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SUSTAINABLE DEVELOPMENT OPTIONS FOR PAPUA

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ABSTRACT

The paper presents some early outputs from a study considering Papua's economic development options. Rich in mineral and forestry wealth, Papua paradoxically suffers the highest levels of poverty in Indonesia; it can be argued that uneven income distribution is as significant as a lack of wealth, or potential. Using secondary data sources the paper looks at how economic development options impact on Papua. However, it concludes that unless Papua resolves its chronic energy shortages economic development will be constrained. Therefore, it considers a number of sustainable energy sources including jatropha and sago and clean technologies: biodiesel, ethanol and anaerobic digestion. An initial cost benefit feasibility study is presented for each option, prior to making some early observations on their economic, social and environmental impact.

Keywords : Anaerobic digestion; Clean energy; Economic development; Papua; Sustainability

1. INTRODUCTION

Western environmentalists have applauded Papua's Governor Barnabas Suebu for his commitment to sustainable development and promise to protect the rainforest (EIA-International, 2010). Nevertheless within Indonesia, Papua has been criticized for failing to address its development needs and unspent budget allocations (extensively reported in the Jakarta Post from June to September, 2010), which are currently the subject of a central government audit (Jakarta Post, 2010). Is this simply an example of poor policy execution, as many have argued (GRM International, 2009), or is there a fundamental tension between economic development and sustainability?

The World Bank (2005) shows that public finances will remain strong in Papua until at least 2021, as a result of the Special Autonomy Fund. Nevertheless GRM International (2009) reiterate the view that existing development initiatives in Papua are not working and argue that the generous public finances in Papua are unlikely to benefit all Papuans. They also argue that Papua does not appear to have the ability to effectively allocate the public money that it currently receives. These contribute to the 'Papuan Paradox'; Papua is one of Indonesia's richest provinces, but also has the highest levels of poverty. In 2008, Baden Pusat Statistik (BPS, 2010) estimated that 31,600 of Papua's urban residents and 701,500 rural residents lived in poverty, representing the highest proportion of any Indonesian province (37.08% compared with 15.42% for Indonesia as a whole; World Bank, 2005).

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Nevertheless the unemployment rate is 4.08%, compared with 7.41% nationally (BPS, 2010). In 2008 the minimum wage was IDR 1,105,500 per month and the average wage was IDR 2,124,610, reflecting the relatively high cost of living in Papua (World Bank, 2005).

For 2008, BPS (2010) estimated the Province's Gross Domestic Product (GDP) to be IDR 54,734bn, making GDP per capita IDR 26,615,000 (compared to the national average of IDR 18,412,000, which is skewed by the very high GDP realized in Kalimantan Timur), reflecting the huge contribution of capital intensive extractive industries (in 2008 BPS showed that they accounted for 60.17% of GDP, 2010; GRM International, 2009). Nevertheless this high level of GDP per capita does not necessarily benefit many Papuans, which is another irony within the Papuan Paradox (GRM International, 2009). This is because few Papuans are employed in higher value sectors, or in higher skilled and therefore, high wage occupations (Development Alternatives, Inc, 2009). One of the reasons why few skilled and semi-skilled jobs go to Papuans is the low educational level of many Papuans (Mollet, 2007; World Bank, 2005; GRM International, 2009). Adult literacy in 2008 was 77.97% for men and 66.61% for women compared with 95.38% and 89.10% respectively for Indonesia, this is a product of fewer years of schooling, with a mean of 7.0 and 5.6 compared with 8.0 and 7.1 (BPS, 2010).

After mining the next most important industry, in Papua, is forestry. In 2008, 5,241,293 hectares of forestry concessions had been granted in Papua, nearly a fifth of the total for Indonesia. Deforestation of Papua is further disadvantaging rural Papuans (GRM International, 2009), taking away their land and livelihoods and forcing them into marginal highland areas (McGibbon, 2004), which have high levels of poverty and deprivation (BPS, 2010; GRM International, 2009). The World Bank (2005) argues that for a one off payment, Papuans are forfeiting their future prosperity when their land is sold to loggers. Indeed they show that land values produce a very low return, compared with the community benefits from the rainforest. The World Bank (2005) develops the argument that deforestation is capable of producing an economic as well as an ecological crisis in Papua. Exploitation of Papua's natural wealth reinforces inequalities (if not causes them), meaning that the current development trajectory exacerbates the Papuan Paradox (World Bank, 2005). This leads the World Bank to pose the question:

"After the minerals are extracted and after forests are clear-cut, what will be the economic foundation of the local economy?" (World Bank, 2005)

Klute (2008) suggests that at current deforestation rates, lowland forests will disappear from Papua by 2023. Combined with the, already all too evident, negative effects of Papua's reliance on revenues from oil and gas, mining and forestry, this is a major concern. The extractive industries have created social and economic divisions within Papua (GRM International, 2009). Pedercini (c2004) argues that only a limited amount of the high wages from the mining and forestry feed back into the Papuan economy, as the bulk are sent in remittances to families in other parts of Indonesia. This leakage from the local economy along with profits going to overseas companies and companies from other parts of Indonesia goes some way to explaining the Papuan Paradox.

New economic activities cannot develop without Papua addressing its chronic shortages of electricity and the high economic, social and environmental costs of its production (World Bank, 2005). Currently the majority of Papua's electricity is generated using diesel generator sets (in 2008 BPS showed that only 2,040 megawatts of Papua's 115,557 megawatts was not generated from diesel, reported in 2010; World Bank, 2005); estimated to be costing over IDR 2,000 per kilowatt hour and this doesn't include the cost to households and businesses of back up diesel generators and the replacement equipment costs caused by disruptions in supply!

GRM International (2009) suggest that Papua requires another 20 megawatts of electricity just to support domestic demand, especially in rural areas which aren't currently covered by the grid (BPS estimates that some 62.9% of households did not have Perusahann Listrik Negara (PLN) electricity connection in 2008, compared with just 10.5% in Indonesia; PLN, 2010). Even in Jayapura there are daily power cuts!

With coal deposits, oil and gas fields in Papua Barat and oil fields in Cenderwasih Bay, there are resources to generate more carbon based electricity. There are also largely untapped clean alternatives. Indonesia has been slow to develop the regulatory framework to stimulate investment in clean energy (Norton Rose, 2010) and the country's investment plans focus on coal fired power stations in Java and Sumatra. Furthermore, compared with countries like China and India, the support for carbon financing is very limited (NEDO, c2005) and with emphasis shifting from the Kyoto Agreement and Clean Development Mechanisms (CDMs) towards deforestation, the options for clean energy financing are diminishing.

Despite the underdeveloped institutional framework supporting clean energy both the Indonesian Government (Klute, 2008) and the Governor of Papua (Development Alternatives, Inc, 2009) have ambitious plans for clean energy, especially biofuels, as these can have an added economic benefit of providing employment and stimulating rural economies. Development Alternatives, Inc (2009) show that currently Papua has plantation feedstocks of 7,700 hectares of palm oil producing 7.7-12.2 tons per hectare of oil palm bunches per annum. Nevertheless Klute (2008) believes that between 5,000,000 and 9,300,000 hectares have already been set aside for palm oil production in Papua. Given the existing investment in oil palm and its tarnished environmental credentials it does not form a part of this study. In addition, there are 240 hectares of jatropha planted near Sentani with plans to produce 10,000 tons per annum; well below the 1,720,00 hectares of suitable margin land. There would, however, need to be a major increase in biofuel feedstock production to match the Governments aspirations (Development Alternatives, Inc, 2009). Current market mechanisms do not produce the correct signals for this increase in production to occur (Dillon et al., 2008).

2. METHODOLOGY

The economic development feasibility study seeks to provide guidance on these issues and address the problems of implementation. To date the focus has been on secondary research on Papua's economy, energy supply and potential energy sources. Although multidisciplinary, the analysis has been largely economic, reflecting the important requirement to evidence the costs and benefits and return on investment to attract international investors and convince aid agencies. Technical and financial inputs and outputs are collated in a spreadsheet model. The reference section provides an indication of some of the many sources used to develop the assumptions within the model, nevertheless few are current, or specific to Papua, and will therefore change as primary evidence is collated. The full assumptions within the model are too expansive to present in this paper, but will be made available by the author as the project develops. Although the majority of the calculations are simple functions, the model does contain a large number of variables, reflecting the sophistication of the processes and enabling sensitivity analysis and scenario planning.

Findings are presented from an early iteration of the model, although much more work needs to be done on refining the assumptions, testing the hypothesis and ultimately in field testing the technology. Following on from the feasibility there is a need to develop environmental impact assessments (Analisis Mengenai Dampak Lingkungan, AMDALs; World Bank, 2005) and, if appropriate, applications for CDMs (Sugiyono, 2001).

Based on the existing 240 hectare jatropha plantation, near Sentani, and generously assuming that each hectare can produce 3,400 liters of biodiesel (Development Alternatives, Inc, 2009; Bromokusumo, 2007) this would produce a total of 816,000 liters. However, by-products of biodiesel production include jatropha cake and glycerol, which can also be used to produce energy (currently there is an over-supply of glycerol, but at times its value as a substance could be higher than its value as a biofuel feedstock). Anaerobic digestion is ideally suited to converting these waste products initially to biogas (Banu et al., 2006) and ultimately electricity. Gasification would also be an alternative technology for converting waste products (Friends of the Earth, 2009). An added benefit of anaerobic digestion is that it also produces fertilizer, rarely used in Papua, but could be effectively utilized to increase crop yields. A further by-product of anaerobic digestion is heat, which if produced in sufficient quantities could through a heat exchanger be utilized for refrigeration (ENTEC, 2009). The model therefore, outputs costs and benefits of combined jatropha biodiesel and biogas production and biogas alone, for 240 hectares.

Naturally occurring sago as a potential biofuel feedstock, is probably more suited, to Papua, than jatropha, or oil palm. Sago is abundant in Papua, extremely hardy and unlike oil palm actually provides protection to the soil from erosion (McClatchey et al., 2004); indeed it is so abundant that harvesting should not impact on the food chain (PEACE, 2007). In addition, nypa palm is nearly as productive as sago as a source of ethanol and is abundant in some areas of Papua. The data relates to the production of ethanol from 1,000 hectares of sago (selectively harvested to ensure sustainability, (Risø National Laboratory 1999; Bradley & Runnion, 1984) augmented by anaerobic digestion of the waste water and the anaerobic digestion only alternative. Whilst the production costs may have been under-estimated, using esterification of the sago starch (Sun & Sun, 2002; Dzulkefly et al., 2007), possibly using the plentiful Papaya Lipase as an enzyme, some considerable savings can be made in ethanol production. In addition, there may be the potential for carbon funding for reforestation of land that has previously been cleared for logging, or eroded by human settlement and agriculture.

Klute (2008) argues that biofuel feedstock production and carbon trading are responsible for increased destruction of protected forests, as more and more land is bought up by multinationals and Indonesian conglomerates. As a result of concerns about protecting the natural environment the model also looks at wild sago. The lower yields from wild sago (possibly as low as 25% of plantation sago) necessitate a larger area to be selectively harvested, however, the greater volume of waste water produces more biogas (Banu et al., 2006), therefore assumptions are based on 3,000 hectares.

The options considered in the model that are presented in this paper are therefore as the following table:

Table 1 Options considered in the methodology

Feedstock	Biodiesel/Ethanol with Anaerobic Digestion of Waste	Anaerobic Digestion Only
Jatropha 240 Hectares	✓	✓
Plantation Sago 1,000 Hectares	✓	✓
Wild Sago 3,000 Hectares	✓	✓

3. RESULTS

Evidence suggests that some biofuel feedstocks are much more expensive to produce and refine that had originally been thought (largely due to lower than anticipated yields), making investment in them even less certain (Bromokusumo, 2007; Dillon et al, 2008; indeed the early results from the model, probably also underestimated production costs). The initial outputs from the study supports with these findings suggesting that as a potential source of clean electricity, jatropha is simply too expensive to produce and refine (Jatrophabiodiesel, 2010), nevertheless the lower capital costs of the anaerobic digestion only option, suggest that this technology is worth considering with all biofuel feedstocks.

Table 2 Outputs

Material	Jatropha Combined	Jatropha AD	Plantation Sago Combined	Plantation Sago AD	Wild Sago Combined	Wild Sago AD
Biogas Metres^3	207,966	3,036,000	10,120,000	50,600,000	30,360,000	37,950,000
Waste Water Meters^3	-	-	4,000,000	0	10,800,000	0
Biodiesel Liters	816,000	0	-	-	-	-
Cake Tons	600	0	-	-	-	-
Ethanol Liters	-	-	14,400,000	0	12,000,000	0
Glycerol Tons	81,600	0	-	-	-	-
Heat Kilowatts	1,387	206,448	688,160	3,440,800	2,064,480	2,580,600
Fertilizer N Kilograms	2,400	357,176	1,190,588	5,952,941	3,571,765	4,464,706
Fertilizer P_2O_5 Kilograms	600	89,294	297,647	1,488,235	892,941	1,116,176
Fertilizer K_2O Kilograms	120	17,859	10,241	297,647	30,724	223,235
Electricity Kilowatts	5,993,602	5,161,200	98,993,120	86,020,000	112,953,840	64,515,000

Table 3 Costs and benefits IDR m

Item	Jatropha Combined	Jatropha AD	Plantation Sago Combined	Plantation AD	Wild Sago Combined	Wild Sago AD
Finance Cost	11,229	3,535	79,157	38,880	64,757	28,276
Revenue	5,991	7,151	105,126	118,884	131,814	89,391
Return	-5,237	3,617	25,969	79,964	67,058	61,115
CO_2e Electricity	456	392	1,094	6,538	821	4,903
CO_2e Reforestation	-	-	700	700	2,100	2,100
Surplus with CO_2e	- 4,782	4,009	27,764	87,202	69,978	68,118
Surplus %	- 43	113	35	224	108	241

4. DISCUSSION

More detailed feasibility studies are required (including those for minihydro and gasification); in addition, there is a need to consider the practicalities of harvesting wild sago in this remote province. Certainly the employment it would create would be a welcome source of revenue to rural Papuans, but with limited infrastructure could the biofuel feedstocks be harvested and transported to a suitable processing plant (PEACE, 2007)?

Pedercini's (c2004) developed four scenarios for Papua using a Systems Dynamic Model (T21). The first scenario was the base case, which assumed that local government policies would continue as they were. The second and third showed that infrastructure development benefitted the extractive industries, but disadvantaged rural communities and placed a burden on public finance. Indeed it shows that building roads into remoter areas of Papua would probably increase logging activities to the detriment of rural Papuans (Pedercini, c2004; GRM International, 2009). The final scenario focused on community based development with investments in education, training and health which she found to create 'an endogenous acceleration of the economic growth' that would benefit local people.

Traditionally policy makers (often encouraged by overseas aid agencies) have focused on large scale infrastructure development (World Bank, 2005; GRM International, 2009), rather than more community based economic development projects. Whilst there may be some issues with policy execution, there is indeed a tension between sustainability and economic development; at least as it is currently being executed (GRM International, 2009). Indeed the Papuan Paradox is as much a product of the uneven distribution of resources and the effects of economic development on reinforcing these, as it is a lack of wealth and resources (GRM International, 2009), or indeed potential.

A part of the conundrum posed by the initial outputs is a product of constraining the study to replicate existing electricity distribution patterns, and assuming that additional energy production would be sold into the PLN grid. With so many Papuan households not covered by the PLN grid, there is a possibility of using microgeneration to provide for local communities and stimulate local economies (Dillon et al., 2008; World Bank, 2005). Again anaerobic digestion, at the community level, could have distinct advantages as a proportion of the biogas could also be utilized for cooking.

The increased availability of electricity in remote areas would also open up the potential for community based development of Papua's mineral wealth. With environmental technologies mining does not have to be large scale and disruptive, they can be small scale, benefitting communities. Even with the new mining regulations (Law No 4 of 2009 on Mineral and Coal Mining) there are environmental alternatives to the large scale processing of minerals that would lend themselves to community enterprises. For example bioleaching has been successfully utilized for copper production and increasingly for other metals in developing countries (Acevedo, 2002). In addition, water hyacinth lagoons can be used for remediation of more traditional chemical leaching (Liao & Chang, 2004) and has the added benefit of also capturing the residual gold contained in the leachate (US National Academy of Sciences 1976:174). If this water hyacinth was then anaerobically digested (Bhattacharya & Kumar, 2010; Almoustapha et al., 2009; Yerima et al., 2009) with the use of advanced membranes the residual gold could be recovered increasing the profitability of community based mining operations.

Papuans could also begin to benefit from their timber wealth by competing with the wood and furniture factories in China's Hainan Province, where a high proportion the value added of Papuan timber is realized (Klute, 2008). Linked to the production of clean energy and the development of processing industries is the need to concentrate development in growth poles (World Bank, 2007), the study focuses on the Jayapura-Sentani City Region, but additional centers are required throughout Papua, including towns in the remoter highland areas. Such development would support the use of localized energy production and local grids. A final outcome from greater access to energy (especially clean energy) could be the growth of ecotourism in Papua.

5. CONCLUSION

Papua's electricity shortages are impacting its economic development and channeling economic activity towards extractive industries. The consequence of this continued exploitation will be environmental degradation, further inequalities and social division. Simply resolving these shortages with large scale carbon based electricity generation is likely to reinforce the current economic development trajectory and the problems it creates. The development of new industries creating more value added and equality within Papua, can be stimulated by community based clean energy production and distribution. Nevertheless any community based economic development initiative needs to be supported by educational and training programs within the community.

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