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Full Length Research Paper

Relationship between grassland protection and sustaining household livelihoods in Tibet, China

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For investigating how grassland protection influence on sustaining household livelihoods in Tibet, this study to elucidate the source of herdsmen's income and to test the hypothesis that both grassland protection (GP) and sustaining household livelihoods (SHL) can be achieved in Tibet China. Effects of 9 key predictor variables on the income increment of Tibetan herdsman was analyzed based on 20 years database from 1986 to 2005 (n = 20) (Tibet Statistical Yearbooks, 1996, 2002, 2008 and 2009). Contributions of the nine key variables of per capita main indicators on economic benefit, including annual increment of rural population (x_1), annual increment of gross domestic product (x_2), annual increment of primary industry product (x_3), annual increment of gross output value of farming (x_4), annual increment of gross output value of forestry (x_5), annual increment of gross output value of animal husbandry (x_6), annual increment of gross industrial output value (x_7), annual increment of gross domestic product of construction (x_8), and annual increment of tertiary industry product (x_9), to per capita income increment of rural residents (y) were investigated via correlations and path analysis for evaluating if the GP conflict with SHL in Tibet. These results showed that neither direct nor indirect effect of x_6 contributes to y. And x_6 was irrelative to the income increment; so, it was educed that GP do not contravene SHL; therefore, both of them can be achieved in Tibet.

Key words: Relationship, grassland protection, income increment, sustaining household livelihoods, Tibet.

INTRODUCTION

As the highest plateau in the world and an important part of the global terrestrial ecosystem on the Eurasian continent, a number of researches concern about the Tibetan plateau (Mulch, 2006; Rowley et al., 2006; Blisniuk et al., 2001; Buroker et al., 2010; Law et al., 2010; Wang et al., 2010; Zhang et al., 2010). Being an ecological shelter for the economically developed eastern and central regions in China (Wang et al., 2005), it has been shown to modify global climate and to influence monsoon intensity (Spicer et al., 2003). Two thirds of the plateau area was grassland (Wang et al., 2005). Therefore, it was important that protection of grassland from degradation and desertification, accelerated by overgrazing during the last two decades. However, can viable incomes be achieved by grassland protection and sustaining household livelihoods?

Being a region relatively behind in terms of rural economic development (Ran, 2007; Du, 2007), the Tibetan Autonomous Region in 2005 achieved an average net income per capita of 2078 yuan (about 259 US$) for the farmers and herdsmen, ranking the 27th nationwide (31 provinces and regions totally) (Tibet Statistical Yearbooks, 1996, 2002, 2008 and 2009), and got an annual increment of income per capita of 217 yuan (about 27 US$); it was considerably, the highest rise

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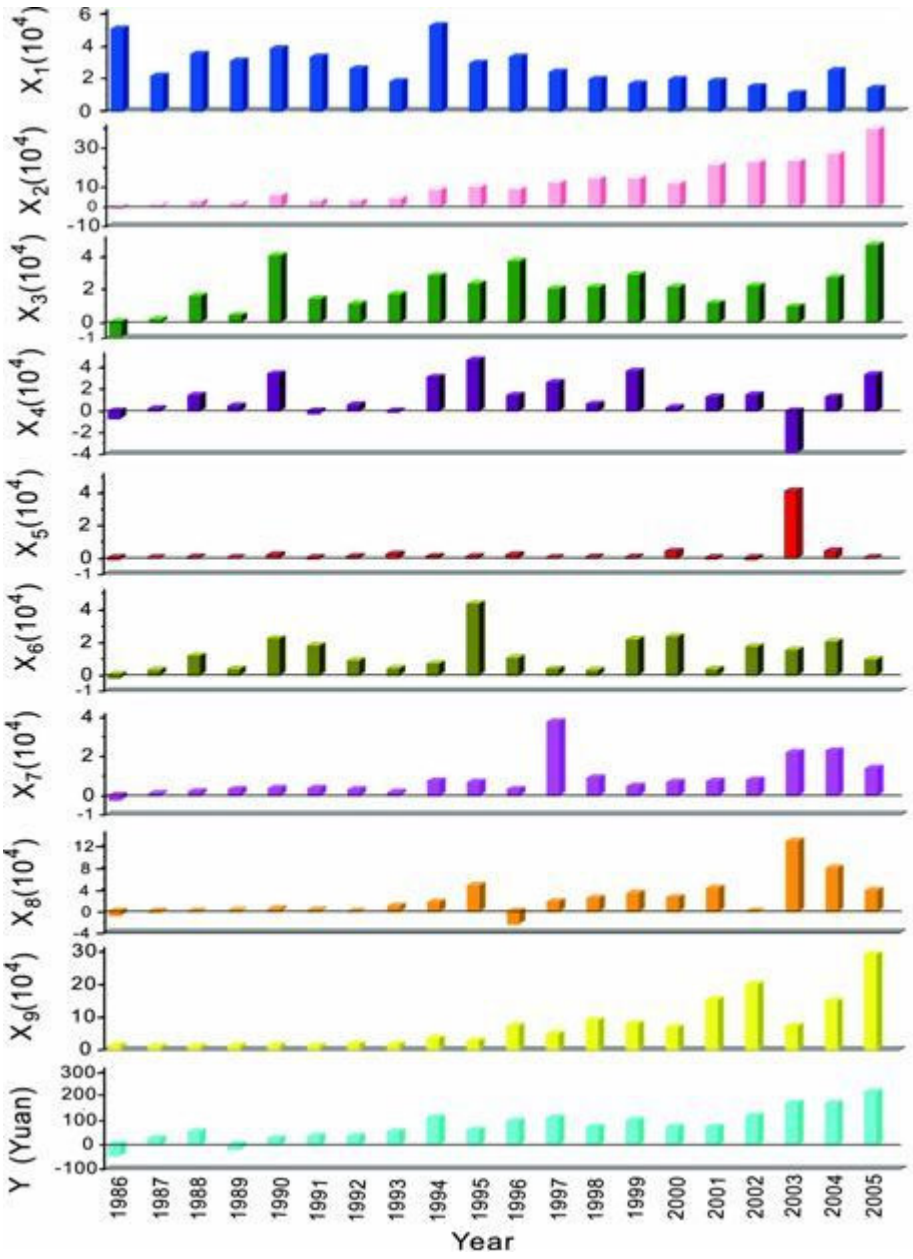

Figure 1. Annual increment of selected key economic indicators related income (x_{1-9}) and income increment (y) per capita during 1986-2005. x_1: annual increment of rural population (10^4 persons), x_2: annual increment of gross domestic product (10^4 RMB Yuan), x_3: annual increment of primary industry product (10^4 RMB Yuan), x_4: annual increment of gross output value of farming (10^4 RMB Yuan), x_5: annual increment of gross output value of forestry (10^4 RMB Yuan), x_6: annual increment of gross output value of animal (10^4 RMB Yuan), x_7: annual increment of gross industrial output value (10^4 RMB Yuan), x_8: annual increment of gross domestic product of construction (10^4 RMB Yuan), and x_9: annual increment of tertiary industry product, y: per capita income annual increment of rural residents (RMB Yuan).

during the last two decades (1986 to 2005, Figure 1), though there is still a big gap from other provinces and regions that are economically developed (Ran, 2007; Zhang, 2003). For Building a Comprehensive Well-off Society, how to raise Tibet farmers and herdsmen's income, to improve their living quality and standard and to develop regional economy have become the priority of the Central Government and Tibetan governments of various levels (Ran, 2007; Du, 2007; Zhang, 2003). For investigating how grassland protection influence the

sustained household livelihoods in Tibet, a further understanding of Tibet farmers and herdsmen's income dynamic changes and income sources is necessary for providing a basis for developing policies of both to increase the farmers and herdsmen's income and to facilitate grassland protection. This study attempts to accurately extract the contributions of animal husbandry to the farmers and herdsmen's income, during the last two decades (1986 to 2005), based on (Tibet Statistical Yearbooks, 1996, 2002, 2008 and 2009) through path analysis. Path analysis was a statistical technique that partitions correlations into direct and indirect effects and distinguishes between correlation and causation (Wright, 1934; Afifi and Clark, 1984; Shipley, 1997; Wadsworth, 1993) and it has been used extensively in agronomic studies (Wadsworth, 1993; Mojarradi et al., 2008; Whittaker et al., 2009; Wang et al., 2004) and in rural economies to investigate relationships between animal husbandry productive factors and herdsmen's income (Cui et al., 2002; Cui and Wang, 2002; Namboodiri, 2006; Roberts, 2005).

The income of Tibetan peasants and herdsmen is a topic that attracts foreign attention (Ran, 2007; Du, 2007) and domestic as well (Wang, 2003; Tudor, 2002; He and Li, 2003; Li et al., 2004; Zhang, 2003; Li et al., 2005, He and Li, 2003); however, previous researches mostly focused on the analyses of the farmers and herdsmen's present income status (Lhorong, 2006; Xu, 2005), problems and proposing strategies for increasing the income (Liu, 2004; Dai, 2004; He, 2004). Few of them adequately discussed the income dynamic changes and the income sources over the years; moreover, there is no report to study the relationship between grassland protection and sustaining household livelihoods in Tibet China. The objective of this study was to elucidate the source of herdsmen's income and to test the hypothesis that both grassland protection (GP) and sustaining household livelihoods (SHL) can be achieved in Tibet China.

RESEARCH METHOD

The study area

The study area is located in the southwest of China, Tibet Autonomous Region, located at 26°50′~36°53′N and 78°25′~99°06′E, on average altitude of 3800 m, is the main part of Qinghai Tibet Plateau to the east of Kashmir and India, and north of Nepal, Bhutan, Sikkim and Myanmar. With a special and complex geographical and climatic condition (Fan et al., 2006), from southeast to northwest, the grassland types are main alpine meadows, steppes and alpine deserts (Chia, 1981), as the spatiotemporal distribution of annual precipitation is extremely unequal, range from 5000 in southeast to 50 mm in northwest, with an average annual temperature of about 0℃. Therefore, as a whole, the grassland productivity is kept to a relatively low level, and grass yields range from 881 to 195 kg/hm^2. Tibet, more than 95% of the population is of Tibetan Nationality, belongs to the section of alpine climate of Qinghai Tibet Plateau, with an area of 1.22 × 10^6 km^2, is the second largest province in China.

Data collection, survey and analysis

Information was derived from Tibet Statistical Yearbooks (1985 to 2005) and documents provided by government agencies. In this study, the annual increment of variables was taken to analyses for avoiding the influence by price index. The effects of 9 key predictor variables on the income increment of Tibetan herdsman was analyzed based on 20 years database from 1986 to 2005 (n=20) (Tibet Statistical Yearbooks, 1996, 2002, 2008 and 2009). Contributions of the 9 variables of per capita main indicators on economic benefit, including annual increment of rural population (x_1), annual increment of gross domestic product (x_2), annual increment primary industry product (x_3), annual increment of gross output value of farming (x_4), annual increment of gross output value of forestry (x_5), annual increment of gross output value of animal husbandry (x_6), annual increment of gross industrial output value (x_7), annual increment of gross domestic product of construction (x_8), and annual increment of tertiary industry product (x_9), to per capita income increment of rural residents (y) were investigated via correlations and path analysis for evaluating if the GP conflict with SHL in Tibet (Figure 1).

Figure 1, annual increment of selected key economic indicators related income ($x_{1\text{-}9}$) and income increment (y) per capita during 1986 to 2005. Note x_1: Annual increment of rural population (10^4 persons), x_2: Annual increment of gross domestic product (10^4 RMB Yuan), x_3: Annual increment of primary industry product (10^4 RMB Yuan), x_4: Annual increment of gross output value of farming (10^4 RMB Yuan), x_5: Annual increment of gross output value of forestry (10^4 RMB Yuan), x_6: Annual increment of gross output value of animal (10^4 RMB Yuan), x_7: Annual increment of gross industrial output value (10^4 RMB Yuan), x_8: Annual increment of gross domestic product of construction (10^4 RMB Yuan), and x_9: Annual increment of tertiary industry product, y: per capita income annual increment of rural residents (RMB Yuan).

RESULTS

Pearson correlation coefficients (Table 1) for years from 1986 to 2005 shows that x_2 (0.8883, P<0.0001), x_9 (0.7533, P<0.0001), x_7 (0.6432, P<0.001), x_3 (0.6272, P<0.001) and x_8 (0.6178, P<0.001) are positive correlation with y significantly, whereas x_1 (-0.5080, P<0.001) negative; x_6 is not significantly correlative with y. x_1 is negative correlation with x_2 (-0.5839, P<0.01), x_8 (-0.4620, P<0.05) and x_9 (-0.5282, P<0.05); x_2 is positive correlation with x_3 (0.5348, P<0.05), x_7 (0.5492, P<0.05), x_8 (0.6191, P<0.01) and x_9 (0.9327, P<0.0001). Direct and indirect effects of x_1-x_9 on y are presented in Table 2. The direct effects of the nine x on y was in decreasing order as, $x_9 > x_8 > x_3 > x_7 > x_2$ significantly, and the indirect effects in decreasing order as: $x_2 \rightarrow x_9$ (that is x_2 via x_9 on y)> $x_1 \rightarrow x_2 > x_3 \rightarrow x_9 > x_7 \rightarrow x_9 > x_5 \rightarrow x_8 > x_8 \rightarrow x_9 > x_2 \rightarrow x_8 > x_4 \rightarrow x_3 > x_7 \rightarrow x_8 > x_2 \rightarrow x_3 > x_9 \rightarrow x_3 > x_1 \rightarrow x_8 > x_5 \rightarrow x_2 > x_1 \rightarrow x_9 > x_3 \rightarrow x_2 > x_7 \rightarrow x_2 > x_8 \rightarrow x_2 > x_9 \rightarrow x_2$ significantly; the times of indirect effects in the list earlier stated was orderly as: x_2 (9 repetitions) > x_9 (7) > x_8 (6) > x_3 (5) > x_7 (3) and x_1 (3) > x_5 (2) > x_4 (1) > x_6 (0). Neither direct nor indirect significant effect of x_6 contributes to y. Sum of the indirect effects of x_1-x_9 to y, it is inferred that the contributions of the nine

Table 1. Correlation coefficients of x_1-x_9, y.

	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	y
x1	-0.5839**	-0.1290	0.1841	-0.3273	-0.1115	-0.3422	-0.4620*	-0.5282*	-0.5080*
x2	1.0000	0.5348*	0.1514	0.2688	0.1802	0.5492*	0.6191**	0.9327***	0.8883***
x3		1.0000	0.6439**	-0.1259	0.4063	0.2259	0.0657	0.4963*	0.6272**
x4			1.0000	-0.6197**	0.4035	0.0269	-0.2464	0.1971	0.1451
x5				1.0000	0.1173	0.3538	0.7649***	0.0083	0.3792
x6					1.0000	0.0380	0.3219	0.0321	0.2109
x7						1.0000	0.5696**	0.3423	0.6432**
x8							1.0000	0.3279	0.6178**
x9								1.0000	0.7533***

x_1: annual increment of rural population (10^4 persons), x_2: annual increment of gross domestic product (10^4 RMB Yuan), x_3: annual increment of primary industry product (10^4 RMB Yuan), x_4: annual increment of gross output value of farming (10^4 RMB Yuan), x_5: annual increment of gross output value of forestry (10^4 RMB Yuan), x_6: annual increment of gross output value of animal (10^4 RMB Yuan), x_7: annual increment of gross industrial output value (10^4 RMB Yuan), x_8: annual increment of gross domestic product of construction (10^4 RMB Yuan), and x_9: annual increment of tertiary industry product, y: per capita income annual increment of rural residents (RMB Yuan). ***, ** and * significant at P=0.0001, 0.01 and 0.05, respectively.

Table 2. Path analysis showing direct and indirect effect of x_1~x_9 to y.

	Direct effect	**Indirect effect via**								
	→y	**x_1→y**	**x_2→y**	**x_3→y**	**x_4→y**	**x_5→y**	**x_6→y**	**x_7→y**	**x_8→y**	**x_9→y**
x1	-0.0261		0.9477*	-0.0805	0.0025	-0.0770	0.0079	-0.1265	-0.3159*	-0.8401*
x2	-1.6229*	0.0153		0.3338*	0.0020	0.0632	-0.0129	0.2030	0.4233*	1.4834*
x3	0.6241*	0.0034	-0.8680*		0.0087	-0.0296	-0.0290	0.0835	0.0449	0 .7893*
x4	0.0134	-0.0048	-0.2457	0.4019*		-0.1458	-0.0288	0.0099	-0.1685	0.3134*
x5	0.2352	0.0086	-0.4363*	-0.0786	-0.0084		-0.0084	0.1308	0.5230*	0.0131
x6	-0.0714	0.0029	-0.2924	0.2535	0.0054	0.0276		0.0140	0.2201	0.0511
x7	0.3697*	0.0089	-0.8913*	0.1410	0.0004	0.0832	-0.0027		0.3895*	0.5444*
x8	0.6838*	0.0121	-1.0047*	0.0409	-0.0033	0.1799	-0.0230	0.2107		0.5214*
x9	1.5904*	0.0138	-1.5137*	0.3097*	0.0026	0.0019	-0.0023	0.1266	0.2242	
Total indirect effect		0.0513	-4.3044	1.3217	0.0099	0.1034	-0.0992	0.6520	1.3370	2.8760

x_1: annual increment of rural population (10^4 persons), x_2: annual increment of gross domestic product (10^4 RMB Yuan), x_3: annual increment of primary industry product (10^4 RMB Yuan), x_4: annual increment of gross output value of farming (10^4 RMB Yuan), x_5: annual increment of gross output value of forestry (10^4 RMB Yuan), x_6: annual increment of gross output value of animal (10^4 RMB Yuan), x_7: annual increment of gross industrial output value (10^4 RMB Yuan), x_8: annual increment of gross domestic product of construction (10^4 RMB Yuan), and x_9: annual increment of tertiary industry product, y: per capita income annual increment of rural residents (RMB Yuan). Significant at P= 0.05; Arrows illustrate directions of effects.

factors to y are orderly x_9 (2.876) > x_8 (1.337) > x_3 (1.3217) > x_7 (0.652) > x_2 (-4.3044) significantly (Table 2). The order is the same as the significant direct effects (1.5904, 0.6838, 0.6241, 0.3697, -1.6299) (Table 2).

DISCUSSION

Evidence for relationship between the increment of gross output value of animal husbandry (x_6) and the income increment (y) was first statistically described. The results indicated that, the increment of gross output value of animal husbandry (x_6) is neither significantly correlated with Table 1 nor significantly contributed to Table 2, the income increment (y). Therefore, the hypothesis that both GP and SHL can be achieved in Tibet could be validated.

The income sources of the herdsmen's household

The largest contribution to the increment income is the increment of tertiary industry product (x_9), which is mainly services, then comes increment of gross domestic product of construction (x_8) and increment of primary industry product (x_3). A survey about changes of the farmers and herdsmen's income sources in Tibet reported that, the increase of income from labor payment percentage is the fastest from 0.22% in 1990 to 28.33% in

2003, whereas the income from animal husbandry percentage decreased from 30.87% in 1990 to 14.07% in 2003 (Li et al., 2005), compared with the per capita income of the herdsmen which increased from 582 RMB Yuan in 1990 to 1691 RMB Yuan in 2003. This contribution was made by industrial and related production; for example, the product of construction and services means that Tibetan herdsmen had more cash income than before in the non-animal husbandry production (Lhorong, 2006). It was mostly due to the increment of tertiary industry product (x_9), that increased from 1.01×10^4 RMB Yuan in 1986 to 29.05×10^4 in 2005 (Figure 1) because a tremendous achievement in the progress of rural economic development, which partly resulted from the input of the Central Government into Tibet and the aid given to Tibet by other provinces of the country during 1997 to 2005. For example, accumulative total input of the Central Government into Tibet for capital assets was 100 billion RMB Yuan (about US$ 14 billion) since 1987 (CCTV news at 26 March 2008). Most part of the aided fund was used on improving the functions of city and towns and so helping the neighboring agricultural and pastoral areas apart from used on protecting the ecological environment. A demonstration study indicated that, the subsidies revenue of Central Government into Tibet, durably contributes to per capita net income of Tibetan rural residence in the last three decades (1978 to 2007) (Jia and Yang, 2009). Therefore, the GDP of Tibet in the same period maintained a growth of more than 10% (Lhorong, 2006).

Consequently, about one fifth the rural population (mostly young people) that work at construction enterprises and service in city or town, get wages from non-farm or non-animal husbandry production in the last decade. The income ways have been diversified from the 90's, and the proportion of non-agricultural industry has been more predominant in Tibet (Li et al., 2004).

The relationship between herdsmen's income and grassland protection

The gross output value of animal husbandry is a vast majority of output value of grassland. Results of the present study indicats that increment of gross output value of animal husbandry (x_6) is statistically irrelative to the income increment.

First, the increment of gross output value of animal husbandry fluctuates from -0.18×10^4 RMB Yuan in 1986 to 0.93×10^4 RMB Yuan in 2005 compared with the increment of gross domestic product (x_2), which increased from -0.83×10^4 RMB Yuan in 1986 to 39.6×10^4 RMB Yuan in 2005 (Figure 1). However, the income increment increased from -43 RMB Yuan in 1986 to 217 RMB Yuan in 2005 (Figure 1).

Secondly, Tibetans always have a natural idea of grassland protection owing to the fact that, they deify and worship Nature to the utmost and depend heavily on Mother Nature (Lhorong, 2006).

Thirdly, in the last decade, with stepping up to aid Tibet by the Central Government and other provinces, numerous construction projects in Tibet are offering good chances for the surplus rural labor for getting cash income (Zhu, 2005). For instance, at the Tsongdu Village of Lhundrup County, nearly half of the residents' income comes from industries other than agriculture or animal husbandry, including from the employment offered by construction projects (Lhorong, 2006).

The grassland protection projects in Tibet

Since the economic reforms in China, the governments' prime has always been both to increase the living standards of the people and to protect the ecological environment. Tibet has formulated and undertaken a series of policies, including "Environmental Protection Regulations", "Geological and Mineral Resources Control Regulations", "Land Law", "Water and Soil Conservation Law", "Wildlife Conservation Law" and "China Grassland Law". Grassland Law aimed to attain the twin goals of rational use and effective protection of grassland resources. It calls upon governments at all levels to improve grassland protection, so as to maintain the nation's ecological security and coordinate the development of economic, societal and ecological environments. Consequently, the administrative and monitoring system of grassland protection are quite effective. The majority of different type of grassland, wild animals and plants are all under its aegis. For example, there is a significant effectiveness of the "China Grassland Law" (CGL) and "Detailed Rules of Implementing China Grassland Law in Tibet" (DRGLT) in achieving the goals of rational use and effective protection of grassland resources. For instance, that grassland should give priority to protection, strengthen regeneration and reasoned utilization; priority of ecological benefits combines economical and social benefits is published both in article 18 chapter 3 in CGL and in article 15 chapter 3 in DRGLT and brought into effect in Tibet. It is emphasized that the government donates foodstuff and financial assistance to the families whose livestock were closely raised and grazed under systems of rotational rest and use of grassland in both CGL and DRGLT.

In conclusion, both grassland protection and sustaining household livelihoods can be achieved by income increment analysis in Tibet China. The annual increment of gross output value of animal husbandry (x_6) is a vast majority of output value of Tibetan grassland, but x_9 (4.4664, that is direct effect 1.5904 + indirect effect 2.876), x_8 (2.0208) and x_3 (1.9458) are important predictor variables for increasing the income increment of Tibetan herdsman; Statistically, x_6 is irrelative to the income, it is educed that GP do not contravene SHL, therefore, both of them can be achieved in Tibet.

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REFERENCES

Afifi AA, Clark V (1984). Path analysis. In Computer-aided multivariate analysis. Lifetime Learning Publ., Belmont, CT, pp. 235-237.

Blisniuk PM, Hacker BR, Glodny J, Ratschbacher L, Bik S, Wu ZH, McWilliams MO, Calvert A (2001). Normal faulting in central Tibet since at least 13.5 Myr ago. Nature, 412: 628-632.

Buroker NE, Ning XH, Zhou ZN, Li K, Cen WJ, Wu XF, Ge M, Fan LP, Zhu WZ, Portman MA, Chen SH (2010). Genetic associations with mountain sickness in Han and Tibetan residents at the Qinghai-Tibetan Plateau. Clin. Chim. Acta, 411: 1466-1473. DOI: 10.1016/j.cca.2010.05.043.

CCTV news at 26 Mar. 2008, http://www.cctv.com/video/xinwenlianbo/2008/03/xinwenlianbo_300_20080326_27.shtml

Chia SS (1981). China's grassland types: The locality and improvements, in Proc. 14th Int. Grassland Congr. Lexingto, KY, pp. 598-600.

Cui J, Wang QZ (2002). Contributions of grassland productive factors to animal husbandry by path analysis. Land Inne. Mongolia, 4: 19-21.

Cui J, Wang QZ, Liu AJ, Shi HJ (2002). Path analysis on herdsmen's net income in Inner Mongolia. J. Inne. Mongolia Agri. Univ. Soc. Sci. Edit., 4: 7-10.

Dai AG (2004). Realizing the agriculture industry turns the valid increment in management agriculture herds people' s income. Tibetan Agri. Sci. Techn., 26: 11-14.

Du P (2007). Xobar Pintrue: All for increasing the income of farmers (herdsmen) in Tibet Autonomous Region. China Report, pp. 6-34.

Fan JH, Wu CY, Cheng GW (2006). Distribution characteristics and influencing factors of geological hazards in Tibet. Wuhan Univ. J. Nat. Sci., 11: 806-812.

He G (2004). Analysis on the way to enhancing the income of rural residents in Tibet. Tibetan Stud., 4: 102-111.

He XR, Li HX (2003). Analyses on farmers' Income structure at half animal husbandry half agricultural area of TiBet. Issu. Agric. Econ., 24: 65-68.

Jia W, Yang X (2009). A demonstration study on the influence of subsidies revenue of central government upon per capita net income of Tibetan rural resident – base on vector auto-regression model. J. Southwest National. Univ., 7: 6-11.

Law W, Salick J, Knight TM (2010). The effects of pollen limitation on population dynamics of snow lotus (Saussurea medusa and S. laniceps, Asteraceae): Threatened Tibetan medicinal plants of the eastern Himalayas. Plant Ecol., 210: 343-357. DOI::10.1007/s11258-010-9761-6.

Lhorong D (2006). A Study of the income of Tibetan peasants and herdsmen. China Tibetol., 1: 3-14.

Li XM, Liu H, Peng CZ, Zhong XH (2005). Dynamic dynamic changes of the farmers and herdsmen's income sources in the Tibet Autonomous Region. Wuhan Univ. J. Nat. Sci., 10: 745-750.

Li XM, Liu J, Zhong XH (2004). A study on income structures and sources of farmers (herdsmen) in the Tibet Autonomous Region. Geographic. Res., 23: 561-569.

Liu Q (2004). Discuss on increasing the income of the peasants under agricultural industrialization in Tibet. J. Tibet Nationalit. Institut. (Phil. Soci. Sci.), 25: 108-111.

Mojarradi GR, Zamani GH, Zarafshani K (2008). Analysis of factors influencing farmers' attitude toward private crop insurer using path analysis. Americ.-Eurasian J. Agric. Environ. Sci., 3: 247-2552.

Mulch A, Chamberlain CP (2006). The rise and growth of Tibet. Nature, 439: 670-671.

Namboodiri, NV (2006). Contributions of rural innfrastructure to agricultural income and rural poverty. Indian J. Agric. Econ., 61: 505.

Ran GR (2007). The status, problems and strategies of Tibetan agriculture and animal husbandry. China Tibetolog., 2: 18-24.

Roberts D (2005). The role of households in sustaining rural economies: A structural path analysis. European Rev. Agri. Econom., 32: 393-420.

Rowley DB, Currie BS (2006). Palaeo-altimetry of the late Eocene to Miocene Lunpola basin, central Tibet. Nature, 439: 677-681.

Shipley B (1997). Exploratory path analysis with applications in ecology and evolution. Am. Nat., 149: 1113-1138.

Spicer RA, Harris NW, Widdowson M, Herman AB, Guo SX, Valdes PJ, Wolfek JA, Kelley SP (2003). Constant elevation of southern Tibet over the past 15 million years. Nature, 421: 622-624.

Tibet Autonomous Region Statistic Bureau. Tibet Statistical Yearbooks, 1996, 2002, 2008 and 2009. China Statistic Publishing House, Beijing.

Tudor W (2002). A View on Increasing Income of Tibetan Farmers and Herdsmen. Tibetan Dev. Forum, 2: 25-26.

Wadsworth J (1993). Use of Causal Path-Analysis to Predict Optimum Extension Strategies - A Case-Study of Costa-Rican Livestock Producers. Agric. Syst., 41: 503-523.

Wang QZ, Han JG, Zhou H, Zhong Y, Liu FY (2004). Correlation and Path Coefficient Analysis between Seed Yield Components and Seed Yield on Bromus inermis L. J. Plant Genet. Resour., 5: 324-327.

Wang WC (2003). Base of Increasing Farmers and Herdsmen's Income and Tibet Anti-poverty: rural development. China Tibetol., 3: 3-12.

Wang XD, Zhong XH, Pan G (2010). A GIS-based decision support system for regional eco-security assessment and its application on the Tibetan Plateau. J. Environ. Manage., 91: 1981-90.

Wang X, Han J, Dong Y (2005). Recent grassland policies in China- an overview. Outlook Agric., 34: 105-110.

Whittaker A, Vazzana C, Vecchio V, Benedettelli S (2009). Evaluation of direct and indirect effects of flavonoids, mineral elements and dry weight on antiradical scavenging activity in leaf material of field-grown Trifolium pratense cultivars using Path Analysis. Field Crops Res., 113: 1-11. DOI: 10.1016/j.fcr.2009.04.001.

Wright S (1934). The method of path coefficients. Annu. Mathematic. Stat., 5: 161-215

Xu WD (2005). The situations, causes and management of the income difference of the Tibetan citizen and rural residents. J. Chongqing Technol. Bus. Univ. (West Forum), 15: 53-54.

Zhang HX (2003). Increasing the income of farmers (herdsmen) is a great duty for Building a Comprehensive Well-off Society in Tibet. Tibetan Dev. Forum, 6: 17-19.

Zhang ML, Fritsch PW (2010). Evolutionary response of Caragana (Fabaceae) to Qinghai- Tibetan Plateau uplift and Asian interior aridification. Plant Syst. Evol., 288: 191-199. DOI:10.1007/s00606-010-0324-z.

Zu X (2005). Modernisation of Tibet as part of the overall development of western China. China Tibetol., 1, 1-9.