Infrastructure Strategies for Papua and West Papua
1.1. Challenges for Development in Papua and West Papua

The provinces of Papua and West Papua are immense and varied. Together, the two provinces are roughly the size of California, or twice the size of Great Britain. Although they contain abundant natural resources, economic development is unusually challenging. Barriers to development are physical – great distances, steep mountains, swampy lowlands, fragile soils, and heavy seasonal rainfall – and social -- low population density and extreme cultural fragmentation. Fewer than 3 million indigenous Papuans speak 250 different languages, and have unique, and in some cases confrontational cultures.

Papua and West Papua are rich in non-renewable resources. So far, deposits of gold, copper, silver, petroleum, natural gas, and coal have been discovered in Papua and West Papua. Nobody doubts that more deposits will be identified. Papua and West Papua also contain the third-largest expanse of remaining rainforest in the world, after the Amazon basin and the forests of central Africa. Great variety in altitude and rainfall provide conditions for remarkable ecological diversity. Moreover, and unlike the situation in neighboring PNG, Papua and West Papua’s forest cover is largely intact. Nearly half of Indonesia’s remaining forest is in Papua and West Papua. The surrounding sea, particularly in the north, also is exceptionally rich in species. This is truly a unique pocket of the biosphere. Indigenous people traditionally have relied heavily on local plants and animals, but with relatively little impact on the environment. Since large parts of the forest contain trees of high commercial value, including sandalwood and merbau, there is considerable interest in commercial forestry.

Yet human development indicators remain low. Surrounded by mineral and forest wealth, most of the people of Papua and West Papua remain very poor. The demand for infrastructure reflects the desire to change this. In the interior of Papua and West Papua, imports are tremendously expensive, the result of high transport costs. People want roads to lower the cost of imports. Local and international business interests also want better infrastructure in order to extract and export the non-renewable mineral and forest assets. For this reason, within Papua and West Papua, the focus in the discussion of infrastructure development has been on transport, especially on road development. But infrastructure development must also help isolated communities gain access to education, health care, water, sanitation, power, and communication technologies. The average level of education today is low and health outcomes are threatened by widespread malaria, gastro-intestinal infections, and HIV-AIDS.

Economic growth in Papua and West Papua so far has been concentrated in a few places that interact relatively little with each other. Most of these are on or very near the coast. In the interior, the mountainous highlands mostly contain scattered, small economic units centered on public administration and subsistence farming.

Papua and West Papua today stand at the threshold of enormous change. As in other parts of the world richly endowed with non-renewable resources, there is great pressure to convert these assets to cash. Every tree, every ounce of gold and ton of coal, represents new houses, automobiles, and aircraft, when it is removed and sold.
Better infrastructure means lower extraction and transportation costs, raising the returns to owners of logging and other resource extraction enterprises. Outside interests with the resources to build roads and other infrastructure stand ready to promise income and development in exchange for local permission to harvest the forest and mineral wealth of Papua and West Papua. Papuans and other Indonesians, too, stand to obtain some of the income that exploitation of resources will generate. The prospect of trading resources for income and infrastructure is hard to resist. The question is: what would such short-term gains imply for development in the long run? The basic challenge is to develop the region in a way that creates broad opportunities for future generations as well as for those who enjoy immediate income from the extraction of non-renewable resources.

1.2. The Sustainability Challenge

Looking to the long run, it is useful to consider three aspects to this challenge: economic, environmental, and cultural "sustainability." By sustainable development we mean change that permits future generations to enjoy economic, environmental, and cultural services at least as great as what the current generation enjoys. Change is not sustainable if some generation in the future will have fewer economic, environmental, and cultural opportunities than Papuans and West Papuans have today. Sustainability is not always achievable, but it always should be a standard against which any proposed change is measured.

1.2.1. Economic sustainability

A development strategy is economically sustainable if it generates income not simply for a few decades, but over generations. Without planning, exploitation of non-renewable resources is likely to follow a boom-bust cycle, leaving degraded opportunities behind. What will the people of Papua and West Papua do after the "gold-rush?"

Exploitation of a mineral deposit may last for decades. During this period, it is essential that investments be undertaken that will provide livelihoods after the deposit is exhausted. The Freeport mine in Papua is an interesting case study in the efforts of a private investor and the public sector to generate sustainable development out of a mining venture (see Box 5).

Forests generally are removed much faster. In contrast to mines or hydrocarbon deposits, in which a few hundred square kilometers can generate income for many years before the resource is exhausted, tens of thousands of square kilometers of forest can be clear-cut in less than a generation. Between 1982 and 2005, according to the Indonesian Ministry of Forestry, about 34 million hectares of forest were removed. Over this 23-year period, Indonesia’s forests were harvested at the rate of 40 square kilometers per day (about 30 sq km/day after 2000).

Forests are not necessarily non-renewable. Sustainable forestry technologies exist, involving selective harvesting, replanting, and active management of standing forests. Unfortunately, such "low-impact forestry" is sometimes called "low-income forestry," because in the short run, clear-cutting a forest will generate far more net revenue than is possible using sustainable practices. In recent history, most forest exploitation has not been sustainable. Whether in the Amazon basin, PNG, or Kalimantan, once an area is opened up, entire forests are removed. Europe experienced deforestation centuries ago and North America is also facing the challenge of making forestry there sustainable.
We estimate that the gross value of the timber on a hectare of forested land is about USD 13,500 when the land is clear-cut. Of this, on average, taxes and government revenues absorb about 16% (USD 2,160), and payments to the indigenous “customary owners” make up another 0.5% to 3.5% (USD 67.5 to USD 472.5). That leaves more than 80% (USD 10,868 to USD 11,273) of the value of the timber to be divided between extraction costs, transportation, and profit.

We calculate the Total Economic Value of an average hectare of Papuan or West Papuan forest to be on the order of USD 5,700/ha/year of which approximately USD 1,100 accrue to the direct users (the local people) and USD 4,600 accrue to indirect users (beneficiaries of watershed services in the lowlands, carbon sink services and so on). The local land users can accept a one-time payment of USD 472.5 for a hectare of their forests, or they can receive the same “value” over less than six months. Of course, this value is distributed over a large population in ways that the cash payments are sometimes not, so the temptation will always be there, but it is clear that, on average, the local people are the big losers when the forests are logged.

In some cases, deforested land can continue to generate income after the timber is removed. With clear property rights and favorable conditions, land newly cleared of a forest can be converted to cultivation of plantations, annual crops, or grazing land. Indeed, most of today’s agricultural heartlands of Europe and North America once were covered with forests. But in other cases, fragile soils and steep slopes make cleared land unsuitable for agriculture. In such cases, deforestation leads to landslides, erosion, and loss of economic opportunities. Even today, generations after Maoris first cleared land with fire and Europeans cleared land for agriculture, large areas remain deforested and unproductive due to erosion, creating economic losses of USD 100-150 million per year.

A large proportion of Papua and West Papua may be unable to generate sustainable income if forests are removed. Steeply sloping highland areas covered by thin young soils as well as marshy lowland areas with peat soils are unlikely to support sustainable economic uses if forests are removed from them. Of course, once forests are removed, those forests’ services to local populations are ended and their global services in the form of carbon storage, nutrient cycling, and preservation of genetic diversity are ended too. Rapid short-term exploitation of non-renewable resources often has led to development that could not be sustained even in the medium run, so that economic opportunities for local people after only one generation end up significantly worse than at the starting point.

1.2.2. Environmental sustainability

Almost any development will damage the forests and the animal and marine life of Papua. Still, it is possible in principle, to avoid the collapse of biological diversity through creation of reserves and national parks. If access to non-renewable resources is limited, and their extraction is monitored, erosion and destruction of habitats can be limited. Unfortunately, such strategies are easier to put on paper than to put into action. As with economic sustainability, one cannot point to many successful efforts to enforce environmentally sustainable efforts to extract non-renewable resources, particularly forest resources.

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2 See Appendix 1.
3 See Appendix 1.
4 For further information, see www.teara.govt.nz
The environmental challenge in Papua’s development is particularly complex because the development of Papua will affect every person on earth, through the effects on climate and global biodiversity. In principle, the people throughout the world who gain from Papua’s forests should pay for these benefits. The costs of preservation should not fall on the poor people who happen to live in Papua and West Papua. But again, it is easier to formulate such principles than to apply them in practice. Efforts to create schemes whereby the rest of the world pays rent for the services of tropical forests are underway, but not much has been done yet and not much money is flowing. As noted above, the indirect annual flow of benefits to humanity from a hectare of Papuan or West Papuan forest (USD 4,600) – both in close proximity through watershed services and far away through carbon storage services – is over four times the direct value to the indigenous land users (USD 1,100).

1.2.3. Cultural sustainability

The indigenous cultures of Papua and West Papua are threatened. It is inevitable that contact with the world through education, commerce, and migration will continue to change the cultures of Papua and West Papua profoundly and irreversibly. Many aspects of traditional life will disappear within a generation or two. Many languages, too, are likely to disappear.

“Cultural sustainability” in the context of Papua and West Papua should be centered on the consequences of development for indigenous Papuans and West Papuans. It is not possible to preserve all of the threatened aspects of local culture, some of which cannot survive in modern, interdependent society. But the cultures of Papua and West Papua must change through indigenous people acquiring vital knowledge and skills in a timely way, rather than through a cultural tsunami. Development in Papua and West Papua must not be viewed simply as change that increases average income, education, and life expectancy of the residents of Papua and West Papua; the welfare of indigenous Papuans must be paramount.

Alternative infrastructure development strategies can have powerful impacts on cultural change. More than any other force, new migration is likely to change cultural and economic systems. Experience – both international and domestic – suggests that new transportation infrastructure tends to generate large inflows of external migrants. Traders, business people, and transmigrants will use new transportation infrastructure to take advantage of new opportunities for themselves. Such interactions have been a source of recurrent tension. New infrastructure that leads to rapid extraction of non-renewable assets is likely to result in a forced outflow of indigenous peoples from degraded areas to urban centers. If not managed well, this easily can lead to clashes among ethnic groups and rising communal tensions. Infrastructure programs focused on community development, by contrast, help to create stability.

Infrastructure development strategy in Papua and West Papua must actively combat the threat of marginalization and exclusion of indigenous people. The governments of Indonesia and Papua and West Papua must do much better than the governments of the Americas and Australia in sustaining and respecting indigenous cultures.

1.2.4. Sustainable Infrastructure

Investment in infrastructure must be realistic within budgetary and technical limitations. There is a constant danger that investment in infrastructure will be spread too thin, with too little planning, so that the results do not survive to deliver services for future generations. Under pressure to expand road, water,
power, and other infrastructure systems, governments focus on constructing new capacity. This leads to neglect and premature loss of existing capacity. Such a construction-focused strategy ultimately delivers less usable infrastructure than if operation and maintenance had received adequate resources.

As the stock of infrastructure is expanded, proper maintenance will eat up more and more of any fixed budget. Obviously, the more existing capacity there is, the greater will be the cost of keeping it in working order. In spite of pressure to add infrastructure capacity there is a limit on the amount of infrastructure that any budget can sustain. At some level of infrastructure, all available annual spending should be devoted to maintenance. This ceiling cannot be exceeded without a larger budget that will cover both the maintenance of existing infrastructure and the new construction. For example, if proper annual and periodic maintenance costs, as well as funding for reconstruction local access roads in a kabupaten, require 10% of the initial construction cost, then once the stock of infrastructure is worth ten times the annual budget, the maximum sustainable level of infrastructure has been reached. If the annual road expenditure budget is IDR 40 billion, and this is enough to construct 40 km of single lane rural access roads to gravel standard in the first year, then with an annual maintenance and reconstruction cost of 10%, the budget is sufficient eventually to support no more than 400 km total of roads. If more than 400 km of roads are constructed from this budget – by deferring maintenance of existing roads – the rate of loss of existing roads will actually reduce the usable road system to fewer than 400 km.

1.3. The Infrastructure Development Challenge

1.3.1. Construction Costs

Difficult terrain and remote location combine to make construction costs very high in most of Papua and West Papua. In the swampy lowlands, peat soils (histosols) are common. These are tricky to drain and expensive to build on. Much of the mountainous area is covered by thin young soils on steep slopes (entisols). Soils with severe drainage problems or with serious threat of erosion and landslides make up more than 40% of Papua and West Papua. Because of the difficult geological and weather conditions and the environmental impacts of road construction in such circumstances, the construction costs of a sustainable road connection to appropriate standards are far in excess of the costs that have been incurred or assumed so far. It would cost IDR 6–10 billion/km to build a good, sustainable road into the highlands, depending on the alignment and the design standard. This is on the order of twice the cost of a good road in Java and ten times the cost often cited in Papua and West Papua.

Table 1: Cost of a Bag of Cement in November 2008

<table>
<thead>
<tr>
<th>City</th>
<th>Price per Sack (IDR)</th>
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</thead>
<tbody>
<tr>
<td>Jakarta</td>
<td>50,000</td>
</tr>
<tr>
<td>Jayapura/Manokwari</td>
<td>75,000</td>
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<tr>
<td>Wamena</td>
<td>500,000</td>
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<tr>
<td>Mulia</td>
<td>1,300,000</td>
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<tr>
<td>Oksibil</td>
<td>1,500,000</td>
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</tbody>
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Source: World Bank staff surveys

Low population density of the region means that every rupiah of infrastructure outside urban areas is likely to serve relatively few people. For example, Papua and West Papua have a road density per capita of roughly 7 km per 1000 people, well above the average for Indonesia (1.3) and other Asian countries. But the road density per 1000 square kilometers, 47, is well below the average for Indonesia (174) and other Asian countries. Low population density drives up the cost of providing infrastructure services.
1.3.2. Maintenance

Maintenance of existing infrastructure is a chronic problem. The existing road network and water supply systems of Papua and West Papua are under-maintained. Power systems, too are operating well below capacity due to poor initial construction and inadequate maintenance. Many roads and water systems become inoperable only a few years after they are built, requiring expensive rehabilitation when proper construction and routine maintenance would have kept them serviceable at much lower total cost. For example:

- The Wamena – Mulia road is barely passable.
- The Jayapura – Wamena road is entirely impassible.
- Piped water systems, which serve only 25% of the population, are not maintained.
- Sewage disposal systems are in decline.
- Power supply is unreliable; output is only 60% of installed capacity.

We estimate the optimal expenditure over the next 5 years, for rehabilitation and maintenance of Papua and West Papua’s roads alone is IDR 2.2 trillion per year. While we have no exact data for past spending on operation and maintenance of infrastructure, our estimate of urgent maintenance requirements is substantial compared to all spending, of all levels of government, in Papua and West Papua, which were about IDR 29 trillion in 2008.

Inadequate maintenance results in short-lived infrastructure. Optimal maintenance is like good juggling: it is possible to keep more balls in the air at one time if the juggler pays attention not only to the ball he is throwing into the air but to all the others already in the air. If maintenance is deferred, existing infrastructure will tumble down, and new construction will no longer increase the total. Optimal maintenance also reduces private costs. If roads are so bad that vehicles wear out rapidly; and if power supplies are so unreliable that businesses are forced to provide their own back-up generators, then private costs as well as public costs rise as a result of inadequate infrastructure maintenance.

1.3.3. Planning Capacity

More than any other type of spending, infrastructure development requires good planning. The high initial costs and long potential life of infrastructure means that any decision – good or bad – will have a long-lasting impact. Infrastructure development requires well-informed choices. Individual projects
must be placed within a comprehensive plan. Each project’s technical details and feasibility must be analyzed carefully before any work is begun. Well-functioning infrastructure development system should have the following components:

- Spatial planning based on topography, soil conditions, natural resource concentrations, and existing commercial networks and population concentrations;
- Master-planning that coordinates various modes of infrastructure so that there is no unnecessary duplication and so that all components – transportation, power, communication, water and sanitation – are phased to be completed in a timely way for productive use;
- Short and medium term planning that fits within the master plan and specifies intermediate targets each year for the next few years;
- Feasibility analysis that compares specific options such as road alignment and type, alternative hydropower projects, and river port development so that options can be chosen that are technically feasible and satisfy financial and economic criteria;
- Trained and experienced public employees at all levels of government who can carry out these tasks in coordination with one another.

Unfortunately, the governments of Papua and West Papua are far from meeting these requirements. Spatial planning has begun at the provincial government level in Papua and West Papua but it is not yet flowing through into project planning and does not have buy-in from the kabupatens. No master plans are in place for the major types of infrastructure. While the 20 year and 5 year plans do state goals, these often are inconsistent (i) with what is feasible within budgetary and technical constraints and (ii) between different organizations operating in the sectoral area. For example, government plan for electrification of Papua calls for 75% electrification by 2015, while the electric utility, PLN, sets a goal of 38.4%. Annual spending is almost entirely detached from the 20 and 5-year plans. Instead annual spending is driven by the annual budget cycle and release of funds. There is no rolling medium term plan into which annual spending is fitted. Since annual spending often is undertaken with pressure to spend money fast, far too little project appraisal is undertaken.

The Indonesia formal planning process and cycle is rigid. The 20-year plan, which is divided into four successive 5-year plans, in principle provides a useful framework and direction for sectoral development. However, these long run plans lack sufficient detail with regard to costing and economic/financial evaluation of alternatives. Furthermore, they do not map out the requirements and elapsed time for the project preparation, approval, and procurement steps. As a result, expenditure planning remains heavily focused on expenditures within the annual budget cycle. This cycle typically stretches several months past the start of the budget year. Expenditure planning is made more difficult because approvals are required by the respective parliaments. These procedural barriers undermine good infrastructure planning. Almost all infrastructure investment requires a long-term view and considerable evaluation and preparation work. Several years of planning typically are followed by several years of implementation in a well-organized infrastructure investment project.

Resources budgeted for project and program preparation are grossly inadequate. Instead of devoting more resources to the challenge, regional governments devote too little to all types of planning. Planning for a road that will run hundreds of kilometers may have a budget smaller than the cost of a single kilometer of good road. As a result, cost-benefit studies prepared for major investments rarely examine alternative projects, technological solutions, or optimal timing options; instead project appraisals tend to focus narrowly on justifying a given investment concept without evaluating alternatives.
Box 1: Poor Planning Produces Poor Outcomes

A shortcoming of current planning, programming, and budgeting practices is that projects are chosen with the aim of spreading them over many communities simultaneously, rather than on the basis of needs and transport demand. This is compounded at the implementation stage by spreading out funding thinly over a large number of small incremental contracts, which often form part of a larger scheme. Over the long term such an allocation process seriously reduces the benefits of the investments that are implemented.

Consider a simple example of 3 projects with a 3-year implementation period, with rates of return of respectively 10%, 12%, and 14%. If annual available funding is sufficient to implement only one project at a time and implemented sequentially, starting with the project with the highest rate of return, the aggregate rate of return is 12.5%. If on the other hand all three projects are implemented in parallel, implementation is stretched out over a nine-year period and consequently the aggregate rate of return is reduced to 8%. This less favorable outcome is mainly the result of having to wait 9 years before benefits start flowing. In contrast, under the first scenario where projects are completed sequentially, benefits start flowing after 3 years. In addition, it should be recognized that under an approach of small contracts the construction costs will be higher than with larger contracts. For example, if in this example there would be a 15% increase in construction costs because implementation is on the basis of 9 small contracts rather than 3 much larger contracts, the rate of return would fall further to less than 7%.

Box 2: Infrastructure Projects that Need More Planning and Evaluation

Three major investment projects provide examples that illustrate the risks of proceeding without proper planning and evaluation: (1) projects to improve access to the Highlands, (2) the Trans-Papua road system, and (3) infrastructure/industrial/urban schemes.

Access to the Highlands.

Proposed investments to improve access to the Highlands are an example where proper planning and evaluation of alternatives will enable Papua and West Papua to achieve its access objectives at much lower cost. Current approaches involve simultaneous development of several road connections as well as an additional air connection. The high costs of road construction into the highlands (IDR 6–10 billion/km to build a good, sustainable road) justifies a focused study that takes into account all the key factors having a bearing on the costs and benefits of different alternatives.

While road corridors and alignments are being considered, other modes of transport merit attention too. Here, the efficiency of air transport access to the highlands should continue to be improved. Air transport will remain a credible alternative to road transport for the foreseeable future. Air can provide transport at a cost in a range of IDR 10,000–25,000/ton/km depending on volume and route. In comparison, a road transport alternative, say between Jayapura and Wamena, would require road traffic volume to be at least twice the current volumes of air cargo coming into Wamena to make the road connection competitive with air transport. It is the high cost of building and maintaining the road that require this high level of traffic.

A multimodal connection to Wamena in the Highlands via Dekai involve river transport to a port situated some 20 km from Dekai, from which goods would be transported by road to an upgraded airport at Dekai and from there by air to Wamena. The advantage of this alternative is reported to be that the cost of river transport is low and the high-cost air segment from Dekai to Wamena is much shorter than say from Jayapura to Wamena. However, air transport costs are not proportional to distance traveled; they also depend on landing and takeoff costs and on the steepness and route of the climb. Flights from Dekai, which is located close to steep mountains, into Wamena might in the end cost no less than direct flights from Jayapura to Wamena. Also, transshipment through Dekai would involve: (i) two additional transshipments (water to land followed by land to air) – adding to handling costs and to the incidence of damage to goods and (ii) new issues concerning the reliability of river navigation in various seasons. Clearly, such an elaborate scheme requires careful consideration of all factors having a bearing on costs and quality of service.
Box 2: Trans-Papua Road Links

Papua and West Papua’s main urban centers are located along the northern and southern coasts and are connected by shipping and by air at much lower cost than would be possible by road. This is because a proper comparison of various modes of transport should include not only the private cost of operating a truck or boat or airplane, but also the full cost of providing infrastructure support. The cost of road transport properly should include full road construction and maintenance costs over the life of the road. For example, the cost of general cargo transport by coastal shipping between Jayapura and Manokwari is estimated at IDR 875,000/ton, including the cost for shipping and transshipment at the ports. Adding in the full infrastructure cost (the value of the subsidy in the port costs), the full economic cost is estimated at about IDR 950,000/ton. Under more efficient coastal shipping operations, this cost could be reduced significantly, probably to IDR 650,000/ton. If a road alternative were available – involving a distance of 840 km – the private trucking cost is estimated to be no less than IDR 550,000/ton, not very different from the all-inclusive shipping cost. But this private cost of carrying freight by road between Jayapura and Manokwari ignores the cost of building and maintaining the road. In fact, road transport between Jayapura and Manokwari is only competitive with shipping when the cost of the road infrastructure is ignored. To justify building interregional roads suitable for long distance transport of goods and people, traffic levels on the order of 200–300 vehicles/day are required. If traffic is lower, it is not possible economically to justify the cost of building and maintaining a road. Such traffic levels are only observed today in Papua and West Papua in the immediate vicinity of the major centers of economic activity.

At this time, major investments in Trans-Papua links would provide negative returns for the economy. Available funds can be used to much greater effect when applied to maintenance and rehabilitation of existing roads where traffic levels are already substantial or to other infrastructure investment options.

Infrastructure/Industrial/Urban Development Schemes. The scheme for development around lake Sentani to the west of Jayapura provides a third example of investments requiring very careful master plan, feasibility, and engineering studies. Such mega-schemes require a thorough evaluation of the merits of the overall package and of the contribution of each of its components. They also require analysis of risk in case some parts of the plan fail to fall into place (for example, if a private industry decides not to proceed with its investment).

The scheme being contemplated west of Jayapura is highly complex. New power, industrial, and urban ventures are essential components of the scheme. Assuming that the urban development scheme is mainly driven by new industrial investments, the key challenge will be to stage each of the components in coordination with the industrial development, to avoid making major investments in infrastructure before the private industrial development has been locked in. This is where careful design of the Public/Private Partnership and the associated allocation of risks will be essential. Poor timing of the investments and failure of any of the government or private parties to fulfill their respective roles and meet their responsibilities could result in an unbearable financial burden. For example, if road investments are several times overdesigned in relation to prospective traffic and taxation revenues associated with the urban investments will not materialize until far into the future, the government could end up with an unmanageable burden paying for road construction and maintenance.

These three examples underline the fact that Papua and West Papua have much to gain by devoting greater attention to master plan, feasibility and engineering studies before proceeding with major investments, which will lock in costs and returns far into the future.

1.3.4. Decentralization

Since 2000, decentralization of Indonesian public administration has intensified the challenges to public sector capacity for planning and implementing infrastructure investment and for maintaining existing infrastructure. Much more money is flowing to Papua and West Papua from Jakarta, but the problems of intergovernmental coordination of infrastructure planning have been made much harder, too. Today Papua and West Papua receive the largest per capita transfers of resources from Jakarta of all regional governments. New financial resources and new responsibilities have been thrust on provincial and local governments. At the same time, a large number of new administrative subdivisions have
been created; a single province was split into two and ten kabupaten/kotas (local governments) were subdivided into thirty-six (see Figure 2). As a result, many of the institutions responsible for building and operating infrastructure in Papua and West Papua are very new and somewhat unsure of their powers and responsibilities. The many governments with responsibilities for infrastructure in Papua and West Papua must increase their administrative capacities and responsibilities for operation and maintenance of infrastructure need to be better aligned to effect operation and maintenance of infrastructure in Papua and West Papua.

The continuing administrative decentralization process has some advantages. Development in each administrative unit is focused heavily on its capital, so more administrative capitals means that development is spread into more corners of the region. However, administrative fragmentation of Papua and West Papua makes it harder for the limited trained personnel even to track expenditures. There is little experience nor is there training in the new governments for planning, implementing, running, and maintaining infrastructure projects. And as the number of administrative borders grows, more and more projects involve multiple jurisdictions.

**Figure 2: Number of Provincial and Local Governments in Papua and West Papua**

![Figure 2: Number of Provincial and Local Governments in Papua and West Papua](image)

*Source: BPS (Central Statistics Bureau)*

Decentralization has brought an explosion in financial transfers from the central government to provincial and local governments. These transfers have grown thirteen fold in nominal terms and six fold in real terms since 2000. Currently, financial transfers from Jakarta to provincial and kabupaten/kota governments are the major source of money income outside a few pockets where extractive industry dominates. These transfers exceed USD 2 per day per inhabitant. With the growth of commercial activity that has come with the growth of income transfers, migration of Indonesians from other parts of the country has increased.

**Figure 3: Central Government Transfers to Sub-National Governments 1997-2008**

![Figure 3: Central Government Transfers to Sub-National Governments 1997-2008](image)

*Source: Ministry of Finance and World Bank staff estimates*
Box 3: Allocation of Government Responsibilities

Overview. Law 32/2004 on Regional Autonomy (as well as its legal predecessor Law 22/1999) allocates responsibilities for government affairs to central, provincial, and kabupaten/kota governments. The law also stipulates that the center will provide regional governments with financial resources to implement tasks for which they are responsible (‘decentralized tasks’). These resources are channeled to the regions as grants (mainly as DAU, DBH or DAK), and form part of the regional government budget. Tasks for which the center remains responsible are implemented either by central government departments or by regional government agencies. In the latter case, the center would provide the regions with financial resources from the central government budget. In practice, many issues regarding responsibility for administration and finance are not yet fully resolved.

Centralized tasks. Law 32/2004 confers the responsibility for all government affairs to provinces and kabupaten/kota, with the exception of:

- Six ‘core’ affairs. These are: foreign affairs, defense, security, justice, fiscal and monetary policy, and religion.
- Central government affairs stipulated in PP38/2007. This is a recently issued regulation that defines, in great detail, the allocation of responsibilities among central, provincial and kabupaten/kota governments.

In general, the central government is responsible for standard setting and affairs that affect more than one province; provincial governments are responsible for affairs affecting more than one kabupaten/kota, and kabupaten/kota governments for affairs that are confined to their jurisdictions.

To carry out its responsibilities, the central government has maintained regional offices throughout the country. Examples of such offices are: police stations, tax collection offices, and branch offices of the central bank.

Deconcentrated and co-administered tasks. Since 2001, most central government departments that are not responsible for any of the six ‘core’ affairs no longer have a network of regional offices. These departments are required to delegate the implementation of responsibilities in the regions to the Governor, who – as head of a province – acts as a representative of the centre. The Governor, in turn, delegates the implementation of these ‘deconcentrated tasks’ to the relevant provincial government agencies. The implementation of deconcentrated tasks is financed from the central government budget. Decentralized tasks consist of all tasks needed to undertake government affairs that are not explicitly defined as a Central Government responsibility. Because PP38/2007 defines a large number of tasks that are shared among various levels of government, the identification of financing responsibilities has become highly complex.

Shared responsibilities according to PP38/2007. PP38/2007 identifies 31 government affairs for which central, provincial and kabupaten/kota governments are collectively responsible. For all these ‘non-core’ affairs, a detailed appendix – which form an integral part of the law – show central, provincial and kabupaten/kota responsibilities. Of the 31 affairs are classified as compulsory affairs, the most important include: education, health, environment, public works, spatial planning, development planning, telecommunications and IT, social affairs, and community empowerment.

Allocation of responsibilities for selected infrastructure sectors. In principle, if a regional government is responsible for a certain infrastructure services, it should also finance the investment and operating cost for these services (with the notable exception of land, which should also be financed by kabupaten/kota governments, also for national roads and other infrastructure services otherwise under central government auspices).

Another symptom of the “big-bang” decentralization in Papua and West Papua is the severe lack of coordination between levels of government. At present, any coordination that happens between individual kabupaten/kota governments and between those governments and the provincial governments happens mainly on an ad hoc basis. For example, kabupaten roads are being built without any plans on how they will be linked to the broader provincial and central government networks and, as a result, cannot possibly generate the traffic volumes that are required for them to be considered a productive investment.

Kabupaten/kota governments managed budgets worth IDR 17.0 trillion in aggregate in 2008, as compared to the budgets of the provincial governments: West Papua’s total budget of IDR 1.5 trillion and Papua’s
total budget of IDR 3.3 trillion (see Figure 3: Central Government Transfers to Sub-National Governments 1997-2008). This is far too large an amount of money to be spent in such an uncoordinated fashion.

The Provincial Government of Papua has begun the set-up of what is to be known as the Papua Accelerated Development Unit (PADU). The Papuan Governor intends that this unit operate much like the BRR (Badan Rehabilitasi dan Rekonstruksi, or the Body for Rehabilitation and Reconstruction) operated at the level of a central government ministry to assist in planning and coordination in Aceh and Nias following the 2004 earthquake and subsequent tsunami that decimated the area. Final approval has yet to be received from the central government for this initiative, however, recruitment of staff has begun and associated institutions such as the Papua Knowledge Centre data repository are also beginning to operate. No such organization is planned for West Papua in the short-term.

Box 4: Planning and coordination raise difficult issues without clear answers

All master planning activities undertaken in Papua and West Papua must have buy-in from all agencies at all levels of government affected by the plans. As a current example, Kabupaten Teluk Wondama was split from Kabupaten Manokwari in 2002. This new kabupaten has an enormous natural endowment with the Cendrawasih Bay National Park off its coastline and the vast majority of its land allocated as protected forest under the provincial spatial plan. The environmental services that these protected natural assets provide in the form of biodiversity maintenance, carbon sinks and so on are a wonderful thing for the rest of Indonesia, and indeed the world who have squandered their own such assets. The World Wildlife Fund refers to this area as “being the basis for the local fishing industry and hav(ing) a high potential for visitor use and research.” However, not all residents of Kabupaten Teluk Wondama can be fishermen or researchers. Commercial activities are severely limited within the protected forest area as well. How is the government expected to bring economic opportunity to its people when it is not allowed to build infrastructure networks and its people are not allowed to conduct commercial activities?

Note: Map source: www.bkpm.go.id

All sectoral and cross-sectoral master plans listed above must have buy-in from all agencies at all levels of government. This will raise many difficult political issues. Decisions will have to be made that mean that certain remote areas will be linked with roads in the short-term, while others will have to rely on air-transport for the next 20 years. It will not please everybody, however prioritization process must occur for infrastructure development to proceed in Papua and West Papua with all parties pulling in the same direction. Donor resources are potentially available to assist in the technical aspects, but government must drive the process.

There is no clear answer on the best way to drive this process forward. Whether it happens through a regionally based central government body as is envisioned by the Papuan governor or through some other mechanism; this can only be worked out between the governments themselves. What is clear is that coordination must improve if these master plans are to be useful and to not simply sit on the shelf.
1.4. Development Vision for Papua and West Papua

Given the many challenges faced in developing infrastructure in Papua and West Papua in a sustainable manner, a development vision that foresees an inter-connected Papua – a vision that underlies the ambition to build a huge road network to connect all the major towns – is not feasible. Existing conditions make such an inter-connected road network infeasible and detrimental if pursued in earnest in the shorter run. The population density in Papua and West Papua is too low to justify such a huge grid. Moreover, the high construction and maintenance costs make this vision financially infeasible under current conditions. In addition, the risk is too great that such a grid would lead to unsustainable harvesting of Papua and West Papua’s natural resources, combined with a surge of inward migration from other parts of Indonesia, leading to economic, social, and environmental calamities rather than development.

1.4.1. Ink-spot infrastructure network

Instead, policy makers in Papua and West Papua should consider an “ink-spot” vision of development that foresees growth expanding from current centers of activity. For the next several decades, Papua and West Papua’s development vision must be to expand development from existing and future growth poles, by adding infrastructure that serves each area and its hinterland. Just as ink-spots spread on a page, the growth of local road systems, power grids and other infrastructure will lead naturally to increasingly strong connections among some of these growth poles.

Figure 4: Ink-Spots Vision of Development for Papua and West Papua

Ink-spot development will lead, one step at a time, toward full development. Development in and between ink-spots should proceed within provincial and national spatial plans. Master plans for transportation should set out the intended steps toward a final network (and they should be updated continuously to reflect new realities). At present, without master plans and without sufficient project appraisal, it is too
soon to predict when and where interconnections among ink spots will be technically and economically feasible. It is quite clear, however, that to move toward a complete grid system without the underlying planning and feasibility analysis, without the population density or economic activity to justify such grids, and without the tens of trillions of rupiahs needed every year to construct and maintain such a system, is a recipe for disaster.

Expansion of ink-spots will be based on the growth of population and economic activity outside existing and perhaps new growth poles. For example, a power grid may grow to include both Timika and Enarotali, and then Nabire; a road between Merauke and Oksibil, or between Bintuni and Manokwari, may become justified as the prospect of traffic increases; and improved river port infrastructure will enable improved services of waterborne transport and may justify the construction of a connecting road to a village near the port, or of a canal to connect rivers.

Today, around urban areas, many roads are being extended as traffic warrants. Almost all the good roads are within and near to provincial and kabupaten capitals. That makes sense because that is where the traffic is. A light duty motorcycle road might be warranted long before a road for heavy vehicles. Similarly, local power installations using solar or micro hydro will be feasible long before a province-wide power grid is complete. The highlands will be particularly dependent on such limited, self-sufficient local power sources that do not depend on fuel being shipped in by air.

Investment in road access to the highlands is unlikely to be warranted in the short run. Access to the highlands is often presented as an issue of road access. However, successful economic development and integration of the highlands does not necessarily depend on road access. This is illustrated by the examples of island nations and Alaska, which do not have road connections between the different sub-regions and yet have been able to thrive without an integrated region-wide road infrastructure. Japan developed for centuries before various islands were connected by roads. The question remains, however, where and when it will be opportune to establish road connections between various places in the highlands and various other regions of Papua and West Papua. To answer this question, it certainly makes sense to begin now with the planning process – including both master planning and feasibility studies – of future roads into the highlands.

One important grid can be established without physical connections among various growth poles: telecommunication. It is feasible to plan to connect targeted population concentrations with telephone and internet service long before the road and power grids are complete. It is possible today to install a solar power source, with a battery that is recharged from the solar appliance, connected to a satellite dish, to establish telephone communication with the rest of the world. The cost of communication satellite services is relatively expensive, but it will be possible to connect most of the provinces to the global telecommunication network at a modest cost. At the coast, telecommunication connection through fiber optic cable should be feasible in a few years, and the interior of Papua and West Papua will be able to connect to these cable access points through a combination of fibre, microwave, wireless and satellite technologies. Enhanced access to telecommunications throughout Papua and West Papua will permit distance learning, medical consultation, banking services, improve communications between government offices, reduce the cost of doing business, and provide other services that can substantially improve opportunities for isolated populations, as well as contact with family members far away.
In the long run, Papua and West Papua will build the road, water port, airport, power and telecommunications grids that knit together all the people of this huge region. But, as in every case of economic development throughout history, this will take time. After all, an economy that grows at the explosive rate of 7% per year still takes ten years to double its income (and if it starts very poor, even at double the income, it will remain poor after a decade of rapid growth). In the case of Papua and West Papua, the best overall strategy is to build from current strengths. As the ink spots grow larger – adding infrastructure every year and maintaining existing infrastructure – connections will be expanded and deepened.

The Governor’s vision of development for Papua – and indeed the development of each ink-spot growth centers – is centered around a “commodity-based” development strategy and a “community-based” development strategy. These complement the ink-spot development vision, where either the commodity or the community based development can help enlarge individual ink spots. In the highlands, in particular, community-based development is key to ink-spot growth.

1.5. Commodity-based Development: The Role of Private Sector in Infrastructure

The interests of private investors and of the general public in terms of infrastructure development are not necessarily the same. The public interest is to provide infrastructure to people where they live in order to meet basic needs and alleviate poverty. Private investors want infrastructure that serves their specific needs – roads that lead directly from ports to timber or mineral concentrations, power to run their dedicated machinery, water to be used in extractive or industrial processes. What is more, private firms extracting non-renewable resources have no direct interest in building infrastructure that will survive beyond the end of their operations. In the case of logging, the required useful life of a road may be only a few years. The public, on the other hand, needs infrastructure that will promote a broad range of economic activities into the indefinite future.

Potentially divergent interests can be reconciled through a clear division of responsibilities. Large private investors that need infrastructure to enable resource extraction should build and maintain their own infrastructure dedicated to their production and distribution needs. Their taxes should provide the public sector with the resources to invest in infrastructure for the general public. The private sector should not be looked upon as a substitute for government in provision of public goods. Nor should private producers expect the public sector to build infrastructure to meet their parochial needs.

When public and private interests share infrastructure each should pay full cost for its use. If a road serves both logging trucks and the general public, the users that do most of the damage to the road should pay for building and operating it. The damage a vehicle inflicts on a road depends on its weight, with heavy vehicles (measured in tons per axel) doing more than proportional damage. If a road is heavily used by large trucks, it should be built and maintained by the firm that operates the trucks, with the public sector contributing toward the minor damage inflicted by other vehicles. Road user taxes should reflect the road damage they impose on public roads. Similarly, private users of electricity provided by PLN or the public sector should pay the full cost of producing that electricity, not a subsidized rate.
To ensure non-negative externalities of investments by mining and logging companies, investors should be required: (i) to bear the full financial responsibility for any new transport infrastructure that is needed for the scheme; and (ii) to cover their appropriate share of the cost of the use of any existing infrastructure. In the case of a new investment, this will incentivize the investors to adopt proper life cycle and total system cost minimization in the design of the infrastructure. When a private investor requires the use of existing infrastructure, it should assume the cost of strengthening the infrastructure and/or compensate for the cost of additional heavy wear and tear.

It is possible that private industry can finance infrastructure development that provides services to the broader society. For example, Freeport Indonesia runs hospitals and builds roads, some of which are available to the general public. Freeport Indonesia provides a useful case study of private-public interactions in the construction and use of infrastructure (see Box 5).

In Papua and West Papua, small market size may require public sector involvement in private provision of some infrastructure. Some services that normally are delivered by the private sector, such as waterborne transport services and telecommunications, may not be profitable in parts of Papua and West Papua where delivery costs are high and incomes and population density are low. In such cases, government support of investment and sometimes even of operating costs may be desirable. Two principles should govern the negotiations concerning such subsidies: (i) since the private provider will generate some revenues from its operation, the aim must be to provide the lowest possible subsidy that will enable service provision; and (ii) the choice of the provider of services should be determined through periodic competitive bidding. The terms of such subsidies must be transparent and open to review.
Box 5: Private Sector Participation: Lessons from Freeport

Background
PT Freeport Indonesia (PTFI) – majority owned by the American company Freeport-McMoRan Copper & Gold Inc. – began constructing its mine in Papua in 1970. Despite staggering challenges, PTFI constructed a 74-mile road across a swampy coastal plain rising into steep mountains; built the mine and processing facilities at elevations exceeding 4,000 meters; and built a 195MW coal-fired, 60 Hz power plant next to the newly completed port, with transmission lines to the mine and mill. The mill began exporting only three years after full-scale construction began. PTFI runs the largest gold mine and the second largest copper mine in the world. It is one of Indonesia’s largest taxpayers, with tax, royalty and dividend payments of about $1.8 billion in 2007. Since its original Contract of Work (CoW), confirmation of nearby ore bodies have increased estimated reserves 64 fold. While PTFI’s current CoW, signed in 1991, extends to 2041, there is little doubt that the mine can be exploited profitably for decades beyond.

PTFI employs almost 12,000 people directly at its mine site and offices, 27% of whom are Papuan, and employs an additional 9,000 people through its various dedicated service companies and contractors. PTFI’s operations and ancillary support services led to the establishment of the town of Timika, between its highland operations and its port. The town, nonexistent in 1970, has a population of 165,000 today.

Forty years of experience with PTFI’s mining operation offers lessons to all levels of government in Indonesia. In some areas, PTFI exemplifies some corporate practices that other companies that come to Papua for its non-renewable resources should follow. In other areas, there is room for improvement.

National
Work Force Training Program. Since 2001, PTFI has run a training program for indigenous Papuans, which lasts three years and costs USD 15,000 per student. It includes literacy skills as well as work with computerized simulators and real equipment. Trainees – many of whom may initially be illiterate – are selected from seven local “tribes” on the basis of tests to determine their aptitude for acquiring the sorts of skills required to carry out their work. These skills have high market value, not the least at the PTFI mine itself: heavy equipment operation and repair and other aspects of mining technology. PTFI’s training program proves that adults with no formal education can be screened for aptitude and trained to become highly productive in the modern global economy. The prospect of developing a substantial cadre of Papuans skilled in the operation and repair of heavy equipment is likely to make a permanent contribution toward the successful transition of Papua’s indigenous population. PTFI’s program of work force development deserves to be reproduced wherever possible.

Provincial
Potential partnerships in power. At present, PTFI runs two separate power networks: one 60 Hz network for the mine and a separate 50Hz diesel network for its lowland facilities. PTFI also has significant power needs in the coming years, for itself and for its suppliers, including a potential cement plant to meet PTFI’s heightened need for cement when it moves entirely underground in about 2016. By contrast, the local PLN power network is decidedly weak. The visible disparity between the services provided by PLN and PTFI’s power plants causes resentment by the local populace towards PTFI.

There is potential for development of significant hydropower capacity not far from Timika. (The site at Urumuka is receiving closest scrutiny.) Such development deserves serious attention. PTFI can help the Indonesian power authority advance the plan for hydropower and commit itself to a long-term contract to purchase its 50 Hz power needs from the project. Assuming the project continues to meet financial and environmental standards, international donors should support project development and implementation. In the event that hydropower development is not feasible, PTFI could provide their technical expertise to help the government contract and design a power plant that meets both its needs and the needs of the local populace.

Challenges of Urbanization. A major challenge to PTFI is the explosive growth of urbanization of Timika. PTFI is concerned about the total dependence of the local economy on its mine, but so far, there is essentially no other economic foundation for Timika’s economy. Around Timika itself (though not in the highlands near the mine), urban growth is unconstrained. This poses the challenge to create a more diversified local economy and manage internal migration.
Box 5: next

Some employers include in their labor cost the transportation of workers to their home villages or to other dispersed and different locations. Other magnets for migrants, such as offices and training institutions, similarly could be dispersed to distant locations. Such measures taken together can become quite costly, and contractors that supply inputs would need to follow similar policies. Yet the specter of economic collapse of a large urban complex after a non-renewable resource is fully harvested is sufficiently threatening that governments and private investors should be willing to bear substantial costs to avoid this outcome.

Kabupaten
Local institutional capacity. Despite a slow start, PTFI now shares a significant portion of its substantial profits beyond the taxes it pays. In 2007, it spent $106 million on “social development” - $53 million of which comes from one percent of its gross revenues that is channeled to a local NGO Lembaga Pengembangan Masyarakat Amungme dan Kamoro (LPMAK, sometimes also referred to as the Freeport 1% fund) building housing for local people, providing effective health care, and contributing to schools, scholarship programs, and local business development activities. PTFI also builds roads, maintains them, and provides other public goods when the local government lags in its attention to these matters.

While resources available to local governments are substantial – decentralization has delivered more than IDR 400 billion annually in additional revenue transfers from Jakarta to Mimika, the local kabupaten, since 2005 – many local government functions, such as building and maintaining local roads, financing education and delivering health care, are still being delivered in large part by PTFI. PTFI needs to work harder to help build institutions that deliver effective public services. Every extraction of non-renewable resources will come to an end. Private investors must aim to phase out smoothly, administratively as well as economically. PTFI should consider seconding selected members of its staff to provide temporary technical assistance and accepting local government personnel as counterparts in the quasi-public services PTFI offers. Even if the transfer of skills is inefficient and slow by PTFI’s standards, it is important for private investors such as PTFI to transfer responsibilities to local authorities rather than simply to deliver the services expected of those authorities. PTFI should include among its corporate responsibilities the need to help build more effective public institutions rather than simply delivering public goods and services.

The Bottom Line
The ultimate test of any economic activity in Papua and West Papua is whether it contributes to sustainable development, and on this count the jury is still out on PTFI. In the remaining 32 years or more of its operation in Papua, Freeport must help establish an economy that will not crash after the gold and copper are gone; it must leave institutions of local management and governance that can deliver community services that PTFI itself still delivers; and it must continue to make the average Papuan of the region better equipped to meet the challenges of modern life.

1.6. Community-based Development: Village-level Infrastructure Development

Community-driven micro-infrastructure investment is increasingly significant throughout Papua and West Papua, but it is particularly important in remote highland areas. The PNPM-RESPEK program not only delivers simple infrastructure - primarily clean water supply, latrines, gravel roads between villages and connecting to main roads, wooden bridges, school buildings, health clinics and small electrification projects - but also builds the capacity of local communities to plan, build, and maintain the infrastructure.

The World Bank-supported Kecamatan Development Program (KDP) was scaled up dramatically in 2008 in response to the PNPM-RESPEK program (Strategic Plan for Village Development), an initiative of the Papuan and West Papuan provincial governments, to provide more than USD 40 million (IDR 400 billion) a year directly to communities for investment in five priority areas: (i) nutrition; (ii) basic education; (iii)
primary health care; (iv) livelihoods; and (v) village infrastructure. Between 2002 and 2006, of the nearly USD 5 million that KDP channeled to communities in Papua, 86 per cent financed village infrastructure projects, two-thirds of this to roads, water, and sanitation.

Through RESPEK, the provincial governments provide annual block grants of 100 million Rupiah (approximately USD 10,000) to all 3,923 villages in Papua and West Papua, and KDP’s successor, the National Program for Community Empowerment (PNPM), provides technical assistance. Small teams of community development facilitators (a mix of social mobilization specialists and field engineers) assist communities with a participatory process that plans and then implements investment activities. Although KDP and PNPM follow an “open menu” approach (allowing communities to choose a development activity in a participatory planning process), historically the majority of activities have tended to be small infrastructure projects.

The quality of the infrastructure produced under KDP and PNPM-RESPEK is generally satisfactory to good, but it is not always well maintained. Village maintenance teams are established for all infrastructure projects built under the program, but these teams do not always have sufficient technical skills or funds to carry out proper operations and maintenance. Since PNPM-RESPEK is relatively new to most villages, the infrastructure constructed with its funds is largely still in working order. But the maintenance problem is certain to grow over time, and so far, PNPM-RESPEK appears to be in danger of reproducing at a micro level the neglect of maintenance – and the attendant short life – that plagues infrastructure at a larger level. A stronger emphasis on technical training for communities would help address this. But the key change that might solve the problem, and in the process create a bottom-up improvement in infrastructure management, would be to treat maintenance of existing infrastructure as the first item to be budgeted for each year, with new construction only undertaken with the remaining funds. Villages would learn quickly that unless they supplement PNPM-RESPEK grants with internal funds – notably from user fees for water and power – the PNPM-RESPEK money left for new construction would shrink every year as the stock of capital to maintain, and its age, increased. This is a key lesson for asset management.

PNPM-RESPEK investments must also be better coordinated with kabupaten and provincial governments. Before a project is undertaken, it must be clear whether local governments will help provide operating and maintenance funding and personnel. Such coordination should also help distant governments recruit local workers to help in the maintenance and operation of the infrastructure that they build.

Chronic shortages of technical facilitators have posed a challenge to infrastructure development in PNPM-RESPEK. The rapid scale-up of the program combined with a shortage of qualified engineers in Papua meant that only around 200 of the more than 400 field engineer positions were filled for most of 2008. The shortage was particularly acute in the highlands, where it is most difficult to attract and retain engineers from outside. This shortage is being addressed by a special engineering training program. In September 2008, 120 local senior high school graduates were selected to join a six-month intensive training course in basic civil engineering, mechanics, micro-hydro power generation, construction/building analysis, budget planning and implementation and social facilitation skills. In March 2009, 106 successful graduates were recruited and mobilized as technical facilitators for PNPM-RESPEK. These ‘Barefoot Engineers,’ 90 per cent of whom are indigenous Papuans, also have the advantage of speaking local languages, which has a significant impact on the quality of facilitation, and therefore community participation, in remote areas.

Another major obstacle to community-driven infrastructure development in the highlands is the high cost of materials that need to be transported by light plane. The community grants provided by the provincial governments under PNPM-RESPEK are a flat amount per village, regardless of the remoteness or the high
In the central highlands, where a sack of cement can cost up to IDR 1.5 million, the sorts of projects that can be undertaken with these funds is quite limited. The provincial governments are currently discussing adjustments to the allocations that would take account of population size and remoteness, but have yet to agree on a formula. A number of kabupaten governments are beginning to allocate additional funds through PNPM-RESPEK, ranging from IDR 40 million to 300 million per village on top of the IDR 100 million provided by the provincial governments, but the highlands kabupatens -- where arguably the needs are greatest and the costs highest -- contribute the least.

PNPM-RESPEK could feasibly absorb annual grants of up to IDR 500 million per village, enabling highland communities to develop more sophisticated infrastructure such as micro-hydro electricity generation projects and larger bridges, but better systems for operations and maintenance would need to be built in. Two demonstration micro-hydro projects will be built in Papua in 2009, with full-time technical specialists based in the province to train local facilitators in design, construction and maintenance. If the schemes are able to be built at a reasonable cost, and communities provided with adequate training to operate and maintain them, the government should give serious consideration to expanding micro-hydro electricity generation within PNPM-RESPEK.

Community development through PNPM-RESPEK builds skills and understanding of project choices at the same time as it provides isolated villages with some power to shape their own future. It is important that the financial security of the program should be assured, so that it can count on a growing stream of funding in the future. One of the central lessons of the program is that planning must be for the long run. If proper attention is to be paid to coordinating investments, providing for operation and maintenance, and taking responsibility not only for the initial allocation decision but for preserving the assets created, the program requires a secure and growing source of funding, not only from the provincial governments but from all interested governments and donors.

What is more, by drawing on the skills of PNPM-RESPEK employees and of local villagers, some of the problems of managing infrastructure assets can be solved. For example, maintenance of motorcycle paths and re-aiming of communication antennae can be undertaken by unskilled workers with minimal training and supervision. Community involvement will spread understanding of asset creation and management challenges. Community development activities offer a path to help resolve one of the central barriers to successful infrastructure development in Papua and West Papua: development of planning and implementation capacity. Community involvement in investment and maintenance of infrastructure should be central to infrastructure development. It should start at the village level.
Box 6: Infrastructure for the Highlands

The first recorded contact with outsiders in the interior of New Guinea took place in the 1920s in eastern New Guinea, and not until 1938 did Europeans enter the densely populated Baliem valley in Papua. Since then, the highlands have undergone a uniquely accelerated transition in little more than two generations. From the mid-1950s, Christian missionary activity, followed by Indonesian government engagement has spread international languages, technology, and new cultural practices throughout the highlands of Papua and West Papua.

But the highlands remain an extremely isolated region. Public roads are passable only a few dozen kilometers from the coast. To enter the mountainous interior one must travel by air or on foot, traversing the high mountains and malarial swamps which separate the highlands from the coast. Remoteness applies within the region as well: the road network among highland communities is very rudimentary, indeed entirely lacking in most parts of the Papuan highlands. Heavy seasonal rainfall, steep terrain, and fragile soils have led to deterioration of interior roads, which quickly have become barely passable tracks.

This isolation of the interior of Papua and West Papua has both economic and cultural consequences. Economically, the interior remains a largely subsistence economy with an overlying cash economy fueled mostly by expenditures and transfers from the Indonesian central government. With all imports moving by air, transport costs are very high. This not only makes it difficult for the indigenous population to produce anything for export, it makes it so costly to exploit the forests and other non-renewable resources of the interior that very little mining or forestry takes place in the highlands, to say nothing of manufacturing.

But the remoteness of the Papuan highlands has meant that indigenous communities have been exposed at a relatively slower pace to pressure for change. Local languages, cultural practices, and communities still are intact throughout most parts of the highlands, in spite of the demand for change in the form of education and higher income. Still, there are reports of significant, though largely unmeasured, back and forth migration between the coasts and the interior. Migrant workers send remittances home from the coast. This may also be an important source of cash in the economy, but no data are available.

Better education and healthcare are needed urgently in highland communities to permit the indigenous people to cope with continuing rapid change. Evidence suggests that many highland schools are functioning poorly, with high teacher absentee rates. Only very limited healthcare is available in the highlands. Physical infrastructure, too, is minimal, with few communities that have access to power or piped water. Nevertheless, mobile telephone coverage is spreading surprisingly rapidly.

Infrastructure Development

It is clear that infrastructure is a key to future developments in the highlands. Yet for all the potential benefits that infrastructure development can bring to the Papuan highlands, there are enormous potential costs as well. It will be very expensive to build good roads into and within the highlands. When high maintenance costs are included in infrastructure development plans, the need to develop highland roads carefully is more pressing. Low levels of inter-highland trade reduce potential benefits of roads to the current residents of the highlands. On top of this, the potential for profound damage – both cultural and environmental – that roads from the coast can inflict on the highlands, lead to the conclusion that building heavy-duty roads is unusually risky, as well as unusually costly, in highland Papua and West Papua. Roads will not simply bring imports into the highlands at lower cost. It also brings in new economic migrants. And roads enable the deforestation of the highlands. In addition, the steepness of Papua and West Papua’s mountains and the fragility of much of the soil means that road building and attendant deforestation could leave the natural environment unable to support subsequent economic activity. As in every other country, new roads also will increase the spread of new disease, notably HIV-AIDS.

A number of the benefits of roads can be approximated, at lower risk and lower cost, through improvements in power and communication infrastructure. Small scale power, through micro-hydro or solar/battery facilities, combined with satellite-based telecommunication will permit widespread use of distance learning in education, medical consultation in health care, banking, price information, and other commercial services in even the remotest parts of the highlands.

As with all infrastructure investment, but particularly urgently in the highlands, where skills are so scarce, investment in infrastructure must be accompanied by investment in training so that the indigenous people of the highlands can manage the assets themselves.
1.7. Finance: Sources and Uses

Papua and West Papua long have been among the regions of Indonesia most favored by transfers to provincial and local governments from Jakarta. In 2002, the region (then a single province with 14 Kabupaten) received about IDR 1.7 million per capita (second only to Kalimantan Timur). In 2009, Papua and West Papua (and the 36 kabupaten/kota within them) are expected to receive IDR 7.5 and 8.9 million respectively per capita, more than any other province. This rapid growth of transfers is illustrated in Figure 5, below. Twice in a decade – in 2001 and again in 2006 – transfers roughly doubled from one year to the next. From 2000 to 2008, nominal transfers grew 1,340%. This puts a tremendous strain on the absorptive capacity of provincial, but especially the kabupaten/kota governments who, in 2008, received 78% of all central government transfers to the region. Nearly half of total transfers (45%) went to governments that did not manage a budget until 2001 or later.

Figure 5: Central Government Transfers to Sub-National Governments 1997-2008

Evidence does not support the idea that international aid is likely in the future to be a major source of finance for infrastructure investment. If we compare the intranational flows of revenue from Jakarta to Papua and West Papua with international aid flows, we get some idea not only of how large these flows are, but how much international aid might be expected to supplement domestic sources of finance in Papua and West Papua (see Table 2).
Table 2: International Aid per Capita 2007

<table>
<thead>
<tr>
<th>Country</th>
<th>International aid per capita (current US$) 2007 plus transfers from Jakarta to Papua and W. Papua</th>
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</thead>
<tbody>
<tr>
<td>Palau</td>
<td>$1,108</td>
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<tr>
<td>Solomon Islands</td>
<td>$501</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>$262</td>
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<td>Lao PDR</td>
<td>$68</td>
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<td>Papua New Guinea</td>
<td>$50</td>
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<td>Cambodia</td>
<td>$46</td>
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<tr>
<td>Sub-Saharan Africa</td>
<td>$44</td>
</tr>
<tr>
<td>Low income</td>
<td>$31</td>
</tr>
<tr>
<td>Vietnam</td>
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</tr>
<tr>
<td>Philippines</td>
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<td>Myanmar</td>
<td>$4</td>
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<tr>
<td>Indonesia</td>
<td>$4</td>
</tr>
</tbody>
</table>

Source: World Bank, World Development Indicators

Set against the aid flows from Jakarta, international aid flows are relatively small. The international aid going to governments in Papua and West Papua in 2008 came to USD 17 per capita, relatively little in this context, though four times the Indonesian average. But per capita flows from Jakarta exceed USD 740 per year, almost three times the international flows to East Timor and more than ten times the international aid flowing to PNG. Increases in international aid are unlikely to be a large proportion of the future finance for Papua and West Papua’s infrastructure.

Annual rental payments for the services of the region’s standing forests may generate financial flows in the future. The best hope for international financial flows into Papua and West Papua may be not from international aid by bilateral or multilateral donors but from “carbon offsets” purchased by private sector polluters elsewhere in the world. One such idea receiving much attention is the Reduced Emissions from Deforestation and Degradation (REDD) scheme. Our estimate of USD 5,200 in annual global benefits per hectare of unharvested forest, for an area of, say, 200,000 square kilometers (roughly half of Papua and West Papua’s total area) gives an annual global benefit of USD 104 billion. Current resource flows from Jakarta are less than three percent of this total, so if the rest of the world would agree to pay each year a few percent of the annual benefits the world receives from Papua and West Papua’s standing forests, to the local governments, in return for measures to prevent forest destruction, large financial flows could be involved.

Accumulated savings by the governments of Papua and West Papua so far are insufficient to be a major source of infrastructure investment in the future. While spending has fallen short of income every year since 2005, the annual surpluses have been small. (See Figure 7). The accumulated surplus we estimate for the period 2005-2008 comes to roughly IDR 8 trillion. The actual balances in the bank accounts of sub-national governments in 2007 were slightly more than IDR 4 trillion. These balances can be compared to the annual flows of transfers from Jakarta, which were about IDR 22 trillion in 2008. If we view the accumulated savings of the governments of Papua and West Papua simply as precautionary reserves, they do not seem particularly large. Reserves on the order of approximately two to four months worth of flows are not excessive, particularly since many components of the annual flows are variable. These resources are small relative to annual flows as well as relative to infrastructure investment requirements. Of course, systematic efforts to save in the future could build these modest savings to substantial size.
Looking ahead, the outlook for future transfers from Jakarta is clouded in the near term, but favorable for the long run. In the recent past, growth of transfers from Jakarta has provided substantial resources for potential infrastructure investment. Further growth is to be expected, but the next few years might be rocky. Four central events drive the forecasts of revenue transfers for the next two decades:

- Burden sharing policy will reduce transfers beginning 2009;
- The worldwide recession and the decline in commodity prices (gold excepted) will drive down revenue for the next year or two;
- Revenues from the Tangguh gas field will begin to flow to West Papua in 2010 and rise sharply in 2017;
- Otsus revenue sharing will end in 2022.

2009-2010 will see transfers from Jakarta to sub-national governments slip, but the growth in flows should resume vigorously for the subsequent decade. West Papua, especially, should experience a substantial increase in DBH flows with the increase in tax and royalty payments by BP for Tangguh. Apart from the consequences of the end of Otsus, in 2022, the long run outlook for transfer payment growth looks good. Our forecasts suggest that transfers from Jakarta should reach IDR 30 trillion by 2015 and IDR 40 trillion by 2018, from about IDR 22 trillion in 2008 (and IDR 9 trillion in 2005). (See Figure 7)
Financial resources for infrastructure investment will continue to be substantial. The good news regarding finance for future infrastructure investment is that growth in transfers from Jakarta should resume in a few years. The bad news is that it is not likely that growth rates over any decade in the future will match the rapid growth of transfers over the recent past. What is more, international aid is not likely to play a dominant role in the finance of future infrastructure investment. Unless there is a breakthrough in the form of new payments to Papua and West Papua for the annual global benefits of its standing forests, the existing flows of resources from Jakarta to the non-national governments of Papua and West Papua must be looked upon as the major source of finance for future infrastructure investment. Private industry may also play a role by providing infrastructure for its own use.

Over the next few years, apart from vigorous rehabilitation of existing roads, water, and power systems, a reasonable goal for provincial and local governments is to accumulate sufficient reserves to begin substantial new investment projects once transfers resume their growth and after necessary planning has been completed. Too much of the investment of recent years – in large new government office complexes, roads built to inadequate standards, and new runways for underplanned transportation hubs – is unlikely to provide many services or to generate much income in the future. While infrastructure master plans are being prepared and projects are being appraised, it is much wiser to save money than to spend it. This is particularly true of mega-projects that will require trillions of rupiah and years of construction to complete.

Spending has grown together with revenues. Figure 8 suggest how the flood of new revenues to local governments has been spent in recent years. There has been some decline in the share of development spending going to public administration and an increase in public works. It is not clear, however, how productive any of this spending has been. For example, if routine maintenance is excluded from development spending while construction of largely empty new government office buildings is public works, then it becomes problematic to evaluate spending.

Infrastructure investment has been heavily skewed toward road transport. Not surprisingly, transport expenditures have received high priority in government spending. Total expenditures on all transport modes combined are estimated to have been IDR 4.6 trillion in 2007 representing almost 20% of total expenditures in the two provinces. Expenditures on transport by all levels of government combined have grown faster than other expenditures. Road expenditures accounting for almost 15% of total government expenditures and about 75% of transport sector expenditures. The heavy emphasis on road works is similar to development experiences in other regions of Indonesia and the world. But elsewhere, population
density is higher and economic activity is already spread more evenly across the territory than in Papua and West Papua. The key question is whether the transport needs of the productive sectors and improved access for remote communities cannot be better served through a different combination of investments that has a multimodal transport focus. (See Box 8: Modal Coordination and Intermodal Transport)

**Table 3: Total Expenditures and Expenditures in the Transport Sector (IDR billion)**

<table>
<thead>
<tr>
<th>Source of funds</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Expenditures by</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APBD total</td>
<td>8,379</td>
<td>8,347</td>
<td>12,695</td>
<td>18,694</td>
</tr>
<tr>
<td>Deconcentration</td>
<td>1,312</td>
<td>973</td>
<td>992</td>
<td>930</td>
</tr>
<tr>
<td>Central Govt</td>
<td>0</td>
<td>2,065</td>
<td>3,378</td>
<td>4,023</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9,691</td>
<td>11,386</td>
<td>17,064</td>
<td>23,647</td>
</tr>
<tr>
<td>Roads Expenditures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APBD Public Works Exp</td>
<td>520</td>
<td>1,115</td>
<td>2,737</td>
<td>4,031</td>
</tr>
<tr>
<td>Share Roads</td>
<td>0.70</td>
<td>0.70</td>
<td>0.70</td>
<td>0.70</td>
</tr>
<tr>
<td>APBD Roads Exp (Estimated)</td>
<td>364</td>
<td>781</td>
<td>1,916</td>
<td>2,821</td>
</tr>
<tr>
<td>Central Govt</td>
<td>241</td>
<td>278</td>
<td>418</td>
<td>478</td>
</tr>
<tr>
<td><strong>Total Roads</strong></td>
<td>605</td>
<td>1,058</td>
<td>2,333</td>
<td>3,299</td>
</tr>
<tr>
<td>Roads as % of total exp</td>
<td>6.2%</td>
<td>9.3%</td>
<td>13.7%</td>
<td>14.0%</td>
</tr>
<tr>
<td>Other Transport Modes Expenditures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APBD</td>
<td>87</td>
<td>114</td>
<td>170</td>
<td>637</td>
</tr>
<tr>
<td>Central Govt</td>
<td>352</td>
<td>268</td>
<td>495</td>
<td>644</td>
</tr>
<tr>
<td><strong>Total Transport (MOT)</strong></td>
<td>439</td>
<td>382</td>
<td>665</td>
<td>1,281</td>
</tr>
<tr>
<td>Transport as % of total exp</td>
<td>4.5%</td>
<td>3.4%</td>
<td>3.9%</td>
<td>5.4%</td>
</tr>
<tr>
<td>Total roads and other modes of transport</td>
<td>1,044</td>
<td>1,440</td>
<td>2,998</td>
<td>4,580</td>
</tr>
<tr>
<td>Roads and Transport as % of total expenditures</td>
<td>10.8%</td>
<td>12.6%</td>
<td>17.6%</td>
<td>19.4%</td>
</tr>
</tbody>
</table>

### 1.8. A Phased Strategy

A number of concrete recommendations follow directly from the foregoing analysis. For the immediate future,

- focus on rehabilitation and maintenance of existing infrastructure
- produce coordinated spatial plans and master plans for transportation, power generation, water and sanitation, and telecommunications.
- resolve the division of responsibilities among various levels of government for operation and maintenance of infrastructure as well as for training the workers who are to perform these jobs.
- review the procedures for setting and enforcing user fees for those who benefit from infrastructure. Fees for power, water, sanitation, and telecommunications must at least cover operating costs and in some cases they should cover full costs, including capital costs.

Resources devoted to maintenance, planning, and project appraisal must be increased. It is not possible steadily to add to the stock of productive infrastructure without greatly increasing resources devoted to planning and maintenance. A steady source of income for operating expenses depends on a well-functioning system to collect fees from users.

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5 Estimate based on the 2008 proposals by local governments for APBD expenditures on roads
It is possible to paint a general picture of the future, but not specifics. Without information about the costs and benefits of alternative projects and how they fit into a master plan, it is not possible to make specific recommendations concerning the projects that are most promising. Nevertheless it is possible to outline the shape of infrastructure development, as it is likely to evolve.

1.8.1. Transportation

Building a road system involves financial commitments that will last decades. Before any construction activity begins, road corridors and road alignment must be chosen. Not only current and future concentrations of population and economic activity must be considered, but soil conditions, slopes, and maintenance requirements. Even the best built road, requires annual and periodic maintenance to remain productive. The cost of a road is the total expenditure over its lifetime, for planning, construction, operation and maintenance. The cost of construction depends only on this year’s construction plan. But since the cost of maintenance depends on the size of the road network, that cost will grow larger and larger as more roads are built. Proper budgeting for roads begins with the maintenance cost and only uses remaining resources for new construction. Maintenance costs will take up a bigger share of the budget as the road network grows. While it is tempting to spend resources on new roads, built quickly and cheaply, such a strategy will in the end deliver a smaller usable road network than proper budgeting.
Box 7: Comparison of “Best Practice” versus “Poor Practice” Road Works Policy

Given that different road building policies and practices have different outcomes, it is instructive to explore the differences through a simulation analysis. Consider the case of a kabupaten government that wishes to open up and develop a region by building a network of local access roads and is able to allocate a fixed annual amount for this purpose. The interesting question is: what will be the outcome in terms of total number of km of roads in use and their condition after a 20 year period under alternative policies. For illustrative purposes best practice policies are contrasted with “poor practice” approaches and it is assumed that the annual budget available for the development of the new network is IDR 10 billion. It is assumed further that the terrain, availability of materials and traffic volume (10 – 30 vehicles/day) warrant construction of a single lane gravel road at a cost of IDR 1 billion/km. Thus, it will be possible to build 10 km of road during the first year of the program under both scenarios.

Scenario 1. This scenario is based on the following: designs and alignment have been selected carefully taking into account the kind of terrain and soil conditions; construction quality is of best practice standard; and routine and periodic maintenance allocations are adequate and carried out professionally. Under this scenario the roads built every year receive periodic maintenance at 6-year intervals and have a 20-year life before there is a need for reconstruction. Given the budget constraint and the commitment to proper maintenance, under this scenario, starting in year 2 and during subsequent years, the number of km that can be built will decline gradually to only 1 km at the end of the 20 year period. By that time some 102 km will have been built which are kept in good condition.

Scenario 2. This scenario is characterized by poor designs and alignment selection and poor construction quality and maintenance practices. Maintenance takes the form of ad-hoc interventions to deal with emergencies such as landslides and mud slides that engulf sections of the road; bridge failures and pavement failures; and washouts that require spot rehabilitation to keep the road open. This set of policies and practices requires emergency interventions in years 4 to 7 and shortens the life of the road to 7 years with the result that in year 8 the road needs to be reconstructed at a cost of 85% of the original construction cost. Based on the available budget, during the first three years it is possible to build 10 km every year. However, starting in year 4 emergency maintenance in the amount of IDR 40 million is eating into the annual construction budget and the number of km that can be built declines to 7.6 km in year 7. By that time the total km built amounts to 64 km and from this point onward every year practically the full budget is needed to reconstruct roads that reach the end of their life. The useable road network will stabilize at about 64 km in the subsequent period of 7 years but it will be in very poor condition most of the time with vehicle operating costs that are substantially higher than under scenario 1.
Transportation planning should focus on multiple transport modes. Roads that carry heavy vehicles are only one of several important transportation modes. In Papua and West Papua, a large part of the transportation burden will continue to be carried most economically by other modes of transport: waterborne, airborne, and light vehicle. Even if a road were available free of cost to truckers, sea transport of people and goods still would be competitive between Jayapura and Manokwari. Along the coast and in the interior where rivers are navigable, waterborne transport is likely to be a dominant transportation mode not only in the short run but in the distant future too. The highlands will continue to depend on air transport for many years.

Air transport and light duty roads deserve attention in the highlands. Even as roads move inland from the coast, initially they will reach only a few places in the interior. Many distant, isolated villages will depend on airstrips as an alternative to walking. In the highlands, improvements in airports – expansion, instrumentation, and runway enlargement – should be a focus of transportation planning. It is likely, too, that paths for light vehicles, notably motorcycles, will be far easier and cheaper to build and maintain than heavy-duty roads. Such light duty roads will require bridges and surfaces that are passable in all seasons, but the light weight of the vehicles using them and the narrow gauge of the paths will make them far easier and cheaper to develop. Motorcycles can be adapted to facilitate movement of goods and passengers. Of course, light duty roads require no less planning in the selection of road corridors and of the route location within these corridors than do heavy-duty roads. Indeed, it is likely that many light duty roads eventually will be enlarged and strengthened to support heavy vehicle traffic.

Multimodal transportation planning is needed to avoid costly duplication and transitions between modes. Multimodal transport – with heavy and light duty roads, sea, river, and air as important components – requires careful planning. It is important to avoid expensive duplication of modes: if riverine transport is effective, development should focus on improving river ports and perhaps canals rather than duplicating service with roads. Switching points between transportation mode – where people and freight move from river transport to sea transport or to road transport or to air transport or to light-duty road transport – should be made easy to use at low cost.

Box 8: **Modal Coordination and Intermodal Transport**

To overcome the handicap of high transport costs both externally and internally, Papua and West Papua need to develop the appropriate mode of transport that delivers the lowest cost for the economy. Where coastal shipping and river transport are available or are an option, these modes will usually be the lowest cost. For other transport needs in the interior, where flows are small, air transport usually will be the preferred mode. Given the high cost of sustainable roads, road transport will only be economical when traffic reaches certain thresholds, for paved roads on the order of 300 vehicles a day, for gravel roads on the order of 30–70 vehicles a day, and for earth roads on the order of 10 vehicles a day. An efficient, integrated transport system requires two key policy initiatives: (i) selecting and developing the most economical mode of transport for each link of the system; (ii) developing transfer points between modes so that passengers and freight can shift at lowest possible cost from one mode to the next.

**Selection of the Most Economical Mode.** Traditionally, road planners plan roads; port planners plan ports; and too few resources are devoted to choosing and planning intermodal transitions. In the case of land transport the focus on heavy-duty roads has led to neglect of other options, such as, light-duty paths suitable for bicycles and motorbikes. Such paths, which can be built at much lower cost than heavy-duty roads for 4-wheel vehicles, could be constructed and maintained to be usable in all seasons. Compartmentalization of transport planning seriously hampers consideration of modal options and coordination at the planning stage. Multimodal transport planning is made more difficult by a lack of good coordination within each mode between the investments funded under the central budgets and those at the provincial and kabupaten level. For most situations, proper intermodal coordination of facilities must be studied and planned at the regional/local level.
Box 8:  

For many isolated communities that can be reached by waterborne or air transport, initial access or improved access using these modes can be provided at much lower cost, through the construction of jetties or airstrips, than through new road construction. Not only is construction cost of such jetties or airstrips (in a range of IDR 100–500 million) much less than even one kilometer of road, but also these facilities will in most cases serve many more people than an average km of road. In other words, the cost effectiveness of these facilities will easily be ten times greater than road construction.

**Efficient Intermodal Connections.** Efficient connections at the modal transfer points – between sea/river ports and airports and local distribution by heavy and light duty roads - play a critical role in reducing overall transport costs. Lowering costs will often involve careful spatial planning at the local city level where the ports are located. For example in Manokwari, part of the port area that is currently being used as a makeshift container freight station is being considered to be converted into a car park. When the available land within the port area is adequate and as long as the number of containers remains manageable within the port area, it will preferable from the point of view of transport efficiency to keep the container freight station within the port area so as avoid hauling of containers in and out of the port. Such hauling not only is directly costly, but it contributes to traffic congestion and road damage in the inner city. Clearly, port planning from the point of view of transport efficiency needs to be coordinated with city master planning in order to achieve optimal development of the transportation system within the city and optimal use of scarce waterfront land.

**Recommendations to Improve Intermodal Planning**

- At main ports, facilitate transshipment between main line and coastal shipping, river transport and road transport.
- At airports, facilitate improvement in navigation and airport landing equipment to ensure fewer flights are cancelled last minute. This will improve aircraft utilization and reduce operating costs.
- At city level, increase connectivity at transfer stations between the various land transport (vehicles, bus, car/ taxi, motorbike, becak).

*Some planning documents mention investment in railways. Except possibly dedicated lines serving high volume mineral extraction, railway transport is not a viable option in Papua and West Papua. Railway lines carrying much higher traffic volumes are being closed all over the world because governments can no longer afford the annual subsidy payments. In the case of Java, which has among the best potential for railway transport in the world, only passenger services are financially feasible while general freight services are loss making without much prospect for becoming viable in the foreseeable future under current transport sector policies.*

### 1.8.2. Power

Today power in Papua and West Papua is costly to produce and unreliable. But cheap power potentially is one of Papua and West Papua’s major sources of comparative advantage. In addition to large gas and coal deposits, the region has enormous potential for hydropower: more than 140 times the total of today’s installed power generating capacity. Yet almost all power today is generated using old diesel generators, operating at 60% of capacity. Growth of capacity – less than 4% per year from 2002 to 2007 – has been half as fast as the growth of demand, far too slow to improve the chronic problem of inadequate power supplies.

It is essential that governments take the lead in promoting power development. More than roads, power is vital to development in the major towns of the coast. Diesel generators are far too costly to operate. Electricity tariffs cover less than a third of the cost of supplying such power. Diesel must be replaced by more efficient power sources, and tariffs must be raised to cover costs. Reliable power must be a central goal of infrastructure development and, again, institutional reform, including tariff restructuring, must be part of the program.
Hydropower is especially promising. Potential hydropower installations at Urumuka, Paniai, and Mamberamo all deserve careful scrutiny and full project appraisal. Of these, the Urumuka project, with potential demand from Freeport Indonesia, Timika town, a potential cement factory, and Enarotali and Nabire towns, appears the most promising. A power master plan, which should receive high priority, must include a survey of hydropower potential at these sites as well as others, including potential for micro hydro installations. All detailed project appraisal should include evaluation of environmental and social impacts as well as the economic consequences of each project.

Micro hydro and solar power should be evaluated for isolated locations. For years to come, power in most of the highlands must be delivered to each site, off-grid. Solar power and micro hydro should be evaluated for these places. The diesel generators now in use in many isolated villages are tremendously expensive to operate, not only because small generators are inefficient but because the cost of fuel, delivered by air, is so high. The planning of small power development must be coordinated with site choices for facilities that depend on power, such as schools and government offices (which will need computers), and small businesses that use power (such as small woodworking shops). The transmission of power generated on a small scale becomes far more costly beyond a kilometer, so buildings must be located near to power generating capacity.

1.8.3. Water and Sanitation

In most of Papua and West Papua, water is abundant, but few households have access to piped water, and none have access to piped potable water. The neglect of maintenance of installed capacity is a chronic problem, tied to failure to collect appropriate user fees for water delivery. Half of the water that enters the system is lost for technical and administrative reasons. Yet the cost of rehabilitating the existing piped water systems and expanding piped water delivery is not at all prohibitively high.

Investment in water supply is relatively low cost. The total cost of adding 95,000 urban connections and 261,000 peri-urban and rural connections (109,000 of these in the highlands) by 2020 – to reach the targets of 80% urban and 60% rural piped water service – is about USD 250 million (IDR 2.5 trillion). To put this cost in perspective, it is roughly the cost of building about 250 kilometers of good road, or about one tenth of the total transfer payments the governments of Papua and West Papua received from Jakarta in 2008.

Sanitation infrastructure is in poor shape in Papua and West Papua. Solid waste is being dumped where it threatens ground water and where it is likely to spread after heavy rains. Sewage treatment no longer is undertaken in Sorong, the only town that once had a sewage treatment facility. Building codes governing waste disposal are not enforced. In the two towns where sewage sludge is collected from septic tanks, Jayapura and Sorong, it is now dumped untreated in locations where it leaks into streams and groundwater, contributing to waterborne disease. In other locations, there are no sanitation services.

Investment in sanitation is less costly than investment in water supply. Even more so than water delivery, improvement in sanitation services can be achieved at relatively low cost. For USD 50 million (IDR 500 billion) it would be possible to provide eight towns with sewage sludge treatment plants and to install a piped sewage system in Jayapura.

Water and sanitation delivery must be better managed. More dramatically than for other infrastructure, the barrier to improved water and sanitation infrastructure is not cost and it is not technology. The key shortcomings are in maintenance and in management of the water and sanitation systems, including enforcement of user fees that cover operating costs. Water and sanitation services could be dramatically
improved; for the cost of 300 kilometers of good road, all the major towns and much of the rural area
could have much improved piped water delivery and all the major towns could introduce treatment of
sewage sludge. This budget includes the construction of a piped sewage system for Jayapura.

Proper operation and maintenance of the water and sanitation systems will require budgeting discipline
and revenue collection. The water system should cost about USD 30 million (IDR 300 billion) per year to
operate and maintain. With about 459,000 connections, the O&M cost of about USD 66 per connection
per year cannot be treated lightly. Collection of user fees will be important.

1.8.4. Telecommunications

Telecommunications provide an opportunity for rapid development. Investment in telecommunications
infrastructure offers an opportunity to jump directly into some of the newest technologies on earth,
better connecting Papua and West Papua internally and to the outside world.
About half the population of Papua and West Papua now has access to mobile
phone networks, and there is mobile coverage in all larger population centers,
plus many villages. Internet usage is also rising, particularly in larger towns,
both on the coast and in the highlands. However, these developments are
constrained by the cost of computers and power supply, and the limited
(satellite) transmission capacity. The main challenges are to increase coverage
of the telecommunications network and to increase its carrying capacity, or
bandwidth. This can be achieved through a combination of submarine fiber-
optic cable to major coastal cities of Papua, fiber optic or microwave links to
the interior (co-located with roads, pipelines or power lines if feasible) and
increased deployment of new more cost-effective satellite technologies to
remote locations.

Public sector support may be needed for remote locations. Investment
in telecommunications comes primarily from the private sector, which is
also responsible for operations and maintenance. The private sector is profit-driven, and therefore less
inclined to service more remote and sparsely-populated areas. There are opportunities for partnerships.
For example, provincial and kabupaten/kota governments can work with the private sector to stimulate
new investments in such areas by subsidizing capital investments, preferably on a competitive basis;
and by pre-purchasing telecoms/Internet capacity (for use by government offices, schools, and health
centers, for example) thus guaranteeing the private investors a minimum market for telephone and/or
internet services.

Important private investment is already underway. Private telecommunications companies are laying
fiber optic cable to eastern Indonesia in the “Palapa Ring,” which includes Sorong as one landing point and
is scheduled for completion in the next few years. A “tail link” could extend this cable to Manokwari, Biak,
Sarmi, Jayapura, Fakfak, Timika and Merauke for a capital cost of about USD 145 million (IDR 1.45 trillion, see
Annex 7 Telecommunications for further information). Connection to the Palapa Ring deserves prompt
evaluation. Participation in this fiber optic network would catapult telecommunication capacity in Papua
and West Papua to top global standards. Telephone and internet carrying capacity would become for all
practical purposes unlimited. Any part of the highlands that connected to a coastal hub using microwave
technology would instantly become part of the same system. It may be possible to connect Wamena to
Jayapura by microwave using as few as four towers, taking advantage of the high mountains of Papua’s
interior. The map below illustrates one version of this plan.
Isolated locations can use satellite connections. Even in those parts of the highlands where population is too small or terrain too challenging to justify microwave connection to the coast, telephone and limited computer connections are quite feasible using local power supplies and satellite technology. A solar/battery power supply combined with a satellite antenna can connect almost any inaccessible place to the global telecommunication system at a capital cost of USD 12,500 (IDR 125 million) per site.

To put these numbers in perspective, again, the cost of extending the Palapa ring on the north and south coasts of Papua and West Papua is equivalent to about 150 kilometers of good road, while the cost of providing 1000 villages with new satellite-based telephone connections is about 125 kilometers of good road.

1.9. Conclusion

A wise expert on infrastructure said recently “If you build infrastructure right, it will take a lot of money and a lot of time. If you cut corners, it will take more money and more time.” Papua and West Papua hold great promise for development. But it would be easy to end up not with development but with plunder of the region’s non-renewable resources and with irreversible harm to the Papuan people. Somebody, somewhere in the world, might become very rich. But how many pennies would local Papuans get for every dollar in banks overseas?

Infrastructure in Papua and West Papua should be developed carefully. Projects must be coordinated among all levels of government within well prepared master plans. They must be properly appraised.
before they are undertaken. There are many opportunities for productive investment in transportation, power generation, water and sanitation, and telecommunication that are not mega-projects with mega price tags; there are a few large projects, as well, that are likely to pass muster. The central government of Indonesia, the provincial governments of Papua and West Papua and all of the kabupaten and kota governments in both provinces must move hand-in-hand along the road to development rapidly, but one step at a time.