12.908			
	SOC3	deleted			
	SOC4	13.063			
	SOC5	12.694			
	SOC6	12.470			
	SOC7	12.382			
	SOC8	8.118			
	SOC9	9.220			
	SOC10	11.141			
	SOC11	deleted			
Natural capital	NAT1	11.675	0.76	0.77	0.35
	NAT2	11.835			
	NAT3	11.424			
	NAT4	12.563			
	NAT5	11.840			
	NAT6	11.820			
	NAT7	deleted			
Physical capital	PHY1	deleted	0.72	0.74	0.49
	PHY2	deleted			
	PHY3	11.662			
	PHY4	4.825			
	PHY5	9.072			
	PHY6	deleted			
	PHY7	deleted			
Human capital	HUM1	11.940	0.81	0.82	0.43
	HUM2	12.357			
	HUM3	11.492			
	HUM4	11.513			
	HUM5	11.914			
	HUM6	11.366			
	HUM7	deleted			
	HUM8	deleted			
	HUM9	deleted			

Figure 3 depicts the CFA framework of the components of livelihood capital among farmers engaged in the cultivation of MPs. In this figure, the loading factors (correlation) are presented in their standardized state. The acceptable cut-off value for factor loadings was 0.4, meaning that indicators with factor loadings less than 0.4 were removed from the final scale for confirmatory factor analysis (Table 5).

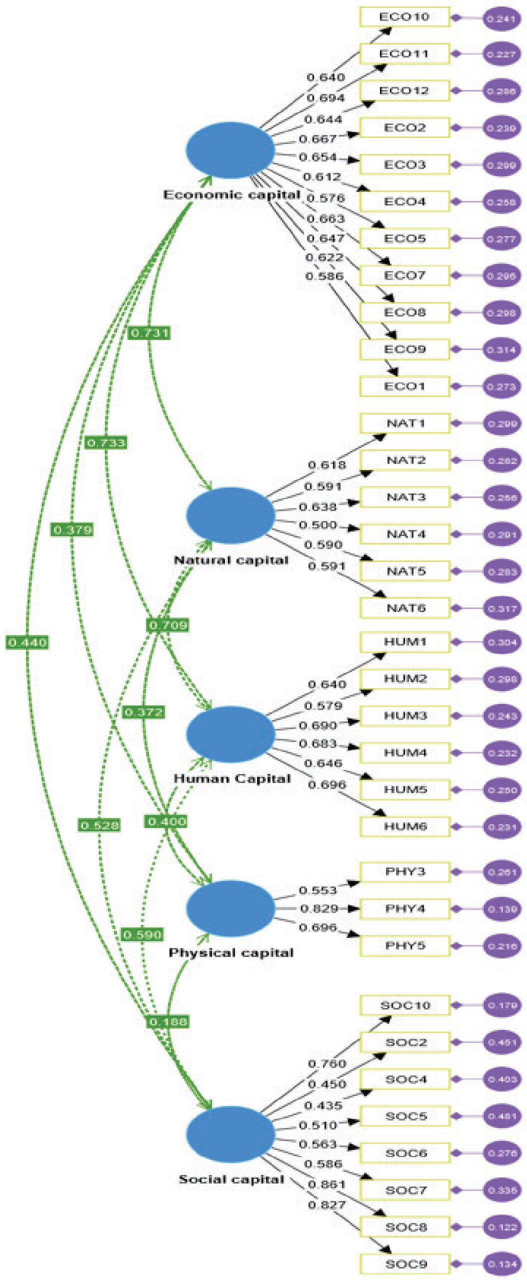

Figure 2. the CFA Framework of the Components of Livelihood Capital

The findings of the conEvaluation of relationships between variables

Pearson's correlation was used to examine the correlation between the components of livelihood capital among farmers (Table 6). The findings indicated that the economic capital component (r=0.804; p<0.01) had a positive and significant correlation with farmers' livelihood in planting MPs. Additionally, the natural (r=0.795; p<0.01) and human (r=0.793; p<0.01) components showed a positive and significant correlation with farmers' livelihood in planting MPs. This indicates that there is a positive and significant relationship between the natural conditions of the region, the diversity of MPs, the skills and abilities of farmers, and the improvement of their livelihood. The social capital component (r=0.787; $p<0.01$) also revealed positive and significant correlations with farmers' livelihood in planting MPs. This suggests that increased participation and interaction among farmers and villagers regarding the planting of MPs are likely to improve their livelihoods. Finally, the physical capital component (r=0.729; $p<0.01$) showed positive and significant correlations with farmers' livelihood in planting MPs, signifying that as access to production facilities and markets increases, so does the probability of improving farmers' livelihoods.

Table 6
Correlation Matrix of the Theoretical Framework Variables.

Variables	Social capital	Economic capital	Natural capital	Physical capital	Human capital	Mean	SD
Social capital	1					3.53	0.48
Economic capital	0.508**	1				3.13	0.44
Natural capital	0.537**	0.613**	1			3.23	0.42
Physical capital	0.729**	0.477**	0.493**	1		3.21	0.42
Human Capital	0.531**	0.559**	0.501**	0.450**	1	3.12	0.50

** $p < 0.01$ (two-tailed test).

The findings Comparison of men's and women's views on livelihood capital

To compare the opinions of male and female farmers about livelihood capital resulting from MP cultivation, the non-parametric Mann-Whitney test was used since the data did not follow a normal distribution (Table 7). The results indicated that men and women have a significant difference in terms of social, economic, and human capital. Indeed, men had a higher average than women in each of the social, economic, and human capitals resulting from planting MPs.

Table 7
Mann-Whitney U results: Comparison of Men's and Women's Views on Livelihood Capital.

Dependent variable	Leveling variable	Gender	Number of farmers	Mean rank	Mann-Whitney U	p-value
Livelihood	Social capital	Female	105	161.43	11382.500	0.000
		Men	263	193.71		
	Economic capital	Female	105	163.32	11584.00	0.01
		Men	263	192.95		
	Natural capital	Female	105	169.37	12218.500	0.083
		Men	263	190.54		
	Physical capital	Female	105	175.29	12840.500	0.291
		Men	263	188.18		
	Human Capital	Female	105	166.33	11899.500	0.05
		Men	263	191.75		

Friedman's test was employed to rank livelihood capital factors among male and female farmers cultivating MPs based on their current status (see Table 8). The Chi-square statistic from Table 6 indicates a significant difference ($p<0.01$) in the average ranks of the five investigated factors between women and men. The results show that "social capital" achieved the highest rank in both groups, while among men, "human capital" had the lowest rank, and among women, "economic capital" had the lowest rank.

Table 8
The Results of Ranking the Components

Gender	The dependent variables	Mean	Mean Rank	Rank	Chi-square	p-value
Male	Social capital	3.57	4.22	1	218.864	0.000
	Natural capital	3.26	2.94	2		
	Physical capital	3.22	2.86	3		
	Economic capital	3.17	2.58	4		
	Human Capital	3.16	2.40	5		
Female	Social capital	3.44	4.22	1	98.483	0.000
	Natural capital	3.17	3.04	2		
	Physical capital	3.19	3.01	3		
	Human Capital	3.04	2.43	4		
	Economic capital	3.04	2.30	5		

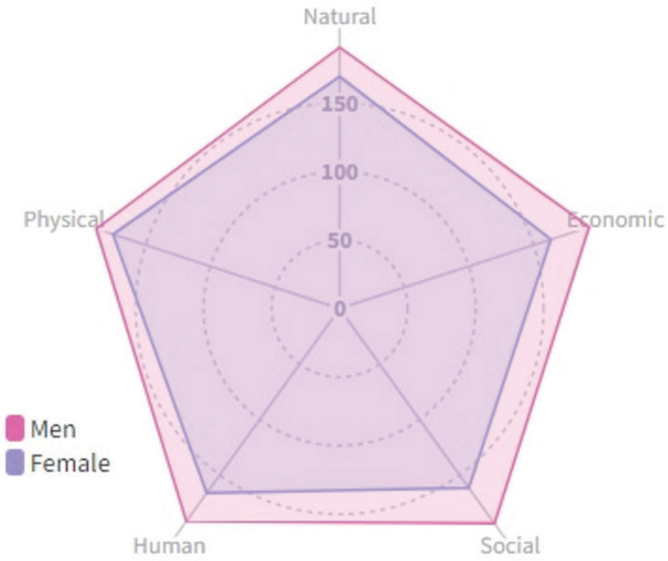

Figure 3. The Position of Livelihood Capital Factors by Gender.

As depicted in Figure 4, men exhibit higher economic capital from cultivating MPs compared to women, indicating a disparity. This difference contrasts with the finding that there was no significant divergence between men and women concerning natural and physical capital. Moreover, a notable distinction was observed in human capital between the genders. Overall, the results suggest that female medicinal plant farmers generally possess lower levels of livelihood capital compared to their male counterparts.

Discussion

A significant portion of Iran's territory is classified as arid and semi-arid areas (Emadodin et al., 2019), which are characterized by harsh environmental conditions that make these ecosystems fragile and vulnerable. Iran faces challenges such as inadequate and uneven distribution of rainfall (Kaboli et al., 2021), frequent severe droughts, rising temperatures (Vaghefi et al., 2019), water scarcity (Ashraf et al., 2019), and increasing occurrences of extreme weather events (Mousavi et al., 2020). These factors are anticipated to decrease agricultural productivity in many regions globally over the next 50 years. Agriculture serves as the primary livelihood for a large proportion of rural and urban populations in developing countries (Abid et al., 2015; Keiko Yamaguchi et al., 2020; Teka and Lee, 2020). Given the critical role of agriculture in providing employment, stable income, and livelihoods for rural communities, cultivating medicinal plants (MPs) could offer solutions. MPs typically require less water and are adaptable to harsh environmental conditions. By promoting the cultivation of MPs, these initiatives can potentially mitigate the severity of environmental challenges faced by agricultural communities in Iran and similar regions.

An examination of livelihood capitals among rural men and women engaged in medicinal plant cultivation revealed significant differences across social, human, and economic capitals, while no disparity was observed in physical and natural capitals. Social capital emerged as the highest valued capital among both genders, whereas human capital showed the lowest value.

The study highlighted significant discrepancies in social capital between women and men involved in medicinal plant cultivation. This disparity may stem from women's limited participation in village affairs due to socio-cultural constraints, hindering their active engagement in community activities. Women also have less access to officials, experts, and agricultural resources, potentially limiting their economic and social development opportunities compared to men, who benefit from higher literacy rates and better media utilization for job-related information. The findings underscored a significant difference in economic capital, with men typically controlling household income, thereby influencing economic decisions even when women contribute through employment. Women's economic activities often go unpaid or unrecognized, reinforcing their economic dependency on men and diminishing their societal economic role.

Moreover, the study revealed disparities in human capital, suggesting that men are more actively involved in medicinal plant cultivation, possibly due to better educational opportunities and societal conditions favoring men's participation in such endeavors. This trend aligns with previous research emphasizing the link between economic activities and livelihood improvements among rural populations.

In conclusion, these findings highlight the complex interplay of social, economic, and cultural factors influencing rural livelihoods, particularly concerning gender disparities in agricultural activities like medicinal plant cultivation. Addressing these disparities requires targeted interventions to enhance women's access to resources and opportunities, thereby promoting more equitable and sustainable livelihood outcomes in rural communities.

Conclusions and recommendations

The findings of this research not only contribute to understanding the social, economic, and human dynamics impacting rural livelihoods but also offer actionable insights to mitigate vulnerabilities and improve conditions. Measures such as establishing educational facilities and providing skills training are crucial. Enhancing interactions between local functions and creating market-farm communication channels can boost farmers' incomes.

Socially, policymakers should prioritize promoting membership and participation in cooperatives, which can empower farmers and facilitate access to credits, incentives, and tax exemptions. However, it's noted that cooperatives and related NGOs in the region lack mobility and dynamism compared to counterparts in other regions.

Regarding natural capital, ensuring access to water resources, both underground and from nearby rivers, is crucial for agricultural sustainability. Efforts should focus on providing rural households with sustainable water access while considering environmental implications.

In terms of physical capital, addressing the lack of processing industries for medicinal plants is essential. Developing local processing capabilities can add value to products and facilitate exports, significantly boosting rural incomes. Furthermore, bridging the gap between grassroots perspectives and top-down policies is vital. Proposing adaptable and preventive measures can effectively address vulnerabilities in rural communities, ensuring sustainable development. It's important to note that this study solely focused on gender analysis and did not explore other demographic variables. Future research should consider these variables to provide a more comprehensive understanding of rural livelihood dynamics and inform targeted interventions effectively.

Practical concepts

Livelihood funds are essential for enhancing the living conditions of farmers and benefiting local communities. The findings from this study offer critical insights for policymakers within organizations, cooperatives, and farming communities to implement necessary measures for improving rural livelihoods. While regional and national variations in living conditions and resource availability exist, the study's findings can provide valuable perspectives for planners and policymakers aiming to uplift farmer livelihoods. The study underscored the significant roles of social, human, and economic capital in enhancing the livelihoods of medicinal plant (MP) farmers. Therefore, efforts should prioritize improving skills in planting and processing medicinal plants among farmers, alongside facilitating their access to innovative technologies. Training programs and workshops can empower farmers to increase productivity and product quality. Additionally, establishing and sustaining rural cooperatives and organizations are crucial steps. These entities can serve as platforms for information sharing, marketing pharmaceutical products, and enhancing social capital. Strengthening cooperatives can enable collective action and enhance overall productivity. Given the demand for facilities expressed by many households, management and planning departments should prioritize addressing these needs and removing obstacles that hinder farmers' access to essential resources. In conclusion, by leveraging the insights from this study, policymakers can formulate targeted strategies to support agricultural communities, foster economic development, and improve overall quality of life for rural residents.

Authors' Contributions

Shahla Choobchian* (First Author and Supervisor) was responsible for overseeing the research design, as well as the analysis and interpretation of the data. Mahboobe Dalir administered the research process and coordinated data collection efforts. Enayat Abbasi served as the advisor and edited the manuscript. Yadgar Momenpour contributed to the literature review and manuscript draft. All authors reviewed and approved the final version of the manuscript.

Acknowledgments

The authors would like to extend their sincere gratitude to Tarbiat Modares University for its financial support, which was crucial in making this research possible. We also wish to acknowledge the invaluable assistance of the administrative staff, whose support and resources were instrumental in successfully completing this study.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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How to cite this article:
Choobchian, Sh., Dalir, M., Abbasi, E., & Momenpour, Y. (2024). Gender Analysis of Medicinal Plant Cultivation from the Aspect of the Security of Livelihood Capitals. *International Journal of Agricultural Management and Development, 14(1), 15-38.*