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Roads Improvement for Poverty Alleviation in China

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Contents

List of Figures

List of Tables

List of Boxes

Abbreviations

ACER	Adjusted Cost Effectiveness Ratio
ADB	Asian Development Bank
CER	Cost Effectiveness Ratio
CIDA	Canadian International Development Agency
GVOAI	Gross Value of Agriculture and Industry
ICT	Institute for Comprehensive Transportation
LGEDPA	Leading Group for the Economic Development of Poor Areas
MoC	Ministry of Communications
MTE	Medium Truck Equivalent
MVs	Motor Vehicles
NMT	Non-Motorized Transport including Pedestrians and Animal Drawn Transport
NMVs	Non-Motorized Vehicles
PCUE	Passenger Car Unit Equivalent
RIPA	Roads Improvement for Poverty Alleviation
RTI	Rural Transport Infrastructure
RTS	Rural Transport Services
SDPC	State Development Planning Commission
SSB	State Statistical Bureau

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1. Introduction

1.1 Roads Improvement for Poverty Alleviation (RIPA)

About 3.0 billion people in the world, live in rural areas, and about 1.3 billion of them exist on less than 1 US$ per day. In China and India alone, there are about 400 million people who live below the official poverty lines, of whom about 200 million are in absolute poverty, as defined by their governments (United Nations, 1996). Many of these people live in either partial or full isolation and are often required to spend a large portion of their meager resources meeting their basic needs (Gannon and Liu, 97; Lebo, Schelling and Beusch, 98).

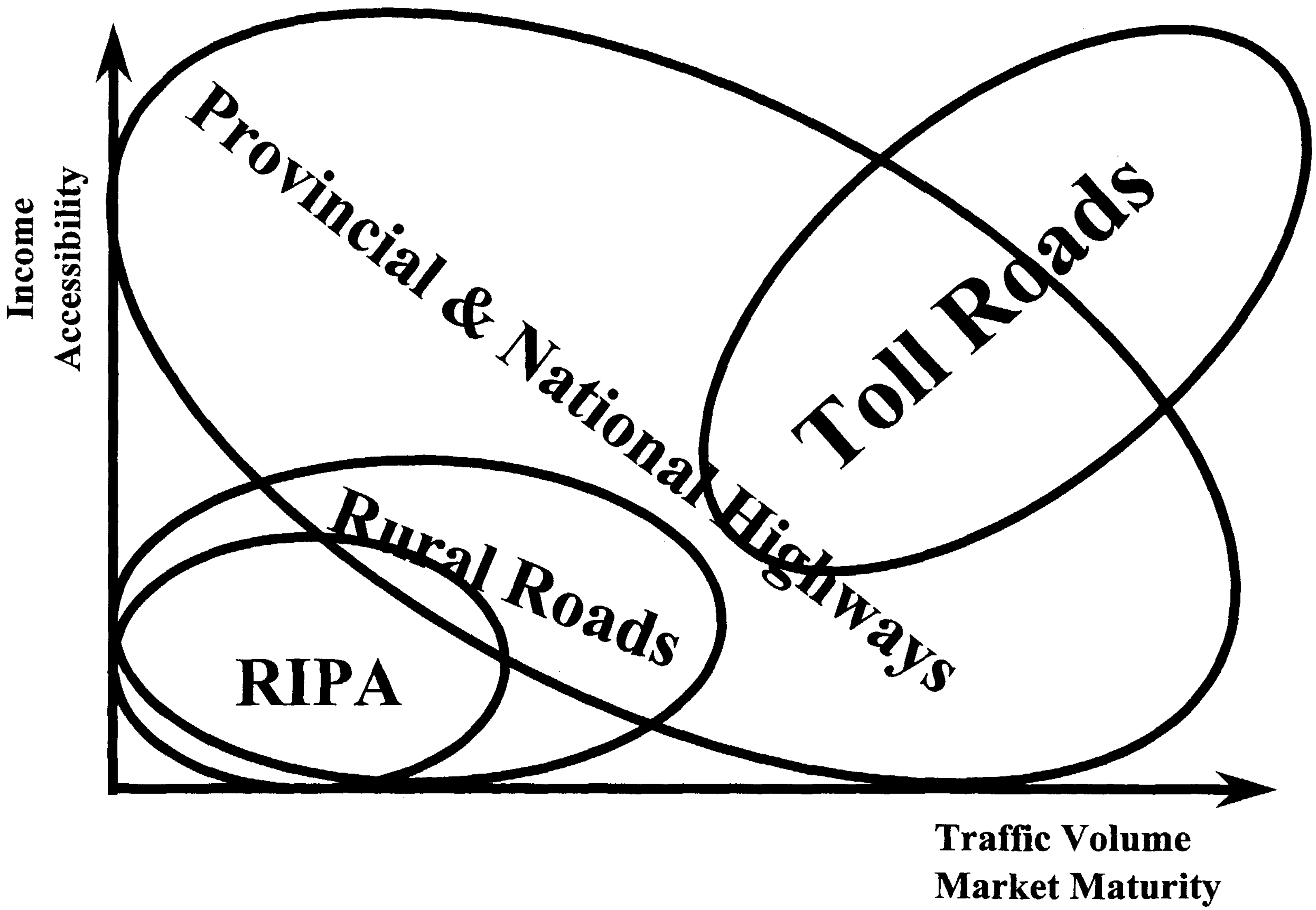
Having to live in isolation requires them to pay more for transport and therefore, restricts their ability to access basic goods and services. The inevitable impact of this inaccessibility makes it more difficult for them to harness higher level economic opportunities outside their remote settlements. These factors contribute to their impoverished condition.

Traditionally, rural road improvements have been adjuncts to other development programs such as agriculture, irrigation and rural development. However, many countries are beginning to realize that improvement of access to rural communities can be an effective instrument of poverty alleviation. As a result, improvement of access to the rural population (roads and related transport infrastructure) has been included in various development programs. The Bank has completed several studies during 1983-98, on various aspects of rural transport infrastructure (Barwell, 1996. Beenhakker and Lago, 1983., Connerley and Schroeder, 1996., Ellis, 1996., Gannon and Liu, 1997., Kerali et al, 1991., Lebo, Schelling and Beusch, 1998., Malmberg Calvo, 1998 and Riverson et al, 1991). The Bank has also been involved in many projects which include rural roads as part of regional development, agriculture, irrigation and highways (World Bank, December 86. World Bank, October 92., World Bank, February 94., World Bank, Apr 94., World Bank, February 96., World Bank, April 96., World Bank, May 96., World Bank, September 96., World Bank, May 98. and World Bank, July 98b).

In China, rural road improvements have been integrated with major highway projects, implemented with Bank assistance, during 1995-98. These improvements were called, "Roads Improvement for Poverty Alleviation", and were linked to on-going poverty alleviation programs. These Bank assisted projects are in five provinces of China: **Gansu, Henan, Inner Mongolia, Ningxia and Shaanxi** (WB, Feb 96. WB, May 96. and WB, May 98). The RIPA concept, as applied in these projects, is shown in **Figure 1**. RIPA focuses upon linking those rural villages and townships, which do not currently have basic all weather access to the existing road networks of a higher order.

This paper focuses, from a conceptual, analytical and methodological view point upon the RIPA experience in the above mentioned Bank assisted projects in China. It also describes the background to poverty alleviation programs and the linkages to roads improvement in China. It reviews current practices and recommends appropriate design standards, and a framework of monitoring indicators. It is hoped, that the RIPA concepts and the experience in China, with appropriate modifications, can be applied to similar rural roads improvement situations in other developing countries, particularly those in Asia.

Figure 1. Market Maturity and Road Hierarchy



1.2 Scope of the Paper

This paper focuses on those road systems which provide access to the rural population in designated poor counties in China. **The primary objectives are to:**

A. Provide a conceptual framework for RIPA,
B. Describe Chinese poverty alleviation policies linked to roads improvement,
C. Develop a screening methodology for prioritizing the counties for implementation of RIPA,
D. Develop a screening methodology for RIPA road segments and road systems,
E. Develop an analytical framework for the appraisal of RIPA road systems,
F. Develop appropriate design standards for different classes of RIPA roads,
G. Develop a system of monitoring indicators,
H. Discuss the potential for the replicability of RIPA in other developing countries.

2. Poverty and Transport

2.1. Poverty and Transport

The deprivation trap consists of five forces: **Isolation, Powerlessness, Vulnerability, Poverty and Physical Weakness.** Lack of adequate transport infrastructure results in partial or full isolation. Poor accessibility in the rural areas perpetuates the deprivation trap by denying the rural population adequate access to their most basic needs.

Poverty and isolation are linked together because when people are isolated, they are unable to harness the economic and social opportunities within a wider geographic region. Isolation, through poor accessibility, also slows down the diffusion of new technologies, increases marketing and production costs, and limits access to health, education and other social infrastructure.

A number of studies have shown that a significant portion of the rural population in the developing countries lack proper access to the road network. They often have very limited mobility beyond their immediate settlements because of their geographic isolation, difficult mountainous terrain and high costs associated with improving transport infrastructure. Consequently, they are not able to take advantage of employment opportunities beyond their settlements.

There are some villages and towns in China which have no road access at all. Many more have access only during the dry season. Some others have roads which are in a substandard state of maintenance and repair. For example, in 1984, 70% of the villages in India did not have direct access to all weather roads while 53% were not connected to any road at all (Carapetis et al. 1984). Similarly in 1995, 16% of the villages in China had no road access and most others were accessible by road only in the dry season (World Bank, February 1996b).

Transport directly impacts the personal welfare of all income groups. Lack of access, particularly affordable access, deprives the poor of their ability to take advantage of job opportunities and even of very basic social services such as health, education, recreation and welfare. These services have a relatively higher value for the poor.

Obviously, transport improvements provide people with more convenient access to a broad range of social and economic opportunities. Because these access improvements also have strong income effects by lowering transport costs of various goods and services, basic transport access is essential if the poor are to extricate themselves out of their impoverished condition. Also, improvements in the quality of transport can have far greater welfare implications for the poor than for the rich. As incomes grow, people are able to gain additional access to more employment opportunities and more social interaction.

Adequate transport is only one instrument of enhancing the welfare of the poor. It is important as an enabling tool. Mobility and accessibility are very much linked to the potential opportunity of poverty alleviation (World Bank, February 1994). If the key objective of development is to reduce poverty through sustainable economic development, then the most important question within the transport sector is: How can transport operations best contribute to poverty alleviation?

To place the role of transport in indirect and direct approaches to poverty reduction are important for poverty alleviation. Direct approaches are concerned with enhancing human capital formation, especially in education and health, and improving access to economic and social opportunities, including labor and product market, schools and health facilities. Indirect approaches involve increasing the efficiency of resource allocation, especially the performance of markets, the flexibility of adjustments, and of fostering economic growth. Typically, direct approaches operate at the level of improving basic access for the poor and indirect approaches operate at the level of improving overall mobility (Gannon and Liu, 1997).

The provision of transport infrastructure is an important tool for poverty alleviation. The key issue, is to establish a proper balance between indirect and direct approaches to poverty alleviation. **A Sole emphasis on the economic criteria can orient decisions away from helping the poor**. It may often benefit the rich more than the poor, and in some cases, may in fact, hurt the poor. For example, the measurement of costs and benefits based on willingness to pay, tend to favor the higher income groups. Rights of way are often imposed on the poor communities for high mobility infrastructure projects which may not benefit the poor of these communities directly. Commercialization in the transport sector may lead to higher prices for services which were previously affordable to the poor (Gannon and Liu, 1997).

The role of transport in poverty reduction through direct interventions is important, but requires careful design. For example, labor-intensive methods in road work, where relatively low wages make them cost- effective, provide a sustainable source of supplementary employment for the poor, especially in rural communities.

High-cost transport often indicates geographical, social, and economic isolation. In poor rural areas, lack of adequate and reliable transport penalizes those pursuing cash crop farming by increasing farm to market costs. It also penalizes those seeking non-farming employment opportunities by increasing the transport costs. Transport access must also be complementary to the availability of other basic "merit" services such as health care, education and other services. The challenge is in recognizing the needs of the very poor and making use of the transport sector to establish linkages to enhance economic and social development.

2.2. Transport and Economic Development

The relationship between transportation investments and economic development is complex. The conventional approach has been to focus on cost savings in goods and services to users and consumers. Improvements to transportation infrastructure enhance access, reduce travel times and vehicle operating costs. Many of these savings accrue to local and regional economies in the form of reduced costs to users and consumers. Cost savings, in excess of costs they impose, lead to increases in incomes, the essence of economic development.

The surest way to foster economic development through transportation investments is to focus on cost savings in goods and services to users and consumers, <u>as well as to provide adequate access to basic social infrastructure and services.</u> Improvements that yield cost savings to users and consumers are quantifiable despite numerous complexities associated with measurement. However, the value associated with increased access to social and human development services is more qualitative than quantitative and cannot be measured in absolute terms.

Long term productivity and safety gains resulting from transportation investments are difficult to quantify. These benefits include the ones derived from the availability of access to social and economic infrastructure and services in other villages and towns. These may have even broader impacts on the national economy as a whole.

At a macro level, investments in transportation infrastructure combined with other investments provide a key boost to local, regional, and national economies. High rates of capital investments create markets conducive to technological improvements which in turn spur technological advances and improve productivity. These investments stimulate economic growth which generate higher standards of living, over the longer term.

The key conceptual question, when evaluating the relationship between transportation investments and economic development, is how to produce a reasonable balance between these quantifiable and non-quantifiable benefits (Lynch, 1994).

2.3. Transport for the Poor or Poor Transport?

Transport services for the poor must be comprehensive. Current strategies, which emphasize road infrastructure exclusively without complimentary transport services, do not necessarily assist the poor who rely mainly on non-motorized transport. They are more helpful to those who own motor vehicles, even though non-motorized vehicles also use the roads. A paradigm shift is required here to focus attention on the appropriate transport needs of the poor fitting their trips and their vehicles rather than the focus on building roads for motor vehicles only. It is essential that road improvements be combined with adequate provision of rural transport infrastructure services for the poor. Thus, poverty alleviation measures through the transport sector, must first consider the appropriateness of access roads to the prevailing vehicles, trips and income characteristics and allow for a spectrum of transport services to be provided. Only then, will the mobility of the rural people be enhanced concurrently with increased accessibility (Howe, 1996).

About half of all rural travel is work-related. This is exclusive of household farming and subsistence activities which may involve substantial amounts of travel, off the road network. The amount of work-related rural travel increases with increasing economic development. Personal travel is an important activity in rural developing areas. Because of the lack of infrastructure, this travel consumes a substantial amount of time and effort which can otherwise be devoted to more productive activities.

At present, mobility is by foot, by bicycle, and as incomes increase, with the acquisition of motor cycles and later the more expensive four wheelers. It can be improved substantially by the provision of improved access and through the provision of improved transport infrastructure services. In rural mobility enhancement efforts, non-motorized vehicles play a very important role in providing significant mobility increases to the rural poor, once accessibility is increased through the provision of improved access (Howe, 1996).

Although a wide variety of vehicles are used in the rural areas, many of the trips on rural road networks are still by non-motorized vehicles. Therefore, all rural road improvements need not necessarily be designed for motorized vehicle standards as is the current practice. Often, simple clearing, improving drainage, spot surfacing, and safety improvements may do as much to enhance the opportunities for personal travel in areas where foreseeable traffic levels are not likely to justify more expensive investments.

The process of rural development and the stimulus provided by road improvements may induce a shift among these vehicle types as their comparative costs and advantages change. An exclusive focus on four-wheeled motor vehicles may therefore miss much of the change in traffic patterns that is likely to take place in response to rural road improvements.

There are several dimensions of accessibility: population density, economies of scale, access improvements and the availability of appropriate rural transport services (Beenhakker, 1987). These dimensions are seldom uniform in any given region and vary according to incomes, economic base, proximity to transportation networks, terrain, and the nature of products and services. In designing rural transport services, it is important to consider all aspects of mobility using all available modes of transport, including non-motorized transport.

Accessibility is defined as the ability of people to move to and from services or resources (mobility). Changes which improve the degree of accessibility, in a particular area, are:

- Improvements in the means of transport (lower-cost transport vehicles and services),
- Improved transport infrastructure (roads),
- The reduction in the time or risk associated with travel.

The choice of appropriate intervention for improved access requires careful weighing of the costs and benefits across alternatives, or sets of alternatives, within these categories. For example, the siting of water closer to a village can often improve access to water much more cost effectively than a road or path to a far away water source.

Population Density and Economies of Scale have an impact on costs and benefits of access improvements. The benefit of improved siting of services is typically most cost effective where there is no need to exploit economics of scale. For example, because population densities in rural areas are typically low, services such as secondary schools, hospitals, or larger markets of exchange are only viable at larger communities where economies of scale efficiencies can be exploited. For others resources, such as water wells, primary schools, firewood sites, and dispensaries, a smaller scale operation is possible, and therefore a location closer to the source of demand is usually more cost effective than transport.

The Availability of Rural Transport Services is key to enhancing personal mobility. Roads, tracks, paths and the vehicles that move on them are mutually necessary elements of rural transportation. It is important, therefore, to consider options for improving vehicle access (both NMT and motorized) when looking at mobility issues which impact quality of life or economic opportunity. Since the level of vehicle ownership is low in most rural areas, it is the efficiency and availability of transport services on which rural inhabitants nearly fully depend. Rural Transport Services (RTS) are typically limited to the range of passenger and cargo carrying motor vehicles operating on roads and tracks. It is, therefore, important to consider those factors impacting price, availability, and reliability of transport services (Lebo, Schelling and Beusch., 1998).

2.4. Rural Mobility and Accessibility

Rural areas in developing countries lack adequate road systems and prospects are poor for their full development. Combined with this situation is the inadequacy, and, in some cases, complete lack of rural transport services. Several rural transport studies by the Bank lead to a number of robust conclusions (Howe, 1996).

:

A. Where all-weather roads exist, motor vehicles frequently provide services. Often, these services are available on seasonal roads, albeit often at premiums of 200 to 400% above those on all-weather routes. Non-motorized vehicles sometimes fill the gap in services on dry season roads but at higher unit costs.

B. Limited extent of the effective road system and the poor prospects for its extension. A significant proportion of the population, in some cases the large majority, has only seasonal access. This situation could be expected to improve but very slowly. In many of the poorer countries economic prospects have worsened in recent years.

C. Among those who do have all-weather road access, a significant proportion are not able to afford those services that are provided.

D. Household travel is dominated by subsistence tasks. Their prime transport requirement is for the movement of frequent small loads over short distances. Social and welfare needs are the main motivation for longer-distance travel for which road transport might be appropriate. Few households possess any motor vehicles, and so walking, cycling and movement by animal drawn carts dominate.

E. On both on and off the road systems, a wide variety of unconventional and simple vehicles are used, this being more so in Asia than in other developing countries. Important aspects of these vehicles are their relatively low cost and modest infrastructure needs.

F. There is an apparent lack of perception of local level transport problems by policy makers. Many of the real transport problems, faced by the rural population, remain unperceived and neglected. Existing policy analysis and planning procedures have evolved to deal with the more visible parts of the economy such as exports, imports, industry, and their major investment and infrastructure requirements. The procedures and criteria by which investment programs are determined tend to ignore the non-users of motor vehicle transport services and the local level mobility needs of rural people. These are likely to be addressed only if the starting point of the analysis is a local-level perspective.

Dimensions of rural access include both the transport infrastructure (paths, tracks, roads etc) and transport services. Locational constraints regarding various services for the poor are important considerations in the development of rural access. Locational constraints are sometimes referred to as 'siting characteristics". It is the combination of all these requirements that will determine what improvements need to be made to rural transport infrastructure. These are described in **Box 1.**

There is a substantial difference between basic access and full access. **Full access implies an engineered all weather road with a uniform standard. Basic access is defined as the least-cost solution for providing access with some constraints and some reductions in service levels. Basic access implies a lower level, social and economic access for the prevailing motorized and/or non-motorized vehicles, often tolerating minor delays and interruptions in access.** Examples of such situations are heavy floods of short duration when a road may not be passable and may be closed to traffic for a short duration. This approach allows a system of roads, with a tiered level of service criteria, to be considered for implementation. This system of roads would depend upon the type and number vehicles, head loads, and the nature of commodities transported, as detailed in **Box 2.**

The level of service criteria for rural roads can be varied, from unimproved tracks and paths, partially improved tracks and roads, to fully engineered roads consistent with traffic volumes. This tiered system allows for providing varying access to varying communities and improving the infrastructure over a longer period of time as traffic and vehicles change. These concepts are detailed in **Box 3.**

Box 1. Dimensions of "Rural Access"

Access encompasses "the movement of real people and their goods to meet their domestic, economic, and social needs, by any means, along paths, tracks, and roads." It is a multifaceted concept that seeks to simultaneously consider the level of mobility of individuals and the siting and quality of service-providing facilities.

- "Mobility" expresses the ease or difficulty with which rural people move themselves and/or their goods.
- "Siting" is a measure of the average distance or time which the population served has to travel in order to avail themselves of the service provided.
- Ease of "mobility" is affected by transport infrastructure and means of transport.

In many cases, the infrastructure of "rural access" as consisting of the lowest level of gazetted roads, any ungazetted roads that may exist and all paths, tracks, and trails. The means of transport commonly used in rural area range from walking and bicycling and to the use of motorized vehicles of various types.

The Components of Rural Accessibility

<table>
<tr><td colspan="6">Accessibility</td></tr>
<tr><td colspan="5">Mobility</td><td rowspan="3">Siting and Quality of Facilities</td></tr>
<tr><td colspan="2">Rural Transport Infrastructure</td><td colspan="3">Means of Transport</td></tr>
<tr><td>Community Roads, Paths, Tracks and Trails</td><td>Tertiary Roads</td><td>Walking (with and without loads)</td><td>Non-Motorized Transport</td><td>Motorized Transport Services</td></tr>
</table>

It is access which is crucial, rather than transport per se, and that access is multidimensional and can be improved in different ways. Different types of economic activities have differing dependencies on the importance of timely movement of inputs and outputs. Sometimes storage facilities can serve as a substitute for some transport needs. Improving local storage may prove to be a lower cost alternative to attempting to provide all-weather access to external markets. On the other hand, some commodities, e.g., unprocessed milk, cannot be stored for long and are likely to require reliable year-around transport infrastructure. Thus, rural transport planning for economic activities should not only consider alternatives to transport, but should also distinguish between levels of access necessary. Some routes may require reliable access during particular seasons of the year coincident with agricultural production schedules, while others may have demands placed on them throughout the year.

Source: Connerley and Schroeder, 1996.

Box 2. Basic Access and Full Access

A **"basic access"** approach provides useful guidance for the design and evaluation of rural road interventions, and can easily be combined with existing engineering and evaluation techniques. For example, providing farm roads as part of a rural development would likely be consistent with both "basic access" and "economic efficiency" objectives. Similarly, improving roads in order to improve school attendance may be justified on both economic and "basic needs" criteria. Unlike other criteria, however, "basic access" allows for the establishment of simple criteria for determining minimum transport requirements in a variety of circumstances. That is, given the practical requirements of socio-economic activity, **"basic access"** criteria suggest that, at a minimum, rural transport infrastructure must be consistent with the following criteria:

- ***Provides "social" access***--access to centers of health, education, and administration (or the local provision of these services) requires timely all-weather transport. For example, health services or schools, whether provided locally or at district centers, are of little effect if medicines, doctors, or teachers arrive only seasonally. In addition, access to critical care is unlikely if travel time and unreliability of road infrastructure is high.
- ***Trafficable by prevailing rural transport vehicle***--motorable roads or tracks and paths should be designed to a standard which meets the minimum requirements (loading and dimensions) of the predominate rural transport vehicle. For example, if locally harvested goods are typically carried by 4-ton truck, designing roads to a "pick-up truck" standard is not sufficient for providing basic access. For NMT and IMT, for example, this may imply bullock cart or animal passablity.
- ***Provide a connection to higher level road***--the integration of transport system is a prerequisite for successful interventions. The ultimate benefit of most of what moves in rural areas (cargo or passengers) is the possibility of travel to higher level of the network (district or urban centers). Therefore, "basic access" roads should connect in some manner to a higher level road.

Given these criteria, a "basic access" road, path, or track is defined as the least-cost solution for providing passability between two points consistent with:

(i) all-year access with certain exceptions during extreme weather (high level/low duration floods);
(ii) reliable access to the prevailing rural transport vehicles in the area, including non-motorized;
(iii) access from one or several villages to a higher category road in good condition;

Full access, in nearly all cases, implies an engineered gravel road with a uniform standard, which can usually be justified at traffic levels above 500 AADT. Up to a traffic level of 150 vehicles a day roads should be one and a half lane wide (carriageway width of 4.5 to 5.5 meters), while above 150 vehicles two lane roads can usually be justified (6 meters carriageway with shoulders). The provision of a bituminous surface (double/triple surface dressing) can usually only be justified at traffic levels of between 200 to 400 vehicles per day. However, as stated earlier, the above is relevant rather for provincial/regional roads than for rural roads of which the large majority carry traffic of less than 50 AADT. Therefore, when looking at rural access problems, it is important to understand the relationship between observed activities. Basic access, full access, design standards and overall accessibility for the rural population.
Source: Lebo, Schelling and Beusch., 1998

Box 3. Level of Services Criteria for Rural Roads

Upgrading the rural road has several impacts on "accessibility," from the perspective of "level of service." That is, each type of improvement provides for a particular level of passability. For example, an earth road will typically provide seasonal motorized access, while all-weather access would require drainage/slope and pavement gravelling works. Design and its "functionality" impact alternative investments differently. Depending on the combination of local geography (soil, rainfall, and terrain), there is a range of interventions which will provide functional characteristics falling into one of four categories of access:

• ***unimproved***-the degree of passability which would exist without any improvements, i.e., the natural condition and degree of passability of existing tracks and paths;

• ***Partial***-level of service which exists with some improvements to naturally occurring tracks and paths (earth work, spot improvements, etc.), allowing typically seasonal, but improved access;

• ***basic***-minimum investment required to provide simple all-weather access;

• ***full***-consistent standard engineered road for quality (high speed, low roughness) all-weather access

Options for improving rural roads begin with some form of unimproved roads to a partial access standard, then to an improved year-round standard. For the latter, there are three levels of upgrade, seasonal standard (earth road, a minimum standard for year-round vehicle passability (whether motorized or non-motorized), or a higher engineered standard, e.g., usually increased width, formation, and higher surface integrity/travel speed.

Increased standards will expand types of usage, by improving passability and re-liability, and will therefore provide a different level of service to the rural population. For example, a '*basic access road*' is defined as the lowest cost means of providing motorized access (in most areas, an unarticulated 4-ton truck or pickup). In situations where roads are not "affordable" (low population density, mountainous or flooded terrain) or where motorized transport services are not available, perhaps the most cost-effective basic access option will be an all-season standard improved path.

Source: Lebo, Schelling and Beusch, 1998.

3. Poverty Alleviation In China

3.1 Poverty in China

3.11 On Defining Poverty:

China's recent achievements in sustained high economic growth have obscured the fact that China is still a developing country with extreme disparities in incomes and living standards, where millions of people live close to or below subsistence levels. Depending upon which measure (poverty line definition) is used, between 70 and 350 million people in China live in poverty (CIDA, 1997).

The above lower estimate of 70 million is based upon the definition of the poverty line for the absolute poor and the higher estimate of 350 million is based upon the assumption that one needs an equivalent of 1 US$ per day to survive. This latter base line is used in many international comparisons. However, it is unrealistic to use the higher base line China because it would mean that any one making less than an annual income of 3,000 RMB would be classified as poor. The incomes recorded in China are exclusive of substantial social benefits in health, education and housing. Under these circumstances, it would appear that the number of poor people, in China, is somewhere between these low and high estimates.

Absolute poverty level, as defined by the state in China, is an annual income of <318 RMB and the near poor with <454 RMB in 1990 prices. According to official figures, 5.2% of the total population (62 million) were classified as absolute poor and another 8.8% (106 million) as near poor (World Bank, 1997). This means some 168 million people, in China, were living in poverty.

3.12 Increasing Incomes and Increasing Inequality

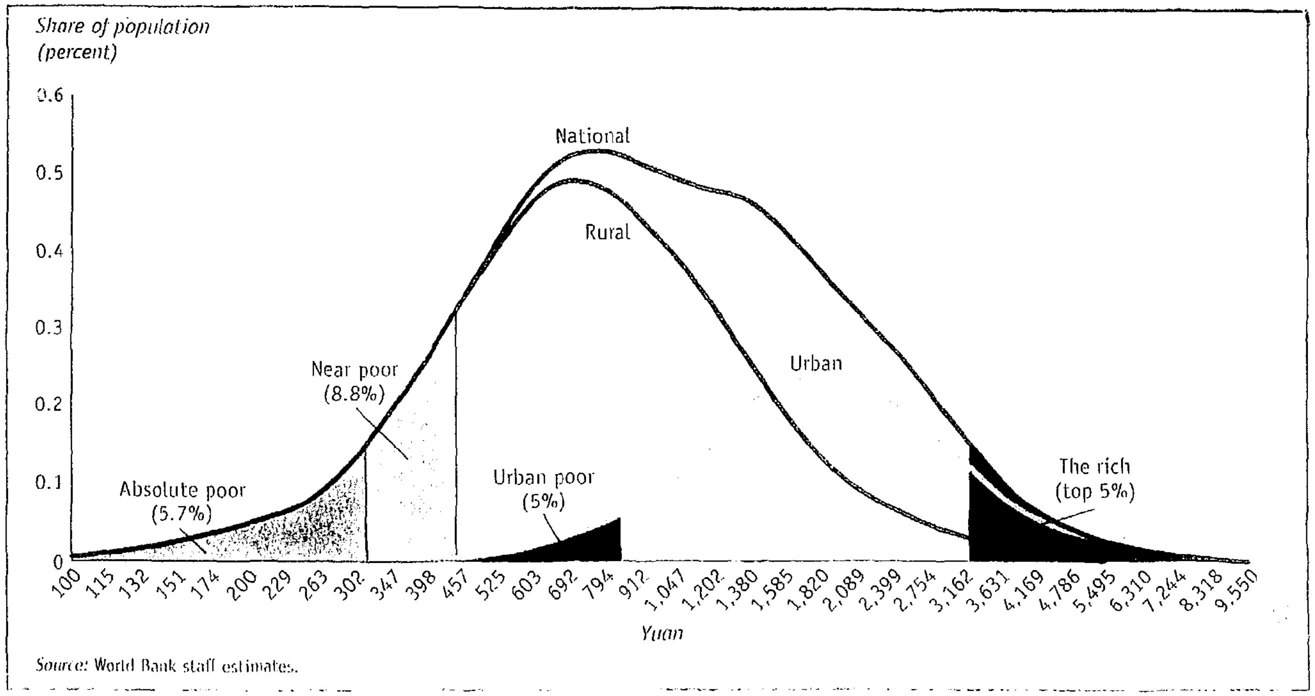
Since 1978, overall incomes have increased considerably. However, income distribution has become more unequal. The Gini Coefficient (a measure of inequality of income distribution ranging from 0=absolute equality, to 100=absolute inequality) which was 28.8 in 1981 reached 38.8 in 1995. China was an egalitarian society in 1981, with its income distribution resembling that of Finland and The Netherlands. Its rapid economic growth has since brought about a dramatic change in its income inequality pattern. It now resembles the average for the world. However, absolute income levels remain quite low when compared with other industrialized countries (World Bank, 1997).

3.13 Rural/Urban Divide

Absolute poverty in China is overwhelmingly a rural phenomenon. This is only partly due to the fact that China's population is still predominantly rural. In 1990, about 95% of China's poor lived in the rural areas, a much higher proportion than of the rural population as a whole (CIDA, 1997)). The distribution of the rural and urban poor over various income ranges is shown in **Figure 2.**

The most notable characteristic of rural poverty is " its regional clustering". Far from being evenly distributed in the country, rural poverty is concentrated in a number of well-defined regions with particular physical and social characteristics. The highest incidences of rural poverty are found in rural areas of inland provinces (rather than coastal provinces) and in remote mountainous areas.

Figure 2. Rural Poor and the Urban Poor in China : Income Ranges



Source : World Bank, 1997.

Rural poverty is less a product of household by household disparities than a byproduct of differences in conditions such as the economic conditions that provide for the possibility of income augmentation or the local differences in ecological conditions that provide for basic subsistence. Since virtually all of China's rural population received land use rights as part of the implementation of the production responsibility system during the early 1980s (also known as family or farm responsibility system), there are few, if any, landless laborers. Instead the majority of the rural poor are, now, concentrated in resource-deficient areas and comprise entire communities located mostly in the upland sections of the interior provinces of northern, northwestern and southwestern China. Although these poor have land use rights, in most cases the land itself is of such low quality that it is not possible to achieve subsistence levels of crop production. The poorest households are further disadvantaged by social and economic factors such as high dependency ratios, ill health and lack of education (World Bank, May 1997).

Rural poverty is correlated with extremely low educational and health status, especially among women. Lack of access to safe drinking water is also a correlate of rural poverty and so is inadequate housing. Many of these settlements and villages do not have the necessary social infrastructure to support their health and education needs and rural residents often have to travel long distances on paths and tracks to receive these services (CIDA, 1997, and World Bank, May 1997).

The rural/urban divide in China is increasing. While rural incomes grew rapidly in the early period of reforms, they began to trail increases in urban incomes in 1985, a trend which reversed slightly in 1995. The rural/urban income gaps explained one third of total inequality in 1995. Internationally, the urban/rural income ratio rarely exceeds 2.0, as it does in China. In most countries, it is below 1.5.

However, even China's high disparity ratio fails to capture the full extent of disparities in living standards between city dwellers and rural residents. An elaborate set of publicly provided services including housing, pensions, health, education, and other entitlements augment urban incomes by an average of 80%. When official data is adjusted for these factors, rural/urban disparities accounted for more than half of the inequality in 1995 and explains most of the increase since 1985 (World Bank, 1997).

3.2 Geographic Distribution of Poor Counties

In 1986, the state designated 327 counties as "national poor counties", or **"state designated poor counties"** eligible to receive grants from the Poor Area Development Office (PADO) of the central government. This designation was based upon rural income and agricultural production in each county. A county was eligible if its average annual per capita rural income was less than 200 RMB in 1985 or its average annual agricultural production was less than 200 kilograms of grains. If a county was an early revolutionary base, then it could have a per capita annual rural income of 200-300 RMB.

Also in 1986, the provinces designated another 372 counties as "provincial poor counties", eligible to benefit from province level assistance. Provincial poverty lines varied from 200-500 RMB annual per capita rural income, depending upon any unique characteristics. There are ten provinces whose share of poor counties exceeds their total share of counties. These are the provinces with the highest incidence of poverty in descending order: Yunan, Guizo, Shaanxi, Gansu, Inner Mongolia, Guangxi, Ningxia, Sichuan, Shanxi and Henan. Four of these provinces are in the central macro region and the other six are in the western region(Cai, 1992).

In 1992, the central government, using the State Statistical Bureau's (SSB) household data, revised the list of poor counties. A county was considered a **"national poor county or state designated poor county"** if its average annual per capita income was less than 400 RMB in 1992 and the county was not on the 1986 list, or if its average rural per capita income was less than 700 RMB in 1992 and the county was still on the 1986 list. **There were 592 "national poor counties" in 1996** (World Bank, 1997), 28% of all 2,148 counties in China. The geographical distribution of these counties is shown in **Table 1.**

The criteria used by the provinces for designating "provincial poor counties" has not changed much since 1986. However, because of increasing incomes, **the number of provincially designated poor counties has declined from 372 in 1986 to 232 in 1998.** For implementing RIPA programs, both **" provincially designated and nationally designated counties "** are considered. **Figure 3 shows all the 824 poor counties (592 state designated and 232 provincially designated) in 1998.**

3.3 Poverty Alleviation Policies

China's record on reducing poverty is enviable. Since the reforms started in 1978, China has lifted some 200 million people out of absolute poverty (World Bank, 1997). Most of this progress occurred during the early years of reform when the introduction of the household responsibility system transformed the countryside. During 1981-95, over all GDP growth has helped substantially in reducing poverty.

China's commitment to eradicate poverty remains strong. Repeated policy declarations have been made to eliminate poverty by the year 2000. These declarations have been backed up by budgetary allocations, assignment of policy priority in socio-economic planning and the structuring of significant institutional capacity directed at the goal of poverty reduction. In the mid 1980s, coinciding with the Seventh Five year Plan (1986-90), the government launched a nationwide integrated poverty relief campaign to overcome the sluggish economic development in low income areas.

The Leading Group for the Economic Development of Poor Areas (LGEDPA) was created by (and reports to) the State Council in 1986, as the central agency responsible for coordination of poverty alleviation. This is an inter-ministerial task force consisting of representatives from 17 ministries as well as relevant research organizations, with counterparts at all administrative levels. An increase in financial allocations was earmarked for poverty alleviation. As the LGEDPA's executive agency, the Poor Area development Office (PADO), has emerged as the principal advocate of China's rural poor and is now the key agency responsible for coordinating more than US$ 1 billion in annual funding for China's poverty reduction programs (CIDA, 1997).

The 8th Five Year Plan (1991-95) confirmed the central role of the LGEDPA in poverty reduction, including its role as the coordinating body responsible for poverty measurement and research, project planning, monitoring and management of domestic and international (bilateral and multilateral) assistance for poverty reduction. In 1994, an ambitious seven year program (8-7 Poverty Eradication Plan, 1994-2000) was launched. This was aimed at solving the problems related to providing adequate food and clothing for China's (then) remaining 80 million poverty-stricken people in the rural areas.

The 8-7 Poverty Eradication Plan (1994-2000) outlines a series of detailed targets to be achieved by the year 2000. Targets include:

- Net annual per capita income for the majority of the households in 592 targeted poverty counties must surpass 500 RMB in 1992 prices;
- Provide assistance to poor households to create conditions to solve the food problem;
- Provision of adequate drinking water for people and livestock;
- **Efforts to strengthen infrastructure facilities linking most "poor townships" to highway systems, power grids and telecommunications networks in order to connect them to commodity and other rural product market; and**
- Efforts towards improving the backward situation in cultural, educational, and health fields.

Many central government agencies have special programs in poor areas in the form of partnerships and twinning with a particular agency or a region. For example, the Ministry of Civil Affairs spent nearly 2 billion RMB during 1985-90 for promoting employment for 1.1 million rural people. Another component of the Poverty Alleviation Program is the Food for Work Project (FWP) Funding, also called the Relief Works Funding. **Total expenditures by the Western Regional Office of the State Planning Commission during 1985-92 reached 10 billion RMB (including matching funds by provincial and local governments) and have resulted in the construction of 110,000 km of rural roads (CIDA, 1997 and World Bank, June 1992).**

The Ministry of Communications (MoC) has been the lead agency with regard to construction, and rehabilitation roads to poor areas. MoC has done this by providing funds for RIPA (construction, rehabilitation and maintenance). It has provided this assistance in partnership with the provinces. MoC provided 506 million RMB in 1992 which increased to 739 million RMB in 1996 (an increase of 46%). The provinces have also recognized the importance of providing proper access to the poor and have increased their assistance substantially. During the same period, 1992-96, provincial funds dedicated to RIPA have increased from 494 million RMB to 2.973 billion RMB, an impressive increase of 502%.

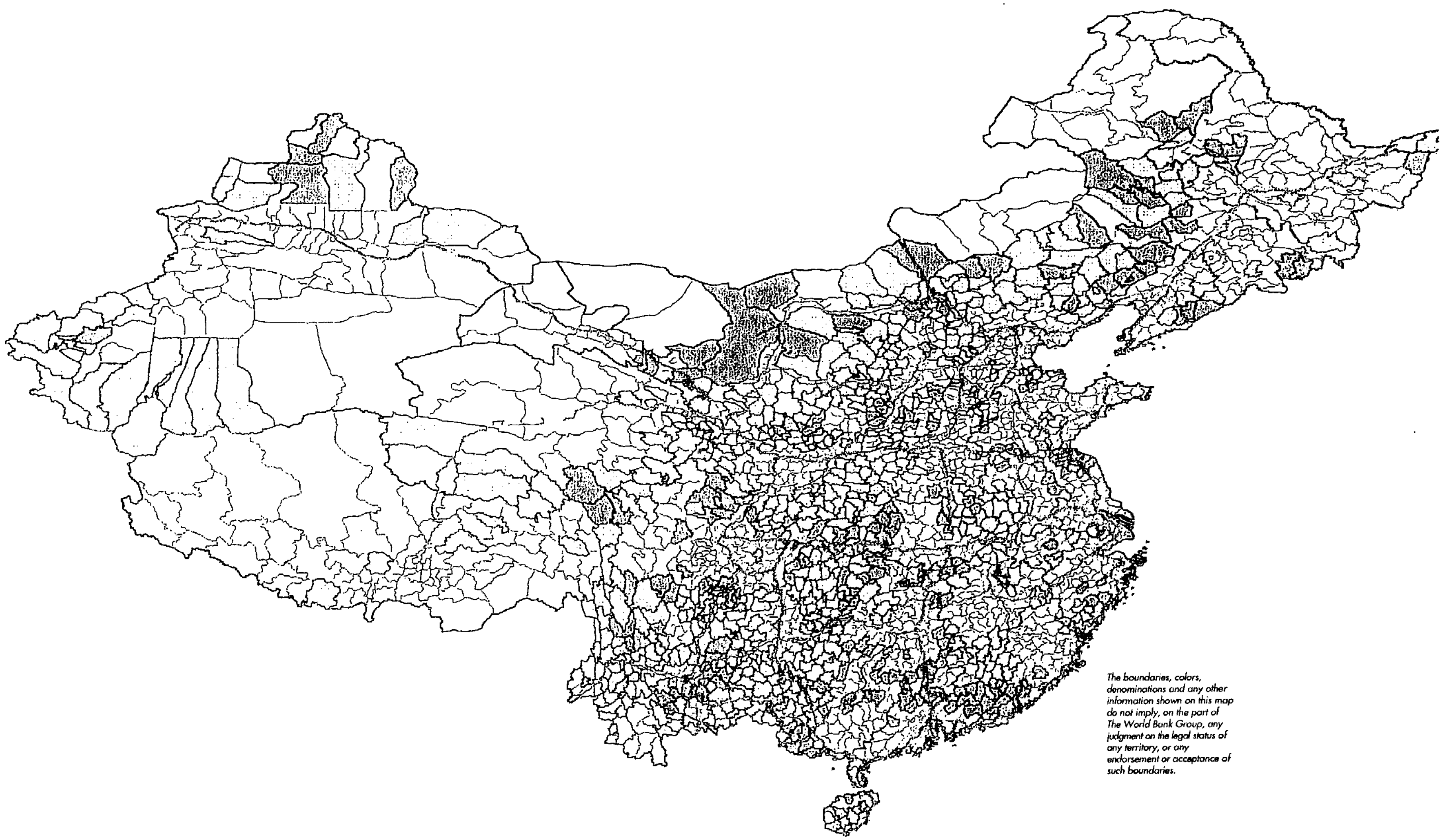
Table 1. Distribution of 592 State Designated Poverty Counties, 1998

Provinces	Number of Counties or Equivalents	Number of Poverty Counties	Poor Counties as % of Total Counties
National Total	**2,148**	**592**	**27.56%**
Guizhou	80	48	60.00%
Yunnan	123	73	59.35%
Gunsu	75	41	54.67%
Shaanxi	92	50	54.35%
Ningxia	18	8	44.44%
Inner Mongolia	84	31	36.90%
Hubei	69	25	36.23%
Qinghai	39	14	35.90%
Shanxi	100	35	35.00%
Guangxi	81	28	34.57%
Hainan	17	5	29.41%
Xinjiang	85	25	29.41%
Hebei	139	39	28.06%
Anhui	68	17	25.00%
Sichuan*	174	43	24.71%
Henan	116	28	24.14%
Jiangxi	84	18	21.43%
Liaoning	44	9	20.45%
Heilongjiang	68	11	16.18%
Fujian	63	8	12.70%
Jilin	40	5	12.50%
Hunan	92	10	10.87%
Shandong	95	10	10.53%
Tibet	77	5	6.49%
Zhejiang	64	3	4.69%
Guangdong	78	3	3.85%

*Including Chongqing

Source: "The Analysis and Evaluation on the Present Situation of Socioeconomic and Rural Roads in China's Major Poverty-Stricken Areas", The Institute of Comprehensive Transportation, November 1998, State Development Planning Commission, Beijing, 1998.

Figure 3. Poverty Counties in China



NTHS (priority route)
NTHS (longterm route)

Poverty Counties
State Poverty Counties
Provincial Poverty Counties

4. Rural Road Systems in China

4.1 Road Classification

In 1996, China had 1.19 million Km of roads. **Table 2** shows an inventory of classified roads in various categories. National roads are the primary responsibility of the national government. The provinces do the construction, rehabilitation, and maintenance with funding assistance from the national government. Provincial roads are the responsibility of the provinces. Counties, townships and villages are responsible for their own road systems and they receive funding assistance from the provinces and the national government. Industrial roads are the responsibility of various enterprises. They are built and maintained by these enterprises.

Of the 1.19 million km of existing roads, 9% are national roads, 15% are provincial roads, and the remaining 76% (847,905 km) of roads in China are county, township and village roads. **These are the rural roads**. A small portion of this rural road network, (5,327 km or 6%) is composed of high-grade roads, such as Expressways and Class I Roads. Of the remaining 94% of rural roads, 18,793 km were Class II roads (2%) and another 95,780 km (11.5%?) were Class III roads. Class II and III roads are largely roads for commerce and they serve the rural population also.

Table 3 details data on county, township and village roads. Even within the counties, townships and villages, there are some higher grade roads. There are 847,905-km of roads under the jurisdiction of counties, townships and villages. Of these roads, 136,731 Km (16.1%), are Class I,II & III roads. There are 507,150 km of Class IV Roads (59.8%) and the remaining 204,024-km (24.1%) are Unclassified Roads. Class IV and Unclassified Roads, which total to 711,174 Km (83.9%), are of primary importance to the rural population, especially the rural poor.

Table 4 shows the townships and administrative villages in the poor counties, without road connections. In 1996, there were 2,148 counties in China. Of these, 592 counties were State Designated Poor Counties (27.6%). There were a total of 49,445 townships. Of these, 1,335 townships (2.7%) did not have road access. There were a total of 747,408 administrative villages, of which 120,048 villages (16%) did not have road access, not counting provincially designated poor counties.

Table 5 shows the level of service provided by the county, township and village roads. In general, they are lower class roads with gravel or cobblestone, and dirt roads. **Only 8% of these roads were high-grade gravel surfaces. 85% of the road length had some level of gravel surfacing, albeit of lower grade.** A substantial number of townships and villages do not have road access and many more have only seasonal access. For those with road access, the condition of roads vary, but in general, they are gravel roads of varying quality.

Table 2. Classified Roads in China, 1996

Classification	Total Length		High Grade Roads (km)				Ordinary Roads (km)		Unclassified Roads (km)
	(km)	%	Express-Way	Class I	Class II	Class II	Class III	Class IV	
Total	**1,185,789**	**100.0%**	**3,422**	**11,779**	**4,130**	**92,860**	**216,619**	**617,608**	**239,371**
National Road	110,375	9.3%	2,316	5,497	2,913	35,778	33,139	23,280	7,450
Provincial Road	178,129	15.0%	1,060	3,873	1,213	37,204	59,033	50,923	24,823
County Road	378,212	31.9%	46	1,352		14,625	76,160	197,680	88,349
Village and Town Road	469,693	39.6%		760		4,168	39,620	309,470	115,675
Industrial Road	49,380	4.2%		297	4	1,085	8,667	36,255	3,072

Source: "The Analysis and Evaluation on the Present Situation of Socioeconomic and Rural Roads in China's Major Poverty-Stricken Areas," The Institute of Comprehensive Transportation, November 1998, State Development Planning Commission, Beijing, 1998.

Table 3. County, Village and Town Roads: Road Classification, 1996

Road Classification	County Road (km)	Village and Town Road (km)	Total Length (km)
Expressway and Class I	1,398	760	2,158
Percent of Total Roads	0.37%	0.21%	0.34%
Class II	14,625	4,168	18,793
Percent of Total Roads	3.87%	1.18%	2.92%
Class III	76,160	39,620	115,780
Percent of Total Roads	20.14%	11.19%	17.98%
Class IV	197,680	309,470	507,150
Percent of Total Roads	52.27%	87.42%	78.76%
All Classified Roads (km)	289,863	354,018	643,881
Percent of Total Length	76.64%	75.37%	75.94%
All Unclassified Roads (km)	88,349	115,675	204,024
Percent of Total Length	23.36%	24.63%	24.06%
Total Length of Roads (Classified and Unclassified)	378,212	469,693	847,905

Source: "The Analysis and Evaluation on the Present Situation of Socioeconomic and Rural Roads in China's Major Poverty-Stricken Areas", The Institute of Comprehensive Transportation, November 1998, State Development Planning Commission, Beijing, 1998.

Table 4. Townships and Administrative Villages Without Roads, 1996

Counties, Townships and Villages	Roads
Total Counties	2,148
Poor Counties (State Designated)	592
Poor Counties as % of all Counties	27.56%
Total Townships	49,445
Townships Without Roads	1,335
Percent of Townships without Roads	2.70%
Total Administrative Rural Villages	747,408
Administrative Rural Villages Without Roads	120,048
Percent of Administrative Rural Villages without Roads	16.06%

Source: "The Analysis and Evaluation on the Present Situation of Socioeconomic and Rural Roads in China's Major Poverty-Stricken Areas", The Institute of Comprehensive Transportation, November 1998, State Development Planning Commission, Beijing, 1998.

Table 5. County, Village and Town Roads: Road Surface, 1996

Road Classification	County Roads	Village and Town Roads	Total Km	Total %
High Grade Roads (km)*	1,398	760	2,158	
%	0.37%	0.16%		0.25%
Sub-High Grade Roads (km)**	14,625	4,168	18,793	
%	3.87%	0.89%		2.22%
Medium Grade Roads (km)***	76,160	39,620	115,780	
%	20.14%	8.44%		13.65%
Lower Grade Roads (km)***	197,680	309,470	507,150	
%	52.27%	65.89%		59.81%
Paved Roads (km)	289,863	354,018	643,881	
%	76.64%	75.37%		75.94%
Un-Paved Roads (km)	88,349	115,675	204,024	
%	23.36%	24.63%		24.06%
Total Length of Roads	378,212	469,693	847,905	100.00%

Notes: * Bituminous pavements, ** Majority of these road are paved with cobble stone/gravel, *** Dirt roads with some gravel/sand pavement.

Source: "The Analysis and Evaluation on the Present Situation of Socioeconomic and Rural Roads in China's Major Poverty-Stricken Areas", The Institute of Comprehensive Transportation, State Development Planning Commission, Beijing, 1998.

4.2 Bearing the burden: Who pays for what?

Investment in county and township road construction has steadily increased since 1992. This is particularly so because of the emphasis, in the 8-7 Poverty Eradication Plan (1994-2000), on providing all weather access roads to the rural people. Poverty Alleviation Funds, from MoC and the provinces are, generally, **used for Class IV and Unclassified roads. Annual investment, in county and township roads, increased from 1.7 billion RMB in 1992 to 17.6 billion RMB in 1996, a 5 year increase of more than 1000%. Table 6** shows these investment patterns during 1992-96.

Table 6. Investment in County and Township Roads, 1992-96

Year	Investment (million RMB)	% of Increase over Previous Year
1992	1,698.20	
1993	5,791.09	241.01%
1994	5,258.69	-9.19%
1995	10,196.19	93.89%
1996	17,556.80	72.19%

Source: The Research on Funding Sources for Rural Road Construction and Maintenance in China's Major Poverty Stricken Areas, The Institute for Comprehensive Transportation, State Development Planning Commission, Beijing, 1998.

The cost of building China's transportation infrastructure is shared in a variety of ways between citizens, users, and local and state governments. Sources and extent of contribution are detailed in **Table 7.** Rural peasants contribute time or money as **"peasant worker construction activity".** This is an established practice of many years emphasizing local responsibility for local roads. Traditionally it was a strict donation of labor, but now it is assessed at a maximum of 3 days of labor per adult farmer per year or its equivalent value in RMB on all adult individuals living in the influence area of the road. This contribution is based on the premise that farmers are the major beneficiaries of these rural roads which provide year round access to markets. On average, most farmers provide labor, however, a small number of farmers are now able to pay in cash. The total contributions, in terms of labor and cash, are estimated at approximately **30% of the total annual infrastructure investments.** It is estimated that **11% of the total funding for RIPA** in China is derived from this fee.

In 1998, the state approved an **additional fee of 0.02 RMB per liter on motor fuels,** to be levied in 1999, to replace the road maintenance fee. This is a new additional fuel tax applied to all motor vehicle fuels in China. It will be collected by the national government and earmarked for road maintenance. It is expected to be distributed to the provinces in accordance with regulations yet to be established. Approximately 50% of this new revenue will be used for road repair and maintenance and the remaining 50% for road construction and renovation. **About 20% of tax revenue derived from this source is expected to be used for rural roads.**

Table 7. Funding Sources for RIPA, 1998

Funding	Source and Description	% of Total
1.Peasant Worker Construction	No more than 3 days per year for workers. No more than two days per year for vehicles (excluding bicycles) and vessels.	30%
2. Additional Fuel Fee (Replacing the Road Maintenance Fee)	Enacted in 1998 to replace the Road Maintenance Fee. 50% of the revenue is used for highway maintenance and 50% for construction and renovation. About 20% of the total is used for rural roads. This fee is collected by the provincial communications authorities.	11%
3. Passenger and Cargo Transport Additional Fee	The rate is 0.01 to 0.02 RMB per person/km and 0.01 RMB per ton/km for cargo. This fee is levied by the provinces and municipalities. An additional fee of 0.01 RMB is in effect in 1998. About 20% of these revenue is used for passenger transport station and facilities as well as some road construction	2%
4. Tractor Road Maintenance Fee	Collected by individual district-level cities and all revenue is used for county and village road construction and maintenance. The fee is based on standard tonnage and/or engine power (2HP = 1 ton).	10%
5. Work In Place of Relief Fund	The State authorities provide these funds as materials and supplies in salary equivalents. Local authorities will match the funds at 0.5 to 1.0 RMB for each RMB of State Funds	8%
6. State Poverty Alleviation Funds	Ministry of Communications allocates some of the revenues, from vehicle purchase taxes collected by them, to subsidize rural road construction in poor counties.	4%
7. Provincial Poverty Alleviation Funds	The provinces also provide, from their poverty alleviation budget, funds for road construction and maintenance in poor counties.	17%
8. Local (County, Town, Village) Funding	This is about 0.5 to 1 % of the local fiscal income.	15%
9. Local (County, Town, Village) Highway Beneficiary Fees	Enterprises along the roads are required to make contribution either in cash or in materials.	1%
10. Loans (Domestic and International)		2%
Total Funds		100%

Source: Adapted from "The Research on Funding Sources for Rural Road Construction and Maintenance in China's Major Poverty-Stricken Areas", The Institute of Comprehensive Transportation, November 1998, State Development Planning Commission, Beijing, 1998.

The user **fees levied on passenger and cargo transport operators** are detailed in **Table 7.** These user fees generated approximately **2% of the total** investment in road infrastructure in China during 1998. Revenues generated by this user fee are used primarily to support the construction and operation of passenger transport terminals and facilities throughout China. Only a very small portion of revenues generated by this user fee is used for road construction and maintenance. **Tractors** are charged a maintenance fee based upon the size of the tractor. This is also a road user fee based upon weight and size. These fees are estimated to amount to about **10% of the total** RIPA investment.

State authorities provide funds (essentially materials and supplies in salary equivalents) for **"work in place of relief".** This assistance is meant to provide paid work for the unemployed persons. Local authorities match the state funds, varying from 50% to 100%. This is a program which provides labor for various public works, including rural roads construction and maintenance. The value of this labor was **estimated at 8%** of the total investment in RIPA.

The state provides a variety of **poverty alleviation assistance funds,** some of which are used for public works in the designated poor counties. The Ministry of Communications, which is responsible for the highway system, uses some of the revenues from vehicle purchase taxes as poverty alleviation funds. State funds are supplemented by provincial poverty alleviation funds, which have been substantially higher than the funds allocated by the state (MoC) in recent years.

Table 7 shows that state and provincial poverty alleviation funds amount to 21% of total funding requirements. The **work in place of relief funds and the state poverty alleviation funds, together, amount to 12%** of RIPA investment in 1998. **Fifteen per cent** of RIPA funds are derived from local government (county, township and village level) resources. This is a large amount in terms of the capacity of local governments to raise revenues. **The remaining 3%** comes from a variety of sources including loans.

Table 8. Poverty Alleviation Funds
Allocated for Road Construction and Maintenance in Poor Counties

Year	Total Poverty Alleviation Funds Allocated to Poor Counties Million RMB	Funds from Ministry of Communications		From the Provinces	
		Million RMB	% of Total	Million RMB	% of Total
1992	1,000	506.22	50.61%	493.95	49.39%
1993	339.97	25.52	7.51%	314.45	92.49%
1994	n/a	n/a	n/a	n/a	n/a
1995	2,604.20	888.12	34.10%	1,716.08	65.90%
1996	3,711.34	738.56	19.90%	2,972.78	80.10%

Source: "The Research on Funding Sources for Rural Road Construction and Maintenance in China's Major Poverty-Stricken Areas," The Institute of Comprehensive Transportation, November 1998, State Development Planning Commission, Beijing, 1998.

Table 8 shows the allocation of poverty alleviation funds (State and Provincial) for RIPA between 1992 and 1996. In 1992, the poverty alleviation funds allocated for RIPA were 1.0 billion RMB, increasing to 3.7 billion in 1996 (an increase of 371%). State contributions for RIPA have come from MoC, with 506 million RMB in 1992 increasing to 739 million RMB in 1996 (an increase of 46%). On the other hand, the provincial funding for RIPA has increased dramatically from 494 million RMB in 1992 to 2,973 million in 1996, a staggering increase of 502%. In 1992, 51% of these funds came from MoC which has now decreased to 20%, with the provinces increasing their funding very substantially.

Most of the existing rural roads in the poor counties are unclassified roads. In general, these roads are the responsibility of the counties for both construction and maintenance. However, the counties now receive funding assistance as detailed above. When these counties are able to propose upgrading of the unclassified roads to Class IV standards, they receive funding from the provinces.

The cost sharing arrangement for the construction of RIPA roads vary from province to province. The arrangement in Shaanxi province is shown in **Table 9.** Although the proportion of assistance may vary in various provinces, the principle remains the same: **the provinces generally do not contribute to the construction and maintenance of rural roads of unclassified standard. Most of these unclassified roads are primarily in the areas where the rural poor live.**

Table 9. Province/County Cost Sharing for Road Construction Shaanxi Province, 1995

Road Type	SPTD Share	County Share
New Construction, Class IV Road	75% of 0.6M RMB per km	The Remaining Portion
Rehabilitation, Class IV Road	75% of 0.3M RMB per km	The Remaining Portion
Upgrade Unclassified Road to Class IV Road	75% of 0.3M RMB per km	The Remaining Portion
Upgrade Class IV Road to Class III Road	75% of 1.0M RMB per km	The Remaining Portion
New Construction, Unclassified Road (50,000-100,000 RMB per km)	No Subsidy	All paid by County
Rehabilitation and Maintenance of Access Roads	No Subsidy	All paid by County

Source: Shaanxi Provincial Transport Department (SPTD), 1995

4.3 Vehicle Mix, Traffic Volumes and Road Classification

4.3.1 Vehicle Mix and Traffic Volumes

It is the practice in traffic engineering to convert various types of motor vehicles into a single common unit such as the Passenger Car Unit Equivalent (PCUE). Generally, only the motor vehicles are converted into PCUE. Then PCUEs of ADT are used in Road Classification, which, in turn, are used to determine the appropriate Functional and Structural Design Standards.

These concepts were conceived and developed in western countries during the 1960s and have been revised many times since. In these countries, the car ownership rates were and are high and non-motorized traffic has been quite low. The emphasis for highway construction and use was the "passenger car". All other motor vehicles are considered in terms of their equivalencies of the average passenger car, based upon the size and weight. These equivalencies became the basis for functional classification and the design of highways of various classes. Most of the traffic on the highways of these countries is primarily composed of cars and trucks of various sizes and weights. Therefore, this method has worked reasonably well in the western countries where passenger car ownership rates continue to be very high, with practically every family owning and using a car.

However the vehicle mix is quite different in developing countries. In China, there is a tremendous mix of motorized (MVs) and non-motorized vehicles (NMVs). On rural roads, passenger cars, including for hire vehicles, range from 5% to 10% of the total traffic volume only. This reflects the current low personal car ownership rates. In addition, most of the cars and other lightweight vehicles are owned by various enterprises rather than by individuals. However, individual ownership rates are becoming common, especially in richer provinces. Other MVs include buses, trucks and tractors. In China, tractors are used quite extensively for off the farm transport of persons and goods especially for short distances.

NMVs are used extensively for urban (within the village and township) and short distance rural travel (outside the towns and villages) in China and other Asian countries (Replogle, 1992; Padeco, 1995; Pendakur, 1996). Bicycles (two and three wheels) are used for both passenger and goods transport. Bicycle carts (rickshaws) and animal carts are used extensively for goods transport, especially in rural areas. **Much of the travel in poor counties is "on foot", with and without head loads.** Non-motorized Transport (NMT), in China, consists of both the NMVs and Pedestrians.

For classification and design of roads in China, both the Passenger Car Unit Equivalent (PCUE) and the Medium Truck Equivalents (MTE) are used. A medium truck is defined as a vehicle whose gross vehicle weight is more than 2.5 tons and less than 7.0 tons. For rural roads, in general, MTE is used. **Table 10** shows the PCUE and MTE for various vehicles using rural roads in China. The assumptions underlying these equivalencies introduce various biases into the design practices. For example, the data presented in **Table 10** assumes that 10 bicycles are equivalent to one medium truck. If the bicycles are primarily used for personal travel, these equivalencies are biased in favor of the bicycle. If they are used for the transport of goods, they may be still biased in favor of the bicycle. **Table 10** also shows that two bicycle carts are assumed to be equal to one medium truck. While this is exaggerated, the equivalency of two animal carts to one medium truck, is quite appropriate.

Table 10. Passenger Car Unit Equivalent (PCUE) and Standard Medium Truck Equivalent (MTE) For Rural Roads

Vehicle Classification	Loading Capacity, House Power, Vehicle Type	PCUE	MTE
Bicycle - 2 wheels	Including motorized bicycles	0.20	0.10
Bicycle - 3 wheels	Including motorized bicycles	0.60	0.30
Motorcycle - 2 wheels		0.40	0.20
Motorcycle - 3 wheels		0.60	0.30
Carts/Rickshaw - 2 wheels	Including Manual rickshaw, hand cart etc.	1.00	0.50
Cart, Drawn by 1 Horse	Including single animal-powered rickshaw, cart etc.	2.00	1.00
Cart, Drawn by 2 Horses	Including multi-animal-powered rickshaw, cart etc.	4.00	2.00
Passenger Car		1.00	0.50
Taxi		1.00	0.50
Small Tractor	Less than or equal to 12 HP	2.00	1.00
Medium & Large Tractor	More than 12 HP	2.00	1.00
Small Bus	Less than 20 seats, Including cars, jeeps, passenger motorcycles etc.	1.00	0.50
Large Bus	Equal to or more than 20 seats	2.00	1.00
Van	Less than 2.5 tons	1.20	0.60
Large Van	Less than 9 tons	2.00	1.00
Small Truck	Less than 2.5 tons, includes freight motorcycles and rickshaws	1.50	0.75
Medium Truck	Between 2.5 to 7 tons, includes cranes and specialty vehicles	2.00	1.00
Large Truck	Greater than 7 tons, includes cranes and specialty vehicles	3.00	1.50
Tractor Trailer	Includes semi-trailers and trailers	3.00	1.50

Sources: 1. "Highway Design Hand Book, 1995", Ministry of Communications, Beijing 1995.
2. "Technical Standards of Highway Engineering, 1998", Ministry of Communications, Beijing 1998.

Vehicle equivalencies are very important as they are used in determining the functional classification of highways and the design standards, which have a direct impact on the cost of access. In case of roads, which are primarily for basic access and where vehicular traffic volumes are very low (in MVs and MTEs), it is necessary to exercise caution in determining the standards. **If appropriate standards are not used, roads may be built to a substantially higher standard than necessary and hence at a higher cost.**

Given the limited resources for RIPA, higher standards than required means that the total length of roads built will be less than otherwise. Consequently, connecting fewer number of communities will be connected and therefore, fewer number of people will have their accessibility improved. **Higher costs reduce potential access available to the poorer areas. The key issue is to develop appropriate standards for the required traffic volumes and vehicle mix, and then improve these roads to a higher standard as the traffic volumes increase.**

4.3.2 Road Classification

Table 11 shows the highway classification standards used for inter-city roads in China. RIPA roads fall into, essentially, Class IV and Unclassified Roads. Most of these roads are basic access roads, in the category of Class IV (Single Lane) and Unclassified Roads.

Table 11. Highway Classification Standards, 1998

Types of Highway	**Traffic Volume (ADT/MTE*)**	**Traffic Volume (ADT/PCUE*)**
High Speed Highways MVs Only		
Expressway - 8 Lane		60-100,000
Expressway - 6 Lane		45-80,000
Expressway - 4 Lane		25-55,000
Highways		
Class I		15-30,000
Class II	3,000-7,500	
Class III	1,000-4,000	
Class IV - Double Lane	200-1,500	
Class IV - Single Lane	< 200	
Unclassified Roads	< 200	

Source: Socio-Economic Benefit Analysis of Proposed highway System # 41, Baihe County, August 1995, Shaanxi Provincial Transport Department, 1995.

Their current traffic volumes (ADT) are, generally <200MTE. Unclassified Roads are generally built with dirt/earth surfacing and in some cases with cobble stone surfacing. Class IV Roads are built with gravel/sand/cobble stone pavement surfaces. These are primarily low volume roads. The key issue is that all weather accessibility requires careful design, construction and maintenance of slopes, grades and drainage structures.

As shown in **Table 11,** the current classification standards allow for low volume roads of ADT less than 200 MTE to be built as Class IV Single lane or Unclassified roads. Most of the roads linking towns and villages in poor counties will continue to have traffic volumes (ADT) of less than 200 MTE. Many will have less than 100 MTE.

Table 12 shows the traffic volumes in ADT and converted MTEs for a typical RIPA Road (Len-Hou Highway in Baihe County) in Shaanxi Province in 1995. **About 13% were passenger cars, 12% buses, 39% goods vehicles, 30% agricultural vehicles, and the remaining 6% NMVs.** Pedestrians with head loads were not counted. This road was upgraded from an Unclassified Road to a Class IV Road in a recent RIPA program.

4.4 Current Design Standards

Table 13 shows the current functional, geometric and structural design guidelines for rural roads. These design guidelines are from a recent RIPA project in Shaanxi Province. However, design standards, for Class I, Class II, Class III and Class IV roads in China, are mandated by the Ministry of Communications. All provincial, prefecture, and county authorities are required to follow these guidelines. The primary difference between Class IV Roads and Unclassified Roads is in the required total width and paved width. Class IV roads are paved (sand and gravel with compacted sub-grade) to a minimum width of 3.5 m. The geometric and functional design standards are the same for Class IV Roads and Unclassified Roads.

Unclassified roads are a responsibility of the provinces. They delegate this responsibility, to a large extent, to the counties. They are generally compacted dirt and earth roads, with minimum shoulders.

4.5 Appropriate Design Standards for RIPA Roads

There are three types of accessibility problems which confront the rural population:

A. No Road Access At All
B. Seasonal Roads, with Unreliable Passability
C. All Weather Roads in Poor Condition, Unreliable Passability

Access roads can be considered at three levels as follows:

A. **Partial Access Roads,** for trip purposes which do not require all weather accessibility. Examples of these roads are farm access and forestry access roads.
B. **Basic Access Roads**, the minimum investment required to provide all weather passability (with some exceptions for extreme but infrequent weather conditions such as high floods of short duration causing a short duration delay or road closure) consistent with traffic safety and the functional requirements of prevailing and forecast traffic volumes and vehicle mix,
C. **Full Access Roads** which are fully engineered commensurate with prevailing and forecast traffic volumes and vehicle mix, providing all weather accessibility.

Rural residents are vocal in demanding the same accessibility linkages to the outside world as other communities who have such access. However, in upgrading the accessibility of these villages and towns, **the level and phasing of upgrading should relate to available resources as well as prevailing traffic volumes, forecast traffic volumes and the vehicle mix.**

Table 12. ADT*, and PCUE* and MTE* for a Typical RIPA Road, 1995
Len-Hou Highway, Baihe County, Shaanxi Province, 1995

Vehicle Type	Len-Hou Highway					
	Medium Truck Equivalent (MTE)			Passenger Car Unit Equivalent (PCUE)		
	Conversion Factor	Traffic Volume (ADT)	MTE	Conversion Factor	Traffic Volume (ADT)	PCUE
Pick-up	1.0	10.00	10	2.0	10	20
Medium Size Truck	1.0	30.00	30	2.0	30	60
Heavy Truck	1.0	20.00	20	2.0	20	40
Car/ Passenger Vehicle	0.5	20.00	10	1.0	20	20
>20 Seats Bus	1.0	18.00	18	2.0	18	36
Freight Hauling Tractor	1.5	10.00	15	3.0	10	30
Small Tractor <12HP	1.0	19.00	19	2.0	19	38
Medium & Large Tractor	1.0	16.00	16	2.0	16	32
Manpower Rickshaw	0.5	14.00	7	1.0	14	14
Bicycle	0.1	70.00	7	0.2	70	14
Total			152			304

* ADT = Average Daily Traffic, MTE = Standard Medium Truck Equivalent, PCUE = Passenger Car Unit Equivalent.
Source: "Socio-Economic Benefit Analysis of Proposed Highway System No. 41 in Baihe County, August 1995", Shaanxi Provincial Transport Department (SPTD), 1995.

Table 13. Design Guidelines for Roads, Shaanxi Province, 1995

Road Type	Width in Meters				Pavement Type*	Vertical Grade	Horizontal Curve Radius	Traffic Volume (ADT/MTE)
	Flat Terrain		Mountain Terrain					
	Total Width	Paved Width	Total Width	Paved Width				
Unclassified Road	4.5				G, E	9-12%**	<15m	<200
Class IV, Single Lane	6.5	3.5			G, E	<9%	>15m	<200
Class IV, Double Lane	7.0	6.0			G, E	<9%	>15m	200-1,500
Class III	8.5	7.0	8	6	M, G, E	<8%	>30m	1,000-4,000
Class II	12.0	7.0	9	7	M, G			3,000-7,500

Notes: *Pavement Type: E = generally dirt/earth combination with some cobble stone surfacing, G = Sand and Gravel Surfacing, M = Macadam/ bituminous pavements

** In mountain terrain, grades upt 12% are allowed

Sources:

1. Shaanxi Provincial Transport Department (SPTD), 1995
2. "Technical Standards of Highway Engineering Guidelines, 1998", Ministry of Communications, Beijing, 1998.

Accessibility of poor rural villages and towns, and the mobility of this population is quite low in the poor counties of China. Programs to enhance the accessibility of villages and towns in the poor counties are hampered by:

A. Lack of adequate resources to undertake improvement programs in all poor counties
B. Design Standards that may be appropriate for upper end low volume roads(ADT of 100-200 MTE or 200-400 PCEU) but not appropriate for very low volume roads (ADT of <100 MTE or <200 PCUE)

If high-end traffic volume design standards are applied to all the lower end traffic volume roads, the implementation costs will be inappropriately higher. **It is, therefore, necessary and important to devise new classification systems for very low volume roads, followed by the appropriate revision of design standards to fit these low traffic volumes**. Current design standards, shown in **Table 13**, are quite high for the very low volume roads(<100 MTE = <200 PCUE).

The primary objective of such a new design standard is to build roads to standards that are appropriate for existing and forecast traffic volumes. At the same time, this approach would reduce costs in most cases, thus making it possible for the limited resources to be spent on providing basic access roads to more communities. However, the question of a lower standard for very low volume roads is worth examining in the context of basic access. **Significant savings can be achieved in reducing the total width for very low volume roads to say, 3.5m from the current 4.5m. However, the design would have to allow for carefully selected pass-by sections, wide enough for passing vehicles.** Over time, as traffic volumes increase with increasing economic activity, it would be necessary to upgrade these very low volume roads..

This has to be tempered by the context of terrain (mountain terrain, grades, and drainage) and has to be followed with reasonable flexibility. Key issues are traffic safety, long term maintenance and rehabilitation costs. The width should be appropriate for vehicles to pass each other safely. The proposed width of 3.5m allows for safe passing of animal carts, cars, jeeps, tractors, three wheelers and careful passing of heavy trucks and buses. As the traffic volumes increase over time, it would be necessary to upgrade these very low volume roads to current Unclassified Road Standards.

The economic growth rates and the consequent motorization rates have been quite high in China during the period 1989-99. Even though vehicle ownership may continue to grow at high rates, the net ownership rate will continue to be low. Personal ownership of private cars is very low now and is expected to continue to be low for some years. Nevertheless, there is likely to be a higher growth rate as well as the net ownership rate for commercial vehicles and motor cycles (Carruthers, 98 and Pendakur, 97). Non-motorized transport and off-farm vehicles will continue to be quite important in the rural areas for some years to come. The vehicle mix and traffic volumes will be dominant factors in the design of RIPA Roads.

For Chinese rural settlements, where the economic growth and motorization rates have been high, it is appropriate to provide all weather access, even though these standards may vary depending upon traffic volumes. Partial access exists for most communities now and is considered by both the citizens and government as being inadequate and inappropriate.

Based upon above factors and the discussion presented in the preceeding chapters, suggested design standards for RIPA roads have been developed and are shown in Table 14. These standards should be tempered by the mix of vehicles, type of commodities transported and especially the terrain. Special attention should be paid to traffic safety and pass-by sections. It is proposed to divide the RIPA Roads into three categories (detailed in Table 14) as follows:

A. **RIPA Road III, Partial Access Road, for ADT of <50 MTE,** partially engineered, seasonal access road, with dirt/earth surfacing, with culverts and bridges designed for a 10 year flood, allowing for 4-6 hour delays during extreme weather conditions such as high floods of very short duration,

B. **RIPA Road II, Basic Access Road, for ADT of 50-100 MTE**, partially engineered, limited all weather access road, with dirt/earth surfacing, occasionally sand and gravel surfacing when raw materials are available at low cost, with culverts and bridges designed for a 20 year flood, allowing for 2-4 hour delays during extreme weather conditions such as high floods of very short duration,

C. **And RIPA Road I, Full Access Road, for ADT of 100-200 MTE,** fully engineered, all weather access road, with sand and gravel surfacing, occasionally cobblestone surfacing when raw materials are available at low cost, with culverts and bridges designed for a 50 year flood.

Table 14. Proposed Design Standards for RIPA Roads

Design Element	RIPA Road I (Full Access)	RIPA Road II (Basic Access)	RIPA Road III (Basic Access Reduced Service)
Functional Standard	**All Weather Access**	**All Weather Access, allowing 2-4 hour delays during floods or high rainfall**	**All Weather Access, allowing 4-6 hour delays during floods or high rainfall**
Traffic Volume (ADT/MTE)	100-200	50-100	<50
Total Width	4.5m	4.0m	3.5m
Paved Width	3.5m	3.0m	3.0m
Pavement Type	Sand and gravel with cobble stone surfacing	Sand and gravel	Compacted Dirt/earth, Sand and gravel if available at roadside
Shoulder Width, each	0.5m	0.5m	0.25m
Shoulder Type	Compacted Dirt/earth, gravel if available at roadside	Compacted Dirt/earth	Dirt/earth
Vertical Grade, Flat Terrain	<6%	<6%	<6%
Vertical Grade, Steep Terrain	<9%	<9%	<12%
Horizontal Curves Radius	<15m	<10m	<10m
Roadside Drainage	Well maintained ditches	Well maintained ditches	Well maintained ditches
Cross Drainage	Pipe or box Culverts, Engineered bridges (stone, concrete)	Pipe or box culverts, Simpler Wood /timber structures	Pipe or box culverts, Simpler Wood /timber structures
Drainage design Criteria	Uninterrupted, all year access, 50 year flood design	All year access, 2-4 hour delays for floods, 20 year flood design	All year access, 4-6 hour delays for floods, 10 year flood design
Side Slopes	<12%	12-15%	12-15%
Road Surface Maintenance	Regular maintenance, repairs and grading	Periodic maintenance and repair	Periodic maintenance and repair
Drainage Maintenance	Regular monitoring and clearing of ditches and drainage structures	Periodic monitoring and clearing of ditches and drainage structures	Periodic monitoring and clearing of ditches and drainage structures

5. RIPA Implementation: Methodological Aspects

5.1 Introduction

In developing countries, the accumulated needs of rural access roads improvements, far exceed the available resources. Some countries, albeit a small number, are able to meet this challenge by marshalling internal resources. Most others are struggling to meet the minimum access needs of the rural poor. In general, rural access and transport services needs do not receive the urgently needed priority for investments.

As discussed earlier in Chapter 2, a large portion of the rural population, in many countries, still lacks the basic transport infrastructure and services to enable them to be connected and achieve better economic standing. Under these circumstances, there is much subjective pressure on the governments by various groups, such as of political, regional and social interests, to capture the meager financial resources available for rural access investments for their own counties and districts.

Unless there is an understandable and objective methodology for determining RIPA investment priorities, these improvements and therefore, the related investments could be distorted. Such distortions can result in inefficient investments, yielding far less benefits for the investment than otherwise. Therefore, there is an urgent need to develop objective methods for identification, selection and prioritization of RIPA investments based upon sound economic and social cost-benefit principles. **The methodological framework, discussed below, has been developed, implemented and refined in RIPA programs in Bank assisted projects in five provinces of China: Gansu, Henan, Inner Mongolia, Ningxia and Shaanxi and has been time tested over five years.**

5.2 Methodological Framework

There are several iterative methodological steps for the identification, selection and prioritization of RIPA improvements. These steps are:

A. Designation of Poor Counties
B. RIPA: Screening, Selection and Ranking Process
C. RIPA Counties: Economic Ranking
D. RIPA Counties: Social Development Ranking
E. Selection of Counties for RIPA Implementation
F. RIPA: Improvement Priorities-Initial Basket
G. RIPA: Cost Effectiveness Ranking
H. RIPA: Inaccessibility Ranking
I. RIPA Plan Priorities: RIPA Road Systems

These steps will lead to a basket of RIPA Road Systems, prioritized by a systematic ranking score, for implementation consideration. This initial basket of proposed RIPA systems is further subject to economic and social cost/benefit analysis to determine both the priorities and whether some systems will be implemented at all. These analyses are discussed in the Chapter 6.

5.3 Designation of Poor Counties

Methods of designating poor counties differ from country to country. It is common to use some measure of income, income disparity, sometimes combined with social indicators such as literacy and education. It is not imperative to devise new systems of poor county designation unless there are serious distortions in the practice in a given country. The most important criteria should be those related to income, social development and inaccessibility.

The system used to identify and designate poor counties in China was discussed in detail earlier (Chapter 3.2) and is shown in **Figure 4.** The income criteria for identifying and designating poor counties are as follows:

A. For those counties which were not designated a poor county in 1986, per capita annual income not exceeding 400 RMB in 1992
B. For those counties designated as a poor county in 1986, per capita income not exceeding 700 RMB in 1992

In addition, the provinces use a variety of income and other criteria to designate additional counties as "poor counties". For the purposes of RIPA, both the nationally designated and provincially designated poor counties were included.

5.4 RIPA: Screening, Selection and Ranking Process

Because the available resources are very limited in relation to the over all rural road infrastructure needs, it is necessary to establish priorities for RIPA investments even within the designated poor counties. The screening process is shown in **Figure 5** and consists of a series of steps based on the status of economic and social development of each county. The screening criteria include economic conditions and potential, social development, cost effectiveness and the level of inaccessibility. The detailed steps are discussed below.

5.5 RIPA Counties: Economic Ranking System

The first step is to establish economic ranking criteria. They should include indicators of income and poverty, and the potential for economic development. The indicators, used in China, include average annual income, level of poverty, agriculture and forestry lands indicating the potential for further development, value of mineral production also indicating the potential, and food for work expenditures indicating the level of welfare expenditures as well as the number of impoverished people. Depending upon the availability of data at the county level in other countries, these indicators can be substituted by other suitable ones. **Economic Ranking** is composed of four criteria, as shown in **Figure 6:**

A. **Income Ranking**, the higher the average income in the county, the lower the ranking for the county, thus assuring the poorest counties receive highest priority
B. **Poverty Ranking**, the higher the poverty level in the county, the higher the ranking for the county
C. **Agriculture and Forest Land Ranking**, the higher the acreage of lands, the higher the ranking, recognizing the current and potential economic activity

Figure 4. RIPA: Designation of Poor Counties

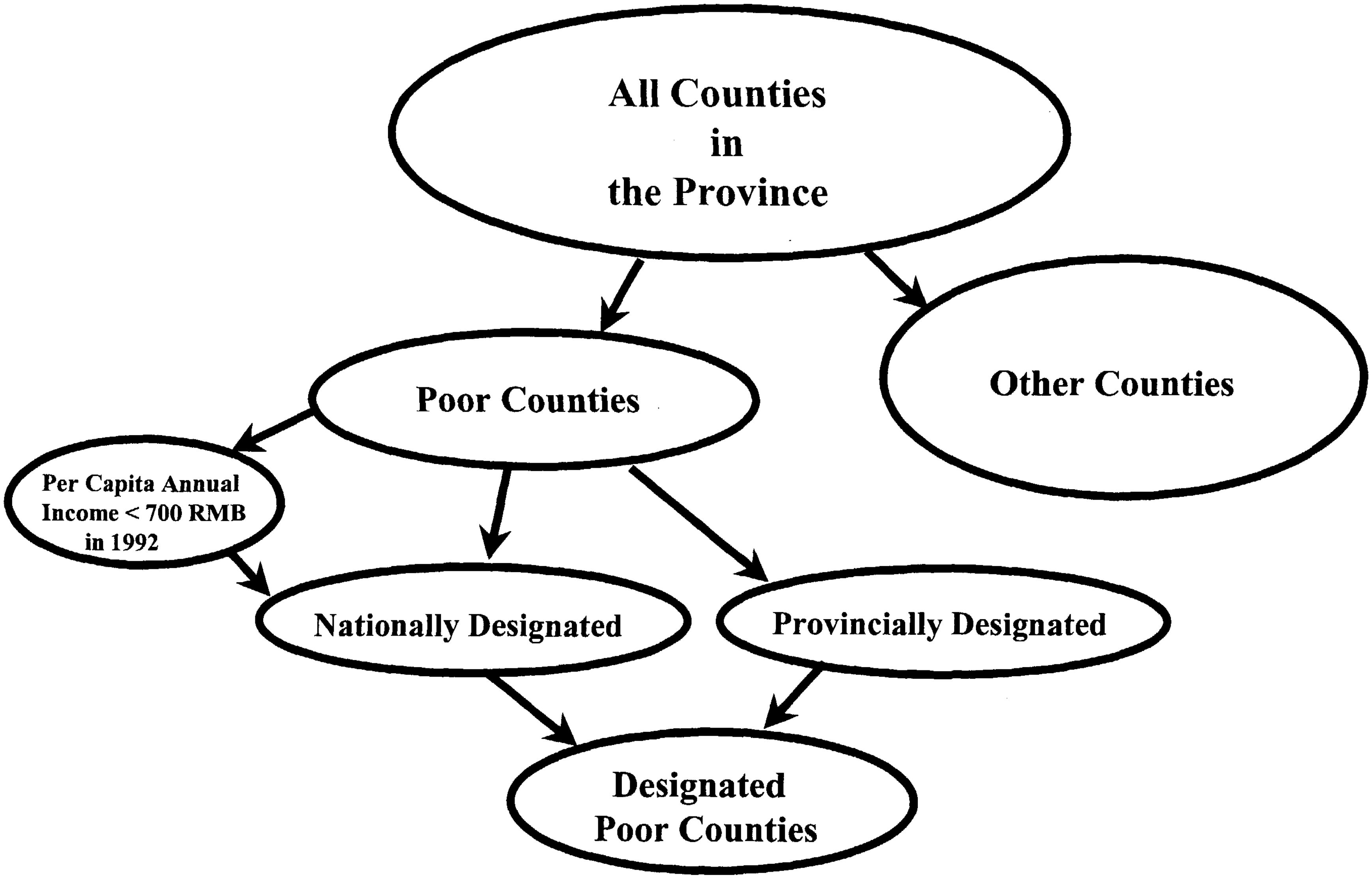


Figure 5. RIPA: Screening, Selection and Ranking Process

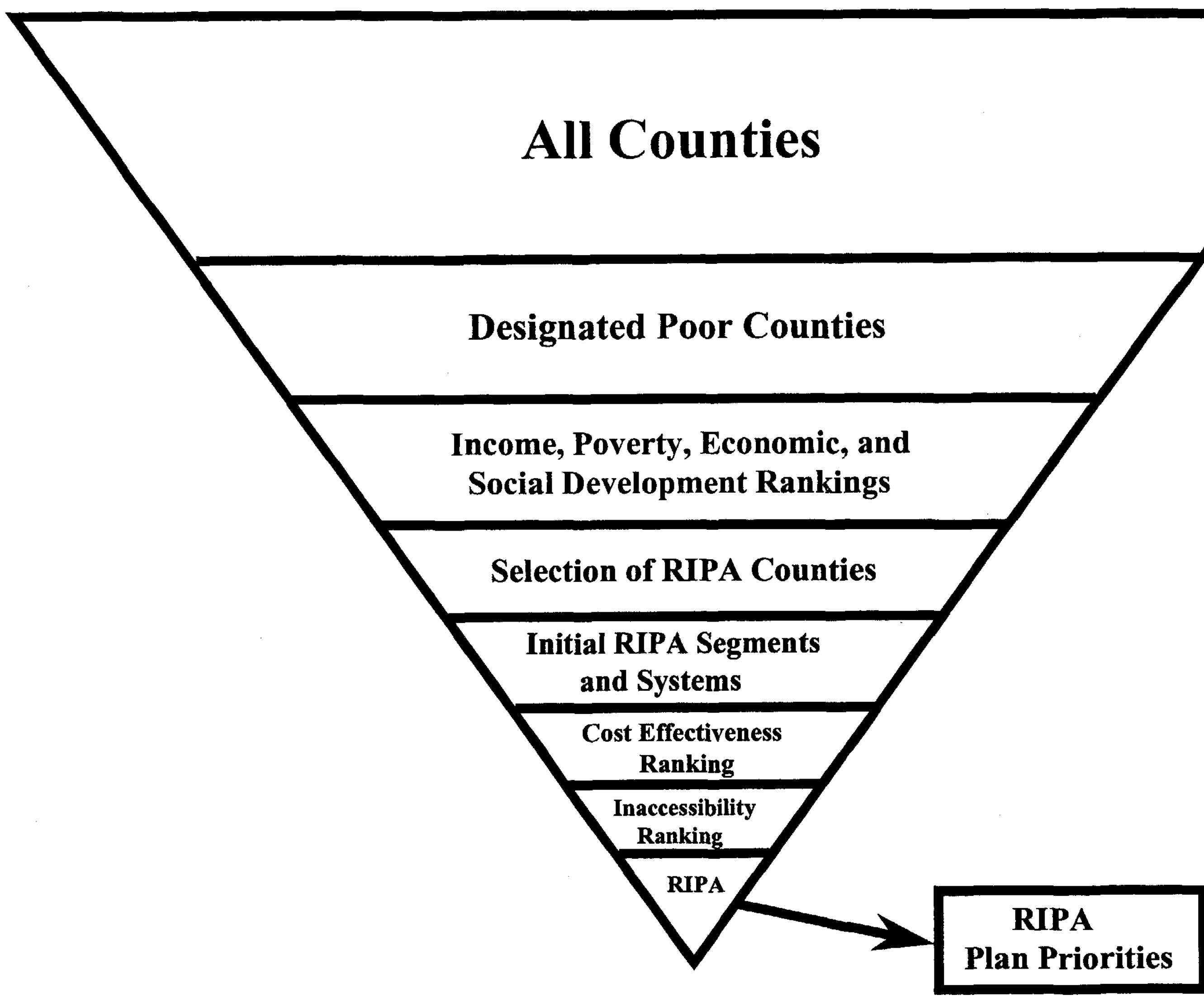
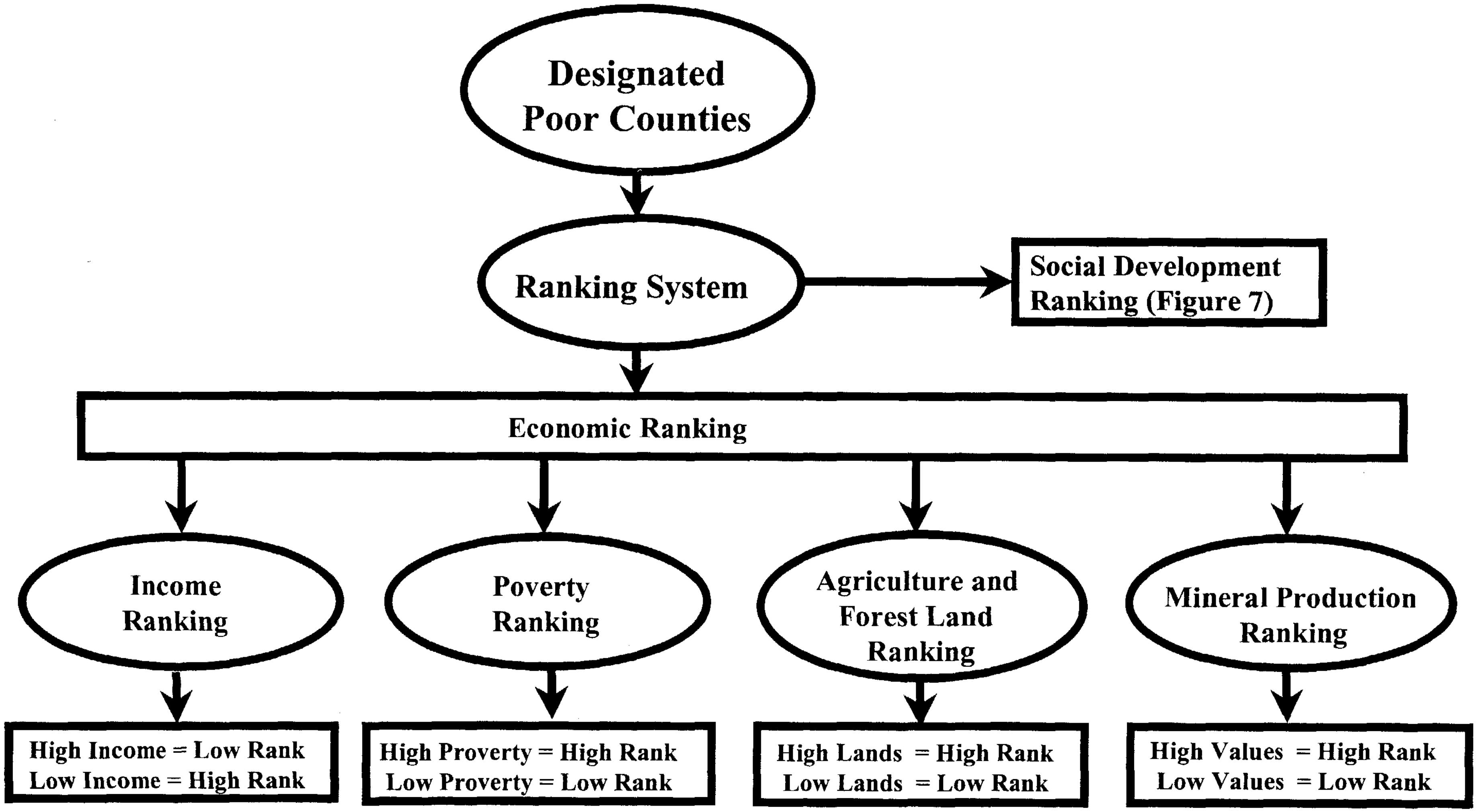


Figure 6. RIPA Counties: Economic Ranking



D. **Mineral Production Ranking,** the higher the values of production, the higher the ranking, recognizing an important economic sector

Income and poverty ranking criteria emphasize high priority for the poorer of the designated poor counties. Agriculture and forestry lands is a surrogate for the value of agricultural and forestry products. Together with values of mineral production, these criteria emphasize that access should be improved consistent with existing and potential economic activity. When available, Gross Output Value of Agriculture and Industry (GVOAI) can be used instead of using forestry, agriculture and mineral production. The ranking is done on a point basis, 5 points for each of the four criteria listed above.

5.6 RIPA Counties: Social Development Ranking System

In addition to economic factors, it is important to include social development factors in ranking the counties for RIPA investments. Social development factors such as availability of education and health services contribute to poverty and deprivation. Depending upon the availability of data, there is need to improvise simple indicators of social development which can be used in assessing the relative handicaps of these counties in solving their problems of access and economic development.

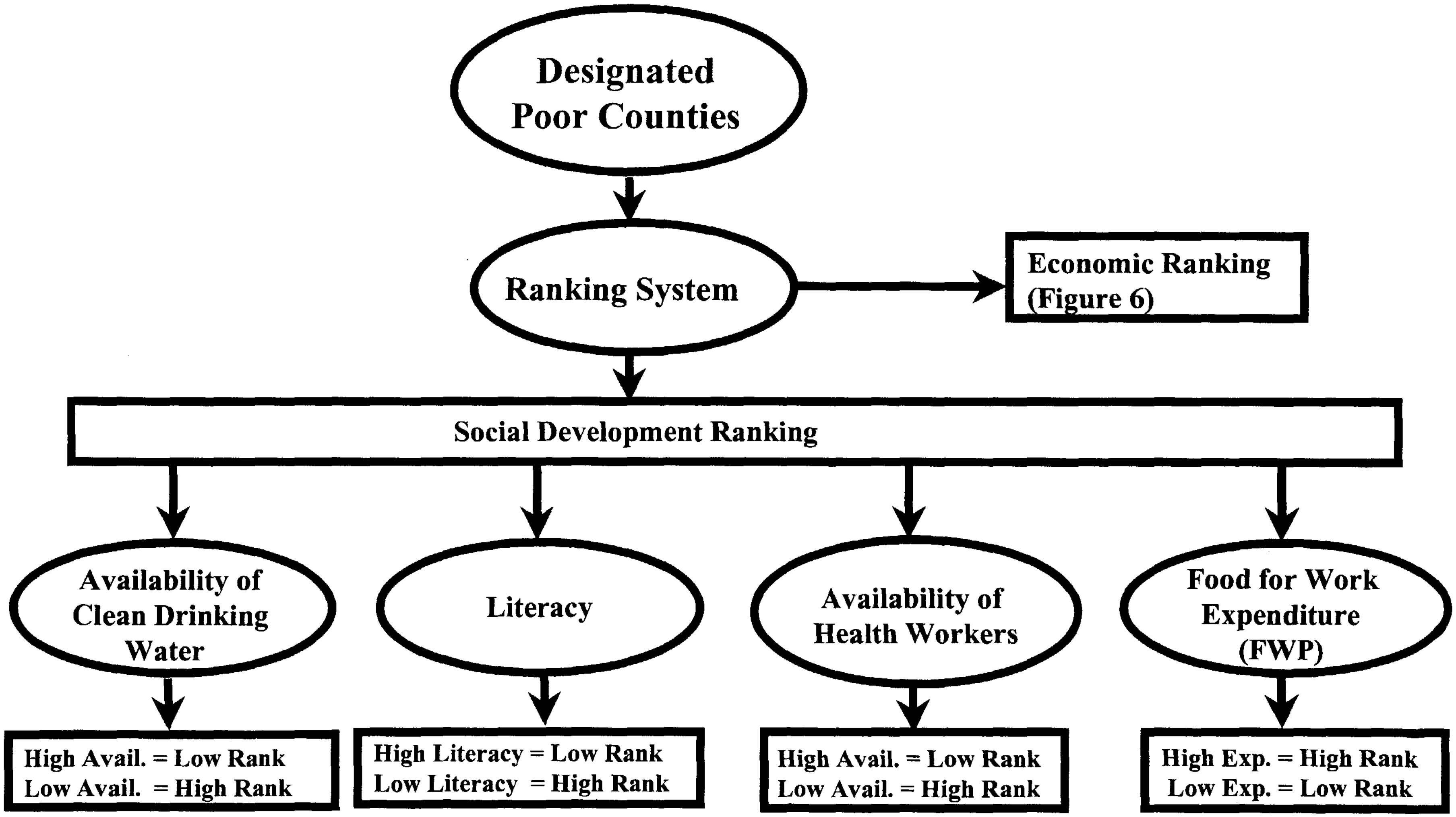
In China, availability of clean drinking water, literacy levels and availability of health care workers were used as indicators of social development. In China the unemployed persons are provided food and minimum allowances in return for working on public work projects. It is called **"Food for Work Program"**. These expenditures were also used as another indicator of social development as they provide a comparative assessment of the level of unemployment in the counties.

The Social Development Ranking System is shown in **Figure 7.** This ranking system is composed of the following four criteria:

A. **Availability of Clean Drinking Water**: the higher the percentage of the county population with access to clean drinking water, the lower the ranking
B. **Literacy**: the higher the percentage of literate population, the lower the ranking
C. **Availability of Health Workers**: the higher the number of health workers per capita, the lower the ranking
D. **Food for Work Program(FWP) Expenditures,** an indicator of unemployment and poverty, the higher the expenditure, the higher the rank.

This ranking was also done on a point's basis. Clean drinking water, literacy and health worker availability were given one point each and FWP expenditures are given 2 points. The social development indicators account for a total of 5 points.

Figure 7. RIPA Counties: Social Development Ranking



5.7 Selection of Counties for RIPA Implementation

The economic and social development parameters together account for 25 points, with economic parameters counting for 20 points and social development parameters counting for 5 points. The counties are ranked for RIPA implementation in order of points received in the ranking system. The higher the total score, the higher the ranking for RIPA investments. A sample ranking table (economic and social development factors) used in Henan province is shown in **Table 15.**

This priority system is further refined as shown in **Figure 8.** Counties with good road systems and good network connections are deleted as well as those counties with economic opportunities to build roads outside of RIPA. The resulting set of counties is the group of counties considered for implementing RIPA, in order of priorities indicated by the ranking table.

5.8 RIPA Priority System-Initial Basket

5.8.1 Priorities for Road Investments

Iterative steps performed as shown in **Figures 4 to 8**, lead to the prioritization of counties for RIPA investment. The next step is to determine which road segments in these counties need to be improved and to what extent. A system of policy priorities, for determining RIPA improvements, is applied in order to develop an initial basket of RIPA Systems, for consideration. This system is shown in **Figure 9**. **The policy priorities for RIPA improvements are to:**

A. Provide new all weather roads to all administrative villages and townships;
B. Improve existing drainage systems and stabilize slopes to assure all weather access;
C. Upgrade existing seasonal roads to all weather roads;
D. Upgrade existing all weather roads to higher class roads, where traffic volumes warrant;
E. Rehabilitate and upgrade, as necessary, connecting links to major market centers.

5.8.2 Road Segments and Systems

The above priorities are applied to determine and select the road segments, which are candidates for improvement (new roads, upgrading and rehabilitation), in the counties selected for RIPA (**Figure 8).** Identified RIPA road segments are then grouped into contiguous systems, based upon settlement patterns and population connectivity. These steps will result in a number of proposed RIPA road systems with a variety of improvements on various road segments. This then is the RIPA Systems-Initial Basket, **shown in Figure 9**,which will be subject to further screening.

Table 15. Poor Counties in Henan Province

Economic and Social Development Ranking for RIPA, 1996

ID No.	County Name	Income Ranking (1 to 5)	Poverty Ranking (1 to 5)	Agriculture & Forest Land Ranking (1 to 5)	Mineral Production Ranking (1 to 5)	Total Social Development Ranking (0 to 5)*	Overall Ranking
1	Yichuan	3	1	2	5	1	12
2	Yiyang	2	2	3	3	2	12
3	Louning	2	4	2	1	3	12
4	Luanchuan	2	2	4	5	0	13
5	Songxian	2	4	3	1	3	13
6	Ruyang	5	3	3	1	3	15
7	Xinan	3	2	2	5	2	14
8	Lushi	3	4	1	5	2	15
9	Mianchi	3	4	2	2	3	14
10	Lushan	5	5	2	5	3	20
11	Nanchao	3	3	5	2	1	14
12	Xichuan	2	1	1	2	2	8
13	Tongbai	3	3	3	2	3	14
14	Xinxian	2	1	3	1	1	8
15	Shangcheng	2	1	1	1	2	7
16	Xinyang	1	1	2	1	1	6
17	Luoshan	3	2	3	2	2	12
18	Guangshan	2	1	2	2	2	9
19	Gushi	3	2	1	2	2	10
20	Huaibin	2	1	3	1	3	10
21	Huangchuan	2	2	2	1	1	8
22	Xixian	2	3	3	1	2	11
23	Pingyu	2	3	4	1	3	13
24	Xincai	5	4	4	1	3	17
25	Shangcai	2	1	5	1	3	12
26	Queshan	3	1	3	2	2	11
27	Beiyang	2	2	4	1	1	10
28	Ningling	3	2	5	1	4	15
29	Suixian	2	1	5	1	4	13
30	Yucheng	2	2	5	1	3	13
31	Yongcheng	2	1	4	1	3	11
32	Taiqian	2	3	4	1	2	12
33	Puyang	1	1	5	1	3	11
34	Fanxian	2	1	4	1	2	10

Figure 8. RIPA: Counties for Implementation

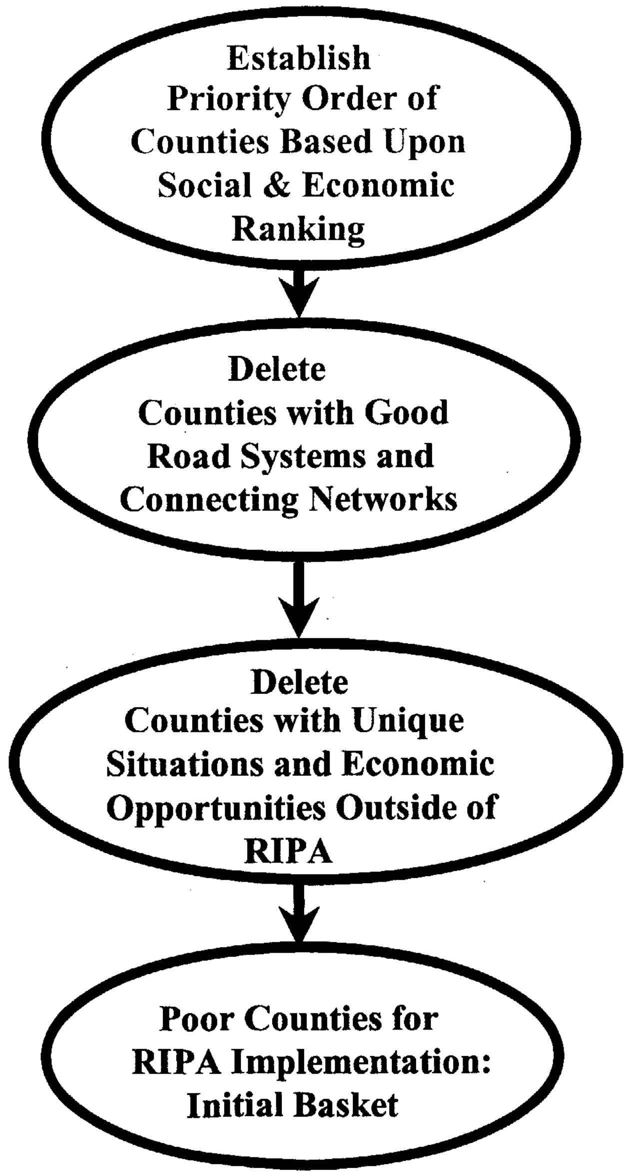
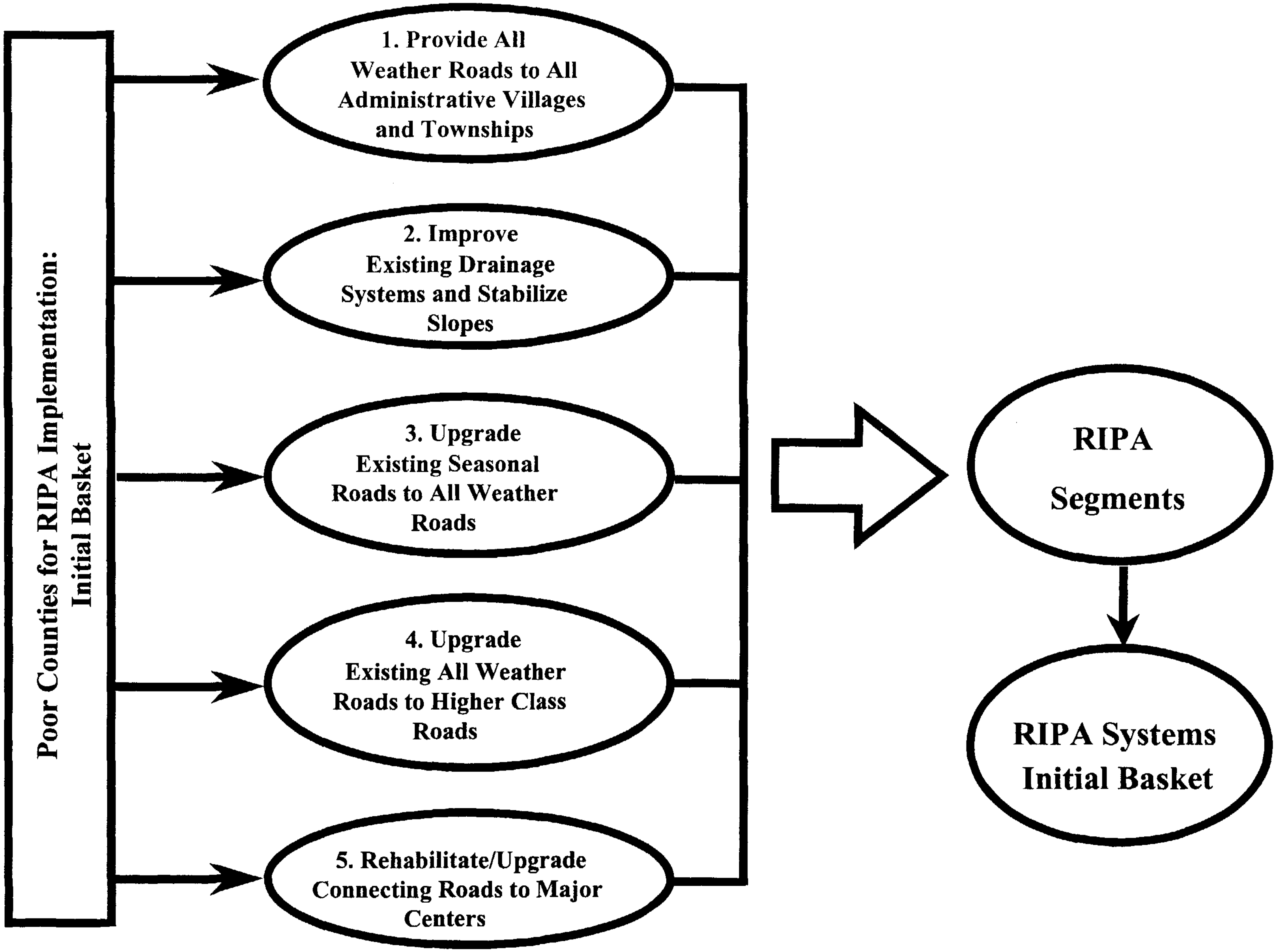


Figure 9. RIPA: Road Improvement Priorities - Initial Basket

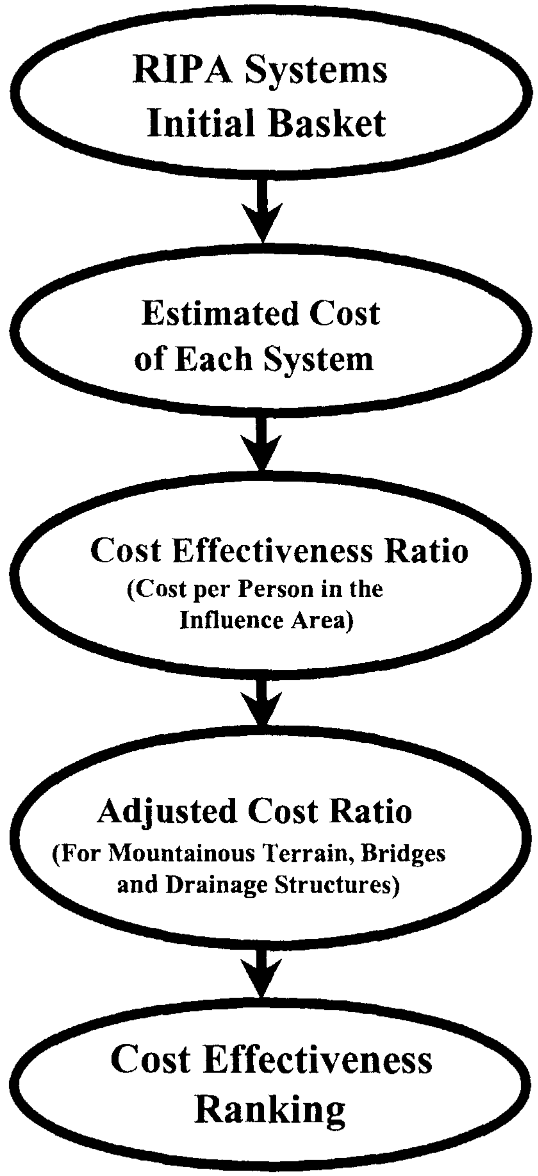


5.9 Beneficiary Population and Cost Effectiveness

Cost is an important factor in enhancing the accessibility and mobility of the rural population. This cannot be based simply upon the engineering cost or the cost of the road per km. Cost effectiveness must be based upon comparative costs and benefits derived. Recognizing that each system will be subject to further economic and social cost-benefit analysis, the purpose of determining cost effectiveness is to provide a ranking system for the implementation of the proposed road systems. The cost effectiveness concept is not applied to each segment of road but to each road system. This is because taken individually, some road segments may be too small or not effective. However, considered as a part of a system, they have an impact on the influence area. Cost Effectiveness Ratio (CER) is defined as Cost of the Proposed Road System Per Person in the Influence Area. In other words, what is the per capita cost of accessibility improvements? This is done on a system by system basis and not on a segment by segment basis. Cost effectiveness ranking process, as shown in **Figure 10**, consists of the following steps:

A. Estimate the cost of the proposed improvements in each system
B. Estimate the population of the influence area of each system
C. Calculate the Cost Effectiveness Ratio (Cost per person in the influence area)
D. Adjust the Cost Effectiveness Ratio for Mountainous Terrain
E. Determine the Cost Effectiveness Ranking

Figure 10. RIPA: Cost Effectiveness Ranking



The estimated costs of the proposed improvements include planning, design and construction costs. The population of the influence area includes the population of all settlements in the influence area of the proposed road system. The CER is derived by dividing the total cost of the system improvements by the influence area population.

In mountainous terrain, the cost of road improvements, in general, is substantially higher than in flat or rolling terrain. Comparing road system costs without making allowances for terrain impact on costs would be inequitable. Therefore, CER is adjusted downward by a factor of one-third in mountainous terrain. If there are major bridges in the proposed improvements, they are not included in comparing system costs. The Adjusted Cost Effectiveness Ratio (ACER) was derived, in aforementioned RIPA projects in China, by multiplying the estimated system improvement costs by 0.67. Where substantial cost differences exist even within the mountainous terrain, it may be necessary to stratify these cost adjustment factors.

The proposed RIPA systems are then ranked according the ACER. An example of the ranking table used in Inner Mongolia is shown in **Table 16.**

5.10 Inaccessibility Criteria

The procedure for Inaccessibility Ranking is shown in **Figure 11.** There are villages and towns with seasonal access and there are some with no roads at all. Inaccessibility is defined, here, as the total number of days during which a particular road is closed thus affecting the accessibility of the communities served by this road. The population with no roads means that, for the purpose of this ranking, the road is closed for 365 days a year, thus giving this population the highest inaccessibility priority. The higher the number of the days when the road is closed, the higher the inaccessibility. The rank order is determined by using a 5 point scale.

The cost effectiveness ranking (5 points) shown in **Table 16** is combined with inaccessibility ranking (5 points) to determine the overall ranking for implementation. **Table 17** is an example from Inner Mongolia.

5.11 RIPA Implementation Priorities

Implementation priorities are established by following the procedures discussed earlier and also detailed in **Figure 12**. The higher the combined rating, the higher is the priority. Poor counties were selected for RIPA implementation by using the process detailed in **Figures 4 to 8.** By applying the policy priorities shown in **Figure 9**, road segments in these counties were chosen for consideration and road systems were developed by using system continuity and the communities served. This resulted in the RIPA initial basket of priorities.

Then by applying the steps shown in **Figures 10, 11 and 12,** RIPA systems are prioritized for implementation. However, all of these systems are further subjected to economic and social cost-benefit appraisal, as shown in the following chapter.

Table 16. Poor Counties in Inner Mongolia: System Cost Effectiveness Ranking for RIPA

County ID Number	County Name	System Number	Segment Number	System Cost (10,000 RMB)	Population of Influence Area	System Cost Ratio (Cost Per Person) (RMB)	System Cost Adjustment Ratio	Adjusted System Cost Per Person (RMB)	System Cost Effective-ness Ranking (1-5)*
1	Duolun County	I	1	1,530	22,451	681	1.00	681	2
2	Wuchuan County	II	2	900	68,000	132	0.67	89	5
3	Darhan Muminggan Joint Banner	III	3	900	34,143	264	1.00	264	4
4	Aohan Banner		4						
5	Hexigten Banner		5	4,950	217,961	227	1.00	227	5
6	Linxi County	IV	6						
7	Bairin Right Banner		7						
8	Siziwang Banner								
9	Qahar Right Wing Middle Banner		8						
10	Zhuozi County	V		4,215	347,027	121	1.00	121	5
11	Huade County		9						
12	Shangdu County								
12	Shangdu County		10						
13	Hangjin Banner		11						
14	Ejin Horo Banner	VI	12	2,150	120,391	179	1.00	179	5
15	Uxin Banner								
16	Horqin Right Wing Middle Banner	VII	13	1,100	23,000	478	0.67	320	4

Note: * County with an adjusted system costs per person (ACPP) of 64-257 RMB = 5 Points, County with an ACPP of 258-450 RMB = 4 Points, County with an ACCP of 451-643 = 3 Points, County with an ACPP of 644 - 836 RMB = 2 Points, County with an ACPP of 837 - 1,028 RMB = 1 Point.

Figure 11. RIPA: Inaccessibility Ranking

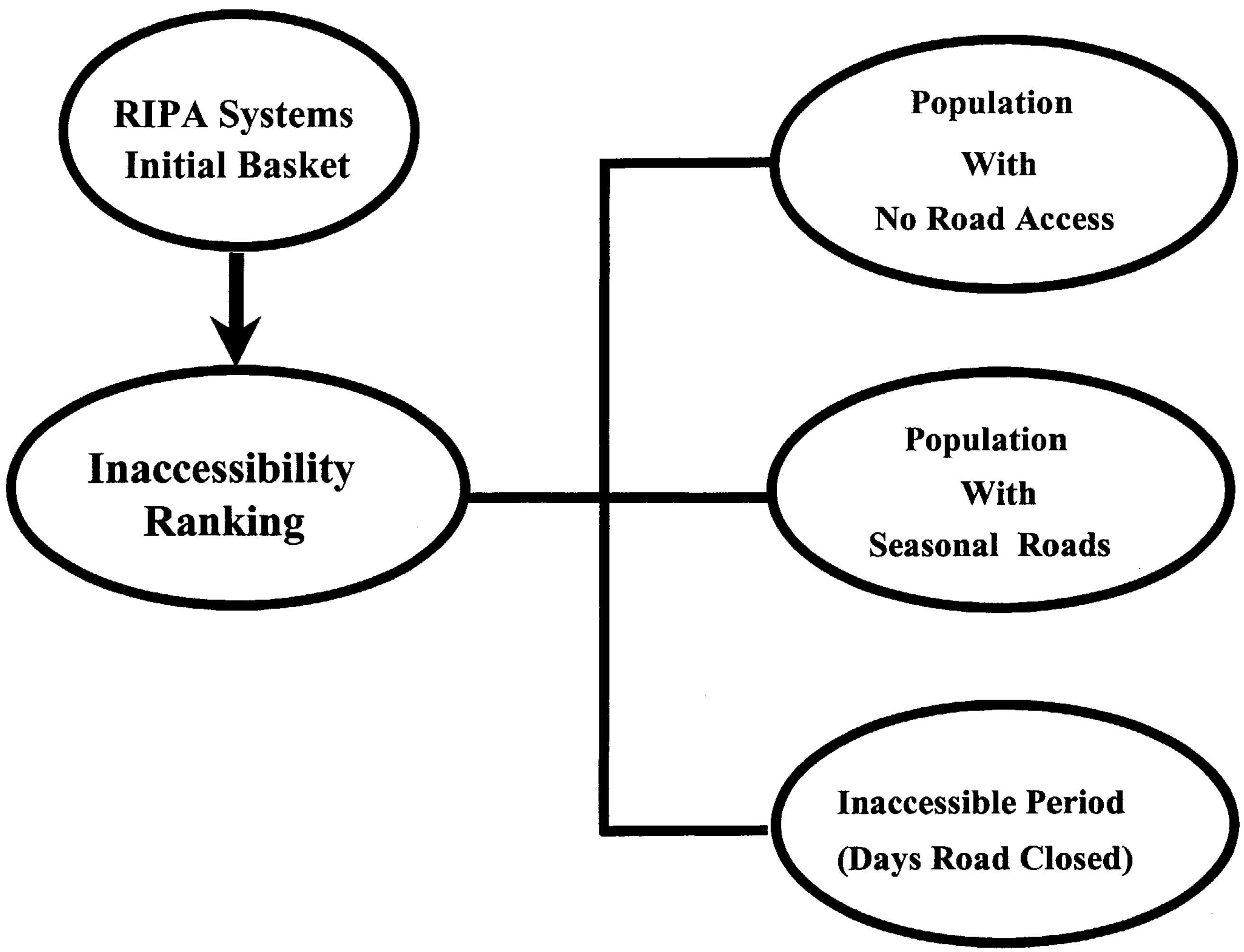
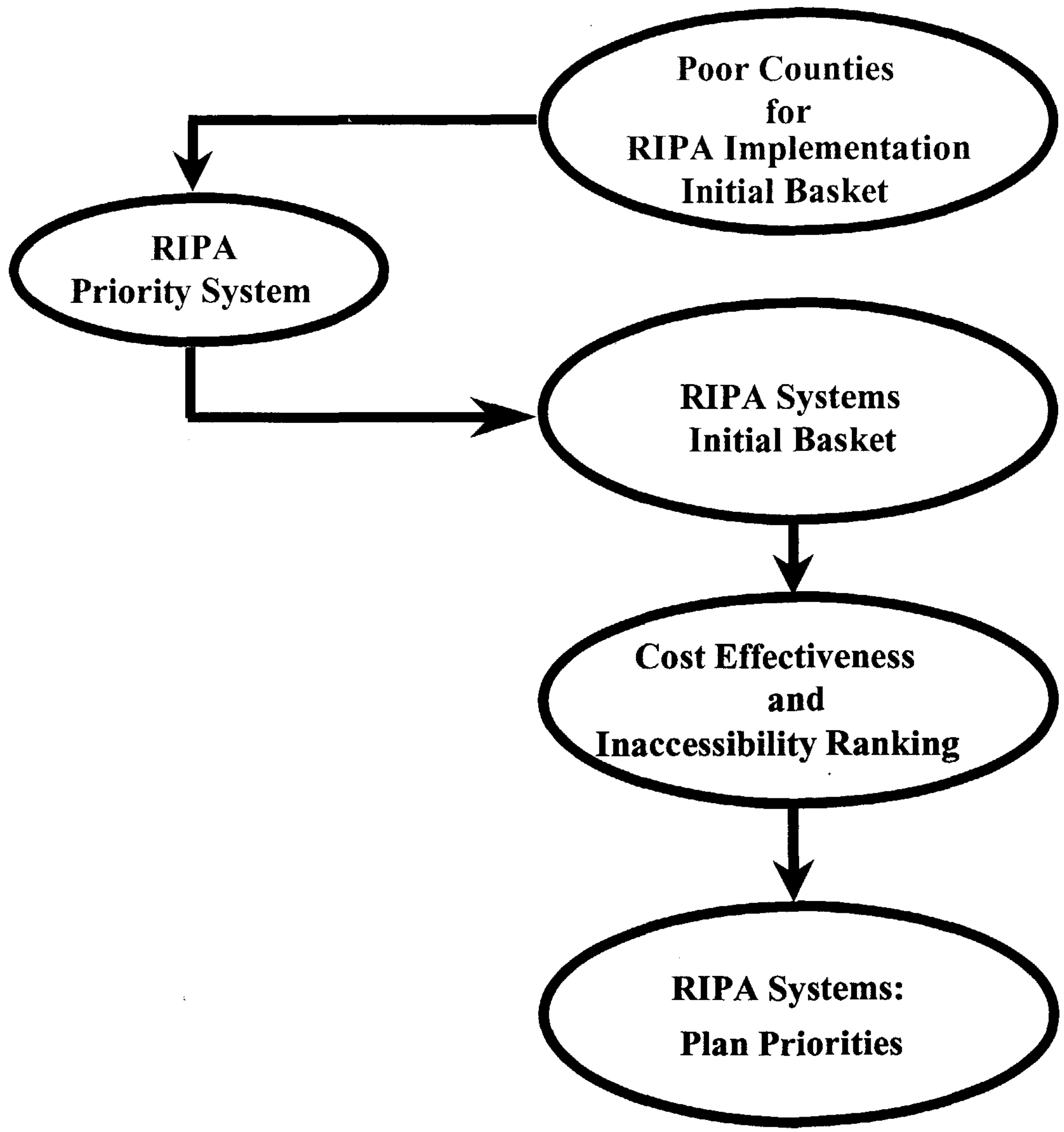


Table 17. Poor Counties in Inner Mongolia
Inaccessibility and Cost Effectiveness Ranking

County ID Number	County Name	System Number	Segment Number	Inaccessibility Ranking*	System Cost Effectiveness Ranking*	Overall Ranking	Overall Priority
1	Duolun County	I	1	3.00	2	5.00	7
2	Wuchuan County	II	2	3.50	5	8.50	1
3	Darhan Muminggan Joint Banner	III	3	3.00	4	7.00	2
4	Aohan Banner	IV	4	1.5**	4	5.50	5
5	Hexigten Banner		5				
6	Linxi County		6				
7	Bairin Right Banner		7				
8	Siziwang Banner	V	8	2.00**	5	7.00	2
9	Qahar Right Wing Middle Banner						
10	Zhuozi County						
11	Huade County		9				
12	Shangdu County						
12	Shangdu County		10				
13	Hangjin Banner	VI	11	1.50**	5	6.50	4
14	Ejin Horo Banner		12				
15	Uxin Banner						
16	Horqin Right Wing Middle Banner	VII	13	1.50	4	5.50	5

Notes: *Maximum 5 points. **Average of County Inaccessibility Ranking.

Figure 12. RIPA Systems: Plan Priorities



6. Feasibility Analysis

6.1 Analysis Framework

There are three sets of benefits which are accrued to the population when road improvements are made:

A. **Economic Benefits**
B. **Accessibility Benefits**
C. **Other Social Benefits**

These are estimated separately for feasibility analysis. The economic and social benefit analysis process is outlined in **Figure 13.**

6.2 Economic Benefits and Rates of Return : A Tiered System

There are three economic criteria which are widely used in making **Road Investment Decisions:**

A. **Net Present Value**
B. **Benefit-Cost Ratio**
C. **The Internal Rate of Return.**

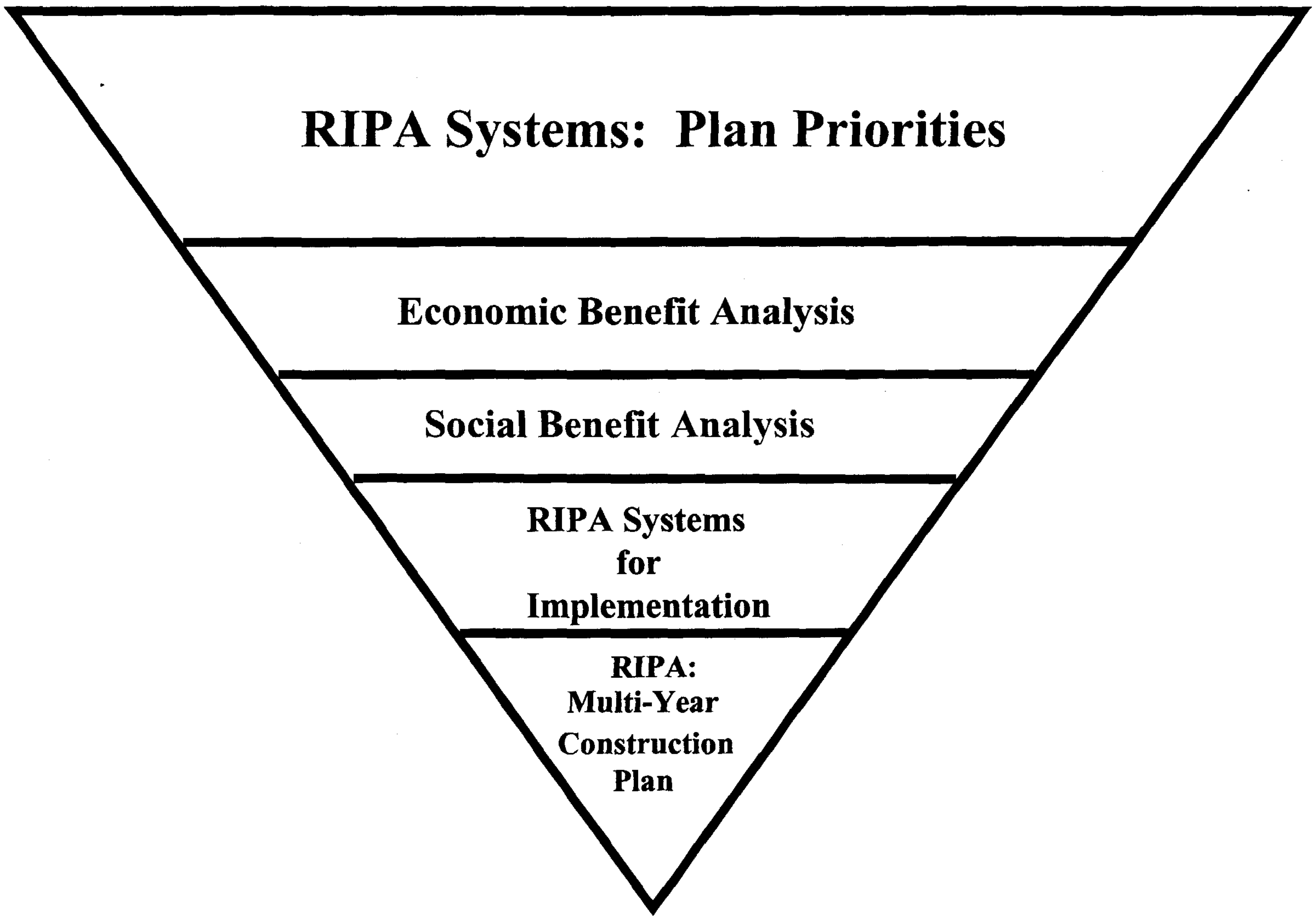
Net Present Value (NPV) is the present value of all the benefits less the present value of all the costs. Benefit and cost streams are discounted at the minimum return requirement (opportunity cost) on resources employed over the useful life of the project, generally a 20 year period. As a rule, decision criteria require that the NPV be greater than zero to make the investment worthwhile.

The Benefit-Cost Ratio (BCR) is the present value of all the benefits divided by the present value of all the costs expressed as a ratio. This again is discounted at the minimum return requirement (opportunity cost) on resources employed over the useful life of the project, generally a 20 year period. In analyzing projects to determine whether or not it is worthwhile, acceptability requires that the BCR be greater than one.

The Economic Internal Rate of Return (EIRR) is the rate of return generated on the outstanding capital in each year of the life of the project. The EIRR is the rate of discount where the net present value equals zero. For project investments to be feasible, this EIRR should be at least equal to, or greater than the discount rate (opportunity cost of money).

The issues related to full access, basic access and partial or seasonal access and their linkages to poverty and development were discussed in **Chapters 2, 3 and 4.** The purpose of economic and social evaluation is to enable decision-makers to make investment decisions and assign priorities for investments, based upon expected benefits and not other factors. However, the purpose of RIPA is to increase the accessibility and mobility of the rural poor and to enable them to have access to markets, employment opportunities and social services in nearby townships, which provide these opportunities. These communities are in remote areas and often in mountainous terrain, which further increases the cost of proposed improvements. Their capacity to pay for services or road improvements is rather limited.

Figure 13. RIPA: Economic and Social Benefit Analysis



Until their economic condition improves, some of these proposed improvements may not yield high rates of return. It is important that investment decisions be made by balancing the traditional economic approach of expecting fixed or high rates of return with the social science approach which considers access as a basic need, to be provided to every one at the same minimum standard. Investment decisions and priorities should be based upon a thorough analysis of both the economic and social benefits arising out of road investments. In essence, what is the value of "Basic Access"? Can this be assigned a monetary value in calculating the benefits?

Based upon the RIPA experience in five provinces of China (Gansu, Inner Mongolia, Henan, Ningxia and Shaanxi), it is proposed that the expected minimum rates of return be a tiered system and be related to design standards, detailed in Table 14. These proposed standards are for RIPA roads with less than 200ADT/MTE, divided into three categories as shown in Table 14 (Full Access Roads of ADT/MTE of 100-200, Basic Access Roads of 50-100 ADT/MTE, and Basic Access Roads with Reduced Service of <50 ADT/MTE). The design standards are going to be higher for those RIPA systems serving larger populations and higher traffic volumes. Although these road systems will cost more, they serve more people and carry more traffic. They should be expected to yield higher returns than the lower traffic volume RIPA roads.

At the lower end of the scale, the design standards are going to be lower for those RIPA systems serving remote communities with lower populations with lower traffic volumes. Here we should be prepared to accept lower rates of return as long as the social benefits of increased accessibility and social services are of a reasonably high order with reference to the population served.

It was also proposed in **Chapter 4 (Table 15)** that there should be three separate design standards for the three tiers of RIPA roads (Full Access, Basic Access and Partial Access). This recognizes the cost and benefit considerations, and as well allows for building these access roads at a slightly lower standard now (for lower traffic volumes), without preventing their upgrading at a later date as economic activity and traffic volumes increase.

Based upon these considerations, it is proposed that the expected rates of return be a tiered system which specifies high rates of return at the high end and lower rates of return at the low end of population and traffic volumes.

User cost savings (vehicle operating costs and time savings) are the major economic benefits of road improvements. It is the general practice to count only the motor vehicle users. This has worked well in countries where most trips are predominantly by motor vehicles. However, this is inappropriate for the developing countries because of the different vehicle mix which includes many kinds of non-motorized vehicles as well as pedestrians with head loads. Under these circumstances, traffic counts should be made for all modes including NMVs and Pedestrians with head loads. **It is important to include in the computation of benefits vehicle operating costs (NMVs and MVs), travel time savings for all modes (MVs, NMVs and Pedestrians with and without head loads).**

In Bank assisted RIPA projects in the five provinces of China (Gansu, Inner Mongolia, Henan, Ningxia and Shaanxi), during 1995-1998, there were only two categories of RIPA roads: **Class IV Roads and Unclassified Roads. Both these classes of roads were all weather, "full access roads".** Class IV roads were further divided into two categories depending upon traffic volumes.

Class IV double lane roads were for traffic volumes of 200-1500 ADT/MTE, indicating higher economic status. Class IV single lane roads were for traffic volumes of <200ADT/MTE, indicating lower economic activity.

Unclassified roads were also for traffic volumes of <200ADT/MTE, but in areas of much less economic significance. The general discount rate used in China is 12%. **However, recognizing the value of "Accessibility", the expected minimum EIRR for low traffic volume roads was slightly reduced. For Class IV Roads, the minimum expected EIRR was reduced to 10% (from a discount rate of 12%), and for Unclassified Roads to a minimum of 8%. Both roads were for traffic volumes of <200 ADT/MTE.**

Recognizing the fact that there are many communities where the current traffic volumes are very low and the populations require basic access to improve their economic condition (even at reduced service), the design standards proposed in Table 14 show three categories of RIPA Roads: "Full Access Road" (RIPA Road I), "Basic Access Road" (RIPA Road II), and "Basic Access Road with Reduced Service" (RIPA Road III) based upon traffic volumes. This approach enables the provision of basic access to more communities, albeit with reduced level of service, with same investment resources. As the economies improve and traffic volumes increase, these roads can be upgraded, at the appropriate time in the future.

Based upon the above discussion, it is proposed that the expected Economic Internal Rate of Return (EIRR) on proposed investments be a tiered system as follows:

A. For "Full Access Roads" (RIPA Road I) >10%
This EIRR is the same as the one used in Bank assisted projects in China. The general discount rate is 12% and the minimum expected EIRR was 10% for Class IV Roads (for <200 ADT/MTE). In other countries, this rate would be 2% less than the discount rate.

B. For "Partial Access Roads" (RIPA Road II) >8%
This EIRR is the same as the one used in Bank assisted projects in China. The general discount rate is 12% and the minimum expected EIRR was 8% for Unclassified Roads(for <200 ADT/MTE). In other countries, this rate would be 4% less than the discount rate.

C. For "Partial Access Roads" (RIPA Road II) >6%
These are very low volume roads with a reduced level of service as shown in Table 14. They are fundamentally basic access only roads, enabling economic opportunities. In bank assisted RIPA projects in China, there were no roads in this category. In other countries where such low traffic volumes exist, the expected minimum EIRR would be 6% lower than the discount rate.

Alternatively, it is possible to assign a value for basic access if income data sets are available for comparable communities with and without access within the same area. The differentials in per capita income could be attributed to basic access, if there are no unique differences between the communities. These differences in incomes can be counted as benefits over project life time. The approach proposed above, simplifies the computations and recognizes the problems related to the availability and accuracy of data in many developing countries.

6.3 Beneficiary Population and Access Benefits

Accessibility and mobility of the rural population is an important aspect of the economic development of the rural regions. The number of people benefiting is an important consideration. Beneficiary population is the total population of the influence area, for each road system being considered. Access benefits are defined as the number of days when the roads are closed currently and would be fully open when these roads are built.

6.4 Social Benefits

Social benefits accruing to the populations are primarily:

A. Ability to attend schools without loss of days
B. Ability to access health services without the health risk that goes with reduced access
C. Ability to access economic opportunities in other townships

As long as there is information available on road closures and the beneficiary population in the influence area, it is possible to estimate the above benefits.

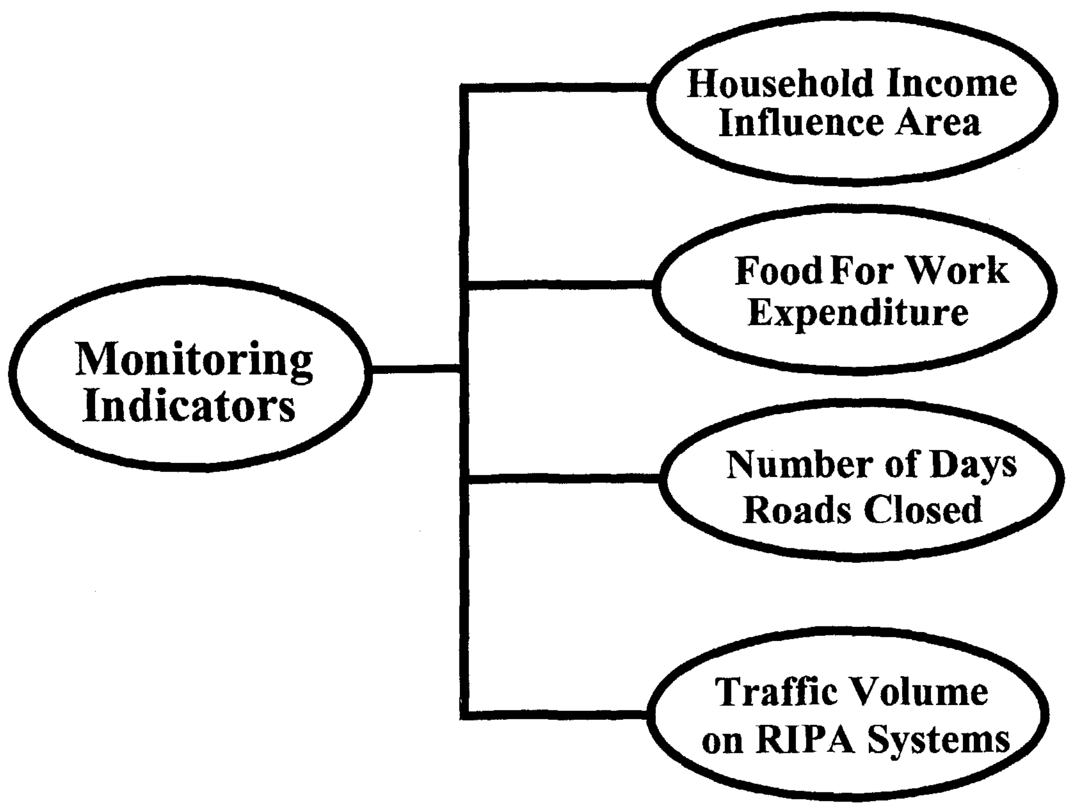
6.5 RIPA Implementation Package

RIPA road systems, which meet the EIRR criteria should be selected for implementation. Those indicating the highest rates of return ought to receive the highest priority for implementation. At the same time, it is important that a careful review of the accessibility and social benefits be conducted for those systems not meeting the minimum rates of return criteria. Where the social benefits are indicated to be of high order, those systems should also be included for implementation. While it is difficult to assign priorities based primarily on social benefits criteria, it is suggested that accessibility benefits should weigh heavily in determining priorities. Design standards, and therefore the costs should be adjusted according to traffic volumes, economic rates of return and inaccessibility benefits, as discussed in earlier chapters. After screening and applying the methodological and analytical steps, outlined above, a RIPA Implementation Plan is prepared.

6.6 Benefits Monitoring

It is necessary to monitor the forecast benefits. This will assist in correcting the forecast methodologies as well as suggest new approaches in future projects. The Monitoring indicators shown in **Figure 14** are household incomes in the influence area, food for work expenditures (FWP), number of days when roads are closed and traffic volumes. Household incomes and FWP Expenditures can be substituted by other equivalent criteria. Any increase in incomes would indicate that increase in accessibility is contributing to increased economic welfare of the communities. Similarly a reduction in the FWP expenditures would indicate an increase in employment. Monitoring of road closures is an indicator of the quality of construction and maintenance as well as the validity of the design standards. Finally, the traffic data would facilitate the monitoring of the accuracy of traffic forecasts and enable the refinement of forecasting methods.

Figure 14. RIPA: Monitoring Indicators



7. Lessons from Experience

7.1 Balancing Economic and Social Benefits

It is comparatively easy to make implementation decisions when economic criteria are met. However, since it is not possible to assign strict monetary values to social benefits, it is complex when proposed investments are marginal economically but provide major social benefits. These social benefits are primarily due to increased accessibility which in turn will result in increased economic and social opportunities. This paper proposes a rational methodology for quantifying, in a simple way, the accessibility benefits. Although it can be further refined, it is a simple but effective tool for including the benefits of accessibility. This methodology was used by the Chinese to prepare rural road components where foreign financing was involved.

The question of providing basic access, even at a reduced level of service (interrupted service) for all communities, should be a matter of national policy with regard to basic human needs. The foregoing discussion implies that access improves the opportunity spectrum, enlarges the area of economic opportunity and also enhances the social opportunities for education, health and other interaction. It becomes, therefore, important to give priority to basic access needs as part of poverty alleviation programs and economic development plans.

7.2 The Challenge of Appropriate Design Standards

It is reasonably easy to establish design standards for those roads with ADT of >200 MTE. However, it becomes more difficult to balance the conflicting arguments between those of basic access being a basic need and of getting the expected rates of return for the investments, under low traffic volume conditions. The conceptual basis for the discussion in Chapters 4.4 and 4.5 regarding design standards is that for low volume roads, investments can be made on the basis of social need but the design standards need not be the same as those for higher traffic volume RIPA roads. **The argument here is that it is better to make a start by providing basic access.** Design standards (level of service) can be improved over time as the traffic volumes build up concurrently with increasing economic activity.

However, this is not easy as citizens demand of their provincial and national governments equal treatment, often meaning, equal design standards. Even if the level of service is reduced, in terms of waiting time at water crossings due to occasional and infrequent heavy rainfall or floods, there should be no compromise on traffic safety. It is necessary and important to prevent accidents and to protect loss of property and human lives.

7.3 Institutional Systems and Maintenance Practices

It is important to have, if not create, institutional systems and mechanisms for regular maintenance of rural roads. It is considerably easier, in China, as they have a tradition of good maintenance practices with regard to rural roads. As detailed in Chapters 3 and 4, the maintenance of rural roads in China, is the responsibility of the counties. Taxation for maintenance and related maintenance practices, having evolved over the past 50 years, emphasize village and citizen level participation. This is not necessarily the case in other Asian countries. It is important, therefore, to devise and establish institutional systems, and supporting manpower and finances for proper maintenance of rural roads. Otherwise, new roads can deteriorate into a condition where access benefits will revert back to what they were before the road investments were made.

7.4 Replicability to Other Countries

The RIPA experience in China, detailed in this paper, can be of substantial value to other countries in devising their programs of access enhancements in rural communities. However, the program linkages, revenue raising methods, cost sharing methods, role of national, provincial and county governments, and maintenance practices, discussed in Chapters 2, 3 and 4, have to be adapted to varying governance systems in different countries.

The screening and investment prioritization methodology, discussed in Chapter 5, has been tested and used in five provinces of China over the past five years in Bank assisted RIPA projects and has proven to be effective. This can be adapted in other countries with modifications, dependent upon what indicator data is available. It should also be possible to use different surrogate values for various social and economic indicators used in the screening process in China. However, the principles, underlying the screening process and the methodology described in Chapter 5, remain intact for application in other countries.

The fundamentals of feasibility analysis described in Chapter 6 are applicable to the provision of rural roads in poor areas in other countries. It is possible, however, to improve the methodology to more sophisticated levels by assigning monetary values to all the social benefits. This has to be tempered by availability of resources to conduct more sophisticated analysis as well as whether such an analysis would produce any different results. The discussion and the analyses provided in this paper are of such a fundamental nature that it is quite possible to make changes and adapt them to various situations in other developing countries, especially those in Asia.

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