Sustainable Development and Ending Poverty in Bashang: With the Observations for Thirty Years (C Case)

3. Growing Value of Blue Sky in 21st Century

3.1 Air Pollution Control and Duststorm in Beijing

Beijing was one of the top dirty cities in the world based on the observations of the Global Environmental Monitoring System of UN. Beijing ranked 5th in total suspended particulates (TSP) in 1980s, windblown dust accounts for 40% to 60%. The greatest proportion of TSP in Beijing is windblown dust and coal fly ash (Daisey et al. 1983). Since coal accounts for a large part of the total energy consumption, there exists a continuing background particulate load which increases significantly during the winter.

In 1993, Beijing failed being selected as host of the 2000 Olympic Games, to a certain extent, because of air pollution. In 2001, with the unbelievable effort in environmental improvement, Beijing launched a successful bid to host the 2008 Olympic Games.

Strong duststorms frequently occurred in North China during 1970s. As shown in Figure 3-1, somehow the number of dusts-blown days kept decreasing in 1980s. However, duststorms turned stronger and more frequently in the first few years this century. (Zeng et al. 2006) There were 11 duststorms in the spring of 2000. The strongest duststorm occurred on March 19-20, 2002, affected areas of 1.4 million km², including Gansu, Inner Mongolia, Ningxia, Shanxi, Shannxi, Hebei, Beijing, and Tianjin.

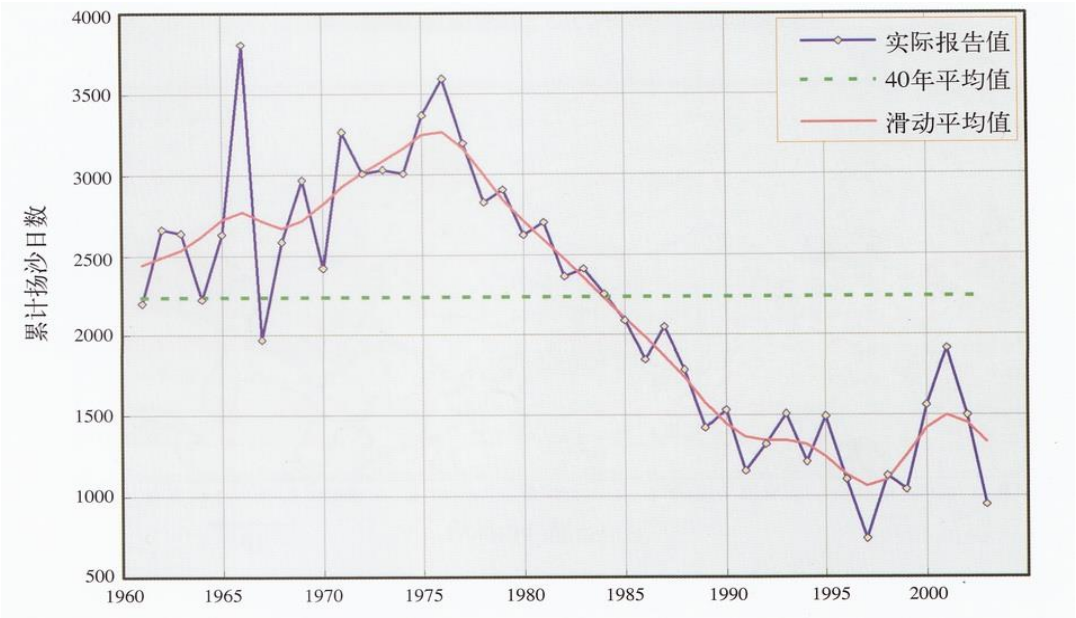

Figure 3-1 Dust Blown Days of 175 Weather Stations in North China (1961-2003)

From 1999 to 2005, as industrial emission decreased, wind-blown dust caused

serious pollution more frequently in Beijing. Suspended particulate was the primary pollutant in 96% observation days in Beijing. In April 2006, the falling dust of one duststorm in Beijing was about 330 thousand tons, (China Meteorological Administration 2006) which is 10 times of total industrial dust emission in 2005 in Beijing, according to Beijing Municipal Environmental Protection Bureau (2006).

After the countdown begun for the Beijing Olympic Games, consensus was formed for improving Beijing air quality by taking the following approaches:

1) Afforesting in upwind erosive areas including Bashang.
2) Reducing air pollution emission in Beijing
   - Replacing coal consumption by natural gas or electricity
   - Moving polluting factories out of Beijing
   - Increasing car emission standards
   - Preventing construction sites from blowing dust.

3.2 The Increasing Value of Blue Sky in Beijing

In 1996, 2000, and 2005, we organized students who took the course of Applied Statistics at Peking University to conduct three questionnaire surveys in Beijing respectively. The students visited 3200 Beijing urban or suburban households and completed more than 2000 questionnaires.

Since the respondents in all three surveys were selected based on probability sampling methods, the survey results can be used to statistically infer all Beijing urban or suburban residents. Survey questions were carefully prepared and focused on Beijing residents' feelings about government policies of environmental protection, traffic and transportation, housing, healthcare, public safety, education and employment.

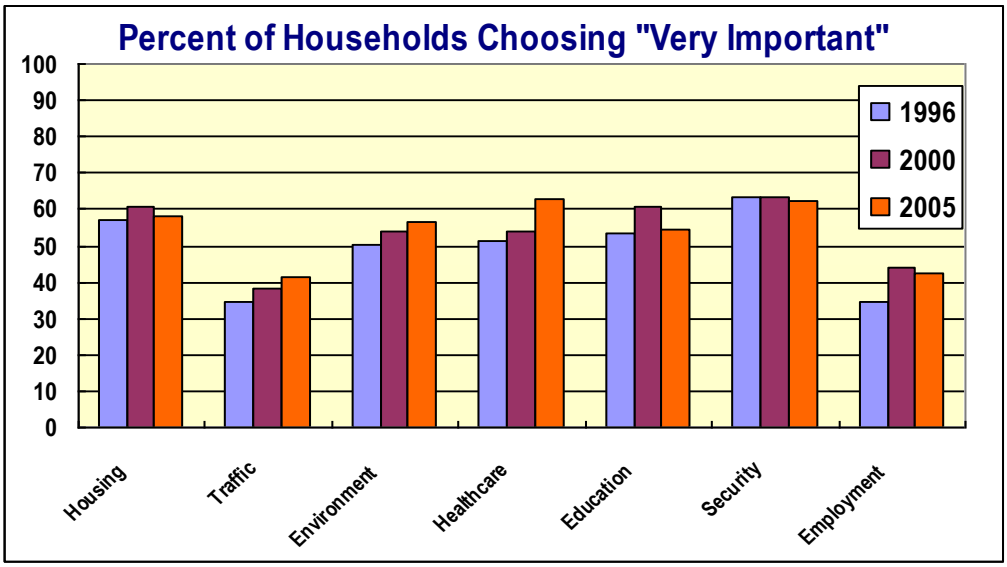

Figure 3-2 Percent of Beijing Households choosing "Very Important"

Figure 3-2 compares the 3 survey results and shows the increasing concerns of Beijing residents about healthcare, environment and traffic conditions during the past 9 years.

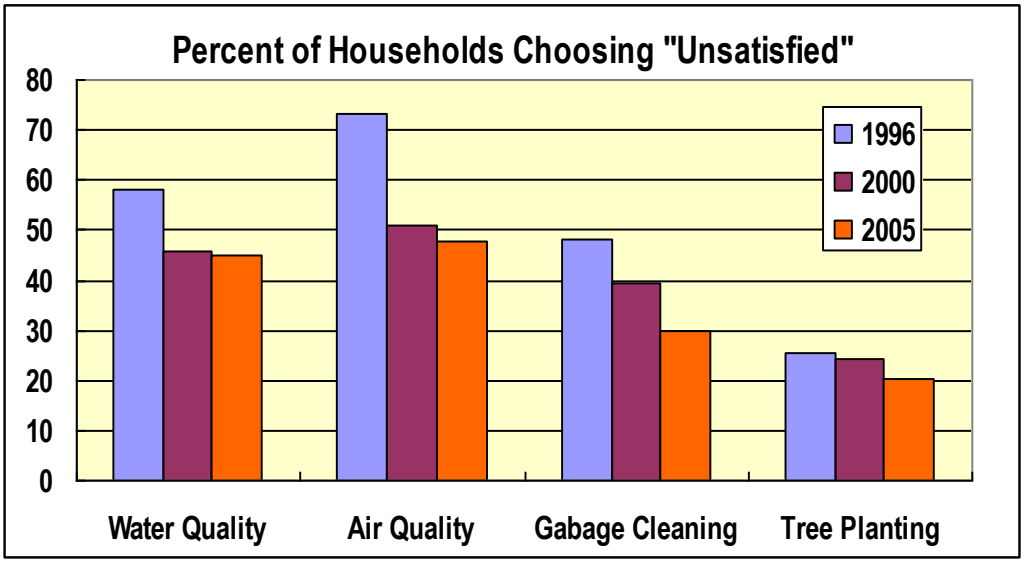

Figure 3-3 Percent of Beijing Households choosing "Unsatisfied"

The percentage of respondents who were unsatisfied with environmental quality decreased from 1995 to 2005 as shown in Figure 3-3. Beijing residents at that time recognized the air quality improvement and the government air pollution control efforts.

3.2.1 Factors correlated to WTP for Blue Sky in Beijing

Figure 3-4 compares the estimated willingness to pay (WTP) for air quality improvement in Beijing in 3 surveys in 1996, 2000 and 2005.

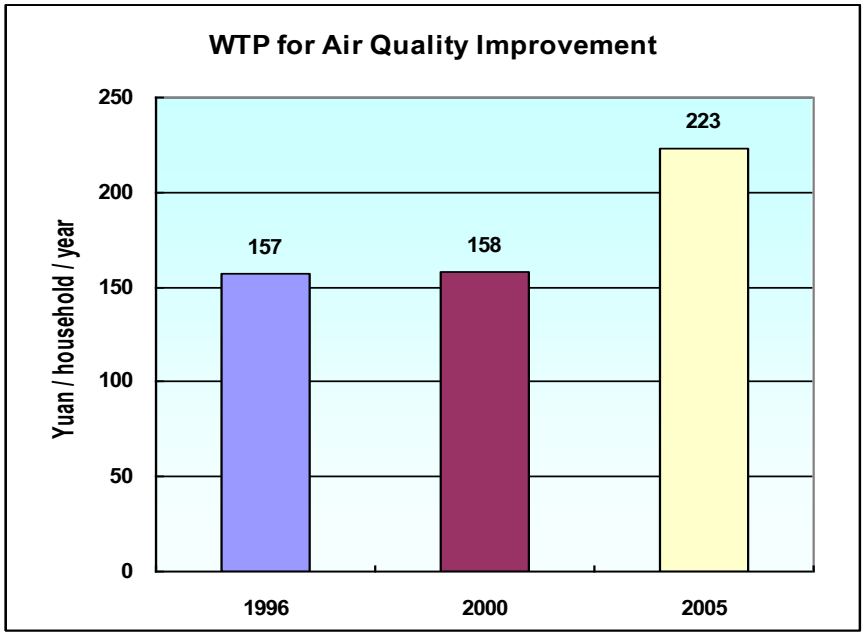

Figure 3-4 Estimated WTP for air quality improvement in Beijing in 3 surveys.

There is a 40% increase in the value of WTP in 2005. For further information about estimation of WTP, one may refer to Section 2.3 on detailed question about valuation of downwind air pollution.

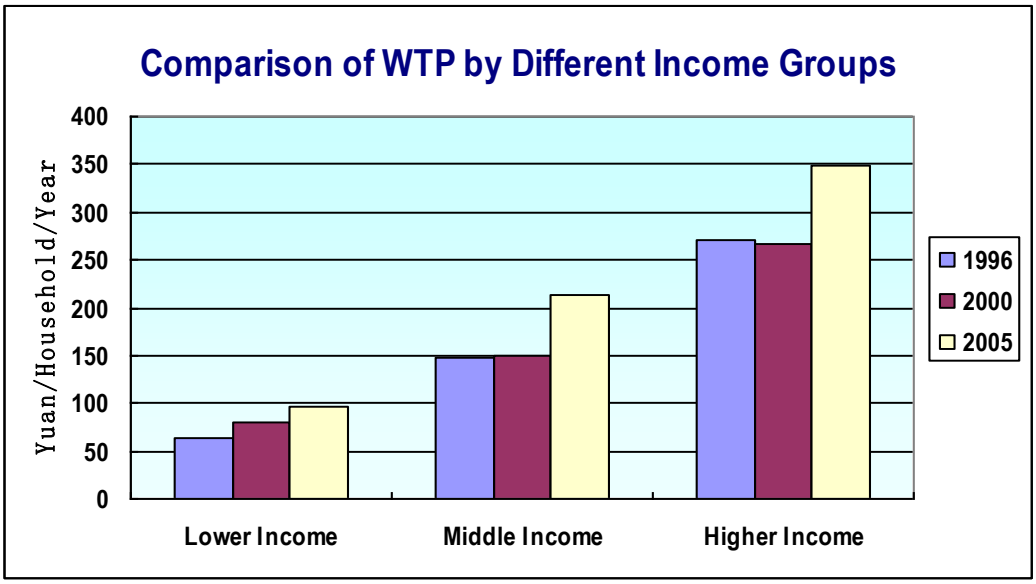

Figure 3-5 A Comparison of WTP among different income groups

In previously research results, WTP for air quality improvement would increase with households' income growth. The previous findings are consistent with the Beijing household survey data as shown in Figure 3-5.

To further study more factors that could be related to Beijing residents' WTP for air quality improvement, we developed a fixed effect regression model:

$$WTP = b_0 + b_1 INC + b_2 EDU + b_3 AGE + b_4 DUMMY00 + b_5 DUMMY05 + residues$$

Where, INC is household annual income, EDU is respondent's education years, AGE is respondent's age. In addition, we use two dummy variables to fix the effects of surveys in 2000 and 2005 respectively, with the survey in 1996 as a baseline.

Table 3-1 Regression results:

Variables	Estimate	t Value	p value
Income	0.011	4.26	<.0001
Education	18.497	5.16	<.0001
Age	-1.626	-2.32	0.0205
Dummy00	6.061	0.25	0.8045
Dummy05	10.138	0.36	0.7181

(Sample size N=1707, Adjusted R square =.0443)

The regression results shown in Table 3-1 can be explained as follows:

1) WTP for air quality improvement increases when household income increases, or respondent education level increases;
2) WTP for air quality improvement decreases as the age of respondent increases.
3) In comparison with the survey in 1996, there are increases of WTP for air quality improvement in 2000 and 2005. However, both increases are NOT statistically significant. The implication is that survey in different years may not significantly influence the value of WTP, with no change in other related variables.
4) It is worth to notice the limitations of regression analyses. Many factors affecting WTP for air quality have NOT been included in this simple model because there are not enough observations or have even not been identified.

It is possible to obtain hypothetical answers using questionnaire survey methods to value WTP for environmental improvement. We further compared the stated value with the revealed behavior of Beijing residents on environmental concerns in Table 3-2.

Table 3-2 Comparison of WTP with revealed behavior of Beijing residents

	1996	2000	2005
WTP for dust reduction (yuan/year)	157	158	223
Home air filters (%)	7	17	22.6
Home water filters (%)	10	36	64.9
Household Income* (yuan/month)	1825	2942	5375

* Nominal income

From 1996 to 2005, Beijing household income increases 194.5% while WTP increases 42%. In comparison, the percentage of home air filters increased more than 3 times and home water filters increased more than 6 times during the same time period. Hence, the WTP for air quality improvement in Beijing could be used as a conservative estimate for value of air quality improvement.

3.2.2 A benefit-cost analysis of changing energy consumption structure in Beijing

The total benefit of air improvement in Beijing can be estimated using the estimated WTP. The average annual WTP per household is 223 yuan according to survey in 2005, there are more than 2.2 million households in at that time 8 urban/suburban districts in Beijing. Thus, the total value of WTP exceeds 490 million yuan per year.

The total costs of the first project of transferring natural gas from Shanxi to Beijing is 3.3 billion yuan. Thus, the total costs of fuel structure changes construction can be exceeded by the total benefits of air improvement within 7 year.

It was reported that the second project natural transferring gas to Beijing finished in 2008 with the total cost of 8 billion yuan.

Figure 3-6 Construction of the second natural gas transferring project to Beijing.

3.3 Rapid Growth of Private Cars in Beijing during 2000-2010

In three Beijing household surveys conducted in 1996, 2000 and 2005 respectively, we asked the respondents whether their family have private cars. For those who do not have a car, we further asked if they have a plan to purchase a car within 5 years.

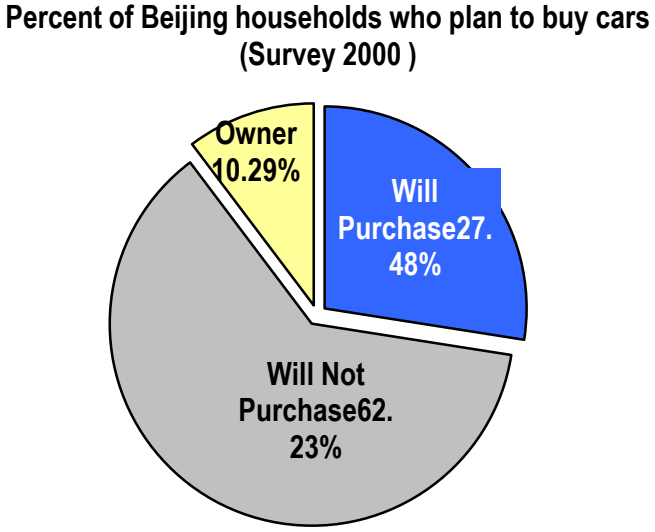

Figure 3-7 Percent of Beijing households who plan to purchase cars within 5 years

1) In 2000, there were 2.199 million households in Beijing urban & suburban area.

Based on the third survey results, we can estimated the number of households who own cars: 10.29% x 2,199,000 = 226,000

2) Predicted the number of households willing to buy cars within 5 years:

27.48% x 2,199,000 = 604,000

In fact, about 600 thousand personal cars were sold in Beijing urban and suburban areas from 2000 to 2004. On the average, 150 thousand personal cars were sold each year in Beijing. In comparison with the fact, the estimated figures have very small errors.

The third survey in 2005 shows 39.1% respondents have plan to purchase cars within 5 years. Thus, the predicted number of households who will buy cars from 2005 to 2010 should be:

39.1% x 2,199,000 = 857,600

However, from 2005 to 2010, the total number of vehicle registered in Beijing increased about 2 million that is more than twice of our survey based prediction. During that time period, changes in vehicle regulation of Beijing municipal government played a critical role in the rapid growth of car sales in Beijing.

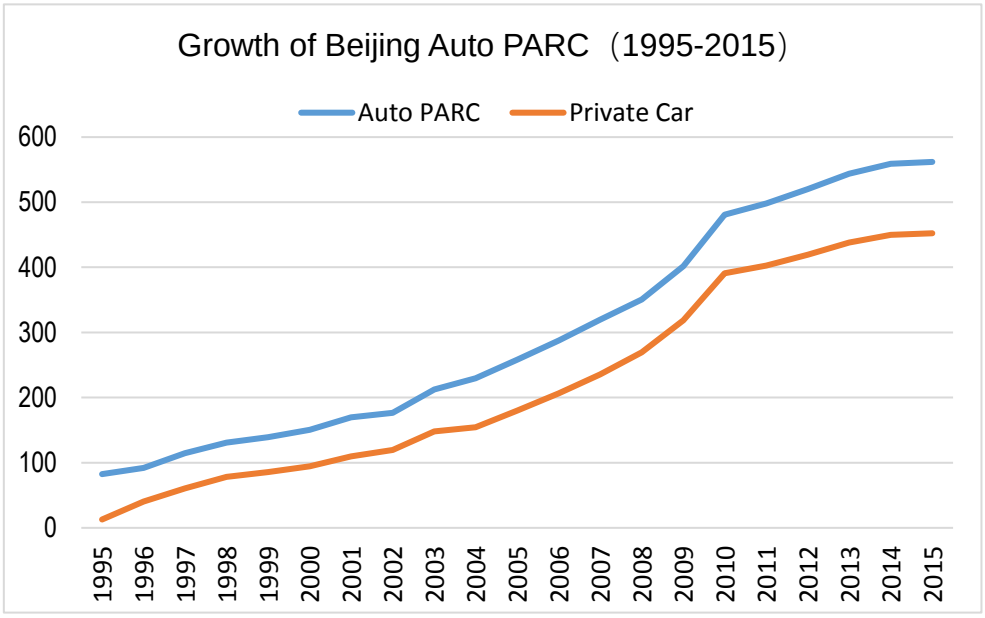

Figure 3-8 Growth of Beijing Auto PARC from 1995 to 2015

Before 2007, only Beijing residents allowed to register private cars in Beijing. In 2006, Beijing Auto PARC increased by 180 thousand. The year of 2007 is the first year when non-residents allowed to purchase and register private cars in Beijing. Beijing Auto PARC increased by 250,000 in 2007. Then, Beijing Auto PARC increased by 380,000 in 2008, by 510,000 in 2009 when traffic restrictions based on the last digit of license plate numbers, and by 750,000 by 2010 before implementation of lottery-based car registration.（Liu 2010）

For a long time, Beijing is one of the largest auto producers in China. The sales of automobile in 2010 reached 160 billion yuan, accounting for 26% of the total retail sales

of consumer goods. About 40% increase in retail sales of consumer goods attribute to automobile industry. (Liang 2012)

As a result of rapid growth of Auto PARC, car emission aggravates the concern of air pollution and gradually replaced the industrial emission and dust pollution to become the primary air pollutant in Beijing. In addition, the rapid growth of vehicles significantly increased the traffic block in Beijing and thus led to more serious emitted air pollutant.

On the other hand, travel become more convenient for the whole families since the percentage of Beijing households having private cars keep increasing. Nowadays self-driving travel to resorts in Bashang for sightseeing become very popular in weekends, especially during summer holidays.

3.4 Poverty Alleviation in Bashang

3.4.1 Trend of Rural Development in Bashang

In 2011, the Poverty Alleviation Office of the State Council announced a goal of nearly wiping out absolute poverty in 2020. The new poverty line is 2300 yuan of per capita income. In the 4 Bashang counties, over 662 thousand people, which accounted for 68.7% of rural population, were living below the poverty line in 2012.

Figure 3-9 shows in the long run there is an inverse U-shape curve of total area change of farmlands in Bashang, a rapid increase in 1950s and early 1960s with shortsighted cultivating grassland, gradual decrease from 1970s to 1990s to learn lessons from disrupting ecological balance, and a dramatic drop with returning cultivated lands to grasslands and forestlands from 2005.

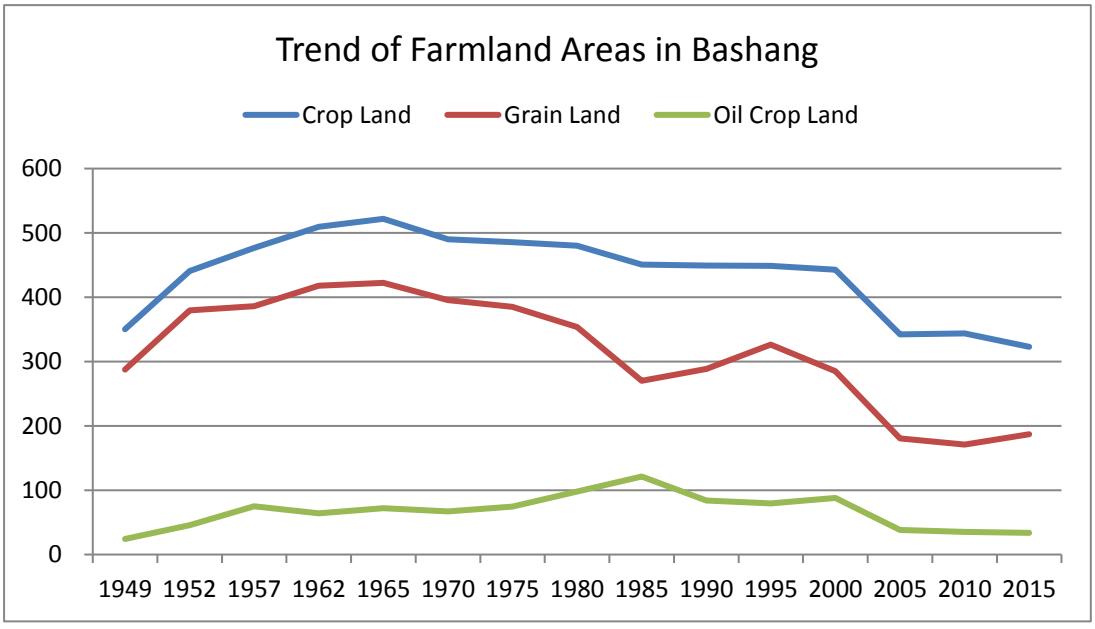

Figure 3-9 Trend of Farmland Areas in Bashang

In Figure 3-10, very large variation of total crop production reflects the sensitive weather-crop yield relations under the disturbed ecological system in Bashang. As the discussion in the end of Chapter 2, to keep the natural balance of the fragile ecological system in Bashang, it is not easy to find a way for rapid economic development and significant rural income growth.

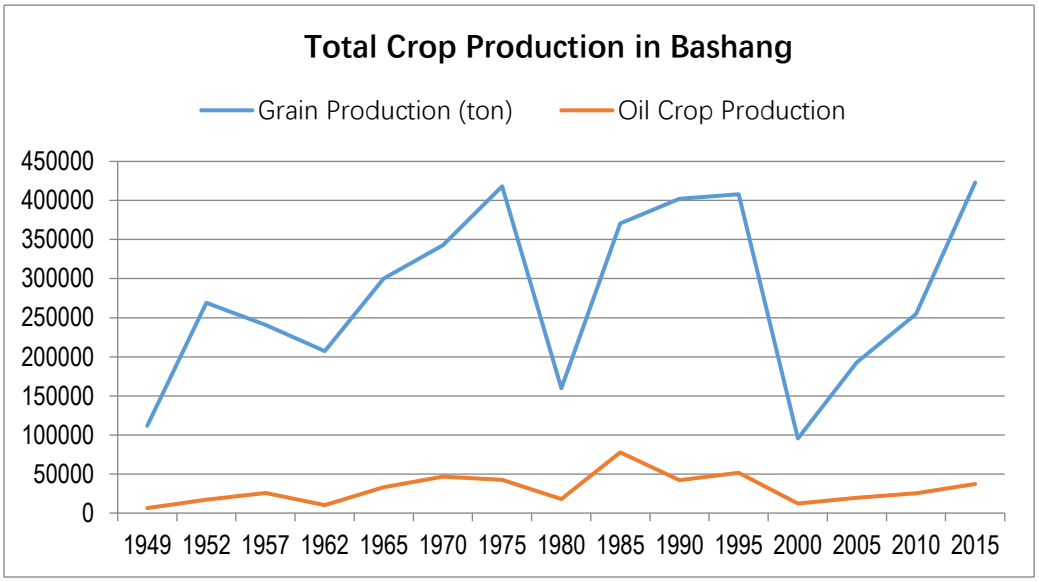

Figure 3-10 Total Crop Production in Bashang
Data Sources: 1) Zhao et al. 1997, 2) Statistic Bureau of Hebei Province.

Figure 3-11 demonstrates that in comparison with other rural regions of Hebei province and the nearby Inner Mongolia regions, the gap of rural net income per capita in Bashang 4 counties did not reduce during the past 10 years.

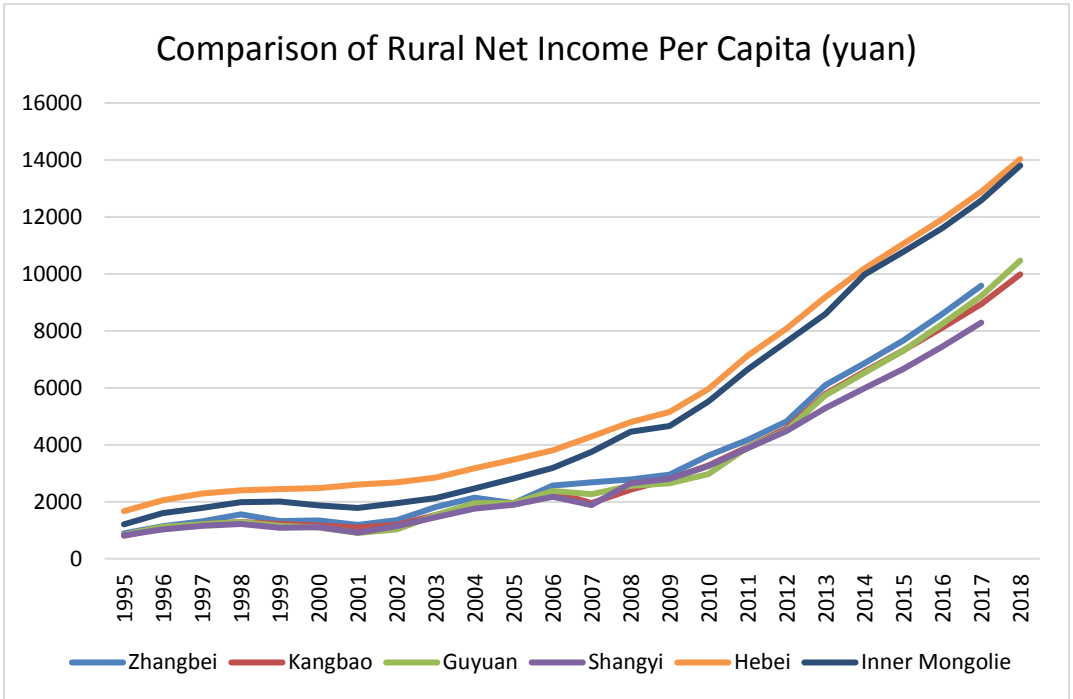

Figure 3-11 Comparison of Rural Net Income Per Capita

It is very difficult for development only to rely on agricultural production in Bashang. However, the natural environment and fragile ecological system provide no advantage in development of manufacturing production. To live a better life, to end poverty and to have sustainable development in Bashang, one should explore some other ways.

3.4.2 Tourism as an engine for Bashang development

Tourism is one of strong drivers of poverty alleviation in Bashang with rolling mountains stretching to the border of Beijing, rippling lakes and a clear river turning around vast grasslands. People getting rid of busy office block in Beijing and Tianjin would like to enjoy the Inner Mongolian dance and folk with a charming plateau pastoral scenery.

In 2018, Zhangjiakou city government announced a long term plan of tourism development, aiming to make the whole city a national tourism demonstration area in 2020, and to prepare an excellent service for worldwide visitors coming to watch the 2022 Winter Olympic Games.

According to the city long run development plan, the Bashang 4 counties will display its competitive advantages in plateau pastoral scenery to become a famous summer resort and a national demonstration area for grassland tourism.

At the same time, the Bashang counties are preparing to change the disadvantage of cold weather in winter into an advantage for development of ice and snow sports, especially take the opportunity of Beijing-Zhangjiakou Winter Olympic Games in 2022.

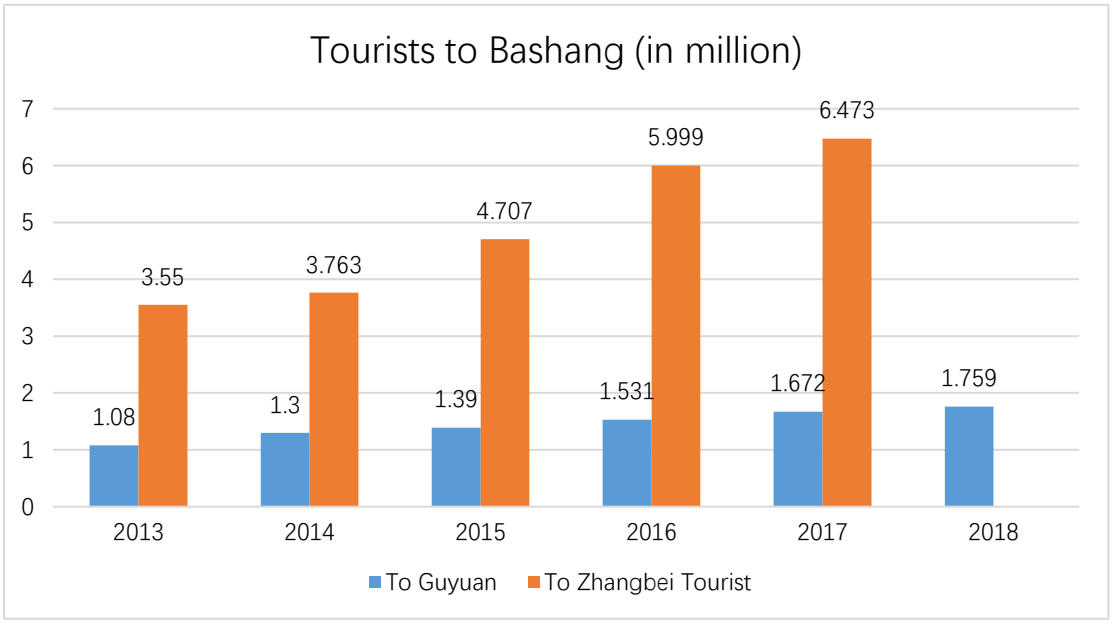

Figure 3-12 Tourists to Guyuan and Zhangbei in Bashang (2013-2018)

In recent years, local government efforts in marketing Bashang tourism achieved large amount of investment and significant improvement in tourism facilities. Bashang has attracted more and more tourists. Figure 3-12 shows the increasing tendency of tourists to Zhangbei and Guyuan from 2013 to 2018.

In 2018 more than 73.55 million tourists visited Zhangjiakou and created 85.94 billion yuan tourism income. In comparison of previous year, tourists increased by 17.5%, tourism income increased by 23.39%. The city government has set up an ambitious goal of attracting 100 million tourists and getting 150 billion yuan by the year of 2020, to help 100 thousand poor rural people to end poverty, most of them in Bashang counties.

Figure 3-13 Development of tourism and renewable energy in Guyuan County

3.4.3 Development of renewable energy resources in Bashang

Beijing-Tianjin-Hebei region is the most important urban agglomeration region in North China with more than 100 million population. In 2018, this region produces GDP of 8500 billion yuan, and consumes electricity of 537 TWh, most of which was generated by coal burning.

In 2013, the State Council announced a plan on air pollution control, and require Beijing-Tianjin-Hebei region keep reducing coal consumption and using more renewable energy. Therefore, there is a great demand for renewable energy provided from Bashang.

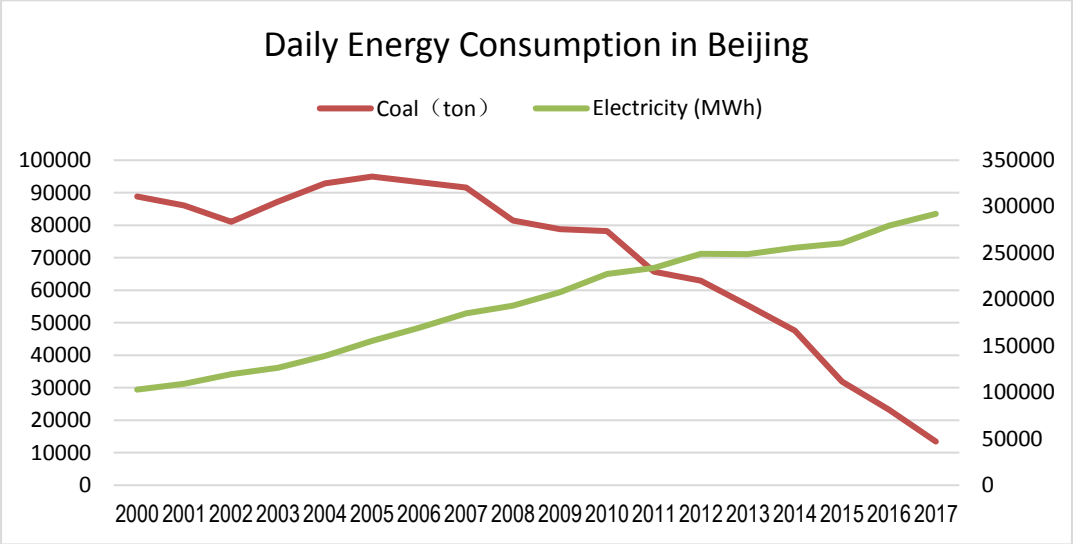

Figure 3-14 Daily energy consumption in Beijing from 2000 to 2017

Located in southeastern part of the Inner Mongolia Plateau, Bashang is the nearest region with very rich renewable energy resources. With the elevation from 1300 to 1700 meter above sea level, the landform of Bashang is generally flat plateau with some gentle slope terrain. The fluctuant terrain increases wind speed, the average annual strong windy days in Bashang is 63 days, with a record of 96 days. The annual average effective wind power reserve in Bashang 4 counties is greater than 1000 kW/m2, with greater than 50,000 of the annual effective wind power hours.

With scarcely populated degradation land and little industrial facilities, Bashang has its advantage in construction of large-scale wind farms and arrangement of electric transmission lines with relatively lower costs. In 2010, three 220 kV substations were constructed in Zhangbei, Kangbao and Shangyi, and one 500 kV substation was built in Guyuan, in favor of power grid access, and greatly supported the rapid growth of wind power installed capacity, as shown in Figure 3-15.

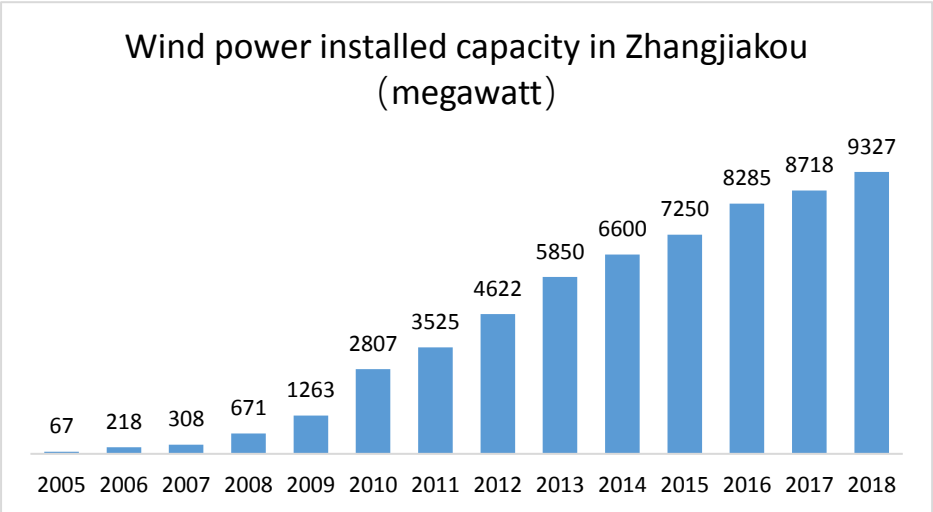

Figure 3-15 Wind power installed capacity in Zhangjiakou（MW）

Besides, the solar power resources are also very rich in Bashang with an estimate of more than 30GW. For example of Guyuan County, the range of annual sunshine hours is from 2616 to 3246 hours, with the average of 2764 hours. The annual total solar radiation in Guyuan County is 139.5 kcals/cm2, which can produce solar power 2GW. Therefore, Bashang is considered the best place for solar power development in Hebei province.

Table 3-4 renewable energy installed capacity in Bashang 4 counties (10MW)

	Wind Power Completed	Wind Power combined to the grid	Solar Power combined to the grid
Zhangbei	238	228	57.5
Kangbao	172.7	172.7	29.8
Guyuan	133	133	33.9
Shangyi	166.9	166.9	
Total	710.5	700.5	121.2

Data source: Survey to local government agencies,

According to our surveys to local government agencies in 2019, the most recent renewable energy installed capacity in Bashang 4 counties is listed in Table 3-4.

Approved by the State Council in 2015, Zhangjiakou City became the Ecological Conservation Area in Beijing-Tianjin-Hebei region, and was also named as the important renewable energy production base and electric transmission channel hub.

In 2018, the Zhangjiakou consumption of renewable energy accounts for 23% of its total terminal energy consumption, ranked first in China. This ratio will increase to 30% by 2020 according to the city development plan of renewable energy demonstration.

3.5 How to think of rural migration and population reduction?

Reclamation in Bashang area started about 100 years ago. In 1950s, population pressure drove more people to cultivate grasslands and forestlands. In 1980s, over-reclamation led to deterioration of ecological environment and a reduction in agricultural production. Since 1990s, great changes have taken place in Bashang. As a result of carrying out the project of Return Farmland to Grassland or Forestland in the beginning of this century, surplus rural labor started to transfer to urban area. This tendency continues and leads to rural population reduction in Bashang.

According to the results of fifth national census in 2000, rural residents account for 70.94% of the total migrants out of Hebei province, among the moving out population, 41% of them went to Beijing and 12.51% went to Tianjin. However, most of the rural

migrants moving to cities would still retain their rights of farmlands, and thus they could go back to do farm work during rural busy seasons (Duan et al.2008).

In 2003, a sample survey to 5056 rural households in Beijing-Tianjin-Hebei region indicated that 46.07% of rural households in Bashang and mountainous areas had migrants, this percentage was much higher than the average of 33.19% in Hebei province. Among total migrants, 60.23 % would move to Beijing.

When asked about the migration reasons, 85.29 % of respondents chose the option of "Get higher earning than farming work", 33.04 % of them chose "Have nothing to do at home", 23.82 % of them chose "Moving out to learn more skills". With the rural surplus labor, the incentive for migration is clearly to increase famers' income, especially in the poor rural areas such Bashang. (Shi et al. 2004)

The movement of the labor force from low income sectors to high income sectors has become the key motivation in Chinese economic growth and the main explanation of the migration from the poor rural areas to the large cities.

In Hebei province, more than 5.38 million farmers migrated to the urban areas from 2000 to 2010. Among them, 2.5 million went to manufacture industry, 1.4 million went to construction, 1.1 million went to work for sales and catering, and 400 thousand went to transportation, as shown in Figure 3-16.

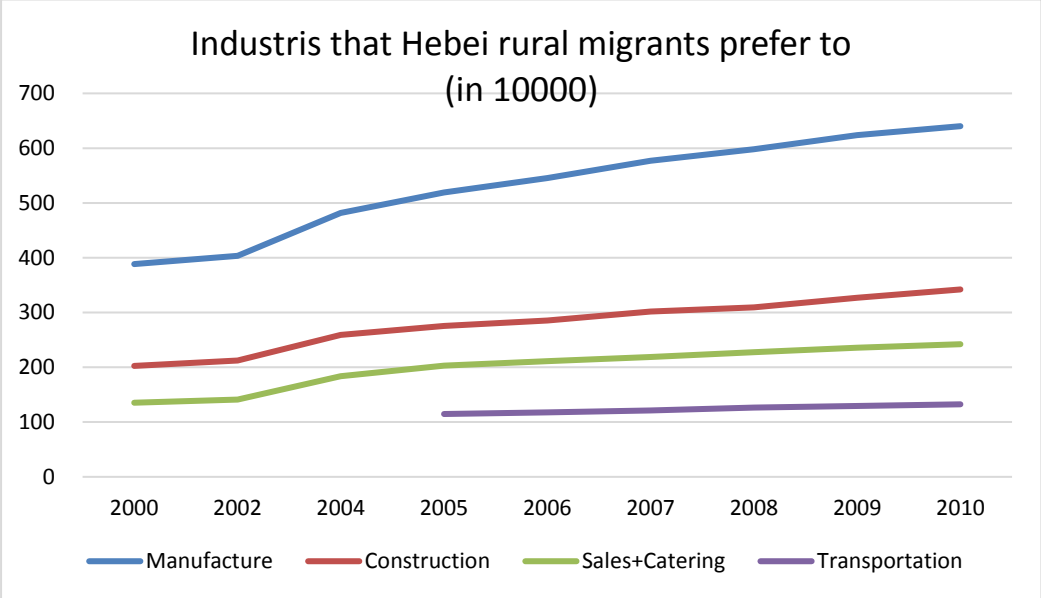

Figure 3-16 Hebei rural labor migration from 2000 to 2010

According to the "Report on the Development of floating population in China" announced by the National Health and Family Planning Commission in 2014, on average, rural migration households received annual income from working urban areas is 62,450 yuan, (Dai 2014) which is lower than 72,796 yuan of the average annual disposable

income of urban household, but much higher than 42644 yuan of the average annual income of rural household. (China Statistic Yearbook 2014)

A field study investigated 6 villages in Zhangbei County. Among 1117 rural residents of 413 households, only 520 uneducated residents and 185 households chose to stay home to farm. More than half rural residents migrated to the cities to seek better life. The average age of the farmers stayed home was older than 54 years. (Bi 2013)

How about the younger generation? Are they going back to rural areas in future? In 2013, 62.5% migrant population had their children of 6 to 15 years with them. The proportion increased by 5.2% in two year.

In 2013, China's "total floating population" was 245 million, accounting for 18% of the nation's total population. About 80% of the floating population migrated from rural areas to cities. More than 10 years ago, the migrant laborers consisted largely of poor, rural people moving to the cities in search of jobs, eventually returning home to raise a family.

But now migrant populations become increasingly diverse in terms of education and income levels. According to the most recent report, about 20% of them have college education and entering a more diverse range of industries and occupations. Of the new generation of floating population, 97.3% like the cities they are currently living, 95.3% pay attention to the change in their living cities, 93.3% would like to join the local urban residents. (Gan 2018)

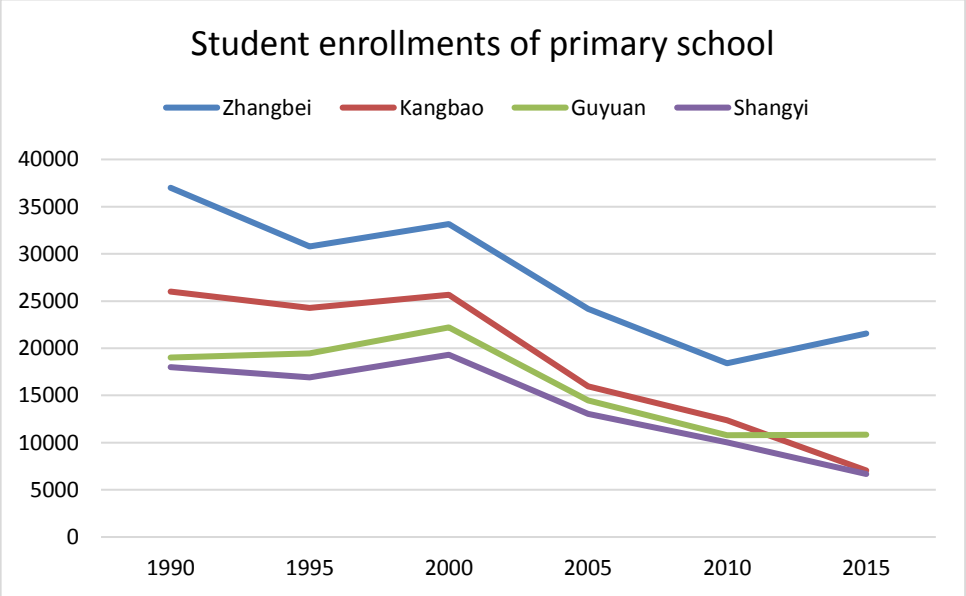

Figure 3-17 Enrollments of primary school in Bashang 4 counties

Figure 3-17 and Figure 3-18 indicates a tendency of reduction in student enrollment in primary schools and middle schools in Bashang 4 counties.

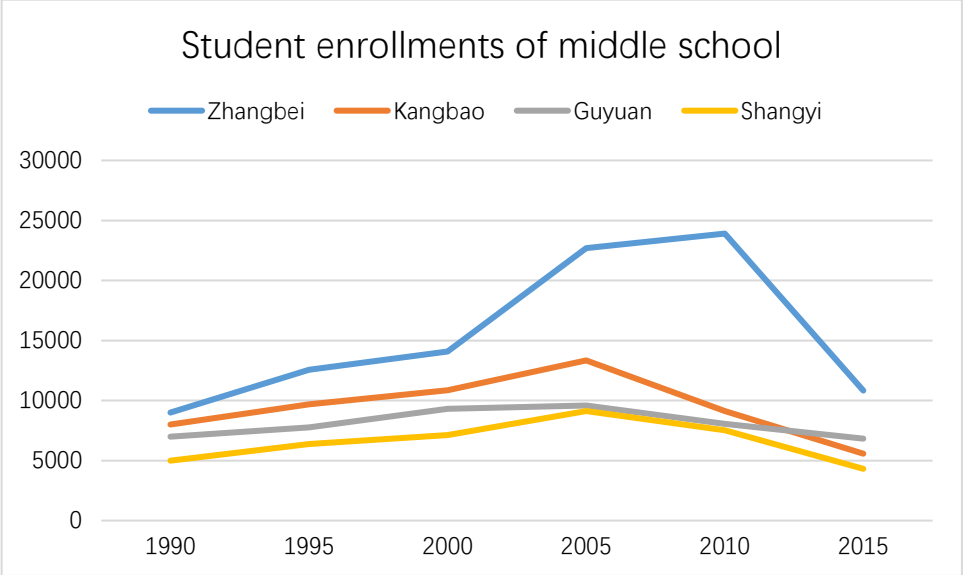

Figure 3-18 Enrollments of middle school in Bashang 4 counties

Metropolis such as Beijing, has the responsibility to help the nearly poor areas to end poverty. The rural poor migrants to the capital to support themselves and provide various services for urban residents should be regarded as poverty alleviation sent into the city. (Zhou 2017)

3.6 Concluding Remarks

Once the fragile Bashang ecological balance is broken, it needs much more time to recover. During last century, migrants went to cultivate grasslands in Bashang. However, their ignorance and misbehavior received the punishments from nature and destroyed their dream of a better life. Now moving more Bashang rural people down to urban areas could be the best choice, to return farmlands to grassland and forestlands and to end poverty for a long time.