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Estimation of Economic and Ecological Value of Raising Sheep in Pastoral Area

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Abstract Tibetan sheep is a unique breed of livestock in Alpine pastoral areas, which is one of the main economic pillars of animal husbandry in pastoral areas, in order to analyze and compare the estimated the economic and ecological benefits of Tibetan sheep under different feeding modes, this paper used a simplified model from multiple angles of animal production, economics and Ecology, The results show that: (i) Under the traditional grazing condition, the annual income of raising one ewe is only 23.4 yuan; (ii) Under the high-efficiency breeding mode, the average income of ewes bred by high-efficiency technology was 168 yuan/(head · year), which was 7 times higher than that of ewes under traditional grazing; each lamb could produce an indirect economic benefit of 500 yuan; (iii) The ecosystem service value affected by each Tibetan sheep through grassland was above 150 000 yuan.

Key words Tibetan sheep, Alpine pastoral area, Traditional grazing, Ecological value

1 Introduction

Ecological animal husbandry in Qinghai is a complex ecological-economic system which uses comprehensively modern agricultural development concepts, modern production factors, modern science and technology and management methods and integrates multiple values of ecology, economy and society, with "ecology, production and life" as a win-win goal. The main purpose is to transform the traditional grassland production and management methods by establishing a grass-livestock balance mechanism, realizing the harmonious development of man and nature. Remarkable results have been achieved after 10 years.

Tibetan sheep high-efficiency breeding technology is a set of comprehensive technologies suitable for Tibetan sheep production that Qinghai has spent eight years researching and exploring in the practice of ecological animal husbandry. From perspectives of ewes' supplementary feeding in the key breeding period and lambs' semi-confinement mode, technical intervention was performed with the traditional Tibetan sheep production, subverting the traditional concepts of seasonal estrus, slow growth, *etc.* of Tibetan sheep in the past. The economic benefits of Tibetan sheep high-efficiency breeding technology are remarkable and have been widely recognized by the government and the masses in Qinghai Province. It has effectively sped up the breeding efficiency of Tibetan sheep in pastoral areas and has grown into a major supporting technology to promote the development of ecological animal husbandry in Qinghai.

Considering the economic and ecological benefits of Tibetan sheep high-efficiency breeding technology, there is still no "simple account" that is clearly explained by the industry department and understood by the Tibetan people, hindering the strategic advancement of the technology and the herdsmen of Tibetan areas relying on technology to increase income. In this article, based on years of practical work, the direct economic benefit, indirect economic benefit and ecological value of the technology were estimated, with a view to providing a basic reference for all circles to carry out corresponding work.

2 Direct economic benefit of highly efficient breeding technology for Tibetan sheep

2.1 Estimation ideas

2.1.1 Natural grazing mode, *i.e.*, herdsmen in Tibetan areas in Qinghai using pure grazing to raise Tibetan sheep. Generally, herdsmen raise all species of sheep in mixed groups without supplementary feeding. One ewe produces one lamb a year, and lambs usually begin to be put on the market when they are one (generally sold with a gross weight above 20 – 25 kg, for fattening, but herdsmen are usually unwilling to sell at this time) or two (generally sold with a gross weight of 30 – 35 kg) years old, and in fact, most of them are sold when they are two years old. Herdsmen traditionally do not count grassland and labor costs, so that revenue from sales is regarded as income.

2.1.2 High-efficiency breeding mode, *i.e.*, production mode with the use of efficient breeding technology for Qinghai Tibetan sheep. Generally, sheep are first divided into groups, and then

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subjected to grazing + semi-confinement feeding to produce ewes, and for the ewes in late pregnancy and lactation, specific feed is supplemented to the diet. Lambs are bred in sheepfolds throughout the course (supplemented with occasional grazing or no grazing). Lambs can be slaughtered at 6 months of age (weight up to 35 kg), and female lambs can be used for breeding that year. Generally, one ewe produces a lamb one year, and a small proportion of ewes can achieve 3 parities in 2 years.

2.2 Assumptions

2.2.1 The basic production parameters were determined according to the actual production in Qinghai. The yield of fresh grass in the grassland was calculated at 2 700 kg/ha, the average fresh grass intake of each Tibetan sheep was assigned as 4 kg/d according to the provincial standard, and the amount of grass consumed by each lamb in the first year (including 6 months of high-efficiency breeding) was halved. In the mode of traditional grazing, one ewe usually produced one lamb a year. The reproductive survival rate and the annual loss rate of ewes were assigned as 80% and 2%, respectively. Lambs were slaughtered when they reached 2 years of age (weight 32 kg), and the slaughter rate was calculated at 47%. In the high-efficiency breeding mode, one ewe produced one lamb a year. The reproductive survival rate and annual loss rate of ewes were assigned as 95% and 0.5%, respectively. When the body weight of six-month-old lambs reached 37 kg, they were put one the market. The slaughter rate was calculated at 48%.

2.2.2 The production cost price refers to the actual price in recent years. Grazing sheep consumed grassland fresh grass. The price of non-market purchased green hay was calculated at 0.2 yuan/kg, and the labor cost was calculated at 0.1 yuan/(d · head) according to the actual conditions of the pastoral areas. In late gestation, ewes were fed supplementarily according to the dose of 0.1 kg/(d · head) for 45 d. During lactation, 0.25 kg/d of feed was supplemented to the diet of each ewe, lasting for 60 d. Lambs were semi-confined for 6 months, and 72 kg of feed was supplemented to the diet of each of them. The prices of meat, feed for late gestation, feed for lactation and feed for semi-confined lambs were calculated at 50, 2.7, 2.8 and 3 yuan/kg, respectively. In sum, the cost of feed supplementation for each period of ewes was 54.15 yuan, and the cost of feed supplementation for lambs was 216 yuan. The loss cost of sheep was assigned as 800 yuan/head.

2.2.3 Simplifying some calculation conditions. For comparison and calculation convenience, it was assumed that all ewes were normal reproducible ewes; all lambs (including female lambs) were sold at the age of 6 months (without extended calculation); economic costs of sheep production were composed of only forage and labor costs, ignoring other miscellaneous items; and fluctuations of factors such as grassland production, ewe parity, management level, sheep price, utilization of by-products (including fur), epidemic cost and production depreciation and amortization were consistent under the two production methods, and they were ignored in calculation.

2.3 Estimation results

2.3.1 Natural grazing.

(i) Gross revenue. The direct economic benefits of natural grazing and high-efficiency breeding were measured. As the herdsman's perspective and the economic perspective are different, this article also distinguished when calculating. In order to uniform calculation scale, facilitate comparison and make results more objective and reasonable, 100 ewes were taken as a base figure, 2 years were taken as a complete production cycle, and the gross income of herdsmen from raising 100 ewes for 2 years was calculated. Gross income = Number of ewes × Reproductive survival rate × Lamb slaughter weight × Slaughter rate × Meat price × Number of batches = $100\times80\%\times32\times47\%\times50\times2=120\ 300$ yuan. That is, the annual income was about 60 000 yuan, *i.e.*, the annual income of herdsman from each ewe raised was 600 yuan. From the perspective of the lamb, the income of each lamb raised was $600/80\%=750$ yuan.

(ii) Cost. ① Forage cost of ewes = Number of ewes × Number of feeding days × Forage intake per day × Price of fresh forage $=100\times365\times2\times4\times0.2=58\ 400$ yuan. ② Forage cost of lambs = Number of lambs × Number of feeding days × Forage intake per day × Price of fresh forage $=(80\times365\times4\times0.2)+(80\times365\times2\times0.2)=35\ 040$ yuan. Note: Forage intake of one-year-old lambs was assigned as 2 kg/d, and that of two-year-old lambs was assigned as 4 kg/d. ③ Labor cost of ewes = Number of ewes × Number of feeding days × Labor cost per day $=100\times365\times2\times0.1=7\ 300$ yuan. ④ Labor cost of lambs = Number of lambs × Number of feeding days × Labor cost per day $=160\times365\times2\times0.1=11\ 680$ yuan. ⑤ Normal loss of sheep = Loss rate × Number of years × Price per sheep $=100\times2\%\times2\times800=3\ 200$ yuan.

(iii) Benefit. The first perspective was that from the perspective of herdsmen. Income was regarded as gross income. The income from raising 100 ewes for 2 years was 120 000 yuan, 60 000 yuan per year. Under the second perspective, *i.e.*, the economic perspective, the income from raising 100 ewes was: Gross income − ① − ② − ③ − ④ − ⑤ = 4 680 yuan. It is equivalent to 46.8 yuan per ewe for 2 years and 23.4 yuan per ewe per year, which is very similar to the previous research results of some scholars[11].

2.3.2 Efficient breeding. (i) Gross revenue. Gross revenue = Number of ewes × Reproductive survival rate × Slaughter weight of lambs × Slaughter rate × Price of meat × Number of batches = $100\times95\%\times37\times48\%\times50\times2=169\ 000$ yuan.

(ii) Cost. ① Forage cost of ewes = Number of ewes × Number of feeding days × Forage intake per day × Price of fresh forage $=100\times365\times2\times4\times0.2=58\ 400$ yuan. ② Forage cost of lambs = Number of lambs × Number of feeding days × Forage intake per day × Price of fresh forage × Number of batches $=(95\times180\times2\times0.2)\times2=13\ 700$ yuan. ③ Labor cost of ewes = Number of ewes × Number of feeding days × Labor cost per day $=100\times365\times2\times0.1=7\ 300$ yuan. ④ Labor cost of lambs = Number of lambs × Number of feeding days × Labor cost per day $=95\times180\times0.1\times2$

= 3 400 yuan. ⑤ Feed cost of ewes = Number of ewes × Cost of supplementary feed × Number of batches = 100 × 54.15 × 2 = 10 800 yuan. ⑥ Feed cost of lambs = Number of lambs × Cost of supplementary feed = 95 × 2 × 216 = 41 000 yuan. ⑦ Death loss = Death rate × Number of years × Price of each sheep (yuan) = 100 × 0.5% × 2 × 800 = 800 yuan. Total cost referred to the sum of the above, and it was 134 500 yuan.

(iii) Benefit. From the perspective of herdsmen, the income from raising 100 ewes, excluding the cost of feed, was 117 200 yuan, with 58 600 yuan per year. The average annual income of a ewe was 586 yuan, which was 14 yuan lower than that (600 yuan) under natural grazing. However, a lot of labor and grassland were saved. Each lamb earned 888 yuan, nearly 18.4% higher than that (750 yuan) under traditional grazing. Under the economic perspective, the income from raising 100 ewes was the difference between gross revenue and total cost, that is, 33 600 yuan. It is equivalent to 336 yuan per ewe for 2 years and 168 yuan per ewe for one year, which was 145 yuan (*i.e.*, 7.2 times) higher that (23.4 yuan) under traditional grazing.

(iv) Demonstration of pastoral areas. Compared with the simplified model in this article, the actual production of pastoral herders is more complex and dynamic. There are certain differences in production modes in various regions. This article strove to make the model simple, and so, some disturbance factors were regarded as exogenous factors, not included. Under traditional grazing, the breeding rate of lambs was about 5%, while after the introduction of high-efficiency breeding, the breeding rate of lambs reached more than 70%, and the effect was very obvious. Second, the development of male lambs in the high-efficiency breeding mode was generally better than that under traditional grazing, and the male lambs in the high-efficiency model were more likely to become breeding rams to obtain subsidies from policy projects. This part of income estimated by the Qinghai Tibetan Sheep High-efficiency Breeding Research Group ranged between 50 – 100 yuan. The monitoring statistics of the large-scale use of high-efficiency breeding technology in various prefectures also included these factors (Table 1). This was consistent with the caliber of 200 – 300 yuan generally reported by pastoralists in many areas of the province.

From a policy perspective, efficient breeding will effectively activate the factors of animal husbandry production, thereby contributing to releasing the potential of animal husbandry production. First, after the grassland resources were freed up, additional cattle and sheep could be raised to increase the income (that is, indirect income, see below). Second, when lambs were breeding efficiently, they were basically in a state of no grazing or light grazing. Thus, the pressure of the original grassland was suddenly reduced, which would inevitably affect the ecological benefit of the grassland (see below). Third, when producing in this way, the herdsmen could safely hand over the sheep to cooperatives for operation, and the manpower freed can be engaged in other industries. The strategic goal of ecological animal husbandry in Qinghai, "reducing livestock but not reducing income", has become a reality in pastoral areas.

Table 1 Benefit estimation of highly efficient breeding technology for Tibetan sheep in various prefectures in 2011 – 2016

Year	Region	Number of ewes	Number of lambs fattened	Total revenue 10^4 yuan	Total cost 10^4 yuan	Output value newly increased // 10^4 yuan	Profit newly increased // 10^4 yuan
2011 – 2012	Haibei Prefecture	91 600	87 990	10 302.07	2 717.45	6 503.19	3 785.74
2012 – 2013	Haibei Prefecture	112 600	107 995	12 474.73	3 346.80	7 708.89	4 362.10
2013 – 2014	Haibei Prefecture	158 200	151 397	15 930.64	4 809.58	9 790.74	4 981.16
	Hainan Prefecture	19 600	18 541	1 976.92	584.99	1 254.36	669.37
	Haixi Prefecture	23 800	22 300	2 345.62	716.34	1 481.33	764.98
	Sub-total	201 600	192 238	20 253.18	6 110.91	12 526.43	6 415.51
2014 – 2015	Haibei Prefecture	316 870	302 420	28 373.03	9 473.21	17 719.26	8 246.05
	Hainan Prefecture	196 000	183 554	17 088.76	5 735.87	10 712.25	4 976.38
	Haixi Prefecture	86 000	79 679	7 238.46	2 528.84	4 524.90	1 996.06
	Huangnan Prefecture	38 000	35 264	3 470.33	1 111.50	2 076.53	965.03
	Yushu Prefecture	400	350	33.54	11.39	22.21	10.89
	Guoluo Prefecture	500	426	38.79	13.96	25.33	11.37
	Sub-total	637 770	601 693	56 242.91	18 874.77	35 080.48	16 205.78
2015 – 2016	Haibei Prefecture	586 000	573 987	47 953.02	16 990.36	28 485.99	11 495.63
	Hainan Prefecture	234 000	219 258	18 544.97	6 738.51	11 207.31	4 468.80
	Haixi Prefecture	142 000	131 634	10 905.94	4 116.47	6 591.41	2 474.94
	Huangnan Prefecture	84 500	78 416	7 074.29	2 437.05	4 014.88	1 577.83
	Yushu Prefecture	600	527	47.37	16.94	30.05	13.11
	Guoluo Prefecture	1 000	855	74.29	27.47	47.63	20.16
	Sub-total	1 048 100	1 004 677	84 599.88	30 326.80	50 377.27	20 050.47
Total		2 091 670	1 994 593	183 872.77	61 376.73	112 196.26	50 819.60

Note: Data are from the reports of the governments of the six prefectures (internal data).

3 Indirect economic benefit brought about by efficient breeding

3.1 Estimation idea Taking 100 lambs as an effective breeding unit, the number of sheep that could be produced in the pasture saved by each lamb after the six months of breeding was calculated.

3.2 Assumptions The feeding methods and assumptions stated above were established. It was assumed that all the forage grass saved would only be used in the traditional grazing mode.

3.3 Estimation results In the traditional mode, each lamb was slaughtered after 2 years and consumed 2 190 kg of fresh forage. In the efficient breeding mode, lambs were put on the market after 6 months of breeding. Thus, 1 830 kg of fresh forage was saved, and in theory, it could be used to raise 0.835 sheep under traditional grazing mode, equivalent to an indirect income of 501 yuan, *i.e.*, raising a lamb using the high-efficiency technology could bring indirect economic income of 500 yuan through saving forage.

4 Indirect estimation of ecosystem service value in Tibetan sheep efficient breeding technology

4.1 Estimation ideas Using grassland ecosystem service value as a measure of the ecological value of Tibetan sheep efficient breeding technology, referring to the results of previous literature studies, on the basis of the results calculated by previous scholars, the value of indirect ecosystem services involved or affected by Tibetan sheep highly efficient breeding was estimated indirectly through the amount of grassland consumed by Tibetan sheep.

4.2 Estimation basis and remarks

4.2.1 Basis of estimation. (i) Breeding modes and parameters were as mentioned above. (ii) Referring to the research results of previous scholars: Costanza *et al.* [1] proposed the concept of ecosystem service value and 9 types of functional factors; Chen Zhongxin *et al.* [2] estimated the value of grassland ecosystem in China; Yin Jianhui *et al.* [3] accounted the value of forage producing using market value; Ren Jizhou[4] evaluated the nature, structure and health of grassland resources in China; Xie Gaodi *et al.* [5] estimated the ecological value of natural grassland in China and the ecosystem service value of natural grassland on the Qinghai – Tibet Plateau; Zhao Xinquan *et al.* [6] studied the theory and practice of sustainable development of alpine meadow grassland animal husbandry in Qinghai; Zhou Huakun *et al.* [7] studied the degradation succession and ecological restoration of alpine grassland in the Three – River Headwater Region; Xin Yuchun *et al.* [8] estimated the value of ecological service function of natural grassland in Qinghai; Min Qingwen *et al.* [9] evaluated the value of grassland ecosystem services in Qinghai; Wu Haoyi *et al.* [10] estimated the ecosystem service value of natural grasslands in Guinan County, Qinghai; Xu Shixiao *et al.* [11] accounted for the economic and ecological benefits of cattle and sheep house fattening in Maqin County, Qinghai Province; Zhao Miaomiao *et al.* [12] estimated the value of grassland ecosystem services in Qinghai Province from 1998 to 2012; Zheng Shuhua[13] evaluated the service function value of *Leymus chinensis* grassland ecosystem under different grazing intensities; Zhang Xiaoyun *et al.* [14] made a long-term estimation on the dynamic changes in the service value of the wetland ecosystem on the Zoige Plateau.

4.2.2 Additional remarks. (i) The specific estimation method of ecosystem service value is relatively complicated. Different studies have different perspectives, and the results are different. This article does not review extendedly due to the subject limitations. The concept and 9 types of functional factors proposed by Costanza *et al.* [1] are the main framework and mainstream method of value evaluation. In measuring the value of grassland ecosystem services on the Qinghai – Tibet Plateau, scholars often use the method proposed by Xie Gaodi *et al*[5].

(ii) Scholars of different periods have estimated the ecological service value of grassland in different regions. In order to facilitate the comparison, in this article, the data were conserved into the ecosystem service value of each acre of grassland (Table 2). As can be seen from the literature, the value of grassland ecological services has increased year by year.

Table 2 Ecosystem service value converted from research results of different scholars

Reference	Grassland area//10^4 ha	Ecosystem service value per year	Equivalent to the value per hectare//yuan	Notes
[2]	434.984 4	$8\ 697.68 \times 10^8$ yuan	1 999.35	1994, national Land area
[5]	12 834.9	212.8 dollars/ha	1 759.80	Qinghai – Tibet alpine meadows and alpine grasslands (conversion based on the benchmark exchange rate of 8.27:1, the same below)
[9]	3 345	203.83×10^8 dollars	5 018.85	2004, typical grassland in Qinghai
[11]	1	$4\ 776.44 \times 10^4$ yuan	4 776.44	2005, Maqin County, Qinghai
[12]	3 161	$(235.63 \pm 304.79) \times 10^8$ yuan	7 454.25 ± 971.85	1998 – 2012, available grassland area in Qinghai
[8]	4 191.72	$4\ 068 \times 10^8$ yuan	9 704.85	2012, Qinghai natural grassland
[10]	1.914 2	$40\ 939 \times 10^4$ yuan	21 494.10	2014, a village in Guinan, Qinghai
[11]	The productivity of the alpine grasslands in the Three – River Headwater Region was medium. The average grassland area required by per unit of sheep was 1.11 ha. The economic and ecological benefits of each sheep were 34.25 and 5 301.85 yuan, respectively			
[13]	The direct value of the non-grazing and light, moderate and heavy grazing areas was 5.88%, 4.81%, 3.95% and 1.57% of the indirect value, respectively, and the indirect value was much greater than the direct value (Inner Mongolia, 2006)			
[14]	From 1975 to 2006, the dynamic change of the material production value, gas regulation value and water storage value of the wetland ecosystem of Zoige Plateau was 3.02/72.05 (4.24%), and the change in the relationship between the value of grass products and the indirect value was close to 5% (Sichuan)			
[10]	From the perspective of the grass-livestock-human complete social ecosystem, the value of the natural grassland ecosystem service function was 20 times the value of the existing government statistics, but its estimation on biodiversity was too great (accounting for 85%)			

(iii) The value of ecosystem services is divided into direct value and indirect value. In general research, the value of grass products and livestock (food) products is regarded as direct value, and others including gas regulation, climate regulation, water conservation, soil formation and protection, waste treatment, biodiversity maintenance, raw material production and leisure and entertainment are considered as indirect value. There is currently no direct literature and method for measuring the ecological value of cattle and sheep. Only through the ecological value of grassland consumed by sheep, can be ecological value of cattle and sheep be measured indirectly. Therefore, the ecosystem service value involved in this article was only the "involved" or "affected" value of Tibetan sheep breeding, and could not be expressed as the ecological value "generated" by Tibetan sheep.

4.3 Assumptions The feeding modes and assumptions stated above were established; the utilization level of grasslands in efficient breeding of lambs is no grazing-light grazing; and the value of indirect ecosystem services is the ecological value affected by Tibetan sheep.

4.4 Estimation results

4.4.1 Direct ecosystem service value. One sheep required 1.07 ha of land. Each hectare of land produced grass with a value of 556 yuan, *i.e.*, direct ecosystem service value. This is also in line with the actual prices of pastoral grassland circulation in Qinghai in recent years.

4.4.2 Indirect ecosystem service value. The first estimation method was as follows. Referring to the research results of Zhang Xiaoyun *et al.*[11] and Wu Haoyi *et al*[8], the value of indirect ecosystem services was estimated at 20 times the value of direct ecosystem services, that is, 556 yuan × 20 = 11 120 yuan. Using efficient breeding method to produce a Tibetan sheep would save 0.93 ha of grassland, and the value of the ecosystem services involved was 14 times 720 yuan, *i.e.*, 155 680 yuan.

The second estimation method was as follows. On the basis of the direct research result of Xin Yuchun *et al.*[6] using the factor method in 2012, *i.e.*, 9 705 yuan/ha, the value of the ecosystem services involved was 14 times 647 yuan, *i.e.*, 135 870 yuan. For the third estimation method, grassland value of 556 yuan[10] was taken as the direct value, and according to the proportion of direct value in indirect value under the no grazing-light grazing mode (5.88% −4.81%), the indirect value of per hectare of grassland was calculated as 9 456 – 11 559 yuan. The ecosystem service value involved in the efficient breeding of a Tibetan sheep was between 132 384 – 161 830 yuan. Based on the above, this paper believed that 155 000 yuan could be used as the ecosystem service value affected by each Tibetan sheep.

5 Main conclusions

Under the traditional grazing situation, from the perspective of herdsmen, raising a ewe would earn 600 yuan per year, and the income from raising a lamb was 750 yuan; but if the grassland and labor costs were included, the actual annual income from raising a ewe was only 23.4 yuan. In the mode of efficient breeding, the herdsmen seemed to earn 586 yuan per ewe every year. The difference from the traditional grazing was not obvious but a lot of labor and grassland was saved. But if the pasture and labor costs were included, the annual income of each ewe was 168 yuan, more than 7 times that of traditional grazing. The grassland saved by efficient breeding of one sheep could bring indirect economic benefit of 500 yuan. Efficient breeding of Tibetan sheep affected the value of grassland ecosystem services by reducing the burden on the pasture. The value of ecosystem services affected or involved by each sheep was as high as 155 000 yuan.

The original intention of this study is to provide decision makers, producers and promoters with a more objective and clear "reference frame". The parameters in this article are mostly based on the actual level of production in pastoral areas in Qinghai in recent years, taking the overall situation as a priority. There may be many details that are worth discussing, and some deep-seated issues have not been investigated, and so, follow-up research and criticism are welcome. Based on the estimation results, it could be concluded that the promotion of high-efficiency Tibetan sheep breeding technology in pastoral areas has significant positive benefits whether from the economic perspective or the traditional herdsmen' perspective, and it has important economic and ecological significance.

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pliers. These suppliers will develop and produce spare parts according to the design drawings of a certain style of car proposed by Hyundai, and then supply them to Hyundai. These companies and Hyundai Motor Company form an extremely closely related business ecosystem, they rely on each other, co-exist and co-evolve. Hyundai Motor Company strictly controls the entire ecosystem through automotive design drawings (namely, platforms).

4.4 Channel control type business ecosystem When establishing such an ecosystem, it is necessary to set the platform downstream of the industry chain, connecting the finished product manufacturers and final consumers. The core enterprise only opens the platform to specific objects. Only licensed members can connect and use the platform. The core enterprise strictly selects the ecosystem members suitable for the platform. Although the two sides have formed a high level of interdependence through information sharing and other means, the control of the entire ecosystem is still taken by the core enterprises. Circulation channels are the most typical of this type, such as the ecosystem of Wal-Mart, Carrefour, department stores and other large circulation enterprises and their suppliers. Taking Wal-Mart as an example, suppliers must be carefully selected to meet Wal-Mart's requirements in order to become a licensed supplier in order to be eligible to connect and use Wal-Mart's circulation channels (platforms) to contact consumers. Wal-Mart uses the circulation channels (platform) to strictly control the entire ecosystem.

5 Conclusions and prospects

The platform is core and foundation of the business ecosystem. It determines the structure and operation mode of the business ecosystem. On the basis of the platform's "control mode" and "position on the industry chain, we designed four types of construction modes of business ecosystem: open participation, open technology, close symbiosis and channel control. In addition, combined with typical cases, we discussed the structure and operating characteristics of each type of business ecosystem. In this study, although we proposed four models for building a business ecosystem based on the nature of the platform, it has certain theoretical significance and strong practical guidance significance, but there are still deficiencies. For example, we made no in-depth analysis of the internal and external environment and resources of each construction model, therefore, it is difficult to propose a competitive strategy applicable to each model. Besides, we did not consider the dynamics of the business ecosystem and did not conduct strategic analysis based on different stages of development. Therefore, in the future, it is necessary to strengthen the research on strategic analysis according to the types of construction models and development stages, and propose corresponding more specific construction strategies and competition strategies.

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