Poverty and Social Assessment and Impact Evaluation
People’s Republic of China: Ningxia Liupanshan Poverty Reduction Rural Road Development Project

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Table of Contents

I. MAIN GEOGRAPHICAL FEATURES 3
II. POVERTY ANALYSIS AND SOCIAL ISSUES IN THE PROJECT REGION 4
   A. Methodology of Poverty Assessment 4
   B. Poverty Profile in the Project Counties 4
   C. Causes of Poverty 8
   D. Gender and Social Issues 8
   E. Outcome of the Field Study 8
III. ROAD ACCESS AND TRANSPORT SERVICES 10
IV. EXPECTED POVERTY IMPACTS OF RURAL ROAD IMPROVEMENTS 14
   A. Scientific Evidence from International Research 14
   B. Impact assessments from China 23
   C. Possible impacts expected by beneficiaries 25
   D. Summary 28
V. METHODOLOGY AND APPROACH OF THE IMPACT EVALUATION 29
   A. Rational and research questions 29
   B. Methodology of the impact evaluation 30
   C. Indicators for impact assessment 33
VI. KNOWLEDGE AND CAPACITY BUILDING NEEDS FOR PAOS 34
List of Figures

Figure 1: Share of Agricultural Value Added ................................................................. 3
Figure 2: Per Capita GDP in Project Counties ................................................................. 4
Figure 3: Income and Consumption in Project Counties ................................................. 5
Figure 4: Poverty Incidence in Project Counties ............................................................. 6
Figure 5: Percent of Designated Poor Villages in Project Counties ............................... 7

List of Tables

Table 1: Main Geographic Indicators of the Project Region ........................................... 3
Table 2: Features of poor villages in the Project counties .............................................. 6
Table 3: Number of Durable Consumer Goods Owned Per 100 Rural Households by City and Country (2013) ................................................................. 7
Table 4: External and internal access of poor villages ................................................... 10
Table 5: Travel patterns of rural households in the survey villages .............................. 11
Table 6: Marketing volumes and travel patterns in the survey villages ....................... 13
Table 7: Impacts of road condition on marketing and accessibility of social services ....... 27

Abbreviations

ADB  Asian Development Bank
PIMS  Poverty Information Monitoring System
PAO  Poverty Alleviation Office at the County administration
IVDP  Integrated Village Development Plans
I. MAIN GEOGRAPHICAL FEATURES

1. The program region includes seven counties: Haiyuan, Jingyuan, Longde, Pengyang, Tongxin, Xiji, and Yuanzhou. The whole region is hilly or mountainous with a relative low population density. Haiyuan and Tongxin have large land areas, while Longde and Jingyuan are small in size. The total population of Yuanzhou, Haiyuan, Xiji, and Tongxin is over 300,000 and the other three counties have population equal to or less than 200,000. Population density is much higher in Longde and Yuanzhou and exceeds 120 person/square kilometer (km$^2$). Tongxin, Haiyuan, and Pengyang have the lowest population density.

2. The majority of the population is in rural areas, especially in Haiyuan and Xiji. Yuanzhou and Tongxin are more urbanized. Ethnic minorities are highly unevenly distributed across the region. Over 70% of total population is ethnic minorities in Tongxin, Jingyuan, and Haiyuan, and the share of minority is less than one-third in Longde and Pengyang. Since the whole region is agriculture dominated, only a few industrial enterprises exist in the seven project counties (Table 1).

Table 1: Main Geographic Indicators of the Project Region

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Unit</th>
<th>Haiyuan</th>
<th>Jingyuan</th>
<th>Longde</th>
<th>Pengyang</th>
<th>Tongxin</th>
<th>Xiji</th>
<th>Yuanzhou</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relief</td>
<td></td>
<td>Hilly</td>
<td>Mountainous</td>
<td>Mountainous</td>
<td>Mountainous</td>
<td>Undulating</td>
<td>Hilly</td>
<td>Hilly</td>
</tr>
<tr>
<td>Land Area</td>
<td>km$^2$</td>
<td>6,377.64</td>
<td>1,442.67</td>
<td>1,268.24</td>
<td>3,238.31</td>
<td>5,666.70</td>
<td>4,000</td>
<td>3,501.01</td>
</tr>
<tr>
<td>Population</td>
<td>person</td>
<td>393,782</td>
<td>101,552</td>
<td>163,262</td>
<td>201,497</td>
<td>325,834</td>
<td>359,085</td>
<td>418,683</td>
</tr>
<tr>
<td>Rural Population</td>
<td>%</td>
<td>82.42</td>
<td>75.10</td>
<td>76.33</td>
<td>73.61</td>
<td>64.71</td>
<td>80.73</td>
<td>60.75</td>
</tr>
<tr>
<td>Minority Population</td>
<td>%</td>
<td>73.82</td>
<td>78.81</td>
<td>12.02</td>
<td>31.21</td>
<td>88.94</td>
<td>57.43</td>
<td>47.91</td>
</tr>
<tr>
<td>Population Density</td>
<td>person/km$^2$</td>
<td>61.74</td>
<td>70.39</td>
<td>128.73</td>
<td>62.22</td>
<td>57.50</td>
<td>89.77</td>
<td>119.59</td>
</tr>
<tr>
<td>No. of Industrial Enterprises</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>15</td>
<td>5</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>


3. Agricultural activities are dominated by farming, followed by animal husbandry, as depicted in Figure 1. While in Xiji, Yuanzhou and Haiyuan farming makes up more than 70% of the value added, in Tongxin and Jingyuan animal husbandry gains a larger importance. In the mountains of Jingyuan large forest are planted and the farmers grow small pine trees to be sold for the deployment in public parks.

Figure 1: Share of Agricultural Value Added

II. POVERTY ANALYSIS AND SOCIAL ISSUES IN THE PROJECT REGION

A. Methodology of Poverty Assessment

4. Poverty assessment was done by the county poverty alleviation offices (PAOs) with instructions from the national and provincial PAOs. The number of both national and provincial poor populations are estimated annually by the National Bureau of Statistics (NBS) using its national wide household survey data. The National PAO takes NBS estimation as the basis for poor people identification and assigns upper limits for each provinces to total number of poor people that should be identified. The provincial PAOs then assign quota for each county and county PAOs assign quota to each township and village for poor people identification.

5. The actual identification was carried out by the village committees using a method called public assessment. Leaders in each natural village nominate candidates of poor households and the village committee organizes meetings of villager representatives to discuss and determine the name list of poor households within the village. The whole name list will be made public in the village for transparency. If anyone questions the justice of the identification of some poor households, he/she can go to the village committee for reassessment. Voting is usually used as the last resort for settling the dispute.

6. Poor villages are also identified by the county PAOs with the quota set by provincial PAOs. Multiple criteria such as income, housing conditions, infrastructure, social services, income generation activities, and remoteness are used to identify poor villages.

B. Poverty Profile in the Project Counties

7. Ningxia identified a total of 702,600 poor people through a public nomination and approving process at the village level, which accounts for 17.4% of the total rural population. Some 1,100 villages have been designated as poor villages, accounting for 48.1% of the total administrative villages. Causes for poverty are multidimensional. Of the designated poor households, 10.7% is due to serious illness, 5.1% due to physical or mental disability, and 16.2% due to heavy education expenditure. A total of 15.1% of the poor people have difficulty to access safe drinking water and 29.6% of them live in unsafe houses.

8. Average gross domestic product (GDP) per capita in project counties was CNY12,778 in 2013 that is only 32.4% of Ningxia’s average and 30.5% of the national average. Economic development level measured by GDP per capita varies a lot within the project counties. Yuanzhou has the highest GDP level, and it is 1.2 times higher than that of Haiyuan (Figure 2).

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1 Ningxia PAO identified 702,600 poor people, but only 510,000 was included in the PIMS because NBS’s estimation is much lower.
9. Average net income and consumption per capita of the rural residents were CNY5,220 and CNY4,769 respectively. The income level of the project counties amounts to 75% of Ningxia’s average and 58.7% of the national average. The consumption level of the project counties is 73.5% of Ningxia and 72% of the national average. The differences in income and consumption are not substantial amongst the project counties (Error! Reference source not found.). Compared to per capita GDP, the gaps of both income and consumption both between the project areas and Ningxia, as well as between the project counties and the national average are much smaller, indicating decreasing inequality in terms of actual living standards. Out-migration for wage income is a common practice and has contributed greatly to narrowing the regional income gaps. Transfer of government revenues from the central to western provinces and from province to poor counties and large scale of poverty reduction intervention have also contributed to the equalization of living standard among rural residents.

Figure 3: Income and Consumption in Project Counties


10. Total rural population of the seven project counties is 1.93 million and the designated poor population reported by the county PAOs is 0.61 million with average poverty incidence of 31.7%. However, these reported poverty figures are much higher than statistics from the NBS and PAO. The total number of poor people is estimated for Ningxia in the national Poverty Information Monitoring System (PIMS) is only 0.51 million, which is less than the reported poor population in seven project counties. The national official poverty line used for rural poverty estimation is CNY2,800 per capita per year. The large discrepancies between the two estimations indicate that project counties exaggerated their poverty situations. Since poverty data in PIMS is more reliable, village level data from PIMS should be used to identify project villages. Among the project counties, Xiji, Yuanzhou, and Tongxin have higher poverty incidences, while poverty status of Jingyuan, Longde, and Pengyang are relatively better off.
There are 1,159 administrative villages within the project counties and 865 villages are designated as poor villages, which account for 74.6% of total administrative villages. Haiyuan, Pengyang, Xiji, and Jingyuan designated more than 75% of their villages as poor villages, while Longde and Tongxin designated less than 65% poor villages. The PIMS indicates that 16% of the poor villages have an annual income below CNY2,800, and 13% of inhabitants in poor villages receive minimum standard subsidies. The average income per capita in poor villages is between CNY3,000 and CNY4,600. Poor administrative villages have 4–7 natural villages in average.

### Table 2: Features of Poor Villages in the Project Counties

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Haiyuan</th>
<th>Jingyuan</th>
<th>Longde</th>
<th>Pengyang</th>
<th>Tongxin</th>
<th>Xiji</th>
<th>Yuanzhou</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of administrative villages(#)</td>
<td>141</td>
<td>84</td>
<td>70</td>
<td>122</td>
<td>100</td>
<td>238</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>Number of natural villages(#)</td>
<td>953</td>
<td>338</td>
<td>329</td>
<td>538</td>
<td>465</td>
<td>1507</td>
<td>753</td>
<td>6.8</td>
</tr>
<tr>
<td>Natural / administrative village</td>
<td>6.8</td>
<td>4</td>
<td>4.7</td>
<td>4.4</td>
<td>4.7</td>
<td>6.3</td>
<td>6.8</td>
<td>6.8</td>
</tr>
<tr>
<td>Number of population (#)</td>
<td>345,866</td>
<td>96,237</td>
<td>84,936</td>
<td>151,718</td>
<td>240,850</td>
<td>348,825</td>
<td>233,338</td>
<td>26,575</td>
</tr>
<tr>
<td>Number of poor population (#)</td>
<td>77,778</td>
<td>16,636</td>
<td>18,215</td>
<td>32,424</td>
<td>50,390</td>
<td>73,492</td>
<td>58,831</td>
<td>26,575</td>
</tr>
<tr>
<td>Number of persons receiving minimum living standard subsidy</td>
<td>39,573</td>
<td>12,429</td>
<td>13,096</td>
<td>16,967</td>
<td>23,839</td>
<td>58,472</td>
<td>58,472</td>
<td>26,575</td>
</tr>
<tr>
<td>Average income per capita (CNY)</td>
<td>0.00</td>
<td>5.00</td>
<td>10.00</td>
<td>15.00</td>
<td>20.00</td>
<td>25.00</td>
<td>30.00</td>
<td>35.00</td>
</tr>
</tbody>
</table>

Consultations with officials from the county PAOs and village leaders revealed that the selection of poor villages varies across counties and it is very subjective and not based on reliable indicators. County governments have annual plans to bring a certain number of poor villages and poor people out of poverty. In these plans, poor villages are usually the main targets of poverty investment and interventions. Integrated village development plans (IVDP) are launched for these targeted villages to promote community development and poverty reduction through infrastructure construction, social service provision, agro-business, and other income generation activities.
13. Road construction and upgrading are usually the main components of the infrastructure improvement. In the counties interviewed, investments in roads usually did not exceed 10% of the IVDP budget. Since often the annual funds are not sufficient to build an entire road, only sections are constructed.

**Figure 5: Percent of Designated Poor Villages in Project Counties**

14. Since income data tend to be unreliable, additional information about the endowment of households with consumer items deliver additional information. Table 3 shows that most counties range below the Ningxia average. While Haiyuan comes close to the province’s average or exceeds it in some cases, households of other counties such as Jingyuan, Pengyang, Tongxin, and Xiji have a worse endowment. The strongest deficits may be found among refrigerators, bicycles, motorcycles, and mobile phones.

**Table 3: Number of Durable Consumer Goods Owned Per 100 Rural Households by City and Country (2013)**

<table>
<thead>
<tr>
<th>County</th>
<th>Washing Machine</th>
<th>Refrigerator</th>
<th>Water Heater</th>
<th>Bicycle</th>
<th>Motorcycle</th>
<th>Telephone</th>
<th>Mobile Telephone</th>
<th>Color TV</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ningxia Average</td>
<td>90.7</td>
<td>64.9</td>
<td>30.4</td>
<td>37.8</td>
<td>90.7</td>
<td>20.5</td>
<td>263.5</td>
<td>117.5</td>
<td>19.8</td>
</tr>
<tr>
<td>Haiyuan</td>
<td>90.9</td>
<td>60.2</td>
<td>24.3</td>
<td>18.1</td>
<td>87.3</td>
<td>9.7</td>
<td>259.1</td>
<td>115.5</td>
<td>9.0</td>
</tr>
<tr>
<td>Jingyuan</td>
<td>89.1</td>
<td>28.3</td>
<td>39.3</td>
<td>3.6</td>
<td>53.8</td>
<td>21.4</td>
<td>222.8</td>
<td>99.4</td>
<td>5.9</td>
</tr>
<tr>
<td>Longde</td>
<td>91.7</td>
<td>41.5</td>
<td>29.0</td>
<td>8.1</td>
<td>59.3</td>
<td>30.5</td>
<td>287.9</td>
<td>127.7</td>
<td>16.7</td>
</tr>
<tr>
<td>Pengyang</td>
<td>78.5</td>
<td>27.6</td>
<td>31.8</td>
<td>17.0</td>
<td>80.9</td>
<td>16.5</td>
<td>230.6</td>
<td>101.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Tongxin</td>
<td>80.3</td>
<td>62.0</td>
<td>38.7</td>
<td>32.5</td>
<td>94.0</td>
<td>6.9</td>
<td>241.4</td>
<td>98.9</td>
<td>9.6</td>
</tr>
<tr>
<td>Xiji</td>
<td>83.9</td>
<td>47.1</td>
<td>17.9</td>
<td>14.3</td>
<td>95.0</td>
<td>26.1</td>
<td>238.3</td>
<td>106.9</td>
<td>15.3</td>
</tr>
<tr>
<td>Yuanzhou</td>
<td>88.9</td>
<td>56.2</td>
<td>9.5</td>
<td>35.9</td>
<td>90.4</td>
<td>28.9</td>
<td>256.2</td>
<td>113.2</td>
<td>19.4</td>
</tr>
</tbody>
</table>


---

2 This statistic relates to all households, not only poor households.
C. Causes of Poverty

15. Causes of poverty are multidimensional. Based on data provided by PAOs of the project counties, the most important causes for poverty is insufficient access to credit that prevents poor farmers to increase their agricultural production and to generate non-agricultural income. Illness, medical expense, and lack of labor and skills are major determinants of poverty. Bad road conditions also affect some poor households via limiting transportation of products and increasing transportation cost.

D. Gender and Social Issues

16. Field visits reveal that in project counties households depend heavily on migration and wage income for their living. Men are more likely to migrate out to work in cities in Ningxia and nearby provinces such as Gansu, Qinghai, Shaanxi, and Inner Mongolia. Women and children are left behind in rural areas in about 8 months of the year. Women have to take all the housework, engage in most of the farming activities, and raise livestock. Hard work is unavoidable in certain times of the year, especially the harvesting seasons. Road improvement can greatly reduce the workload of the women who are left behind.

17. Electric motorcycles are widely used by women in the project area for commuting purposes. Unpaved roads not only slow down the speed, but also reduce the life span of the vehicles. When there are rains or snow, unpaved roads are not passable for electric motorcycles and ambulance in times of emergency.

18. Good roads are very helpful to primary school children who need to go to school every weekday. Primary schools usually locate in the same villages with no boarding facilities.

E. Outcome of the Field Study

19. The field study was conducted in six villages, two villages in each county (Tongxin, Xiji, and Jingyuan) we visited during the mission. Village level data on geography and demography, poverty status, road networks, and accessibility from the natural villages was collected from the village leaders. In depth group discussion with village leaders, representative poor households and women were organized to collect information on a wide range of issues including poverty, agricultural production and marketing, road use, condition and maintenance, and possible impacts of road improvements on natural village, poor household, and women. Some important findings of the field study are discussed below.

20. Incidences of poverty range between 14% and 51%, with Gaozhao village the highest poor population share and Xipo village the lowest in Xiji (Figure 7). The most important causes for poverty are illness, lack of labor due to disability and elderly, and lack of land.
21. Since poor household identification is very subjective and hard to compare across villages, information on durable goods and access to electricity, telecommunication, safe drinking water, and clean toilets are important indicators of living standard. Almost all households in these six villages have access to electricity, telecommunication (mobile phone), and television. Access to clean toilets is a serious issue in these six villages. In addition to Longtan village in Jingyuan county where about half of the households have clean toilets, all other villages have no access to clean toilets. Possession of other durables such as refrigerator, washing machine, water heater, and motorcycles varies a lot across villages. The majority of households possess motorcycles (more than 90% beside in Gaozhao) and washing machine is common in three villages (Fengchuan, Longtan, and Hongqi). More than half of the households in four villages do not have refrigerators and water heater is widely used in Jingyuan County, but not in other counties. Safe drinking water is not an issue in Jingyuan County, but a serious issue in Xipo village in Xiji County (Figure 8).

22. Agricultural production varies according to ecological and land resources in each village. Potato, corn, and millet are commonly grown in most villages, and cattle and sheep are raised in every village. Cash crops and tree nursery are practiced in some villages. Marketing of the above product differs across both village and products. Cash crops and trees are 100% sold out.
Marketing share of cattle and sheep are also high (50%–100%). Over 80% of produced potatoes are marketed in Xiji where potato is the main agricultural product, while less than 50% of potato are sold in Tongxin and Jingyuan.

23. Wage income from migrants is an important source of income. As shown in Figure 9, more than 50% of laborers in two villages working outside the village for more than 6 months in a year and 30%–50% of laborers work outside in three other villages.

![Figure 9: Proportion of Laborers Working Outside the Village for More than 6 Months in a Year](image)

III. ROAD ACCESS AND TRANSPORT SERVICES

24. The PIMS database gives an overview on the accessibility of poor villages. The external access describes accessibility from the administrative village to the town. Eventhough according to the transport bureaus all administrative villages have paved road access, 54% of the poor villages still have unpaved roads that are connecting to the town. This means, in many cases either an unpaved road or a detour has to be used to reach the next town. This implies that there is considerable potential for village road improvement, in the order of 3.000 km.

25. Another important feature of accessibility is the availability of bus services. At present, only 44% of the poor villages are supplied with bus services. Transport in the remaining villages is either done by private vehicles or informal collective transport. About 54% to 94% of the households possess and own a motorcycle, which will be used to transport passengers. Nevertheless, to transport children to school will require considerable time and might be impossible during bad weather conditions.

<table>
<thead>
<tr>
<th>Table 4: External and Internal Access of Poor Villages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All administrative villages</strong></td>
</tr>
<tr>
<td>Number of administrative villages</td>
</tr>
<tr>
<td>Number of natural villages</td>
</tr>
<tr>
<td>Number of natural villages unconnected by paved road</td>
</tr>
<tr>
<td>Total length of unpaved natural village roads</td>
</tr>
</tbody>
</table>
26. Internal access is another important issue to describe the accessibility of poor villages. As PIMS database states, more than 2,000 natural villages have no paved access to the administrative center, which amounts to 42% of all natural villages. Since the average unpaved road length amounts to 3.6 kilometers (km), the potential for improvement amount to more than 6,500 km, which is more than double of the potentials for village roads.

Table 5: Travel Patterns of Rural Households in the Survey Villages

<table>
<thead>
<tr>
<th>Destination</th>
<th>Tongxin County</th>
<th>Xiji County</th>
<th>Jingyuan County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearest town</td>
<td>1.5 km, motorcycle, 20 mins</td>
<td>10 km, motorcycle, 40 mins</td>
<td>7 km, motorcycle, 60 mins</td>
</tr>
<tr>
<td>County capital</td>
<td>3 km, motorcycle, 40 mins</td>
<td>15 km, motorcycle, 60 mins</td>
<td>45 km, bus, 180 mins</td>
</tr>
<tr>
<td>Next local and regional market</td>
<td>1.5 km, motorcycle, 20 mins</td>
<td>15 km, motorcycle, 60 mins</td>
<td>7 km, motorcycle, 70 mins</td>
</tr>
<tr>
<td>Nearest primary school</td>
<td>1 km, walk, 40 mins</td>
<td>0.1 km, walk, 10 mins</td>
<td>3 km, walk, 60 mins</td>
</tr>
<tr>
<td>Nearest middle school</td>
<td>3 km, car, 40 mins</td>
<td>10 km, motorcycle, 40 mins</td>
<td>7 km, motorcycle, 70 mins</td>
</tr>
<tr>
<td>Nearest high school</td>
<td>3 km, bus, 40 mins</td>
<td>15 km, motorcycle, 60 mins</td>
<td>45 km, bus, 180 mins</td>
</tr>
<tr>
<td>Nearest hospital</td>
<td>1.5 km, motorcycle, 20 mins</td>
<td>10 km, motorcycle, 40 mins</td>
<td>4 km, motorcycle, 30 mins</td>
</tr>
<tr>
<td>Major places of employment</td>
<td>3 km, motorcycle, 40 mins</td>
<td>15 km, motorcycle, 60 mins</td>
<td>45 km, bus, 180 mins</td>
</tr>
</tbody>
</table>

27. Presently, no actual information about the travel patterns of rural households in the project area is available. To get an impression about the transport activities, a field study in six villages in the Tongxin, Xiji, and Jingyuan counties was conducted (see chapter II.E). Important results are subsumed in Table 5.
(i) The county capital is up to 3 hours away. For distances under 1 hour, a motorcycle is used, for the other trips a bus.

(ii) The nearest town can be reached within 20–60 minutes mainly by motorcycle and in only two cases by bus. The motorcycle is mostly used as well to reach the next local market, which is 10 to 70 minutes away.

(iii) The primary school is often in the village, but for two cases requires a 2–3 km walk. Middle schools are up to 30 km away and the motorcycle is mostly used to reach the school. Travel patterns to high and middle schools are of lower importance, since they are boarding schools and travel only occurs in the weekends.

(iv) The nearest hospital is 10–60 minutes away and mostly reached by motorcycle.

(v) The distance to the major places of employment vary considerably among the survey villages: While in four villages the distance is below 15 km and daily commuting is possible, the remaining two villages can only reach places of employment within 3 hours bus travel.

28. Transport of agricultural products to the market is one of the main bottlenecks for local development. The field survey revealed that the villages market considerable amounts of agricultural products as listed in Table 6. The amounts per village can reach 2,000 tons of potatoes, 800 cattles, 7,000 sheeps, and 900 pine trees. In two cases, the village markets all their products directly through traders that enter the village with their vehicles. None of these villages report roads that are impassable during rains, while the remaining four villages report transport constraints of 11 to 30 days per year, especially during the rainy season where up to 3 days per month the roads are not passable.
Table 6: Marketing Volumes and Travel Patterns in the Survey Villages

<table>
<thead>
<tr>
<th>Destination</th>
<th>Tongxin County</th>
<th>Xiji County</th>
<th>Jingyuan County</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fengchuan Village</td>
<td>Shengou Village</td>
<td>Xipo Village</td>
</tr>
<tr>
<td></td>
<td>sheep:7,200</td>
<td>potato: 90 ton, cattle:200</td>
<td>sheep:2,400</td>
</tr>
<tr>
<td>How are these products marketed?</td>
<td>traders</td>
<td>red onions: local market, cattle and sheep: direct</td>
<td>potato and millet: direct; cattle and sheep: traders</td>
</tr>
<tr>
<td>Means of transport</td>
<td>three-wheel agrimotor or motorcycle</td>
<td>three-wheel agrimotor or motorcycle</td>
<td>three-wheel agrimotor or motorcycle</td>
</tr>
<tr>
<td>Travel time [min/trip]</td>
<td>60</td>
<td>180</td>
<td>140</td>
</tr>
<tr>
<td>No. trips to market [trips/year]</td>
<td>1,500</td>
<td>1,200</td>
<td>2,000</td>
</tr>
<tr>
<td>Cost of transport to market [CNY/trip]</td>
<td>30</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Cost market transport [CNY/year]</td>
<td>45,000</td>
<td>72,000</td>
<td>100,000</td>
</tr>
<tr>
<td>How does the road condition affect seasonal transport activities and accessibility?</td>
<td>In rainy season (May-Sep), 3 days/month unpassable, which affects cattle and sheep marketing.</td>
<td>In rainy season (May-Sep), 2 days/month unpassable, which affects cattle and sheep, red onions marketing.</td>
<td>In rainy season (Jun-Sep), 2 days/month unpassable, which affects cattle and potato marketing.</td>
</tr>
</tbody>
</table>

29. The remaining four villages bring their products by motorcycle or tricycles with a payload of 1 ton (agrimotor) to the local market. The travel time to the market ranges between 40 minutes and 3 hours. For marketing, a considerable amount of time is needed, since up to 2,000 trips are needed annually per village. Direct marketing involves considerable transport costs that range between CNY24,000 and CNY100,000 per village and year ($3,800–$15,600). These costs could be reduced considerably if traders using larger vehicles would enter the village. The example from Gaozhao village (box below) shows which impacts transport improvement may have on the overall transport costs.
Village Visit in Gaozhao

30. Gaozhao is an administrative Village in Xiji County with 1,775 inhabitants (263 households) that live in nine natural villages, of which three have a paved road access. The total length of natural village roads amounts to 28 km, of which 8 km need paving.

31. The earth roads are built on clay soil from loess that becomes slippery during rainfalls. Xiji has between 4 (November) and 13 (July) rainy days per month. During this time, passenger vehicles, trucks, and ambulances are not able to pass the unpaved roads. About 12 hours after the last rainfall, the road was passable again by four wheel drive and motorbikes. Nearly every household possesses a diesel-driven tricycle with a load capacity of 1,000 kg that is able to pass the road even during rains. Maintenance of the roads is done by the villagers.

32. The village is located in an area that has annual rainfalls of 318 mm and the extremely fertile loess soils provide an excellent basis for agricultural production. Gaozhao is growing agricultural products such as potatoes, millet, maize and sunflowers, and some animal breeding. The annual amount harvested is estimated at 4,500 tons, of which two-thirds are sold in markets, the rest is used for subsistence consumption. The main market is Xiji, which is 45 km away, which is reached by private tricycles. Due to the road condition, no private traders are entering the village. Therefore, annually 4,500 trips with the tricycles are needed to Xiji town to sell the harvest. Given that the natural roads are improved and traders could access the natural villages with a 10 ton truck, the number of trips would be reduced.

IV. EXPECTED POVERTY IMPACTS OF RURAL ROAD IMPROVEMENTS

A. Scientific Evidence from International Research

33. In the last 20 years, a considerable number of studies have been undertaken assess the impacts of rural roads. An overview on the impact studies is given in the annex. The studies found various impacts on

(i) Transport Improvements: Improved markets, health services, school enrolment and completion, visits by other social services, transport services and transport costs; and

(ii) Social and economic impacts: marketing activities, income, wages, consumption, non-farm employment, agricultural production, effects on poverty, effects on women.

34. The German Financial Cooperation with Cambodia (KfW 2013) conducted a major impact assessment study about their Rural Infrastructure Program (RIP) II in Bangladesh and observed a number of positive effects.

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(i) An average increase of 197% on annual household income among respondents across nine influence areas;
(ii) A reduction of about 37% on total annual household transport cost;
(iii) A reduction of about 15% on the average “unit transport cost”;
(iv) A reduction of 56% on average transport time;
(v) An increase of 86% on average daily traffic along the program roads with 139% increase for motorized vehicles;
(vi) A small but relevant increase of 0.65% on primary school attendance;
(vii) A remarkable increase of 26% on the lower secondary school attendance, as well as an increase of 16% on the upper secondary school attendance;
(viii) More people are availing the health services from the health centers, the record showed an increase of 36% in total average;
(ix) Agricultural production has the following increases, rice (11%), grains (4%), cassava (146%), fruits (16%), and vegetables (23%); and
(x) Almost three quarters (74%) of the respondents in the household survey perceived that the good roads have helped in the marketing of their products and in the improved flow of goods into the villages.

1. **Impacts on Agricultural Production and Marketing**

35. Starkey and Hine 2014 conducted a large-scale literature review on transport and poverty assessing 360 documents on transport. They resume their findings as follows: “Most rural communities depend on agriculture (including crops, livestock, fisheries and forestry) for subsistence and income generation. There are numerous research studies and several wide-ranging reviews that demonstrate how improving rural access has led to increased agricultural production, lower costs for farm inputs and lower transport costs for marketed outputs. Studies in Ethiopia, India and Nicaragua showed increased fertiliser use, higher yields, enhanced production, employment, living standards and poverty reduction. The effects of improved rural transport on agriculture and poverty can be complex. Better road access leads to price changes in inputs and outputs and may affect cropping patterns, land prices and land ownership. It also provides various new opportunities for employment, immigration and emigration. How individual poor households are affected depends on local circumstances. People with resources are most able to adapt to changing market conditions and economic opportunities.

36. With agriculture being the main source of income in rural areas, impacts of rural roads on agriculture are most important. In India the large rural transport programme, was researched by Mohapatra et al (2007). The programme made it easier to transport agricultural inputs to villages which has led some farmers to switch from food crops to cash crops (such as ginger, jute, sugarcane, sunflower). Similar results were observed in West Bengal were agricultural productivity increased that helped raising income levels and expanding household consumer choices among poor farmers (Raychudhuri, 2004).

**Transport Induced Local Market Development**

37. The above findings confirm the hypothesis of TILD (Transport Induced Local Market Development) through the improvement of rural roads. Ren Mu and Dominique van de Walle (2009) researched the rural roads and local market development in Vietnam and found “significant average impacts on the presence and frequency of markets and on the availability of various services.”
38. In Afghanistan USAID (2006) rehabilitated 49 rural road segments within the Rebuilding Agricultural Markets Program (RAMP). As an effect of this programme, the volume of net surplus exported from the treated villages increased, farmers got better prices for their products as they were able to transport their products to main markets and sell at competitive prices. This suggests that opportunities for commercialization of agriculture in the 2km zone of influence were far better with rehabilitation of the roads.

Impacts of Rural Roads in Afghanistan

39. Though not quantified due to lack of time, observations during the survey and PRA interactions with local informants indicate that the roads have also improved access to people traveling to district agriculture departments and medical centers. Survey data also revealed that farmers are able to procure farm inputs with great ease from nearby cities. Local shops are fully stocked with merchandise items and prices are reasonable. A number of new economic initiatives have also sprung in some locations, like mills and workshops. Although it is difficult to attribute these developments entirely to the rehabilitation of roads, it is quite clear that the roads have provided the impetus for increased agricultural output and incomes.

40. Evidence from Kivu Region in Eastern Kongo (Ferf 2014) shows, that rural roads play a role in the economic growth of central road-side villages (hubs), in particular through the growth in numbers of restaurants and shops. Roads stimulate the demand for construction materials from rural areas (brick and wood), mainly driven by the booming construction sector. Respondents in this study observed a significant increase in the supply of consumer products and inputs at the markets as a consequence of road improvement, including salt, flower, vegetable oil, dried fish, medicines, clothes, mattresses and construction materials such as nails, locks and metal sheets. To a lesser extent, they also observed increases in the demand for their products, including palm oil, cassava, charcoal, wood and sweet potatoes. Some residents observed an increase in the demand for local products as well as a small improvement in prices for their products and an improvement in the supply of consumer goods. However, the general assessment by the authors “sober these expectations... Overall, however, the use of roads is limited.”

Roads and markets in Kivu District, Kongo

41. Even poor people can now sell goods at the market or along the road. Before upgrading the road, there was no demand for products. In the past, products like salt and soap were not regularly available. These things are now available. They are expensive, but prices are slightly lower than before.

42. An issue which has been rarely researched up to date was raised by Steyn et al (2014) who quantified the effects of riding quality on low volume roads on selected damage levels of tomatoes in California. Even though physical effects were clearly demonstrated, the research was not conceived in a manner to assess the impacts on prices due to damages on the products. However, the effects of improved riding quality was observed by the aforementioned USAID Program (RAMP, 2006). Farmers started to grow high-value vegetables in large quantity, presumably because high spoilage loss associated with poor roads has fallen by 50 percent for perishables. Most crops in the treated villages also exhibit higher yields than in control villages, arising from increased intensification of input use and higher cropping intensities. Therefore the

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5 Interview with local inhabitant in Ferf et al (2014).
RAMP Program attributed about 40 percent of the total benefits to increased agriculture production and marketing, 26 percent was due to improved fares and rates accrued to farmers, and the remaining 33 percent was saving made by transport operators by way of reduced vehicle operation costs.

43. Some authors are critically questioning the above findings: De Walle’s (2009) is critical about the impacts of rural roads on market development. He suggests “suggest that small road improvement projects … could have vastly larger impacts on local market development if they were targeted to places with initially lower market development, and equally important, accompanied by complementary social and economic policies aimed at improving certain attributes (e.g. adult literacy) or reducing the disadvantages of others (policies to reverse the effects of historical discrimination towards ethnic minority groups) that interact with roads to reduce their impacts.”

44. In theory, producer prices increase after road rehabilitation due to the lower transport costs which are transmitted to local producers in a competitive transport market. This evidence is supported by the above RAMP Project. However, the theory is contradicted in a scientific very credible research in Sierra Leone (Casaburi 2013) which showed that improved roads reduced market prices of local crops. These price effects were stronger in markets that are further from major urban centers and in less productive areas. In addition, these price effects are reversed in areas with better cell phone penetration. The latter is probably the explanation, since cell phones enable farmers to receive market price information and give them a better bargaining position with traders, especially in remote areas.

Impacts on wages, consumption and employment

45. One of the most frequent observations was the shift from agricultural self-employment to wage-earning employment. Asher et al (2015) compiled large datasets from India’s rural road construction program that has built paved roads to over 100,000 previously unconnected villages since it began in 2000. The authors find “that rural roads increase economic well-being, as measured both by household earnings and night light luminosity. In the case of night lights, which is measured annually, we find that road construction leads to an acceleration of the growth rate rather than a one-time increase in the level … Road construction to previously unconnected villages lead to a 10 percentage point reduction in the share of households and workers in agriculture, with an equivalent increase in wage labor market participation. This sectoral reallocation is concentrated among males and households with low levels of land, precisely those groups who have the lowest costs and highest returns to sectoral reallocation. Labor reallocation to wage labor is strongest in locations close to major cities, suggesting the importance of access to urban markets in the process of structural transformation.” The authors interpret these findings as evidence that rural roads facilitate structural transformation by increasing the access of rural workers to external labor markets, either via commuting or short-term migration.

46. Additionally Mohapatra et al (2007) observed that after the construction of roads, an improvement in the employment situation in terms of more job opportunities, avenues for self-employment, and so on were observed. On farm employment opportunities also increased due to shift from grains to cash crops and also multiple cropping.

47. Van de Walle (2009) confirms that in Vietnam after road constructions rural households were switching from agriculture to non-agricultural, mostly service-based, activities. A research by Escobal (2003) in Peru “presented evidence of the impact of road rehabilitation on the
importance of waged sources in rural household’s income generation strategy...Furthermore, it recognizes non-agricultural wage income as the main source of positive impact of both motorized and non-motorized roads rehabilitation in the short-term.”

48. Road improvements in Bangladesh (Khandker et 2006) also had a significant impact on men’s agricultural wage (increases by 27 percent), fertilizer price (falls by about 5 percent) and aggregate crop indices (price indices increase by about 4 percent, while output indices rise significantly by about 38 - 30 percent). The overall effect of road improvement on household per capita annual consumption is 11 percent.

49. Randa (2011) evaluated the employment-generating impact of rural roads in Nicaragua. He observed “an increase in hours worked per week attributable to the intervention of around 9.5–12.3 hours. Moreover, he observes tendencies of a graduation process taking place in the labor market: individuals moving out of unemployment predominately achieve employment in the agricultural sector (self-employment), whereas newly created service sector jobs primarily are taken by workers previously working in agriculture. Finally, the analysis suggests that the employment-generating effect comes through a combination of reduced travel time and better access to markets and larger, more integrated road networks.”

Impacts on Poverty Pro Poor Growth

50. The major question for development cooperation is how do the above described effects take effect on rural poverty. First of all there seems to be strong evidence that poor people benefit from rural road improvements. A large study (Fan et al. 1999) carried out by the International Food Policy Research Institute on linkages between government expenditure and poverty in rural India revealed that an investment of 10 Million Rupees in roads lifts 1,650 poor persons above the poverty line. This equals an investment of only 140 US$ per poor person. Public investment on roads impacts rural poverty through its effect on improved agricultural productivity, higher non-farm employment opportunities and increased rural wages. Improvement in agricultural productivity not only reduces rural poverty directly by increasing income of poor households, it also causes decline in poverty indirectly by raising agricultural wages and lowering food prices (since poor households are net buyers of food grains). Similarly, increased non-farm employment and higher rural wages also enhance incomes of the rural poor and consequently, reduce rural poverty. The total productivity effect on poverty, 75 % arises from the direct impact of roads in increasing incomes, 15% arises from lower food prices and 10% from increased wages (10 per cent).

51. Khandker et (2006) researched rural road investments in Bangladesh, which “reduce poverty significantly through higher agricultural production, higher wages, lower input and transportation costs, and higher output prices .... We find a poverty reduction (moderate and extreme) due to road improvements of about ... 5-7 percent. Thus, had the duration of road pavement taken about 5 years, we could argue that each year poverty fell by about 1 percent, solely due to rural road improvements.” Additionally, road investments are pro-poor, meaning the gains are proportionately higher for the poor than for the non-poor.” The results suggest that the savings of household transport expenses are quite substantial, averaging about 36 - 38 percent in the project villages.

52. A number of other studies corroborate the above findings:
• The development of all-weather rural roads in the Lao PDR, a country with extremely difficult upland topography and many villages without access to such a road, appears to lower the rural poverty incidence by 7 percentage points (Warr, 2006).

• Kwon (2000) found for Indonesia that the poverty impact of growth was almost four times higher in provinces with high levels of road provision compared with those with poor levels of provision.

• Balisacan et al (2002) found similar results for the Philippines, but also found that the impact is increased if coupled with education investment.

• Glewwe et al (2002) found the poor households living in rural communes with paved roads in Vietnam had 67 per cent higher probability of escaping poverty than those in communes without paved roads.

• Dercon (2007) confirms the above findings through a research in Ethiopia, which revealed that “access to all-weather roads increases consumption growth by 16 per cent and, reduces the incidence of poverty by 6.7 per cent.”

• These findings are confirmed by Gibson (2002) in Papua New Guinea: “Our results appear to support the argument that poor areas have the least access to infrastructure and so people in those areas may benefit the most from new investments. Thus, infrastructure spending, whether on new assets or maintenance of existing facilities, can provide a form of targeted interventions that favors the poor.”

53. Van de Walle et al (2002) differentiates the impacts on the poor in his survey for Vietnam: “The most interesting finding at the household level is that impacts significantly vary across income groups, and that the strongest impacts were for the poorest. In particular, although the time needed to walk to various places declined overall, time savings were more pronounced for the poorest 40 percent of households.”

54. Duncan (2007) contradicts van de Walle regarding the effects on the poorest. “Project experience from several countries suggests clearly that households that do not report benefits from transport improvements fit the socioeconomic profile of chronic poor, typically suffering from disabilities, chronic disease, low education levels, and high dependency ratios. Nonetheless, short-term transport benefits may materialize for such households in the form of improved access to education, health care, and social services, which may then pave the way for better income opportunities in the future.”

55. Starkey and Hine (2014), in their comprehensive literature review, have a rather skeptical appraisal: “Where transport investments have stimulated economic growth, the poor have often benefitted only marginally – in many cases, they have not had the resources to take advantage of the opportunities afforded by better access. Good transport infrastructure is a necessary condition for economic growth and poverty alleviation, but transport investments alone cannot address the problems of the poorest households.”

56. This skepticism stems from the fact, that the poorest sectors of society may not be able to benefit from improved transport and they may actually be marginalised by the externalities related to that growth (e.g. Hettige, 2006; Raballand et al, 2010; Khandker et al 2011; van de Walle et al, 2011). From an impact analysis of rural road projects and integrated rural projects in Asia (one of each type in Sri Lanka, Indonesia and the Philippines) Hettige (2006) concluded while communities and the poor benefitted, there was little evidence that the ‘very poor’ benefited from the roads.
57. Duncan (2007) argues that “transport planning for poverty reduction must take into account that poverty is not so much a village as a household phenomenon. There are poor households in well-off communities, and well-off households in poor and disadvantaged communities. Experience shows that bringing transport to a community initially creates benefits for the relatively rich households, while enabling some of the poorer ones too. The extent to which transport investments bring economic benefits to a household depends on the assets the household can mobilize to take advantage of the improved opportunity”

58. Better rural roads are a necessary but not sufficient condition for graduating from poverty. There is little evidence that roads have impacted directly in terms of reducing income poverty on those groups in each study community who were identified explicitly as being very poor. The ability of the poor and very poor to make significant economic use of a road depends on their asset base and the entitlements to resources and opportunities that they can command, as well as on the passage of time. Hettige 2006

**Impacts on transport speeds, costs and patterns**

59. Obviously, rural road improvements changed transport patterns of their users. The RAMP Project in Afghanistan USAID (2006) observed that farmers have saved travel time, ranging from 0.51 minutes/km by taxi/car to 1.14 minutes/km by truck, depending on the condition of the roads before the rehabilitation. Substantial gain of up to 5 minutes/km was also made by non-motorized transport. The supply of transport had increased substantially, especially share-ride taxis and mini-buses offering frequent service, whereas in the past the only service was a rural bus offering one or two runs a day. Improved roads have also influenced the number of trips farmers make to markets and district centers. On average, farmers are able to make 5 percent more trips per year with rehabilitation as the roads are open throughout the year and the transport service is quite competitive. Vehicle operation costs have gone down by at least 16 percent, thus benefiting both transport operators and farmers – the latter by way of reduced fares and rates. Survey data indicate that freight costs for transporting inputs and outputs between markets and villages has gone down by 10 percent after rehabilitation of the roads.

60. Van de Walle (2002) states for Vietnam that the “the road rehabilitation projects significantly increased the availability of freight services in the project communes, although they had no overall impact on passenger transport”.

**Improved access to health services and education**

61. Starkey Hine (2014) state that rural transport infrastructure and means of transport (including transport services) are crucial to overcoming the potentially fatal ‘three delays’ in health care (particularly perinatal care) i) the decision to seek health care, ii) the travel to reach care and iii) the treatment within the healthcare system (including referrals) all depend on access to transport. Where people are far from roads, their decision to travel is influenced by the problems of travelling by human porterage, stretchers, animals, bicycles or motorcycles. Good access to infrastructure and transport services are needed to ensure medical staff and supplies are available in health centers. Evidence from India, Nepal and other countries suggests that constructing and maintaining rural roads, paths and bridges leads to improved health outcomes and healthier rural communities (although there can be complex interactions and externalities that affect poor people).

**Interview with Church leader Manzini- Chefferie de Malumba, Kivu, Kongo**
However, in the past patients of this village needed to be carried by men to the hospital in Walungu (30 km) while when they died the body had to be carried back. In case the patient died after 15:00 there was no time to bring the body back, and it had to be buried there. If a taxi must be hired for transport of a sick person, this cost USD 25. Sometimes they get it for USD15 when the owner is from the village.\(^6\)

Research in India (Banerjee et al 2015) shows, that the provision of roads increases the use of preventive health care by women and households. This is confirmed by an older research in India (Mohapatra 2007), there has been an overall improvement in access to health facilities like PHCs, sub-centers, and district hospitals. Positive impact was observed on accessibility to preventive and curative health care facilities; better management of infectious diseases, and attending to emergencies and increase in frequency of visits by health workers. Improvement in antenatal and post-natal care was observed by beneficiaries, thereby decreasing obstetrics emergencies. Road connectivity and an improved transport system enabled families to opt for institutional deliveries in hospitals outside the village. Decrease in infant and child mortality was reported.

De Walle (2002) confirms these findings through his research in Vietnam: “The time needed to reach the closest hospital in case of a serious injury declined by an impressive three-quarters of an hour. In general, however, there are positive (or non-negative) impacts on the availability of services in the project communes. In particular, increases in pharmacies, in the availability of credit from the Agricultural Bank of Viet Nam and in other government development projects were attributable to the road projects.

Starkey and Hine (2014) resume their literature study regarding access to education as follows: “Investment in rural roads, particularly to provide initial connectivity, leads to greater school enrolment (evidence from many countries including Bangladesh, Ethiopia, India, Morocco, Pakistan and Vietnam). Investment in rural roads also leads to better staffing at village primary schools (evidence from India, Zambia and elsewhere)”. Atsushi (2015) researched rural road improvements in Brazil and found “that improved rural roads changed people’s transport modal choice. People used more public buses and individual motorized vehicles after the rural road improvements. The paper also finds that the project increased school attendance, particularly for girls.” Van de Walle (2009) confirms for rural roads in Vietnam that “perhaps most notable, the project had significant, early and sustained impacts on primary school completion rates.”

### Investment in Feeder Roads versus Trunk Roads

An issue discussed controversially is the scope of the road investments and the question which investments reap the largest benefits, feeder or trunk roads. Starkey and Hine (2014) suggest that the improvement of local networks is assessed rather positive, since “building roads (and/or trails and footbridges) to connect rural communities to the road network provides numerous benefits and reduces the numbers of people in extreme poverty. Trails and roads enable safer and faster access to markets and services.” Evidence from Ethiopia, Ghana, Nepal, Uganda and elsewhere shows that upgrading footpaths to basic motorable roads provides much greater benefits than upgrading existing rural roads to all-weather quality.

\(^6\) Ferf, etal. 2014.
67. Starkey and Hine (2014) quote a study of spatial data in Africa showing that overall agricultural productivity of rural areas was correlated with the travel time to a large town. The travel time included small rural roads and then larger national roads, but the most cost-effective way to reduce this was investment in minor rural roads.

68. A study of public investments in rural Uganda (Fan et al 2004) suggested that the most basic ‘feeder’ roads had a benefit-cost ratio of 7.2, with 34 people taken out of poverty for each million shillings invested. In contrast, the benefit-cost ratios of gravel or tarmac roads were not significant. The impact of small feeder roads on poverty reduction was three times greater than gravel or tarmac roads, per unit of investment.

69. Government spending on rural roads in Uganda had substantial impact on rural poverty reduction. The impact of low-grade roads such as feeder roads is larger than that of high-grade roads such as murram and tarmac roads (Fan 2004).

70. Fan et al (2005), in an important study of the investments in roads in China, concluded that while China’s huge investments in expressways was economically beneficial for China, the greatest returns to investments came from the construction of low-volume rural roads. The benefit/cost ratios of ‘low quality’ (rural) roads were four times greater for national GDP than investments in ‘high-quality’ roads. Therefore Banjo, Gordon and Riverson (2012) in their World Bank review of rural transport, emphasized the need to focus rural transport investments on the lower end of the rural road network—community roads, paths and trails—in order to meet the rural access and mobility needs of smallholder farmers.

71. Chongvilaivan (2015) found in Timor-Leste that proximity to main roads may not necessarily result in improved welfare. Instead, ensuring all-weather access to roads appears to be a more significant factor in raising household well-being. Specifically, road accessibility during the rainy season reduces is regarded as essential. “This suggests that in Timor-Leste, and likely in other developing economies under similar conditions, maintenance of existing roads is more essential to well-being than building more roads. Rather, our findings suggest that it is necessary to improve the quality of roads such that they remain intact at all times, thereby ensuring constant and uninterrupted accessibility”.

72. The above positive assessments are contradicted by Raballand (2009), who observed in Cameroon that “isolation from a tarred road is found to have no direct impact on consumption expenditures in Cameroon. The only impact is an indirect one in the access to labor activities. The paper reasserts the fact that access to roads is only one factor contributing to poverty reduction (and not necessarily the most important in many cases). Considering that increase in non-farming activities is the main driver for poverty reduction in rural Africa, the results contribute to the idea that emphasis on road investments should be given to locations where non-farming activities could be developed, which does mean that the last mile in rural areas probably should not be a road.”

73. This opinion is as well corroborated by Qiaolun Ye (2006) in his case study about the Southern Yunnan Road Development Project (China), which is described in detail below. Instead of improving access to poor and remote areas, the author favors an approach where rural roads should connecting high potential areas, where employment on commercial farms may be generated.

Gender issues
Seven authors mentioned positive impacts of rural roads on women. This concerns often female visits of health centers. Cook (2005) ascertains that “women, particularly poor women are often at risk by the lack of or poor quality of transport … services. Reliable transport seems particularly important in encouraging parents to allow girls to continue their education, and in enabling women to participate in social and economic activities, outside the village.” The positive impacts generated for women involved in road maintenance is mentioned as well by Qiaolun Ye (2006).

### B. Impact assessments from China

Some studies from China have already been mentioned above, which shall be taken up again in this chapter. Fan et al. (2000) examined the factors which contributed to the exceptional growth and to the reduction of poverty in China during the past decades. Government spending on rural infrastructure (roads, electricity, and telecommunications) had substantial impact in reducing poverty and inequality as well, owing mainly to improved opportunities for nonfarm employment and increased rural wages. Among the three infrastructure variables considered, the impact of roads is particularly large. They conclude that that with every 10,000 Yuan (about $1200) spent on rural roads eleven persons are lifted above the poverty line. In terms of impact on growth, for every Yuan invested in roads, CNY 8.83 in rural GDP is produced. Roads yielded the largest return to rural nonfarm GDP, at CNY 6.71 for every Yuan invested, 35 percent higher than the return to education investment.

Fan et al conducted another study in 2005 that concluded, “whilst the rapid introduction of the expressway network did play a part, the much shorter lengths of low standard feeder roads made an even more important contribution to growth and poverty reduction, achieving about four times greater benefit/cost ratio than did the expressways. The most significant finding of this study is that low-quality (mostly rural) roads have benefit–cost ratios for national GDP that are about four times greater than the benefit–cost ratios for high-quality roads. Even in terms of urban GDP, the benefit–cost ratios for low-quality roads are much greater than those for high-quality roads. In terms of poverty reduction, low-quality roads raise far more rural and urban poor above the poverty line per Yuan invested than do high-quality roads. Another significant finding of the study is the trade-off between growth and poverty reduction when investing in different parts of China. Road investments yield their highest economic returns in the eastern and central regions of China while their contributions to poverty reduction are greatest in western China (especially the southwest region).”

However, Fan et al (2005) pour as well some water in the wine regarding future impacts of roads: “Since as more and more investments are being spent on these projects, the marginal returns are beginning to decline, although they are still positive and economically sound. At the same time, low-quality roads or rural roads have received less attention than high-quality roads, and as a result, their marginal returns are much larger today than the returns for high quality roads. “

Cook et al (2005) looked at the impact of transport and energy investments supported by the ADB and the World Bank in China, Thailand and India. They concluded that the poor do appear to benefit proportionally from rural infrastructure investments and reduction in travel times in the medium term, although some could be marginalized. They observed a better performance in poverty reduction in villages with road access that was attributed to two main factors: easy access to credit and technical training, and direct effects of road access and transaction costs and time. Smoother and faster motorized road transport also facilitated a shift to high-value perishable products. Households, both poor and non-poor, substantially increased
the share of their income coming from off-farm employment over this period. Village road access did not seem to have made a significant difference in this respect.

79. In an ADB review on the poverty impacts of transport investments in China, Duncan (2007) concluded that good transport infrastructure was essential for economic growth and overall poverty reduction, but transport investments alone were not sufficient to address the problems of the poorest households. “The poorest of the poor tend to be chronically poor for reasons that are not linked to the availability of transport services. This group constitutes a rather small portion of the poor in the PRC. Their mobility is so limited beyond their household, that the challenges of meeting their demands for a better life will be more effectively met by non-transport measures.” Additionally, the less productive among the local producers may suffer, since they will be exposed to competition from outside suppliers.

80. They may not travel or transport goods themselves, but they will nevertheless benefit from improved access to jobs, consumer goods, and inputs to whatever they are engaged in producing. Transport creates opportunities to increase the productivity of the poor.

81. Another research by Jalan et al (2002) in rural southern China observed robust evidence of geographic poverty traps. The authors found that “there are publicly provided goods in this setting, such as rural roads, which generate non-negligible gains in living standards.”

Southern Yunnan Road Development Project

82. The above quoted Qiaolun Ye (2006) undertook an extensive ex-post evaluation on the poverty impacts of the Southern Yunnan Road Development Project. The author presents findings that differentiate between areas with high development potentials and remote poor villages.

- In areas with “high potential for developing commercial crops, especially tobacco, tea, and sugarcane, … most households rose from poverty by growing these crops, which were promoted by commercial firms that signed contracts with farmers and purchased their production. In these areas, good roads were critical to attracting commercial firms to engage in contract farming. The OEM interviewed technicians from a tobacco company, who stressed the availability of all-season roads as critical to their selecting a particular village for contract farming tobacco. Without good roads, they observed, transporting tobacco leaves might be delayed by days during the rainy season, causing heavy losses to the company. “

- In contrast, “in areas visited in Yunnan … upgrading isolated roads to poor, small villages located in remote and poorly endowed mountainous regions had a marginal impact on poverty reduction. Poor resource endowment and adverse farming conditions meant the poor in remote villages had little surplus to sell and the improved roads, while making walking more convenient, did not mitigate lack of employment, the key cause of poverty, and therefore did not substantially change villagers’ circumstances”.

83. The author concludes that a “better alternative could have been upgrading roads in other parts of the county that had high potential for commercial agriculture, such as areas adjacent to towns, or large villages in lowlands with sufficient land and favorable conditions, such as sufficient water, even if they are not poor. If the lack of an all-season road was the only constraint to commercial agriculture in non-poor areas, and if half of the farmland in these areas could shift from grain to cash crops after road development, demand for labor would stimulate
seasonal migration of the poor from nearby poor villages to work in cash crop production, thus generating employment for surplus labor from poor villages."

84. The author adds that in the villages visited in Sichuan, migration was the primary strategy to escape poverty used by the great majority of households in the past 10–15 years. A major role in the creation of rural employment played contract farming with private or government-owned commercial firms by introducing new crops and reorganizing the value chain from production to processing and marketing. Off-farm employment was rather limited in many poor villages visited.

**Ningxia Roads Development Project (Rural Roads Component)**

85. The Ningxia Roads Development Project (33469-013), financed by ADB from 2003 to 2013, focused mainly on the construction of expressways and rural roads. The local road components consisted of 18 sections of local roads in the same seven counties as this Project, with total length of 505 km. The impact assessment (ADB 2011) of this roads project was conducted by analyzing statistical data over the time period of project implementation. Since neither household surveys were conducted nor control groups established, the assessment rather describes the development in Ningxia and not so much road impacts. Additionally, the effects of highway construction could not be separated from rural road impacts.

86. The impact report revealed that the "increase in rural net incomes per capita in the Southern Part of Ningxia, where the project took place, is much larger than that in the Northern Part. ... Therefore, it can be reasoned that the current economic situation of Ningxia is improving, and the DPA’s economic situation is also improving. ...The poverty rate (annual income lower than CNY 1000) was about 39% in the Southern Part of Ningxia in 2009, which is 18% lower than that of project initial stage (2001)". The report does not quantify the impacts due to expressway compared to rural road improvements.

87. The construction of rural roads, connecting Administrative Villages to the markets, lead to a significant improvement of accessibility. "The average distance to the nearest market is about 7km in each county except Tongxin (about 15km). It is nearer than that of project initial stage (13km)."

88. The report states as well that there are many "non-quantifiable benefits from access improvements: increased knowledge and farming know-how; reduced risk of illness; better education; greater competition for the supply of daily necessities; better and cheaper seeds, fertilizers and tools; greater food security, and so on. Life is generally better in a well-connected village." The ex-ante assessments of the project assume that 86%-100% of poor population would be benefitting, simply by calculating the share of poor population in the villages.

89. Another important effect is the employment of unskilled laborers during the Project construction from 2004 to the end of 2009 which amounted to 31,355. All laborers came from the villages surrounding the project sites, and most of them belong to the local poor population. They could earn approximately CNY900 in an average month.

**C. Possible impacts expected by beneficiaries**

90. During the field study already mentioned above, the inhabitants of six villages where asked about the possible impacts of road improvements. A selection of answers is presented in Table 7.
91. Major impacts on agricultural production and marketing is anticipated. Presently, when during rains agricultural machinery is not able to pass on the unpaved roads. Additionally, narrow roads are not suitable for the large machines. With improved road condition, agricultural machines can be easily used for planting and harvesting that will increase productivities and save production costs under the circumstances of increasing labor cost. The impact is bigger for households that is lack of laborers due to illness, aging and migration. The estimated annual benefits are between 1,500 to 2,500 CNY per household. This would increase annual income by 7-12 percent.

92. When being asked which type of road the beneficiaries preferred, they uniformly asked for paved roads. With the paving of the roads, a significant reduction of transport cost is expected, which ranges between CNY 1,000 and 2,000 per household per year. Additionally, the travel time on the local roads will be shortened by of 30%-50%.

93. One of the strongest impacts to be expected from road improvements is the access to social services: health services may be reached more easily and ambulances can reach the village. Children travel more conveniently and faster to school, banking services are more easily accessible and fire brigades are able to reach the village.
Table 7: Impacts of road condition on marketing and accessibility of social services

<table>
<thead>
<tr>
<th>Destination</th>
<th>Tongxin county</th>
<th>Xiji county</th>
<th>Jingyuan county</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fengchuan village</td>
<td>When it rains agricultural machinery can't pass</td>
<td>When it rains agricultural machinery can't pass</td>
<td>no effect</td>
</tr>
<tr>
<td>Shengou village</td>
<td>When it rains agricultural machinery can't pass</td>
<td>When it rains agricultural machinery can't pass</td>
<td>Narrow roads are bad for transportation of agricultural products</td>
</tr>
<tr>
<td>Xipo village</td>
<td>sell and buyout more easily</td>
<td>production: no affected marketing more easily</td>
<td>less affected</td>
</tr>
<tr>
<td>Gaozhao village</td>
<td>save and buyout more easily</td>
<td>sales revenue increasing 10%-20%,about 3000 CNY/hh</td>
<td>sales revenue increasing 5%,about 1000 CNY/hh</td>
</tr>
<tr>
<td>Longtan village</td>
<td>sales revenue increasing 10%,about 500 CNY/hh</td>
<td>sales revenue increasing 10%,about 2000 CNY/hh</td>
<td>sales revenue increasing 10%,about 2000 CNY/hh</td>
</tr>
<tr>
<td>Hongqi village</td>
<td>sales revenue increasing 10%,about 2000 CNY/hh</td>
<td>sales revenue increasing 10%,about 2000 CNY/hh</td>
<td>sales revenue increasing 10%,about 2000 CNY/hh</td>
</tr>
<tr>
<td>Change in agricultural production and marketing</td>
<td>less affected</td>
<td>less affected</td>
<td>less affected</td>
</tr>
<tr>
<td>Increase of agricultural marketing [CNY/a]</td>
<td>less affected</td>
<td>profit increase 10%,about 500 CNY/hh</td>
<td>sales revenue increasing 10%,about 2000 CNY/hh</td>
</tr>
<tr>
<td>Save time 30%, costs reduction about 1000 CNY</td>
<td>save time 50%, costs reduction about 500 CNY</td>
<td>save time 50%, costs reduction about 1000 CNY</td>
<td>if have bus, save bus fee 20%, costs reduction about 200 CNY</td>
</tr>
<tr>
<td>Improvement of transport costs [CNY/a]</td>
<td>save time 30%, costs reduction about 1000 CNY</td>
<td>save time 50%, costs reduction about 1000 CNY</td>
<td>10m big truck available, save transport costs 40%, costs reduction about 2000 CNY</td>
</tr>
<tr>
<td>Improved access to social services</td>
<td>less affected</td>
<td>ferry the children to and from school, seek medical advice, deposit and withdraw more convenient</td>
<td>see the doctor more convenient</td>
</tr>
<tr>
<td>Other positive impacts expected</td>
<td>no</td>
<td>export of labor services more convenient</td>
<td>deposit and withdraw more convenient</td>
</tr>
</tbody>
</table>

- When it rains, agricultural machinery can't pass.
- Narrow roads are bad for transportation of agricultural products.
D. Summary

International literature review

94. An overview of the international literature review is presented in the annex. Even though the observed impacts were very much dependent on the local economic and geographic conditions, a large consensus amongst the researchers may be observed regarding the positive effects of rural roads on income and poverty as well as on accessibility to social service and places of employment. Generally there were two major impacts observed:

(i) Many studies confirmed that rural roads induce a market led local development which entails strong impacts on agricultural marketing and increasing incomes through farming.
(ii) Other studies revealed that rural roads increased the revenues from non-farming activities. This implies a shift from subsistence agricultural to commercial agriculture or manufacturing, which is achieved though commuting or even resettlement to locations of employment.

95. Consequently, a number of authors argue that rural roads should be improved to the locations where poverty was most severe and through improved access to markets provide opportunities for subsistence farmers to integrate into the market economy and thus increase farm production, marketing and agricultural incomes.

96. Other authors argue that rural roads should be primarily improved to locations where economic opportunities are best and thus induce a dynamic process for commercial farming and manufacturing, which again creates places of employment. Only one ex-ante study on rural road impacts was conducted in China by Qiaolun Ye (2006) who is a representative of the latter approach on economic development through job creation.

97. Widely it was perceived that rural roads have considerable positive impacts on poverty through the above effects. However, it has to be emphasized that roads are a condition sine qua non for development, but not sufficient to generate a process on its own. The ability of the poor and very poor to make significant economic use of a road depends on their asset base and the entitlements to resources and opportunities that they can command, as well as on the passage of time. Thus, it is not imperative that the very poor benefit from the road improvements. This problem may be overcome by selecting roads to villages with a large share of poor inhabitants.

99. Many authors claim that roads at the lower end of the network, such as upgrading of paths, tracks and feeder roads have a stronger effect than improving the main road network. This is especially the case, if in the past major road networks have already been improved.

Impacts in Ningxia

100. With specific focus on Ningxia, a field survey revealed that local inhabitants expect considerable impacts from the feeder road rehabilitation. Villages will receive new opportunities by providing direct access to all-weather roads. This may imply that traders drive with larger vehicles directly into the village to purchase farm products, competition amongst traders increases, more transport services may be offered. Most importantly, access is guaranteed all
year around (if snow removal is well organized). Altogether this will have larger impacts on poverty than upgrading of existing all-weather roads.

101. Providing direct access to rural farmsteads and fields generates new opportunities for the farmers (i) to shift for higher value or heavy crops, (ii) to increase production, (iii) to market directly, or (iv) to traders. A direct impact on farmgate prices and thus income may be expected. All-year access is delivered through feeder roads connecting the Natural Villages to the surfaced road network.

102. One of the strongest social impacts to be expected from improvements of Feeder Roads is the access to social services: health services may be reached more easily and ambulances can reach the village. Children travel more conveniently and faster to school, banking services are more easily accessible and fire brigades are able to reach the village.

103. The improvement of Trunk Roads will have impacts on the overall efficiency of the road network and thereby reduce transport costs through shorter travel times, reduced vehicle operating costs and reduced environmental costs. This will have a certain impact on poverty as well, since farmgate prices will increase. If the roads in Ningxia were in a very bad condition the impacts would be considerable, since vehicle operating costs would be reduced significantly. However, the road conditions in Ningxia are acceptable and therefore, the economic impacts will relate more to faster travel times and a moderate reduction of vehicle operating costs. Therefore, the poverty impact will probably be lower than the improvement of Feeder Roads.

V. METHODOLOGY AND APPROACH OF THE IMPACT EVALUATION

A. Rational and research questions

104. The aforementioned research on rural roads revealed various types of impacts on the socio-economic development of rural areas. However, the observed impacts were very much dependent on the local economic and geographic conditions. The project therefore will take a holistic approach by improving both the network of core roads connecting to the places of non-farming employment, and the network of feeder roads and smaller roads reaching to the poorest villages through the improvement of maintenance practices and creation of maintenance groups. In the absence of similar sound impact studies in PRC, the main purpose of this study is to research where the generated impacts will stem from and how they were generated, through the following questions:

105. Even though, the PPTA team is convinced that considerable positive benefits will be generated through rural road construction in Ningxia, it is unclear where exactly the generated impacts will stem from and how they were generated. In the absence of Chinese impact studies, the main purpose of this study is to research the following questions:

- Which of the expectations laid down in the project proposal have materialized?
- In the project counties, all Administrative Villages are connected with surfaced roads, while many Natural Villages are only accessible through earth roads, tracks or footpaths. Even though the distances are fairly small (3-5km), the provision of access might generate measurable impacts. The important question is about magnitude of the impacts on the inhabitants of Natural Villages.
- One of the most important questions is the comparison of network efficiency improvements with the provision of access. This project provides a good opportunity, since the core and feeder roads are geographically separated and not directly connected
in the network. The impacts by Natural Village Roads may be compared to the effects generated by the improvement of the core road network.

- How strong was the impact on poverty alleviation? How were rural inhabitants able to escape the poverty trap: through increased farming or through new employment?
- Which other lessons for other rural road project can be drawn for future rural road projects in China and other Asian countries?

B. Methodology of the impact evaluation

106. The approach for the impact evaluation of the rural roads is to conduct basically two surveys and necessary follow-up surveys to evaluate longer term impacts:

- A baseline survey (ex-ante) to collect comparative data before the investments were conducted
- A end-line survey (ex-post) to analyze the project outcome and impacts
- Follow-up surveys (ex-post) to analyze longer term impacts.

107. In the surveys, the use of e-survey tools (using tablets and/or smartphones) will be adopted so that end-line surveys can be conducted to exact same households with proper GIS location data and photographic records and the survey efficiency can be improved.

108. This proposal is related only to the conduct of a baseline survey, the end-line survey will be conducted within the planned sector project. However, in order to ensure a scientific sound outcome that fulfills all due diligence requirements it is necessary to develop the methodology of the whole impacts assessment within this proposal. The impact methodology takes into account all recommendations laid down by van de Walle (2008).

109. The survey will be conducted by interviewing households in the villages with and without road improvements. The impacts of road improvements are estimated by comparing the data from the Baseline survey with the ex-post (or follow up surveys). In order to filter the road impact out of general economic and social changes in the region, a control group must be included in the survey. Thus, impacts should be compared with comparable households in villages without road improvements (control group). The following methodology may be applied:

\[
Y_i = \Delta RY_i - \Delta NY_i
\]

\(Y_i\) = Impact on Indicator \(i\)
\(\Delta RY_i\) = Change in indicator \(i\) in treatment villages before and after road improvement
\(\Delta NY_i\) = Change in indicator \(i\) in comparable villages with NO road improvement during the same time period (control group).

110. Since the treatment and control villages are not randomly assigned, a simple difference-in-difference estimation will be biased estimators. To estimate the real treatment effect on the treated, we assume that selection is based on observables, so that systematic differences in outcomes between treated and control observations with the same values of the covariates can be attributed to the treatment. A number of regression-based and matching estimators have been proposed to estimate treatment effects under this unconfoundedness, or exogeneity

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7 It is a recommendation by Atsushi et al 2015 to carry out multiple follow-up surveys over the long run, although longer-term evaluations also run the risk of losing part of the control group.
assumption. Matching methods have the advantage of relying less on distributional or parametric assumptions, which minimizes bias, but possibly at the expense of less precision (Imbens, 2004; Abadie and Imbens, 2006a). They do not rely on linearity or other functional form assumptions relating outcomes to a set of covariates, and are less subject to bias caused by a lack of common support.

111. Although the exogeneity assumption may seem strong, specific features of the data and estimation algorithm can significantly improve the reliability of matching estimators, producing results that have been shown to be very close to those based on a randomized design (Smith and Todd, 2005; Abadie and Imbens, 2006a). Smith and Todd (2005) counsel that geographic mismatch between matched observations should be avoided, common survey questions and survey methods should be used for treatment and control groups, and difference-in-differences matching is preferred to cross-sectional matching. Abadie and Imbens (2006a) propose a method to eliminate bias caused by imprecise matching of covariates between treatment and control observations using nearest neighbor matching with a fixed number of matches.

112. For each treatment observation \( i \), we can write the following expression for the estimate of outcome \( Y_i \) absent treatment (\( \hat{Y}_{i}(0) \)) and if treatment occurred (\( \hat{Y}_{i}(1) \)):

\[
\hat{Y}_{i}(0) = \frac{1}{M} \sum_{j=3_{m(i)}} (Y_j + \hat{\mu}_0(X_i) - \hat{\mu}_0(X_j)) \\
\hat{Y}_{i}(1) = Y_i. \tag{1}
\]

113. The function \( \hat{\mu}_0 \) is a fitted linear regression function of \( Y_i \) on covariates \( X_i \) using the control observations. It is used to adjust the counterfactual estimates to account for differences in the matching variables for each treatment observation (\( X_i \)) and its matched control observations (\( X_j \)). This correction leads to an unbiased estimate of the average treatment effect on the treated, which can be expressed as:

\[
\tau = \frac{1}{N_t} \sum_{i=1} (Y_i - \hat{Y}_{i}(0)) \tag{3},
\]

where \( N_t \) is the number of treated observations and \( W_i=1 \) signifies that the observation is in the treatment group (Abadie and Imbens, 2006a).

Treatment villages and control group (comparator locations)

114. For this research four groups of villages are selected, in order to assess the impacts of improvements i) on feeder roads and ii) on the core road network. Each of these impacts a treatment and a control group will be defined. Both the treatment and control villages will be selected in the Project counties.

115. The selection of treatment villages is straightforward: A representative set of villages where road improvements are planned will be selected. The selection should include all natural villages where direct access to the location is improved. The exact sample size will be determined after the ADB mission end of April, when the roads have been finally determined.

116. According to Atsushi et al (2015) it is essential to maintain a representative control group to carry out a rigorous evaluation of the Project. Each village should have a matching control
group in another natural village, where no road improvements are planned. Even though we cannot randomly assign treatment and control villages, both villages should have comparable features such as: income levels, accessibility problems, agricultural production, endowment of households with consumer goods, etc. It is essential to use existing data of the Poverty Alleviation Offices to select treatment and control villages.

Selection of households

117. Since not all households in a village may be interviewed, it is essential to choose representative households, either by ex-ante data available or by a sufficient number of randomly selected households. The latter should be at least 5%-10% of the village households. It is similarly important to ensure comparability between baseline and follow-up surveys. The best results may be achieved by choosing identical households to be interviewed before and after interventions to develop panel data (Atsushi et al 2015). A randomized process will be adopted in selecting both the natural village and households.

118. At this stage of project planning it is intended to randomly select 60 natural villages, and 10 households will be randomly selected in each sample village, which lead to a total sample size of 600 households. Since the same number of households will be interviewed in the comparator natural villages, the total number of households interviewed will be 1,200.

Household questionnaires

119. According to Atsushi et al (2015) “the questionnaires used for the interviews must be extremely well conceived and customized to the project’s particular design and context. For example, although questions about the transport distance or time traveled for a particular activity seemed pertinent a priori, with hindsight the questionnaire should rather have focused on the number of impediments to travel due to inclement weather over the past 6 to 12 months (to cover seasonality). This type of question would have been more effective in view of achieving spot improvement works on rural roads, thus allowing for year-round transport. Alternatively, a question about the frequency of foregone medical care due to transport problems would have been more pertinent.”

Follow up surveys (ex-post)

120. The follow up surveys should be developed using the same methodology as the baseline survey, interviewing the same households and compiling the data according to statistical state of the art. These surveys will be conducted within the planned project.

Implementation Schedule

121. The feasibility studies on the project road will be conducted by May 2016, and the location and details of feeder roads will be fixed by then. The baseline survey will be conducted in September-October 2016.

122. The baseline surveys will be conducted near the end of the loan project (currently anticipated in 2021). However, according to ADB (2013 Ningxia project), the period until which impacts may be measured conservatively ranges between two and five years depending on the capacity of the area to respond. Van de Walle (2002) calculated on average 27 month until impacts were observed. Thus, follow-up surveys will be planned if necessary after the project completion.
Procedures for survey development and conduct

123. Baseline survey (ex-ante) and the Follow up surveys (follow up / ex-post) will be undertaken by qualified consultants. The works are tendered by ADB and the tasks laid down in the TOR that will be developed by ADB after approval of this TA. The consultant will have the task to refine the methodology and develop the questionnaire.

C. Indicators for impact assessment

124. During the survey, the following type of data will be collected:

<table>
<thead>
<tr>
<th>Transport</th>
<th>Villages</th>
<th>Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geography and demography</td>
<td>Geography and demography</td>
<td>Size</td>
</tr>
<tr>
<td>Village endowment with services</td>
<td>Agricultural activities</td>
<td>Income and consumption</td>
</tr>
<tr>
<td>Access to services, employment and different markets</td>
<td>Manufacturing services</td>
<td>Consumer goods endowment</td>
</tr>
<tr>
<td>Agricultural activities</td>
<td>Road network and road condition</td>
<td>Agricultural production, marketing and revenues</td>
</tr>
<tr>
<td>Manufacturing services</td>
<td>Road usage</td>
<td>Employment</td>
</tr>
<tr>
<td>Road network and road condition</td>
<td>Transportation costs</td>
<td>Schooling of children</td>
</tr>
<tr>
<td>Road usage</td>
<td>Local prices (particularly farmgate agricultural prices)</td>
<td>Transport activities: Destination, frequencies, purposes, transport costs, etc.</td>
</tr>
<tr>
<td>Poverty Information</td>
<td>Poverty Information</td>
<td>Perspectives, visions and plans</td>
</tr>
</tbody>
</table>

125. The impact evaluation survey has the task to research the effects of road improvements in the project counties. As mentioned in Chapter 3, impacts may be expected on i) income, ii) production and marketing and iii) improved access to social services. The impact survey should collect the following data:

Indicator on income

Available data

126. Income data exist at the county and village levels. In some counties where there are sample households selected for national and provincial rural household survey, county income and consumption data are averages of these sample households though the sample sizes are small. Village income data is just a guess of the village leaders and township officials, it is not comparable across villages. Income data is also collected for poor households by village leaders, analysis of these data reveals that it is completely unreliable and useless.

Data to be collected

127. For sound impact assessment, household income data need to be collected in a scientific way. Structured household survey questionnaires will be used to collect detailed information on all source of income including crop and livestock production, wage and self-employment, transfers from governments and individuals. With this type of data, impact of road improvement on different kinds of incomes can be identified. Specific indicators may include: annual per capita net income (yuan/year), annual per capita net income from crop production (yuan/year), annual per capita net income from livestock production (yuan/year), annual per capita net income from wage employment (yuan/year), annual per capita net income from non-agricultural self-employment (yuan/year), and annual per capita net income from transfers (yuan/year).
Indicator on Production and marketing

Available data

128. There are some county level production and marketing data collected by county Statistical Bureau. No disaggregated data exist for township and villages.

Data to be collected

129. Household and village level production and marketing data need to be collected together with the income data. With this data, impacts of road improvement on changes of production and marketing can be assessed. Specific indicator may include: quantity of main crop and livestock production (kg/year), quantity of main crop and livestock production marketed (kg/year), total value of agricultural production (yuan/year), total value of agricultural production marketed (yuan/year).

Indicator on access to social services

Available data

130. County level data on provision of social services is also collected by county statistical bureau. No data on the access and use of social services at village and household levels is available.

Data to be collected

131. Household and individual level data on the access and use of social services need to be collected to assess the impacts of road improvement on social services such as education, health, culture. Specific indicator may include: distance, travel mode, time, frequency and costs to main service providers such as school, hospital, markets, governments, and banks.

VI. KNOWLEDGE AND CAPACITY BUILDING NEEDS FOR PAOS

132. The Poverty Alleviation Office has rather coordinating function and largely depends on other departments for project funding and implementation even though PAO receive some funds from the central and provincial governments and implements various projects by its own. Poverty Alleviation Plans are done in the national, the provincial and the county levels, with the county plan focusing on specific projects.

133. The discussions of the poverty alleviation offices PAO revealed a number of deficits concerning the administrative capacities:

- There is no clear definition how poor villages are identified. The assessments are undertaken by visual inspection of the villages, supported by data from the PIMS.
- There is not consistent methodology existent on how to rank poor villages and thus prioritize investments. In some cases all rural villages have be identified as poor, in order to receive more government subsidies.
- On the county level the PAOs often lack perspectives and strategies how regional development may be stimulated in a manner that poverty is alleviated. This strategy would as well include as well prioritization of investments needs.
- Workshops with PAOs and other relevant administrative planning units to conceive strategies and measures for rural development on the county level.

134. Knowledge and capacity building could include:

- Training on the method of indicator based poor village and poor household’s identification.
- Training on participatory approaches for assessing the livelihood and living standard of poor households.
- Training on awareness enhancing of women empowerment and other related gender issues.
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### Annex 1: Ex-post impact assessments of rural road improvements

<table>
<thead>
<tr>
<th>Country</th>
<th>Author</th>
<th>Year</th>
<th>Road type</th>
<th>Visit / turnover at markets</th>
<th>Visit / access to health Services</th>
<th>School enrolment/ completion</th>
<th>Visit of other services</th>
<th>Transport services</th>
<th>Transport costs</th>
<th>Income / Wages /consumption</th>
<th>Non-farm employment</th>
<th>Agricultural profits / production</th>
<th>Effects on poverty</th>
<th>Effects on women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>Kandler/Bär</td>
<td>2004</td>
<td>Rural roads</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Khandker</td>
<td>2006</td>
<td>Rural roads</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>Atsushi et al</td>
<td>2015</td>
<td>Rural roads</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
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<td></td>
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<tr>
<td>Cambodia</td>
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* female visits of health centres  ** Women involved in road maintenance

**Impacts:**  
- **++** very positive
- **+** positive
- **+/-** neutral
- **-** negative

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