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A Study on the Current Status of Mongolian Yak Wool Production

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Abstract:- Any issues affecting the betterment of the main players of value chain for yak wool production were defined based on external and internal factors and the impact on the resolution. Following that, the short-term, medium-term, and long-term goals were set for the sector. We assess the current state of yak wool production, internal and external factors were identified based on the 6 factors as well as their impact on the results based on their importance. Then the impact that can be achieved through improving the influencing factors of the current state of the Mongolian yak wool production are identified. The overall value of yak wool production reaches 56.9 percent by 2020. In 2024, if the value of internal factors increases by 0.7 points and the value of external factors increase by 0.4 points, the overall value of yak wool production will increase by 7.5 points, reaching 65.8 percent. In 2024-2028, if the value of internal factors increase by 0.4 points and the value of external factors increase by 0.4 points, the overall value of yak wool production will increase by 8.4 points, reaching 71.7 percent. In 2028-2032, if the value of internal factors increase by 0.5 points and the value of external factors increase by 0.4 points, the overall value of yak wool production will increase by 9.3 points, reaching 78.6 percent with these improvements, the Mongolian yak wool production will reach sufficient capability and trend to further betterment.

Keywords:- *Internal and external factors**,** **CI** (Consistency Index), the **CR** (Consistency Ratio), the **IC** (Internal Consistency), and the **EC** (External Consistency), and SWOT-AHP.*

I. INTRODUCTION

One of the few animals that produce unique fibers that exhibit soft, warm, and high value properties is the yak. The yak's habitat consists of high-altitude mountainous regions which can be found mostly in Central Asian countries such as Afghanistan, Bhutan, India, Kyrgyzstan, Myanmar, Russia, Tajikistan, and Mongolia(Weiner 2003)

Of the world's 15 million yaks, about 90 percent are bred in China where an average of 4000 tons of wool is produced annually(Ahmad 2016). This accounts for 85 percent of the total global production for yak wool, while the remaining 15 percent comes from Mongolia, Russia, and other Central Asian countries(Jian Liu 2009).

In Mongolia, the yak inhabits about 130 soums in 12 aimags favoring and adapting to the extreme climate and harsh natural conditions of the Altai, Khangai, and Khentii mountain ranges as well as the high mountains of Khuvsgul, Kharkhiraa, and Turgen (Bat-Erdene, Mongolian breed yak 2002). In recent years, the yak population has grown, reaching a total count of one million yaks in 2019 which constitutes 21.2 percent of the total cattle herd (organization 2019).

The yak primarily feeds on Taiga and belt area plants that are not typically used by other animals, which as a result, improves pasture resources(Bat-Erdene, Mongolian breed yak 2002), (Weiner 2003). This proves that yak wool is not only a natural textile, but also that yak wool products fulfill today's consumers' demands for sustainable and health-conscious qualities. Therefore, yak wool is considered one of the highest-grade raw materials in the world's textile production (Wei Li 2016).

However, studies have shown that compared to goat cashmere, yak wool scales are relatively thick, stiff, and have a wide fiber diameter. In addition, yak wool has weak dyeability and has short fibers which makes it less probable to correctly prepare the wool and spin for high count yak wool yarn (Jian Liu 2009), (Quilan Luo 2012), (T. Khishigjargal 2014),(Wei Li 2016), (Chan Liu 2017).

With the help of modern and advanced technology for stretch and slenderization (microwave low temperature plasma, MLTP), the dyeing rate for wool has increased by 20 percent (Jian Liu 2009). Furthermore, the introduction of complete compacting spinning (CCS) technology has resulted in pure high count (48Nm and 60Nm) yak wool yarn(Wei Li 2016). It was also determined that the age of the yak and the quality of the wool had a direct correlation (Bat-Erdene, Yak tracking technology 1986),(Longquan 1994)(Tumurjav 2002) for which (T. &. Khishigjargal 2016), tested and developed the methodology for classifying combed and prepared yak wool based on age.

As a result of the implementation of the above efforts, the economic value of one kilogram of raw wool that was previously priced at MNT 300 to 500 increased drastically to MNT 25000 (S. d. Agency 2013),(S. D. Agency 2010), (Tuvshintugs 2015), (T. &. Khishigjargal 2016), ((SECiM 2018), (group 2022). Following this, the export of yak wool products increased in the years 2015 to 2017. In 2017, the total yak wool products exported grew by 11 percent, or 28.7 thousand units, as well as experiencing a 4 percent increase in price (0.65 million USD) and is expected to increase further in the future (Project 2018).

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The color of the yak has a direct relation with the environment and climate in which it lives. According to a study on yak colors, more than 80 percent of yaks in China are black and the remaining yaks are blackish (Wang YZ 2002). Meanwhile, 68.5 percent of yaks in Mongolia are black, blackish, and black-white; 16.9 percent are brown and brown-white; 8.7 percent are blue and gray; and 5.7 percent are light brown and burgundy (Bat-Erdene, Mongolian breed yak 2002). The three main colors of yak wool are gray, brown, and black. From these colors, the color most in demand and preferred by consumers is blue and gray yak wool.

Within the support of theAgricultural Value Chain Project, "Blue yak brand" was created by conducting direct experiments with environmentally friendly models for blue yak wool and participating in all levels of the value chain from the herder's town to the hands of consumers. Leveraging the advantages and unique characteristics of blue yak wool, it was made possible to manufacture wool products with geographical origins and overall, increase the value of wool products ((ADB 2017-2020).

Although numerous studies were conducted on the biological, agricultural, and economic elements as well as the wool properties and processing technology of the Mongolian yak, there is a lack of integrated research on the current and future development of wool production.In our study, we used the Analytical Hierarchy Process (AHP) method developed by American scientists (Saaty.T 1990), (T. L. Saaty 2016).

II. SWOT AND AHP METHOD, MODEL

SWOT analysis is a commonly used for analyzing and external and internal environments in order to acquire a systematic approach and supportfor a decision situation.(Kurttila 2000),(Kanjas 2003), (Yuksel 2007).

The Analytical Hierarchy Process (AHP) method is used to determine relative priorities on absolute scales from both discrete and continuous paired comparisons in multilevel hierarchic structures(T. L. Saaty 1996).

The prioritization mechanism is accomplished by assigning a number from a comparison scale developed by Saaty (1980) to represent the relative importance. Pairwise comparisons of the factors provide the means for calculation of importance.(Saaty.T 1990), (T. L. Saaty 2016), (Sharma 2008).

The first paper was written by Bakei. A, Purev. P, Perenlei. Ch, for strategy plan of Mongolian Agricultural Industry using the AHP. (Bakyei. A 2009). Batmagnai, D examined status for agricultural production. Erdenebat, P. investigated a method to adjust the crop sector. Bakyei. A studied the relative importance of various industry sectors in the economic development of Mongolia(D 2013), (P 2021).

III. RESEARCH METHODOLOGY

In this study,SWOT-AHP isevaluated oncurrent state forMongolian yak wool production. Any issues affecting the betterment of the main players of value chain for yak wool production were defined based on external and internal factors and the impact on the resolution. Following that, the short-term, medium-term, and long-term goals were set for the sector.

The survey's participants included the herders' cooperatives from 15 soums of 5 aimags such as: Ikh-Uul, Otgon, and Tosontsengel soums of Zavkhan aimag; Undur-Ulaan, Ikhtamir, and Chuluut soums of Arkhangai aimag; Ulaan-Uul, Arbulag, and Alag-Erdene soums of Khuvsgul aimag; Must, Munkh-khairkhan, and Duut soums of Khovd aimag; and Khanbogd soum of Umnugovi aimag. The following organizations were selected as representing enterprises for processing and manufacturing: Jinst Murun LLC, Baylag-Ulzii LLC, Sor Cashmere LLC, Uguuj Shim, LLC, Munkhbumuud LLC, Snow Field LLC, Uujin LLC, and Mongol Nekhmel LLC. Additionally, the Ministry of Food, Agriculture, and Light Industry; the Small-Medium Enterprises of Aimags and Soums; professional associations, and research organizations were involved in the research discussions to exchange their views.

We conducted the Saaty's comparison scale (1980) tocreatepairwise comparisons and identified the relative importance between each pair SWOT factors(T. L. Saaty 1980)

To define the goal, a criterion was set consisting of internal and external elements along with the maximum value that is determined. However, if the criteria are unable to be selected, the factor evaluation score will be used. In doing so, the factor evaluation matrix is utilized to measure across external and internal factors.

Evaluation matrix is noted as:

$$(A) = \left(1 a_{1,2} \; \dots \; a_{1,n} a_{2,1} 1 \; \dots \; a_{2,n} \; \dots \; \dots \; \dots \; \dots \; a_{n,1} a_{n,2} \; \dots \; 1\right)$$

Consistency Index (CI) formula:

$$CI = \frac{L_{max} - n}{n - 1};$$

Consistency Ratio(CR) formula

$$CR = \frac{CI}{RI};$$

Priority Vector (PV) formula:

$$PV_i = \sum_i \left(\frac{a_{i,j}}{\sum_j a_{i,j}} \right);$$

And

$$PA_i = \sum_j \left(a_{i,j} \cdot PV_j \right); \quad (i = 1 \div n);$$

Because the evaluation is greatly affected by the choice of factors measured as well as the skills and specialty of team of experts, the evaluation is checked by a credibility screening. The validity of the evaluation is expressed in terms of the **CI** (Consistency Index), the **CR** (Consistency Ratio), the **IC** (Internal Consistency), and the **EC** (External Consistency). If **CR≤0.1,** the choice of factors is considered optimal(P 2021).

IV. RESEARCH APPLICATION

To assess the current state of yak wool production,relevant **internal** and **external** factors (table 1)were identified and built SWOT matrix. Thens as well as their impact on the results based on their importance.

A. Evaluation matrix of Internal factors of current state of yak wool production

According to the current state matrix of internal factors(Table 2), the "nomadic life and economic condition" factor has a baseline score of 5 points as of 2021 with an impact and significance score of 0.133. The "good use of other non-grazing pastures" factor has a baseline score of 5 points and an impact and significance score of 0.210. The "unique natural precious fiber" factor has a baseline score of 5 and an impact and significance score of 0.210. The "weak development of technology and innovation" factor has a baseline score of 3 and an impact and significance score of 0.148. The "decreased livestock quality and increased population" factor has a baseline score of 3 and an impact and significance score of 0.148. The "weak cooperation among associations" factor has a baseline score of 3 and an impact and significance score of 0.148. The total of impact and significance scores across all factors sum up to (A) = 1.0. From the research findings, below are the internal factors influencing the current state of yak wool production.

a) Strengths
- Factor of nomadic lifestyle and economic condition have a weight of 0.133 or 13.3 percent
- Factors such as good use of other non-grazing pastures and unique natural precious fiber have a weight of 0.21, or 21 percent.

b) Weaknesses
- Factors such as weak development in technology and innovation, deteriorating quality of livestock, increasing quantity of livestock, and weak cooperation among associations had a weight of 0.148, or 14.8 percent, and resulted in negative impacts

B. Evaluation matrix of external factors of current state of yak wool production

According to the current status matrix of external factors, the "livestock privatization" factor has a baseline score of 5 points in the base year of 2021 with an impact and significance score of 0.074. The "free market trade and pricing system" factor has a baseline score of 3 and an impact and significance score of 0.264. The "product quality, standards, and certification" factor has a baseline score of 1 and an impact and significance score of 0.126. The "lack of foreign and domestic trade policy and regulation" has a baseline score of 1 and an impact and significance score of 0.113. The "limited freight forwarding services" factor has a baseline score of 1 and an impact and significance score of 0.156. The "nature dependence" factor has a baseline score of 3 and an impact and significance score of 0.264. The total of impact and significance scores across all factors sum up to (A) = 1.0. From the research findings, below are the external factors (Table 3) influencing the current state of yak wool production.

a) Strengths
- Factor of livestock privatization has a weight of 0.074 or 7.4 percent
- Factors of product quality, standards, and certification havea weight 0.126 or 12.6 percent
- Factors of free market trade and pricing system have a weight 0.264 or 26.4 percent

b) Weaknesses
- Factors of lack of foreign and domestic trade policy and regulation have a weight 0.113 or 11.3 percent
- Factors of limited freight forwarding services have a weight 0.156 or 15.6 percent
- Factor of nature dependence has a weight 0.264 or 26.4 percent.

Based on the assessment of the factors influencing the current state of yak wool production in Mongolia as of the base year of 2021, the results considered the feasibility of maximizing opportunities and strengths while minimizing threats and weaknesses. In doing so, assumptions, objectives, and opportunities for influencing factors were set to improve current conditions in 2025, 2029, and 2033. Based on the performance of internal and external factors of 2021, plans set for 2025 were defined as short-term, plans forecasted for 2029 were defined as medium-term, and plans forecasted for 2033 were defined as long-term (Figure 1).

C. Conclusion

The impact that can be achieved through improving the influencing factors of the current state of the Mongolian yak wool production are as follows:
- The overall value of yak wool production reaches 56.9 percent by 2020.
- In 2024, if the value of internal factors increases by 0.7 points and the value of external factors increase by 0.4 points, the overall value of yak wool production will increase by 7.5 points, reaching 65.8 percent.
- In 2024-2028, if the value of internal factors increase by 0.4 points and the value of external factors increase by 0.4 points, the overall value of yak wool production will increase by 8.4 points, reaching 71.7 percent.
- In 2028-2032, if the value of internal factors increase by 0.5 points and the value of external factors increase by 0.4 points, the overall value of yak wool production will increase by 9.3 points, reaching 78.6 percent.

With these improvements, the Mongolian yak wool production will reach sufficient capability and trend to further betterment.

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A. INTERNAL FACTORS		B. EXTERNAL FACTORS	
Strengths (S)	Weaknesses (W)	Opportunities (O)	Threats (T
I. Nomadic life and economic condition	IV. Weak development of technology and innovation	I. Livestock privatization	IV. Lack of foreign and domestic trade policy and regulation
1 3 5 7 9	1 3 5 7 9	1 3 5 7 9	1 3 5 7 9
II. Good use of other non-grazing pastures	V. Decreased livestock quality and increased population	II. Free market trade and pricing system	V. Freight forwarding services are limited
1 3 5 7 9	1 3 5 7 9	1 3 5 7 9	1 3 5 7 9
III. Unique natural precious fiber	VI. Weak cooperation	III. Product quality, standards and certification control	VI. Depends on nature
1 3 5 7 9	1 3 5 7 9	1 3 5 7 9	1 3 5 7 9

Table 1: Internal and external factors

PV	0.1253	0.1983	0.1691	0.1817	0.1764	0.1492			
№	I	II	III	IV	V	VI	PV	PA	PA/PV
I	1	1.0	1.0	0.6	0.6	0.6	0.1253	0.7971	6.3591
II	1.00	1	1.7	0.6	1.7	1.7	0.1983	1.2571	6.3396
III	1.00	0.60	1	1.7	0.6	2	0.1691	1.0707	6.3321
IV	1.67	1.67	0.6	1	1.0	1.0	0.1817	1.1481	6.3187
V	1.67	0.60	1.7	1	1	1.0	0.1764	1.1169	6.3323
VI	1.67	0.60	0.6	1.0	1.0	1	0.1492	0.9366	6.2782
SUM	8.00	5.47	6.53	5.87	5.87	6.93	1	Lmax=	6.3267
								CI=	0.0653
								CR=	0.0527

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Table 2: Evaluation matrix of internal factors

PV	0.153	0.129	0.182	0.184	0.195	0.210			
№	I	II	III	IV	V	VI	PV	PA	PA/PV
I	1.00	0.79	0.98	0.75	0.80	0.8	0.1525	0.8943	5.8636
II	1.27	1	0.60	0.60	0.33	0.6	0.1286	0.7323	5.6920
III	1.00	1.67	1	1.19	0.80	0.8	0.1821	1.0812	5.9364
IV	0.60	1.00	0.84	1	0.33	0.6	0.1257	0.7477	5.9479
V	1.00	1.19	1.00	3.00	1	0.3	0.1952	1.3037	6.6773
VI	0.84	1.00	0.33	1.67	3	1	0.2157	1.4190	6.5772
SUM	5.71	6.65	4.75	8.21	6.27	4.08	1	Lmax=	6.1157
								CI=	0.0231
								CR=	0.0187

Table 3: Evaluation matrix of external factors

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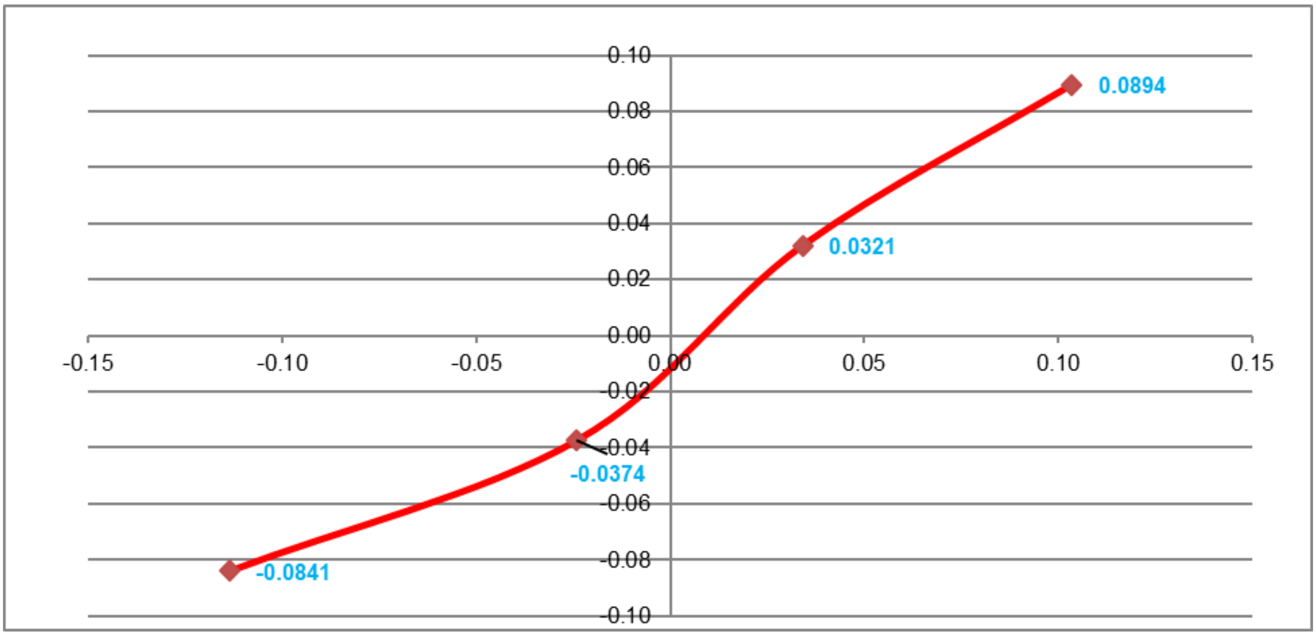

Fig. 1: Evaluation results of external and internal factors