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Structural Analysis of the Development Drivers Affecting the Realization of Multi-purpose Management of Summer Rangeland at Mazandaran Province Based on Future Studies Approach

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ABSTRACT

Aims: Preventing rangeland degradation and conserving them is a challenging task that necessitates targeted changes in rangeland policy and management systems. Planning should aim for the optimal utilization of rangelands while meeting the needs of stakeholders. One of the most crucial measures involves adopting a systemic approach to rangeland management, encompassing all resources, livelihood potentials, and income generated from rangelands through multi-purpose use. To effectively manage rangelands, it is crucial to take a comprehensive approach that considers all resources, livelihood opportunities, and income generated from these areas through multi-purpose use. This involves adopting a systemic approach to rangeland management, encompassing the identification and utilization of non-sustainable potentials within the content of multi-purpose exploitation of rangelands. Such an approach can have a significant impact on reducing the livelihood dependence of pastoralists. Since numerous factors influence its successful implementation in rangeland management, particularly in the summer season, this research was conducted to investigate the influential drivers affecting the development of multi-purpose management in the summer rangelands of Mazandaran Province, utilizing a future studies approach.

Materials & Methods: This descriptive-applied study employed a survey method. The study population comprised experts, deputy heads of departments, and members specializing in rangeland management. Through purposive judgment sampling, 50 individuals were selected from these populations within the natural resources domain in Sari, Mazandaran Province. Data was collected using a researcher-developed questionnaire, and the Cross-Impact Analysis technique was applied to analyze 21 extracted indices from individual and group interviews. The MicMac software facilitated this analysis.

Findings: The study revealed that the primary influential drivers for the advancement of multi-purpose rangeland management included "decentralization and stakeholder participation in the implementation process of multi-purpose plans," "The results indicated that the indicators " decentralization and stakeholder participation in the implementation process of multi-purpose plans," " generation of new employment prospects and strengthening of rural income potentials," " establishment and fortification of rural cooperatives and organizations," " governmental support and assistance," and " trust-building communication between stakeholders and the government" were the most significant drivers with the highest coefficients of 607, 596, 585, 585, and 564, respectively. These indicators influenced the multi-purpose utilization of the studied region's rangelands.

Conclusion: Based on the obtained results, the paramount recommendation of this study, employing a forward-thinking approach, is the development of a long-term vision document encompassing economic, socio-cultural, and environmental dimensions. This strategic move is poised to catalyze the transformation of the multi-purpose rangeland management system in Mazandaran Province.

Keywords: Drivers; Future studies; Mazandaran; Multi-purpose; Rangeland Management.

CITATION LINKS

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Introduction

Iran's per capita rangeland measures 1.32 ha, whereas the global average is 0.82 ha. According to the studies, the global value of one hectare of rangeland per year is 232 dollars. The ecological and environmental values of rangeland in Iran are between 4 and 8 times the value of their fodder production [1]. On the other hand, rangelands are ecosystems that sustain the livelihoods of millions of people and provide various services and functions. However, under current conditions, the primary function of these resources in all rangelands is livestock herding, utilizing their forage without considering sustainability and production aspects.[2]

Globally, the livestock sector encompasses roughly 3.9 billion ha, with approximately 52% comprising extensive low-productivity rangelands, 36% high-efficiency rangelands, and 12% dedicated to cultivated forage plants [3]. Iran has approximately 124 million livestock units, with nearly 83 million dependents on rangelands. The existing rangelands in the country can only provide forage for 37 million livestock units within seven months, or 24.6 million livestock units annually [4].

As of 2020, statistics from the Bureau of Natural Resources and Watershed Management of Iran indicate that the utilization of the country's rangelands exceeds their authorized capacity by more than 2.2 times. Furthermore, the livelihoods of approximately 916,000 rural households and nomads on the sustainable utilization of these rangelands. Rangeland-based systems play a pivotal economic role for these communities. However, they face significant challenges, including climate change and prolonged drought, which have decreased productivity and flexibility in rangeland livestock herding systems, reducing overall rangeland availability [5, 6, 7, 8].

Furthermore, rangelands are vital hubs for producing and growing medicinal and industrial plants, boasting a market value exceeding $5 billion annually. As such, rangeland conservation, restoration, development, and multi-purpose management are significant for livestock feeding and fostering economic growth and community development [9]. Moving beyond a singular focus on forage production is imperative when evaluating rangeland ecosystems. This narrow perspective leads to land degradation and reduced direct utility of rangelands and may not necessarily translate to enhanced economic performance for rangeland stakeholders. Instead, a multi-purpose management approach is imperative [10, 11]. A more systematic approach has been adopted through rangeland management plans to cultivate greater engagement and motivation among stakeholders for the conservation, enhancement, restoration, and proper utilization of rangelands [12].

Many existing rangeland management plans have faced challenges, including unsuitable livelihood conditions for livestock farmers, limited economic viability, and insufficient profitability for rangeland stakeholders. These issues have hindered their success in aligning with the policies of the country's Natural Resources and Watershed Management Organization in recent years. To address this, an economic review of rangeland management plans was undertaken. The focus was on revitalizing and developing medicinal plant habitats, creating alternative jobs based on existing potential, economically empowering local users, and enhancing their resilience. Consequently, adopting a multi-purpose approach to rangeland utilization has yielded economic profitability, job creation for rangeland users, increased participation in implementation, and restricted pressure from livestock on the rangelands [13].

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Rangelands management for multiple uses demonstrates the highest income and profits for those who utilize them in a multifaceted manner (multi-purpose use). This approach offers a viable alternative for addressing ecological crises while preserving productivity [14]. Building on this principle, other compatible capacities and land uses with nature are identified and introduced to facilitate their utilization and contribute to the economic viability of use units and the organization of the rangeland population. In other words, finding the potential of rangelands and investing in alternative livelihoods is one of the fundamental aspects of successful use and multi-purpose management [15, 16, 17]. Implementing multi-purpose utilization through a combination of livestock and other activities provides alternative incomes for stakeholders and enhances their economic resilience [18]. Additionally, this system can significantly impact household food security through diverse food resources [19, 20, 21].

In multi-purpose rangeland management, rangeland forage is not limited to livestock consumption alone. Instead, it encompasses a diverse array of potential uses, including the cultivation of medicinal plants, fruit-bearing and non-fruit-bearing trees for timber production, and the production of forage and alfalfa. Additionally, aquaculture, beekeeping, cultivation of forage crops, ecotourism, livestock fattening, and poultry farming find their place in this multifaceted approach.

This diversification of utilization is particularly crucial in summer rangelands. These areas boast a wealth of natural and non-natural potential, rendering them even more significant than their winter rangelands. Recognizing the paramount importance of rangeland management projects and the imperative for stakeholder involvement, numerous research endeavors have been dedicated to comprehending the factors that influence the execution and ultimate success or failure of these initiatives.

Surprisingly, despite the depth of research in this field, a notable gap exists in the participation of stakeholders in the implementation of multi-purpose rangeland plans, alongside an exploration of the attendant challenges and problems. As a result, the insights gleaned from pertinent studies on rangeland management projects and their associated challenges illuminate various facets of the present investigation. O'Fairchealla [22] identified various influential factors in water and soil conservation projects, including government dependency, membership in social institutions, attitudes towards projects, empowerment of local communities, attention to property rights, job creation, presence of local leaders in projects, social participation, trust in government officials, and future approaches. Bohnet et al. [23] and Brussels [24] concluded in their research that heightened competition among livestock farmers for grazing resources has led to increased resource conflicts and disputes, resulting in livelihood insecurity among pastoral communities. Consequently, the quest for alternative livelihood options becomes imperative. They regarded competition in resource utilization as a significant driver of project participation.

Reinhold-Hurek & Hurek [25] acknowledged that raising awareness among rangeland stakeholders about the process of rangeland degradation can instigate shifts in attitudes towards the potential use and conservation of these lands. Corti et al. [26], in their investigation of multi-purpose utilization in alpine rangelands in Lombardy, Italy, employed targeted indicators to evaluate diverse aspects, encompassing dairy and meat products, tourism services, education, conservation, and other agricultural

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products, as well as social values and rural heritage, landscape, nature, and future planning considerations.

Ferreira & Zanine [15], in their examination of the challenges facing multi-purpose rangelands in Brazil, presented alternative strategies for sustainable rangeland development, including the integration of agriculture and livestock, Silvopastoral systems, and Agrosilvopastoral systems, all with minimal environmental impacts. In another study in Brazil, Maia et al. [18] concluded that the multi-purpose utilization of natural resources leads to an improved profit-to-cost ratio, minimizing production costs and enhancing income generation. Consistent with this, Savian et al. [27] and Nigus [28] contend that grassland revitalization and the integration of agricultural and livestock products can provide feed for livestock, resulting in reduced costs, increased income, and the control of invasive species.

Taylor & Van Grieken [29] investigated the level of interest and encouragement of stakeholders, while Kong et al. [30] examined the impact of motivation and the use of local ecological knowledge on the participation of stakeholders in rangeland conservation programs. Aliyev et al. [31] found in Azerbaijan that involving local people in all stages of projects (planning, implementation, and evaluation), especially their participation in decision-making, can be a practical step in successful project execution.

Based on the research findings of Iskandar et al. [32] in Indonesia, implementing multi-purpose utilization can create new job opportunities in rural areas for non-agriculture and non-livestock activities. Increasing employment opportunities also enhance women's participation in productive activities in rural areas [20]. Furthermore, attracting jobs and improving the rural economy can prevent rural migration [33]. Papadopoulou et al. [10] concluded in their study in Greece that less grazed rangeland and utilizing other capacities of rangeland are more efficient compared to rangeland with higher livestock grazing rangeland. Creating necessary infrastructure for better access to rangeland, planned livestock feeding, and training livestock farmers significantly impact sustainable livestock farming.

The research of Mukhlis et al. [14] demonstrated that the multi-purpose utilization of natural resources can enhance smallholders' income, improve food security, advance gender equality, and stimulate cultural activities in rural areas. Varela et al. [34] concluded from their study in Spain that livestock farmers exhibit a more significant economic interest in multi-functional rangelands than single-purpose grazing. Consequently, integrating livestock grazing with other systems is imperative for sustainable rangeland management. Wafula et al. [35] also found in the Nairobi rangelands of Kenya that the search for pasture, water scarcity, and lack of alternative markets pose multiple livelihood challenges for livestock farmers and sometimes lead to migration to urban areas.

In the Sari region of Mazandaran Province, there are 387,870 ha of rangeland, benefiting 13,500 households through 1,092 informal organizations. Among these, 299,171 ha are designated summer rangeland, 37,249 are middle rangelands, and 51,450 are winter rangeland. This extensive resource supports 1,396,987 livestock units, with 764,415 units operating under authorization.

Given that over 77% of Mazandaran's rangelands are classified as summer rangeland, there is a pressing need for focused planning and a shift away from one-dimensional forage-based management practices. This adjustment is crucial due to the high number of livestock and livestock farmers and economic challenges in justifying livestock farming for household livelihoods.

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Consequently, implementing a multi-purpose approach to rangeland utilization, diversifying employment opportunities and sources of income, and tapping into the non-forage potential of summer rangeland in Mazandaran Province can significantly reduce dependence on this resource and notably enhance resilience, particularly within the financial sector. Therefore, investigating this matter can play a crucial role in the multi-purpose management of rangelands. This way, positive changes in stakeholders' economic and social capabilities can be witnessed while preserving the natural landscape. In other words, by identifying these capacities, a suitable platform can be established for the principled and optimal utilization of rangeland areas, involving local communities and livestock farmers in enhancing the simultaneous improvement of social, economic, and environmental dimensions [3, 36].

The main issue is identifying the influential drivers perceived by livestock stakeholders in the multi-purpose management of the summer rangelands in Mazandaran Province. The aim is to anticipate the future trajectory of multi-functional rangeland management.

In this regard, the present study aims to substantiate the following hypotheses:

1. Land use change is the most influential factor affecting the implementation multi-purpose rangeland management in the summer rangelands of Mazandaran Province.
2. Economic and livelihood factors are the most influential determinants in implementing multi-purpose rangeland management in the summer rangelands of Mazandaran Province.

Materials & Methods

This study is classified as an applied research, characterized as analytical-exploratory. The study population consisted of experts and specialists in rangeland management and faculty members in the Sari area of Mazandaran Province. A sample of 50 individuals was selected using the purposive judgment sampling method.

Therefore, using a targeted approach, 50 specialists in rangeland management and university professors were identified to achieve more precise results in this research. The research instrument employed in this study was a researcher-designed questionnaire. To identify the items and measurement indicators, 10 individual interviews were conducted with experts (7 individuals) and university faculty members (3 individuals), selected through snowball sampling. A focused group technique was utilized to validate the final items and indicators obtained from the interviews, composed of five natural resource experts in the province.

As a result, 189 items were identified. After summarizing and combining these items, 122 items emerged from 21 final indicators and the associated matrix. This questionnaire was then distributed among 50 experts in natural resources, experienced rangeland stakeholders, and university faculty members in the Sari area of Mazandaran Province.

The research questionnaire evaluated and analyzed various aspects along with their respective criteria:

1. Investment indicator for stakeholders in implementing multi-purpose projects and the profitability ratio of activities (9 criteria)
2. Creation of new employment opportunities and strengthening rural income potentials (8 criteria)
3. Enhancement of cultural issues and equality (7 criteria)
4. Formation and strengthening of rural cooperatives and organizations (4 criteria)
5. Decentralization and participation of stakeholders in the implementation process

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of multi-purpose projects (5 criteria)
6. Environmental-ecological status and improvement of natural landscapes in rangelands (6 criteria)
7. Systemic and comprehensive government policy-making and planning (15 criteria)
8. Identification of income-generating plant potentials and processing (6 criteria)
9. Utilization of ecotourism industry in rangelands (4 criteria)
10. Knowledge and skill awareness of stakeholders in multi-purpose rangeland management (8 criteria)
11. Satisfaction level of stakeholders and their attitudes towards the implementation of multi-purpose projects (5 criteria)
12. Utilization of mass media and promotion of social media platforms usage (3 criteria)
13. Action-oriented development of educational and promotional activities and proper information dissemination (3 criteria)
14. Reduction of livestock management problems in rangelands (8 criteria)
15. Management coordination and organizational support (7 criteria)
16. Government support and assistance (5 criteria)
17. Compliance with laws and regulations (3 criteria)
18. Climatic and topographical conditions of the region (4 criteria)
19. Reduction of service and infrastructural problems (3 criteria)
20. Communication and mutual trust between stakeholders and the government (5 criteria)
21. Capacity utilization and diversification in the implementation of rangeland projects (4 criteria)

The scoring ranges from zero to three, indicating the row indices' influence on each column indices. A numerical value of zero represents no influence, one represents weak, two represents moderate, and three represents strong influence [37].

In this study, after data collection and categorization, the descriptive statistics method was employed in the $SPSS_{25}$ software environment to classify respondents' demographic and occupational characteristics based on frequency tables, percentage frequencies, and maximum and minimum values of the data. For structural analysis of driving forces influencing the multi-purpose management of the summer rangelands in Mazandaran Province with a future studies approach, MicMac software was utilized. In this research, by performing two rotations and repetitions of data, the reliability level reached 100%, indicating a very satisfactory status of the examined indices in the structural analysis of influential factors in multi-purpose management development. This confirms the accuracy of the research model selection for data processing and collected information (Table 1).

Table 1) Stability of the data used in the research.

Iteration	Influence (%)	Dependence (%)
1	98	98
2	99	100

Findings

Personal and occupational characteristics of participants: Findings showed that 54% of the study participants consisted of rangeland experts with the highest frequency. In comparison, 18% were university faculty members with the lowest frequency. Based on the obtained results, 82% of the participants were male. The average years of service among the participants was 21.03 years, with the minimum and maximum being 8 and 32 years, respectively. The findings indicated that 60% of participants were most frequently between the ages of 35 and 50, with the lowest and highest ages being 33 and 62, respectively. According to the study's findings, most participants (70%) had completed postgraduate-level

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education. (Table 2).

Initial analysis of the cross-effects matrix data: Based on the results derived from the software output using a 21x21 initial matrix dimension, cross-effects calculation was executed twice on the given matrix. This indicated that the indices achieved a 100% level of desirability and optimality with two rotations, affirming the high validity of the questionnaire and its responses. Moreover, the degrees of matrix filling stand at 92.74%, signifying the extent of variability in the multi-purpose management development variables within the summer rangeland of Mazandaran Province. This implied that the selected factors influenced each other in over 92% of cases. Out of 409 assessable relationships, 32 exhibited a value of zero, denoting that the indicators either did not affect or were not affected by each other. There were 82 relationships with a value of one (indicating a low impact of indicators on each other), 124 relationships with a value of two (indicating a relatively strong influence of indicators on each other), and 203 relationships with a value of three (indicating a high influence and dependence of indicators) (Table 3).

Determining the influence and dependence of indicators on the development of multi-purpose management of summer Rangeland in Mazandaran Province: Based on the values obtained from Table 4, each row's total signifies the level of influence, while the values in the columns represent the degree of dependence on other indicators. In the structural analysis matrix, the sum of values in the rows about each factor indicates its level of influence. Likewise, the sum of values in each column for a given fac-

Table 2) Frequency distribution of respondents according to personal and job characteristics.

Variable type	Groups	Frequency	Percent
Organizational post status	University faculty members	9	18
	Natural resources experts	27	54
	Assistants and heads of departments	14	28
Gender status	Man	41	82
	Female	9	18
Service History (years)	1-10	8	16
	11-20	15	30
	More than 20	27	54
	Mean=21.03 Min=8	Max=32	
Age (years)	Less than 35	7	14
	35-50	30	60
	More than 50	13	26
	Mean=45.88 Min=33	Max=62	
Education level (degree)	Ms	5	10
	MSc	35	70
	Ph.D	10	20

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Table 3) Characteristics of the primary matrix of cross-effects in the development system of multi-purpose management of summer rangeland.

Indicator	Matrix size	Number of iterations	Number of zeros	Number of ones	Number of twos	Number of threes	Total	Fill rate
Value	21	2	32	82	124	203	409	92.74%

tor signifies its degree of dependence.

Based on the results obtained from the analysis of the direct effects matrix, the sum of the numbers in the rows related to the "Management-Policy" dimension was the highest, while the sum of the numbers in the rows related to the "Environmental-Climate" dimension was the lowest compared to other dimensions. Additionally, the sum of the numbers in the columns related to the "Management-Policy" and "Knowledge-Education" factors allocated the highest and lowest values, respectively.

The results highlighted that the indicator "Creation of new employment opportunities and strengthening rural income potentials" significantly influenced the economic investment aspect. "Decentralization and participation of stakeholders in implementing multi-purpose plans" emerged as the most influential social-cultural aspect. "Knowledge and skill awareness of stakeholders in multi-purpose rangeland management" played the most influential role in the knowledge-educational aspect. "Benefiting from government support and assistance" was the most influential management-policy aspect. Finally, "Environmental-ecological status and improvement of natural landscapes in rangelands" emerged as the most influential environmental-climatic aspect. These findings demonstrated the pivotal role of these indicators in developing multi-purpose management of summer rangeland in Mazandaran Province.

Scatter of indices and the framework of analysis structure: In analyzing cross-effects to identify critical drivers, assessing system stability becomes paramount. Consequently, the focus shifts to the distribution of factors (indices) on the four-quadrant scatter plot generated by the software (Figure 1). Generally, a system is deemed stable if the dispersion of the investigated indices resembles the English alphabet letter "L". However, in an unstable system, the indices may exhibit different distributions on the scatter plot. The examination of the indices involved in the development of multi-purpose management of summer rangeland in Mazandaran Province, as indicated by the output of the MICMAC software and the distribution of indices, signals the instability of the multi-purpose summer rangeland use system in Mazandaran Province under current conditions (Figure 2)

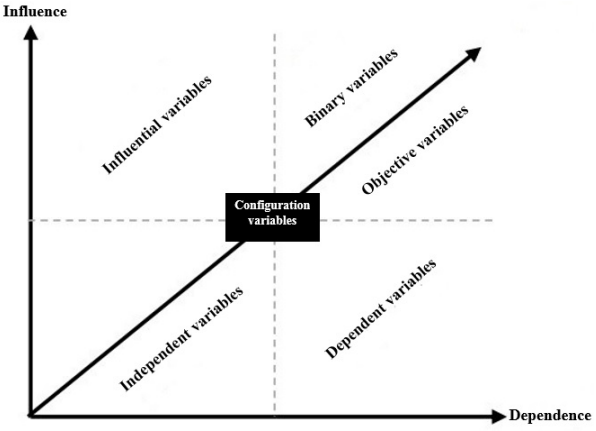

Figure 1) The position of the variables based on their influence and dependence

As indicated by the dispersion of indicators, six indices, namely "systemic and comprehensive policy and planning of the government", "knowledge and skills

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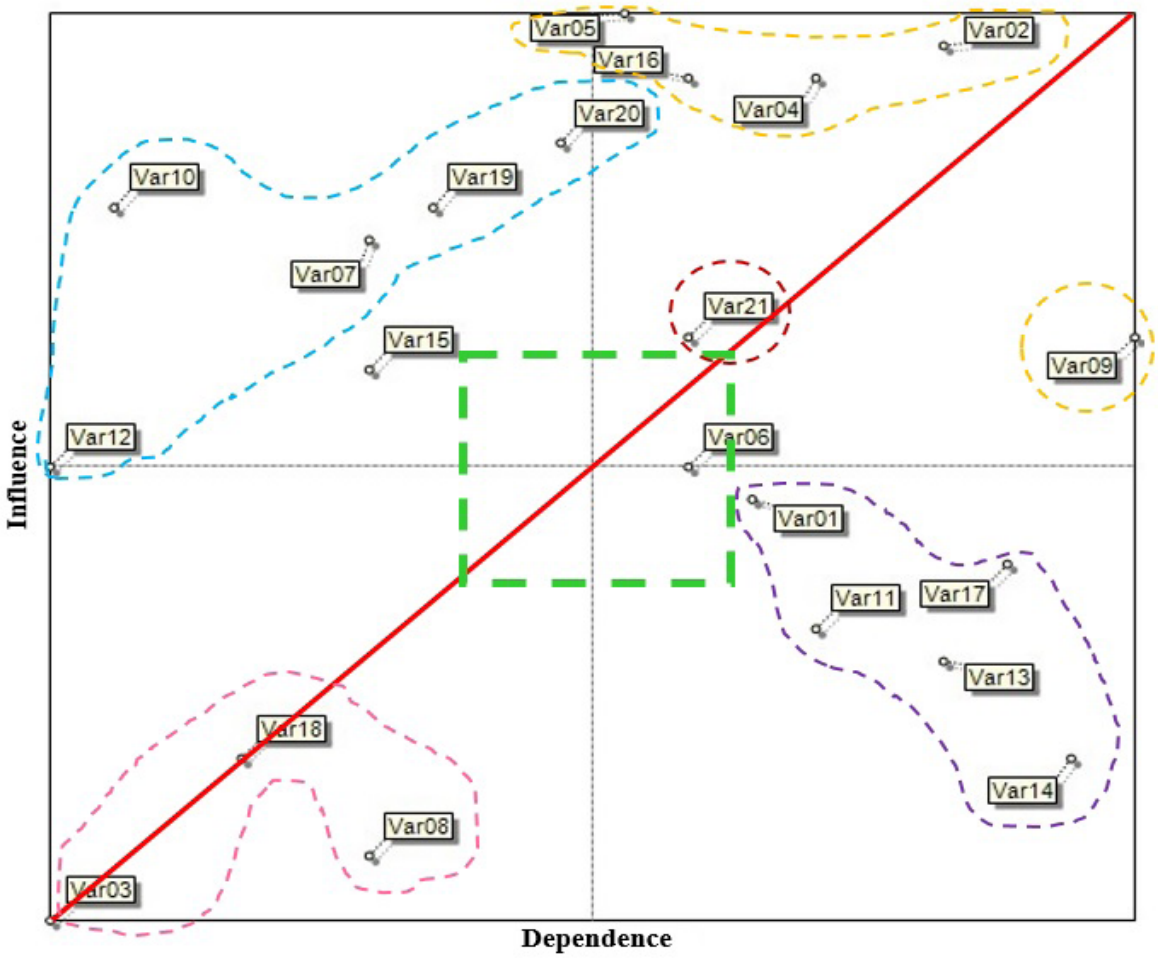

Figure 2) The model of cross-effects (Influence and dependence and distribution of indicators based on direct effects.

awareness of multiple-purpose rangeland management", "utilization of mass media and enhancing the use of social media platforms", "management coordination and organizational support", "reduction of service and infrastructure problems", and "communication and trustworthiness between stakeholders and the government," were identified as the most influential and strategic indicators in the development of multi-purpose management of the summer rangelands in the northwestern part of Mazandaran Province (Blue area). These indicators were also considered as input variables and were of particular importance. Based on their location, the desired indicators had the highest level of influence and the lowest level of dependence. Therefore, the system relied heavily on these variables. In other words, the system was highly dependent on these variables, and controlling them was crucial.

Based on the results obtained, binary variables had been scattered in the northeast region of the scatter plot. These variables had two common characteristics: high influence and high dependence, and any action on them would also affect other variables. Out of a total of 21 indices, six indices were in this group. Binary variables were divided into risk indices and objective indices. The "Utilization of Capacities and Diversification in Rangeland Management Projects" index is situated around the diagonal axis of the northeast region in the diagram (Red area) within the risk variables. These variables had a very high capacity to become critical players in the system because of their

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unstable nature, as they had the potential to become system bifurcation points. Based on the results obtained, the indices of "creating new job opportunities and strengthening rural income potentials," "formation and strengthening of rural cooperatives and organizations," "benefiting from government support," "decentralization and participation of stakeholders in the implementation of multi-purpose projects," and "utilization of ecotourism industries in rangelands" have been placed in the scatter plot of indices in the northeast region (Orange area). These variables were not only influential but also dependent. Therefore, they could be reasonably identified as the results of the system's evolution. Changes in these indices could lead to significant changes in the system. Therefore, these indices represented predetermined results and reflected "possible goals" in the system.

Based on the obtained results, specific indicators, such as "investment by stakeholders in the implementation of multi-purpose projects and profitability ratio of activities," "satisfaction level of stakeholders and their attitude towards the implementation of multi-purpose projects," "development of action-oriented educational and promotional activities and proper information dissemination, " "reduction of livestock and livestock management issues in rangelands, " and "Compliance with established laws and regulations," had been categorized as dependent variables (Purple area) due to their high level of dependence despite their low influence. Consequently, these indicators exhibited heightened sensitivity to influential variables.

Some indicators are situated in the southwest quadrant of the indicator scatterplot, classifying them as independent variables. These can be further divided into two categories: system-independent variables and secondary leverage variables. Examples of independent variables include "Enhancement Cultural and Equality Issues," "Identification of Income-Generating Plant Potentials and Processing," and "Climatic and Topographical Status of the Region" (Pink area). While they did not significantly impede the development of the main variables in the system, and even though these indicators somehow lacked a key and significant role in the development of multi-purpose management of summer rangeland in Mazandaran Province, they still bore some importance and should not have been entirely disregarded.

Furthermore, the scatterplot accommodates secondary leverage variables, which are both dependent and influential. These are located in the upper part of the diagonal line within the southwest quadrant, an aspect not covered in this study.

Within the scatterplot are indicators positioned near the center of gravity of the graph (Green area), which are recognized as control variables. The indicator "Environmental-Ecological Status and Improvement of Natural Landscape in Rangelands" falls within this category. These variables play a regulatory role and sometimes serve as secondary levers. Depending on the planned policies, they can evolve into influential indicators, determining indicators, or target and risk indicators.

Determining the influential factors and their contribution to the development of multi-purpose management of summer Rangeland in Mazandaran Province: Upon comparing the results obtained from both the direct and indirect effects of the examined indicators on the development of multi-purpose management of summer rangeland in Mazandaran Province (as shown in Table 5), it was evident that the following indicators: "decentralization and participation of stakeholders in the

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Table 4) The influence and dependence of factors in the matrix of direct effects on the development of multi-purpose management of summer rangeland in Mazandaran Province.

Symbol	Index	Influence	Dependence
	Economic – Investment		
var01	Investment for stakeholders in implementing multi-purpose projects and the profitability ratio of activities	42	47
var02	Creation of new employment opportunities and strengthening rural income potential	56	50
var09	Utilization of ecotourism and eco-travel industry in rangelands	47	53
	Total	145	150
	Social – Cultural		
var03	Enhancement of cultural issues and equality	29	36
var04	Formation and strengthening of rural cooperatives and organizations	55	48
var05	Decentralization and participation of stakeholders in the implementation process of multi-purpose projects	57	45
var11	Satisfaction level of stakeholders and their attitudes towards the implementation of multi-purpose projects	38	48
var20	Communication and mutual trust between stakeholders and the government	53	44
	Total	232	221
	Scientific-Educational		
var10	Knowledge and skill awareness of users in multi-purpose rangeland management	51	37
var12	Utilization of mass media and promotion of social media platform usage	43	36
var13	Action-oriented development of educational and promotional activities and proper information dissemination	37	50
	Total	131	123
	Management-Policy		
var07	Systemic and comprehensive government policy-making and planning	50	41
var14	Reduction of livestock management problems in rangelands	34	52
var15	Management coordination and organizational support	46	41
var16	Government support and assistance	55	46
var17	Compliance with laws and regulations	40	51
var19	Reduction of service and infrastructural problems	51	42
var21	Capacity utilization and diversification in the implementation of rangeland projects	47	46
	Total	323	319
	Environmental-Climatic		
var06	Environmental-ecological status and improvement of natural landscapes in rangelands	43	46
var08	Identification of income-generating plant potentials and processing	31	41
var18	Climatic and topographical conditions of the region	34	39
	Total	108	126
	Total	939	939

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Table 5) Evaluation of the influence and dependence of the indicators and the final rank of the variables.

Rank	Direct influence				Indirect influence			
	Symbol	Influence	Symbol	Dependence	Symbol	Influence	Symbol	Dependence
1	Var05	607	Var09	564	Var05	605	Var09	550
2	Var02	596	Var14	553	Var02	592	Var14	548
3	Var04	585	Var17	543	Var04	583	Var17	539
4	Var16	585	Var02	532	Var16	579	Var02	530
5	Var20	564	Var13	532	Var20	556	Var13	528
6	Var10	543	Var04	511	Var19	546	Var11	510
7	Var19	543	Var11	511	Var10	540	Var04	506
8	Var07	532	Var01	500	Var07	532	Var01	502
9	Var09	500	Var06	489	Var09	504	Var06	491
10	Var21	500	Var16	489	Var21	491	Var16	487
11	Var15	489	Var21	489	Var15	490	Var21	483
12	Var06	457	Var05	479	Var12	459	Var05	480
13	Var12	457	Var20	468	Var06	458	Var20	473
14	Var01	447	Var19	447	Var01	453	Var19	449
15	Var17	425	Var07	436	Var17	428	Var08	441
16	Var11	404	Var08	436	Var11	393	Var07	441
17	Var13	394	Var15	436	Var13	393	Var15	434
18	Var14	362	Var18	415	Var18	372	Var18	422
19	Var18	362	Var10	394	Var14	363	Var10	398
20	Var08	330	Var03	383	Var08	337	Var03	389
21	Var03	308	Var12	383	Var03	317	Var12	388

implementation of multi-purpose plans," "creating new employment opportunities and strengthening rural income potentials," "establishment and strengthening of rural cooperatives and organizations," "benefiting from government support and assistance," "communication and mutual trust between stakeholders and the government," "knowledge and skill awareness of rangeland managers," "reducing service and infrastructure problems," "systemic and comprehensive policy-making and planning by the government," "utilizing ecotourism and nature-based industries in rangelands," and "utilizing capacities and diversification in rangeland management projects," received the highest rankings, as they had obtained the highest values. Essentially, these indicators emerged as the most influential factors directly contributing to the development of multi-purpose management of summer rangeland in Mazandaran Province.

The results indicated that specific indicators significantly influenced the development of multi-purpose management of summer rangeland in Mazandaran Province. These included "utilization of ecotourism and nature-based tourism in rangelands," "reduction of livestock management issues in rangelands," "compliance with established laws and regulations," "creation of new employment opportunities and strengthening rural income potentials,"

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"Action-oriented development of educational and promotional activities and proper information dissemination," "formation and strengthening of rural cooperatives and organizations," "satisfaction of stakeholders and their attitude towards the implementation of multi-purpose plans," "investment by stakeholders in the implementation of multi-purpose plans and the profitability ratio of activities," "environmental-ecological status and improvement of natural landscapes in rangelands," and "government support and assistance." These indicators were ranked in order of their influence.

Furthermore, the results revealed that four indicators— "creation of new employment opportunities and strengthening rural income potentials," "utilization of ecotourism and nature-based tourism in rangelands," "formation and strengthening of rural cooperatives and organizations," and "government support and assistance"—not only exerted influence on the development of multi-purpose management but were also dependent on other indicators in this context. This implied a higher dependence on the influence of other factors. The obtained values suggested that "creation of new employment opportunities and strengthening rural income potentials," "formation and strengthening of rural cooperatives and organizations," and "government support and assistance" exhibited a greater degree of effectiveness, whereas "utilization of ecotourism and nature-based tourism in rangelands" demonstrated a higher level of dependence in the development of multi-purpose management of summer rangeland in Mazandaran Province.

Discussion

Several factors impacted the successful implementation of multi-purpose rangeland management, especially in summer rangelands. Considering the role and importance of multi-purpose management in rangelands and the simultaneous utilization of rangeland potentials alongside livestock grazing, it could provide a basis for reducing the dependence of exploiters on rangelands for forage production and livestock farming. Now, the question arose about what factors influenced the implementation and successful development of multi-purpose management in rangelands and on which indicators they were dependent. In this regard, the present study aimed to examine the influential drivers of the development of multi-purpose management of summer rangelands using a future studies approach in Mazandaran Province.

Results related to influential indicators: The results indicated that decentralization and participation of stakeholders were the most influential factors in the development of multi-purpose rangeland management. In line with these findings, Aliyev et al. [31] believed that multi-purpose rangeland management had positive effects, such as involving local communities in comprehensive natural resource management. Therefore, by involving and consulting with stakeholders and having local leaders as representatives of local communities [22], motivation for stakeholder participation in non-livestock activities and beyond livestock grazing could be fostered, leading to its development [30]. Successful implementation of rangeland management projects required improved social capital and cohesion among rangeland stakeholders. Therefore, it was recommended to use information and opinions from stakeholders to prepare and implement multi-purpose rangeland management projects to involve them in anticipated rangeland management activities.

Effective planning and forecasting were paramount for creating new job opportunities

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and bolstering income potential in multi-purpose rangeland management areas. The creation of employment opportunities in rural regions, aimed at elevating income levels [32, 38], and the diversification of job roles to reduce unemployment among stakeholders [33] significantly contributed to the empowerment of local communities and the promotion of multi-purpose rangeland management. Providing livelihoods and job security to stakeholders ultimately lessened their reliance on rangelands [24]. One of the most critical factors influencing rangeland sustainability for multi-purpose goals lay in the economic indicator of productivity, which could be enhanced through proper and principled management and the utilization of other products [26].

Supplementary income resources in livestock farming enabled stakeholders to achieve economic self-reliance, reducing their dependency on rangeland forage production. This underscored the importance of bolstering economic flexibility by empowering stakeholders in sustainable rangeland management [39, 40].

On the one hand, market inflation and the high cost of supplementary livestock feed, coupled with the reduced vegetation cover in rangelands due to severe climate fluctuations and recent droughts, presented significant challenges to livestock grazing in these areas [41]. As a result, the livestock unit in rangelands increased from 5 heads to approximately 200 heads over these years, and herding with fewer numbers could have been more economically viable, making the presence of other income sources necessary for household livelihood.

It should be noted that the index concerning the creation of employment opportunities and income sources for livestock farmers in the multi-purpose management of rangelands was influenced by various parameters, making it a significant driver in this domain. Several factors contributed, including a need for more precise knowledge regarding non-forage potentials and capacities in rangelands, implementing non-specific plans and projects that may not align with livestock farming, and inadequate planning for alternative and complementary occupations within rangeland development projects. There needs to be more government subsidies and support, such as the distribution of feed subsidies and a focus on livestock farming, as well as a need for more tourism infrastructure in rangelands, further complicated management within the framework of rangeland development plans. These factors collectively contributed to a need for more viable alternative occupations for livestock farming and hindered the presentation of diverse economic plans at various time horizons. This presented a significant challenge. Therefore, government support and assistance, including initiatives like providing credit and financial facilities, distributing supportive and subsidy inputs [42], and ensuring rangeland stakeholders [12, 43], enhanced stakeholders' financial and economic capacity. This, in turn, could gradually reduce their reliance on non-economic livestock farming [44].

In line with the obtained results, some practical solutions included targeted marketing of dairy and meat products among stakeholders [24], identifying the potential for beekeeping and the income generated from it [45, 46], Aquaculture and production of warm-water and cold-water fish [47], production and processing of edible plants and medicinal industrial plants [13], establishment of tourist and ecotourism spaces [26], identification of regional income opportunities and revival of forgotten local occupations in the region, along with identifying the target market. The payment of low-interest credit facilities [42] and long-term repayment based on the presentation of

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prioritized and economically justified plans in the rangeland played an essential role in introducing and successfully implementing multi-purpose plans in collaboration with maximum participation of stakeholders. One of the key drivers in developing multi-purpose utilization of rangelands was the formation and strengthening of cooperatives and rural organizations. According to Syamsu & Yusuf [38], to improve the sustainability of rangelands, it was essential to strengthen community institutions and engage in social institutions [22]. Developing indigenous and local cooperatives and organizations among stakeholders, along with cohesive social relationships and improved social capital [48], facilitated participation and collaboration among livestock farmers in various conservation, restoration, rehabilitation, and sustainable management activities. Transferring economic rangeland management projects to stakeholders through rangeland management cooperatives or self-organized livestock organizations could have economic and financial implications. This could be achieved by improvement projects in the rangeland, creating conditions for undertakings alongside forge-based and herding activities. Moreover, multi-purpose management of rangelands through community organizations provided conditions for a fair distribution of obtained incomes among stakeholders rather than individual and subjective activities. Therefore, the establishment of livestock cooperatives and organizations, as well as rural micro funds and their development in obtaining rangeland projects within the framework of the law, not only increased the level of regional participation but also created permanent and seasonal employment and income opportunities in specialized activities such as seedling production, shrub planting, seed sowing, water storage operations, and also created alternative job opportunities.

Results related to dependence indicators: According to the findings, creating tourism and ecotourism conditions in the region and constructing proper areas for ecotourism were the most influential factors in managing multi-purpose summer rangelands in Mazandaran Province. The climatic conditions and natural landscapes in these areas have led to the development of the tourism industry and provided an ideal source of income for various segments, especially livestock farmers. Creating human-made attractions in rangelands to attract tourists [26] as ecotourism areas and accommodations for travelers could improve the economic empowerment of local communities. The sale of livestock products, including dairy and meat products, would also be influenced by this matter. The presence of rich natural, social, and cultural attractions in the area would lead to the prosperity of the ecotourism industry in the rangelands. Natural and cultural potentials in rangelands could significantly improve the state of ecotourism and the sustainability of rangeland management [49, 50, 51, 52].

In line with the obtained results, the existence of legal and organizational limitations in establishing and constructing ecotourism facilities in rangelands, multi-tasking within relevant organizations (Department of Natural Resources and Watershed Management and Department of Cultural Heritage and Tourism), lack of government financial support and facilities, lack of infrastructure for attracting tourists, lack of personal investment in non-livestock activities due to the perception of lack of ownership in rangelands, and uncertainty about the profitability of ecotourism activities and the supply of products to tourists were among the most critical factors that had put the tourism

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and ecotourism industry in the rangelands of Mazandaran Province under pressure. Removing or minimizing any of these factors played a crucial role in the success of this economic activity in the studied region. Therefore, it was recommended to establish specific guidelines for launching rangeland ecotourism through household associations of livestock farmers in the review of rangeland management plans and their transformation into long-term multi-purpose plans so that stakeholders could make the necessary investments in this regard while having a sense of ownership of the rangelands.

Reducing management problems in livestock and livestock farming within the summer rangelands of Mazandaran Province was crucial in achieving multi-purpose rangeland management. The absence of winter and middle rangelands intensified pressure on the summer rangelands, resulting in early grazing during non-grazing seasons and excessive grazing when abundant vegetation cover was present. Consequently, overgrazing has become a prevalent issue, leading to frequent suspension of livestock grazing activities in the rangelands. Moreover, dense plant cover in summer rangelands had elevated grazing pressure and intensified competition among livestock farmers [53, 54]. These findings aligned with the research conducted by Brussels [24] and Bohnet et al. [23]. Based on the results, it was recommended to implement measures such as keeping livestock outside the grazing season in summer rangelands. Additionally, exploring alternative occupations and targeted livestock product production while ensuring proper processing and effective marketing could mitigate these challenges. Compliance with the laws and regulations within the rangelands represented another critical indicator influenced by various factors in achieving multi-purpose rangeland management. Inadequate livelihoods among stakeholders, heavy reliance solely on livestock numbers, limited availability of alternative occupations beyond livestock farming, insufficient rangeland area relative to the number of livestock, and the integration of rangelands with forested areas in some parts of the Province had created conditions conducive to non-compliance and violations by stakeholders. Therefore, it was anticipated that implementing multi-purpose rangeland management and establishing viable livelihoods among stakeholders would increase compliance with laws and regulations and responsibility in this regard.

Action-oriented development of educational and promotional activities and proper information dissemination was another independent indicator of the multi-purpose management of rangelands, which could have various reasons. The lack of a suitable information dissemination system [55] and the mismatch between the required training courses and classes for livestock farmers [10, 26] were among the most significant factors affecting the implementation of practical and field-based educational and informational activities in rangelands. However, this could be strengthened by using targeted and effective educational and promotional methods in implementing multi-purpose rangeland management plans. Therefore, by the proposed predictions in rangeland management plans, the necessary training related to them and their implementation could be presented clearly and transparently. Additionally, appropriate information could be provided to stakeholders by regularly monitoring and evaluating rangeland management plans.

Based on the results obtained from the present research, the following recommendations are proposed:

1. considering the influential role of

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stakeholders' participation in the implementation process of multi-purpose rangeland projects, it is suggested that rangeland management plans be reviewed and prepared in the long term based on the common opinions of stakeholders.

2. The results have shown that creating new employment opportunities and strengthening income potentials significantly impact multi-purpose rangeland management. By identifying non-forage potentials and capacities of each region, such as medicinal, edible, industrial plants, beekeeping, poultry and livestock farming, and aquaculture, transparent opportunities for increasing income and employment in rangeland management projects will be provided.

3. To create employment and income opportunities among the region's stakeholders, government support and assistance, including facilitation services and subsidies to livestock farmers with economically viable projects, are required to develop multi-purpose rangeland utilization.

4. Considering the importance and role of cooperatives and rural organizations in developing multi-purpose rangeland utilization, it is recommended that all rangeland activities be entrusted to active organizations, such as rangeland cooperatives and rural micro funds, without unnecessary legal formalities.

5. Since communication and mutual trust between stakeholders and the government have a direct impact on multi-purpose rangeland management, it is suggested that the government and responsible authorities delegate the preparation and implementation of rangeland management plans to the beneficiaries and play a supervisory role while reducing administrative bureaucracy and facilitating the process.

6. Based on the results, other factors in the path of multi-purpose rangeland management have affected the ecotourism industry. Therefore, it is proposed to provide comprehensive and systematic guidelines for ecotourism in natural landscapes, taking into account legal and executive constraints, along with the establishment of local markets with products produced and processed by livestock farmers, to promote ecotourism in the summer rangeland of the Province.

7. Considering the susceptibility of appropriate training and information dissemination in multi-purpose rangeland management, it is recommended that with the necessary credits in this matter, tailored to the planned activities in rangeland management projects, the type, amount, and method of conducting necessary training be carefully provided.

Conclusion

The heavy reliance of livestock farmers on forage harvesting as the primary economic activity in most rangelands has increased their vulnerability and dependence on this sector. Therefore, adopting a multi-purpose approach to rangeland management involving the utilization of various resources such as medicinal, industrial, ornamental plants, forage, beekeeping, aquaculture, and ecotourism is a viable strategy for maximizing the potential of these areas.

Embracing multi-purpose utilization and investing in the diverse resources available in rangelands while exploring alternative livelihoods can bring numerous benefits to local communities. This includes using non-wood productive products, gum, tannin, medicinal plants, industrial and non-fodder goods, and ecotourism opportunities, leading to increased employment and income generation.

Adopting a systemic approach to rangeland management unveils a spectrum of resources and potential for employment and income. Identifying and capitalizing on these

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additional capabilities within rangelands by creating supplementary job opportunities is pivotal to thriving, sustainable utilization and management. This should be a focal point for policymakers involved in various rangeland management projects.

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