

INVESTING IN THE FUTURE OF PAPUA AND WEST PAPUA



CAN INFRASTRUCTURE DEVELOPMENT STRATEGY CONTRIBUTE TO SUSTAINABLE DEVELOPMENT IN INDONESIA'S MOST REMOTE REGION?

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Investing in Indonesia's Institutions for
Inclusive and Sustainable Development



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Infrastructure Strategies for Papua and West Papua

1 Infrastructure Strategies for Papua and West Papua

1.1. Challenges for Development in Papua and West Papua

1. **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 both 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 mother tongues, and have unique, and in some cases confrontational cultures.

2. **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, and 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. Exceptional geographical and climatic variation provide conditions for great ecological diversity. Moreover, and unlike the situation in neighboring PNG, Papua and West Papua's forest cover is largely intact, some of it probably never inhabited. Nearly half of Indonesia's remaining forest is in Papua and West Papua. The Indonesian part of New Guinea is the largest ecozone east of the Wallace-line with relatively intact flora and fauna. The surrounding sea, particularly in the north, also is exceptionally rich in species, containing plants and animals from the Pacific, the Indian, and the Southern oceans. This is truly a unique pocket of the biosphere. Indigenous people traditionally have relied heavily on local flora and fauna, 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.

3. **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. This internal demand for infrastructure is bolstered by pressure from local and international interests, which want to exploit 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 serve other purposes such as allowing isolated communities to gain access to education and health care. Water, sanitation, and power infrastructure will supplement education to improve health outcomes, which are threatened today by widespread malaria, gastro-intestinal infections, and HIV-AIDS.

4. **Economic activity is scattered.** 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.

5. **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, pressure to convert assets to cash is intense. Every tree, every ounce of gold and ton of coal, represents new houses, automobiles, and aircraft, when it is removed and sold. 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, taxes and revenues absorb about 16%, and payments to the indigenous “customary owners” make up another 0.5% to 3.5%. 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?

6. **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.** By definition, non-renewable resources can be harvested only once. What is the best strategy to develop the region so that future generations of indigenous Papuans will enjoy expanding rather than shrinking opportunities?

1.2. The Sustainability Challenge

7. **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 does not irreversibly deprive future generations of opportunities to enjoy economic, environmental, and cultural services at least as great as what the current generation enjoys.* Sustainability is not always achievable, but it always should be a standard against which any proposed change is measured.

1.2.1. Economic sustainability.

8. **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 in its wake. What will the people of Papua and West Papua do after the “gold-rush?”

9. **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 6 below).

10. **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).

11. **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 referred to by some as “low-income forestry,”

because in the short run, clear-cutting a forest will generate far more net revenue than is possible using sustainable practices.

12. **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.

13. **In some cases, deforested land can continue to generate income.** With clear property rights and favorable conditions, land newly cleared of a forest can be converted to cultivation of plantations, annual crops, or animal husbandry. Indeed, most of today's agricultural heartlands of Europe and North America once were covered with forests. In other cases, fragile soils and steep slopes make cleared land unsuitable for agriculture, subject to landslides, erosion and further degradation.

14. **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.

15. **In principle, land-use strategies can limit environmental destruction.** Almost any development implies some damage to the forests and the marine life of Papua, but it is possible to avoid the collapse of biological diversity through designation of some areas as reserves or national parks. If access to non-renewable resources is limited, and their extraction is monitored, erosion and destruction of habitats can be limited.

16. **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.

17. **Papua's forests serve the entire planet.** 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 would pay rent for the services of tropical forests have been widely discussed, but such ideas remain only partially explored and minimally implemented.

18. **We estimate that the value of the services of a standing forest in Papua is \$5200 per hectare per year.** More than half of this total arises from the value of carbon storage. Yet

the value of carbon storage in a few hundred square kilometers of forest, to the people who stand to gain from harvesting the forest, is essentially zero.

1.2.3. Cultural sustainability.

19. **The indigenous cultures of Papua and West Papua are vulnerable.** 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. Norms and beliefs that have persisted for thousands of years are being put to the test. Many will disappear within a generation or two. Many languages, too, are likely to disappear.

20. **Cultural change must be sustainable.** “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 aim to preserve many of the threatened aspects of local culture, some of which are dysfunctional in modern, interdependent society. 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 that leaves chaos in its wake. 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 and participation of indigenous Papuans must be paramount.

21. **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. International experience suggests that new transportation infrastructure tends to generate large inflows of external migrants, while the degradation of resources due to extraction of non-renewable assets results in a forced outflow of indigenous peoples to urban areas. If not managed well, this easily can lead to clashes among ethnic groups. Infrastructure programs focused on community development by contrast tend to maintain relative stability.

22. **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.

23. **Investment in infrastructure must be realistic within inescapable budgetary and technical limitations.** The goal of sustainable infrastructure is narrower than economic, environmental, and cultural sustainability, but it cannot be neglected. 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. 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. Such a construction-focused strategy ultimately delivers less usable infrastructure than if operation and maintenance had received adequate resources.

24. **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.

25. **At some level of infrastructure, all available annual spending should be devoted to maintenance.** In spite of pressure to add infrastructure capacity there is a limit on the amount of infrastructure that any budget can sustain. 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 of a network of local access roads in a kabupaten requires 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 Rp. 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. Summary: The Infrastructure Development Challenge

1.3.1. Construction Costs

26. **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). Altogether, soils with severe drainage problems or with an acute 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 Rp. 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 sometimes cited in Papua and West Papua.

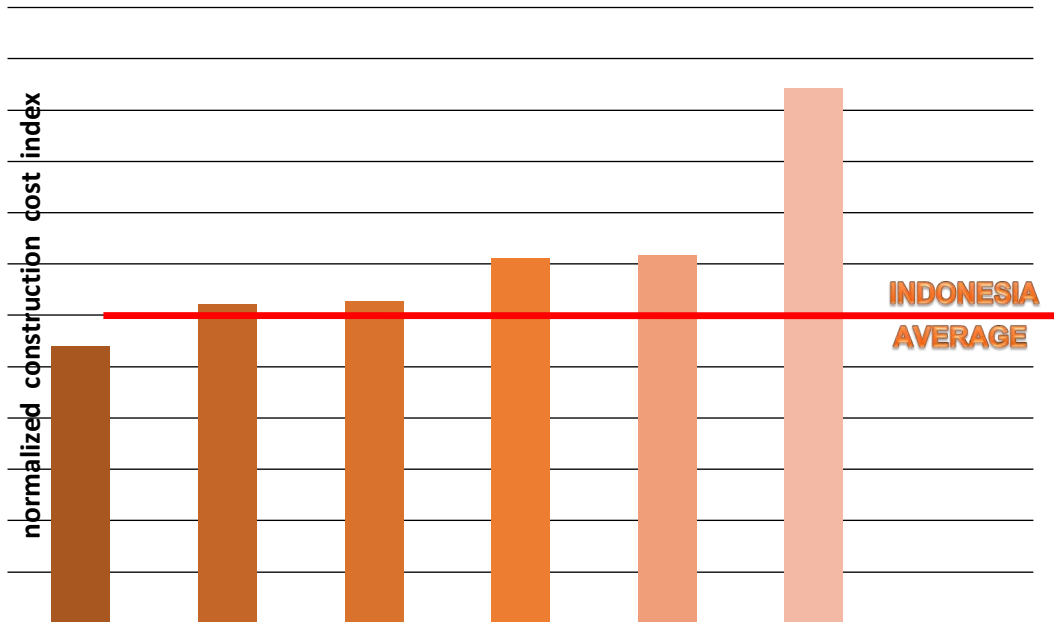
Table 1: Cost of a Bag of Cement in November 2008

City	Price per Sack (Rp.)
Jakarta	50,000
Jayapura/Manokwari	75,000
Wamena	500,000
Mulia	1,300,000
Oksibil	1,500,000

Source: World Bank staff surveys

27. **More than this, the 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 most other Asian countries. It takes many more kilometers of road or electric transmission lines to serve a million people in Papua than in more densely populated areas, which further drives up the cost of providing infrastructure services.

Figure 1: Cost of Construction in Papua and West Papua



Source: Ministry of Finance

1.3.2. Maintenance.

28. **Maintenance of existing infrastructure is a chronic problem.** As everyone is well aware, 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 inadequate maintenance. Many roads and water systems become inoperable only a few years after they are built, requiring expensive rehabilitation when routine annual and periodic 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.

29. **We estimate the optimal expenditure over the next 5 years, for rehabilitation and maintenance of Papua and West Papua’s roads alone is Rp. 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 Rp. 29 trillion in 2008.

30. **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.

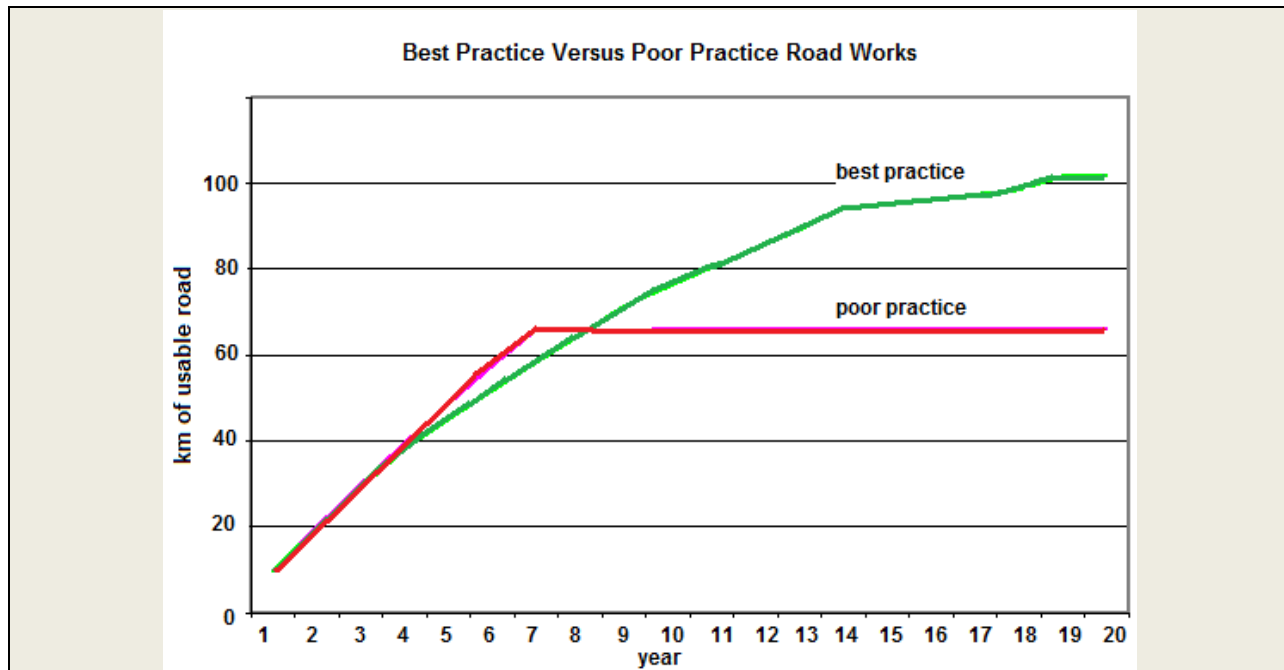
31. **Optimal maintenance also reduces private costs.** If roads are so bad that vehicles wear out rapidly and if power supplies are so unreliable that businesses are forced to provide their own back-up generators, then private costs as well as public costs rise as a result of inadequate infrastructure maintenance.

Box 1: 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 Rp. 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 Rp. 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. See graph below.

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 land slides and mud slides that engulf sections of the road; bridge failures and pavement failures; and wash-outs 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 Rp. 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.



1.3.3. Capacity.

32. **More than any other type of spending, infrastructure development requires good planning.** With high initial costs and long potential life, infrastructure development requires well informed choices. It must take place within a comprehensive long run plan, with technical details and feasibility analyzed carefully. 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.

33. **Unfortunately, the governments of Papua and West Papua, working within the institutions and procedures of Indonesia, are far from meeting these requirements.** Spatial planning is just beginning in Papua and West Papua and is not yet flowing through into project planning. 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 with what is feasible within budgetary and technical constraints. For example, the 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, driven instead by the annual budget cycle and release of funds, which often must be spent quickly. There is no rolling medium term plan into which annual spending is slotted. Since annual spending often is undertaken with pressure to spend money fast, far too little project appraisal is undertaken.

34. **The Indonesia formal planning process and cycle is rigid.** While the 20-year plan, which is divided into four successive 5-year plan tranches, in principle provides a useful framework and direction for sectoral development, 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 associated with the project preparation, approval and procurement steps. As a result, expenditure planning remains heavily focused on expenditure plans in the context of the annual budget cycle, which stretches several months past the start of the budget year, with approvals required by the respective parliaments. This is a serious shortcoming, as the majority of 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.

35. **Resources available for project and program preparation are grossly inadequate.** Planning is difficult within the institutional system, but 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 road. As a result, cost-benefit studies prepared for major investments rarely examine alternative concepts, technological solutions, or optimal timing options; instead project appraisals tend to focus narrowly on demonstrating the economic justification of a given investment concept without evaluating any alternatives.

Box 2: 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 a tradition of 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.

This can be illustrated by considering a simple example of 3 projects with a 3 year implementation period and 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 if they are 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 whereas under the first scenario 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%.

36. **On top of these institutional problems, most of the governments charged with managing infrastructure investment are start-ups themselves.** Of the 40 non-central governments in Papua and West Papua in 2009 that receive basic transfers from Jakarta (two provincial governments and 38 kabupaten/kota governments), 29 have come into existence since 1999. Each of these governments must find the skilled people to implement the measures

required for a good infrastructure development program. And they must coordinate with each other. Yet the average education in six of the 27 Kabupaten of 2007 was less than 4 years and in another 19 Kabupaten average education was between 4 and 8 years.

Box 3: Infrastructure Projects that Need More Planning and Evaluation

The institutional weaknesses in Indonesia's formal planning and project evaluation process too often lead to serious misallocations of resources in transportation planning. Several major investment programs and projects provide current examples that illustrate the risks of proceeding without proper planning and evaluation:

1. the Trans-Papua road links,
2. projects to improve access to the Highlands,
3. infrastructure/industrial/urban schemes.

Trans-Papua Road Links The selection of road corridors and of the route location within these corridors needs to take into account many aspects, including geotechnical, engineering, environmental, social, land use, and economic factors. Outcomes affecting future generations will be very different depending on whether the planning work is done carefully and professionally, superficially, or barely at all. This road system will lock in corridors of human settlements and economic activities for the very long run. There is ample time to carry out the indispensable study and preparation work, as the transport demand in most of the road corridors that these projects aim to establish will remain negligible for the foreseeable future. This provides a breathing space to examine the options in depth and from a broader perspective than just roads.

Papua and West Papua's main centers of activity 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 the full cost of providing infrastructure support as well. 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 Rp. 875,000/ton. This includes the cost for both the 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 Rp. 950,000/ton. Under more efficient coastal shipping operations, this cost could be reduced significantly, probably to Rp. 650,000/ton. If a road alternative were available – involving a distance of 840 km – the trucking cost is estimated to be no less than Rp.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. What is more, to justify building costly interregional road infrastructure 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. Traffic levels rapidly decline the further the distance from the city center.

Clearly, 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.

Access to the Highlands. Proposed investments to improve access to the Highlands are another

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 appear to involve simultaneous development of several road connections as well as an additional air connection. The high costs of road construction into the highlands (Rp. 6 – 10 billion /km to build a good, sustainable road) surely justifies a well-focused and high quality study that takes into account all the key factors having a bearing on the costs and benefits of different alternatives. Again, there is ample time to carry out a proper study.

While road corridors and alignments are being considered, the efficiency of air transport access to the highlands should continue to be developed and fostered. Air transport will remain a credible alternative for the foreseeable future. Air can provide transport at a cost in a range of Rp. 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.

Investments towards establishment of a multimodal connection to Wamena in the Highlands via Dekai also merit careful economic and financial comparison with other alternatives. The Dekai alternative involves 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 thence by air to Wamena. The advantage of this alternative is reported to be that river transport is low cost and the air segment from Dekai to Wamena is much shorter than say from Jayapura to Wamena thereby saving on air transport costs. In evaluating this option it is important to bear in mind that air transport costs are not proportional to distance traveled; they also depend on the frequency of landing and takeoff 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 other air routes which involve more low-cost cruising and less high-cost climbing. Also, transshipment through Dekai would involve: (i) two additional transshipments (water to 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 schemes require careful consideration of all factors having a bearing on costs and quality of service.

Infrastructure/Industrial/Urban Development Schemes. The scheme being contemplated 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 not only require a thorough evaluation of the merits of the overall package and of the contribution/role of each of its components, but also require analysis of risk in case some components fail to fall into place: (i) an evaluation of the risks attached to each of the key components of the scheme; (ii) strategies to control the risks for regional/local government through careful structuring of the Public/Private Partnership in terms of financing and implementation responsibilities; and (iii) a critical path analysis of the various implementation steps.

Worldwide experience shows that difficulties in implementation, even of comparatively simple projects – such as for example development of a greenfield port – are the rule when the scheme involves the participation of different government and private sector parties. Completing a coordinated project requires more than the construction of port infrastructure; a host of other actions and achievements have to come on stream in a timely fashion. An experienced port operator has to be selected and appointed, shipping lines have to be willing to make calls at the port, there has to be proper road access, and electricity, water, and telecom all must be available when they are needed, but not too long before. Such schemes require a strong and very experienced overall project management team that is fully empowered to coordinate the various essential components.

The scheme being contemplated west of Jayapura many times more complex than just a greenfield

port. 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 of each of the components in a coordinated manner in concert with the industrial development, to avoid making major investments in infrastructure before the industrial development has been locked in. This is where a very 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 oversized 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 road construction and maintenance burden.

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.

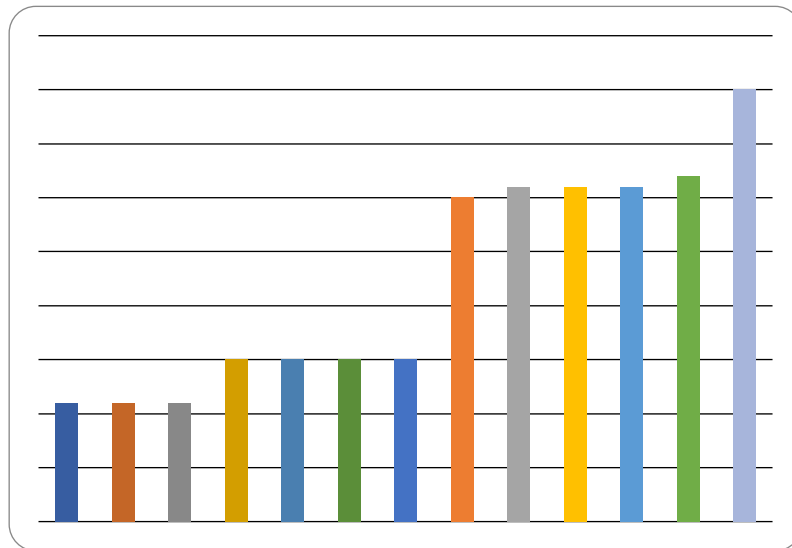
** The Mission was shown figures which suggest a cost of Rp. 150 billion per km for the Jayapura ring road*

1.3.4. Decentralization.

37. **Since 2000, decentralization of Indonesian public administration has had a substantial economic impact on the region.** Papua and West Papua today 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 10 kabupaten/kotas (local governments) were subdivided into 38 (see Figure 2, below). As a result, many of the institutions responsible for building and operating infrastructure in Papua and West Papua are very new, somewhat unsure of their powers and responsibilities, and essentially untested.

38. **The continuing administrative decentralization process has some advantages.** Development in each administrative unit is focused heavily on its capital, so proliferation of administrative capitals has spread development into more corners of the region. However, administrative fragmentation of Papua and West Papua puts further strains on limited trained personnel and makes it more difficult to track expenditures, to say nothing of managing infrastructure projects that cross administrative borders.

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



Source: BPS (Central Statistics Bureau)

39. **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 principal driver of the non-subsistence economy outside a few pockets where extractive industry dominates. These transfers exceed USD 2 per day per inhabitant. Growing migration of Indonesians from other parts of the country, in search of economic opportunity, has further challenged the isolation and fragmentation of indigenous populations. Administrative capacity, financial resources, 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.

Box 4: 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 centre remains responsible are implemented either by central government departments or by regional government agencies. In the latter case, the centre 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. These 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. The allocation of responsibilities was based on three criteria: externality, accountability and efficiency. The majority of the 31 affairs are classified as compulsory affairs, the most important of which include: education, health, environment, public works, spatial planning, development planning, telecommunications and IT, social affairs, and community empowerment. The remainder is classified as optional affairs. Central government agencies are responsible for setting norms, standards, procedures and criteria for the implementation of both compulsory and optional affairs within two years from the issuance of PP38/2007, i.e. before August 2009.

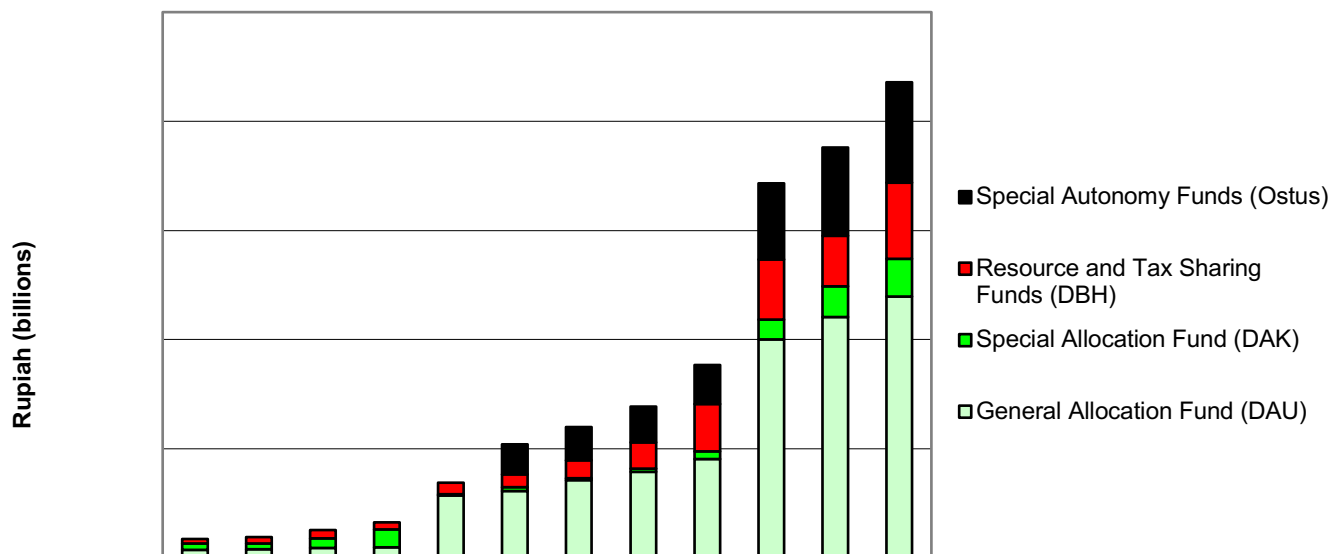
Recognition of Central Government spending on decentralized tasks. Before and after issuing PP38/2007, GOI has issued several regulations that are seemingly inconsistent with this PP (such as PP16/2005 on Drinking Water Supply Systems and PP 48/2008 on Education Financing). These regulations have provided central government ministries with the legal basis to continue the financing of regional government responsibilities from central government budgets. GOI has since pursued 'synchronization' of central government transfers with deconcentrated funds.

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).

1.4. Finance: Sources and Uses

40. **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 Rp. 1.7 million per capita (second only to Kalimantan Timur). In 2009, Papua and West Papua (and the 38 kabupaten/kota within them) are expected to receive Rp. 7.5 and 8.9 million respectively per capita, more than any other province. This rapid growth of transfers is illustrated in Figure 3, 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 1340%. This puts a tremendous strain on the absorptive capacity of provincial and local governments.

Figure 3: Central Government Transfers to Sub-National Governments in Papua and West Papua



Source: Ministry of Finance and World Bank staff estimates

41. **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

	International aid per capita (current US\$) 2007 plus transfers from Jakarta to Papua and W. Papua
Palau	\$1,108
Solomon Islands	\$501
Timor-Leste	\$262
Lao PDR	\$68
Papua New Guinea	\$50
Cambodia	\$46
Sub-Saharan Africa	\$44
Low income	\$31
Vietnam	\$29
Philippines	\$7
South Asia	\$7
Myanmar	\$4
Indonesia	\$4

Domestic transfers from Central Government to PWP: 110,000

Pre-existing aid flows to PWP: \$17

Source: World Bank, World Development Indicators

42. **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. If Papua and West Papua received international aid comparable to Papua New Guinea, such aid would roughly triple. If aid were comparable to that received by East Timor, the international aid flows would be more than 15 times as large as they were in 2008. But, against these international flows, 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.

43. **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. Our estimate of USD 5200 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.

44. **Accumulated savings by the governments of Papua and West Papua so far are insufficient to be a major source of investment funds in the future.** Some observers note that spending has fallen short of income every year since 2005, leaving small annual surpluses to be saved (see Figure 4). So far, the hope that these add up to a substantial resource for future infrastructure investment appears unfounded. The accumulated surplus we estimate for the period 2005-2008 comes to roughly Rp. 8 trillion. The actual balances in the bank accounts of sub-national governments in 2007 were slightly more than Rp. 4 trillion. These balances can be compared to the annual flows of transfers from Jakarta, which were about Rp. 22 trillion in 2008. Precautionary 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 highly variable. It might be possible to squeeze a few trillion rupiahs for infrastructure investment from savings, but these resources are small relative to annual flows as well as relative to infrastructure investment requirements. It would be foolish to deplete reserves to finance long-term investment as we enter a time of short-term economic instability. Of course, systematic efforts to save in the future could build these modest savings to substantial size.

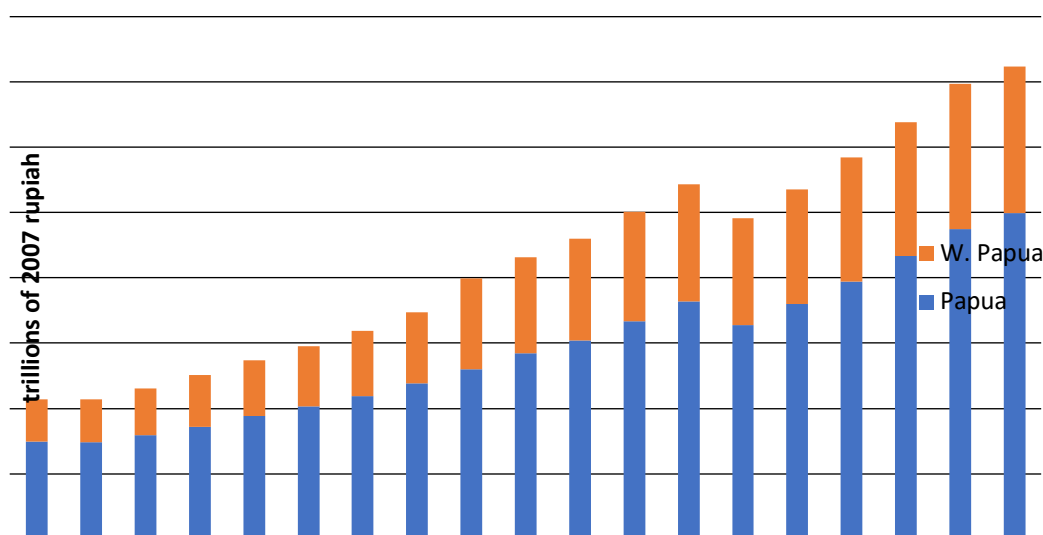
45. **Looking ahead, the outlook for future transfers from Jakarta is clouded in the near term, but favorable for the long run.** In the recent past, growth of transfers from Jakarta has provided the resources for potential infrastructure investment. Further growth is to be expected, but the next few 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;

- Ostus revenue sharing will end in 2022.

46. **2009-2011 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 Ostus, in 2022, the long run outlook for transfer payment growth looks good. Our forecasts suggest that transfers from Jakarta should reach Rp.30 trillion by 2015 and Rp. 40 trillion by 2018, from about Rp.22 trillion in 2008 (and Rp.9 trillion in 2005). (See Figure 4)

Figure 4: Projected Transfers from Central Government to Papua and West Papua 2009-2027

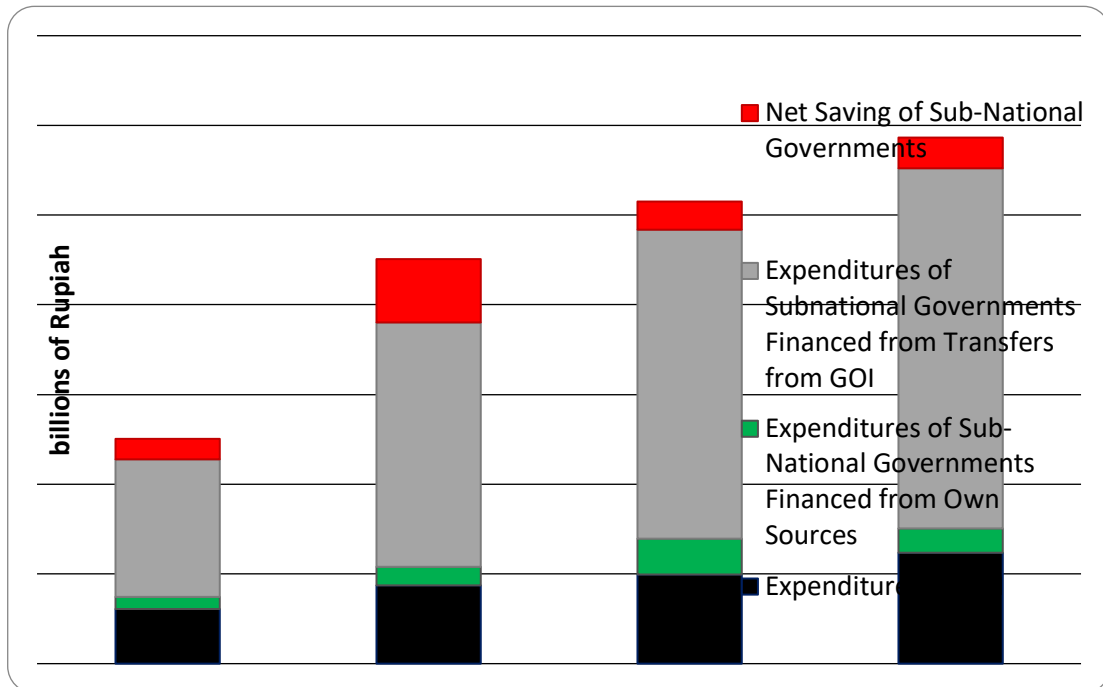


Source: WB estimates

47. **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 past decade. 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 an important role.

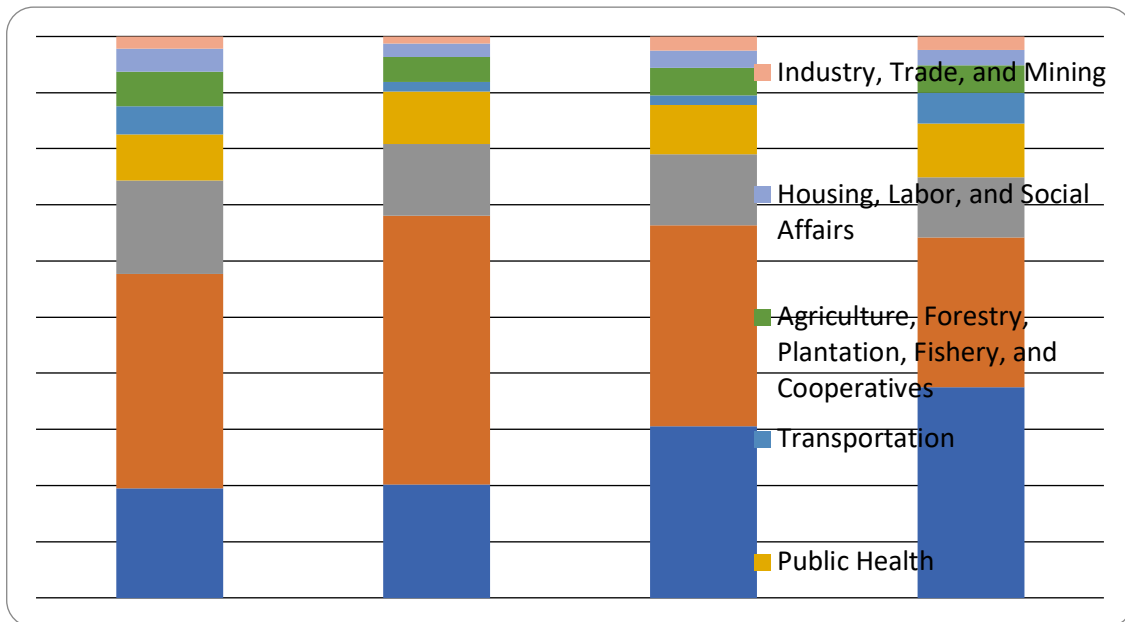
48. **Spending has grown together with revenues.** Figure 5 and Figure 6 suggest how the flood of new revenues to local governments has been spent in recent years. There has been some decline in the share of spending going to public administration and an increase in public works. It is not clear, however, 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 the significance of changing spending priorities.

Figure 5: Sources of Public Expenditures in Papua and West Papua 2005-2008



Source: Based on Ministry of Finance data with staff estimates

Figure 6: Allocation of Development Expenditures 2004-2007



Source: Based on Ministry of Finance data with staff estimates

49. **Infrastructure investment has been heavily skewed toward road transport.** We have put together better quality data concerning government spending on transport. Not surprisingly, such expenditures have received high priority in government spending. Total expenditures on all transport modes combined are estimated to have been Rp 4.6 trillion in

2007 representing almost 20 % of total expenditures in the two provinces (Table 3). Expenditures on transport by all levels of government combined have grown faster than other expenditures. The expenditure data also indicate a very strong emphasis on road development, with 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. Are road building projects on a massive scale are the best use of available resources at this point? (See Box 5 on Intermodal Transport)

Table 3: Total Expenditures and Expenditures in the Transport Sector (Rp. billion)

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

Box 5: Modal Coordination and Intermodal Transport

To overcome the handicap of high transport costs both externally and internally, the result of geographic challenges and low population density, Papua and West Papua need to rely for each transport flow on the mode that is able to deliver 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 cost². 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

¹ Estimate based on the 2008 proposals by local governments for APBD expenditures on roads

² Some plan documents mention investment in railways. It should be clear, however, that except possibly for dedicated lines serving high volume mineral extraction, railway transport is not a viable option in Papua and West Papua. Railway lines, that are carrying much higher traffic volumes than can ever be expected in Papua and West Papua, are being closed all over the world because governments can no longer afford the annual subsidy payments. Even in the case of Java, which has among the best potential for railway transport in the world, given its level of urbanization, population density and spatial development, only passenger services are potentially economically and financially feasible while general freight services are loss making without any prospects for becoming viable.

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 that uses the most economical mode for each link, 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. When these elements are in place, an intermodal system can achieve efficient operations all along the transport chain and at each of the transfer points. Such intermodal efficiency will depend as well on regulatory policies that support rather than frustrate intermodal transportation.

Selection of the Most Economical Mode. Traditionally expenditure planning both at the national and local level has been focused on relatively small projects within a narrow modal mindset. Road planners plan roads; port planners plan ports; too few resources are devoted to choosing between river and road transport and on planning intermodal transitions. In the case of land transport the focus on heavy duty roads has led to neglect of another option: light-duty paths suitable for non-motorized and light motorized vehicles such as motorbikes. Such paths, which can be built at much lower cost than roads for 4-wheel vehicles, could still be constructed and maintained to be usable in all seasons. However, compartmentalization of transport planning seriously hampers consideration of modal options and coordination at the planning stage. Efforts at the national level to remedy this situation are frustrated by the fact that the country is too vast and conditions on the ground are too diverse for these efforts to have a chance to bear fruit. The issue is compounded 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. Even many planners for specific modes of transport fail to appreciate the importance of a modern multi-modal transport system that is well integrated both nationally and internationally. For most situations, proper intermodal coordination of facilities must be approached and studied at the regional/local level.

The lack of modal coordination in investments leads to duplication of capacity and to ineffective intermodal connections. This can occur at the inter-regional level (for example the construction of costly road connections along the coastline where for the foreseeable future the focus should be on improvement of coastal shipping), at the regional level and even at the very local level, where it should be easier to remedy. For example, there is evidence that in many instances communities that are already served by river transport are provided relatively costly road access while improved river transport would have been a much lower cost solution to meet their rising mobility expectations. More than this, building a road can have severe negative network effects on the river transport system by drawing traffic away from the river side and hence reducing the overall attractiveness of the river transport system for those communities that remain dependent on the river.

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 Rp. 100 – 500 million) often much less than even one kilometer of road, but in addition 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 and river ports and airports on the one hand and local distribution by heavy and light duty roads on the other - also 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. The port of Manokwari, which is receiving increasing numbers of containers, provides an illustration of the kind of issues that may arise. For example, it has been suggested that part of the port area that is currently being used as a makeshift container freight station would be converted to a parking area.

This raises the question of the optimal use of scarce waterfront land in the face of competing claims for space of a developing city and a growing port located in the city center. 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 be preferable from the point of view of transport efficiency to keep the container freight station within the port area so as to avoid costly hauling of containers in and out of the port, which in addition will contribute to traffic congestion and road damage in the inner city. Clearly, port planning from the point of view of transport efficiency needs to be done in concert with city master planning from the point of view of optimal development of the transportation system within the city and 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 facilities to ensure that fewer flights have to be 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 and walking. This is already being done in concept but requires careful analysis and great skill.

- assign a strong coordinating role to BAPPEDA/BP3D through the establishment of a single document that provides an overview of all transport investments in the 3-4 year rolling programs from all modes of transport and all levels of government;
- introduce the use of project management software at the level of both individual projects and programs to establish professionalism in identifying all the technical and administrative implementation steps;
- improve planning of maintenance activities for all transport modes. Begin with a full inventory of key infrastructure and facilities and their condition.

1.5. The Role of the Private Sector in Infrastructure Development

50. **Private industry has a big stake in infrastructure development in Papua and West Papua.** Access to “free” road use, subsidized electric power, good seaports and high-speed, good quality telecommunications transmission networks can greatly reduce the cost of private production, raising the profitability of private firms. For example, if a publicly financed road grid enabled delivery of cut logs to port, a far larger proportion of the USD 13,500 value of standing timber per hectare of forest could be retained by the firm that cuts the logs. On the other hand, 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.

51. **But the interests of private investors and of the general public are not 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 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.

52. **Potentially divergent interests can be reconciled through a clear division of responsibilities.** Private investors 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.

53. **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 will be 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. Annual registration taxes on vehicles 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.

54. **In summary, private users should pay for the infrastructure they use.** To ensure that investment schemes by mining and logging companies will only proceed when they are viable for the investors and will also be worthwhile from the point of view of the economy, the 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 life cycle and total system cost minimization in the design of the infrastructure. In respect of the use of existing infrastructure, it may require the investors to assume the cost of strengthening the infrastructure and/or to compensate for the cost of additional heavy wear and tear. Finally, if the infrastructure is to revert to the host country at the end of the concession, appropriate safeguards – in the form for example of bank guarantees - should be included in the concession agreement.

55. **Freeport Indonesia provides a useful case study** of private-public interactions in the construction and use of infrastructure (see Box 6, below)

56. **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 both incomes and population density are low, while delivery costs are high. 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. First, 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. Second, 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 6: 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 4000 meters; and built a 195MW coal-fired, 60 hertz 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 \$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 into the global economy. PTFI's program of work force development deserves to be reproduced wherever private firms exploit non-renewable resources.

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 use its technical expertise to help the Indonesian power authority develop plans for hydropower and commit itself to a long-term contract to purchase its 50-hertz 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 nearby 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, and to any new developer of extractive industries in Papua, is the explosive growth of urbanization. Early in this process, while opportunities are opening up, job seekers and ancillary service providers – from shop keepers to sex workers – will flock to the area. When the locomotive of extraction runs out of fuel, an economic crisis will follow.

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, but it also challenges policy makers in the private and public sectors to ask

whether it would be possible to extract non-renewable resources without such profound effects on migration.

Some employers include in their labor cost the transportation of workers to their home villages or to other dispersed and distant locations. Other magnets for migrants, such as offices where potential workers are interviewed and training institutions for new workers, 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 both should be willing to bear substantial costs to avoid this outcome.

Kabupaten

Local institutional capacity PTFI certainly is helping to build human capital in Papua. More ambiguous is its contribution to the development of local public institutions. When PTFI wants something, it does it itself or it finds a highly competent vendor. This delivers the goods and services in a timely and cost-effective manner, but it undercuts the development of local institutional capacity.

The resources available to local governments are substantial – decentralization has delivered more than Rp. 400 billion annually in additional revenue transfers from Jakarta to Mimika, the local kabupaten, since 2005 – yet 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 themselves out of the picture 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.

PTFI similarly needs to develop a strategy to reduce its administrative role in community development. 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* (LPMAM, 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.

As with its relations with local government, PTFI has not come to terms with the gap between its own efficient, results-oriented expectations and local culture. Thus, whether it manages its community development activities directly or does so through its NGO, LPMAM, its control system is essentially, top-down.

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.

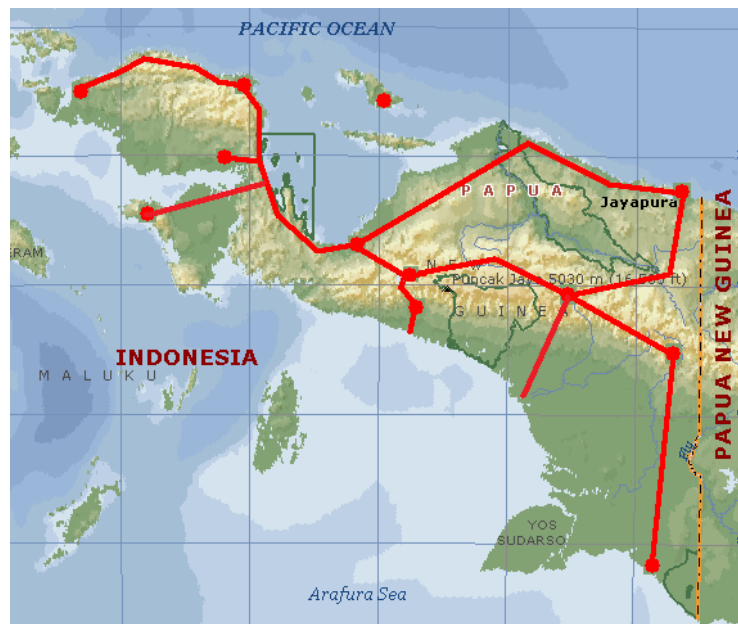
1.6. A Long Run Vision for Development of Papua and West Papua

57. **Papua and West Papua must develop.** In the future, a road grid, a power grid, and a combination of fiber-optic and next-generation satellite transmission networks will cover Papua and West Papua. Power will be generated mostly from local resources – hydro, gas, and coal. Every household will have piped, potable water, and waste will be disposed of sustainably. Every part of the region will produce goods and services for export to the rest of the world, and the citizens of Papua and West Papua, too, will be as educated, healthy, and economically productive as citizens of every part of Indonesia or, indeed, of the world.

1.6.1. Fishbone infrastructure network

58. **One vision of development foresees great advances on all fronts.** This vision underlies the ambition to build a huge road network, as soon as possible, to connect all the major towns of Papua and West Papua. The image below illustrates an example of this “fishbone” vision, with a backbone network stretching from one end of the island to the other with arterial networks linking the coast to the highland.

Figure 7: Fishbone Vision of Development for Papua and West Papua

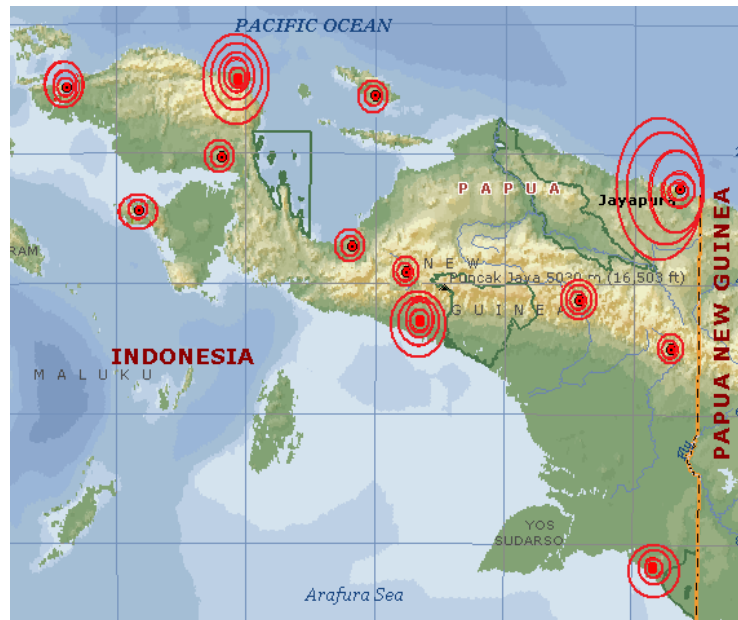


59. **The fishbone vision makes sense for the long run** (although perhaps some of the specific road connections illustrated below never will make economic sense compared to waterborne transport). But several barriers make it infeasible in the shorter run. First, population density is too low to justify such a huge grid. Second, construction and maintenance costs make this vision financially infeasible under current conditions. Third, 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.

1.6.2. Oil-spot infrastructure network

60. **The oil-spot vision foresees growth expanding from current centers of activity.** The short and medium run goal must be to expand development from existing and future growth poles, by adding infrastructure that serves each area and its hinterland. Just as spots of oil spread on water, 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 8: Oil-Spots Vision of Development for Papua and West Papua



61. **Oil-spot development will lead, one step at a time, toward full development.** There is value in planning for the fishbone. Development in and between oil-spots should proceed within provincial and national spatial plans. Master plans for transportation should set out the intended final network (and they should be updated continuously to reflect new realities). At present, given that such master plans do not exist and without sufficient project appraisal, it is too soon to predict when and where interconnections among oil 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 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.

62. **Expansion of oil-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 Enotaroli, and then Nabire;
- a road between Merauke and Oksibil, or between Bintuni and Manokwari, may become justified as the prospect of traffic increases.
- 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.

63. **Today, 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 motorcycle path 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.

64. **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, it should be recognized that successful economic development and integration of the highlands is not necessarily contingent 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. The question remains, however, where and when it will be opportune to establish road connections between the highlands and the other regions of Papua and West Papua.

65. **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, all for a capital cost of about USD12,500 per installation. The cost of communication satellite services is relatively expensive – beginning at about USD 500 per month for a low bandwidth that could serve many simultaneous telephone calls, but only a few computers – but it will be possible to connect most of the country to the global telecommunication network at a modest cost. At the coast, telecommunication connection through fiber optic cable should be accessible in only a few years, and the interior of Papua and West Papua will be able to connect to these cable access points through microwave. Enhanced access to telecommunications throughout Papua and West Papua will permit distance learning, medical consultation, banking services, and other services that can substantially improve opportunities for isolated populations, as well as contact with family members far away.

66. **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 oil spots grow larger – adding infrastructure every year and maintaining existing infrastructure – connections will be expanded and deepened.

1.7. A Phased Strategy

67. **A number of concrete recommendations follow directly from the foregoing analysis.**

- Use the next few years to focus on rehabilitation and maintenance of existing infrastructure

- Use the next few years to produce coordinated spatial plans and master plans for transportation, power generation, water and sanitation, and telecommunication.
- Use the next few years to 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.
- Use the next few years to 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.

68. **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.

69. **It is possible to paint a general picture of the future.** 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.

1.7.1. Transportation

70. **Focus on multiple transport modes.** Roads that carry heavy vehicles are 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.

71. **Light duty roads deserve evaluation.** 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 good and passengers as well as the drivers.

72. **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.

73. **Institutional change must support multimodal transportation.** In order to develop an effective multimodal transportation system, supporting institutions must be developed at the same time. These include alignment of responsibilities for regulation and maintenance among the different levels of government with financial and institutional capacity to assume such responsibilities. The level of government responsible for training workers to perform administrative, operating, and maintenance duties, as well as government support for the development of private sector firms that build and repair essential equipment such as ships and motorcycles converted to goods transport should be determined based on financial and institutional capacity to perform these roles.

1.7.2. Power.

74. **Low cost power can spur development in Papua and West Papua.** 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. (Freeport Indonesia runs a large coal fired plant for its own use.) 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.

75. **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 very 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.

76. **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.

77. **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, as there will be no extensive power 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.

1.7.3. Water and Sanitation.

78. **Water is available, but not piped and treated water.** 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.

79. **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, Rp. 2.5 trillion (at 2008 prices). 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 the single year 2008.

80. **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.

81. **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 (Rp. 500 billion) it would be possible to provide eight towns with sewage sludge treatment plants and to install a piped sewage system in Jayapura.

82. **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 with only a small proportion of the money that will be flowing to Papua and West Papua. 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 also includes the construction of a piped sewage system for Jayapura. With Jayapura as the model city, improvement of water and sanitation could be a dramatic example of the commitment of the governments of Papua and West Papua to infrastructure investment and improved management.

83. **Operation and maintenance will be costly.** 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 (Rp. 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.

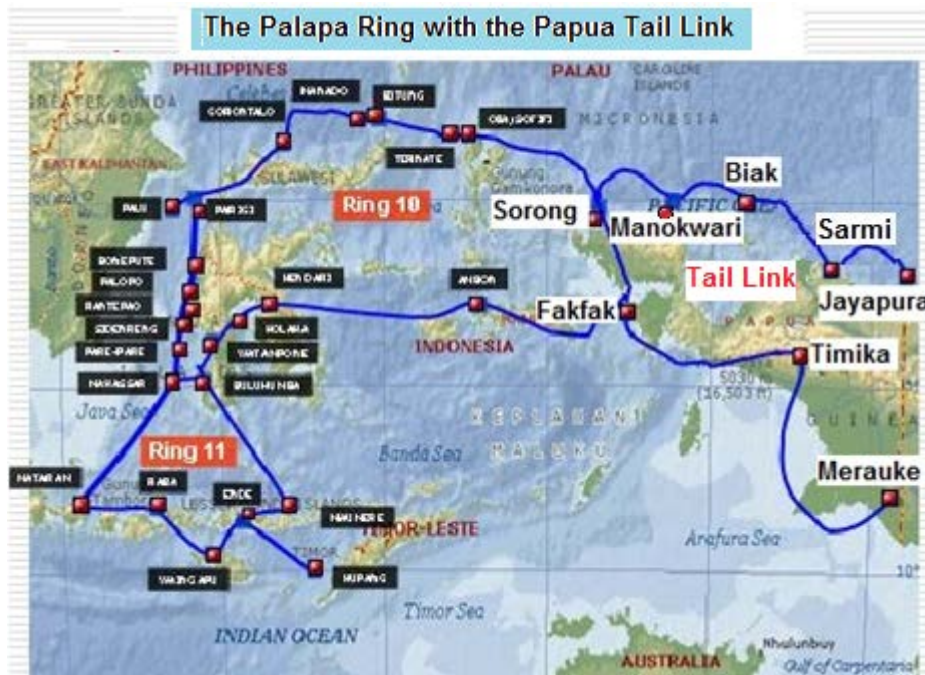
1.7.4. Telecommunications.

84. **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, but 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.

85. **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.

86. **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 which is scheduled for completion in the next few years. A so-called “tail link” could extend this cable to Manokwari, Biak, Sarmi, Jayapura, Fakfak, Timika and Merauke for a capital cost of about \$150 million (Rp. 1.5 trillion). The map below illustrates one version of this plan.

Figure 9: Proposed Palapa Ring Fiber-Optic Network



87. **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.

88. **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 (Rp. 125 million) per site.

89. **Investment in telecommunications is relatively low cost.** 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 telephone connections is about 125 kilometers of good road.

1.7.5. Community Development.

90. **PNPM-RESPEK brings community involvement to infrastructure development.** Infrastructure investment is not normally considered a near relative of community development. But in Papua and West Papua, community development programs, notably PNPM-RESPEK, can play a vital role in the infrastructure development strategy. Some investment funds are channeled directly through PNPM-RESPEK, which provides each village with an annual grant that it must allocate to some development project. Though the resources involved are small, the PNPM-RESPEK program can develop essential concepts and skills of investment planning and

asset management. For example, PNPM-RESPEK could teach the importance and the techniques of maintenance of infrastructure assets (although it does not do so now).

91. **Communities can contribute to operation and maintenance.** 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.

92. **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: 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 7: 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. Again, heavy seasonal rainfall, steep terrain, and fragile soils have led to deterioration of interior roads, which quickly have become barely passable tracks, or worse.

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, apart from Freeport, very little mining or forestry takes place in the Highlands, to say nothing of manufacturing.

For all its economic costs, the remoteness of the Papuan highlands has meant that indigenous communities have been exposed at a relatively slower pace to pressure for change than would occur with mass inward migration. 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. More certain is the frighteningly rapid spread of HIV-AIDS into highland communities.

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. Given results in Sumatra and Kalimantan, it is likely that roads into the interior of Papua and West Papua will serve to export the non-renewable resources while simultaneously enabling rapid immigration of new residents. In the interior of Papua and West Papua as at the coasts, the indigenous population could be marginalized economically, socially, and politically, their traditional livelihoods destroyed and their numbers overwhelmed by immigrants. Furthermore, 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.

The physical challenges to building and maintaining decent roads in the punishing meteorological and geological conditions of the highlands, combined with the low level of inter-highland trade and 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.

A number of the benefits of roads can be approximated, at lower risk and lower cost, with improvements in power and communication infrastructure. Small scale power, through micro-hydro or solar/battery facilities, combined with satellite-based telecommunication would 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 as well as budgeting for recurrent costs, so that the operation and maintenance of new capital is ensured. Problems in operation and maintenance will arise and must be accounted for in the investment plan.

Priorities for Coordinated Investment in Highland Communities

Specific details concerning a particular road, power facility, or telecommunication installation should be part of an integrated highland infrastructure master plan combined with project appraisal.

Transport infrastructure investment is likely to focus on improving the air traffic system. Air travel will be the backbone of the highland-wide transport system for some years. Therefore, enabling safe and reliable services should be a high priority. Furthermore, the region has relatively many experienced air traffic professionals (including missionary pilots), an important resource which is not usually present in a remote, developing economy. These skilled people may be useful in training a new generation of air transport professionals. Alternative transport modalities should be investigated in a cost-benefit framework that considers environmental and social, as well as financial and economic, consequences of various transport options. Smooth transitions from waterborne to air to road transport modes must be incorporated into the planning exercise. Light duty roads (for two wheeled vehicles) should be considered as an alternative to heavy duty roads.

Electricity provision is likely to include a large component that is based on hydro-power. While one or more major hydro electric project may pass muster, most of the highlands will have to be served by dispersed, small scale hydro and solar/battery generating capacity. Investment in other infrastructure, including communications capacity and public buildings, should be planned together with power infrastructure to minimize transmission costs and losses.

Telecommunications infrastructure is likely to be based on satellite technologies (probably based on the low-cost, low-power satellite technology), and should be made far more widely available across the Papuan highlands. This should be coupled with a program to provide computer hardware to rural administrative centers and schools. As with all infrastructure investment, operation and maintenance personnel must be trained or arranged for together with the initial investment.

Box 8: Community Driven Infrastructure Investment

Community-driven micro-infrastructure investment is increasingly significant throughout Papua and West Papua, but it is particularly important in remote highland areas, which most development programs fail to reach. 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 (Rp. 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.³

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. Small infrastructure development plans under PNPM-RESPEK must not be orphaned because they have been ignored in government plans. 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

³ These figures were obtained from the program's Management Information System for the period 2002-2006. Data for the period 1998 - 2002 has been lost, and 2007 and 2008 data is not yet complete.

engineers from outside. This shortage has now been largely addressed, however, 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 100 million Rupiah per village, regardless of the level of remoteness or the local cost of materials. In the central highlands, where a sack of cement can cost up to 1.5 million Rupiah, 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 40 million to 300 million Rupiah per village on top of the 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 500 million Rupiah 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.

The program is also starting to move away from the traditional infrastructure focus. PNPM-RESPEK retains KDP's open menu, but the Papua and West Papua provincial governments have articulated the five priority areas mentioned above. Complete data for PNPM-RESPEK activities in 2008 is not yet available, but the current data suggests that the proportion of infrastructure activities will have decreased substantially compared to KDP in previous years. There are several possible explanations for this apparent trend. The prohibitively high cost of materials is certainly a factor, but the shift also reflects community preferences, and may be partly due to the provincial governments' emphasis on the four other priority areas. Given the pressing human development needs and the paucity of basic health and education facilities in highland villages, this diversification into non-infrastructure projects is appropriate and stands to make an important contribution.

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.

1.8. Conclusion

93. 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."

94. 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 in Switzerland and Singapore?

95. Infrastructure in Papua and West Papua should be developed carefully. Projects must be coordinated 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 governments of Papua and West Papua must move along the road to development rapidly, but one step at a time.

Sectoral Challenges Facing Papua and West Papua

2 Roads and Road Transport

2.1. Current Status of Sector

2.1.1. Road Network and Condition

96. **Papua and West Papua have high road density per capita, but low density per unit area.** Based on provincial data, the Papua Province network was 16,899 km in length in 2006 including some 13,489 km of Kabupaten roads while in West Papua the network was 5,184 km in length in 2007 of which 3,882 Kabupaten roads (Table 4 and Table 5). In addition, there are village roads which are estimated to total about half that of Kabupaten roads, or some 7,500 km. Table 6 shows the length of the Papua and West Papua road system in 2006 based on data from Bina Marga and consolidated data from the two provinces for 2006/07⁴. Assuming a road network of 20,000 km⁵ at end 2008, when related to population, this gives a road density of 6.7 km per 1000 people, which is well above the average for Indonesia (1.3) and other Asian countries. However, road density in terms of total land area at 47.6 km per 1000 km² is well below the average for Indonesia (174) and most other Asian countries.

Table 4: Road Network - Papua Province (km)

year	Administrative Class			Surface type				Total
	National	Provincial	Kabupaten	Asphalt	Gravel	Earth	No Data	
2004	267	576	2,029					2872
2005								
2006	1848	1562	13489	3222	4457	6131	3089	16899
2007								

Source: Papua in Figures

Table 5: Road Network - West Papua Province (km)

year	Administrative Class			Surface type				Total
	National	Provincial	Kabupaten	Asphalt	Gravel	Earth	No Data	
2004								
2005	345	487	1115					1947
2006	345	488	1122					1955
2007	616	686	3882	1137	2226	1804	17	5184
2008								

Source: West Papua in Figures

97. **Road network management is complicated by poor intra-governmental coordination and low capacity.** During the past 15 years the central and local Papua and West Papua governments have placed great emphasis on extending the size of the road networks for which they have responsibility. Data on the road network by administrative class have been in a state of flux in recent years following new construction and changes in administrative status⁶.

⁴ Some proportion of these roads, in particular Kabupaten roads, may not be in use because of impassable sections.

⁵ Based on data in Table 4, Table 5, Table 6 and staff estimates

⁶ Based on Bina Marga data, the following changes occurred in the length of the road network between 2000 and 2006: nationwide, national roads increased from 26,271 km to 34,629 km, provincial roads decreased from 46,032 km to 33,612 km, and district roads increased from 223,318 km to 249,080 km. In

98. Three levels of government are involved in the management of the road network (see Table 4 and Table 5). The Kabupaten are responsible for the larger part of the network and this places a heavy burden on their managerial capabilities as they do not have sufficient qualified and experienced staff nor streamlined operational procedures for the task at hand.

99. **Percentage of paved roads is low compared to the rest of Indonesia.** Based on the provincial data some 4,350 km or 22% are paved (asphalt surface) while 15,650 km or 78 % are unpaved roads (gravel and earth surface). This indicates that the percentage of paved roads is below the average for Indonesia (55%) and most other regions of the world.

Table 6: Road Network (km)

Year	Administrative Class			Surface type				Total
	National	Provincial	Kabupaten	Asphalt	Gravel	Earth	No Data	
2006*	2,303	1,210	12,438					15,951
2006/2007**	2,464	2,248	17,371	4,359	6,683	7,935	3,106	22,083

* Bina Marga data, ** Provincial data

100. **Data are inconsistent for road quality; however, the situation does not look good.** Available information on the condition of the Papua and West Papua road network is not conclusive. Data for a subset of 9,358 km of roads in Papua Province (Table 7) indicate that 31 % of the roads are in good condition while 41% are in bad condition. For West Papua Province, condition data for a subset of 964 km of national and provincial roads indicate that 22% are in good condition and 57% in poor and bad condition. The Indonesian Road Management System (IRMS) which has a nationwide database for national and provincial roads also provides information on road condition. The most recent information is for the year 2004 and relate to a total of 3,011 km of road covering both Papua and West Papua provinces. These data on road condition would suggest that if the subsets of data for Papua and West Papua are fully representative there would not be a significant difference between the road condition in Papua/West Papua and the average for Indonesia. On the other hand, data for the year 2006 prepared by Bina Program, suggest that the condition of the Papua and West Papua road network is significantly below the average for Indonesia: 70 % of the roads are in poor or bad condition compared to 49 % for Indonesia as a whole. Furthermore, data from the same source for national roads for the period 2000 – 2006 indicate that on average 15 % of national roads were in poor to bad condition in the country as a whole whereas the percentage for Papua and West Papua was 55%.

Papua and West Papua national roads increased from 1,702 to 2,303 km, provincial roads decreased from 1,873 km to 1,210 km, and Kabupaten roads increased from 9,140 km to 12,438 km.

Table 7: Condition of the Road Network

Data Source	Road Length (km)			Condition (%)					
	National	Provincial	Kabupaten	Good	Fair	Poor	Bad	No Data	Total
IRMS 2004 Indonesia	26,828	45,519		29	52	11	2	6	100
IRMS 2004 PWP	1706	1305		24	63	10	0	3	100
Papua Subset	1411	1298	6650	31		28	41		100
W Papua Subset		964		22	21	25	32		100
Bina Program Indonesia 2006	34,506	33,612	249,080	22	29	31	18		100
Bina Program PWP 2006	2,303	1,211	12,438	12	18	28	42		100

101. Qualitative data suggest that there is a higher incidence of early road failures than in other regions of Indonesia and most of the world. This appears to be caused by a combination of several factors including: engineering designs that are not appropriate for the difficult terrain and soil conditions; resulting cost estimates and budgets that are inadequate; poor construction quality and construction supervision the impact of which is subsequently compounded by inadequate maintenance.

2.1.2. Major Challenges to Road Development in Papua and West Papua

102. **Much of the soils of Papua and West Papua are difficult to build on.** In regard to topography and soils it is noteworthy that almost 25 % of the total land area is covered with mangrove, swampy forest and swampy shrub; this accounts for the fact that about 22 % of the land area is comprised of peat soils (also referred to as histosols). In addition, more than a quarter of the land area is estimated to be made up of entisols which are very young soils occurring mainly on recent alluvium or on steep slopes where soil erosion takes place, or on coastal deposits. The prevalence of these soil conditions combined with the topography of the terrain and the heavy rainfall suggest that there is a higher incidence of very fragile soils than in the rest of Indonesia and most other parts of the world. This characteristic of the soils clearly has important implications for the selection of road building corridors and on road building costs.

103. **Construction quality is poor due, in part, to weak contracting industry.** In addition to the issues mentioned above, poor construction quality is in part caused by weaknesses of the contracting industry. But the industry itself is faced by several issues which constrain its development and which among other result in significantly higher costs for road works in Papua and West Papua than in the rest of Indonesia, estimated to be on the order of 35%⁷. These issues include: (i) the high costs of inputs in general, a factor which is exacerbated in the highlands where the cost of some inputs can be a multiple of that in the coastal ports; (ii) delays in payments which affect the contractors' cash flow; and his ability to fully utilize his resources (iii) the relatively small size of most contracts which impacts the ability of the contractor to bring expensive, but more efficient, equipment to the work site.

104. **Traffic volumes are very low, meaning roads have low economic rates of return.** The fleet of passenger cars, trucks and buses of Papua and West Papua totaled some 59,333

⁷ Under the World Bank EIRTP project, costs of road rehabilitation works in Papua and West Papua were estimated to be 36% higher than in other parts of Eastern Indonesia, while for betterment works costs in Papua and West Papua were found to be 40% higher.

units in 2006/7 (Table 8) with over half of the vehicles in the truck and bus category which is an indication that the economy is at an early stage of development. Motorization is still low at 19.8 vehicles per 1000 of population compared to 43.9 for Indonesia as a whole. In terms of vehicles per km of road, at a level of 3, motorization is also very low compared to the average for Indonesia, which was 24.6.

Table 8: Number of Motor Vehicles by Type

	Cars	Trucks	Buses	Sub-Total	Motorcycles	Total
Papua 06	21,577	11,827	14,371	47,769	195,485	243,254
W Papua 07	5,228	4,127	2,149	11,564	58,756	70,320
Total PWP	26,865	15,948	16,520	59,333	254,241	313,574

105. As can be expected from the above figures on the vehicle fleet, average traffic levels on the Papua and West Papua roads remain low compared to other regions of Indonesia. But there are huge differences between the different parts of the network. Traffic levels on the main roads in the urban and sub-urban areas of the larger cities are in a range of 5,000 – 10,000 vehicles/day and in a range of 1,000 to 5,000 in a second tier of cities. On roads in the rural areas traffic levels are estimated to be in a range of 10 -150 vehicles/day.

2.2. Past expenditures

Table 9: Expenditures in Roads and Road Transport (Rp. Billion)

		2004	2005	2006	2007
Total Public Works Expenditures	APBD	520	1,115	2,737	4,031
	Share Roads ⁸	0.7	0.7	0.7	0.70
Roads Expenditures under Public Works	APBD	364	781	1,916	2,821
	Central Govt	241	278	418	478
	Total	605	1,058	2,333	3,299
Rd Transport & Traffic Expenditures by MOT	APBD ⁹	11	15	22	83
	Central Govt	21	21	25	56
	Total	33	35	47	138

Source: Based on MOF data

106. **Estimated Papua and West Papua expenditures on road works experienced a strong increase in 2006 and 2007** reaching almost Rp. 3 trillion. Expenditures were mainly directed at expanding the size of the road network. The increased allocations to road works do not appear to have been matched by improvement in road condition.

107. **Contracts are often small, not permitting economies of scale.** Information at the project level indicates that road works are implemented on the basis of a large number of small contracts executed in parallel. This approach results in a significant loss in benefits compared to an alternative where projects are prioritized and then implemented sequentially through larger contracts and at a faster pace.

⁸ Estimate based on the 2008 proposals by local governments for APBD expenditures on roads

⁹ Estimate based on the 2008 proposals by local governments for APBD expenditures on road transport and traffic

108. **Maintenance budget is far below what is required and is not managed well.** The available aggregate data do not permit to separate out the funds allocated to road maintenance, but information provided by staff at various levels indicates that maintenance expenditures, in particular routine maintenance, have been substantially below requirements. An allocation of Rp 1 million per km is reported to be provided whereas an adequate level would be on the order of Rp.25 million. In addition, the execution of routine maintenance works is generally well below good practice standards and this is the result of several systemic factors which are present with varying degrees of seriousness in most regions in Indonesia. These include:

- **Maintenance generally has a low profile** within the activities of the central and regional road agencies, this being related to the traditional low funding levels and an image of being a “low tech” activity
- **A curative rather than a preventative approach to maintenance is taken.**
- **An ad-hoc approach as opposed to a systematic approach** spread over the year and covering the whole network. For example, routine maintenance activities are generally included as part of periodic maintenance or betterment contracts on adjacent road sections. Under this approach, which certainly has merits, maintenance may not receive the highest attention of the contractor and supervision consultant and will cease when the main contract works are completed.
- **Late release of budgetary funds** which often results in funds lacking when the requirement is the greatest or the potential impact of timely intervention is the most significant.

2.3. Existing Plans for the Future

109. **Due to the planning cycle, there are no current formal multi-year plans.** Owing to the nature of the GOI planning cycle and planning and budgeting procedures, at this point in time there is no formal multi-year road expenditure plan covering all road networks and all categories of works. This notwithstanding, road investment plans and proposed project lists with associated indicative implementation timetables are prepared periodically. These plans, however, are not the outcome of detailed analysis and evaluation aimed at identifying the most worthwhile investments and developing well justified expenditure programs, mainly because of inadequate planning and evaluation resources, both in terms of staffing and funding,

2.3.1. Trans-Papua Links.

110. The proposed Trans-Papua highway include the following: road links along the northern coastline, connecting Jayapura via Sarmi and Waren to Nabire and from there on to Manokwari and Sorong; a southern loop from Sorong via Bintuni to Manokwari; road links to connect Jayapura via Nimbotong, Lereh to Wamena and from there on to Mulia, Enarotali and Nabire; a connection from Merauke to Tanah Merah, and then via Oksibil and Ubrub to Jayapura.

111. **These are very ambitious investments, the justification and timing of which requires careful consideration.** Before embarking on a major road building program it is indeed best practice to prepare early on a road master plan to guide the development of the road network and the transport system as a whole in the long term. The critical inputs to such master plan are:

- the spatial or macro-zoning plan of the territory;

- the predicted development of the economy in terms of centers of economic activity and associated transport demand;
- the geographical constraints on account of areas that have been designated as protected;
- environmental and social factors both during construction and afterwards in terms of impact on forests, natural resources and the habitat; and
- geotechnical and soils conditions¹⁰.

112. **Planning will help identify which sections should be built, and when.** The structure of the road network should be planned taking these factors into account and with the aim of achieving maximum efficiency of the transport system in serving the needs of the economy and the major settlements reserving the right of way in the corridors where roads will be built at some point in the future. Once the road master plan has been professionally designed, it will allow building individual sections on the basis of a stage construction approach by gradually filling in the priority sections as these become economically justified.

113. **It is critical to build roads only as traffic warrants and should be weighed against sea and air modes.** In the absence of such prior study work, it is inevitable that road sections will be built that will later prove not to be part of a rational network and such investments will be a drain on Papua and West Papua resources. If the main long term goal of the Trans-Papua road investments is to link major centers of activity, then it is critical that sea and air transport alternatives are carefully considered as such alternatives will in most cases provide a lower cost alternative for current cargo flows and cargo flows to be expected in the foreseeable future.

114. **Any road master plan must be part of a broader multi-modal strategy for both provinces.** Given the need for a multimodal approach in Papua and West Papua, ideally a road master plan study would be part of an integrated transport system development study which encompasses all modes of transport and maps out the development of the various modes as transport demand increases.

2.3.2. Road Links to Provide Access to the Highlands.

115. **Due to the complexity of the issues, a separate Highlands transport master plan is justified.** Various road links are put forward to provide access to the Highlands from the coastal centers, including: Jayapura – Nimbotong - Lereh – Wamena; Nabire – Enarotali; Oksibil – Dekai – Wamena; Timika – Enarotali; Timika – Mulia. Some of these links are a subset of a Trans-Papua arterial road network but because such links entail a number of more complicated issues a separate master plan analysis focusing on Highland access would be justified. The special issues include the following:

- several route alternatives are already being pursued and it is not economically justified nor financially feasible to implement several alternatives simultaneously;
- the very high cost of building a road through mountainous terrain and generally fragile soils (see above);

¹⁰ Particular caution should be exercised in areas featuring peat soils (covering about a fifth of the territory and a much higher proportion in certain regions), in mountainous terrain and in areas covered with fragile soils (also accounting for about a fifth of the territory)

- each of these alternatives cause varying and significant environmental impacts the mitigation of which compounds the high costs,
- each alternative has different implications for the associated road network requirements to serve the main communities in the highlands region proper; and
- the alternatives have different implications for the Trans-Papua links discussed above; and (vi) air and river transport will continue to play a role in providing access.

116. It follows that the question of access to the highlands needs to be framed in terms of identifying an economically and financially viable staging of strategic road investments over the long term.

2.3.3. Road Works to Improve Access to Remote Communities.

117. **Connecting remote communities is not a purely economic exercise.** Because of their nature these works are seldom justified on grounds of purely traffic volumes or increased economic activity and associated economic benefits. But improved transport access for these communities has many less tangible benefits which are highly valued by society. These include in particular better access to basic services such as education, health, agricultural extension as well as to safe water and agricultural inputs. Also, evidence from around the world indicates that there is a link between transport improvement and poverty reduction.

118. **Yet the cost/benefit analysis of the different modes should be conducted: sea, river, air, and even light vehicle tracks.** In the case of Papua and West Papua, improvement in access is not necessarily always a matter of road connections, as many communities can be better served through improvements in air connections and improvements in coastal shipping or river navigation. When land connections are the only option, the challenge is to identify the most cost effective design and construction alternative. For access to very small communities and relatively short distances, improved paths suitable for non-motorized and light motorized vehicles will be an alternative to be considered. These have already been built under the KDP program in other parts of Indonesia. The focus of the works would be on river crossings, steep slopes, and improvements in otherwise difficult terrain conditions. For implementation priority should be given to community participation, learning from and building upon the experience in other regions with such works.

2.4. Assessment.

119. **Current plans do not bode well in Papua and West Papua.** In broad terms, the (indicatively) planned expenditures exhibit two main issues: (i) a lack of balance in the road expenditure program between road preservation and road network expansion; and (ii) a drive for rapid expansion of the road network without the benefit of appropriate master plan, network, feasibility and engineering studies. Such expenditure policies will likely result in allocation of scarce resources to roads that do not serve transport demand nor any other clear purpose while resulting in high road rehabilitation and reconstruction costs. This will not only present an economic loss for the central, provinces and kabupaten/kota governments but, when pursued on a large scale, will create a financially unsustainable situation.

2.4.1. Sustainability of the Road Expenditure Program.

120. Rapid expansion of the road network while existing road assets are poorly maintained not only raises the issue of economic viability of each of the sections but also the question of the financial sustainability of the endeavor as a whole. Financial sustainability can be considered from different angles.

121. **Papua and West Papua have a high ratio of road assets to regional GDP.** An indicator of sustainability is the value of road assets compared to regional GDP. Based on international comparison, a ratio in the range of 0.2 - 0.4 is considered the right balance between the size of the economy and the demand for road assets. For Indonesia the ratio was 0.31 in 2004. For Papua and West Papua the road asset value is estimated at Rp. 29 trillion¹¹, which is high when compared to regional GDP at Rp. 55.4 Trillion, or a ratio of 0.53. In the case of Papua and West Papua where mining has so far been an enclave activity which does not rely on the public road network for its activities it would be appropriate to exclude mining from the GDP value for this comparison. Thus, when mining is excluded, the regional GDP is Rp 17.5 Trillion and the ratio rises to 1.65.

122. **Vehicles and population per road kilometer are also low.** The above comparison advocating caution in the pace of new road construction is underscored by other indicators casting doubt on the sustainability of a rapid expansion of the road network. Road density at 6.7 km per 1000 people is already very high in Papua and West Papua (compared to an average of 1.3 for Indonesia as a whole). In addition, the vehicle fleet amounting to some 60,000 units (excluding motorcycles) is small when compared to the size of the road network again suggesting that an emphasis on network expansion as part of Trans-Papua links as opposed to consolidation of existing road assets is premature. As pointed out in the chapter on the Road Transport System of Papua and West Papua, the transport cost of cargo by road between Jayapura and Manokwari would be significantly higher than by sea if the full cost of both road infrastructure and trucking were to be charged.

123. **These facts indicate that the existing road network in Papua and West Papua is stretching available resources.** When these macro factors are considered together with the fact that a legacy of poor construction quality and insufficient maintenance is placing an additional burden on the upkeep of the assets owing to the huge requirement for road rehabilitation (see above simulation on best practice policies versus poor practice and the estimate of road maintenance and rehabilitation requirements) it is apparent that the size of the existing network will be seriously stretching the resources of Papua and West Papua and may not be sustainable. For the near term the aim should be to define a network that serves the growth of existing activities and to stabilize this network to a condition that is maintainable. From this base the network can be expanded in accordance with the above outlined approach.

Box 9: Roads and Illegal Logging

There is evidence from Indonesia and other parts of the world suggesting that roads have played an important role in facilitating illegal logging activities, which in turn often result in permanent deforestation. While roads are no doubt only one of the many factors in the dynamic leading to illegal logging and deforestation, well designed road development policies can be an important tool

¹¹ Maximum asset value based on optimal road condition. Using current road condition the asset value is estimated at Rp. 16 trillion

in a government's tool box for preventing or controlling illegal logging and associated adverse consequences. From this perspective, the contribution from the road sector to better management of logging activities has three dimensions.

The first part of an effective policy approach is at the level of the principles. It requires that a clear distinction be made from the conceptual and funding point of view between roads that serve industrial scale logging activities and public roads that serve general economic activities. The former consist of two kinds: the logging roads within the logging concession and the roads off-concession to get the logs or timber to the nearest processing facility or port. These off-concession roads are the ones of interest here, and while they may or may not coincide with existing public roads they are part of an industrial process for which public funds should bear no responsibility. If at the start of a concession there is no existing public road then the principle should be that the logging operation assumes full financial responsibility for that road (of course always in full compliance with government safeguard policies). If on the other hand there is an existing road then in an economy such as Papua and West Papua the logging transport will likely become the major user of the road and the major cause of its deterioration. Hence, the logging activity should also assume financial responsibility for maintenance, rehabilitation and reconstruction of that existing road. This principle will ensure that the local government will not subsidize logging activities that would normally not be economically viable.

The second element of an effective approach is at the level of road planning and road designation. The instruments are: (i) the arterial road master plan (or strategic or Trans-Papua Road Plan) defining the main road corridors; and (ii) the detailed network plan following on from the master plan. The master plan is developed in full agreement with the spatial plan which respects protected areas and incorporates potential environmental and social impacts. The more detailed road network plan encompasses all administrative road classes and functional road categories. Under the road network plan, planning for public roads and planning of evacuation roads for approved logging activities proceed from different objectives and parameters and will result in the selection of different road corridors, route alignments and design standards.

Under a policy where logging activities should be financially responsible for their own transport infrastructure, logging companies, owing to the economics of logging, are unlikely to be interested in logging in areas that are far removed from potential coastal or river ports. Also, the evacuation routes that they are interested in for transport from their concessions to these ports will in most cases not be of great interest to the rest of the economy. Clearly, under such a policy regime, roads that are of interest to industrial logging activities (which in Papua and West Papua would be almost exclusively for export) will not extend far from the ports from where the product is being shipped. Thus, in recognition of the inherent diverging interests of logging companies and the general economy it would not be appropriate to delegate roads planning and road building to logging interests.

There may or will in some areas be an overlap between the roads recommended for general public use and roads required for logging schemes that form part of a bona fide government development program involving logging. When this is the case, a decision has to be made as to which party (government or logging company) should have prime responsibility for the road based on its use by the logging activity and the public respectively, and appropriate agreements need to be put in place between the parties for compensating the other party for the use of the road and the wear and tear costs incurred.

The value that logging interests attach to the forestry resources in a particular area will be reflected in their competitive bid for the concession rights. The associated royalty income flowing to government can then be used more effectively for road building serving the wider community or for other pursuits of interest to the affected communities.

The third element is at the level of implementation to ensure that only roads – whether public roads

or off- concession logging roads - that have been properly evaluated and designed in accordance with the above principles and plans will be built. The mechanism to ensure this is the approval/vetting authority assigned to the provincial BAPPEDA/BP3D of the annual and medium term road works programs covering all functional classes and categories of roads. This should ensure that roads that are to serve logging activities will only proceed if they are approved at the level of the BAPPEDA/BP3D.

Under such a policy regime, there no doubt remains a risk of illegal logging and mainly in the areas where legal logging takes place. This of course needs to be controlled with other instruments that government has at its disposal. Approval of sawmill capacity in line with logging concession agreements and surveillance and monitoring of sawmill activity and logs transport (by specially plated and approved vehicles) will no doubt be part of such instruments.

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Road Building in Exchange for Logging Concession

Private sector parties have made proposals to build roads in exchange for wide ranging logging concessions. The discussion of roads and illegal logging has underlined that there is seldom a congruence of the infrastructure needs of industrial scale logging companies and the infrastructure needs of the wider economy. The onus will have to be on the promoter to demonstrate that his needs coincide with the needs of the economy. In most cases this will be very difficult. Also, there is no basis for crediting loggers with the technical expertise and experience to build sustainable roads. That is not their core expertise. Professional private sector road construction companies can be employed to build sustainable roads. The loggers can build logging roads and should do in compliance with safeguard policies.

If there is value for the private sector in having a logging concession, then the government should mobilize that value in the form of royalty and tax payments through the bidding for the concession and not through commitments to build infrastructure. There is no way that the value of such commitments can be assessed by government. And the private loggers have no way of knowing in advance how much their commitment will cost them. With the income generated under the concession government can employ specialized private sector road construction firms to build the infrastructure that will serve the needs of the wider economy.

2.5. Recommendations

2.5.1. Increase Resources for Planning and Evaluation.

124. **Investments in planning and evaluation have big payoffs.** When the costs of road master planning, project evaluation and engineering studies are compared to the above mentioned benefits it is clear that they have a very high rate of return. In addition to an across the board increase in resources for planning and evaluation as discussed above, a number of

focused planning studies merit early attention. The study of road access to the highlands is a case in point.

125. **A definitive strategy to link the highlands should be undertaken before further road work proceeds.** To clarify the question on how to proceed, a comprehensive master plan study to recommend on a staged approach for providing road access to the highlands should be carried out. In view of the implications of such a master plan for Trans-Papua links (see above) this study would preferably also have to recommend on the location of corridors as part of the relevant regional component of a Papua and West Papua wide road master plan. Given that the cargo flows to and from the highlands can continue to be managed with air transport for the foreseeable future, there is ample time to carry out the indispensable study work.

2.5.2. Road Network Development in Exchange for Logging Concession

126. **A commitment by a logging company to road network development in exchange for logging rights is a bad public/private partnership model** and government should not entertain such proposals (see Box 9: Roads and Illegal Logging for further information. If there is value for the private sector in having a logging concession, then Government should mobilize that value in royalty payments through the bidding and not through promises to build roads. There is no way that the value of such commitments can be accurately assessed by government. The private loggers have no way of knowing in advance how much their commitment will cost them. And given the volatility of world market prices, neither party can project with confidence how much revenue the concession will generate. With the revenue generated by the concession government can employ specialized private sector road construction firms to build the infrastructure that will serve the needs of the wider economy.

2.5.3. Development of Annual Road Works Programs.

127. **For the near to medium term the focus should be on improving the composition of the expenditure program** covering all road classes and categories of work with the aim of developing a better balance between road preservation expenditures and road expansion. This includes the following in particular:

- **Refine the estimated allocation needed for routine road maintenance** based on more accurate information on the road network and its condition and on implementation capabilities and readiness
- **Develop a detailed work program for preservation and improvement of the existing road assets** (rehabilitation, periodic maintenance, betterment) based on more accurate information on the road network and its condition using existing well established GOI tools and estimate funding requirements.
 - for roads that serve the productive sectors, prioritize in terms of economic benefits to be obtained, i.e. road works that will serve existing traffic and which will lead to reductions in vehicle operating costs
 - for roads that are aimed primarily at providing access, use cost effectiveness approach to ensure minimum level of accessibility
- **Seek a balance between roads that generate economic activity and those that provide basic access.** For remaining funds available under the road sector funding envelope, develop a balance between new roads designed to support economic activities which will translate into traffic on the one hand and roads aimed at providing access to communities on the other.

- As indicated above the first category should be closely coordinated with other parts of local government responsible for the development schemes that the roads are to support.
- In the case of major roads, proper feasibility and engineering design needs to be carried out and if located in a corridor that would be part of the prospective Trans-Papua links then a regional roads master plan needs to be part of the feasibility stage of the study.
- In determining the size of the latter works take into account macro-implications of overstressing the capacity of the economy to preserve the asset base and explore alternative modes and technologies in the highlands and other areas with particular terrain or soil conditions (e.g. light motorized paths)
- **Establish a rolling medium term expenditure program covering all highway sector works** and expenditures on the three administrative classes to be coordinated in a first round by the Dinas Bina Marga and in a second round under the provincial BAPPEDA/BP3D
- **Coordinate closely with development and refinement of the spatial plan** in an interactive way, as spatial planning requires inputs from transport. Once spatial plans have been firmed up and approved, the planning of road infrastructure should align with the approved spatial plan

Box 10: Estimate of Road Maintenance Requirements for Papua and West Papua

An estimate has been developed of road maintenance requirements for a network of 20,000 km of roads. The analysis¹² is designed to develop an optimal mix of road works (routine maintenance, periodic maintenance and rehabilitation) that will minimize costs for the economy over time (a 20-year period) and without any budget constraint. The costs to the economy are composed of the costs of the maintenance programs carried out by the road agencies on the one hand and the costs incurred by road users on the other. *Inadequate funding for maintenance and poor maintenance policies and practices may involve lower costs for the road agency but will cause the vehicle operating costs of road users to be significantly higher.* And these costs are of much greater magnitude than the road maintenance costs, under some conditions by a factor of more than 10.

Assumptions. The main assumptions of the analysis are the following:

<ul style="list-style-type: none"> ● Length of Road Network (km): 20,000 <ul style="list-style-type: none"> ○ National 2,300 ○ Provincial 2,100 ○ Kabupaten 15,600 	<ul style="list-style-type: none"> ● Road Pavement - % paved <ul style="list-style-type: none"> ○ National 75 ○ Provincial 65 ○ Kabupaten 8
<ul style="list-style-type: none"> ● Road Condition - % in good and fair condition <ul style="list-style-type: none"> ○ National 36 ○ Provincial 35 ○ Kabupaten 30 	<ul style="list-style-type: none"> ● Vehicle Fleet – Units <ul style="list-style-type: none"> ○ Cars 27,000 ○ Trucks 16,000 ○ Buses 17,000 ○ Motorcycles 255,000
<ul style="list-style-type: none"> ● Road Utilization by Road Condition - % of vehicle km <ul style="list-style-type: none"> ○ Good condition 14 ○ Fair condition 43 ○ Poor condition 29 ○ Bad condition 14 	<ul style="list-style-type: none"> ● Cost of Road Works - National and Provincial Paved Roads – Rp. Million/km <ul style="list-style-type: none"> ○ Periodic resurfacing (overlay) 1,100 ○ Rehabilitation (strengthening) 2,100 ○ Reconstruction 4,000
<ul style="list-style-type: none"> ● Cost of Road Works - Kabupaten Paved Roads – Rp. Million/km 	<ul style="list-style-type: none"> ● Cost of Road Works - National and Provincial Gravel Roads – Rp. Million/km

¹² Based on the World Bank Road Network Evaluation Tool (RONET)

○ Periodic resurfacing (overlay)	800	○ Periodic regravelling	250
○ Rehabilitation (strengthening)	1,500	○ Partial reconstruction	550
○ Reconstruction	3,000	○ Full reconstruction	800
• Cost of Road Works - National and Provincial Earth Roads – Rp. Million/km		• Cost of Routine Maintenance Works – Rp. Million/km	
○ Heavy Grading	10	○ Asphalt pavement	10 – 30
○ Partial reconstruction	150	○ Gravel pavement	5 – 15
○ Full reconstruction	400	○ Earth roads	1.5 – 6

Note: The above assumptions of costs of road works are network averages and mask significant variation between costs in different regions and terrain conditions.

Findings. The main findings of the analysis can be summarized as follows:

Category of Road Works	Average Years 1 – 20	Years 1 – 5	Years 6 – 20
Rehabilitation	600	1,800	200
Periodic Maintenance	400	300	400
Routine Maintenance	100	100	100
Total	1,100	2,200	700

Source: WB staff estimates

Optimal maintenance program. The optimal average annual expenditure level (averaged over 20 years) is estimated at Rp. 1,100 billion, comprising Rp. 100 billion of recurrent maintenance expenditures, Rp. 400 billion of periodic maintenance expenditures and Rp. 600 billion of rehabilitation expenditures. Because more than 50% of the network is in poor or bad condition the optimal maintenance policy mix is heavily focused on rehabilitation.

Minimum maintenance program. The minimum average annual expenditure level is estimated at Rp. 700 billion, comprising Rp. 30 billion of recurrent maintenance expenditures, Rp. 190 billion of periodic maintenance expenditures and Rp. 520 billion of rehabilitation expenditures. This reduction in expenditures compared to the optimal program, however, will cause an increase in average annual road user costs on the order of Rp. 3,000 billion, which underlines that the higher level of expenditures is very worthwhile from the point of view of reducing the cost of doing business in Papua and West Papua.

Distribution of works. Works on Kabupaten roads, at Rp.430 billion represent 40% of the total. This is understandable considering that these roads make up more than 75% of the network. From the point of view of program preparation and implementation this will pose formidable challenges for many of the local governments.

Phasing of expenditures. The above average annual expenditures relate to the 20 year evaluation period. However, in order to achieve the estimated benefits, expenditures under the optimal program would need to be about twice as high during the initial years to reduce the backlog of rehabilitation of roads in poor or bad condition. Total annual expenditures required during the first 5 years are estimated to be on the order of Rp. 2,200 billion. This represents a dramatic increase compared to current maintenance programs and such rapid ramping up of expenditures is not feasible from the point of view of program preparation and implementation in particular since 40% of the works would need to be carried out on Kabupaten roads. During years 6-20 required expenditures would reduce to Rp 700 billion.

2.5.4. Implementation and Management Aspects

128. Involve local communities in construction, maintenance and – where possible – design. For routine road maintenance works, explore the potential for new arrangements involving participation of local communities and tapping local knowledge about soils and erosion control. For construction of feeder and local access roads, explore the potential of new arrangements involving labor-intensive construction techniques.

129. **Implement performance based contracting.** For the complete cycle of routine and periodic maintenance of earth roads, explore the potential for multiyear performance based contracting, for example, based on speeds.

130. **New works must have a solid technical basis before construction begins.** For new roads/rehabilitation works, several items are critical in the Papua and West Papua context

- alignment selection, in view of the large proportion of the terrain that presents special conditions (peat soils, mountainous terrain, fragile soils, protected areas)
- design specifications appropriate to the terrain and soil conditions
- construction quality

131. **Work with the contracting industry.** With regard to construction quality, some issues affecting the contracting industry can be addressed as these are within the control of the road agencies. This includes: larger contract sizes, greater use of multiyear contracting; and developing multiyear work programs by sub-region which are made publicly available. This will give the contracting industry a better picture of the volume of work that will be available, give them a better basis for planning and financing their activities and in the process lead to greater competition, more efficient execution and ultimately to lower costs.

Ports and Waterborne Transport

2.6. Current Status of the Sector

132. **Waterborne transport is vital to the growth of Papua and West Papua.** Papua and West Papua is dependent on waterborne transport (and aviation) to a much greater extent than regions that are part of a continental land mass where road transport and rail play a much more significant role. In Papua and West Papua waterborne transport comprises a variety of elements including: ports, domestic inter-island shipping, coastal shipping, ferry crossings and inland navigation. The potential of the natural and associated man-made assets, however, is insufficiently exploited.

2.6.1. Ports and Related Infrastructure.

133. There are 22 commercial ports equipped with quay facilities in Papua and West Papua of which 10 in Papua province and 11 in West Papua. In addition there are about an equal number of Pioneer ports. The 22 ports are relatively small with total quay length exceeding 200 m only in Jayapura, Merauke and Sorong. Traffic volumes in most of these ports remain modest in the range of 50,000 to 750,000 tons per year. Only in Jayapura is there a significant amount of container traffic on the order of 50,000 TEU/year.

Table 10: Ports in Papua and West Papua

Quay length (m)	Papua		West Papua	
	Commercial ports	Pioneer Ports	Commercial Ports	Pioneer Ports
< 50	3	8	2	
50 << 100	4	3	5	14
100 << 200	1		3	
200 <	2		1	
Total	10	11	11	14

Source: Papua Province: Dinas Perhubungan Papua
West Papua Province: Studi Transportasi Irian Jaya Barat, December 2007

134. Six of the 22 commercial ports in Papua and West Papua are part of Indonesia Port Corporation IV (Sorong, Jayapura, Biak, Merauke, Manokwari, Fakfak) while the remaining ports are administered by the Directorate General of Sea Transport (DGST) under the Ministry of Public Works. These port administration arrangements may change at some point in the future. Shipping Law 17/2008 introduces the concept of Port Authorities based on the Landlord Port Model to be established by the Minister of Transport and to be responsible for one or more ports in a particular area. Details on the management and oversight arrangements and tariff policies are being developed with the target date for effectiveness of the new regime by mid 2010.

135. **Most ports in Papua and West Papua remain under the authority of DGST.** With regard to devolution of responsibility for regional/local ports to the regions, the law appears to reflect a reversal in the decentralization drive initiated under the autonomy laws of 1999 and 2001, which had envisaged that operational responsibility for the DGST administered public ports would over time be transferred to regional governments. No progress had been made in the implementation of this policy in large part because the local ports had little prospect of becoming financially viable in the near term even if they were free to set their tariffs and tariffs

were raised substantially. In view of the time needed to adopt the relevant regulations and implement the new policy, it can be expected that for the near term the existing management arrangements as well as policies in respect of port tariffs will remain unchanged. For the longer term, however, the new law holds the potential for the introduction of different arrangements for port operations, for example through greater involvement of the private sector in stevedoring operations. Under the new law tariffs would also be set on the basis of commercial negotiation.

136. **And there are no plans to change this situation.** Responsibility for navigation infrastructures outside of the port basin, such as access channels and breakwaters are the responsibility of the central government and the related harbor charges are collected by central government. This arrangement is also expected to continue in the future.

2.6.2. Shipping.

137. Shipping activities serving Papua and West Papua are part of the shipping industry operating in the Indonesian archipelago in general. Several shipping lines have regular cargo operations in Papua and West Papua. For passengers, P.T. Pelni the state owned shipping line, is by far the main player operating scheduled passenger ships serving the main Papua and West Papua ports.

138. **Most issues pertaining to shipping in Papua and West Papua are common to the rest of Indonesia.** Shipping – whether inter-island or coastal – is affected by conditions in the Indonesian shipping industry, the efficiency of which is below best practice. Chief among the factors that have contributed to this situation are the maritime sector policies pursued in the past. These have focused on regulations covering many aspects of the industry, including on: entry and exit; routes and tariffs; on vessel age; vessel specifications and vessel sourcing. Other factors include the failure to modernize the legal (ship mortgage) and financial sector framework affecting ship finance, and ineffective policies relating to the ancillary service industries such as ship building and ship repair. Indicative of the unsatisfactory state of the shipping industry is that the general cargo fleet registered in Indonesia around 2004 was composed predominantly of small and relatively old vessels with almost half of the fleet less than 1000 DWT and about two thirds being more than 25 years old.¹³

139. **The new law makes some progress.** The new shipping law is addressing some of these issues and simplifies licensing for inter-island and coastal shipping somewhat. However, in regard to liner services the law provides for continuation of the current system requiring the shipping companies to be part of a system-wide network of routes serving the whole archipelago, and to be determined jointly by DGST and the national association of shipping lines. For the category of “people’s shipping”, encompassing traditional sailing vessels, auxiliary sailing vessels and motor vessels of less than 175 gross tons, the new law, in recognition of regional autonomy since 1999 delegates the authority for issuing of licenses to local government.

140. Freight rates for goods are unregulated and can be agreed by shipping lines and cargo owners on a commercial basis. Indicative freight rates are as follows: Jayapura - Surabaya Rp 3,965,000/ton, Manokwari – Surabaya Rp 3,090,000/ton and Jayapura – Manokwari Rp. 875,000/ton. Economy passenger fares are regulated by MOT/DGST. PT Pelni, a state owned enterprise, is the main provider of passenger services and has been receiving government

¹³ Indonesia Country Report: Promoting Efficient and Competitive Intra-ASEAN Shipping Services, March 2005. ASEAN Secretariat.

support mainly by way of equity injections in the form of vessels entered on its books at no charge to the company. A typical fare on the Pelni services for economy class travel is: Jayapura – Sorong: Rp 286,000. The new law reaffirms the current regime whereby freight rates for goods can be agreed freely between the shipping company and the shipper. For passenger fares the law reaffirms the powers given to DGST to set passenger fares for economy class passengers.

2.6.3. Pioneer Shipping.

141. **Subsidized Pioneer Shipping activities make significant impacts in Papua and West Papua sea transport.** Indonesia has had a long standing policy of providing subsidized shipping services through a program called Pioneer Shipping with the objective of providing access and transporting essential goods to remote regions at affordable rates. Pioneer shipping is mainly concentrated in Eastern Indonesia and Papua and West Papua routes figure prominently in the program. In 2002/2003, 4 of the 21 base ports were located in Papua and West Papua and about 20 of the 49 routes were making calls in Papua and West Papua ports. The routes are reviewed periodically in relation to needs and available funds, which are provided under the APBN budget of DGST.

142. **While the objective is worthwhile in itself, the subsidy mechanism that has been employed has not been effective.** This consists of paying the shipping company operating a route the difference between (i) pro-forma calculated total operating costs plus a 10% profit margin; and (ii) the revenues as reported by the shipping company. This formula enables the companies to receive subsidies covering their total costs regardless of operating efficiency, the amount of cargo and passengers carried and the quality of service. A review of the performance of Pioneer Shipping carried out under the Stramindo Study¹⁴ for the period 1994-2002 found that load factors were very low and that the average revenue represented not more than 11% of the subsidy received.

143. **The service is indeed cheap, but is not an effective use of funds.** Tariffs are regulated by Minister of Transport Decree, the latest having been issued in 2002 (KM 86/2002). Under this tariff schedule a 250 mile (460 km) trip would cost Rp. 22,650. Cargo for the same trip would be charged Rp. 20,385/ton/m³ (90% of the adult fare). This is no doubt a very affordable fare but, given the poor service provided by Pioneer shipping, it is doubtful that Papua and West Papua and the other regions in Eastern Indonesia are well served by the program in its present form. That the services are not up to expectations is evidenced by the fact that, over the 9 year period covered by the analysis, on average only 279,000 passengers and 93,000 tons were carried annually by the 37 vessels deployed with an average of 22,000 DWT in total. The new shipping law reaffirms the commitment to Pioneer Shipping services to remote areas where commercial operations are not viable with sufficient frequency, reliability and safety. The law allows contracting out of the services on the basis of long-term contracts. This may provide an opening for introducing a more effective mechanism for awarding the contracts competitively based on minimum subsidy requested and clear performance criteria along the lines of a public service obligation.

2.6.4. Ferries.

144. **Ferries represent another important element of the Papua and West Papua transport system.** These are considered as land bridges connecting roads on different islands

¹⁴ Study on the Development of Domestic Sea Transportation and Maritime Industry in the Republic of Indonesia, 2004.

and come under the authority of the Directorate General of Land Transport (DGLT) but with DGST responsible for the licensing of the vessels. The DGLT goal is to increase the number of ferry routes providing regular services and connecting the Papua and West Papua mainland and the smaller islands along its coastline. It also has a program of subsidized Pioneer Ferry routes, which are operated by ASDP the publicly owned ferry transport corporation. Out of a total of 106 routes in operation in 2007, 68 were Pioneer routes. The total subsidy amounted to Rp. 85,900 million.

2.6.5. Inland Navigation.

145. **In contrast to inter-island and coastal shipping, inland navigation is not well developed in Papua and West Papua**, but is beginning to receive greater attention. Studies have recently been initiated to assess the situation and the scope for development of river navigation in a number of areas. At present, commercial navigation on the Digul and Mamberamo rivers is not well developed, port facilities are very rudimentary and navigation aids are practically non-existent. There is also small-scale river navigation using traditional boats and speed boats on dozens of smaller rivers all along Papua and West Papua's coast line. A first reconnaissance study on river transport in Papua and West Papua was completed in early 2009.

146. **Tariffs for passenger transport are set by Government Decree, while freight is negotiated.** For freight, tariffs are not governed by Government Decree and can be negotiated between cargo owners and transport operators. Rates are variable depending on many factors, including season of the year, navigation conditions, and type of cargo.

147. **There is potential for expansion.** There is also potential for expansion of navigation on Lake Sentani through establishment of services connecting the various communities living on the shores of the lake and introduction of better frequencies in the services. This is currently being considered by the local government.

2.6.6. 2008 Shipping Law.

148. **The new law provides opportunities for reform.** While from the perspective of Papua and West Papua, the new law does not open the prospect of fundamental change in the regulatory and policy framework for inter-island shipping, it has the potential of bringing about some improvement and opens opportunities in three areas.

- **For ports**, the law introduces the concept of landlord ports through the establishment of port authorities, which will work in collaboration with regional/local government. This potentially provides opportunities for introducing better management practices through operation on commercial principles and/or greater involvement of private sector operators and for cost recovery as tariff setting would be on the basis of commercial negotiation.
- **For people's shipping and river transport**, the delegation of authority to local government¹⁵ for licensing opens opportunities for a proactive policy promoting this neglected component of the Papua and West Papua transport system. Not only can Papua and West Papua governments be instrumental in improving the basic elements of the infrastructure such as small coastal and river ports, anchoring places

¹⁵ For inland waterways and ferry transport, however, an additional license – a route permit - is still required; and inland waterway transport and ferry operators must obtain a ship operating approval.

and jetties as well as land access to such infrastructures but also by playing an active role in improving the human capital through targeted training programs for owners and operators of small water craft so that the licensing conditions can begin to take into account essential competency factors.

- **For pioneer shipping services** the potential is in terms of improved arrangements for contracting with private operators. Whether these opportunities will be realized will depend in large part on how the implementing regulations will be developed and how Papua and West Papua regional and local governments will seize the new opportunities that are provided to them.

2.7. Recent Developments

Table 11: Expenditures on Waterborne Transport - Papua and West Papua (Rp. Billion)

	2004	2005	2006	2007
APBD all Transport Modes	87	114	170	637
Share Waterborne ¹⁶	44%	44%	44%	44%
APBD Waterborne Transport	38	50	75	280
Central Govt Ports	117	119	198	196
Central Govt Ferry Transport ¹⁷				
Central River Transport				
Central Govt Inland Waterways & Lake				
Grand Total	156	169	273	476

Source: Based on MOF data and staff estimates

149. **Much of the budget increase since 2004 has been under sub-national governments, yet is proving insufficient.** It is estimated that central government was the major source of expenditures in waterborne transport until 2007 when the level of APBD expenditures in transport increased dramatically (Table 11 above) APBD became the main funding source. The above estimates do not include expenditures in the six ports that form part of Pelindo IV. A high proportion (between 50 – 60 %) of the central government expenditures is estimated to have been spent on staff compensation and goods with the remainder on what it is termed capital expenditure. The latter is understood to comprise expenditures on: dredging works to maintain or deepen navigation channels; navigation aids; breakwater maintenance or upgrading; minor port infrastructure and superstructure; and equipment as well as repair and maintenance works. In general, funding levels appear to have been inadequate to meet growing traffic flows and the requirements to keep existing infrastructure and facilities in good operating condition.

2.8. Existing Plans for the Future

150. **Like in other sectors, planning resources are insufficient.** Owing to the nature of the GOI planning cycle and planning and budgeting procedures, at this point in time there is no formal multi-year expenditure program covering the various components of ports and waterborne transport in Papua and West Papua. This notwithstanding, investment plans and

¹⁶ Estimate based on the 2008 proposals by local governments for APBD expenditures in Transport

¹⁷ Information on Central Government expenditures in ferry, inland waterway and lake transport not available

lists of proposed projects with associated indicative implementation timetables are periodically prepared. Because resources available for planning and project evaluation have been insufficient, both in terms of staffing and funding, few of the plans have benefited from proper in-depth analysis and evaluation. Such preparation work aimed at identifying the most worthwhile investments and developing well-justified expenditure programs, including detailed cost estimates, and implementation and procurement schedules is indispensable if funds are to be used to good effect. Implementation planning is also hampered in general by uncertainty regarding the level of funding that will be available.

151. A brief summary of existing plans is as follows:

- **For ports**, the list of investment requirements prepared in 2008 by Dinas Perhubungan of Papua Province provides for extensions of the quays in 7 ports, major upgrading in 2 ports, construction of one new port and studies for 4 new ports. For Pioneer ports it provides for construction of small berths (35mx7m) at 16 locations in the period to 2012 and some other 25 locations thereafter. Concept plans have been prepared for a new greenfield port in Depapre some 50 km to the west of Jayapura. The investment would provide an alternative to future expansion of the port at its existing location, which is constrained by the surrounding city and steep hills.
- **For river navigation**, the indicative program includes construction of 9 small wooden berths on the Mamberamo River to serve traditional wooden vessels up to a capacity of 150 tons. A concrete berth on the Yahukimo River is currently under construction.
- **For lake navigation**, there is an indicative program of construction of 9 small wooden jetties on Lake Sentani to serve water taxi operations.
- **For ferry transport**, there is an indicative program of construction of 6 movable access ramps of 500 gross ton capacity to serve ferry connections between the Papua and West Papua mainland and small islands off the coast.

152. **Yet project preparation remains inadequate.** No cost estimates are provided for these proposals; details are lacking on equipment that may be required and on the state of readiness for implementation in terms of designs and specifications, bidding documents, etc.

2.9. Assessment

153. **Careful diagnosis and evaluation of port capacity requirements is lacking.** Port congestion or capacity issues can be the result of many factors, ranging from: adequacy of infrastructure and facilities such as berth length, berth load bearing capacity and configuration, handling equipment, port layout and storage areas to operating practices in respect of cargo handling, cargo storage or other port activities. Sometimes, investments need to be undertaken not because of fundamental capacity constraints but to accommodate changes in vessel sizes and shipping technology. This underlines the point that a definitive assessment of the merits and priority of the above indicative expenditure proposals and indeed of any proposals which are not supported by detailed analyses and justifications will require additional information on traffic flows and forecasts, on conditions and operating practices in each of the ports and a thorough evaluation of alternatives to meet growth in demand. In the interim, when capacity issues are likely to arise, a first line of response must always be an examination of the scope for improvements in operations, starting with the most essential, such as extending port working

hours. To better anticipate future expansion requirements, port operating monitoring systems may need to be upgraded and streamlined.

154. **A number of proposed expansion investments are intended to meet demand in container transport.** It is good practice to anticipate changes in ship sizes and technology rather than wait till serious capacity constraints are reached with attendant increases in costs for customers and the economy at large. Thus, investments to accommodate small container carrying vessels in response to the ongoing shift from general cargo and break bulk to containerized shipments will in principle often be justified. These will most often need to be accompanied by other transformations in the port working areas, in particular the storage areas, including space and facilities for stuffing/stripping of containers as less than full container loads will likely continue to be the predominant form of shipment for the foreseeable future in small ports.

155. **Proposed investments in quay extensions solely to accommodate the large Pelni passenger ships need to be considered more carefully** and in the context of the broader question of the sustainability in the long term of operating these large vessels on the thin Papua and West Papua routes. This relates to the broader question of the appropriate ship size on different routes taking into account: (i) traffic demand by route for both passengers and cargo; (ii) service frequency; and (iii) trip length.

156. **The expansion program of Pioneer ports can be supported, however, with some caveats.** The important point is to ensure that these expenditures will indeed fill a gap in the supply of affordable transport services to communities that are poorly served or not served at all. In this regard two aspects are of critical importance. First, there is a need to establish that the service will indeed require subsidy and will not undermine or pre-empt the provision of these services on a commercial and cost recovering basis. Second, there is a need for careful selection of the port site from the point of view of access from the ocean and from the land side.

157. The fundamental issue is, however, that the delivery mechanism of the subsidy will need to be reformed for the program to be worthwhile. As indicated above, under the current subsidy regime funds are not being spent cost-effectively on Pioneer shipping. It will be crucial therefore that MOT/DGST, in concert with Papua and West Papua and with the other regional governments benefiting from the program, develop alternative more effective arrangements for subsidy delivery. Papua and West Papua should participate in the debate on the future arrangements for Pioneer shipping as it is a major beneficiary of the program. One approach to consider may be to allow for a differentiation in the arrangements between the different island groups depending on the local conditions.

158. **Anecdotal evidence suggests that maintenance of port assets is receiving neither adequate attention nor appropriate funding.** Maintenance is mainly carried out in a curative mode rather than as part of a preventative approach. There appears to be no up-to-date and accurate database of existing facilities and their condition, which is a basic requirement for effective programming and budgeting of maintenance activities.

159. **Poor standards and practices for ship maintenance and repair need work.** For coastal and riverine navigation to be viable and prosper it will be important that there is an effective local capacity for maintenance and repair of small to medium sized vessels and for building small craft based on efficient and economical designs. This is all the more important considering that two thirds of the Indonesian shipping fleet is over 25 years old and that the situation in this regard is unlikely to be better in Papua and West Papua.

160. With the aim of developing a best practice local capacity for building small craft and for repair and maintenance of small to medium sized vessels it may be worth considering the concession model as an effective approach in view, among others, of the limitations on foreign ownership in the sector. Under this approach, the government would invite foreign shipyards (possibly in association with a domestic yard) to bid for the right to modernize and operate an existing yard (or establish a new shipyard) for a period of say 20 years. The agreement would provide that at the end of the concession, the yard would be privatized or alternatively that the right to the concession would be rebid under new terms. There would be no subsidies for the operation of the scheme and no protection from competition. Initial start-up assistance could be justified, but once established, the business should be able to operate without government support. If any start-up assistance would be needed to make the investment by the foreign yard viable, it would be reflected in the bids for the concession, for example: (i) in the bid price offered for the concession to operate the existing yard and to take over whatever valuable assets are available; or (ii) in the amount of initial support requested, for example, in terms of tax holiday or depreciation allowances to get the business up and running.

161. **Opportunities for human resource development are limited.** A sustainable waterborne transport industry can hardly be envisaged without the full participation of the local communities dependent or affected by waterborne transport. The communities that have traditionally engaged in fishing and in coastal and riverine shipping are ideally placed to participate in the operations and workforce of a modernizing industry. This underlines the need for an aggressive human resource development initiative initially focusing on two areas: (i) improvement of the managerial and business skills, in particular basic costing and financial aspects and targeted at existing small shipping companies/owner operators; and (ii) improvement of the technical skills of the seafarers in key relevant areas such as navigation, mechanical, communication, and basic maritime technology.

162. To effectively launch a human resource development initiative, it may be worth considering a partnering arrangement with a successful foreign vocational training institution in waterborne trades and a domestic training institution. The aim of the arrangement would be curriculum development and assistance in the start-up of training modules in basic concepts of business management, costing and cost control, and performance monitoring ratios as well as in the various technical aspects of the industry. The long term goal would be that following initial investment in curriculum development and in start up activities the operating costs of the training would gradually become self-financing based on the fees paid by the companies that are sending their staff for training.

163. **Construction of greenfield ports is a substantial undertaking.** It will be important during the remaining master planning and feasibility study phases to bear in mind the worldwide lessons of experience of such greenfield port investments. These lessons indicate long delays in getting to commissioning of the new facilities, major cost overruns, and numerous start-up difficulties. One of the major causes for the delays is the need for all the essential complementary investments in other infrastructure, such as land access, power, water and communications, to come on stream in a coordinated manner. This is not mainly or only a technical issue but often principally a financing issue, namely: who will finance the initial investment requirements in all these other sectors? If the greenfield expansion is driven purely by the requirements of strong growth in existing traffic, then the port business should in principle be able to bear the costs of all these other infrastructure requirements. If on the other hand the greenfield port forms part of a broader regional development scheme then the costs of bringing the other infrastructure on stream can be shared with the other stakeholders in the overall

development scheme. But in either case the challenge of bringing all sectors on stream in a coordinated manner remains.

2.10. Recommendations

2.10.1. Maximize the Comparative Advantage of Waterborne Transport.

164. **Waterborne transport is, in principle, the lowest cost transport mode**, in particular for bulk commodities, and should therefore receive high priority along the coastline and where there are navigable rivers. To fully exploit the advantages of waterborne transport requires not only that the infrastructure facilities are available and of high quality, but also and of equal importance, that sector policies affecting shipping and other essential operators and service providers in the industry promote entrepreneurship, competency and efficient operations.

165. **Dialog must begin on with central government and Pelindo.** Responsibility for port infrastructure and facilities and for port management in Papua and West Papua remains largely the domain of Pelindo IV and central government. Policies affecting waterborne transport are also mainly a central government responsibility and notwithstanding many good intentions, central government policies have achieved limited success in fostering an efficient and low cost industry. Notwithstanding these constraints, decentralization and the new Shipping law provide new opportunities for targeted interventions. The waterborne infrastructure can be developed to higher standards and operations can be improved by following a two-pronged approach: (i) through close collaboration between MOT/DGST and Papua and West Papua in formulating and implementing improvement and expansion programs; and (ii) taking initiatives in those areas where the new legal framework makes this possible.

2.10.2. Collaboration Strategy.

166. Enhanced collaboration between MOT/DGST and Papua and West Papua would be based on the following principles and objectives:

- **A commitment from MOT to provide technical input** in program design and preparation while Papua and West Papua would commit to much greater cost sharing.
- **An understanding on cost sharing** would be predicated on Papua and West Papua continuing to receive the same share of central government budget allocations as in the past
- **MOT to focus on bringing the Papua and West Papua infrastructure for coastal shipping and river navigation up to appropriate standards** in terms of aids to navigation, dredging where required and basic port infrastructure using central government funds
- **Papua and West Papua regional governments assuming increased cost-sharing** for maintenance, rehabilitation and upgrading of port superstructure, facilities and equipment
- **Development with MOT of arrangements aimed at improving operational efficiency and greater involvement of the private sector in port operations**

- **Facilitation towards the establishment/development of related industries**, such as ship maintenance and repair, building of small craft and other shipping and transport related services
- **Assistance in human resource development** in respect of both government staff and the work force in the private sector

167. **The last two points are of fundamental importance** for the development of a healthy and sustainable waterborne transport industry in Papua and West Papua and the regional/local governments should be prepared to share in the costs and to take initiatives involving the participation of competent foreign entities in the area of human resource development and ship repair and maintenance along the lines outlined above.

168. **In future a new policy on Pioneer Shipping must be sought.** In regard to strategic sector policy decisions affecting the long term future of the waterborne transport industry, Papua and West Papua should take part in the debate on the appropriate policy framework for financially sustainable shipping in Eastern Indonesia and in particular on the respective roles of Pioneer shipping and People's shipping. In evaluating options decision makers should be mindful of the fact that if Pioneer shipping is provided where commercial People's shipping is viable in the context of a supportive policy framework, the subsidy under Pioneer shipping will be counterproductive in the long term.

2.10.3. Implementation and Management Aspects.

169. **In the area of expenditure planning and programming in general:**

- **Initiating asset management**, starting with inventory of key infrastructure/facilities and their condition so as to provide the basis for developing maintenance, rehabilitation and replacement requirements
- **Streamlining and strengthening the system of port performance indicators**, covering: berth occupancy ratios, ship turn-around time, ship waiting time, port down time, effective working time, idle time, and initiate comparison with best practice performance in other similar ports
- **Continue investigations of conditions on main rivers and of scope for development**, learning from elsewhere in Indonesia and the world at large

170. At the level of investment program preparation:

- **For ports**
 - in planning of port facilities, pay particular attention to coordination of the interface between river navigation and coastal shipping and between the latter two and road infrastructure so as to facilitate multimodal transport
 - in respect of container shipping bear in mind the need for auxiliary service providers around ports – inland container depots, warehousing operators, container consolidators, freight forwarders
- **For river transport**
 - Where communities are reliant on river transport seek to improve existing situation rather than provide alternative road access

- Develop appropriate design and construction standards for basic quay and jetty structures learning from experience in Papua and West Papua and elsewhere in Indonesia.
- In general, identification of aspects requiring further study work

3 Air Transport

3.1. Current Status of the Sector

3.1.1. Airport Infrastructure.

171. Papua and West Papua is heavily reliant on air transport as is evidenced by the fact that out of the 188¹⁸ airports forming part of Indonesia's public air transport system 91, or 48 % are located in Papua and West Papua while the land area of Papua and West Papua is 22 % and the population is just over 1 % in the total. Papua and West Papua have a density of 30 airports per million people as compared to 0.8 for Indonesia as a whole. In terms of airports per land area (per 10,000 km²) the density is 2.2 whereas for Indonesia it is 1. Most of the airports, however, are small and are of the category of Pioneer Airports. This is illustrated in Table 12 and Table 13 below for Papua and West Papua Provinces

Table 12: Airports in Papua Province by Category, Runway Length and Runway Surface - 2008

Runway Length	Airports				Pioneer Airports				
	Total	Asphalt	Penetration Macadam	Other	Total	Asphalt	Penetration Macadam	Grass	Concrete
L < 800	10	4	5	1	27	2	11	14	
800 < L < 1200	3		3		2		2		
1200 < L < 1800	4	3	1		2		1		1
1800 < L < 2400	4	4							
2400 < L < 3000									
3000 < L	1	1							
Total	22	12	9	1	31	2	14	14	1

Source: Dinas Perhubungan, Jayapura

Table 13: Airports in West Papua Province by Category, Runway Length and Runway Surface - 2008

Runway Length	Airports				Pioneer Airports				
	Total	Asphalt	Penetration Macadam	Other	Total	Asphalt	Gravel	Grass	Other
L < 800					31	1	1	24	4
800 < L < 1200	1	1			2		2		1
1200 < L < 1800	1	1			1	1			
1800 < L < 2400	2	2							
2400 < L < 3000									
3000 < L									
Total	4	4			34	2	3	24	5

Source: Dinas Perhubungan dan Komunikasi, Manokwari

¹⁸ As reported in the Master Plan Study of the Air Transport Sector in the Republic of Indonesia, 2004. This total includes Timika airport which was developed and is operated by PT Freeport Indonesia, but is in public use.

172. **In addition there are several hundred airstrips scattered over the provinces** catering for small aircraft with a carrying capacity of up to 15 passengers, which have been developed by local communities, non profit (mainly religious) organizations and recently also by local governments. These often play an essential role in providing access to small isolated communities.

173. **There are four large airports in Papua and West Papua.** Biak, Jayapura, Sorong and Timika have traffic volumes greater than 200,000 passengers per year, with Jayapura well in excess of 500,000. A second group of four airports – Manokwari, Nabire, Merauke, and Wamena – have traffic volumes in the range of 50,000 – 200,000 passengers per year. The remaining airports have much lower traffic; with many only a few thousand passengers per year.

174. **With the exception of the airports of Biak and Timika all airports in Papua and West Papua are administered by the Directorate General of Air Transport (DGAT).** The airport of Biak forms part of Airport Corporation II while the airport of Timika is a privately developed and operated airport which is also in public use. These airport administration arrangements may change at some point in the future. The new Aviation Law UU No 1/2009 provides for the establishment by the Minister of Transport of Airport Authorities responsible for one or more airports in a particular geographic area. Details on the management and oversight arrangements and tariff policies under the new regime still need to be developed and specified in Government Regulations and this will likely take more than a year.

175. **As with ports, decentralization of airports has no occurred in Papua and West Papua.** With regard to devolution of responsibility for regional/local airports to the regions, the new law appears to reflect a reversal in the decentralization drive initiated under the autonomy laws of 1999 and 2001, which had envisaged that operational responsibility of the DGAT administered public airports would be transferred to regional governments (provinces and Kabupaten). No progress had been made in implementation of this policy in large part because most of the regional airports had little prospect of becoming financially viable even when free to set their tariffs. Given the time needed to develop the government and ministerial implementing regulations and then to actually implement the new policy it can be expected that in the near to medium term future, existing management arrangements as well as policies in respect of airport tariffication and airline fare setting will continue.

176. **Central government is responsible for standards and safety.** In addition to the landside and airside facilities of airports, an air transport system comprises many elements that need to function in a well coordinated and integrated manner, including: visual landing facilities, air traffic management, communications, navigation and surveillance. These are part of a national system on which regional government has no or little control. A whole range of advanced technologies, which are rapidly evolving, are used in these various elements. In addition, technologies and procedures in these areas are governed by international standards, norms and guidelines with a focus on aviation safety and these are necessarily managed at the national level. Regional governments and the users of air transport are primarily concerned with airport facilities and providers of air transport services and these will be the focus in the remainder of this chapter.

3.1.2. Airline Deregulation.

177. **The number of scheduled and charter airlines has increased rapidly** following deregulation of the airline industry in 2001 (Ministerial Decree KM 11/2001 on Commercial Airlines). In 2000 there were 117 aircraft in operation and in 2006 this number had grown to

226 with 31 registered airlines. Some 15 airlines have operations in Papua and West Papua including the two airlines operated by missionary organizations. For example, in 2008, 11 airlines had operations at Wamena airport.

178. **Deregulation of the airline industry also brought about a major reduction in fares and tariffs in the aviation sector in Indonesia.** In the years following deregulation airlines started offering economy fares that were below the official tariffs promulgated by the Ministry. In the event, in February 2006 the Ministry issued a Decree with revised economy fares that were on average 46% lower than the fares indicated in the Decree of February 2002. Actual fares, however, will depend heavily on conditions in the market and can be close to the new reference fares or much above. So, for example, while the economy return fare between Jayapura and Wamena is in the range of Rp. 1,000,000 – 1,500,000¹⁹, the reference fare based on the 2006 Decree is only Rp. 358,000. For freight, the tariff between Jayapura and Wamena is on the order of Rp. 9,000/kg which in terms of ton/km is on the order of Rp. 37,000. These rates could come down further judging by air cargo rates under efficient operations in other countries²⁰.

179. **Yet safety standards remain low.** The deregulation policy that was pursued at the national level since the late 1990s established an environment that was relatively liberal and allowed the airline industry to expand and serve the needs of a growing economy. It was not accompanied, however, with sufficient attention to aviation safety issues. This is being corrected as evidenced by enactment of a new aviation law in December 2008, which has a strong focus on aviation safety. For Papua and West Papua this is particularly important given its heavy reliance on air transport.

3.1.3. Pioneer Services.

180. **Subsidized pioneer services are active but are planned to wind down in the future.** The new aviation law provides for continuation of the long-standing policy to improve access to communities in remote areas by operating or providing support for so-called Pioneer services. These are services on routes that are not commercially viable and require a subsidy. At present these are contracted out annually to commercial airlines on the basis of a competitive selection. The current indicative plan of the Dinas Perhubungan of Papua Province expects a gradual reduction of the number of Pioneer services following annual evaluation of the routes and upgrading of some to a commercial route.

181. **The fares for Pioneer services are set by Ministerial Decree, are heavily subsidized and are intended to be affordable for the people living in the remote locations.** They are adjusted periodically to reflect inflation. Under the tariff that became effective in May 2008 the fare from Jayapura to Oksibil a distance of about 250 km, for example, is Rp. 131,000 and cargo is charged at Rp. 1000/kg. The fare from Wamena to Dekai is Rp. 50,000 and for cargo it is Rp. 400/kg.

3.2. Recent developments

Table 14: Expenditures in Aviation - Papua and West Papua (Rp. Billion)

	2004	2005	2006	2007
APBD all Transport Modes	87	114	170	637

¹⁹ This fare level is comparable to fares under competitive conditions in other countries.
²⁰ In Alaska cargo rates can be in a range of Rp. 10,000 – 25,000 ton/km depending on volume and route.

Share Aviation ²¹	0.43	0.43	0.43	0.43
APBD Aviation (estimated)	38	49	73	274
Central Government	169	119	268	335
Total	207	168	341	609

Source: Based on MOF data

182. **Both central and local government have increased expenditures on the aviation sector in recent years.** Of the central government funding, about one third was spent on staff compensation and goods with the remainder being allocated for investment in new facilities and upgrading of existing facilities. Yet, available funding appears to have been insufficient to meet requirements for aviation safety investments and investments to meet growing demand

183. **Resources are spread thinly.** In general, as a response to a lack of adequate funding there has been a tendency to spread the limited funding over too large a number of projects which resulted in implementation periods that often times are stretched out far too long.

184. **Noteworthy is that in recent years some Kabupaten governments embarked on imaginative ventures such as the acquisition of aircraft.** This was no doubt in large part, motivated by the goal of improving communications and connections for the benefit of the local economy and community at large. The sudden and dramatic increase in revenues, experienced by local governments in Papua and West Papua in 2006 and 2007, would have posed a challenge for any local government in any country that is concerned with obtaining the best value for money possible from the available resources. This raises interesting practical and strategic questions some of which are discussed in Box 11.

Box 11: Aircraft acquisition by local governments

This kind of expenditure raises practical and strategic questions. At the practical level, there are the issues of legal and operational arrangements. As the local government will not be in a position to obtain an aircraft operating license, it needs to associate with a bona fide airline to take care of the operation of the aircraft. The aircraft asset will presumably be the contribution of the local government in a joint venture. The legal structure of this joint venture entity and the agreement between the two parties (or several parties if there are other investors) will determine how costs and income will be shared and ultimately determine the outcome of the fundamental question whether the venture is worthwhile for the local government.

The latter question can be approached at the strategic level by comparing the investment in the aircraft with an alternative investment in an annuity. This involves comparing the present value (PV) of the net annual income stream over the remaining life of the aircraft flowing to the local government with the PV of the annual income stream from an annuity of equal duration that can be bought in the financial market with the amount invested in the aircraft. If the annuity gives a better return than the aircraft investment, then the local government has to ask itself two key questions: First, whether it is getting other benefits from the venture that are equal or greater in value than the shortfall in return compared to the annuity; and second whether it could not get these benefits at lower cost by buying them in the air transport market.

For example, such other benefits could consist of a higher level of service than would be provided by a fully commercial operation by an airline company to the local traveling public and business community in terms of frequency of services and to local government officials in terms of extra travel facilities or privileged access. Of course any services or facilities that would not normally be

²¹ Estimate based on the 2008 proposals by local governments for APBD expenditures in Transport

provided by a fully commercial operation involve additional operational costs which have a price that will be reflected, explicitly or implicitly, in the joint venture agreement between the local government and the airline company. Thus, for the joint venture scheme to be worthwhile, (i) the value of these benefits would need to be higher than the difference in PV between the two income streams; and (ii) the cost in the market of these benefits, for example by providing an operating subsidy to an airline or by buying the travel facilities in the charter market as and when required, would have to be higher than is being obtained under the joint venture. Clearly, if the desired benefits can be bought in the market at a lower cost than available under the joint venture, then it is in the interest of the local government to buy the travel benefits in the market.

If alternatively however, the aircraft ownership gives a better return than the annuity, then the interesting question is why this would be the case²², and in particular why the airline company would rather operate the aircraft owned by the local government than an aircraft that it can lease in the market under streamlined contractual agreements. Several factors could contribute to the outcome. For example, it is possible that the joint venture entity has a more favorable tax status than the aircraft leasing company; that there is a higher insurance risk premium attached to operating a leased aircraft in Papua and West Papua; or that the cost of the aircraft was unusually low. In regard to the latter point, however, the local government should naturally be wary of situations marked by asymmetric information where its evaluation of the remaining life of the aircraft is different from that by the market. In that case, the ex-post return will of course be different from the ex-ante evaluation, but this will only be revealed when the aircraft reaches the end of its life sooner than anticipated.

The possibility that in the short term the initiative by the local government has had some positive impact should not necessarily be dismissed. For example, it may have unlocked potential demand that was not appreciated by the airline industry and therefore not entertained. In the process, the local government may have contributed to the development of a better supply of air transport services. It can be expected, however, that with the advent of a more developed air transport industry and associated better market coverage and with concomitant improvements in aviation safety, local government's role in improving the supply of aviation services will not be through aircraft acquisition, but rather through ensuring that infrastructure facilities are adequate and operated efficiently.

3.3. Existing Plans for the Future

185. **Planning resources remain inadequate.** Owing to the nature of the GOI planning cycle and planning and budgeting procedures, at this point in time there is no formal multi-year aviation sector expenditure plan. This notwithstanding, investment plans and lists of proposed projects with associated indicative implementation timetables are periodically prepared. Because resources available for planning and project evaluation have been insufficient, both in terms of staffing and funding, few of the plans have benefited from proper in-depth analysis and evaluation. Such preparation work aimed at identifying the most worthwhile investments and developing well-justified expenditure programs, including detailed cost estimates, and implementation and procurement schedules is indispensable if funds are to be used to good effect. Implementation planning is also hampered in general by uncertainty regarding the level of funding that will be available.

²² Assuming that all key parameters, such as annual and periodic maintenance costs and remaining life of the aircraft, have been properly accounted for.

186. The 2004 master plan study of the air transportation sector²³ reviewed requirements at 6 Papua and West Papua airports (Manokwari, Sorong, Nabire, Merauke, Wamena, and Jayapura) and made indicative recommendations for improvements related mainly to aviation safety, expansion of terminal facilities to meet traffic growth and extension of the runway of Wamena airport to 1,800 m. At the time of the study, the new airport at Sorong was to be financed with mainly GOI funds after the funding under an ADB project had been cancelled. Apart from the extension of the runway of Wamena airport, not many of the recommendations of the master plan study have been implemented.

187. **Plans for the sector are ambitious.** The list of investment requirements prepared in 2008 by Dinas Perhubungan of Papua Province provides for runway extensions at 5 existing airports, betterment/upgrading through extension and strengthening of runways at 4 existing airports and construction of 5 new airports. In addition, in respect of Pioneer airports it provides for runway extension of one airport, betterment/upgrading of 17 airports and construction of 1 new airport. The upgrading relates mostly to improvement from grass strip to asphalt.

188. **However, proposals have not been costed, nor do they give details on the associated facilities and equipment required.** Also, no indication is provided on the state of readiness for implementation in terms of designs and specifications, bidding documents, etc. In principle, however, such investments are justified on account of minimum safety standards and/or traffic requirements.

189. Concept plans have also been prepared for new terminal buildings at Jayapura and Manokwari and possibly other airports.

3.4. Assessment.

190. **Further local government cost sharing is required.** Indications are that the aviation sector in Papua and West Papua has been underfunded in recent years. There are several reasons for this but important contributing factors are no doubt that available funding at DGAT level has been inadequate and that there is as yet no streamlined arrangement for cost sharing between local government and central government. This issue is compounded by the fact that expenditure program preparation requires a high level of technical expertise in a variety of fields and careful coordination of the various elements that make up the aviation system. In these circumstances a focused effort by an experienced team of staff or consultants is needed.

191. That overall funding has been inadequate for the identified needs is all the more regrettable considering that local government revenues have dramatically increased in recent years and could have contributed to help fund critical aviation sector requirements. This is illustrated by the fact that some local governments have applied budget resources to big ticket acquisitions such as aircraft, no doubt in recognition of the important role played by aviation in the life of their communities and with the aim of improving the level of aviation services for the benefit of the local economy and community at large.

192. **Proposed airport development investments still require further project preparation.** As to the indicative list of expenditures proposed for the near term future, this includes mainly: runway extensions and widening, runway upgrading in particular of Pioneer

²³ The Master Plan Study on the Strategic Policy of the Air Transport Sector of the Republic of Indonesia, July 2004

airfields, and unspecified aviation sector facilities and equipment in general. These are, in principle, well justified on account of safety standards and/or traffic requirements. There is a need, however, to have these expenditures properly costed and prioritized, and then to proceed with preparing integrated implementation and acquisition programs on an airport-by-airport basis.

193. **With continuing growth in traffic, terminal buildings at the 6 - 8 most important airports will need expansion and/or modernization** and this should be addressed as soon as the above safety and airside requirements are being met. This will likely pose financing challenges as under the current airport administration regime the funds have to come from central government. But central government's finances will remain constrained for the foreseeable future and there is unlikely to be much enthusiasm for these projects as the aviation and airport system of Papua and West Papua as a whole is far from recovering its costs, in particular in light of current charging and cost recovery policies for aviation and airport sector facilities and infrastructure. This underlines the need to formulate appropriate and streamlined cost sharing arrangements.

194. **Asset management needs to be taken seriously.** While key facilities in the aviation sector are generally better maintained than in other sectors because safety considerations require adherence to minimum standards and norms, which are established under international agreements, indications are that there is scope for improvement in maintenance operations and practices. The 2004 Air Transportation Master plan Study found that maintenance expenditures represented only about 15% of operating expenses and that there was no reliable inventory of existing infrastructure and facilities. The situation is unlikely to have been different in Papua and West Papua. This points to the need to seriously consider establishing an asset management system.

3.5. Recommendations

3.5.1. Focus on Safety and Efficiency of Aviation.

195. **Improving safety and efficiency air transport in Papua and West Papua will have dramatic effects on costs in remote areas.** In view of the critical importance of aviation in Papua and West Papua's transport sector the underlying aim of expenditure program preparation should be to enhance aviation safety and to seek improvements in facilities (navigation, landing aids, runway conditions) that will contribute to improving the efficiency of the airline industry and hence to a lowering of costs. Investments that will allow the airline industry to achieve higher operating efficiency, e.g. fewer delays or flight cancellations because of weather conditions, should receive high priority. Considering that transport volumes are still limited on most routes in Papua and West Papua, air transport will remain more economical than road transport if the cost of the road infrastructure is included in the comparison. The highlands in particular will continue to be dependent on air transport for the foreseeable future, even if plans are developed and implemented for providing road access. The objective should therefore be to establish and maintain an infrastructure and an air transport system of world-class efficiency that will lead to a further lowering of air transport costs.

196. **Aircraft acquisition by local governments is unlikely to be the most efficient use of funds.** It is unlikely that with the advent of a safer and more efficient aviation and air transport sector and associated better market coverage by private airline operators, local government's role in improving the supply of aviation services would be through aircraft acquisition. The

benefits of such investments by local government over cost sharing in airport and terminal building expenditures should be clearly demonstrated.

3.5.2. Collaboration Strategy.

197. The key to meeting the challenge of improving air transport safety and increasing capacity in response to growing demand is close collaboration between MOT/DGAT and Papua and West Papua in formulating and implementing improvement programs for the Papua and West Papua aviation sector. Such collaboration would be based on the following principles:

- **A commitment from MOT/DGAT to provide technical input in program design and preparation** while Papua and West Papua would commit to much greater cost sharing.
- **An understanding on cost sharing** would be predicated on Papua and West Papua continuing to receive the same share of central government allocations as in the past.
- **MOT/DGAT to focus on actions to bring the Papua and West Papua aviation system up to appropriate safety standards using primarily central government funds.**
- **Papua and West Papua regional governments should assume cost sharing for maintenance, rehabilitation and extensions of runways and upgrading and improvement of terminal buildings and associated facilities.**
- **Development of arrangements with MOT/DGAT for greater involvement of the private sector** in the management of passenger areas of the terminal buildings, for example through an association of franchise holders operating in and around the terminal building.

3.5.3. Implementation and Management Aspects.

198. Expenditure planning and programming in general:

- **Establishment of collaboration mechanism with DGAT.**
- **Identification of study requirements** to firm up components of the expenditure program and preparation of TOR and request for proposals
- **Initiation of basic asset management system** starting with condition inventory of some essential facilities

199. In respect of terminal building expansion, the aim should be the development of cost effective concepts and approaches. In particular, these concepts and approaches should:

- **Provide for stage construction**, incorporate local themes and building materials when competitive with materials sourced from outside Papua and West Papua and be geared towards the profile of the traveling public.
- **Seek as much private sector participation as is possible** under current laws and regulations, e.g. management and maintenance of public areas.
- **Give greater attention to facilitating multimodal transport** by improving the facilities and arrangements for intermodal connections

200. For the interim, minor upgrading and management of existing terminal building facilities should aim at:

- **maximizing the use of existing space** and making passenger areas more client-friendly, inter alia, by seeking the collaboration of franchise holders
- **facilitating multimodal transport**

4 Power

4.1. Current Status of the Sector

201. **Papua and West Papua provinces have relatively rich primary energy resources for power generation**, both fossil and renewable. According to the Ministry of Energy and Mineral Resources (MEMR), Papua has 24.14 TSCF²⁴ natural gas resources, 153.42 million tons of coal reserves, 121.15 million barrels of oil reserves and around 50 MW of geothermal resources. In addition, Papua has very rich hydropower resources. According to MEMR's estimates, the total hydropower potentials in Papua amount to 24,974 MW, over 140 times of the existing installed generation capacity in the provinces.

202. **The geographical conditions, and the distributions of population and economic activities in Papua and West Papua Provinces, make the supply of electricity in the provinces extremely challenging.** By the end of 2007, the per capita electricity consumption was 194 kWh, only 36 percent of the national average. The electrification ratio was only 27.5 percent, among the lowest of all the provinces in the country.

203. **PLN is the monopolistic power supplier in the two provinces** and owns and operates all the major public generation, transmission and distribution assets. A few large multinational mining and oil companies own and operate some large captive power generation facilities but exclusively for their own uses. Finally, there are a number of isolated power sources, such as solar PV panels, micro-hydropower stations, and small diesel generators to supply electricity in the remote areas. These isolated facilities were mostly financed by the government budget under a small and fragmented rural electrification program. There are no integrated large power systems in these two provinces. Electricity is supplied by a handful of isolated small urban distribution grids powered mostly by aged diesel generators.

204. **MEMR has set very ambitious electrification targets.** The long-term energy sector development plan²⁵ recently published by MEMR has set electrification targets for the Papua and West Papua provinces. According to the plan, the electrification ratios of Papua will reach 50 percent by 2010, 63 percent by 2015, 75 percent by 2020 and 90 percent by 2025. This is obviously a very ambitious development targets, especially for the period from 2009 to 2015. Significant amount of investment and project preparation and implementation efforts will be required to achieve these targets.

205. **Yet PLN is not so ambitious.** There are three principal ways of reaching the target, (i) through an expansion of the main grid to un-served areas, (ii) the establishment of isolated grids for relatively isolated areas and (iii) through individual/institutional solar PV systems, for relatively dispersed areas and very small loads where even small independent grid systems are not viable. PLN will be mainly responsible for grid extension while the government is mainly providing off-grid solutions to un-connected consumers. According to PLN's ten year development program (2009 to 2018), the electrification ratio will reach 32.2 percent by 2010, 38.4 percent by 2015 and 43 percent by 2018.

²⁴ Trillion Standard Cubic Feet

²⁵ Rencana Umum Ketenagalistrikan Nasional(RUKN) 2008-2027, Ministry of Energy and Mineral Resources – Republic of Indonesia

Table 15: Electrification Targets for Papua and West Papua

	2007 (actual)	2010	2015	2020	2025
Government	27.5	50	75	90	100
PLN	27.5	32.2	38.4	43.0*	

* 2018 targets

4.1.1. Barriers to Development of Power Sector Infrastructure

206. **Lack of strong local government leadership.** Nowhere in the world has successful electrification been achieved without strong local government ownership, leadership and coordination especially when access rates are low. Strong public sector leadership and sustained political commitment have been key factors in successful electrification programs in developing countries across the world. We have not seen this leadership and commitment from local government in Papua. While local governments have greater responsibility for electrification under the policy of decentralization, ambiguity as to their precise role and also a lack of experience in the sector is preventing them from rising to the challenge.

207. **Failure to follow cost recovery principles.** Electrification is neither viable nor sustainable without being able to cover its full costs through two sources: customer tariffs and public subsidies. Current electricity tariff level is too low to cover the supply cost of electricity and the almost fully diesel based power generation makes cost recovery tariff system almost impossible in Papua given the limited affordability of the consumers in the provinces.

208. **Weak private sector participation.** The level of private sector investment in power sector of Papua is very low as compared with other parts of the country. Although there are some significant private investments in oil, gas and mining sectors, the perspectives of private investments in power sector infrastructure are not encouraging.

4.2. Recent Developments

209. **Development of the power sector infrastructure in Papua is still at very early stage.** Expansion of PLN's power system in the past few years focused on installing diesel generators and expanding the medium and low voltage distribution system in various PLN's small urban power systems. From 2002 to 2007, PLN's installed generation capacity increased from 137.0 MW to 165.8 MW, with an annual average growth rate of 3.9 percent. The length of its 20 kV distribution lines increased from around 2,000 km to 2,257 km.

210. **By the end of 2007, PLN has established ten small urban electric power systems in all the major cities and towns in the two provinces.** The total installed generation capacity of these systems was 165.82 MW of which, only 4.04 MW is hydropower, the rest are diesel generators. In 2007, the total electricity generated was 604.62 GWh, of which only 18.51 GWh was generated by hydropower and diesel generators generated 586.11 GWh, representing a very expensive fuel mix.

211. **Low tariffs mean that PLN has no incentive to expand their network.** PLN field offices reported substantial pent up demand from residential and commercial users.

212. **Facilities are in poor condition.** As most of the diesel generators in the systems are aged, the total dependable capacity of the generation system was 99 MW, representing only around 60 percent of the installed capacity and leading to very lower supply reliability. Electricity consumers are suffering serious power shortages all over the provinces.

213. The highest voltage level of the power system is 20 kV. By the end of 2007, the total length of the 20 kV distribution lines was 2,257 kilometers and there were 1,732 20 kV transformers in the system with a total capacity of 172.37 MVA. Again, most of these small distribution systems are primitive and outage rates of the systems are high. In 2007, there were 1,331 outages of the 20 kV lines - 59 outages per 100 km, twice as high as the national average.

214. **PLN's power generation system is almost purely diesel based.** Following the rapid rising of oil prices in the international market, the removal of subsidies on petroleum products by the Government in 2005 and the Government's suspension of electricity price increases since 2004, PLN's supply costs are much higher than the regulated electricity prices, significantly hindering PLN's motivation to expand the capacity of power supply infrastructure and preventing private investments in the sector. According to PLN's statistics, in 2007, the average electricity supply cost was Rp 2,195 /kWh, while the average sale price of electricity was only Rp 624/kWh²⁶.

215. **In recent years, PLN has started to diversify the fuel mix** of its generation system by investing in coal fired power plants as part of the national 10,000 MW coal fired power generation expansion program, and in small and mini hydropower projects. Three small and mini hydropower projects with a total capacity of 23 MW are under construction and financed by the Asia Development Bank. The total project investment cost is estimated at US\$ 71 million.

216. **Substantial privately owned captive power infrastructure exists.** In addition to PLN, some large multinational companies own and operate significant amount of captive power generation facilities in Papua. For example, Freeport Corporation owns and operates a large coal fired power plant with installed capacity of 190 MW (3X65 MW) and five heavy duty diesel generators of 25 MW (5X5MW), all operating at a frequency of 60 Hz. It also owns and operates a small 50 Hz system, comprising a number of small diesel generators with installed capacity of around 4.5 MW and supplying electricity to its auxiliary facilities, such as administrative offices, hotels, schools, etc. None of these power facilities, however, are accessible to consumers outside the company.

217. **Government's electrification budget has mainly provided grant financing to small isolated generation facilities, such as solar PV panels, in remote areas.** The typical annual spending of the government is around US\$ 8.5 million. This usually includes around US\$ 6.5 million by local government through APBD and around US\$ 2 million from MEMR's rural electrification budget. The impact of these grant supports appears very limited.

218. **Small-scale rural power projects suffer from a lack of coordination and a whole-of-life approach to investments.** Finally, under small scaled and fragmented rural electrification programs financed by both central and local governments, limited number of isolated solar PV systems and micro-hydro schemes were installed in some remote areas of the provinces. No comprehensive information is available on the status of these facilities, yet field visits and anecdotal evidence suggest that there is little thought given to these assets after the initial investment is made.

²⁶ Data source: PLN.

4.3. Existing Plans for the Future

219. **PLN has developed the long-term national investment plan and this plan has been approved by the MEMR recently.** The power sector investment plan of Papua is part of the plan. The objective of the investment plan is to meet the growing demand in Papua with the least cost. This plan was developed based on the electricity demand growing at 8.6 percent annually. The electricity demand forecast was developed based on the assumptions of annual average GDP growth rate of 5.7 to 6.1 percent and annual population growth rate of 2 percent.

220. **Demand for power is predicted to grow substantially.** According to the demand forecast, the electricity consumption will increase from 562.2 GWh in 2008 to 1,278.2 GWh in 2018. The peak demand will grow from 132 MW in 2008 to 282 MW in 2018. Most of the electricity demand will be from major urban centers in the provinces, such as Jayapura, Sorong, Timika, Merauke, and Manokwari. The electricity demand of other parts of Papua only accounts for less than 10 percent of the total.

221. **To meet the increasing demand, 443 MW of generation capacity will be installed in the provinces in the next ten years.** Nearly 70 percent of the new capacity will be coal fired. Hydropower will account for 15 percent. Diesel capacity accounts for around 7 percent, the rest will be gas and geothermal. Associated with the investments in power generation infrastructure, distribution facility will also be constructed to connect more consumers in the provinces.

222. **Total financing requirements of this investment program were estimated at US\$ 929.7 million,** including US\$ 634.7 million for power generation investments and US\$ 295 million for power distribution infrastructure investments. It is expected that around US\$ 838 million will be financed by PLN with public financing resources, and only US\$ 85.2 million will be financed by private independent power producers (IPPs).

223. **PLN's power sector investment program clearly focuses on system expansion in the urban and coastal areas** while there are more economic activities and population density is relatively high. *Very few resources will be allocated to the vast rural areas and/or highland areas where poverty ratio is high but supply cost is also high. It appears that there are no systematic power sector investment plans developed by the provincial government authorities.* Past experience also shows that the government funding rural electrification program seems fragmented and not sustainable. Finally, there no signs that private companies, especially those multinationals who have significant interests in the provinces, will play an active role in developing power sector infrastructure.

4.4. Recommendations

224. **Cooperation between PLN and local governments must be improved.** The local government should coordinate with PLN for the development of power sector infrastructure and play a leading role in providing off-grid solutions in vast rural areas. To this end, extensive technical assistance may be required to strengthen the capacity government's capacity. A conventional solution to address this is for an international financial institution or donor to provide funds for technical assistance.

225. **Fuel mix must be diversified.** It is necessary to find ways to minimize the costs of serving both new and existing electricity connections. In this regards, the top priority should be to improve the generation mix through better planning and coordination. The current PLN's

generation system is almost purely diesel based. Feasibility should be explored to develop the very rich hydropower resources and other lower cost generation technologies. Improved planning that optimizes benefits from economies of scale can also play an important role. For example, there is currently a tendency to provide small-scale technological solutions, such as the micro-hydro system, and small coal fired power plants. However, large scaled power generation options can produce electricity at much lower cost.

226. **Tariff reform must be initiated.** It is necessary to find ways to move tariffs towards greater cost recovery. Even if all technical and institutional options to minimize costs are taken up, it is still likely that the full cost of providing service would be above the current national tariff. While the full cost recovery tariff may not be affordable or politically acceptable, it would still be helpful to promote the principle that high-cost areas should have higher tariffs. This is important because electricity tariffs send important signals indicating where the cost load should be located.

227. **Financing should be sought from a diversity of sources: public and private.** It will be necessary to address the question of financing. This review has identified a gap between the financing options available and the financing needs to achieve the government's electrification targets in Papua. In this aspect, public sector should increase its funding supports to the development of power sector infrastructure while private sectors should also be encouraged to invest in the power sector so that the government's electrification targets can be achieved.

228. For public sector, in addition to PLN's financing program, the government should consider to channel more budgetary supports in a sustainable and systematic way. In this regard, an electrification fund could be set up to provide concessional financing supports to both public sector and private sector investments in power sector. The fund sources could include government budget and concessional financing from international financial institutions and donors.

229. Regarding the private investments, the priority should be to encourage large multinational oil and gas companies who have interests and/or operations in Papua to participate in the development of power supply infrastructure, through their existing community development programs and/or certain types of private-public-partnership (PPP) arrangements. In addition, private investors should be encouraged to invest in power generation facilities as independent power producers (IPPs). Local NGOs and communities should be allowed to play an active role in operating and managing some of the small scaled power supply infrastructures financed by the government with fees to cover at least the operation and maintenance costs.

Box 12: Micro Hydro for Off-Grid Solution

Local Government of Pegunungan Bintang Regency has conducted several feasibility studies on micro hydro potential in their area. The capacity of proposed micro hydro station is ranging from 20-40 KW. Even though the studies are basic, it shows great commitment of local government in developing micro hydro potential as solution for increasing access to electricity. Utilization of hydro potential will replace diesel generator. Typically for operation and maintenance of a small isolated grid supplied by diesel generator local government spends around US\$1,000-1,500/day. This high operating cost also contributed by fact that diesel fuel shall be flown into the area because of land access is not available.

Long term sustainability of off-grid electrification depends on more than technology. It requires effective prioritization and planning to enable economic choices of technology, appropriate infrastructure to ensure that services are provided over the long run. To maximize the chances of

sustaining operation of off-grid electrification projects over the long term, their design must ensure that all key actors along the value chain benefit.

Project design must not be technology driven. A cost-benefit analysis of alternative including grid extension must be carried out to determine least cost solution for each specific project location. Technology choice must be based on practical consideration and final choice must be left up to the service provider who usually has other investment parameters to consider.

For Papua, a thorough rural electrification study is needed, not only to look into technical and financial aspect, but also in institutional aspect to ensure sustainability. Off grid electrification program must complement grid expansion, in Indonesia case; PLN expansion. The government recognition of the role of off-grid options is important; its support, including subsidy commitment, and us of light-handed and simplified regulation, is essential. If the local government is to have a significant implementation role, the implementing agency should appoint competent and dedicated project management staff.

Box 13: Public Private Partnerships for hydro project development to supply power to Freeport

Local government presented to the mission feasibility studies of Urumuka Hydro Power Project (300MW) and Detail Engineering Design of Paniai Hydro Power Project (in total of 1000MW). Basically these two hydropower candidate are in the same river system. In current PLN development plan, these hydro power projects are not in the list to be developed by PLN.

Looking at the demand and nearest load center around the area, Freeport mining activity is the most potential off-taker for these hydro projects. Timika (90-km) and Nabire (120-km) are the nearest city from project site with 8MW and 6MW peak load demand respectively. Freeport and other captive power user demand forecast will be the main determinant of timing to develop this project. Currently Freeport operates 190MW coal power plant, and soon needs additional capacity to match electricity consumption to support production expansion demand.

Strong will from Freeport to work with other stake holders is instrumental for development of this hydro project. Freeport cannot put their mining operation at risk because of power supply reliability. Certainty of Commercial Operation Date (COD) and reliability of supply during operation is crucial factor for Freeport in deciding their involvement in the project.

Commercial arrangement that incorporates benefit and risk of all stakeholders will be the key of project success.

5 Water Supply

5.1. Current Status of the Sector

5.1.1. Water sources²⁷

230. Today, fewer than 25% of households in Papua and West Papua have access to piped water, which is inexpensive and of reasonable quality compared to alternative sources. The majority of the population continues to rely on surface water, groundwater and rainwater (Table 16). With the exception of the highlands in Papua and the mountainous areas in Papua Barat, where surface water is relatively abundant all year round, water is in short supply during the dry season and is deemed unfit for human consumption without some form of treatment (such as chemical filtering or boiling)²⁸. Water borne gastrointestinal disease is a severe problem in Papua and West Papua.

Table 16: Primary Water Sources for Human Consumption, % total

Source	Papua	West Papua	Total
Piped water, urban	10	14	11
Piped water, rural	11	8	10
Groundwater	21	39	25
Surface water	49	26	44
Rain water	8	12	9
Other	1	0	1
Total	100	100	100

Sources: WB estimates, based on PODES (2006)

231. There is a drive for increased access to piped water. The latest national medium-term development plan (RPJM) aims to provide 40% of households in the country with access to piped water by the end of 2009. The National Action Plan on Clean Water, issued by the Ministry of Public Works (MPW) in 2004, describes a strategy to halve the proportion of people without sustainable access to safe drinking water by 2015, in accordance with Millennium Development Goal #7. The primary means to achieve this is to improve access from its current level of about 18% to 62% in 2015, and reduce dependency on other water sources. This requires a major increase in production and distribution capacity (through a combination of system optimization and system expansion) and the number of household connections. In addition, the Government requires that all water utilities supply potable (as opposed to clean) water by the end of 2008²⁹.

232. Most observers agree that it is unlikely that the Government will meet its self-imposed deadlines, but there is general agreement that GOI remains committed to a substantial increase in the number of piped water connections, as was recently confirmed by the vice-president's call for providing 10 million new house connections by 2013 (up from about 6 million in 2008).

²⁷ The scope of this section is limited to municipal water supply only (it does not discuss water supply for agricultural or industrial uses).

²⁸ This section was partly based on interviews with the heads of the provincial water resources departments of Papua and West Papua (Messrs Sigana and Malpac), the general director of PDAM Kab. Jayapura (Mr. Butar Butar), the general director of PDAM Kab. Manokwari (Mr. Taran) and officials of BAPPEDA Provinsi Papua Barat, and the public works department of Kabupaten Manokwari.

²⁹ As required by Government Regulation 16 of 2005.

5.1.2. Piped water supply in urban areas – current state of affairs.

233. In 2005, the urban population of Papua and West Papua was approximately **520,000**, distributed over eight towns of over 25,000 inhabitants (Jayapura, Biak, Merauke, Sentani, Serui and Timika in Papua, and Manokwari and Sorong in West Papua). About half of the population in these towns had access to piped water provided by municipal water utilities, most of which are (wholly or partly) owned by kabupaten/kota governments.

234. **The organization of the piped water sector remains highly fragmented**, in both provinces, with over a dozen PDAMs providing piped water, of which only PDAM Kabupaten Jayapura operates more than 20,000 connections (Table 17). In recent years, the performance of most utilities has deteriorated, as they can no longer rely on central government grants and loans from multilateral and bilateral sources, formerly major sources of funding. (Exceptions are the utilities of PDAM Sorong and PDAM Biak, which have established joint ventures with a Dutch water utility – Waterleidingmaatschappij Drenthe or WMD –providing managerial and financial support.³⁰)

235. **Maintenance of existing systems has been a chronic problem** in most towns. Revenues are usually far lower than the full cost of the service due to downward political pressure on tariffs. As a result, most utilities have resorted to ‘stop-gap’ measures including deferring essential maintenance expenditures and defaulting on loans from the Ministry of Finance (MoF). Water losses, both physical and administrative, average 50% of production. In some areas, groundwater abstraction through individual and often unregistered wells has started to cause seawater infiltration. Water quality and regularity of service delivery are declining, especially in urban areas, and none of the utilities currently supplies potable water.

Table 17: Water Utilities in Papua and West Papua

Water Utility	House Connections ('000)	Household Coverage (% LG)*	Arrears on MoF Loans (IDR b)	Owned by**
Papua	36.6	10	33.9	
PT. War Besrendi (Biak)	5.1	26	6.1	LG (49%), WMD (51%)
PDAM Kab. Jayapura	23.9	41	27.7	LG (100%)
PDAM Kab. Jayawijaya	0.5	1	–	LG (100%)
PDAM Kab. Merauke	2.8	9	–	LG (100%)
PDAM Kab. Nabire	1.5	5	–	LG (100%)
PDAM Kab. Paniai	NA	NA	–	LG (100%)
BPAM Kab. Timika	NA	NA	–	MPW (100%)
PDAM Kab. Yapen Waropen	2.9	21	–	LG (100%)
Papua Barat	16.8	14	22.8	
PDAM Kab. Fakfak	3.1	27	–	LG (100%)
PDAM Kab. Manokwari	3.9	13	8.3	LG (100%)
PT. Tirta Remu (Sorong)	9.7	21	14.5	LG (49%), WMD (51%)
Total	53.3	11	56.6	

Sources: MoF (2008), WB estimates, based on PERPAMSI (2004) and BPS (2005)

* Coverage of entire local government, assuming five persons per household

** LG = local government, WMD = Waterleidingmaatschappij Drenthe, MPW = Ministry of Public Works

³⁰ WMD has also signed, but not started implementing, JV agreements with Kab. Jayapura and Kabupaten Jayawijaya. Kabupaten Merauke and Kabupaten Manokwari cancelled JV agreements signed with WMD.

5.1.3. Piped water supply in peri-urban areas – current state of affairs.

236. **Peri-urban water supply was constructed by central government, but, largely, has not been maintained.** Towns with a population of 5,000 – 25,000 are classified as ‘peri-urban’. Most of these towns possess small-scale systems that were financed and constructed by the Ministry of Public Works, and usually supply 200 to 500 households. Formally, the responsibility for the management of such systems lies either with the kabupaten/kota government public works department (Dinas PU) or with community groups. In practice, however, management units either never were established or are no longer functioning. This problem is closely connected to the fact that households connected to the systems usually pay nothing for water. According to detailed records of the provincial water resources department of Papua, the majority of the small-scale systems have fallen in disrepair. The actual coverage rate of piped water supply in Papua may therefore be substantially lower than indicated by official statistics.

5.1.4. Piped water supply in rural areas – current state of affairs.

237. At present, fewer than 10% of over 3000 villages (of up to 5000 inhabitants) are believed to have access to piped water. Most of these ‘micro-systems’ in are financed from two sources:

- **Central and provincial government grants.** Through the *Program Nasional Pemberdayaan Masyarakat* or PNPM, central and provincial government channel grants for small-scale infrastructure to villages. The utilization of the grant is largely determined by the villages themselves. A sample of 168 grants indicated that piped water supply systems were the third most popular investment, after roads and electricity. Most grants for water supply (IDR 100 million per village in 2008) were used to construct small-scale gravity-fed systems with up to 100 connections.
- **Municipal government grants.** Since 2005, the central government provides kabupaten/kota with a special allocation (*Dana Alokasi Khusus* or DAK) for the water supply sector. Several kabupaten/kota, such as Manokwari, use the allocation to finance piped water supply systems in villages. A typical system consists of 5 to 15 public taps, gravity-fed by rubber pipes with a built-in filter, with a raw water source 1 to 2 km from the village. The average cost of a system is IDR 200m (approximately USD 20,000).

238. **As is the case with most peri-urban systems, many rural water supply systems have fallen in disrepair** shortly after they were installed, primarily because institutions are not in place to manage the systems and collect revenue for maintenance and repairs.

5.2. Existing Plans for the Future

239. **Provincial and kabupaten/kota government plans for the water sector are dictated by their sectoral mandates, as outlined in Government Regulation 38/2007.** According to this regulation, provincial governments are responsible for the regulation of government affairs in the water sector that affect more than one kabupaten/kota government (*lintas kota/kabupaten*), whereas kabupaten/kota governments are responsible for the provision of water to citizens in their jurisdictions. In Papua and West Papua, kabupaten/kotas established before 2001 have delegated this responsibility to their respective water utilities³¹. In newly

³¹ Kota Jayapura is a special case. In 1993, this Kota was split off from Kabupaten Jayapura, but the PDAM remained fully owned by the Kabupaten and supplies both the *Kabupaten* and the *Kota*.

established kabupaten/kotas, the public works department is held responsible for retail water supply.

5.2.1. Central government plans

240. No known plan exists for Papua or West Papua.

5.2.2. Provincial government plans

241. **Papua.** The provincial water resources department of Papua is currently preparing a 2009-2014 master plan for municipal water supply and urban drainage in and around Jayapura, based on reliable and accurate data (which, according to the head of the department, are currently not available). It has also budgeted funds for preparing water supply master plans for the capitals of six newly created kabupaten/kotas, and plans to establish management units (in the form of *Badan Layanan Umum-Daerah* or BLU-D) in sub-kabupaten/kota capitals to improve peri-urban water supply systems.

242. **West Papua.** This province does not have a water master plan. It is currently preparing a master plan for water resources, covering two municipalities (Kota Sorong and Kabupaten/Kota Manokwari). This draft plan³² lists problems with water supply (such as high levels of unaccounted-for-water in PDAM Manokwari), but does not identify ways for addressing these problems.

5.2.3. Kabupaten/Kota government plans

243. **Information was not available for kabupaten/kota government plans for peri-urban and rural water supply.** Kabupaten are normally not involved in urban water supply, although some kabupaten/kotas finance part of the investment requirements of their water utilities (the province of Papua also provides such incidental financial support). The mission has reviewed the business plans of PDAM Jayapura and PDAM Manokwari which, taken together, supply over 50% of all house connections in the two provinces.

- **Business plan of PDAM Jayapura (2009-2015) projects strong growth.** The PDAM expects the population of its service area to increase from 260,000 to about 450,000 in 2015. To serve this population, it requires an increase of its production capacity from 515 l/s (in the rainy season) to 850 l/s. This estimate is based on the following assumptions: 80% service coverage, 25% UfW, and average consumption per connection remains unchanged. As a first step, it will develop in 2009 an intake from the Bufer River with financial support from the provincial government. With a capacity of 50 l/s, this intake will only cover 15% of the extra capacity needed by 2015 and therefore is only a temporary solution. The PDAM is currently searching for new raw water sources to secure supply in the long term. The PDAM expects to finalize a five-year business plan by the end of 2008.
- **Business plan of PDAM Manokwari (2008-2013) also projects strong growth.** This PDAM intends to increase coverage of its service area of 60,000 persons from 45% in 2008 to 60-70% in 2013. This requires an investment in 2000 new connections (to be financed by the PDAM itself) and an increase of its production capacity of about 50% from its current level of about 150 l/s (to be financed by the province and other external sources). BPKP (a government auditing agency) is

³² *Penyusunan Master Plan Sumber Daya Air Baku di Kabupaten Sorong dan Kabupaten Manokwari Propinsi Papua Barat, Laporan Antara, Oktober 2008*

currently preparing a five-year business plan for the PDAM, covering the period 2008-2013, to be completed by the end 2008.

244. Neither PDAM has plans to provide its customers with potable (as opposed to clean) water, as required by the end of 2008 according to PP16/2005.

5.3. Recommendations

5.3.1. General observations.

245. **As in most provinces in Indonesia, the number of households with access to piped water in both Papua and West Papua is far below national development targets,** and none of the water utilities are currently providing potable water. However, several factors affect the development of the piped water supply systems in Papua and West Papua are not encountered elsewhere in the country to the same degree:

- **Low urbanization rate.** At present, only 20% of the population of the provinces lives in urban areas, which is far lower than elsewhere in Indonesia. Moreover, urban population densities are low (5 to 10 persons per Ha). The combined impact of these factors is a relatively high unit cost for providing piped water supply systems.
- **High transport costs.** Because of unique geographical circumstances, the unit costs of construction materials is significantly higher than elsewhere in Indonesia³³, imposing further upward pressure on the construction cost.
- **Variation in raw water availability.** There is no 'one-size-fits-all' solution for Papua or West Papua. Some areas are blessed with abundant natural water resources (notably the highlands). In contrast, the majority of the population in the southern lowlands continues to be dependent on harvesting rainwater.

246. **In summary, providing piped water is more expensive and – from a planning perspective – more difficult than elsewhere in Indonesia.** At the same time, the need for access to safe water remains as high as ever, given the high and rising incidence of gastrointestinal ailments and other water-borne diseases.

247. In the absence of a long-term development plan for the municipal water sector in Papua and West Papua, we will first present indicative long-term development targets, then provide estimated funding requirements, and conclude with a list of short- and medium-term development priorities.

5.3.2. Long-term development targets.

248. **The Government is currently preparing a national development plan for 2010-2014.** We assume that the quantitative targets for the municipal water sector will be consistent with the vice president's plan to add 10 million house connections by 2013, but – at the same time – be less ambitious than targets mentioned in the 2004 National Action Plan on Clean Water (which no longer appears realistic). Against this background, we assume that both provinces will seek to provide 80% of the urban population and 60% of the peri-urban and rural population with access to piped water by 2020. In 2020, the total population of both provinces is estimated at about 3.5 million persons, of which over 900,000 will live in urban areas (Table 18).

³³ According to BPS, the average construction cost index was 44% above the national average in 2007.

- To provide piped water to 80% of the urban population, the number of connections must triple from 53,000 in 2005 to almost 150,000 in 2020.
- To achieve 60% coverage of the non-urban population, the number of connections must increase at a much higher rate, from 50,000 to over 300,000.

Table 18: Population and Household Connections, 2005 and 2020 (indicative)

Province	Population ('000)			Household Connections ('000)		
	2005	2020	Increase	2005	2020	Increase
Papua						
- Urban	420	756	336	37	121	84
- Peri-urban/rural	1,403	1,888	485	40	227	187
West Papua						
- Urban	94	170	75	17	27	10
- Peri-urban/rural	523	704	181	10	84	74
Total						
- Urban	514	926	412	53	148	95
- Peri-urban/rural	1,926	2,592	666	50	311	261

Sources: WB estimates, based on PERPAMSI (2004) and BPS (2005)

Assumptions: annual population growth rates: 4% p.a. (urban) and 2% (non-urban); household size: 5; coverage targets: 80% (urban), 60% (rural)

5.3.3. Indicative funding requirements.

249. The total investment cost is estimated at approximately USD 250 million³⁴ (in constant 2008 prices). The total investment cost of the required increase in house connections consists of the cost of installing the new connections themselves, plus required investments in water intakes, transmission mains, water treatment plants, distribution networks and other supporting infrastructure. The average cost is lowest in areas where raw water is available from springs (such as the highlands in Papua), which requires relatively small investments in pumps and treatment facilities. The average cost is highest in urban areas, where raw water is usually not available from nearby sources (thereby necessitating substantial investments in transmission mains), or requires expensive pumping systems if the water supply system relies on groundwater. Based on unit cost prices used by the Ministry of Public Works, the average investment cost of a new house connection, in constant 2008 prices, was estimated as follows:

- **Urban: US\$ 880**
- **Peri-urban / Rural (other than highlands in Papua): US\$ 720**
- **Highlands in Papua: US\$ 600**

250. Based on these assumptions, the total investment cost of the required increase is estimated at approximately USD 250 million (in constant 2008 prices), consisting of:

- **Urban: US\$ 880 x 95,000 ≈ appr. USD 80 million**
- **Peri-urban / Rural (other than highlands in Papua): US\$ 720 x 152,000 ≈ appr. USD 110 million**
- **Highlands in Papua: US\$ 600 x 109,000 ≈ appr. USD 60 million**

³⁴ Unit cost assumptions based on the 2004 National Action Plan for Water Supply (rehabilitation and increase in urban connections), and WB mission to Papua (increase in rural connections).

251. Of this amount, about USD 185 million would be allocated to Papua, and the remainder to West Papua.

5.3.4. Indicative O&M financing requirements.

252. **The cost of operations and maintenance (O&M) of a piped water supply system is largely determined by the source of raw water.** If the system largely depends on groundwater, pumping and treatment costs are substantially higher than for a system that sources its water from springs. In a sample of water utilities in Java, the O&M cost of spring-fed systems was approximately USD 0.10 per m³ of water sold. In contrast, the O&M cost (per m³ of water sold) of systems that relied on surface water or groundwater were USD 0.20 and USD 0.35, respectively. These estimates were adjusted for Papua and West Papua because of unusually high construction cost prices. Assuming an average O&M cost of USD 0.30 per m³ of water sold (in constant 2008 prices) throughout both provinces, the annual O&M financing requirements in 2020 are approximately (459,000 connections x 219³⁵ m³ of water sold per connection per year x 0.30 ≈) approximately USD 30 million.

5.3.5. Proposed Short- and Medium-Term Development Priorities (2010-2014)

253. **At present, provincial and kabupaten/kota governments have not prepared clear medium- to long-term strategy for the development of the municipal water sector.** The absence of such plans appears to reflect limited planning skills, coupled to the low profile of the sector (vis-à-vis roads, for example).

254. **Institutional reform of the piped water supply sector is the single most important development priority.** In Indonesia, most investments in piped water have not yielded the expected results. This is especially the case for peri-urban and village water supply systems, many of which cease to function within 3 to 5 years, in the absence of a unit with the authority and revenue to operate and maintain the system. Investments in systems managed by water utilities tend to have a longer economic lifetime but as long as water tariffs are determined by political instead of commercial factors, as the case virtually everywhere in Indonesia, utilities will not become financial viable, and therefore able to maintain and expand the piped water systems in their service area.

255. Options for institutional reform include: (i) the establishment of a public service agency (BLU), as proposed by the provincial water resources department of Papua, (ii) the establishment of a joint-venture between a PDAM and a private investor with a majority share (as explored by WMD, although this model requires modification to meet Indonesian legal standards³⁶), and (iii) the establishment on an independent regulatory body (this option enjoys the support of the provincial government of Papua for the regulation of tariffs by PDAM Kabupaten Jayapura).

256. **Expansion of coverage in distressed peri-urban and rural areas should be a high priority.** As mentioned above, the majority of households in Papua and West Papua remain dependent on water sources that are scarce in the dry season. The absence of clean water is

³⁵ This amount is based on a household size of 5, and average sales of 120 liter per person per day.

³⁶ In recent years, WMD has sought to establish joint-ventures with PDAMs in Eastern Indonesia, whereby WMD would have a 51% share in the joint-venture, and the PDAM 49%. The model has recently been criticized because: (i) joint-ventures were granted a concession without tendering, and (ii) PDAMs have transferred asset to joint-ventures, which are formally still owned by MPW.

most pressing in the lowland areas, where rainwater is sometimes the only source. These include: Yapen, Waropen, Asmat, Merauke, Boven Digoel and Mappi in Papua, and Kaimana and Fakfak in Papua Barat. These areas should receive priority in the allocation of available financing for expansions of piped water supply systems.

257. Provision of access to long-term financing to commercially viable water utilities should be undertaken in Papua and West Papua. The Government is currently implementing a program of PDAM debt restructuring, as a means to establish municipal water utilities on a sound commercial footing. However, because of the absence of a market for long-term capital in Indonesia, even financially sound water utilities will have difficulties to finance network expansion, which typically has a long payback period. We encourage the Government to develop market-based facilities for the financing of long-term infrastructure development projects by public and private providers of piped water.

6 Sanitation

6.1. Current Status of the Sector³⁷

258. **Over one-third of all households in Papua and West Papua currently lack any form of on-site sanitation.** A large portion of the rural population, as well as many low-income households in urban areas, discharge human waste directly into rivers, lakes, and open space. The resulting contamination of surface and groundwater has led to high incidences of waste-transmitted diseases and environmental degradation of water sources, especially in densely populated areas.

259. **On-site sanitation services are limited to major cities.** Households in urban areas have usually established pit latrines or septic tanks. Only in two cities in Papua and West Papua are septic tank emptying services available. In Jayapura, a private company operates a fleet of sludge trucks (*truk tinja*) and dumps the sludge in a location nearby the city, without any form of treatment or protection. The government of Kota Sorong used to operate a fleet of sludge trucks but no longer does so. The trucks used to dump the sludge in a sludge treatment facility (IPLT). This facility was not maintained, so that private operators now dump sludge on an uncontrolled dumpsite. Sludge discharge facilities are not available elsewhere in Papua or West Papua. In Manokwari, citizens either discharge the sludge manually, by dumping into a nearby river, or sometimes build an additional septic tank.

260. **Off-site sanitation services are non-existent.** In the early 1990s, the Ministry of Public Works used part of the proceeds of an ADB loan to finance the construction of a wastewater treatment plant and piped sewerage system in Kota Jayapura. The system was never used, fell in disrepair, and it now covered by a bus terminal that was built over it.

6.2. Existing Plans for the Future

261. **Provincial and kabupaten/kota government plans for the water sector are dictated by their sectoral mandates, as outlined in Government Regulation 38 of 2007.** According to this regulation, the central government is responsible for the development of piped sewerage networks in large and metropolitan cities (which, in the context of this section, only includes Jayapura). Kabupaten/kota governments are responsible for the regulation and provision of sanitation services to citizens in their jurisdictions, usually through the public works department. The role of provincial governments is limited to the regulation of affairs that affect more than one kabupaten/kota.

6.2.1. Central government plans.

262. **During 2010-2014, MPW intends to finance the preparation of an urban drainage master plan for Kota Jayapura** (at an estimated cost of IDR 1.5 billion). The head of the provincial water resources department of Papua was not aware of this plan. According to him, such a plan was prepared relatively recently (in 2004), and requires updating only.

³⁷ The scope of this section is limited to municipal wastewater only (it does not discuss urban drainage or solid waste management).

6.2.2. Provincial government plans.

263. Both provinces consider Kabupaten and Kota responsible for this sub-sector (with investments in physical infrastructure to be financed from DAK and other kabupaten/kota government revenue), and not the provincial governments themselves, neither of which has invested in sanitation in recent years.

6.2.3. Kabupaten/Kota government plans.

264. It appears that kabupaten/kotas governments in Papua and Papua do not provide urban sanitation services, with the exception of solid waste collection and disposal.

6.3. Recommendations

6.3.1. Long-term development targets.

265. In the absence of provincial or kabupaten/kota government plans, the following targets are proposed for the period 2010-2020:

- **Enforce the construction of wastewater treatment facilities.** At present, Kabupaten and Kota governments do not enforce new buildings to have septic tanks or other forms of wastewater treatment. It is recommended to start make the availability of such services conditional for a building permit from 2010 onwards and, in the longer term, enforce the construction of such facilities in commercial establishments (2010-2014), and urban households (2015-2020).
- **Construct sludge treatment facilities (IPLT).** Such facilities must be built with due regards for watersheds. Upon completion, the use of septic tank emptying services must be enforced.
- **Construct a piped sewerage system in Jayapura.** In the long run, the central government intends to provide each large and metropolitan city in the country with a piped sewerage system. By 2020, the population of the CBD of Jayapura will have a population of approximately 60,000 – at which point population densities are sufficiently high to warrant the investment in a piped sewerage system. Before construction commences, the central government will need to have worked out the institutional set-up and responsibilities for O&M, to avoid a repeat of the debacle of the early 1990s.

6.3.2. Indicative funding requirements (public sector only).

266. The total investment cost of the required increases is estimated at approximately USD 50 million³⁸ (in constant 2008 prices), consisting of:

- **Construction of sludge treatment facilities: US\$ 1.25m x 8 ≈ appr. USD 10 million**
- **Construction of piped sewerage connections in Jayapura: US\$ 400 x 10,000 ≈ appr. USD 40 million**

³⁸ Unit cost assumptions based on subproject appraisal reports of the Metropolitan Sanitation Management and Health Project, which is currently being prepared by MPW and ADB.

267. **The investment and operating cost of sludge trucks (*truk tinja*) will be borne by the private sector**, as is the case for investments in on-site treatment facilities by large-scale commercial establishments.

7 Telecommunications

7.1. Current Status of the Sector

7.1.1. Overall supply constraint

268. **Telecommunications offers Papua and West Papua an excellent opportunity to bridge physical distance virtually, and reduce the isolation of many communities.** However, the “digital divide” is still very significant in Papua and West Papua. About half the population of Papua and West Papua currently has access to basic telecommunications, mainly through mobile phones. Internet access is particularly limited. There are major telecommunications access gaps in the Highlands and inland lowland areas due to the relatively high costs of network deployment in mountainous, forested or swampy terrain, lack of supporting infrastructure (power supply, roads), land/site access issues, low population densities, and limited formal economic activities outside “enclave” projects. Large corporate users such as PT Freeport and oil companies in the Bintuni area have set up their own satellite-based communications networks to meet their high demand for connectivity.

7.1.2. Access networks³⁹

269. **As of end-2008 there were about 1.2 million mobile subscribers,** including in all kabupaten/kota capitals, and prospectively in all *kecamatan* centers in Papua and West Papua (see coverage map). Providers are Telkomsel, Indosat and Excelcomindo (XL) with about one million, 100,000 and 20,000 subscribers respectively. PT Telkom has 76,000 fixed lines (copper) in service, 36 percent in and directly around Jayapura city. Further investment in fixed lines is not anticipated due to high unit costs; rather Telkom is deploying cheaper fixed-wireless⁴⁰ service in the main towns, with about 20,000 subscribers at present. More remote localities, particularly across large areas of the Highlands, are connected via very small aperture terminal (VSAT) satellites and/or short-wave (SSB) radio, if at all.

270. **Internet access is generally through slow dial-up connections** where fixed lines are in place (about 10,000 estimated subscribers) and stand-alone VSAT connections for specific customers/locations such as large corporations, missions, some Government offices, and Internet cafes. VSAT connections are offered by the large telecommunications operators above as well as specialized service providers. Broadband or high-speed Internet access is extremely limited. Telkom launched fixed broadband (ADSL) in Timika and Jayapura in 2008, with an initial capacity of 1,500 lines; subsequent roll-out to main urban centers such as Sorong, Manokwari, Biak and Merauke is anticipated. Wireless broadband deployment is in the very early stages. Some Wi-Fi “hotspots” have been set up in towns. Mobile broadband is available on a limited basis: GPRS/EDGE (2.5G) service (which supports basic Internet browsing and Blackberry service, for example) is available in most mobile network coverage areas. Higher-speed or third-generation (3G) mobile broadband deployment is anticipated but has been delayed. Internet cafes operate in major towns, in some cases between twice and three times the hourly usage cost in Java (Rp 15,000 per hour in Wamena, for example); facilities are typically overcrowded.

³⁹ Telecommunications infrastructure consists of *access networks* (fixed lines or mobile base stations reaching end-users) and *backbone networks* which transmit aggregated volumes of telecommunications traffic across long distances (satellite, or terrestrial--microwave or fiber-optic).

⁴⁰ Mobile technology standards: GSM=global system for mobile communications, CDMA=code division multiple access. GPRS=general packet radio service (2.5G).

7.1.3. Backbone or transmission networks

271. **Papua and West Papua depend entirely on satellite transmission**, both to connect major urban centers internally, and externally, to other locations in Indonesia and the rest of the world. This is quite insufficient to meet existing demand, analogous to airline passengers being routed from Jayapura to Jakarta in small boats. So far, there is virtually no terrestrial backbone, such as microwave or fiber-optic cables; there is limited fiber within Jayapura. For example, PT Telkom's Internet bandwidth for the entire Papua and W. Papua Provinces was 30 megabits per second (Mbps) as of mid-2008, equivalent to a typical residential bandwidth offering for three homes in W. Europe, Japan or Korea. Moreover, the cost structure for satellite bandwidth (per Mbps), both capital investment and recurrent costs, is significantly higher over the medium term than for terrestrial backbone. Typically the cost per bandwidth unit on high capacity fiber optic cable routes is 1/50th or lower than for a satellite connection. *This reliance on satellite transmission limits capacity and speed of data transmission, and the quality of service.*

272. **For coastal urban concentrations with short-term prospects of rapidly growing commercial activity, the goal should be to close the access gap and meet the rising demand for bandwidth** through providing access to fiber optic networks. In these places, well-functioning and affordable telecommunications infrastructure is essential for business development, small and medium-sized as well as large.

273. **Throughout the rest of Papua and West Papua, it is not feasible to lay fiber optic cable to most villages and schools, nor are the communications needs as demanding of bandwidth as in coastal growth centers. Yet distant locations as much, or even more than easily accessible locations, will benefit from communications technology** that facilitates electronic delivery of public services, offers opportunities for distance learning, teacher training, and access to medical and commercial advice. In Papua and West Papua, improvements in telecommunications can partly substitute for other infrastructure. For example, a phone call or email may save significant travel time and costs for individuals living in villages where the only alternative is walking or irregular and expensive air service. For such distant locations, low-cost satellite connection should be a goal of infrastructure planning, installed together with local power sources, particularly solar.

7.2. Development Objectives and Strategic Approach

274. The recommended approach to addressing these challenges is to:

- **Increase external bandwidth by connecting the major coastal cities of Papua and West Papua to a new fiber optic submarine cable** which is already scheduled for construction as far as Sorong (Palapa Ring);
- **Where feasible, extend the terrestrial backbone networks inland** through new microwave and fiber-optic connections.
- **Deploy lower-cost technologies for satellite backhaul** to connect highlands and lowland kabupaten/kota centers not accessible by fiber optic cable.
- **Facilitate further expansion of access networks through regulatory incentives and, selectively, targeted subsidies** (universal service obligation);
- **Promote greater use of ICT in government and by communities to increase demand and prompt additional investment.** Use of email and Internet for government communications is still limited.

275. **The Papua and West Papua provincial governments recognize the importance of telecommunications** to support economic activities, reduce the isolation of communities and support the delivery of public services, in particular education. The need for improved connectivity is reflected in planning documents. While funding for telecommunications infrastructure is primarily private sector/commercially-driven the provincial Government has an important role to:

- **Facilitate additional private investment in access network rollout** by helping to identify unserved or under-served areas with particular developmental needs, and to provide private operators assistance with permits and site acquisition;
- **Encourage the Palapa Ring consortium to consider extension of the cable to major coastal cities;**
- **Identify opportunities for co-location of telecommunications with other infrastructure**, both private and publicly-funded (e.g. introduce satellite connections together with new electric power);

276. **The provincial Governments are major potential users of telecommunications capacity.** At the basic level, Government offices need to communicate by phone and email. Government also provides information to the public, and has set up informational websites, for example city profiles and investment opportunities, as well as public Internet access facilities. The Government has several internal information systems needs, for planning and budgeting, and routine reporting. A shift from paper-based to electronic reporting, for example on monthly expenditures in line ministries, on school management and health surveillance, will increase demand for better connectivity. For the longer-term the Government envisages the development of “Papua Online” allowing electronic transactions such as e-procurement and permit applications, and potentially other “e-government” services. Such services will require significantly higher telecommunications capacity than is available today, as well as substantial institutional change management and skills development in government.

7.3. Review of Past Expenditures

277. **Investments in telecommunications have been made primarily by the private sector.** Public investment has been mainly in computer and networking equipment in Government offices, for example by the provincial electronic data center (BPDE) and department of planning (BAPPEDA/BP3D) and, more recently, computer labs and networks for secondary schools. Government has also invested limited funds in a fixed-wireless communication network for 17 kabupaten/kota offices, wireless connections to 4 universities and 16 schools and in SSB radio links for schools and health centers. Many kabupaten/kota governments have deployed VSATs.

278. **Detailed investment and recurrent cost data on access and backbone networks are commercially sensitive and difficult to obtain.** Moreover, past investment levels may not adequately reflect likely future costs due to technological change, for example increased availability of low-cost, low-power mobile base stations and IP VSATs. Recurrent costs for access networks are very high due to reliance on satellite backhaul; these are also expected to come down if terrestrial backhaul options become available. For example, the capital investment required to transmit 1Mbps by satellite is about US\$150,000, compared to US\$2,500 for transmission—or as low as US\$100 when expanding the capacity of an existing route— via fiber-optic cable. Moreover, typical monthly bandwidth costs for satellite capacity are quite high,

between Rp5 – Rp 8 million per month in Papua and West Papua for a VSAT with 128kbps capacity. Though Indonesia’s mobile operators enjoy significant economies of scale, and hence equipment purchasing power, the capital investment for a mobile base transceiver station (BTS) in Papua and West Papua may still exceed US\$200,000, compared to less than US\$75,000 in Sumatra, for example, reflecting the need for additional civil works in remote sites. There are currently about 200 mobile BTS in place with a further 50 or so planned in the near-term.

279. **The order of magnitude of private capital investment to date in fixed lines, mobile BTS and transmission is likely to be at least US\$500-700 million over the last ten years,** reflecting the high cost structure of Papua and West Papua. However, the principal financial burden is operating costs: power supply, road/helicopter access for maintenance, and, as noted above, satellite backhaul.

7.4. Near Term Investment Requirements

280. **Demand for telecommunications services is increasing throughout Papua and West Papua;** from the private sector, provincial, and kabupaten/kota governments, as well as households. As basic telephony needs are met, this demand is shifting towards Internet, which delivers not only voice but also data services and content/media. Projections for Papua and West Papua, particularly for larger population centers, clearly indicate increasing demand for broadband Internet, consistent with Indonesia-wide and indeed global trends. Outside major population centers, demand for broadband in the short-term is primarily institutional: large corporations/projects, government offices, universities, secondary and vocational schools (SMP, SMK, and SMA). For example, the Provincial Education Development Strategy envisages significantly increased connectivity for junior high and secondary schools to support teacher professional development and delivery of teaching/learning materials.

Table 19: Papua & West Papua Telecommunications Demand Projection

	Fixed Lines	Fixed-Wireless	Total Fixed	GSM mobile	3G mobile	Dial-up Internet	Broadband Internet	Internet TV (IPTV)	TOTAL
Subscribers	226,000	319,000	545,000	1,719,000	1,910,000	2,000	468,000	278,000	
% population				46	50				
% households	22	57	79			0	56	38	
Capacity (Gbps)			1.9	6	29	0	133	2	171
% of total			1	2	11	0	86	0.3	

Note: Demand has been calculated as a function of household income data, population projections, availability of schools, hospitals, government institutions, location of businesses. Demand is expressed in terms of number of users, and required capacity (traffic). This scenario also assumes a P&WP-specific GDP distribution to compensate for the extreme remoteness of most rural areas.

281. **At the kabupaten/kota level the highest demand for telecommunications, is projected to be in Mimika, Kota Jayapura, Merauke and Jayawijaya,** followed by Jayapura and Nabire; particularly for broadband by 2020. In West Papua the highest projected demand is in Kota Sorong, Kabupaten Sorong and Manokwari.

282. **To meet this demand, the main near-term backbone investment need is for the extension of the planned Palapa Ring to major coastal cities in Papua and West Papua.**

Indonesia's telecommunications operators have formed a consortium⁴¹ to invest in a fiber-optic submarine cable to provide high-speed connectivity to Eastern Indonesia for a total cost of about US\$255 million (see map). The design originally included nine landing stations in Papua, with the cable ready for service by 2010 but has been scaled back to one, in Sorong, due to financing constraints. In order to extend the Palapa Ring two additional submarine cable routes would need to be completed:

- **Northern route with landing stations at Manokwari, Biak, Sarmi and Jayapura** (1200 km) at an estimated cost of US\$60 million based on average international cost levels;
- **Southern route: landing stations in Fakfak, Timika and Merauke** (1700 km) at an estimated cost of US\$85 million based on average international cost levels.

283. **This would yield a total capacity to P&WP of 80Gbps which is thousands of times higher than existing capacity**, and significant reduce the cost of building additional access networks around these other landing stations. The private sector would be the main source of investment. However, potential roles for the Provincial Governments are to: (a) encourage the consortium to invest in these additional cable routes, possible through **agreements** under which the government would, for example, pre-purchase capacity (for example to support ICT in education or e-government services); and (b) offer catalytic financing for such investments on a private-public partnership basis, for example through a **capital investment subsidy**.

284. **The second main near-term investment need is for additional access networks to connect villages in unserved areas.** The main role of the provincial Government can be to facilitate private investment by helping operators to identify priority sites, and assisting with permit and site acquisition. Land acquisition is particularly challenging and time-consuming in Papua and West Papua due to the prevalence of customary land rights. A further potential avenue of Government support is through a competitively-run capital investment subsidy program. There is a national-level model for this, and such schemes are also widely used internationally. The National Government is implementing a Universal Service Obligation (USO) program, funded by a levy on the telecommunications industry (1 percent of net revenues) to subsidize the capital costs of access network rollout in commercially marginal areas throughout Indonesia. 3,000 villages in Papua and West Papua have been included in this program, for an estimated total subsidy cost of US\$11 million. The tender will be awarded in mid-2009 in consultation with the national government (the Department of Post and Telecommunications, DG Postel); the Provinces could launch a similar tender process for other unserved villages in these provinces.

7.5. Longer-Term Investment Program

285. **For the longer-term, the main investment need is for the extension of terrestrial backbone networks from the coastal landing points for the submarine cable.** This would entail construction of additional submarine fiber-optic cables to link coastal cities and islands and inland fiber optic cables where possible. Inland fiber routes are highly dependent upon other infrastructure to lay cables along like roads, electricity lines, pipelines, railways, etc. In some cases microwave links may be required to bridge difficult terrain. These extension projects

⁴¹ As of May 2009 the consortium members include PT Telkom, Indosat, and Bakrie Telekom. The original membership was seven. Reduction in numbers has meant reduction in investment and hence reduction in the number of proposed cable landing stations.

have been grouped into the following categories, based on likely feasibility from a business and implementation perspective:

7.5.1. Commercially feasible projects

286. **Sorong to Teminabuan and Bintuni.** Some of the main commercial drivers for this project are the large-scale oil and gas activities around the Bintuni bay area. Total cost is around US\$3.2 million if a land cable can be built between Sorong – Teminabuan and Bintuni along roads. An alternative route would be 120 km of land cable along roads up to Teminabuan and 250 km of submarine cable to reach the Bintuni area requiring an investment of around US\$12.5 million. Potential sources of financing would be from the telcos and the oil and gas industry.

287. **Manokwari to Nabire, possibly with a spur to Wasior.** The estimated cost of the main route Manokwari – Nabire would be around US\$14.4 million while the spur route to Wasior would add another US\$3.6 million. The alternative from Biak via Serui is slightly shorter and possibly cheaper but also more difficult due to the land crossing of Pulau Yapen.

288. **Biak – Serui.** The estimated cost of the main route Biak – Serui would be around US\$2.5 million.

289. **Fakfak – Kaimana.** The estimated cost of the main route Fakfak – Kaimana would be around US\$4.5 million assuming a Palapa Ring landing station at Fakfak.

290. **Jayapura - Keerom.** This could be seen as an extension of Telkom’s planned Jayapura Metro Ethernet network. The actual distance is around 50 km but some spurs to specific population centers would be anticipated. The estimated cost is US\$1 million.

291. In addition, the following links are technically feasible but the actual number of inhabitants is low. Some of those cases could be more cost-effectively served by extension of existing mobile networks with associated microwave links: (i) Sorong – Raja Ampat; (ii) Serui-Waren; (iii) Biak-Supiori.

7.5.2. Commercially marginal projects

292. **Highland Kabupaten/Kotas.** Fiber-optic backbone extensions to these areas would have to be undertaken in conjunction with other infrastructure development to be cost-effective. For example, if the road system Jayapura – Wamena – Karubaga Mulia – Enarotali – Nabire were completed then a fiber optic cable of around 845 km could be deployed along this route for about US\$8.5 million. Absent other infrastructure such as roads the main alternative route to the Highlands would be via microwave, but requiring multiple tower constructions including in remote mountain top locations. One of the more promising starting points for such a microwave backbone would be Timika-Enarotali.

293. **Extension to the lowlands North of Merauke.** Fiber-optic network extension to a number of lowland areas like Boven-Digoel would require a land route from Merauke. There is some road infrastructure between Merauke and Tanah Merah and there are plans to extend this route to Oksibil, Pengunungan Bintang. This would imply a land fiber cable project of 470 km at an estimated cost of around US\$5 million if built along a road. Alternatively, a microwave link in combination with mobile coverage could be deployed to connect the lowlands North of Merauke to Merauke and the future Palapa Ring landing station.

294. **Other Kabupaten/Kotas.** Mappi, Yahukimo and Agats are very costly and difficult to connect to fiber-optic backbone, due to lack of (road) infrastructure and low population densities. These areas will depend on satellite backbone for the foreseeable future. This does not preclude roll-out of basic mobile services (voice, low-speed data) even in small remote villages cost-effectively. This could be achieved through more widespread utilization of lower-cost technologies, including: Internet Protocol (IP) mobile base stations, IP VSATs and low-power base stations.

295. **Where expansion of microwave networks is required, the Government can facilitate civil works needed to access remote mountain top locations, as well as site acquisition.** As in the case of stimulating near-term investment in access networks, the provincial Governments could offer catalytic financing, for example through a competitive capital investment subsidy program. The provincial Governments could also contract with the private sector to pre-purchase capacity on such networks since they could be significant users of such network capacity.

296. **Where fiber-optic backbone extensions are possible, the Government can reduce the cost of delivery** by providing ducts along any major roads being constructed and/or upgraded. During road construction the additional cost of adding ducts (or plastic pipes) to allow for “easy” fiber optic deployment inland is low. Laying cables along roads without a duct afterwards is far more costly.

Table 20: Longer-Term Investments in kabupaten/kota Backbone Networks

Project	Kabupaten	Estimated Cost (US\$)
Palapa Ring	Sorong (Kota and Kabupaten) Manokwari Fakfak Biak Numfor Sarmi Jayapura (Kota and Kabupaten) Mimika Merauke	145 million
Route Teminbuan-Bintuni	Sorong Selatan Teluk Bintuni	12.5 million
Extension Manokwari-Nabire	Nabire Teluk Wondama	14.4 million 3.6 million
Merauke – Oksibil Note: assuming completion of the road	Boven Digoel Pegunungan Bintang	5 million
Jayapura – Highlands – Nabire route Note: assuming a road	Paniai Jayawijaya Tolikara Puncak Jaya	8.5 million
Route: Biak-Serui Spur from Palapa Ring Extension of Metro Ethernet Jayapura		
Route: Biak-Serui Spur from Palapa Ring Extension of Metro Ethernet Jayapura	Kepulauan Yapen Kaimana Keerom	2.5 million 4.5 million 1 million
Microwave link + mobile extension from Sorong Microwave link + mobile extension from Biak Microwave link + mobile extension from Serui	Raja Ampat Supiori Waropen	
Continued satellite dependency	Asmat Mappi Yahukimo	

References

In progress