Transport of agrofood products in rural areas of Bolivia, Colombia, Ecuador, Peru and Venezuela (Andean Pact)

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The transport situation in the Andean Pact countries

Transportation is one of the underlying planks of human social development. Without it, mankind would never have reached the levels of development and integration achieved today. Arguably, the development of transport systems is one of the distinguishing features separating developed from developing countries.

In the Andean Pact countries, as in most developing countries, many people are living in relative isolation from markets, cities, and the basic social services. This is due to their problematic access to transportation systems. It is no exaggeration to state that isolation increases in direct proportion to lack of access to transportation, and that isolation is a key augmenter of poverty.

The absence of a well-maintained road network generally has a negative impact on the economy and on the quality of people's lives. It drives up the costs of transport, raises production costs, shrinks the competitive potential of export products, encourages the outflow of foreign currency for the purchase and replacement of transport units, and limits access to markets. All this has repercussions on income, making people poorer. It also limits the access of rural people to public services – the negative impact of this on human development is incalculable.

The importance of rural roads in the Andean countries emerges quite strikingly from the consideration that nearly 30 percent of Peru's population (6.5 million people) live in rural hamlets with fewer than 500 inhabitants, half of whom living in extreme poverty. In Bolivia 61.9 percent of the population (5 million) is rural, of whom 62 percent are extremely poor. In Ecuador, rural people account for 64.3 percent (8.06 million) of the total population.

The purpose of this paper is to serve as a planning and decision-making input for high-level technical or strategic personnel and authorities engaged in some planning, management, support or advisory capacity as well as to address the needs and problems of improving the agrofood transport system serving rural communities in Latin America and the Caribbean, especially in the Andean Pact countries. The paper may also be useful in gaining a strategic overview of action to enhance the efficiency of food transport from farm-gate to market and end consumers. It may also serve as a methodological reference for specialized country studies on the essential and defining factors, variables and indicators influencing the rural transport of food products in Latin America and the Caribbean, and for plans and programmes to improve this sector.

The methodology followed in preparing the paper involved a review of the relevant bibliography on transport themes in general, and food transport in particular. The Internet was searched for information as well, to outline a description of the food sector, and the state of existing road networks in Andean countries. This gave a broad overview of the general theme, and revealed that food transport problems are not uniform throughout the Andean area. Quite the reverse; there are major differences in the cases studied. They vary in accordance with the relative level of development in the regions, the type of product, the market destination, and the economic stakeholders in each particular case.

Further was observed that the food transport issue was viewed depending on the analytical perspective of each stakeholder in the value chain. For the small, rural food producer, for example, the main transport problem is access to the means of transportation and to roads. For carriers, the main problems are operating expenses and how to attain a reasonable balance between loads carried on the outward and return journeys. For the urban consumer, the problem is market supplies. For importers and/or exporters, the problematic issue is the port costs and tariffs that determine the competitive position of their merchandise.

Given this gamut of possible approaches, this paper focuses its initial analysis on the perspective of rural smallholders. They are, after all, the group most affected by transport constraints. The study then moves on to two specific food transport issues in the Andean region, so as to refer the final

recommendations to concrete cases. The first issue concerns the milk circuit in the Department of Cajamarca, and the second the rice circuit in the Department of San Martín, both in Peru.

These case studies were prepared on the basis of studies and analyses by NGO staff working in the region, and field interviews with various stakeholders in each of the two production chains.

The paper is organized in four sections. The first offers an introduction to the importance of transport in the food chain, and describes the paper's objectives and the methodology used in its preparation. Section two describes the socioeconomic and political context of the rural farm sector, and existing overland transport systems in the Andean countries. The third section presents a detailed analysis of the food transport system based on two concrete cases: milk in the southern part of the Department of Cajamarca, and rice in the Department of San Martín. The fourth and final section of the document presents elements and recommendations for consideration in the formulation of food transport development strategies.

Analysis of rural transport systems in the Andean Pact countries

ECONOMIC, POLITICAL AND SOCIAL CONTEXT OF THE ANDEAN PACT COUNTRIES

The Andean Pact includes Bolivia, Colombia, Ecuador, Peru and Venezuela. It embraces a population of some 115 million inhabitants, and covers a geographical area of 4.6 million km² (Table 20).

The region embraces a wealth of diversity in its existing ecosystems and geographic regions. The Cordillera of the Andes and the Amazon Basin are two of the most important areas of the subregion, with a high concentration of plant and animal biodiversity.

This rich biodiversity, or megadiversity, unquestionably represents one of the region's major development potentials. The sustainable use of this immense biodiversity poses one of the prime challenges to the countries of the region. This challenge becomes ever more acute in light of the accelerating rate of natural resource loss in the last few decades – losses that in many cases are irreversible.

Despite this great potential, the region is one of the most backward in all of South America. In most countries of the region, a vast part of the population lives below the poverty line, as Table 21 shows; and within each of these countries, the highest concentration of poverty is among the rural poor. This is clear evidence of structural problems of access to basic services such as energy, drinking water, housing and adequate transport systems and means of transportation. On the international scale, the five countries of the Andean region are classified in the human development index as medium.

ECONOMIC, POLITICAL AND SOCIAL CONTEXT OF THE FOOD SECTOR

Share of the food sector in national GDP

Agriculture plays an important role in the development of each of these countries, accounting for slightly more than nine percent of regional GDP. There are marked differences from one country to the next, however. The counties can be lumped together as Bolivia, Ecuador and Colombia, contributing 12 to 13 percent of GDP, and Peru and Venezuela contributing five to seven percent. Generally speaking, the contribution of the agricultural sector to GDP tends to fall as a country industrializes and becomes more urbanized. This decline is even steeper with reference to the total proportion of the population dependent on agriculture for their livelihood (Caro and Otero, 1999).

Despite this, agriculture and agriculture-related activities are still responsible for much of the growth within the subregion. This becomes obvious from a glance at the figures for the production, marketing and processing of goods of agricultural, livestock and forestry origin.

The agricultural sector therefore continues to play a leading role, as can also be seen in the figures

TABLE 20
Andean Pact countries: area, population and human development

	Area (thousands of km²)	Population in the year 2001 (thousands)	Annual population growth (2001) (%)	Life expectancy in the year 2000 (years)	Human Development Index (2001)
Countries	**4 695.74**	**115 100**			
Bolivia	1 100.00	8 500	2.2	62.6	0.672
Colombia	1 100.00	43 000	1.7	71.6	0.779
Ecuador	283.60	12 900	1.8	69.6	0.731
Peru	1 300.00	26 100	1.7	69.3	0.752
Venezuela	912.14	24 600	2.9	73.3	0.775

Source: Author's adaptation based on World Development Indicators database, April 2002. The World Bank Group and UNDP, Human Development Report, 2002.

TABLE 21
Andean Pact countries: principal macroeconomic indicators

Countries	GDP year 2001 (thousands of million US$)	Annual growth GDP in the year 2001	Per capita GDP in the year 2001(US$)	Population living below poverty line (%)
Bolivia	8.0	1.2	988	60.0
Colombia	82.4	1.4	1 951	55.0
Ecuador	18.0	5.6	1 289	35.0
Peru	53.5	0.2	2 106	49.0
Venezuela	124.9	0.7	4 979	31.3

Source: Author's adaptation based on World Development Indicators database (Portal) INE–National Census of Population and Housing, Bolivia 2001.

of aggregate income of the population. Despite this, it is important to note that a very high proportion of the population in these countries is living in poverty. This is made clear in Table 21, which also shows that the highest concentrations of relative poverty are found in rural areas.

Principal agrofood products

A review of the data supplied by the Andean Community of Nations for the year 1999 shows that the highest volumes of agricultural and livestock products were sugarcane, bananas and plantains, cow's milk, rice, maize and potatoes (see Table 22).

It is also important to look at the largest areas under various crops, and here the top contributors were maize, coffee, rice, bananas and plantain, and soybean.

TABLE 22
Andean countries: principal agricultural sector products

Crops/ products	Production (thousands of tonnes)	Area harvested (thousands of ha)	Yield (tonnes/ha)
Maize	3 713.6	1 889.9	2.0
Rice	6 845.5	1 460.8	4.7
Barley	273.1	289.0	0.9
Sorghum	678.5	265.5	2.6
Potatoes	6 048.6	583.4	10.4
Beans	286.3	300.3	1.0
Tomatoes	853.3	44.8	19.1
Onion	895.1	52.7	17.0
Cassava	3 315.0	390.8	8.5
Bananas and plantains	15 303.1	1.255.8	12.2
Oranges	1 048.4	96.7	10.8
Soybean	891.4	699.5	1.3
African palm	3 737.8	260.8	14.3
Coffee	963.4	1 707.2	0.6
Cocoa	172.7	490.6	0.4
Sugar cane	58 161.1	763.3	76.2
Cotton	348.6	209.4	1.7
Cow's milk	9 562.2		
Hens eggs	779.3		

Source: Andean Community of Nations, 1999

The region's vast potential for forestry development also deserves mention. There was an estimated wooded area of some 257 000 000 ha in 1995. Total estimated cultivable land area for the same year came to around 141 000 000 ha, considering arable land, permanent crops and pasture land (Caro and Otero, 1999).

Forestry potential is however undoubtedly subject to the high rate of deforestation now threatening ecological equilibrium in the region. This is the outcome of inadequate land occupation policies in areas of low population density, such as Amazonia. Other environmental problems related to agriculture and agroindustries include erosion, desertification, water contaminated by agroindustrial and agrochemical residues, waning soil fertility, and carbon and other emissions.

Another agricultural production sector, less significant economically, but important in social and cultural terms is the so-called traditional or smallholder agricultural sector. The results of technological innovation have not reached this sector, because of problems of accessibility or marginality. The sector plays a leading role in the food security of the rural and urban population in this study. The output of this sector is often the result of traditional lore that has been handed down through generations, and has an important function in preserving biodiversity in the Andean and Amazonian regions of the studied countries.

The Andean region is no stranger to the problem of food security, and its close relative, poverty. The FAO report *Food Security in the Andean Countries: towards an integrated rural development and poverty reduction strategy* states that more than 40 percent of the region's people are living beneath the poverty line, and 15 percent cannot cover the basic food requirements necessary to lead a healthy and productive life.

Limited access to productive infrastructure and appropriate technology is another constraint hobbling rural and agrarian development in

the region. The scarcity of irrigated land is an illustrative indicator here.

COMMERCIAL BALANCE OF THE AGROFOOD SECTOR

Tables 23 and 24 list the import and export values of the principal agricultural and livestock products of countries in the Andean region. The region exports large quantities of agricultural and livestock products. Among the main ones are bananas or fresh plantains, coffee, roses and other cut flowers, cacao, asparagus, and others. The principal products imported to meet domestic demand are maize, wheat and beans.

PRINCIPAL STATE POLICIES: REGIONAL OVERVIEW

The process of globalization and structural adjustment began and/or was consolidated in the 1990s, either by internal design or in response to pressure from the international financing agencies.

This process represented a new and awesome challenge for rural producers, especially small-holders. It was based on a process of open markets and unequal competition in the countries of the south, such as the Andean countries. The withdrawal of the State and of its extension, credit and research agencies left a vacuum that the private sector has failed to fill.

The underlying assumption of these measures was that private investment and the free market would fill this vacuum. This did in fact work quite well for commercial agriculture, but not so well for small- and medium-scale agriculture. Indeed the economic situation of this sector worsened (IFAD, 2001).

Concerning agricultural research and extension in the Andean region, a number of agencies are doing innovative work in the post-harvest and processing sectors. All countries in the region have in common a specific instance: the so-called National Agricultural Research Institutes. Each country has its own lead agency: the Bolivian Institute of Agricultural Technology (IBTA) in Bolivia; the Colombian Corporation for Agricultural Research (CORPOICA) in Colombia, the Autonomous National Institute

TABLE 23
World exports Andean Community (thousands US$)

	Year 2002	%
Total trade by selected product	3 947 416	
Bananas or plantains "Cavendish Valery" type, fresh	1 346 507	34.11
Coffee, not decaffeinated, not roasted	985 351	24.96
Cut roses, for decoration, fresh	384 824	9.75
Other flowers and buds, except carnations, chrysanthemums, pompoms (dahlias) and roses, cut for decoration, fresh	321 684	8.15
Cut carnations, for decoration, fresh	191 436	4.85
Cacao beans, whole or split, not roasted	95 496	2.42
Asparagus, fresh or refrigerated	85 023	2.15
Bananas or plantains (for cooking), fresh	59 525	1.51
Mangoes and mangosteens, fresh or dried	45 714	1.16
Brazil nuts, unshelled	31 145	0.79
Beans (red beans, broad beans,common beans) soybean, except for sowing, including brokens	24 043	0.61
Peppers dried, sliced or ground (paprika)	21 826	0.55
Other bananas or plantains, except "plantain" and "cavendish valery", fresh	20 919	0.53
Dark tobacco, not deveined or denerved	20 285	0.51
Fresh grapes	19 065	0.48

Source: Sicext, CAN 2003.

TABLE 24
World imports from the Andean Community (thousands of US$)

	Year 2002	%
Other durum maize (*Zea mays* var. *vulgaris* or *Zea mays* var. *indurata*), yellow, except for sowing	413 718	19.69
Other wheats, except durum, except for sowing	381 068	18.13
Other durum wheat, except for sowing	266 834	12.70
Beans (red beans, broad beans,common beans) soybean, except for sowing, including brokens	215 052	10.23
Uncarded, uncombed cotton	138 076	6.57
Fresh apples	70 594	3.36
Other beans (red beans, peas) common beans (*Phaseolus vulgaris*), except for sowing	46 027	2.19
Lentils and broad beans, except for sowing, dried	40 059	1.91
Barley, except for sowing	35 654	1.70
Technically specified rubber (TSNR), except latex	30 245	1.44
Fresh grapes	28 073	1.34
Other durum maize (*Zea mays* var. *vulgaris* or *Zea mays* var. *indurata*), white, except for sowing	25 633	1.22
Peas, except for sowing, dried	22 215	1.06
Roosters and hens weighing up to 1 850 g, live	21 779	1.04
Fresh pears	17 998	0.86

Source: Sicext, CAN, 2003

for Agricultural Research (INIAP) in Ecuador; the National Institute of Agricultural Research (INIA) in Peru, and the National Institute of Agricultural Research (INIA) in Venezuela.

The National Agricultural Research Institutes have traditionally operated with State funds since their inception in 1960. Their prime focus has been the solution of agricultural productivity-related problems in the top livestock and crop production sectors of the national economies.

However, these research policies have generally distanced themselves from the problems of smallholders in the region, and their condition of vulnerability and poverty. This is further aggravated in agricultural production zones where access is a problem.

Research has also taken an important detour in terms of primary production. This is true even where the institutional mandate also dictates research in the post-harvest and processing sector. In Peru, research in this sector was transferred in 1992 from INIA to the Institute for Agroindustrial Development (INDDA), with unimpressive results.

Moreover, the main focus of research has been the crop, and not the productive system. This has further distanced research findings from smallholders in the region, with their typically diversified productive systems, and a rural mindset based on a marked aversion to risk-taking.

Important changes were introduced in the traditional role of the national research systems with the introduction of structural adjustment policies and the globalization of national economies. These changes are directly related to the process of downsizing the State apparatus. Interesting instances of cooperation between private and public research bodies have emerged in the region. In principle, research priorities are starting to increasingly reflect market demand and requirements, and enterprises and private producers' organization are beginning to contribute technological innovations.

The outstanding challenges to providing rural extension or technical assistance in the current context involve attempts to implement sustainable technical assistance mechanisms that can reach the smallholder. This applies to primary production, as to post-harvest and processing. To put it another way, the challenge is to develop a private market for technical assistance.

PRINCIPAL STATE POLICIES IN THE COUNTRIES OF THE REGION

Bolivia

In line with the 2002-2006 "Plan Bolivia" (República de Bolivia, 2002), the government considers its priority task to be tackling the problem of unemployment. This is the most imperious need of Bolivian society, especially among young people in rural as in urban areas. The approach embraces public investment in road infrastructure and basic services, the provision of cooking gas to homes, rural electrification, and irrigation systems. The State also plans to re-establish rail services.

For production, a policy of productive transformation of the agricultural sector to improve the livelihoods of smallholders and strengthen rural enterprises through the provision of production, credit, marketing and development opportunities is now in place.

As for the problems of ethnic disintegration, a policy of social, economic and cultural inclusion is being promoted for the Quechuas, Aymaras and other ethnic groups of Amazonia, Chiquitania and the Chaco.

The Victor Paz Estenssoro Highway and the East-West Corridor will be built, linking seven departments and five neighbouring countries. These works will enable the people settled along these routes to develop economically, and allow goods to be moved to domestic and external markets.

Colombia

The 2002-2006 National Development Plan (República de Colombia, 2002) includes support to conflict zones and depressed areas. The approach will be to re-establish the local economic foundation in these zones through productive and income-generating projects in the agricultural, forestry, agroforestry and silvopastoral sectors. These projects are to be discussed and decided with the local communities, and will embrace the various stages of production chains, including production, processing and marketing.

The Plan includes action to develop the physical and social infrastructure of depressed areas by means of a strengthened "Colombia Profunda" programme. Works initiated earlier such as road, airport and fluvial projects will be completed. Electrification programmes in areas not yet connected to the grid will be developed through

the introduction of new networks and/or small hydroelectric plant projects.

The Plan tackles the rural issue with an approach emphasizing interaction between the rural sector, small and medium urban centres, and metropolitan areas. It also considers active community participation as a central Plan component. Environmental sustainability, land use planning, gender equity, and specific regional, cultural and ethnic situations are all parameters of Colombia's rural development and and sectoral policies.

Ecuador

One of the most severe problems faced by Ecuador was the economic and structural crisis of 1998-2000. In this context the Government is attempting to tackle what is considered the priority issue: poverty (European Commission, 2002).

The government has thus designed a national strategy to contribute to integrated, equitable and sustainable development. Three poverty-reduction mechanisms have been implemented.

- The Solidarity Voucher Programme, aimed at providing economic compensation through cash transfers to the poorest through the elimination of gas, electricity and fuel subsidies. The Programme reaches 44 percent of Ecuadorian families.
- The Scholarship Programme, aimed at increasing the family income of families living in extreme poverty, and promoting permanent access to basic education for children and adolescents of both sexes, through guaranteed assistance for at least 90 percent of the school year.
- The School Feeding Programme, aimed at enhancing the quality and efficiency of basic education. It provides supplementary feeding, especially in areas with the highest incidence of poverty.

Peru

The 2002-2006 National Strategy Plan (Republic of Peru, 2002) of the Peruvian government gives priority to the following:

- employment generation;
- poverty reduction;
- decentralization;
- modernization of the State.

In the agricultural sector, policies primarily target:

- promoting the development of rural producers organized in production chains designed to achieve developed and sustainable agriculture;
- strengthening and developing rural markets, increasing the coverage and quality of the provision of goods and public services to the agricultural sector;
- reducing poverty and improving the quality of rural employment;
- strengthening institutionality, and private and public organization within the rural sector;
- improving sustainable natural resource management and use.

Policies concerning the transport sector target the following objectives:

- integrating the national territory;
- providing an appropriate road infrastructure for an efficient transport system;
- promoting efficient and safe road transport services within a framework of free competition;
- promoting and providing efficient and safe air and water transport infrastructure and services.

Venezuela

In line with the 2001–2007 National Development Plan (República Bolivariana de Venezuela, 2001), the priority orientation of the public sector is decentralization. The aim is to make the most of the country's potential and achieve a more balanced and sustainable distribution of productive activities, investments and population in the national territory. The strategy designed by the National Government is based on the search for five equilibria.

- *Economic Equilibrium*: to develop an economic model leading to global production of wealth and justice in the use of wealth. The goal is to build an equitable, fair and prosperous society, which means establishing a humanistic, self-managed, competitive economy.
- *Territorial Equilibrium*: to develop a model of land occupation through the strategy of deconcentrated decentralization based on territorial potential, and its environmental and cultural restrictions.
- *Social Equilibrium:* the goal is not just to correct the vast differences affecting the

society with its burden of social injustice and exclusion, but also to achieve the full development of the citizen with reference to the exercise of democracy.

- *Political and Institutional Equilibrium*: the aim is to promote the transformation of the institutional framework within which all political, social and economic stakeholders make plans and take decisions.
- *International Equilibrium*: the goal is the proper insertion of Venezuela in the international context, and promotion of the economic, territorial and energy integration of the countries of Latin America and the Caribbean.

SOCIOECONOMIC CHARACTERISTICS OF THE RURAL AGRICULTURAL SECTOR

Agricultural land area and rural population working in agriculture

Table 25 gives data on the total amount of cultivated land and the total irrigated land area in each country of the Andean region.

Land tenure and land distribution

One important characteristic shared by the Andean countries of Bolivia, Ecuador and Peru is a pattern of extremely fragmented land ownership. This is attributable to the agrarian reform processes of the 1960s and 1970s in these countries, which gave rise to land deconcentration.

As an example, in Peru some 1.8 million agricultural and livestock producers occupy an area of 35.6 million ha (INIA, 1999). According to this same source, over half of these agricultural and livestock units own less than three ha, and occupy only 3.2 percent of all agricultural land. On the other hand, barely more than three percent of all agricultural establishments concentrate 77 percent of the available farmland, with properties larger than 50 ha in size.

TABLE 25
Andean countries: cultivated land area

Countries	Cultivated area[1] 000'ha	Irrigated area	
		000'ha	Irrigated/cultivated land (%)
Bolivia	2 100	88	4.2
Colombia	4 430	1 061	24.0
Ecuador	3 001	250	8.3
Peru	4 200	1 760	41.9
Venezuela	3 490	205	5.9

[1] Arable land and farmlands under permanent crops
Source: Caro and Otero, 1999.

Smallholdings are numerically predominant in the Andean region. However the best lands are held by the medium and large establishments (Chiriboga, 1996).

These structural characteristics of land ownership emphasise the need to seek economic alternatives for the smallholder population. This applies to agricultural alternatives such as appropriate patterns of built-in technical assistance and infrastructure support. And it also applies to non-farm alternatives with proven potential to create employment and generate income in rural areas.

Rural agroindustry in the Andean Region

It is important to point out the great many labour-intensive, small-scale, rural agroindustries in the region working to process local raw materials. Riveros (1997) mentions approximately 785 000 entrepreneurial endeavours of this type, providing work for some 1 962 500 people.

In both the large and the so-called intermediate cities one finds a great many microenterprises processing food in various production lines. They comprise a major alternative for the generation of self-employment and income for sectors of low economic capacity.

The microenterprise sector is in great need of built-in technical assistance and access to adequate financing in rural as in urban areas, so that they can compete in today's globalized markets. These small-scale units also need to become better organized. This means horizontal organization in the form of associations or groups, and/or vertical organization, with providers or producers of raw materials, as with enterprises of larger size or scale.

Globalization, urbanization, and changes in the agrofood sector

The Andean region has been no stranger to the changing patterns of diet and consumption arising from the swift pace of urbanization. Nor has the process of globalization of the food trade in each of these countries passed it by. As Riveros (2001) reports, the current trend is for urban consumers is to eat a good percentage of their meals outside the home, much of which consisting of fast foods, for lack of time. The same author reports major investments in the commercial and industrial segments of the food sector in Latin America, mainly through the acquisition of businesses and mergers.

At the same time, new markets are emerging in the developed countries as environmental awareness spreads among certain segments of the population, sparking a rising demand for organic or "green" products, and equity in production and trade relations, or "fair trade".

Illicit crops

Another major feature of the rural sector in Bolivia, Colombia and Peru is the importance of illicit crops, mainly coca. There are an estimated 50 000 has under coca in Bolivia (involving 61 000 growers), 81 000 in Colombia (160 000 growers), and 150 000 in Peru (40 000 growers) (Cabieses, 1999).

SMALLHOLDER FOOD PRODUCTION CHARACTERISTICS

Various studies agree that the current picture of agriculture in the Andean countries is characterized by its diversity. It is thus difficult to categorically spell out its specific characteristics at this time. Nonetheless, by using an agricultural systems – or production systems – approach, it is possible to tease out certain common features of this sector.

A joint FAO/World Bank publication (*Farming Systems and Poverty*, 2001), identifies seven farming systems of utmost importance in the Andean region in which smallholders are widely represented.

- *Irrigated systems:* primarily applied to fruits, vegetables and grasses.
- *Forest-based systems;* mainly found in Amazonia. There are vast stretches of (migratory) subsistence farming areas, as well as livestock production and plantations.
- *High-altitude mixed systems;* these include the generally well developed inter-Andean valleys, highland valleys, and mountain agriculture, where the most traditional systems of Andean culture continue to subsist (Andean crops and livestock systems).
- *Extensive/mixed systems;* include the savannahs of Colombia and Venezuela.
- *Coastal plantations and mixed farming systems;* where the major export crops are grown, fruit orchards and tubers.
- *Intensive highland-mixed systems;* includes vegetables, coffee, maize, cattle and pigs, cereals and tubers.
- *Extensive rainfed-mixed systems;* cotton, livestock production and subsistence farming are the characteristic systems.

TRANSPORT DEMAND

It is no easy matter to break down the information available in the Andean countries so as to detail means of transport and type of load. An estimate of the share of highway transport of food products in the GDP of individual countries would therefore not be very reliable. Additionally, the data from Bolivia and Venezuela include communications, and, for Bolivia, storage, making comparisons difficult. Despite this, the information presented below (Table 26), taken from a study of the Andean Community of Nations (CAN, 2000), gives some idea of the situation.

The demand for food transport in the rural areas of Andean countries varies by region, in accordance with a range of factors such as production structures, the integration of farm products into production chains and dynamic markets, and the geographical and climatological characteristics.

In some food-producing regions, there may be an intense, constant, and year round demand for food transport due to the diversity and volume of production, and its regional importance in supplying specific national and/or external markets. These are usually found on the outskirts of most major cities in the Andean countries. They tend to be well connected by paved roads and secondary road networks, with access to diversified transport, maintenance and intermediation services. The level of demand may rise or fall depending on weather conditions and the farm calendar, without necessarily signifying any variation in transport technological characteristics.

Elsewhere, product type and production structure may also determine the characteristics of transport demand. One example is the case of

TABLE 26
Andean countries: share of transport and communications in GDP (%)

Countries	Years	GDP (millions US$)	Transport (% of GDP)	Transport (millions UPS)
Bolivia	1997	1 967	8.2	654
	1998	8 575	7.8	666
Colombia	1997	95 925	7.1	6 850
	1998	- -	- -	- -
Ecuador	1997	19 760	6.2	1 225
	1998	19 710	6.3	1 242
Perú	1997	65 173	7.4	4 823
	1998	66 942	7.4	4 954
Venezuela	1997	98 003	5.1	4 998
	1998	98 863	5.9	5 833

Source: Andean Community of Nations, 2000

small cattle ranchers who carry five to ten litres of milk to market every day on muleback, or on their own shoulders, over bridle paths. Another case might be the small rice or coffee grower transporting harvests of roughly twotonnes each, two or three times a year, for which transitable roads and draught animals or motorized vehicles are required. The type of demand and the transport technology will vary with the case at hand.

The less developed regions represent the opposite extreme. Here production is barely integrated into the urban marketing circuits, and there is a lack of road infrastructure, as in isolated Andean communities, or a lack of transport, as in isolated Amazonian communities. In such cases, the demand for food transport is much smaller, sporadic in terms of frequency and volume, and usually combined with other transport requirements such as the need for passenger or messenger services.

ROAD INFRASTRUCTURE AND MOTORIZED FLEET

The situation of road transport in the rural areas of Andean countries tends to be similar throughout the region. These are vast territories, the terrain is rough and difficult and the road networks inadequate, leaving thousands and thousands of people in isolation and poverty. The roads are in poor condition for lack of maintenance, the vehicles are ancient and of many makes, operating and maintenance costs are high, service irregular, there are bureaucratic limitations, budgets are very limited; the problem here, in short, is backwardness and poverty (Table 27).

Often enough, the problem of transport in terms of poverty reduction in extremely poor, remote regions is not so much a question of the access of rural communities to cities and markets, but rather the reverse. The question, in other words, is how can food, and the basic health, education and energy services be brought to these communities?

Transport systems thus form part of the surrounding reality, and mirror the degree of local social and economic development in the areas they serve. Concrete opportunities for improving these services must take these realities as their point of departure, putting forth viable proposals in accordance with concrete capacities.

The road networks of the five countries of the Andean region are described next. Venezuela has a total paved road network of 93 472 km, with an index of occupation of 101 km of roadway for each 1 000 km² of area. Ecuador has 159 km of roadway for each 1000 km² of area. Bolivia and Peru lie at the opposite extreme, with about 50 km of roadway for each 1000 km² of land area.

Looking at the density index instead, Colombia and Peru are the most deficit countries in terms of roadway/inhabitant. Peru is the country with the largest land area unserved by roads, and the greatest numbers of people living in remote areas, isolated from cities, dynamic marketing circuits, and the monetary economy.

Despite extensive efforts by Latin American governments over a period of several decades to provide their countries with adequate road infrastructure, the agencies responsible report the following situation. By the early 1990s, only one third of the principal roads in the region were in acceptable condition and an additional one-third were in need of complete reconstruction. The remainder was urgently in need of rehabilitation.

For secondary roads, the average proportion of roads in poor condition at that time was 65 percent, and the figure was 85 percent for local roads (Bull, 2000). This was why many governments in the region undertook costly road reconstruction projects during the 1990s. There was a strong and marked tendency to replace the old with the new, never concluding that road degradation is

TABLE 27
Andean countries: area, population and length of road network

Countries	Population year 2000 (1 000 inhabitants)	Area (1 000 km²)	Length road network (km)		Density index total road network/1 000 inhabitants	Occupation index total road network/1 000 km² of area
			Total km	Paved km		
Andean countries	111 484	4 714	379 047	61 742	3.40	80.41
Bolivia	8 142	1 099	53 153	2 933	6.53	48.36
Colombia	41 564	1 142	113 500	13 620	2.73	99.39
Ecuador	12 411	271	43 197	5 184	3.48	159.40
Peru	25 661	1 285	75 725	10 051	2.95	58.93
Venezuela	23 706	917	93 472	29 954	3.94	101.93

Source: Andean Development Corporation, 2000

not some natural or inexorable fact, but rather the outcome of absent or misapplied road maintenance policies (IPES, 2001). Nowadays, agencies such as the World Bank and the Inter-American Development Bank offer financial support to the countries of the region in the form of programmes combining road construction, rehabilitation and maintenance, that enlist the participation of local and national governments, the private sector and user communities.

In Peru, the new roads in rural mountainous areas built under the Rural Roads Project have brought the outer world and its markets closer to the three million rural poor living in these zones. The programme design was innovative, forcefully underlining the key factors of poverty reduction, community participation, and the collaboration of key participants: the Ministry of Transport and Communications, the Inter-American Development Bank, the World Bank, and over 25 NGOs. This co-operatively oriented institutional framework was designed to maximise each of the comparative advantages offered by participants. The programme reduced isolation and favoured the integration of target communities, boosting economic opportunities and encouraging the participation of local entrepreneurs. Over 11 000 km of roads were rehabilitated. A total of 32 300 jobs for unskilled labour were created, along with 4 700 permanent jobs in 410 local road maintenance businesses. This innovative programme was awarded a Prize for Excellence in 2001 by the World Bank.

The costs for road rehabilitation in this programme ranged from US dollars 12 000/km for roads averaging less than 15 vehicles/day to US dollars 15 000/km for roads averaging 15 to 50 vehicles/day. In wilder areas, such as those found in Amazonia, the cost could be as high as US dollar 20 000/km. Routine maintenance costs for rehabilitated roads ranged from US dollars 500/km/yr for paved roads and US dollars 230/km/yr for dirt roads.

The characteristic problem of the fleet of motorized cargo vehicles in the Andean countries is the predominance of ageing trucks, more than ten or 15 years old, and past their useful life as stipulated by their makers (Table 28). This is basically an obsolete fleet (CAF, 2000). Another outstanding feature of the fleet in the total flow of cargo is the high percentage of lightweight vehicles, ranging from 30 to 40 percent of the total. This is a reflection of the misuse of the freight transport fleet. In some cases, as much as 60 percent of the vehicles used to transport freight on journeys of 280 to 450 km were light trucks.

TABLE 28

Andean countries: motorized fleet by type of vehicle

Countries	Total commercial vehicles	Truck	Trailer	Trailer and semi-trailer
Bolivia (a)	52 839	n.d.*	n.d.	n.d.
Colombia (a)	139 702	109 752	10 341	19 609
Ecuador (a)	1 438	n.d.	n.d.	n.d.
Peru (2001) (b)	145 549	110 276	17 081	18 192
Venezuela (a)	443 632	231 170	42 582	169 880

Source: (a) Andean Development Corporation, 2000
(b) National Institute of Statistics and Informatics, 2002.
* n.d. = no data available

Another problem that emerged is the high proportion of empty trucks in the vehicular flow. The proportion ranges from 26 to 38 percent of all journeys, implying that 50 to 80 percent of all trucks are empty on the return journey. Clearly, this drives up the cost of transport. Individual carriers comprise the bulk of the smaller-capacity vehicles (up to 20 tonnes), and this in turn accounts for 83 percent of the motorized fleet in the region.

Aspects of transport logistics and administration

Road management has traditionally been the province of the national governments through their Ministries of Public Works or Transport. With very few exceptions, these ministries have not paid enough attention to the issue of roads. The responsibility for this sector was partly or wholly transferred (depending on the importance of the routes) to decentralized or deconcentrated government agencies during the 1990s as part of the State reform process taking place in that era. In most countries, the main routes remained under the management of units with national coverage, such as the National Road Systems, Services or Institutes, whereas management of secondary and local roads tended to be turned over to lower government levels such as the municipality or prefecture.

Decentralization was positive for the main routes in terms of sustainability, and the extent to which transport was concessioned to the private sector or paid for by unsubsidized tolls. But for secondary and local roads, the devolution of management to lower levels of government was, with some exceptions, less successful. There are several reasons for this, including the lack of

legal precision as to the responsibilities of local governments for road management, and the unfamiliarity with road management systems of the new authorities responsible for organizing their running. Budgetary constraints, the priority given to new construction over the maintenance of existing roadwork, and the absence of specialized technical staff were further problems.

Food losses and food safety during transport

There are two major objectives of the application of post-harvest techniques to food of farm origin. The first is to maintain product quality: appearance, texture, flavour, and nutritional value and food sanitation. The second is to reduce losses occurring between harvest and final consumption. Key to achieving these objectives, even more than the use of highly developed technology, is efficient management of the product at every stage of the post-harvest process. While the use of advanced technology may offer certain advantages for large-scale operations, these options are frequently not economically feasible for small-scale producers.

In the case of Peru, the Ministry of Agriculture (MINAG, 2003) estimates post-harvest – losses of unprocessed farm products from farm-gate to consumer at ten percent, in the case of certain specific foods. The same source reports estimated yearly losses of over 900 000 tonnes, the equivalent of US dollars 50 million/yr. Other estimates of damage due to improper handling, storage and transport of food range from 15 to 30 percent. The case studies presented in this report offer estimates of food losses for the supply chains of milk in Cajamarca and rice in San Martín.

The direct causes of losses can be related to a range of factors. These include premature harvesting, poor ripening, poor threshing, inadequate drying, improper cleaning, attacks by bird, rodent or insect pests, or micro-organisms, biochemical changes, theft and pillage, improper moisture content during the storage phase, and inadequate storage and processing techniques. Indirect causes include lack of capital, ignorance of appropriate management techniques, lack of machinery, equipment, pesticides and packaging, and the weaknesses of transport systems and production and marketing organization systems. In any case, the problem of post-harvest losses is unquestionably quite complex, and variable from one case to the next.

CASE STUDIES: FOOD TRANSPORT IN THE DEPARTMENTS OF CAJAMARCA AND SAN MARTÍN

The departments of Cajamarca and San Martín, in northern and northeastern Peru, are representative of the types of food transport systems found in the rural areas of Andean countries.

Cajamarca is one of the most populous and poorest parts of Peru. Its mainly rural population specializes in the production of milk and dairy products to supply the main metropolitan areas.

San Martín, with a close network of urban settlements and good farm soils, has developed a number of agricultural specializations that have changed over time to keep pace with the demands of domestic and international markets. Once a top producer of rubber, followed by maize and coca, the focus now is on rice and coffee.

The following bibliographical references, consulted for the purposes of this analysis, include studies carried out by the Intermediate Technology Development Group (ITDG), Peru, and the Programme to Develop Rural Agroindustry (PRODAR). Within the framework of the PRODAR project, references include *Local agrofood systems: rural agroindustrial strategies and territorial dynamics*, sponsored by the Inter-American Institute for Cooperation in Agriculture. Other sponsors include the International Centre for Tropical Agriculture, and the Agricultural Research Centre for International Development (Boucher, 2000, 2002; Cabieses, 1999; Chiriboga, 1996; Guegan, 2001; Lewis, 1998; Magrath, 1996; Pezo, 1998; and Theenten, 2002).

MILK TRASPORT IN CAJAMARCA

General characteristics of the region

The department of Cajamarca lies in the Andean Cordillera in northern Peru, near the border with Ecuador. It covers a total land area of 33 317 km² – 2.6 percent of the national territory. The region ranges from 550 to 4 200 m. in altitude with an estimated population of 1 498 567 inhabitants – 5.6 percent of the national total. This is one of the most heavily populated parts of the country (INEI, 2002).

Cajamarca's population is relatively young. Fully 43 percent of its people are under the age of 20, and only 7.6 percent over 60. The birth rate is roughly 30.7/1 000, and the mortality rate 7.1/1 000. The department has the densest population

in the country, with less than 25 percent of the population living in urban areas. It is also one of the poorest departments, with over 77 percent of the population living under the poverty line (50 percent is classified as extreme poverty) (INEI, 2002).

Agriculture is the fundamental economic activity in Cajamarca, although mining, manufacturing and construction are also prominent. These four economic branches normally contribute nearly 70 percent of the department's GDP. Most of the population of Cajamarca is not directly involved in mining, but the presence of the Yanacocha mining company is a prime factor in demand and in the generation of regional GDP. The economically active population is concentrated, in decreasing order of importance, in farming, the service sector, industry and commerce.

Cajamarca's road infrastructure

Cajamarca is one of the most heavily populated and rural departments in the country, and yet its road network accounts for only seven percent of the national road network, and only four percent of the paved roads (Table 29). Cajamarca's main road connects the regional capital, Cajamarca, with the Pan-American Highway. This is the backbone of the national road system, running through the cities of Chiclayo, Trujillo and Lima. There is another paved highway crossing the northern part of the department, and in practice linking regions of eastern Amazonia, such as San Martín, with the Pan-American Highway. The regional road network branches off from this paved road, and consists of mostly unpaved roads, except for a few stretches making up 32 percent of the regional network. This in turn branches off into an enormous network of footpaths (61 percent of the regional network), where the bulk of rural output is carried on the backs of people and animals.

The road network is quite extensive, covering most of the territory, but it does suffer from serious problems that severely curtail the mobility of its rural population. The main problem is the poor state of most roads in the network, made worse every year with the arrival of the rainy season. This, the common denominator in most rural areas of the Andes, is the outcome of years of abandon and a chronic failure to serve on the part of those bodies responsible for the sector. It can be traced to budgetary limitations, the technical and administrative incapacity of local governments, and the absence of mechanisms to ensure sustainable rural road maintenance.

Characteristics of the dairy sector in Cajamarca

The department of Cajamarca has specialized in the production of dairy cattle since the middle of the 19th century. Today it is Peru's second milk producer, contributing 16 percent of the national output (Boucher *et al.*, 2000). Cajamarca is also known as a region offering quality dairy products, which are successfully, sold in all the principal markets of the country. The region has about 200 000 agricultural and livestock producers, who own nearly 600 000 head of cattle, producing an average of 1.5 to 2 million litres of milk each week (Theeten, 2002). Most producers own from one to five cows, on the average, each of which produces from 30 to 60 litres of milk each week.

The pattern of land tenure is quite skewed. Fully 67 percent of the farming and livestock units in the region are under 5 ha, and occupy only 14 percent of the arable land. At the other extreme, properties greater than 100 ha, and representing less than one percent of all agricultural establishments, occupy approximately 35 percent of the territory (INEI, 1994). In the poorest areas, the scarcity of agricultural resources is reflected not only in the poor condition of grasslands and the cows that graze on them, but in other agricultural assets as well. According to Lewis *et al.* (1998), 79 percent of smallholders report that they lack the resources

TABLE 29
Cajamarca: length (km) of the road network by type of surfacing 1996

Geographical area	Total length	Type of surfacing			
		Paved	Improved	Unimproved	Path
National total	73 756	8 565	13 280	16 875	35 035
Cajamarca total	5 268	371	877	815	3 206
Primary roads	1 134	350	594	85	106
Departmental roads	739	0	136	498	105
Local roads	3 396	21	147	232	2 996

Source: National Institute of Statistics and Informatics 2002

to enable them to generate enough income to develop an economy of full employment on their farms. Despite this, a bare 18 percent are seeking employment on distant farms or in the commercial sector. This gives some idea of the degree of poverty and isolation is which most farmers in the region live.

An estimated three-quarters of the milk produced in the Cajamarca basin is purchased directly by the big industrial dairy plants in the region. A further 13 percent is sold to the small diary by-product processing plants, and the rest goes for direct consumption or to feed the calves (Boucher *et al.*, 2000).

Milk is a highly perishable product, and marketing conditions are precarious due to the poor state of the roads and footpaths and the isolation of dairy farmers. For this reason a cheese-making industry developed in the region serves as a back-up mechanism for small-scale dairy farmers to preserve their output. In some cases they also use it to obtain a higher price compared to what the dairy plants pay for raw milk. And so when they are unable to sell their raw milk, they turn it into *quesillo* cheese, which is then sold to intermediaries at the weekly fairs held in the villages of Cajamarca. This forms the basic ingredient for the famous regional *mantecoso* cheeses eaten in every city in the country. *Quesillo*, also called *cuajada* or *queso fresco* is the most important ingredient in the production of *mantecoso* cheese. Ten litres of milk are needed to produce one kilo of *quesillo* cheese. The only ingredients used are milk and rennet. Product quality is usually quite poor, given the poor hygiene practices employed in its manufacture. The Institute of Industrial Technology Research and Technical Standards (INDECOP), defines *mantecoso* cheese as a mild, buttery, fresh cheese product, made from whole and reconstituted pasteurized or unpasteurized milk, soft and fine-textured, white or slightly yellowish.

In the district of Encañada in the Cajamarca area some 5 000 *quesillo* cheese producers live in settlements scattered among the communities of Chanta Alta, Quinua Baja and Quinua Alta. They own three to ten head of cattle, on average, and they all engage in the making of *quesillo* cheese, from milking to marketing, and with the active participation of the women of the family.

The producer in this area transports the *quesillo* cheese to the Chanta market (or streetfair) in crates or bags, on foot or horseback. The buyers take the product from Chanta in the same bags or crates, using public transport in the form of minibuses or pick-up trucks (Boucher, 2002).

Boucher (2002) identifies two types of *quesillo* cheese: the traditional product and an improved version. The first, made by most *quesillo* cheese-makers is simply a sort of cottage cheese prepared in a recipient in the same field where the cows are milked. This is a low-tech operation, and there is a serious problem with hygiene. The serum is separated from the curd at home and is then used to feed the livestock.

Improved *quesillo* cheese involves washing the udder with water, and the use of a cloth filter during milking to ensure cleanliness. The milk is taken home and subjected to a simple analysis designed to detect the presence of mastitis. Industrial rennet is used in this case, and the milk is heated to a temperature of 37° C for 30 minutes. The serum is then removed from the cheese, and the cheese is stored. The approximate yield is one kg of cheese per eight litres of milk. This process is still used by a small number of producers.

There is no reliable data on the production volumes of the regional cheeses. This is because the greatest problem of this small-scale sector is that 70 percent of producers prepare and sell their cheese on an informal basis at very low prices and do not conform to hygiene and quality standards. Cheese producers do report, however, that one of the main constraints to the development of this industry is the scarcity of milk produced in the area, as productivity is very low and most of the milk output is earmarked for the dairy plants.

Marketing channels for dairy products

Most of the milk produced is purchased directly in the field by two big industrial plants operating in the region. One collects from 1.14 to 1.19 million litres per week, and the other 210 000 to 420 000 litres (Theeten, 2002). Both companies have established collection systems for this operation. They use unrefrigerated trucks that do a daily run of the rural roads in the region, collecting milk from smallholders for delivery to industrial plants located in the regional capital. The only condition both companies require of their producers is to guarantee a steady, minimum supply of 10 litres of milk/day. This disqualifies a great many smallholders, who are unable to fill this quota.

Smallholders also have to transport their milk containers by horseback over footpaths to the highway collection points where the milk trucks stop. During the rainy season, the roads become

virtually impassable. And so the most distant producers no longer trek out to the collection points, unwilling to run the risk of travelling for many long hours, only to find on arrival no milk trucks due to road circulation problems, or that their milk has turned too sour to be acceptable.

One of the two industrial enterprises in the zone is installing cooling plants at strategic points along the road network to address this problem. This will allow milk to be stored and avoid losses due to spoilage. The milk producers bring their product to the cold plants where they can be checked for degree of acidity and stored until the arrival of the cold truck. Small cold plants that can hold 400 litres have been installed in the field. These can be managed by the smallholder, and are operating quite efficiently. There are also fairly remote zones with improved roads, but not served by the cold trucks. In these areas small-scale dairy farmers concentrate on the production of *quesillo* cheese as an income-generating strategy. They take their cheese to the Chanta market fair on Saturday on horseback, or else sell to middlemen.

Transport costs for producers

In calculating the cost of non-motorized transport to producers, a journey of up to six km per trip is assumed, which can take as long as six hours (coming and going), carrying the load on the producer's own animals. Maintenance costs are estimated at S/. 0.05[1] to feed one animal for one day. The cost for motorized transport is entirely the responsibility of the buyers, who set up service contracts with the owners of the milk trucks. However, the producer does have to travel to the city once every two weeks to collect the money for sales, at an average cost of S/.10 for each round trip, which often reduces the margin of profit and inhibits supplies.

For *quesillo* cheese, first there is the cost of the trip on foot or horseback from the home in the countryside to the weekly fair in the nearest town. Then there is the charge by the trucking fleet to carry the product to the city wholesalers, which costs about S/. 5.00 per 70–80 kg. bag, for an average journey of 70 km.

Transport costs for the carrier

Table 30 lists some average figures drawn from surveys filled out by four *quesillo* cheese carriers operating in the weekly market fairs in the area.

The milk economy in Cajamarca

There is very little data on milk production costs, and consequently on those for *quesillo* cheese. Farmers are not in the habit of calculating their costs, as they have no power to determine the sale price to the intermediary, and are therefore unsure of their gains and losses. Nor are there any academic studies on the subject. What follows are a number of estimates, based on the primary information at hand.

The cost for a small-scale dairy farmer to produce one litre of milk is in inverse proportion to the number of cows owned. On average, such a farmer owns three cows. Considering the full range of costs, a producer will incur losses, since the price he gets for one litre of milk is only S/.0.60 to S/.0.70 per litre.

Small producers who cannot sell their milk to the industrial plants, either because they are unable to meet the minimum production quota, or are unable to move the milk out to the highway pick-up points, have two alternatives. They can sell the raw milk to a third party (many of whom are suppliers to the big milk processing plants) for a little less than that paid by the plants (a difference of S/.0.05 to S/.0.10/litre), or they can turn the raw milk into *quesillo* cheese. This is then sold, either to buyers who collect the cheese on a door-to-door basis for sale at the weekly market fairs. Or they can transport the cheese to the fairs themselves for sale to wholesalers. The producer's margins of profit are tiny, whatever the alternative, and vary in accordance with seasonality, product quality and the conditions for moving the product. The producer's final choice of alternative will depend on a careful calculation of what seems more profitable at any given moment.

A study by Lewis, Agreda and Vargas (1998) showed that the price of milk, and hence the price of *quesillo* cheese is established directly by the biggest of the two dairy plants. Its purchasing power is such that the plant can regulate the price of milk, setting its own criteria and mechanisms of control. In other words, there are no arbitration mechanisms in this region to resolve price conflicts. Nor is there any legal body to whom producers can turn (the State apparently does not intervene in this process). We need to remember that the producer is delivering the milk on consignment, and that the final price will only be determined once the plant has tested for acidity and adulteration in its own

[1] US$ 1.00 = S/. 3.45 (November 2003)

TABLE 30
Cost of *quesillo* cheese transport

Vehicle	**Price**	**Age (years)**	
Purchase price used (5 t truck)	US$ 17 000	17	
	Gasoline	**Diesel**	**Consumption**
Per gallon fuel costs		S/. 8.20	S/. 57.40
Average yield = 20 km/gal			
Average round trip (km)			140
Cost of lubricants/ 3 000 km (oil and filter)			130
Vehicle maintenance			Yearly
Tires			2 100
Parts			1 000
Labour (maintenance)			400
Breakdown average costs		**Depreciation**	**Amount S/.**
Quesillo fleet (average 1 924 kg)			127.00
Passengers			40.00
Transport small animals			35.00
Groceries Cajamarca-Chanta			60.00
Total Income			262.00
Maintenance average/day			1.33
Parts average/day			3.33
Engine maintenance average/day			6.73
Average vehicle maintenance/day			6.06
Fuel cost/140 km			58.00
Driver			15.00
Assistant			10,00
Food			10,00
Total outlay			129.52
Total profit/trip			**132.48**

(*) Assuming 10 yrs of non-intensive use
1 US$ 1.00 = S/. 3.45 (November, 2003)

laboratories. The inference is that the industrial plant can apply its current pricing policy, taking advantage of the fact that producers have no other means of determining milk quality. This situation is only aggravated by the fact that producers are working as independents, and not as members of some association.

Quesillo cheese prices vary with product quality, which is in direct ratio to the water content of the cheese. Lower water content means a higher price for *quesillo*. Prices can be as high as S/.7.00/kg (roughly US$ 2.00). On the other hand, higher water content can drive the price as low as S/.1.50/kg, or about US$ 0.40. The average price ranges around S/.2.50/kg. Pointedly, the price paid by the buyers who purchase the cheese at the farmgate is quite similar to the retail market price. The profit is derived from modifying the scales used to weigh the product. This technique allows a buyer purchasing 250 kg to earn as much as S/.100 (US$ 29.00). Wholesalers buy the *quesillo* in quantities ranging from 250–400 kg and can, in turn, fetch retail prices of S/.0.50 to S/.1.00/kg in the city.

Demand for transport

There is just one truck working to supply the weekly market fairs in the Chanta and Yanacancha areas covered by the study. In Chanta the carrier delivers about 4 000 kg of *quesillo* each weekend to the town of Cajamarca. The average weekly delivery in Yanacancha is about 1 300 kg.

Milk producers in the area report that road infrastructure is considered a crucial factor for development of this industry. Road infrastructure also determines the final destination of the milk produced. According to Lewis *et al.* (1998), there is a direct link between the availability of roads and the final destination of the product. In the Yanacancha area, for example, producers report that before the road was built, all the milk they produced was made into *quesillo* cheese. Furthermore, every other product grown or raised on the farm was intended for home consumption, due to the difficulty of transporting their output along footpaths. And so, when the road was built, the final destination of the milk produced was not the only change. The amount of land under crops increased as well,

especially for potatoes. The road enabled farmers to lower their transaction costs, an obvious benefit for the personal well being of those involved.

In the absence of state road maintenance programmes, many suppliers of the industrial plants are organizing to provide regular road maintenance for the roads used as milk pick-up points. This assures access for the pick-up and delivery trucks serving the weekly fairs in the local towns. The roadwork often does more harm than good, however, because the work squadrons do not have the money to hire and mobilize heavy earth-moving equipment. They are also unschooled in appropriate road-surfacing techniques, and use farm equipment and tools for roadwork and maintenance. This, unfortunately, is directly related to the structural problem of regular financing of rural roads. It would be advisable here to promote the support of public bodies, private enterprise and the cooperation agencies to facilitate the access of milk producers to markets through the construction and improvement of access roads. It is also recommended that more intensive studies focus on the need to develop sustainable road maintenance practices and methods, based on the intensive use of local manpower, and simple and economical road-surfacing techniques.

Producers also need to deal with the problem of how quickly milk sours, in addition to the need for more roads in better condition. Often enough, there is an existing road, but the pickup trucks pass by at irregular intervals. There is a need to promote the technological development of cold systems that will prolong the amount of time milk suppliers can preserve their products. Here it is recommended that collective milk storage centres be promoted, and located strategically near small producer settlements, so as to reduce the margin of loss to the producer.

For *quesillo* cheese, which has a longer shelf life than milk, the transport problem is not as serious as the problem of product quality. Indeed, while all milk producers know how to make *quesillo* cheese, most use unhygienic practices, which reduce the value of the product. In this case technical training programmes to improved *quesillo* cheese-making practices, especially among the poorest women in the region are recommended. This is quite apart from the alternative of upgrading the roads, which would probably have the effect of reducing the amount of cheese produced and increasing the amount of raw milk sold.

Aspects of transport logistics and administration

No administrative authority has been established to regulate food transport in the region.

Some 20 to 30 trucks go by in a week in Bambamarca, for instance, carrying about 70 tonnes of cheese to the markets mentioned above. Only five of these are refrigerated. They carry cheese directly to the city of Lima. At least half these trucks also transport other products at the same time, although the law stipulates that these cheeses must be transported separately. In Cajamarca, on the other hand, where about 14 tonnes of home-made cheese are produced each week, wholesalers buy up this regional product and carry it down to the coastal markets, generally using one of the passenger buses serving the area. About 60 percent of the home-made cheese produced in Cajamarca and 72 percent of that produced in Bambamarca reach Lima by this means. Each of the four or five bus companies operating in Cajamarca carries about 400 kg of cheese to Lima every day.

The industrially produced cheese from the big dairy firms (an output of 30 tonnes/week), is transported to its final destination, the coastal markets, in refrigerated trucks at temperatures of up to 4°C. This prevents the milk from souring, and it is delivered in peak condition. It should be noted here that with the exception of fresh cheese, which is packed in plastic bags, all other cheeses are carried in cardboard boxes. Only *mantecoso* cheese is protected by plastic film.

Food transport development needs

The critical points (Box 1) of dairy product transport in the region basically have to do with the poor quality of the local road network, consisting of tertiary roads with stretches of footpaths. These roads, and they are in the majority, tend to be abandoned to the good fortune of local maintenance by grass roots groups organized for this purpose. This is directly linked to the price structure of products in the field, and their direct impact on producers.

Another critical problem concerns the limited capacity of the regional public bodies for road management. There are usually several national, regional and local bodies with some sort of responsibility for the development and management of road infrastructure. This is characteristic of countries in the Andean region. They often lack the wherewithal to comply with

BOX 1

SWOT analysis of milk transport in Cajamarca

STRENGTHS

- Cajamarca has a fairly extensive road network linking the principal milk-producing zones with the cities, and with the network of primary roads.
- The trunk routes of the regional road network are reasonably transitable, thanks to investments by the central government in recent years.
- The Rural Roads Project in Peru has invested substantially in the rehabilitation of large sections of the network of secondary roads. It has established a system of road maintenance based on local micro-enterprises.
- Certain groups of milk producers have organized on their own to shoulder the task of maintaining local roads.
- The big milk buyers operate a milk collection system using milk collection trucks with regular routes and pick-up points serving the region.
- Milk producers have a fallback strategy of home-made cheese production, to avoid milk losses from spoilage.
- There are a number of relatively well-organized systems for transporting dairy products from rural areas to market.

OPPORTUNITIES

- The process of devolving public administration responsibilities to regional and local administrations offers an opportunity for upgrading the management of regional road networks.
- Regional and local governments will have the power to manage economic and technical resources for the central government and external cooperation agencies. These resources could be earmarked for development and maintenance of the regional road network, following the management models established by the Rural Roads Project and the associations of dairy producers.
- The big dairy firms might eventually help to finance local rural road upgrading and maintenance programmes.
- The industrial dairy plants have set up cold storage modules that can be installed in hard-to-access areas, to keep stored milk from souring.

WEAKNESSES

- The regional road network is mostly made up of poorly maintained local roads and footpaths, the condition of which deteriorates even further during the rainy season.
- Regional governmental bodies lack the technical, organizational and administrative capacity to upgrade regional road management on their own.
- The milk producers who have organized to carry out road maintenance possess neither the proper tools and machinery, nor the expertise in appropriate road-surfacing techniques, nor the necessary economic resources.
- The poor condition of most rural roads in the region limits the number of routes that can be covered by the milk collection trucks. Many milk producers in remote areas thus have no access to this service.
- The most isolated producers have to walk for many hours carrying the milk on horseback (or on their own shoulders) to reach milk pick-up points or local markets.
- Producer costs for milk rise in line with transport problems, even as their incomes plummet.
- The high degree of acidity in milk for sale in rural areas drives down prices as well.

THREATS

- The road networks will continue to deteriorate if local road management capacity is not boosted.
- Strengthening local governments in the near future is no guarantee that the quality of the regional road network will be improved.
- The gradual deterioration of the regional roads tends to constrain milk and dairy collection systems, and to drive up their costs.
- The growth of stabled livestock production and milk production in local areas, where transport costs are lower, is making the big dairy companies much more competitive than the dairy producers of the Cajamarca.

their mandate, and this obviously generates system-wide inefficiency.

None of the local stakeholders in the milk and cheese circuits, however, consider the current availability of transport a serious constraint to the access of their products to market.

Other factors affecting the development of the regional dairy industry have little to do with transport, however. These concern the low productivity of milk cows due to the scarcity of pasture, and sanitary problems caused by the artisanal and unhygienic milk handling and cheese making practices in use. Other factors include the lack of trust between stakeholders involved in the marketing of dairy products, and – a fundamental factor – the lack of strong producers' association that could improve the bargaining power of members *vis-à-vis* the dairy plants.

Income generation from the transport sector in rural areas

No reliable indicators or previous studies exist from which to deduce the volume of employment generated by the transport sector in the region. Clearly, however, some rural municipalities do contract local manpower for truck maintenance and repair work.

Food losses and food safety during transport

In the absence of competent authorities to regulate the transport system in general and food transport in particular, it is virtually impossible to calculate with any degree of exactitude how much food is lost at the various stages of transport. Nor do the records of the transport services shed much light on the problem. Milk producers in the region indicate milk losses of about 1.5 percent for each litre transported, but there is no way of verifying these data.

The problem of souring is a constant threat for small-scale milk producers, and an even greater one in remote areas where access is a serious problem. It is a problem that generates substantially lower prices, thus cutting into the income of producers. Dairy plants lower the price they pay for milk in which high levels of acidity are detected.

Nor is there reliable data available on the volumes of milk that are already acidic at the time of collection. It would be useful to generate information on this subject, and thus be able to suggest viable alternatives in accordance with the volume of losses.

RICE TRANSPORT IN THE DEPARTMENT OF SAN MARTÍN

General characteristics of the region

The Department of San Martín is located in the Amazonian foothills, on the eastern slope of the Andean Cordillera, in northeastern Peru. This is a mountainous region, with soaring hills covered with tropical forest and vast valleys formed by the tributaries of Huallaga River, a major arm of the Amazon river.

The region has an estimated population of 757 740 inhabitants, which is 2.9 percent of the national total (INEI, 2002). Thirty-seven percent of this population is under the age of 14, and 60 percent between the ages of 15 and 65. The bulk of the population – 60 percent – lives in urban areas. Those who do live in rural areas are concentrated in small settlements not far from the principal highway that unites the territory of this region.

San Martín is also one of Peru's poorest departments, with 67 percent of the population living below the poverty line and 36 percent considered extremely poor – compared to national averages of 55 percent and 24 percent (INEI, 1996).

Economically speaking, the region contributes about two percent of the national GDP, mostly in the agricultural and livestock sector, which accounts for 32 percent of the region's GDP (INEI, 1996).

The principal crops are rice (33 percent), oil palm (21 percent), plantains and cassava. Except for plantains and cassava, the principal crops are targeted at extra-regional markets. Illegally grown coca has become an alternative money earner; the tropical forests have undergone uncontrollable depredation; and an incipient tourist industry has taken its first steps.

The road infrastructure in San Martín

Considering the size of the territory, the road infrastructure of the department of San Martín is not very extensive, comprising a mere 2.5 percent of the national network (Table 31). The backbone of the system is National Route 5N, formerly known as the Jungle Border Road and today renamed the Fernando Belaúnde Terry Highway. It runs through the territory from north to south, connecting the principal cities and valleys of the region with the big coastal markets, and the eastern Amazonian region through its link with the river network. Despite its importance for the regional economy and the shipment of heavy

TABLE 31
San Martín: length (km) of the road network by type of surfacing. 1996

Geographical area	Total length	Type of surfacing			
		Paved	Improved	Unimproved	Footpath
National total	73 766	8 564	13 280	16 875	35 035
San Martín total	1 870	47	830	713	280
Primary roads	699	47	567	20	65
Departmental roads	214	0	163	0	51
Local roads	957	0	100	693	164

Source: National Institute of Statistics and Informatics, 2002.

freight between the eastern and western parts of the country, most of this primary road of nearly 700 km is unpaved. This, in the view of most local economic agents, is one of the main constraints to development in the region.

The network of regional roads takes off from this national road. It is made up of surfaced but unpaved roads (82 percent of the total), and footpaths (18 percent of the total). Almost the entire network is in a very bad state of repair, and virtually impassable during the rainy season. Indeed a number of large and economically very promising valleys remain cut-off and undeveloped due to the terrible state of connections with the main road. Most of the agricultural establishments that are part of the regional economic process are located near the Belaúnde Terry Highway because the secondary road network is so undeveloped. Location is thus central to an understanding of rural issues in the region. People living far from this road are virtually excluded from the market economy and, in some cases, from the monetary economy.

Another serious problem is the poor condition of the southern half of the Belaúnde Terry Highway, which is precisely where the major rice-growing areas lie. This stretch of the highway, approximately 500 km long, is in such poor condition that the provinces affected are virtually cut off from the neighbouring regions. People are forced to travel an additional distance of over 1 000 km northwards to offer their products on the Lima market, the main consumer of the rice grown in the region. Paving this long stretch of the highway is, in fact, among the major demands of the region, but the cost is off the charts in terms of local financing capability.

The Poverty Reduction and Alleviation Project (PRA, 2001) estimated the economic loss to the region due to the failure to upgrade this highway at 254 million US dollars each year. This is in consideration of a seven-year planning horizon, and a discount rate of 12.5 percent (in US dollars). The methodology of the estimate used is based on the estimated increase in surpluses for producers in the affected regions as a result of the reduced transaction costs inherent in paving the highway. A planning horizon of seven years was arbitrarily chosen because it is considered a prudent period of time for carrying out road rehabilitation work. The discount rate of 12.5 percent is the figure used by the IDB and the World Bank, lower than the 14 percent figure used by the Investment Office of the Ministry of the Economy.

Paving this stretch of the highway would bring producers in this region within reach of the Sierra and coastal markets, considerably reducing the distance to Lima, as well as the surcosts for freight, which can be as high as 100 percent in some cases.

In short, the major critical points of the regional road network have to do with the limited development of the secondary road network. This has severely curtailed the productive potential of some of the region's large agricultural valleys. The poor quality of the southern stretch of the main road, running from Yurimaguas to Tarapoto to Aucayacu, really drives up the costs of the regional trucking fleets.

Characteristics of the rice sector in San Martín

Rice production in Peru is estimated at two million tonnes/year (2001), of which San Martín contributes about 16 percent: San Martín is Peru's second largest rice producer. The crop accounts for just over 60 percent of aggregate regional agricultural output (1998), contributing nearly one-fifth of the department's income.

There are roughly 63 000 agricultural and livestock producers in the region, of whom over half are rice growers (Ministry of Agriculture, Republic of Peru, 2002). The average per hectare and per harvest yield is estimated at six to seven tonnes – there are two harvests/yr. Some 75 percent of all agricultural and livestock establishments are

TABLE 32
San Martín: farmer/producers and Area

Size of farm units (ha)	Farmers/ producers		Area	
	Amount	%	ha	%
Less than 1	1 817	3	804	0
More than 1 to 5	19 978	32	48 225	4
More than 5 to 20	25 413	40	248 705	22
More than 20 to 100	15 019	24	538 782	49
More than 100	835	1	270 838	25
Total	63 062	100	1 107 354	100

Source: National Institute of Statistics and Informatics.
San Martín statistical records, 1996.

under 20 ha in size, and occupy 26 percent of the available farmland. At the same time, less than one percent of farms occupy roughly the same percentage of land (Table 32).

There are three clearly differentiated rice-growing zones in the region, depending on productivity, rice quality and market accessibility.

The northern rice-growing zone, known as Alto Mayo, produces about half the rice in the region, and has good connections with the coastal cities of Chiclayo and Lima via the paved section of the Belaúnde Terry Highway, and a fairly comprehensive network of secondary roads. However, yields in this zone are quite low at 5.7 tonnes/ha, and 16 different rice varieties of medium quality are grown. The output is sold on markets where purchasing power is not very high, and is often mixed with other qualities of rice.

The central rice-growing area, known as Bajo Mayo, contributes 15 percent of regional output, and is connected to Alto Mayo via a heavily trafficked stretch of highway 150 km long, and currently under repair. The rice grown there is a good quality product, especially the Capirona variety, yielding on average seven tonnes/ha, and destined for medium and high-quality markets.

The southern zone, which is, called Huallaga Central, accounts for 35 percent of the rice grown in the region, but this also includes the most degraded section of the Belaúnde Terry Highway. The rice is of very good quality, and productivity high. The great disadvantage, however, is the high trucking costs due to the fact that carriers have a very long journey northwards through Bajo Huallaga and Alto Mayo to arrive at coastal markets.

Product destination

An estimated 85 percent of the total output of the Department of San Martín is earmarked for domestic markets, and the remainder for home consumption and for seed. Almost all the paddy produced in San Martín is hulled in mills located outside the region, in the coastal cities of Chiclayo and Lima. This is an indication of the department's weak capacity to retain the option of value added for what is its principal commodity. The reasons no doubt lie in its disadvantageous location with respect to the major markets, and are directly attributable to the poor quality of its roads.

The characteristics of the rice circuit differ in accordance with farm size and the grower's location with reference to roads. Among the small producers (60 percent of all rice farmers), 25 percent sell their paddy directly at the farm-gate to buyers for transport to collection centres or directly to local mills. The remaining 75 percent carry the harvested rice to their homes on horseback or by some motorized means of transport, where it is dried for later sale to mills or rice buyers, with enhanced value added. Or it may be destined for home consumption.

Among the medium-sized producers (30 percent of all rice-growers), about 65 percent have their harvest hulled in local mills and sold on the regional market. The remainder is sold as paddy to buyers for delivery to the coastal mills. The big growers transport their entire output as paddy to the coast.

Rice marketing channels

Rice intermediaries basically comprise buyers and sellers working with mills located inside and outside the region, and truckers carrying loads of 20–40 tonnes between the coast and the eastern part of the country.

In Alto Mayo in the northern part of San Martín, the primary and secondary roads are in fairly good condition, enabling easy access for the big coastal mills to the farms where the rice is grown, where they purchase the paddy directly from the farmer, with no intermediaries involved. Here, the easy road access has been put to good use by the mills in neighbouring Chiclayo. At the same time, however, this has inhibited the development of a local post-harvest industry that would have added value to the product for the profit of local people. In this sense the highway has not been favourable to regional development, but it did favour commercial integration with more developed neighbouring regions.

In the Bajo Mayo area, on the other hand, most producers have one to two ha under rice, with yield of about seven tonnes/ha of good quality rice per harvest. Depending on supply and demand, many

mills buy the paddy directly in the field, especially from the poorer farmers, to whom they often advance funds to tide them over to the next season. Other farmers may take their harvests into the city in search of mills offering the lowest drying and hulling costs, or sell to buyers for export, or on local markets.

In the Huallaga Central area, the process is similar, except that there are no big mills in the sector, and moving the harvest to the central zone is extremely costly given the poor road conditions.

One of the main problems with the San Martín mills is the use made of rice by-products (comprising about 30 percent of the whole rice grain). Broken grains are not used for balanced food and no local industry uses rice husks for building materials or as fuel. The husks are therefore taken to dumps outside the city and burned, a high and unrecoverable cost.

Transport costs for growers and rice mills

Most of the rice farms are located near roads, and because the volume of production of an average parcel (10–15 tonnes) is too heavy to transport in small quantities, the usual choice is motorized carriers. Most of these vehicles are farm trucks, and trucks that can carry from four to 40 tonnes. During the rainy season transit becomes a problem on these rural roads, and, as the harvest is smaller, many farmers use animals or carts pulled by tractors to take the harvest from the fields.

Farmers who want to get their rice to the city mills contract the services of farm trucks or pick-up trucks, which charge form S/.1.50 to S/.2.00 t/km. The transport cost varies seasonally and with the movement of the market, but the usual price arrangement is roughly S/.20.00/tonnes for the entire trip (usually 6-10 km, on average), or else a flat rate for the entire load. This service is normally in good supply, and farmers do not appear to contest these charges (Box 2).

The big mills in the central zone take the bags of hulled rice down to the coast in high-tonnage trucks that usually charge around S/.2.00 to S/.3.00/t/km, for average distances of 850 to 1 000 km.

Transport costs for the carrier

Table 33 illustrates the business costs of the rice truckers, as reported directly by the category.

The problem here is not the supply of transport. The big mills send about 100 trucks loaded with rice down to the coast every month. The problem is the business costs of the carriers. They have no problems with ensuring a full load from the rice mills down to the coastal markets. But they often fail to fill the truck on the return journey. This unquestionably generates an economic loss that is passed on to the mills, which in turn pass it on to the small farmer. Likewise, at the height of the harvest season, trucks give greater priority to rice and less to other possible candidates for their services. Losses in fruit harvests are frequent, for

TABLE 33
Cost of rice transport

Vehicle	**New**	**Used**	**Age**
Vehicle purchase cost 20 t capacity	US$ 120 000	US$ 30 000-50 000	15-20 years
Gasoline		**Diesel**	**Amount**
Per gallon fuel cost		S/. 9.20	S/. 4 317.69
Average yield = 20 km /gallon			
Average km per trip (round trip) Tarapoto - Chiclayo			1 500
Average km per trip (round trip)Tarapoto-Lima			3 100
Cost of lubricants per 3 000 Km. (oil and filter)			180
Average yield = 6.5 km/gallon			
Vehicle maintenance			Yearly
Tires			2 500
Parts			3 000
Labour (maintenance)			350
Detail average costs			**Amount S/.**
Rice fleet and other agricultural products, average per trip to coast			5 000.00
Total income			5 000.00
Average maintenance cost per trip			250.00
Fuel cost			4 317.69
Helper			80.00
Total outlay			4 647.69
Total profit per trip			**352.31**

BOX 2
SWOT analysis of rice transport

STRENGTHS

- The Department of San Martín is a major producer of good quality rice.
- The region has a national highway that unites the territory, linking its principal cities to the big coastal markets.
- Most rice growers live in areas located near the road, and so heavy vehicles are able to reach these farms fairly easily.
- The freight transport service available in the region is good, diversified, and relatively modern.

OPPORTUNITIES

- The process of decentralization whereby the duties of the public administration are devolved to subnational authorities provides an opportunity to upgrade the level of management for regional roads.
- The rice market is still highly "elastic", and a promising one for boosting both production and productivity within the region.
- Better roads, particularly the paved part of the Belaúnde Terry Highway, can reduce transport costs considerably, thereby increasing profit margins for small farmers.
- The political will of the new Regional Government has translated into a proposal to swap the elimination of exoneration from VAT for resources to pave the highway.

WEAKNESSES

- The high cost of transporting rice to the big markets reduces the comparative advantages of the region compared to other national and foreign rice growers.
- A major section of the main highway is in very bad condition for traffic, which has driven fleet costs sky-high, and cut the region off from potential neighbouring markets.
- The secondary and tertiary road networks are very limited, and the roadways in very poor condition. Substantial natural resources in the region that happen to lie far from roads thus remain untapped.
- State investment in the development and maintenance of the regional road network has been insignificant, and basically focussed on upgrading specific sections of the main highway.
- There are no local farmers' associations to take local responsibility for road maintenance tasks.
- Truckers carrying big loads of rice down to the markets on the coast find it very difficult to fill their trucks with freight for the return journey. The losses are passed on to the mills that buy the rice, and they in turn pass them on to the small rice grower.
- Other farmers producing other types of commodities have a hard time finding transportation for their products during the big rice harvest.

THREATS

- The road network will continue to deteriorate unless local road management capacity is strengthened.
- The upcoming increase in the power of local governments is no guarantee that the road network will be upgraded.
- The gradual deterioration of the roads tends to limit the rice transport fleets, and to make them more expensive as well.

example, when growers are unable to find transport for their output.

Another problem linked to rice transport is the weight of the truckloads. Technically speaking, loads exceeding 12 tonnes axle are not allowed, as a precautionary measure for maintaining paved roadways in good condition. But in practice, loads of up to 20 tonnes/axle are customary. The same cannot be said of the tax, payable on account, paid by the mills for shipping each tonne of rice and which amounts to ten percent of the estimated value of the sale. Controls by the National Superintendence

TABLE 34
Cost of rice production, Department of San Martín

Heading	Unit of measure	Amount	Unit price (S/.)	Sub-total	Total (S/.)
A. Direct Costs					
Land preparation					770.00
Ploughing	hours	4	70.00	280.00	
Harrowing	hours	4	70.00	280.00	
Puddling	hours	3	70.00	210.00	
Sowing					464.00
Seeds	kg	80	1.80	144.00	
Extraction and loading	days	6	12.00	72.00	
Seedlings					
Transplanting	days	20	12.00	240.00	
Fertilization					160.00
Urea	kg	200	0.74	148.00	
Tillage					247.00
Fertilization	days	4	12.00	48.00	
Application of phytosanitary control	days	5	12.00		
Irrigation	days	6	12.00	72.00	
Border weeding	days	8	12.00	96.00	
Phytosanitary products					449.00
Herbicide	litre	3	70.00	210.00	
Insecticide	litre	1/4	180.00	45.00	
Fungicide	litre	1	80.00	80.00	
Foliar fertilizer	litre	3	38.00	114.00	
Harvest					325.00
Harvest and bagging	days	25	13.00	325.00	
Subtotal					2 456.00
A. Indirect costs					
Unforeseen 5 %/day.					122.30
Technical assistance 10%/day					122.80
Interests					245.60
Sub-total					491.20
Summary					
1. Direct costs					2 456.00
2. Indirect costs					491.20
Total costs					2 947.20
Yield kg/ha					6 500.00
Cost/kg					0.45

Variety: Capirona
Average yield: 6 500 kg /ha
Production costs
US$ 1 = S/.3.45 (November 2003)
Sale prices
Farm-gate price to producer: S/. 650/t
Local price to public: S/. 700/tonne
Ex-region price to public: S/. 850/t
Intermediaries: (Farmer to Mill to Wholesaler to Consumer)
Source: Farmer Manuel Mondragón; 150 ha sown in Consuelo area

of Tax Administration (SUNAT) are so strict on the highways that truckers require prior proof of payment from the mills before they will move the freight. The "efficiency" is lost, however, by the failure to control sales on the wholesale markets of the principal cities, where traders neither request nor issue a bill of sale. As a result, the "sales tax" becomes a "production tax", which cascades back to the original purchase price.

The rice economy

Table 34 presents figures on the production costs for one hectare of irrigated rice, and margins of profit for the average rice farmer in the region.

Generally speaking, the big wholesale dealers in the city of Lima determine the price chain for rice. This means that price fluctuations on the final market are much less than on the production sites in San Martín. These fluctuations bottom out between

May and September, a period coinciding with the harvests in the coastal valleys, where per hectare yields and production volumes are considerably higher than in our study area, and processing and transport costs lower as the network of mills and roads is more developed.

Demand for transport

Bearing in mind that rice yields in the area average 6.5–7.5 tonnes/ha, the demand for transport is reckoned at two or three vehicles/week for an 18–25 tonne truck, hired to deliver to the mills in the region. There is no major gap between the supply and demand for transport, given the importance of rice production in San Martín in terms of supplying the regional market, and thanks to the road infrastructure in the region.

During the off-season, however, the demand for transport contracts considerably. Consequently, carriers face serious economic problems, and may be 15 to 20 days without work in a month.

Food losses and food safety during transport

As in Cajamarca, there are no public authorities in San Martín specifically responsible for regulating and monitoring the food transport services. This has direct repercussions on the recording of data in general, and particularly the data on post-harvest losses during transport.

Information supplied by farmers, millers and carriers suggest that post-harvest losses due to transport can be estimated at 0.6 to 0.7 percent. The damage can be traced to improper handling of the sacks rice is shipped in, wear and tear of these sacks, and higher moisture content of rice during wet weather.

All those interviewed tended to agree that a sizeable percentage of these losses occur during the early stages of the process, when the rice is moved from the farms to the first pick-up point, due to the poor condition of the access roads. These roads are so bad that the big heavy-duty trucks cannot get into some farms, and so the rice has to be brought out on carts pulled by tractors or draught animals. However, the greatest losses occur during the process of drying rice on the ground (the traditional technique used by farmers to lower the moisture content), and not during transport.

Strategies for improving rural food transport

DESIRABLE CHARACTERISTICS OF FOOD TRANSPORT SYSTEMS

An ideal vision of the desirable characteristics of food transport systems in the rural parts of the Andean countries should include a sufficiently extensive road network to unite the various production zones of the region with intermediation centres and consumer markets. This network would be efficiently organized and administered, and there would be sufficient economic and technical resources to ensure its sustainability over time.

It is also possible to imagine transport services and means of transport technically adapted to the production systems and conditions of each production zone, and economically accessible to the poorest farmers in the region. This would not produce the surcosts that make farmers' products less competitive and standards and regulations appropriate for the specific social, economic and technological realities on the ground in each zone would be in place. There would be administrative and management bodies to ensure the development and sustainability of the road infrastructure, and compliance with road safety and other norms.

ANALYSIS OF JOINT INTERVENTIONS TO ADDRESS FOOD TRANSPORT PROBLEMS

Throughout the Andean area, there have been joint interventions by the agencies responsible for the overland transport sector, and other state and private agencies, to promote solutions and programmes to favour development in the Andean regions.

Investments by the big mining companies to build and upgrade transport infrastructure in the region are a case in point. Of course, the specific target of this action is to facilitate access to the mines and the extraction of minerals, but it also affects the surrounding agricultural context in various ways.

The state agencies that were established to generate temporary employment in urban and rural areas have played a major role in the construction and maintenance of rural roads. The same can be said of the state-sponsored settlement programmes in the Amazonian territories. An important investment component in almost every one of these cases was the building of penetration roads. These roads promoted migration into the area, but they also unleashed a whole sequence of unplanned events. These include mechanized tree felling, the use of heavy machinery, inappropriate logging methods, and the invasion of territories belonging to indigenous communities.

Some NGOs active in food support projects have also indirectly contributed to certain aspects of transport infrastructure. The food they deliver to recipients is based on the "Food for Work" concept. The work component generally involves efforts such as roadwork, designed to benefit the community at large.

There are also joint programmes by port and airport authorities to develop multimodal transport systems in areas where the Andean roads, the Amazonian river system, and urban airports converge. State and private capital, such as the dairy firms and mining companies in Cajamarca, foster joint efforts to build and/or improve roads so as to facilitate the circulation of specific goods from one region to another.

Coordination and intervention with local governments is also important. The trend is toward growing local governmental involvement in the development and maintenance of the road networks under their jurisdiction. They are also responsible for supervising the food that comes in and out of urban markets, and monitoring the movements of trucks. There is additional coordination with the police, customs and tax authorities for different transportation controls for inter-regional trade.

The major impact on food transport, however, comes from the road upgrading and development programmes of the Ministries of Transport. An example is the Rural Roads Project of the Ministry of Transport in Peru. The objectives of this World Bank-sponsored programme, with an estimated value of 300 million US dollars, are to upgrade the transitability of rural road networks

in the poorest departments of the Peruvian Andes. This will improve connections between producer communities, urban towns and markets, and make public and private services more accessible. It will help reduce transaction costs, develop markets, generate more jobs, stimulate local and regional economies, and raise the living standards of the rural population.

According to the economic, social and environmental assessment report prepared immediately after the conclusion of the first five years of the Programme (Cuanto, 2000)[1], the impacts generated are closely related to the period of maturity of the works. Initially, the most important and visible impacts concerned aspects directly related to transport conditions, such as notably shorter travel times and increased vehicle transit, and, to a lesser extent, lower costs for the freight and passenger fleets.

Impacts linked to access to public services are less discernible, however, even if medical examinations and health care have been considerably enhanced. But neither the supply nor the demand for educational services has increased. Concerning access to branches of the justice system, no change has been observed. Despite the growing demand for security, it is difficult to understand whether this demand is due to increased access to the administrative branches of justice, or to the increase in social turmoil.

There has been little impact on the spectrum of productive activities as a whole. It is possible that once the works reach full maturity, substantial variations in these aspects may be detectable. There is an observed impact on producer prices, which were higher on average than those in the control zones (outside the project area). This was not perceived by the farmers, however, as farm prices fell throughout the country in the year 1999. There is no evidence of increases in the amount of planted acreage, yields, crop and income diversification, or the percentage of output intended for market.

As for employment, there has been no significant improvement, except in the case of the road maintenance microenterprises. Nor has migration been halted; though there has been a small counter flow of families who had moved earlier for economic reasons.

Concerning gender issues, there has been a significant increase in the access of women to health centres, compared to men. Women felt that the roads had done more for them in social terms, than in terms of productive matters.

In the case of Ecuador, the national government has implemented an IDB-supported project called Rural Transportation Infrastructure (PIRT). It aims to lay the foundation for a sustainably managed rural road system. The pilot application will concern the rehabilitation of 415 km of surfaced roads and 100 km of paved roads.

This model is based on a redistribution of the functions and responsibilities of road management at the different governmental levels, retargeting financial resources, enlisting the active participation of target communities, and introducing technical procedures based on the creation of rural micro enterprises for routine road maintenance.

In Bolivia, the most decentralized of the three countries, there are no government projects *per se* targeted at rural road improvement. However, some local governments are receiving training through an ILO project to promote labour-intensive roadwork.

OPPORTUNITIES FOR HOLISTIC SOLUTIONS FOR IMPROVING FOOD TRANSPORT SYSTEMS

There is a whole range of opportunities for upgrading food transport systems in the Andean region. Rural road network rehabilitation and improvement programmes targeted at physical infrastructure are one priority that needs to be closely linked to local and regional economic development plans promoted by the municipalities. The municipalities need to take on duties and responsibilities concerning transport.

Other unbeatable opportunities for lowering transport costs and promoting social and economic development are those offered by food processing and preservation processes, preferably on-site, that both reduce the weight of food products and add to their value. This is true of cheese-making in Cajamarca, a milk-processing technique to get the product from the farmer to the market, and locally milled rice in San Martín, or the processing of other traditional local products such as fruit. These processes need to be solidly anchored on a series

[1] The assessment was made immediately after the conclusion of the first five-year phase (1995-2000) of the Rural Roads Project, and as a pre-condition for financing the ongoing (2003) second phase.

of marketing, technical, and economic feasibility studies.

The importance of developing and disseminating technologies that are appropriate to the specific social and economic context is of prime importance here. They should enable producers to add value to their primary products at little expense to themselves, thus improving their margins of profit. Processing can in some cases as much as triple the producer's profit. Further benefits are substantial reductions of food losses through food processing, the value added inherent in finished or semi-finished products, and the lower transport cost for these smaller volumes of production.

In a broad sense, technology development means more than the mere development of labour-saving mechanical processes, it also means building the working and organizational capacities of producers working in the same branch or in the same region. There is an indisputable need for technical assistance in this field. This is arguably a serious constraint, and will require the support of private enterprise (through equitable coordination), state technical education services and NGOs. It is vitally important to train local human resources to implement these business initiatives.

The question of access to basic services such as energy and drinking water is crucially important. The point is to meet the basic needs of the rural population, and to guarantee the efficiency and quality of value-added productive processes. There are viable alternatives such as micro-hydraulic water supply systems, and environmental cleanup tailored to rural communities.

It is also important to facilitate access to up-to-date marketing data, to enhance the capacity of smallholder or other rural producers' associations to achieve timely access to regional and extra-regional markets, and to decide to diversify as and when the demand so requires. There are already experiences with rural info-centres, under some of the informational technology projects.

There is a wealth of collective development experiences – some successful and some not, which have been undertaken under various modalities of social organization. Taking the example of the Cajamarca milk producers in our case history, they may quite possibly improve their terms of trade with dairy transnationals if they can successfully organize to offer a standard product on a joint basis. This would also be complemented by the provision of laboratory and cold storage services at the roadside collection points.

COLD CHAINS: AN ALTERNATIVE FOR THE RURAL SECTOR

Undoubtedly, the so-called cold chains are among the most important technological advances in post-harvest management, with the greatest economic impact on the various production chains. Cold chains make it possible to keep highly perishable products fresh by regulating the low temperatures at which products are maintained from when they are harvested to when they are sold to the end consumer. For fruits and vegetables, as for dairy and meat products, cold chains offer a guarantee for the final quality of fresh and raw products.

Small farmers in the Andean sub-region have very little access to cold chains, however, due to the high cost of this equipment and the lack of access to low-cost energy in rural areas. In most cases the cold chains are found where medium or large enterprises are participants, and manage to integrate the various stages of the post-harvest cycle because they are handling large volumes of production.

There are a number of interesting experiences, such as the Cajamarca case study, where one of the big milk buyers is setting up cold centres for milk in rural areas. These centres, each with a daily capacity of 400 to 2 000 litres, are used as collection points for the milk produced by small local dairy farmers.

Access to low-cost energy sources is a pre-condition for milk cooling plants. This is therefore a viable alternative for communities who are already hooked up to the grid, or who have access to some economical alternative source of energy, such as that provided by micro hydroelectric plants.

This equipment can be manufactured locally at lower cost, and disseminated to interconnected collection centres, or to centres with the potential to tap mini hydraulic energy systems. The milk company can then collect fresh milk with controlled acidity, and guarantee higher prices to the farmer.

This last item of course demands a joint effort on the part of organized small producers, private businesses, local government and rural development cooperation agencies.

For these systems to be accessible to small producers, they must organize. Economies of scale and a certain level of managerial capacity *vis-à-vis* the public and private entities involved are both essential. A clearly defined business model for producers' associations is also important. The personnel in charge of management need to

be carefully selected and properly trained in the managerial and technical aspects of their jobs.

PROBLEM PRIORITIZATION

Despite the existing differences between the various road systems in the Andean countries, they do all generally share the same problems and the same constraints. The road networks are insufficient to meet the communication needs of all regions. Most roads are unpaved, and circulation is a frequent problem for lack of maintenance. The regulatory frameworks are often inadequate, and both national and subnational governments face serious budgetary, administrative and technical constraints to proper management of the road networks. Added to this are further limitations such as the poor quality of the transport services, and the technological dependence that inevitably drives up the general cost of transport.

Road infrastructure

The long stretches of roads in the network unsuitable for motorized transport, the scarcity of roads, and the fact that innumerable valleys and regions lie outside the present network, and thus cut off from development, all constitute major road infrastructure problems. A further problem concerns the quality of existing roads, most as yet unpaved and lacking regular maintenance, thus limiting vehicle transit and driving up the costs of commerce.

During the rainy season, most of the unpaved roads become impassable, either because stretches of the road become giant mud puddles, or due to the frequent mudslides that block roads, temporarily isolating communities, or leaving them with serious communication problems. Local governments in the poorest rural areas lack the resources and equipment to deal with emergencies. Nor are there any institutionalized regular road maintenance services, so that road degradation is a continuous process. The situation can get so bad that the roads become impassable to vehicular traffic, requiring costly partial or full road rehabilitation operations, which will shortly again turn to loss, in the absence of regular maintenance.

In some cases road users have organized to carry out maintenance and rehabilitation tasks on their own, usually during the rainy season. But they lack the necessary earth-moving machinery, special skills and appropriate tools, and so the results are doubtful at best.

There are other cases, however, where the government has encouraged the creation of micro-enterprises to do routine maintenance under contract on previously rehabilitated roads. Unfortunately, this is not an economically viable proposition, as the maintenance costs exceed the economic benefits generated. The upshot is that road maintenance is basically a subsidized enterprise, and hence dependent on eventual budgetary injections from the central government to regional and local governments.

The two cases illustrated in this paper are representative of what occurs throughout the Andean region. In San Martín, the road network is minimal given the size of the territory. Extensive valleys with great promise for agricultural development are not reached by roads. Quite logically, their populations are demanding new road-building projects to free them from this state of isolation. In Cajamarca, on the other hand, the road network extends throughout the region, but most of the roads are in a chronic state of poor maintenance, and it is very hard for people in the more remote areas to get their goods to market.

Transport management

One main aspect of the transport issue concerns the distribution of responsibilities and resources among the various levels of government. The national roads, mostly paved and also the most promising in terms of economic return are the responsibility of the national governments through the various branches of the Ministry of Transport. The departmental roads are the responsibility of the regional governments, and the local roads come under the local governments.

Resources earmarked for road infrastructure, deriving as they do from taxes or from external indebtedness, are perennially scarce. The few resources that are available tend to be concentrated among the national agencies to serve the needs of the most important and most economically viable roads. Subnational and local governments on the other hand, who are the ones responsible for rural transport systems, suffer from a lack of the necessary financial, technical and organizational resources to address their responsibilities in this sector. This situation is likely to change in the future, along with the evolving process of decentralization now underway in some countries of the region.

A second aspect of the transport management issue concerns the regulatory framework governing transport activities. This involves road concessions, road safety, vehicular traffic and loads, and the

services supplied by transport firms. The regulatory standards are normally applicable nation-wide, with no regard for regional specifics. Often enough it is impossible for local administrations to comply with established procedures, because they simply lack the necessary minimum financial, technical and human resources to operate in compliance with them.

Technology and access to transport

Available technology is another aspect of the transport issue. It concerns social access to the means of transportation, the businesses offering transportation services, trade intermediation, and vehicular maintenance.

Not only is the cost of acquiring a vehicle quite beyond the economic reach of small producers, the great diversity of makes and models also drives up the maintenance costs for existing vehicles, as well as the cost of parts and repairs.

As an additional complicating factor, many of the vehicles now in circulation are past their useful life, technically obsolete, and in need of replacement. Despite this their owners continue to patch them up, reducing their margin of profit and making the roads even less safe. Many cargo vehicles lack the necessary equipment, loads are not correctly handled, and the whole process generates substantial losses.

Social access to the means of transportation is another problem. While regular transport services do exist in many cases, their costs put them beyond the reach of the poorest small producers. An additional problem here is that carriers find it difficult to fill their trucks on the return journey, and so they need to transport sufficiently large volumes on the outward journey from rural food-exporting areas to make up this loss.

All of the above make freight transport costs a very high-cost item for rural producers – often too high, placing them at a disadvantage with respect to other competitors.

STRATEGIC PLANNING TO ADDRESS FOOD TRANSPORT NEEDS

The determinants of food transport systems in Andean countries vary in nature, and thus come under the jurisdiction of different sectors of public administration and levels of government. Strategic planning aimed at addressing or upgrading the conditions of food transport in general may be aiming at too broad a target. There are so many external factors, involving so many stakeholders (who may have very different – and perhaps conflicting – views and objectives). This is further complicated when the Andean region is viewed as a single unit, despite the great diversity of characteristics and problems among regions and from one country to the next.

Speaking in general, however, strategic planning objectives designed to upgrade food transport systems in Andean country regions mainly concern the same factors. These include infrastructure, the means of transportation, services, equipment, public administration, the kinds of products transported, post-harvest processes applied prior to transport, and relations with marketing agents.

Concerning infrastructure, rural road networks need to be fairly extensive and well maintained. This obviously means solving the problem of funding road maintenance on a regular basis. This in turn assumes the existence of public or private regional road maintenance services, paid for through taxes or road tolls. It is recommended that studies be done on how to develop appropriate, sustainable road maintenance methods and practices based on intensive recourse to local manpower, and simple, economical, road surfacing techniques.

It is also recommended that public agencies, private businesses and cooperation agencies working on rural road construction and improvement projects lend their support. It is certainly important to upgrade existing roads by means of sustainable rehabilitation and maintenance. But it is also important to promote the construction of new secondary and tertiary roads so as to bring now isolated Andean communities into the mainstream, and reinforce commercial flows from the countryside to urban areas.

As for the means of transportation, the sole alternative, given the current context of technological dependence in the Andean countries, is to promote the development of intermediate means of transportation that the less favoured sectors of the population may be able to afford.

Concerning services, what is needed is a supply of duly equipped transport services with appropriate equipment for the various kinds of cargo, offering regular transport service, priced within reach of the local population. This is dependant on a whole series of random external factors, such as market fluctuations, changes in the terms of trade, price hikes for technological maintenance, climatic variables, and so on.

As for infrastructure, community pick-up and storage centres should be built and strategically

sited in areas where small producers cluster, so as to avert losses from spoilage. This is where the big private firms, normally the principal buyers of the output of small producers, can play a leading role in developing rural assets and facilities. Other alternatives such as loans for small cooling plants in remote areas may also be promising.

Concerning public management, the various sectoral, national and regional bodies need to improve coordination to the point where they can efficiently facilitate and promote the development of transport systems and food marketing.

These subnational bodies also need to promote closer links between the supply and demand for technical assistance services in order to promote economic development. In the specific case of food, this assistance should be designed to cover the principal gaps at every link in the food chain.

There is another area in which private enterprise can also make a contribution to upgrading food transport from the countryside to the city. They can help producers to manage their products, and to develop the on-site post-harvest processes that add value to primary products. Processing reduces the volumes to be shipped, lowers the cost of transport, and ensures more favourable terms of trade for the rural poor.

Farmers' associations also need to remain strong and active. Only thus can they protect the interests of small food producers *vis-à-vis* intermediaries and the principal buyers, and ensure the provision of market data and other such services to small producers, including cold storage and credit systems, and promote the existence of rural/urban trade regulatory bodies.

POLITICAL AND SOCIAL CONSTRAINTS TO THE EFFECTIVENESS OF THE PROPOSED SOLUTIONS

Factors limiting the viability of the proposed solutions are generally structural in nature, and their impact on the national transport system is across the board.

We refer particularly to the scant public resources earmarked for building, improving and maintaining national road networks, and the fact that these few resources and the decision on how to spend them are concentrated in the hands of the central government

Often enough, these decisions take a political twist. Hence the recurrent difficulties for regional and local government to address transport problems at their level of jurisdiction.

The weakness of rural economies is another major constraint to resolving transport issues. The margins of profit and local capacity to keep any profits earned within the region do not justify major investment in road infrastructure, except for strategic projects of clear national interest. The same criterion is applied in the area of training and technical assistance from the private sector, which focus on areas that show the greatest potential for development, are most accessible, and where producers can more easily pay for these services.

Other important factors concern the poverty levels and quality of life of most small farmers. They lack the necessary technical and economic resources to make their land more productive, add value to their products and better their terms of trade.

Lastly, the technological dependency of the means of transportation, while not definably a social or political factor, does entail high maintenance and operating costs for the vehicles in the fleet, and exerts a considerable restraint on the potential development of food production and transport.

DESIRABLE BENEFITS OF VIABLE SOLUTIONS TO FOOD TRANSPORT PROBLEMS

The evaluation of the Rural Roads Project in Peru, made by the Cuanto Institute (2000), sheds some interesting light on the potential benefits of upgrading rural road networks.

The benefits or this project to rehabilitate and upgrade rural roads concern the period of maturity of the work concluded. The immediate benefits registered first on transport conditions in the target areas, and especially the shorter transit time, cost of moving freight and passengers, and the increased transit of motorized vehicles. This had a very relevant impact on the producer prices for farmers, due to lower transport costs, despite the fact that the higher earnings were lessened somewhat by adverse weather conditions that reduced production.

There were also relevant increases, though to a lesser extent, in the access of rural people to public services and urban markets. However, the report does not establish whether or not these indicators will grow in the medium term as a result of these road improvements. Nor does it establish definitively whether or not they will increase over time, which might be an indication that being connected or not being connected is not the sole determinant of isolation. It is also significant to

note that the evaluation showed that improving roads has so far had not had much impact on boosting either employment or income, nor has it slowed the outward flow of migrants, or helped to alleviate poverty.

As for the potential benefits of enhancing market-oriented production and postproduction activities, it is hoped, first of all, that this will result in a relative reduction in the transport costs farmers pay, as the volumes of processed *vs*. unprocessed foods are smaller. Secondly, it is hoped that increasing the value added of the products and reducing losses from spoilage will also increase the producer's profit. These reductions in transport costs due to the smaller volumes that have to be transported will not be very significant in the absence of substantial technological changes in the transportation units. It is recommended that funding programmes be promoted to renew the freight transport fleets, and to encourage efforts to upgrade the regional capacities for vehicle maintenance and the manufacture of spare parts.

Access to appropriate technology will also generate greater efficiency in production, at lower cost and enhanced quality. Here it is important to consider the promotion of small farmer organization and associations so as to produce economies of scale to improve market coordination.

Lastly, it is hoped that the process of decentralizing transport systems, now being devolved to subnational levels of government, will facilitate policy decisions and pave the way to more direct participation on the part of producers and the private sector in developing and solving the problems of regional transport systems.

Conclusions and recommendations

The issue of food transport in the rural areas of Andean countries is extremely complex. It involves a great many local and superstructural factors, which may well lie beyond the capacity of national authorities to control. The issue is part and parcel of a much larger problem that involves the general problem of transport, the scarcity of resources of both the State and its citizens, and the isolation in which large sectors of the population live. These recommendations cannot, therefore, be exhaustive for all aspects of the problem, and refer only to specific, important aspects.

MANAGEMENT AND PLANNING

- National management and planning schemes need to be devised for transport systems, and duly devolved to local government levels, but at the same time attuned to overall national transport policy.
- The above assumes a very intense effort on the part of national authorities to build the economic, administrative and technical capacities of subnational governments.
- Likewise, such decentralization also assumes the active participation of the community as crucial to the sustainable development and maintenance of transport systems. It is therefore necessary to continue to seek such mechanisms to ensure sustainability at each project stage.
- People's participation in road maintenance must be channelled through the local governments and communities by means of information, consultations and cooperation.

TRANSPORT SYSTEMS

- Local (municipal) and regional governments and businesses must promote forms of organization to facilitate the hiring of local manpower within the community.
- Non-motorized transport should be promoted and included within transport sector programmes, especially in areas where accessibility problems are most acute.
- Minimum standards for the operation of regional transit need to be adapted to ensure comfort, safety and efficiency.
- The carrying capacity of paved roads and bridges needs to be upgraded.
- The geometric design of roads needs to be upgraded.
- Maintenance programmes with self-financing management need to be developed.
- Market infrastructure for agricultural products needs to be developed in different areas of each country. The CENMA project in Guatemala and the Tiendona project in El Salvador are good examples of this.
- Most functions of the design, inspection, construction, operation and maintenance of the road infrastructure should be transferred to the private sector.
- The planning and regulatory functions of the Ministries of Public Works and Transport should be strengthened.

FOOD PRODUCTION AND POST PRODUCTION SYSTEMS

- The creation of associative road maintenance micro enterprises should be supported, ensuring the use of local manpower, as a contribution to job generation, sustainable roads and a better national economy. Micro enterprises and cooperatives should preferably be made up of local people living in the direct area.
- Food processing to reduce product weight and increase value added should be promoted.
- Sustainable technical assistance schemes should be promoted for primary production and processing of rural products, based on the identification of market demand.
- Technical and entrepreneurial learning incentives for rural people need to be promoted so as to build human capital.

KNOWLEDGE GENERATION

- The experience of the various road and road maintenance funds in the regions should be reviewed and systemized for the purpose

of disseminating the achievements and drawbacks of current experience.

- Institution building depends on earmarking government funds and priorities for lesser interventions such as rural roads that have a direct impact on the lives of people in local communities.

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The agrifood transport sector in Latin America and the Caribbean is a key component of the food supply chain, making a significant contribution to gross domestic product in these countries. Well-developed, efficient food transport systems are crucial to the survival of thousands of people, and pivotal to the success or failure of key economic sectors such as agriculture and other major national and international commercial activities. This publication of the Agricultural and Food Engineering Technologies Service of FAO's Agricultural Support Systems Division presents a detailed study of problems encountered in three Latin American and Caribbean country groups: Central America and Panama, the Expanded MERCOSUR, and the Andean Pact. It covers seventeen countries. The study focuses primarily on stumbling-blocks faced by small farmers, and suggests possible policy and programme interventions to improve the situation in the neediest areas, with repercussions for the population as a whole.

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