Water Management in the Lowlands of Southern Papua Indonesia Using a Decision Support System and Integrating Traditional Ecological Knowledge

By Elisabeth Veronika Wambrauw

Abstract

Papua is the largest Province in Indonesia with the smallest population .This area has abundant natural resources such as mineral reserves, indigenous forest ecosystems, and a diverse marine ecosystem. Papua also has vast fresh water resources in the form of rivers, lakes, and extensive wetlands. The area has a unique ecology, richest biodiversity, mangrove species, and globally significant cultural diversities. Papua has a minimum of 269 ethnic groups.

Even though Papua has vast natural resources which contribute to the nation's economy, the local people live in poverty. The central government has tried to address these issues with special attention to Papua, but as yet government efforts have not solved this problem. In particular, a lot of development has occurred in Papua which is understood to be unsustainable for the environment and the indigenous peoples of Papua.

Recently, lowlands in Papua have been focused on for development, especially for agricultural purposes. However, if the government proceeds with development in an unsustainable way, it will lead to complex problems. The wetlands in Papua are significant at a global level, and environmental issues such as climate change and sea level rise and concerns for the indigenous peoples of Papua.

To assist with better understanding these challenges, the main objectives of the study are to identify best management practice for water resources in the lowlands of Southern Papua using a Decision Support System and integrating traditional ecological knowledge. This exploratory research approach includes; a literature review; the Mauri Model Decision Making Framework; and on-location action participatory research for data collection and analysis.

Key words: Papua, lowlands, water resources management.

1. Introduction

West Papua which is compressing two provinces Papua and West Papua is located in Indonesia (South East Asia). Papua has abundant natural resources, such mines, forests and marine ecosystems and also culture. Papua has a minimum of 269 ethnic groups and 269 living local languages (A. J. Mansoben, 2006; J. R. Mansoben, 2003; Marshall & Beehler, 2007) and has 1,068 clans (BPS, 2011). Papua also lags behind other provinces, even though Papua is a really rich island. Over the last 10 years, Central government has tried to catch up the gap with giving special attention to Papua. The Central Government have divided this province into Papua and West Papua. This programme still has not answered the problems in Papua. A lot of development has been done in Papua resulting in mining, deforestation, and infrastructure developments which are unsustainable. Exploitation of natural resources has negative impacts on the environment. Not only in there exploitation, there is a transmigration programme which is moving landless people from Java to Papua forcing Indigenous people into smaller and smaller areas. In many of the big cities the population of indigenous people is low, such as in Jayapura and Merauke where only around 30 % are Papuan (BPS, 2011). As known, Papuan indigenous people are really close to nature and when they develop something, they always care about its natural power. Other tribes have similar customary beliefs are related to sustainability.

Recently, the lowlands in southern of Papua are developing. Coastal lowlands in Papua are unique and complex with the hydrology of the ecosystem very interconnected. The connections are between land use, hydrology, sea water levels, climate change, CO2 emissions, and cultural aspects. Also, lowlands provide natural resources of food, medicine, shelter and cultural for indigenous people who live around that area.

To address the problems the main objectives of the study are to identify best management practice for water resources in lowland in Southern Papua by making an approach for hydrology modeling with integrated qualitative data regarding human interaction / relationship with ecosystem in a Decision Support Tool. These main objectives can be divided into special objectives, which are:

a) To compare and identify similarities and differences in the hydrology of three areas Merauke, Asmat, and Kimaam Island.
b) To identify the traditional water management practices in Asmat, Kimaam and Merauke.
c) To conduct an assessment of existing water management practices and the use the Mauri model to consider the impact on sustainability.

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Research Methodology

This study use Participatory Action Research and Exploratory Research

Study sites

The study will be conducted in three study case areas; Merauke, Asmat, Kimaam Island.

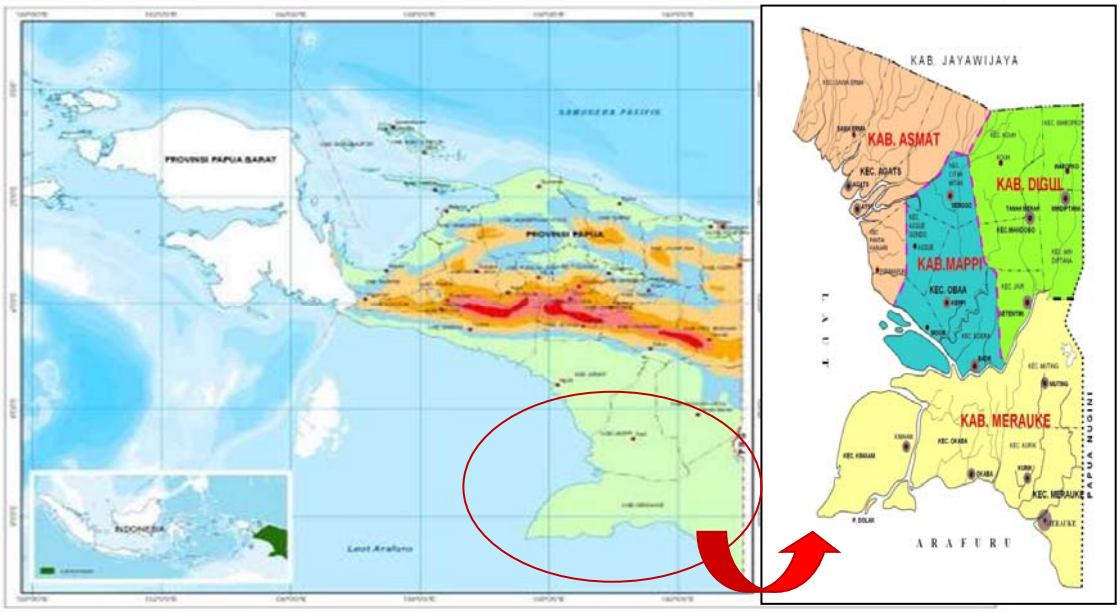

Figure 1 The map of lowland in Papua (Giesen & Houterman, 2009)

2. Discussion

Hydrology in Merauke, Asmat and Kimaam Island

Lowlands in Papua include mangroves, freshwater swamps, peat lands and seasonally flooded savannas. Fresh water swamps and peat swamps in Papua mostly are located in the south part of Papua. There are two systems of lowland in Papua;

recent alluvia-Marine Tidal lowland system and weathered old Lowland Terraces. Figure 2 explains the distribution of the two land systems and the name of places having lowlands.

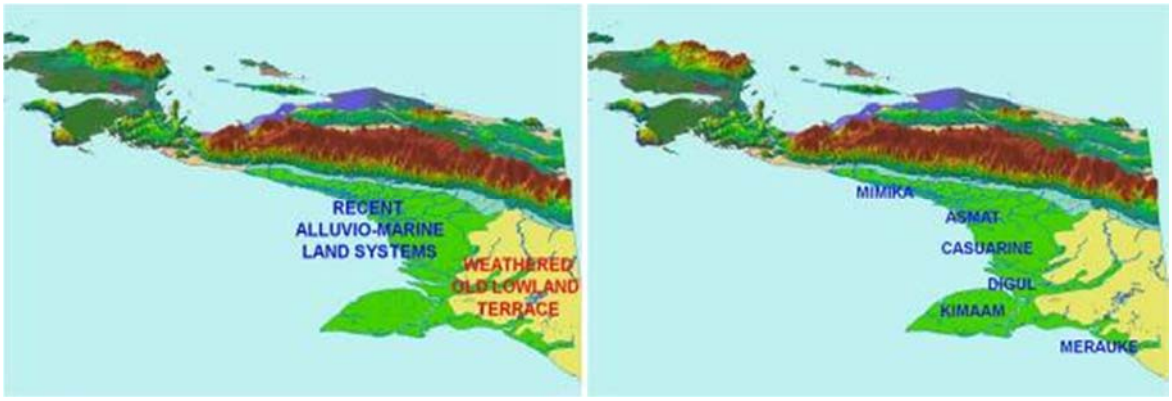

Figure 2 The two lowland land systems of southern Papua (Mawdsley & Houterman, 2010)

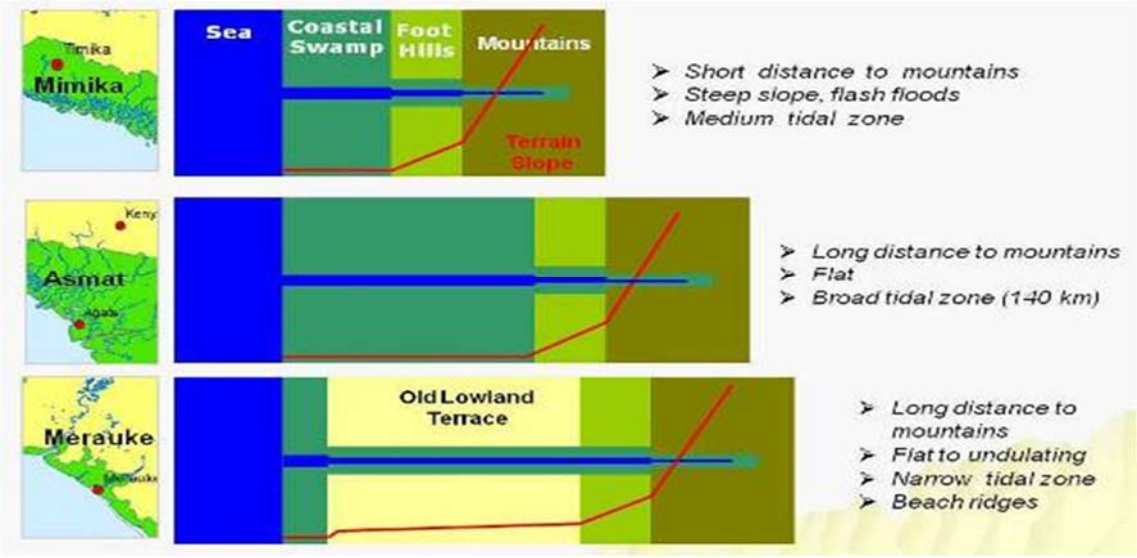

Figure 3 Schematic Diagram of the Transition from Coast to Uplands in the lowlands in Papua (Mawdsley & Houterman, 2010)

While, Figure 3 explains the schematic diagram of the transition from coast to uplands in Mimika (top), Asmat (centre) and Merauke (bottom) that showing the unique of tidal lowlands in Asmat and the unique lowland terrace of the Oriomo plateau and the Fly-Digul shelf extending into Merauke and Mappi districts (Mawdsley & Houterman, 2010) . The detail of the conditions of those areas can be seen in Table 1.

Table 1. The Comparison of those areas

Locations	Key Aspects
Asmat	The Asmat (Agats) area contains the largest area of tidal lowlands in Papua, containing unique bio-physical and cultural aspects. The tidal zone extends up to 140 km inland, with a mangrove zone of some 25 to 50 km wide. The hinterland contains mixed swamp forest and sago associations on shallow to deep peat lands intersected by many rivers and streams. As in Mimika, near the mountain range (flash-) floods and uncontrolled braiding rivers are a serious constraint for development. Deep peat, mangrove and flooded areas unsuitable for agricultural development. Rainfall can be very high up to 5000 mm per year. Deep peat deposits between the rivers are identified, presumably existing as peat domes (see Figure 4), although these have not been characterised in detail. Extensive swamp forests exist, with some logging in the past. Though not a physical characteristic, the cultural value of the Asmat is renowned worldwide. The culture is very much linked to the physical environment. Disturbance of the environment will result in unpredicted and most likely unwanted side effects.
Kimaam Island	Kimaam Island is a low lying wetland tidal area formed by sediment from the Digul River and covered with mangrove, saline wetland, savannah swamp and some woodland. The southern part of Kimaam is a protected area, not to be developed except for indigenous activities. In the northern part, the central area is unsuitable because of drainage restrictions and flood hazard, while other parts are suitable according to old surveys. Other agricultural constraints include the seasonal bird migration from Australia, birds and other pests of (rice) crops, and the monsoon climate with a long dry season.
Merauke	The tidal influence in Merauke coast area is limited. The coastline consists of a complex of (sandy) beach ridges, with a relative narrow strip of tidal lands, bordered by the Oriomo Plateau complex of ‘uplands’ and ‘rawa lebak’.

Source :(Mawdsley & Houterman, 2010)

Based on the secondary data, the study will conduct further research on those areas especially to analyse the change of natural hydrology due to the development.

Traditional Ecological Knowledge

The management of wetlands in Papua is really important because this is related to uncertainty problems including the global environmental aspects and cultural

aspects. Indigenous Papua's have several local knowledge that relates to sustainable natural resource management. Indigenous people are an inseparable part of nature, so their sustainability is related to that of their environment. Sasi is a marine conservation tenure system that prohibits harvesting on land or in the sea to sustain resources and includes fishing area, fishing gear, and target species. This system has been practiced in Papua and some part eastern Indonesia. The system is generally called Sasi, however, some areas have their own local names. Indigenous Papua's who live in Raja Ampat call it Samsom, while, local people of Biak Island say Sasisen. Other parts of Papua such as the Maya tribe from Salawati island call Sasi Rajaha, and the Depapre Tribe who live in Jayapura, call this customary law Takayeti. This system proves that indigenous Papuans care about nature and sustainability (J. R. Mansoben, 2003; MCLeod, Szuster, & Salm, 2009).By using their traditional ecological knowledge, their survival is assured over many generations. Take a example, planting sweet potato in Kimaam Island. Indigenous Papua's of Kimaam island who live in Sabon, Tor and Kladar have developed a certain farming methods. The methods link the traditional knowledge with links to nature like the constellations, tidal calculations, wind direction, land fertility and pet's control. People build a traditional wooden structure called 'para-para or arbors (like vineyards) for gardens which can be located in sandy or muddy areas. The people use a canoe to go to the gardens. They plant in the sandy soil in the beginning of the dry season, and plant in muddy soil in the wet season. However, they have to put sand in the muddy region, which they transport by canoe, as people believe that sand is a fertilizer. During the dry season, farmers dig one metre both left and right side of area, and pile the resulting soil in the middle. They make a deep ditch along the area and the canals have to be kept clean to moisten the soil. They use a rotation system between dry and wet seasons. The soil is planted for two or three years continually and then left for one or two year before replanting. Besides this unique method, Sabon villagers use the movement of constellations to predict the weather. They can read astronomy, they predict the first rainfall in the rainy season by using the cross constellation that is called 'Keyer', while it returns to the start point forecasts the beginning of the dry season. They can forecast the natural condition based on astronomy. If the group of stars "the Kuwan constellation, which move

from east to west, have reached the west it informs of floods, high tides and heavy rainfall. Besides astronomical knowledge the indigenous people understand agricultural too, especially in protecting their agriculture product the sweet potato. In the dry season, they put dry grass down to protect their crop from drying up. They put the bark of bush tree to prevent soil erosion in the wet season. The people make different gardens according to the seasons. They consider water sources in the dry season, and the difficulty in transportation during the wet season. Lastly, the indigenous people really understand about the environment, they can draw maps of their land use and make their life sustainable (L.M.Serpenti, 1977; Manembu, 1995; Serpenti, 1977). Thus, the traditional ecological knowledge can be used alongside scientific data in a Decision Support system. With Participant Action Research, the study will explore further the traditional knowledge in water management.

What is Mauri Model Decision Making Framework?

MMDMF is a sustainable decision support tool that includes indigenous New Zealand culture which consists of four dimensions of well-being, Mauri of Community (social), Mauri of Whanau or family unit (economic), Mauri of the ecosystem (environment), and Mauri of Hapū (culture) which is developed by Kepa Morgan in 2006. This Aotearoa decision making has important attributes which are:

- Inclusive (effective incorporate and represent Māori perspectives).
- Indigenous (adopt a sustainability of indigenous knowledge)
- Holistic (demonstrate ecological integrity).
- Eco-centric (adopt a sustainability measure from indigenous thinking).
- Equitable (deliver intra- and inter-generational equity).
- Legally relevant (be effects focussed and promote social, economic, environmental and cultural wellbeing).
- Integrated (demonstrate interconnectedness between the criteria chosen).
- User friendly (be flexible yet easy to understand in its application).
- Definitive (clearly determine whether a practice is or is not sustainable).
- Transparent (clearly identify applied bias).

The Model is divided into two stages. Firstly, describing well-being as criterion comparison, Mauri dimension and prioritization. Then, identifying case studies and prefer performance Metrics , the models continue to stage two, Māori _ometer that determine Mauri rating from -2 to + 2, which can be shown in this figure (Morgan, 2005, 2006a, 2006b, 2008, 2011)

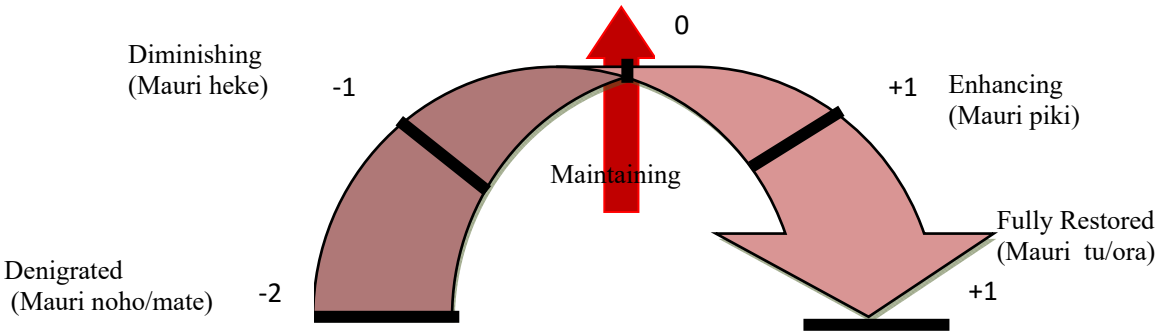

Figure 4 Mauri-ometer

The relevance of using Mauri Model Decision Making Framework in Papua

The Mauri model measures sustainability using the concept of Mauri and the Mauri-ometer. This measurement can be adapted in Papua due to the similarities between Māori and indigenous Papua's in the values concept of life. Papua is need of sustainable development. As Papuans are indigenous peoples, because of a lot of tribes depend on nature and live in traditional ways the people have their own culture and economic factors which distinguish them from other parts of the society (Dove, 2006). It would be good to use some indigenous knowledge to help solve the problems in their society. In the way that Māori knowledge has been integrated into development in New Zealand, by using the unity of nature and environmental and culture, indigenous people in Papua can help address problems including environmental issues such as water cycling and waste water. Māori people are indigenous people of New Zealand. New Zealand also is one of countries which is concerned with indigenous values (Durette 2010). The Mauri model is a concept that believes that nature can support life and it was developed based on Māori knowledge. The Mauri Model measures sustainability with four dimensions like

social, economic, environmental, and cultural aspects. This model was defined as "a new decision making framework that adopts mauri ('integrity' or binding force between the physical and spiritual elements) as the measure of environmental, economic, social, and cultural well-being in place of the monetary basis used conventionally for sustainability assessment. The model is based on Daly's triangle of well-being and adopts his hierarchy for sustainability.' The Mauri Model mentions cultural, social, economic, and environmental well-being as mauri of the Hapū, mauri of the community , mauri of the whānau (family) and mauri of the ecosystem, respectively (Morgan, 2005, 2006a, 2006b, 2008, 2011; Morgan & Yukich). Similarly, Papuan Indigenous peoples believe that humans have a really close relationship to nature. They believe that their ancestors came from nature like animals. Thus, this model can be adopted in Papua.

By doing this study, the data is collected. This data is needed to support the weighting of indicators of Mauri Model Decision Framework in environment and economic dimensions. As Mauri Model Decision Framework measures the sustainability in four dimensions of well-being; Mauri of Hapū (cultural well-being), Mauri of Whana (economic well-being), Mauri of Community (social well-being), Mauri of ecosystem (environmental well-being). Mauri of ecosystem is related to the hydrological and wetland conditions of those areas. The characteristics of wetland and hydrological data are needed to determine the change of those parameters in order to weight of the indicators of Mauri Ecosystem. The indicators of the environmental dimension include biodiversity, air quality, water quantity and quality, tidal parameters, soil conditions and land use. Thus, the hydrological data is need to collect including rainfall data, water table, water quantity, water quality (PH, salinity, hydraulic conductivity ,pollutants), soil testing. While, GIS and remote sensing data are tools to determine watershed and catchment areas including water resources, topography, and geology of in those areas.

Conclusion

This study is still in progress so there are several outcome of the research, which are:

- Determine if local knowledge is relevant in an international development context.
- Identify the transferability of a decision making framework form Aotearoa NZ to Papua.
- Develop new contexts for the application of integrated knowledge system decision making in water management.

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