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

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Civil Engineering, the University of Auckland

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Abstract

Papua is a developing province of Indonesia. However, when the development is driven by decision making frameworks that are incapable of including the values most important to the indigenous people of the districts, there is the potential to create injustice and inequity for present and future generations.

The Mauri Model Decision Making Framework was developed to address this short coming is in Aotearoa, New Zealand. Its adaptation to the Papua Context has been investigated and confirmed as a feasible application in the Asmat and Merauke context.

The Agats Township application looks at a water supply project, while in Merauke the application looks at changing the use of to agricultural purposes. In Agats Township, fresh water supply is a problem for residents. A solution implemented to address the water supply requirements for Agats has introduced inequalities for the regional community. The issues beyond equitable access to the water supply, such as cultural transgressions, raise further questions regarding sustainability. The analysis revealed the high level of complexity posed by this problem. It shows that the project is not sustainable from the Asmat People’s perspective, but could be considered sustainable by the local government. The analysis shows that the predominant benefits are for social and economic well-being, while environmental and cultural well-being are diminished. The differences in worldview values and therefore the perception of an infrastructure project’s sustainability stem from the different values of the stakeholders effected. The findings demonstrate the international applicability of the Mauri Model Decision Making Framework in other cultural contexts. Meanwhile, in Merauke, development in the agricultural sector has four scenarios. Scenarios A, and B are benefit scheme of the mega project Merauke Integrated Food and Energy Estate. Scenario C is sustainable development, and Scenario D is autonomous development. Here Scenario C is superior to the others and the one which benefits all stakeholders.

These case studies offer insight at different levels of understanding showing that the Mauri Model is important for issues involving indigenous people.

Keyword: Mauri Model, water management, Asmat, Merauke, New Zealand
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# Table of Contents

Abstract .......................................................................................................................... ii

Acknowledgements ....................................................................................................... iii

Table of Contents .......................................................................................................... v

List of Tables ................................................................................................................. xi

List Figures ................................................................................................................... xiii

Chapter 1 ...................................................................................................................... 1

Introduction .................................................................................................................. 1

1.1. Introduction ........................................................................................................... 1

1.2. Research Aim and Objectives ............................................................................. 2

1.3. Structure of the Thesis ......................................................................................... 3

Chapter 2 ...................................................................................................................... 7

2.1. Introduction ........................................................................................................... 7

2.2. The Concept of Sustainability and Sustainable Development ......................... 7

2.3. Decision Support System ..................................................................................... 8

2.4. Sustainable Decision Making ............................................................................. 10

2.4.1. Multi Criteria Decision Analysis .................................................................. 12

2.5. The Indigenous Peoples’ Rights ......................................................................... 15

2.6. The Context of Sustainability and the rights of Indigenous People in Papua ......... 16

2.7. Conclusion ........................................................................................................... 18

Chapter 3 ...................................................................................................................... 24

3.1. Introduction ........................................................................................................... 24

3.2. Water Resources Management .......................................................................... 24

3.3. Wetlands .............................................................................................................. 24

3.3.1. The value of water and wetlands ................................................................. 25

3.3.2. The management of wetlands ...................................................................... 27
3.4. River Basin Management .................................................................................. 28
3.5. Integrated water Resources Management ....................................................... 28
3.6. Traditional Knowledge in Water and Wetland Management ............................. 29
  3.6.1. Traditional knowledge in legislation .......................................................... 29
  3.6.2. Agricultural traditional knowledge in wetlands .......................................... 30
  3.6.3. Traditional management in Fisheries ......................................................... 31
3.7. The Regulations for Water and Management in Wetlands in Indonesia .............. 31
3.8. The Regulation of Wetland Management in New Zealand ................................. 34
Chapter 4 ............................................................................................................. 40
  4.1. Introduction ...................................................................................................... 40
  4.2. The Lowlands of Papua .................................................................................. 40
  4.3. The Management of Lowland ........................................................................ 45
  4.4. The Development of Lowland in Papua .......................................................... 46
  4.5. Conclusion ....................................................................................................... 47
Chapter 5 ............................................................................................................. 52
The Mauri Model Decision Making Framework ....................................................... 52
  5.1. Introduction ...................................................................................................... 52
  5.2. The Natural Resources Management in New Zealand .................................... 52
  5.3. Mauri ............................................................................................................... 52
  5.4. The Mauri Model Decision Making Framework .............................................. 53
  5.5. The process analysis of the Mauri Model Decision Making Framework ................ 56
  5.6. Conclusion ....................................................................................................... 60
Chapter 6 ............................................................................................................. 63
Methodology ........................................................................................................ 63
  6.1. Introduction ...................................................................................................... 63
  6.2. Research Question ......................................................................................... 64
ix

9.6. The Ontology and Epistemology of the Malind Anim ........................................ 155

9.6.1. The social network and the concept of sustainability of the Malind Anim .... 166

9.7. Discussion ........................................................................................................ 169

9.8. Conclusion ........................................................................................................ 171

Chapter 10 ............................................................................................................ 177

The Merauke Integrated Food and Energy Estate (MIFEE) ........................................ 177

10.1. Introduction ..................................................................................................... 177

10.2. Description of the Merauke Integrated Food and Energy Estate (MIFEE) .... 177

10.3. Previous study of Water Resources Management in the Regency ............... 181

10.4. The Interpretation of the data using Mauri Model ........................................ 189

10.5. Detailed Analysis Using the Mauri Model Decision Making Framework ....... 192

10.6. Detail Analysis with Adding Indicators of mauri ............................................ 195

10.6.1. The mauri of the cultural dimension ....................................................... 196

10.6.2. The mauri of the social dimension ......................................................... 200

10.6.3. The mauri of the economic dimensions .................................................. 203

10.6.4. The mauri of the ecosystem .................................................................... 206

10.7. The Sensitivity analysis .................................................................................. 208

10.7.1. Scenario A (MIFEE with 1.2 M Ha) ..................................................... 209

10.7.2. Scenario B (the MIFEE with 250,000 Ha) ............................................ 212

10.7.3. Scenario C (focus on sustainability) ...................................................... 215

10.7.4. Scenario D (Autonomous Development) ............................................... 218

10.8. Conclusion .................................................................................................... 221

Chapter 11 ............................................................................................................ 226

Conclusion ............................................................................................................. 226

11.1. Introduction ................................................................................................... 226

11.2. Summary ...................................................................................................... 226
11.3. Limitation of the Research

11.4. Output

11.4.1. Conferences, Symposiums, Posters

11.4.2. Sharing the Mauri Model in Indonesia

11.4.3. Journals

11.5. Future Works

11.6. The Contribution of the Research

References
List of Tables

Table 3.1  The Ecosystem Services and functions of wetlands 26
Table 4.1  Key Features of the Sub-systems of the Tidal Lowlands of southern Papua 44
Table 5.1  The Characteristics of the Mauri Model Decision Making Framework 56
Table 5.2  The Scale Priorities of AHP (Saaty, 1988) 57
Table 5.3  The scale of the AHP-Mauri Model 58
Table 6.1  The Key characteristics of Participation Action Research (PAR) 68
Table 6.2  the typical stages of Participatory Action Research 69
Table 6.3  the position of the research 70
Table 6.4  The Composition of the Respondents (Participants) 83
Table 7.1  Parallels between the Māori and the Asmat 102
Table 8.1  The Budget for the Project of Water Supply in Agats Township 120
Table 8.2  The Mauri Model – Worldview Dimension Priorities 123
Table 8.3  The Ranking Assessment of the Mauri Indicators 128
Table 9.1  Name variations for the MalindAnim tribal peoples 148
Table 9.2  The ecosystem influences the names of the MalindAnim 153
Table 9.3  Ecosystem terms in the Malind Language 154
Table 9.4  The Clans and the Dema and their specific relationships 161
Table 9.5  The Families with their totems. 162
Table 9.6  The Lunar Calendar of the MalindAnim 165
Table 9.7  The age differences of the MalindAnim 166
Table 9.8  The Parallels between these Tribal People 171
Table 10.1  The clusters of the MIFEE 180
Table 10.2  The selected criteria for the multi criteria analysis. 188
Table 10.3  The results of decision analysis 188
Table 10.4  The Result of the Ranking Assessment of the Previous study (Boccalon et al., 2012) 190
Table 10.5  The result of the actual mauri based on previous research. 191
Table 10.6  AHP- Mauri Model showing the worldview priorities of the four stakeholders. 192
Table 10.7  The results of the sensitivity analysis 193
Table 10.8  The Ranking Assessment of the mauri of the culture 198
Table 10.9  The Ranking Assessment of the mauri of the social dimension 201
Table 10.10  The Ranking Assessment of the mauri of the economic dimension 204
Table 10.11  The mauri of the ecosystem dimension 207
Table 10.12  The mauri of the Scenario A 209
Table 10.13  The sensitivity analysis based on the stakeholders’ perspectives 210
Table 10.14  The area of the mauri of the Scenario A 210
Table 10.15  The mauri of the Scenario B 212
Table 10.16  The Sensitivity Analysis of the mauri of the Scenario B 213
Table 10.17  The area of mauri Scenario B 213
| Table 10.18 | The result of the scenario C | 215 |
| Table 10.19 | The sensitivity analysis of the Scenario C | 216 |
| Table 10.20 | The area of the mauri of the Scenario C | 216 |
| Table 10.21 | The ranking assessment of the Scenario D | 218 |
| Table 10.22 | The sensitivity Analysis of the mauri of the Scenario D | 219 |
| Table 10.23 | The area of the mauri of the Scenario B | 219 |
List Figures

Figure 2.1 The Multi Criteria Process (Pohekar and Ramachandran, 2004) 13
Figure 2.2 The stages of Multi Criteria Decision Analysis based on a manual report from the Department of the Communities and Local Government of the United Kingdom (2009) 14
Figure 2.3 The negotiation process between the Asmat People and Local Government in a Jew in the Asmat Regency (photo by Wambrauw, 2012) 19
Figure 3.1 the Institutional Framework of Water Resources in Indonesia (Boccalon et al., 2012) 34
Figure 4.1 Map of the lowlands in Papua Province (Giesen and Houterman, 2009) 41
Figure 4.2 The two lowland systems in Papua (Houterman, 2010) 42
Figure 4.3 Schematic Diagram of the Transition from Coast to Uplands in the lowlands in Papua (Mawdsley and Houterman, 2010) 43
Figure 5.1 The Parallel dimensions of the LGA 2002 and The Mauri Model Decision Making Framework (Morgan, 2011) 54
Figure 5.2 The Venn Diagram which shows the relation of the four dimension in the Mauri Model (Morgan, 2006) 55
Figure 5.3 The steps of the Mauri Model Decision Making Framework 58
Figure 5.4 The ranking of the Assessment of the Mauri Model Decision Making Framework 59
Figure 5.5 Mauriometer 60
Figure 6.1 The Framework of the Research 66
Figure 6.2 The Implementation of Participatory Action Research 71
Figure 6.3 Map of Papua Province (BAPPEDA-Papua) 74
Figure 6.4 Map of Asmat Regency (BAPPEDA-Asmat) 75
Figure 6.5 Map of Merauke Regency (BAPPEDA – Merauke Regency) 76
Figure 6.6 The Map of Agats 77
Figure 6.7 The Reservoir for rain water in Agats Township 78
Figure 6.8 Syuru in Village Agats (photo: Wambrauw, 2012) 79
Figure 6.9 Ramsar Sites in Merauke 80
Figure 6.10 Agats Township 81
Figure 7.1 the location of Asmat in Southern Papua (Asmat Government, 2012) 90
Figure 7.2 A Jew in Syuru Village, Agats, Asmat (Wambrauw, 9 Dec 2012) 91
Figure 7.3 A nuclear family house (photo: Teguh Purwanto) 92
Figure 7.4 The geographical condition of Agats town, the capital of Asmat (photo: Wambrauw, E, 2012) 95
Figure 7.5 Wow ipits or carvers (photo: Theodorus Tethool, March 2014) 95
Figure 7.6 Pictures of manaia (left) (photo: Morgan, TKKB, 2014) and ambirak or amirak (right) (photo: Allan Bryan, June 2014) 98
Figure 7.7 The field study area in 2012 in an urban environment (left) and Syuru Village (right) in Agats, the capital of Asmat 100
Figure 8.1 The Location of Asmat Regency (BAPPEDA- Papua, 2012) 110
Figure 8.2 Asmat Regency (BAPPEDA-Asmat, 2012) 111
Figure 8.3 Agats Town (Asmat Government, 2012) 112
Figure 8.4  Geographical characteristics of the Agats Township (Wambrauw, 2012)
Figure 8.5  The Clearing area to access the Yomot River (Asmat Government, 2012)
Figure 8.6  the intake from the Yomot River, in Yepem Village (Asmat Government, 2012)
Figure 8.7  The three zones of water supply service (Asmat Government, 2012)
Figure 8.8  The reservoir in Agats Township (Wambrauw, 2012)
Figure 8.9  The Interview in Syuru Village
Figure 8.10  The Chosen Indicators
Figure 8.11  The mauri of the economic dimension
Figure 8.12  The mauri of the community
Figure 8.13  The mauri of the ecosystem
Figure 8.14  The mauri of the tribal dimension
Figure 8.15  The average of the mauri dimensions
Figure 8.16  Sensitivity Analysis for both Stakeholders
Figure 8.17  The mauriOmeter result
Figure 9.1  The Cultural zones of Papua Province
Figure 9.2  The Administration Map of the Merauke Regency (Merauke Government)
Figure 9.3  The territory of the Malind Anim, is from (Jan van Baal, 1966)
Figure 9.4  The River Basins in the Merauke Regency showing the hinterland areas for the Malind Anim who mostly live along the big rivers
Figure 9.5  The flag of the Malind Anim (LMA Malind Anim, 2007)
Figure 9.6  The flags of each group (LMA Malind Anim, 2007)
Figure 9.7  Traditional Clothing of the Malind Anim (photo: Wambrauw, E 2014)
Figure 9.8  The Social framework of the Malind Anim (modified from (Corbey, 2010, Jan van Baal, 1966, LMA Malind Anim, 2007)
Figure 9.9  Wambad system (photo: Konny Kameubun ,2013)
Figure 10.1  Areas of the clusters of the MIFEE project (Indonesia Government, 2011, Boccalon et al., 2012)
Figure 10.2  The elements of water planning (Boccalon et al., 2012)
Figure 10.3  The Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers basin (Aditya Engineering Consultant, 2008)
Figure 10.4  The Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers basins and their drainage systems (BAPPEDA Merauke Regency
Figure 10.5  The Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers basins and their drainage systems
Figure 10.6  The indicators that have been modified from the former study (Boccalon et al., 2012).
Figure 10.7  The Result in mauriOmeter
Figure 10.8  The result of the mauriOmeter of the Local Government’s perspective
Figure 10.9  The result of the mauriOmeter of the Agribusiness companies’ perspective
Figure 10.10  The result of the mauriOmeter of the trans-migrant perspective
| Figure 10.11 | The result of the mauriOmeter of the Malind Anim’s perspective | 195 |
| Figure 10.12 | The indicators of the mauri dimensions | 196 |
| Figure 10.13 | The mauri the cultural dimension part 1 | 199 |
| Figure 10.14 | The mauri the cultural dimension part 2 | 199 |
| Figure 10.15 | The mauri of social dimension part 1 | 202 |
| Figure 10.16 | The mauri of the social dimension part 2 | 202 |
| Figure 10.17 | The mauri of the economic part 1 | 205 |
| Figure 10.18 | The mauri of the economic dimension part 2 | 205 |
| Figure 10.19 | The mauri of ecosystem dimension part 1 | 208 |
| Figure 10.20 | The mauri of the ecosystem part 2 | 208 |
| Figure 10.21 | The result of sensitivity analysis with the weighting of the stakeholders | 211 |
| Figure 10.22 | The Sensitivity Analysis of the Scenario B | 214 |
| Figure 10.23 | The Scenario C (focused on sustainable) | 217 |
| Figure 10.24 | The sensitivity analysis of the Scenario D | 220 |
| Figure 10.25 | Savannah in Merauke (Photo :Wambrauw, 2014) | 221 |
| Figure 11.1 | Focus Group with the community in Jayapura Selatan District (Vina Kambu, 2015) | 230 |
| Figure 11.2 | Focus Group with the Local Government (Vina Kambu, 2015) | 230 |
Chapter 1
Introduction

1.1. Introduction

Papua, which borders Papua New Guinea (PNG), is the easternmost and largest province of Indonesia and its least populated. It has an abundance of natural resources (Tadjoeeddin, 2007) from mining, gases, forest, water resources, biodiversity (Pattiselanno, 2003), fishery, a unique ecosystem and cultural diversity. Its resource potential makes Papua one of the largest contributors to the Indonesian economy. However, the people in Papua are still living in poverty (Wulandari and Sulistio, 2013, Wambrauw, 2013) and face inequality and injustice in the distribution of development (Timmer, 2005, Widjojo et al., 2008, Kayoi et al., 2008, Resosudarmo et al., 2014). To address these problems, the Indonesian Government gave Papua special autonomy with Law No 21 in 2001 (Indonesian Government, 2001). This, and the United Nation Declaration on the Rights of Indigenous People (UNDRIP), gives the opportunity for self-determination to local people and Indigenous Peoples and the right to participate in the development of the area. Then, in 2004, to accelerate development in Papua, the Indonesian Government also bisected the province into Papua Province and Irian Jaya Barat, based on Government Law no 45 in 1999 (Wambrauw, 2013). However, this is still not enough to solve the issues of injustice and inequity of the development in Papua (Sullivan, 2003, Bertrand, 2014).

Papua has a unique ecosystem including a glacier (Allison and Kruss, 1977), alpine meadows, cloud forest, lowland forest, savannah, mangrove forest, coral reefs and sea grass beds (Marshall and Beehler, 2007). The lowlands in Papua include grass land, mangroves, freshwater swamps, peat land and seasonally flooded savannas. The Lowland area in northern Papua is located around the Mamberamo River Basin while in the south of Papua the lowland areas are at Mimika, Asmat, Mappi and Merauke Regencies around the big rivers (Mawdsley and Houterman, 2010, Giesen and Houterman, 2009). The southern lowlands of New Guinea Island (for both countries: Papua and Papua New Guinea) are part of the Trans Fly region and really rich in indigenous species (Allison, 2006, Halse et al., 1996, Hitchcock, 2006). According to the Ramsar classification, the types of wetland ecosystem for that area (Chatterton, 2004) are sea grass, coral reefs, sand beaches,
estuarine waters, intertidal forested wetlands, permanent and seasonal rivers, swamps of the coastal river floodplains, permanent freshwater and freshwater swamp forests.

The wetlands of Papua also contribute a lot to the percentage of wetland in the world and are also rich in natural resources (Jack Ruitenbeek, 1994). Wetland ecosystems play an important role in biodiversity given their hydrology, ecology, social and economic outputs, including the availability of water, richness of biodiversity, abundant natural resources, and cultural values (Adger and Luttrell, 2000, Finlayson et al., 1999, Halls, 1997, Matthews, 1993, Barbier, 1994), and also their role in the storage of carbon (Jaenicke et al., 2008) and water (Wösten et al., 2008, Wösten et al., 2006). The management of wetlands in Papua is extremely important because of their relevance to global environmental change, climate change (Allison and Kruss, 1977) and sea level rise, and also the wellbeing of the indigenous people of Papua. Some however still consider that the development of the wetlands in Papua should continue. To minimise the destruction which comes with the development decision makers should be concerned about development policies in Papua.

Indonesian Government policies have been developed to achieve better decisions that take into account the cultural diversity of Papua. Indeed it is vital to the survival of the Indigenous People that policy and decision makers develop or adopt assessments involving cultural values and traditional lore, practised over long generations. Decision making that takes culture into consideration when measuring the sustainability of any development should therefore be used in Papua. The Mauri Model Decision Making Framework (MMDMF) is a sustainable decision support tool that can possibly be used to assess the sustainability of development by involving all stakeholders, including the indigenous people.

Therefore, this research will focus on using the MMDMF to assess currently practised wetland management in southern Papua, especially in Asmat and Merauke Regencies.

1.2. Research Aim and Objectives

The wetland ecosystem is unique and complex with the hydrology of the ecosystem very much connected. The connections between land use, hydrology, sea water level, climate change, CO2 emissions, and cultural aspects have to be involved. The wetland ecosystem occurs in both the uplands and the lowlands, but mostly in the lowland areas. The lowlands provide natural resources like food, medicine, shelter and have cultural significance for the
indigenous people who live in that area. Papua (both Papua and Irian Jaya Barat) are home to a large proportion of Indonesian wetlands (besides Kalimantan and Sumatra).

The sustainable management of the wetland is significant to protect the ecosystem and the people. Since development cannot be avoided, an assessment should be developed to minimise its negative impact. Assessment which includes social justice would seem to be suitable for the areas under study.

The main objectives of this research are to identify best management practice for water resources in lowlands in Southern Papua and to assess the sustainability of the water management practices there using an assessment developed in and for Aotearoa, New Zealand.

This main objectives can be divided into special objectives:

1) To examine the feasibility of transferring the decision making framework developed in and for Aotearoa, New Zealand into the context of Asmat, southern Papua.

2) To assess the sustainability of the water supply project in Agats Township, Asmat Papua.

3) To identify similarities in the cultural concepts of the peoples who live in southern Papua: the Asmat People and the Malind Anim in Merauke Regency, in order to decide whether the decision making framework used to analyse sustainability in Asmat could be applicable in Merauke.

4) To assess the sustainability of the Mega Project Merauke Integrated Food and Energy (MIFEE), given the impact of change in land use and the water demands of the project on the ecosystem and indigenous peoples of the areas.

1.3. Structure of the Thesis

This thesis consists of 11 chapters. Chapter 1 provides the introduction. Chapter 2 establishes the concept of sustainability and the rights of the indigenous people. This shapes the importance of involving the Indigenous People in the decision making about the development of their territory. Chapter 3 discusses water and wetland management and includes definitions of the wetlands, river basin, and regulation of water management in Indonesia. This content is important background to the examination of the management of water practised in Merauke and Asmat in the southern Papua. Chapter 4 describes the lowlands in Papua, especially in its south on which this research is focused. It also describes the current development in southern lowlands in Papua. Chapter 5 explains the
Mauri Model Decision Making Framework (the MMDMF). These are tools used to measure the sustainability or to assess equality in the distribution of development. The MMDMF is used to analyse sustainability in the case study area. Chapter 6 presents and explains the research methodology used in this study, and the tools for analysis which use the MMDMF decision making framework from New Zealand. It also examines the feasibility of transferring the assessment and describes the areas of study. Chapter 7 discusses the feasibility of the transfer of the MMDMF by comparing parallel concepts of sustainability between the Asmat People (the Indigenous People of Asmat Regency, southern Papua, Indonesia) and the Māori People (the Indigenous People of New Zealand). The content of this chapter has been published in the journal, AlterNative, an Indigenous International Journal (Wambrauw and Morgan, 2014).

Chapter 8 analyses the sustainability of the water management practice in Agats Township, the capital of Asmat Regency in southern Papua. The water supply is taken at Yepem Village from the Yomot River which is a sacred place for the tribal people.

Chapter 9 examines the feasibility of transferring the decision making used in Asmat Regency to Merauke Regency by comparing the majority tribes of both areas. In this case study the tribes are the Asmat People and The Malind Anim.

Chapter 10 discusses the sustainability of the changes in land use with the development of the wetland ecosystem for agricultural purposes, termed The Merauke Integrated Food and Energy Estate (the MIFEE project).

Chapter 11 summarises the findings of the study and the contribution it makes to its field of research before presenting recommendations for further research.
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Chapter 2
Literature Review

2.1. Introduction

Chapter 2 establishes an understanding of several definitions that are central to answering the objectives of this thesis. This chapter gives a definition of sustainability, decision making, social justice and the rights of the indigenous peoples that are relevant to Papua’s context. Section 2.2 explains the definition of sustainability and sustainable development. Section 2.3 describes the Decision Support System. Sec 2.4 describes Sustainable Decision Making. Section 2.5 explains the indigenous peoples’ Rights. Section 2.6 explains the context of sustainability and the rights of indigenous peoples in Papua. Section 2.7 concludes this chapter.

2.2. The Concept of Sustainability and Sustainable Development

The word “sustainable” has different meanings depending on the context. For example in an environmental context sustainable is defined (Guttenstein et al., 2010) as

“Relating to designating forms of human activity that enhance economic. Resilience, equitably promote human and social well-being, and protect and enhance the natural resource base and ecosystem functions “

The Cawthron Institute (Challenger, 2013) also explains the definition of sustainability (adapted from Roberts 2005 ) as below:

“When need is met, without overwhelming the rest of nature and society “

Therefore the concept sustainability can be defined as an activity to use natural resources to enhance well-being, but also sustains the needs of the future generations.

The activity of using the natural resources can be separated from development. However, development without concern for the sustainability of those activities will lead to destruction. Thus the concept of sustainability should be involved in all aspects of the development.

There are several concepts which establish the definition of sustainable development.

“Development that meets the need of the present without compromising the ability of future generations to meet their own needs”

The report also promotes four dimensions for sustainability; safeguarding long-term ecological sustainability; satisfying basic human needs; promoting inter-generational sustainability; and intra-generational equality (Holden et al., 2014).

Previously, the World Conservation Strategy in IUCN 1980 (Morgan 2008) stated the definition of sustainable development as;

“The integration of conservation and development to ensure that modifications to the planet do indeed secure the survival and well-being of people”

Meanwhile a conceptual framework regarding sustainable development for agricultural purposes explains the meaning of sustainability (Guttenstein et al., 2010) as;

“Ensuring human right, well-being, and achieving global food security without depleting or diminishing the capacity of the earth’s ecosystem to support life or at expense of other’s well-being. It is a multi-dimensional concept encompassing good governance, social development, environmental integrity, and economic resilience”

The same resource (Guttenstein et al., 2010) states the definition of sustainable development as:

“Development is considered sustainable when all are today able to secure their livelihood, in way which are compatible with maintenance of the environmental and nature resources, thus assuring the ability of the future generations to secure their needs from the same natural resources base. Developmental processes that preserve human, social, economic, and environmental resources are evaluated in relation to value, power relationship, time and space. Interaction between resources, and their relative substitutability, lead to inevitable trade-offs between them.”

Another resource states that sustainable development should be concerned about the three sectors of well-being; the social, economic and environmental dimensions (Giddings et al., 2002, Hopwood et al., 2005).

Thus sustainable development is an action to develop an area using its natural resources wisely so the present and future generations can meet their needs, and the negative impact of the development can be reduced.

2.3. Decision Support System

The Decision Support System (DSS) is defined as a tool to support human decisions and which uses a computer program with a model base and a data base as important parts
(Quaddus and Siddique, 2004). Another definition mentions DSS as a modelling tool that uses a computer to solve the problems (Othman and Naseri, 2008). With regard to management, a Decision Support System in general is defined as follows (Simonovic, 1996)

“computer-based tools having interactive, graphical, and modelling characteristics to address specific problems and assist individuals in their study and search for a solution to their management problems “.

The four characteristics of the DSS are to support the decision makers in their action, to respond to managers, to provide scenarios, and to require the involvement of decision makers (ibid 2008). Decision Support Systems developed around the globe to solve uncertainties in environmental problems include AQUATOOL, used to solve a complex problem in a river basin (Andreu et al., 1996, Sophocleous et al., 1999, Arias Hidalgo, 2012); MULINO Decision Support System, to solve problems in water resources management (Giupponi et al., 2004); the Water Poverty Index, to measure the availability of water and its relationship to the human population (Pal, 2008). The Water Poverty Index can be used to solve water resources management problems (Pallottino et al., 2005, Othman and Naseri, 2008, Mysiak et al., 2005, Salewicz and Nakayama, 2004).

Several criteria should be considered when evaluating a DSS for its appropriateness. These include the development process, (Rajasekaram and Nandalal, 2005) and consist of the DSS component, decision processes, decision outputs, and user satisfaction (ibid 2005). If the users are not satisfied with a decision, problems or conflicts can arise. The purpose of the assessment is to facilitate a more holistic understanding of the distribution of benefits and impacts resulting from physical resource extraction and development, and the drivers for the decisions that allow such progress to occur. As explained in the previous section, Decision Support Systems function to help policy makers in their action to achieve sustainable development. However, sometimes the decision can face uncertainty and complexity if its result cannot satisfy certain groups affected by the action, because every stakeholder has different priorities and understandings.

Environmental, social and economic growth considerations are always major issues to be considered in decisions. This encourages researchers to develop tools suitable to a specific context.
2.4. Sustainable Decision Making

Our Common Future promoted four dimensions for sustainability: safeguarding long-term ecological sustainability; satisfying basic human needs; promoting inter-generational sustainability; and intra-generational equality (Holden et al., 2014).

This concept of sustainability becomes important when development causes an environmental impact, social conflict, or inequity (Hopwood et al., 2005). Thus, the decision makers should act in a sustainable way. The Decision Support System should be developed not only as an engineering tool but it should be developed into a framework or an assessment which gives opportunities to all stakeholders to participate in the decision making which is associated with them. Participation of the stakeholders helps decision makers understand the problems properly and figure out the best solution.

Assessments have developed around the world to assist decision making regarding the equitable distribution of benefits associated with infrastructure development. Societies face complex problems if only considering economic, technical, and environmental issues without considering the socio-cultural ones. Recently, the application of social justice in decision making has developed around the world. Examples are in the UK where it is associated with climate policy (Bell and Rowe, 2012); in water resources management in Cambodia (Heinonen, 2004); and in urban planning in Portugal (Cardoso and Breda-Vázquez, 2009). Other examples are that decision making frameworks can be of use in the assessment for coastal areas (Koundouri et al., 2015), land use conflict (de Groot, 2006), mapping (Hopwood et al., 2005), water supply (Georgakakos, 2007) and agricultural purposes (Guttenstein et al., 2010). These examples show that the decision making has to involve the socio-cultural issues to achieve social justice for the whole community.

Bellagio STAMP establishes the guiding principles for developing a sustainable framework. It contains the eight principles of sustainable frameworks (Becker, 2004), (Pintér et al., 2012) being: the guiding vision, the essential consideration, framework and indicators, transparency, effectiveness and communication, broad participation, continuity, and capacity.

The explanations of each principal are as follows (Pintér et al., 2012):

Principle 1: “Assessment of progress toward sustainable development will be guided by the goal of delivering well-being within the capacity of the biosphere to sustain it for future generations”

Principle 2: “Assessment of progress toward sustainable development will consider: the underlying social, economic and environmental system as a whole and the interaction among its components, including issues related to governance; dynamics and interactions between current trends and
drivers of change; risk, uncertainties and activities that can impact across boundaries; implications for decision making, including trade-offs and synergies.”

Principle 3: ”Assessment of progress toward sustainable development will adopt: an appropriate time horizon to capture both short and long term of effect current policy decisions and human activities; an appropriate geographical scope.”

Principle 4: “Assessment of progress toward sustainable development will be based on: a conceptual framework that identifies the domains within which core indicators to assess progress are to be identified; standardized measurement methods wherever possible, in the interest of comparability; comparison of indicator values with targets, as possible”.

Principle 5:” Assessment of progress toward sustainable development will: Ensure the data, indicators and results of the assessment are accessible to the public; explain the choices, assumptions and uncertainties determining the results of the assessment; disclose data sources and methods; disclose all sources of funding and potential conflicts of interest.”

Principle 6: In the interest of effective communication, to attract the broadest possible audience and minimize the risk of misuse, assessment of progress toward sustainable development will: use clear and plain language; present information in a fair and objective way that helps to build trust; se innovative visual tools and graphics to aid interpretation and tell a story; Make data available in as much detail as is reliable and practicable.”

Principle 7:” To strengthen its legitimacy and relevance, assessment of progress toward sustainable development should: find appropriate ways to reflect the views of the public, while providing active leadership; find appropriate ways to reflect the views of the public, while providing active leadership; engage early on with users of the assessment so that it best fits their needs.

Principle 8:’ Assessment of progress toward sustainable development will require: repeated measurement; responsiveness to change; investment to develop and maintain adequate capacity; continuous learning and improvement”

The objective is to ensure the sustainability of the development using assessments which consider those principles. Another study (Gibson, 2006), describes the general criteria of sustainable assessment that include the integration of the socio-ecology, intra and inter-generational equity, a good livelihood, good government, maintaining the resource efficiently, and combining short and long period considerations. Yet another study states that sustainable assessment can contribute better understanding into decision making to ensure the equity for intra and inter generations (Waas et al., 2014).

Many assessment tools have been developed to support the decision making. One of these which is used in water management (Boccalon et al., 2012) is Multi Criteria Decision Analysis (Arias Hidalgo, 2012, Cinelli et al., 2014).
2.4.1. Multi Criteria Decision Analysis

Multi Criteria Decision Analysis (Gwo-Hshiung, 2010) is an approach to support the decision making involving several options. This approach is popular for assessing environmental issues such as sustainable energy management (Pohekar and Ramachandran, 2004), water management (Srdjevic et al., 2004, Joubert et al., 1997) and wetland management (Turner et al., 2000), rain harvesting (Jha et al., 2014), and natural resources management (Mendoza and Martins, 2006). This assessment is suitable for water resources management which is recognised as complex because it involves several stakeholders and differences in use water resources. For example, the farmers use the water to supply the irrigation system; the urban dwellers rely on it for domestic and industrial purposes; the government agencies need it to develop local infrastructure; and national parks require water for the conservation of ecosystems (Boccalon et al., 2012).

Multi Criteria Decision Analysis is used to integrate several criteria and alternatives to get a better solution. Multi Criteria Analysis is defined as (Belton and Stewart, 2002, Mendoza and Martins, 2006)

“An umbrella term to describe a collection of formal approaches which seek to take explicit account of multi criteria in helping individual or group to explore decision that matter”

The stages of the Multi Criteria Analysis are (Joubert et al., 1997):

The selection of the stakeholders and decision makers associated with the issues. The alternative solutions are also identified in this stage.

a) The identification of the criteria based on the issues raised by each stakeholder.

b) The evaluation of the alternatives according to the perspectives of the stakeholder.

c) The weighting of the criteria of each stakeholder and the ranking assessment of the criteria.

d) The sensitivity analysis to score the criteria based on the priority of the stakeholder.

e) The negotiation and compromises of the result.

According to a manual of Multi Criteria Analysis, which is published by the Department of Communities and Local Government of the United Kingdom (2009), in the process of selection criteria, the selected criteria are as the following:

a) It should be internally consistency and is logical.

b) It should be transparent.

c) It is easy to use.
d) It considers data requirements which are not inconsistent with the importance of the issues.

e) It considers realistic time and man power for the analysis process.

f) It should have an ability to provide an audit trail, and have software availability where needed.

The steps of the Multi Criteria Analysis are shown in Figure 2.1.

Figure 2.1 the Multi Criteria Process (Pohekar and Ramachandran, 2004)
The same resources also described the steps of the Multi Criteria Decision analysis as those following in Figure 2.2

- Establish aims of the MCDA, and identify decision makers and other key players.
- Design the socio-technical system for conducting the MCDA.
- Consider the context of the appraisal.

- Identify criteria for assessing the consequences of each option.
- Organise the criteria by clustering them under high-level and lower-level objectives in a hierarchy.

- Describe the consequences of the options.
- Score the options on the criteria.
- Check the consistency of the scores on each criterion.

- Conduct a sensitivity analysis: do other preferences or weights affect the overall ordering of the options?
- Look at the advantage and disadvantages of selected options, and compare pairs of options.
- Create possible new options that might be better than those originally considered.

- Establish the decision
- Identify the options to be appraised
- Identify objectives and criteria
- ‘Scoring’. Assess the expected performance of each option against the criteria. Then assess the value associated with the consequences of each option for each criterion.
- ‘Weighting’. Assign weights for each of the criterion to reflect their relative importance to the decision.
- Examine the results
- Combine the weights and scores for each option to derive an overall value

Figure 2.2 The stages of Multi Criteria Decision Analysis based on a manual report from the Department of the Communities and Local Government of the United Kingdom (2009)
2.5. The Indigenous Peoples’ Rights

The United Nations International Labour Organisation in 1989 (Wambrauw, 2013) explains the definition of indigenous people as below:

“Peoples in independent countries who are regarded as indigenous on account of their descent from the populations which inhabited the country, or geographical region to which the country belongs, at the time of conquest or colonialization or establishment of present state boundaries and who irrespective of their legal status, retain some or all of their own social, economic, cultural and political institutions.”

ILO Convention No. 169, article 7(1), also states that the Indigenous People have their own rights to determine for themselves the development of the social, cultural and economic well-being which affects their lives (ILO No 169, 2013).

To ensure the Indigenous People own the land, the United Nations also declared the Rights of Indigenous Peoples in 2007 (Assembly, 2007) which stated that the Indigenous Peoples have their own rights. The declaration affirms that the Indigenous Peoples are equal to other people. Even though the people have their own differences, these should be respected. The diversity enriches culture and society and also the heritage of humankind. The UN recognises that to ensure the sustainability of the Indigenous People, their rights should be promoted. The declaration of rights contains 46 articles (ibid 2007). Articles 3 and 4 state that the Indigenous People can determine for themselves how to pursue their development in economic, social and cultural sectors, and establish their own autonomous processes or self-government.

Thus, Articles 3 and 4 support that Indigenous Peoples have their own rights to determine the direction of development within their territory. Article 5 states that Indigenous People have their own rights from either using their political, social and cultural institutions or by participation in the state. Generally, the declaration ensures the Indigenous People have equality, and develop their cultural values, customs and ceremonies freely.

Article 18 supports the Indigenous People’s participation in decision making about themselves (Assembly, 2007), as following

“Indigenous People have the rights to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedure as well as maintain and develop their own indigenous decision making institution”.
The declaration also ensures the rights of the Indigenous People to maintain their lands, their territory and waters and their natural resources, which considers the needs of future generations.

The UN Human Rights Council published a guideline for business (UN-Human Right, 2011) which also protects human rights. The guideline states that the States have a responsibility to protect human rights, cooperate responsibly to respect human rights, and provide access to remedies. Thus every State should ensure the appropriate respect for human rights in the areas where business is done.

Through the analysis of extractive industries in Guatemala, Murphy and Vives (2013) argue that the effects experienced by indigenous communities can be better understood by recognising the different perceptions of justice held by themselves and the State. The recognition of different perceptions of justice identifies a potential weakness in the United Nations ‘Protect, Respect, and Remedy’ Framework which ‘attempts to draw a sharp distinction between duties of States versus responsibilities of business’.

2.6. The Context of Sustainability and the rights of Indigenous People in Papua

Papua has more than 269 ethnic groups and 269 living local languages (Mansoben, 2006) and more than 1,000 clans (BPS 2010). Each of the ethnic groups and tribes has their own traditional knowledge and practices to sustain their way of life. Mostly Papuans have realised the basic concept of sustainability, that the nature belongs to the future generations. One example of the conceptual of sustainability which has been practiced in Papua is ‘sasi’.

Sasi (Akimichi, 1995, Harkes and Novaczek, 2002, McLeod et al., 2009) is a marine conservation tenure system that prohibits harvesting on land or in the sea at certain times to sustain resources and it includes fishing areas, fishing gear, and target species. This system has been practiced in Papua and some parts of eastern Indonesia (Mantjoro, 1996, Harkes and Novaczek, 2002). The system is generally called Sasi, however, some areas have their own local names. Indigenous Papuans who live in Raja Ampat call it Samsom, while the local people of Biak Island say Sasisen. Other parts of Papua such as the Maya tribe from Salawati Island call it Sasi Rajaha, and the Depapre Tribe who live in Jayapura, call this customary law Takayeti. This system proves that indigenous Papuans care more about nature and sustainability. Samsom means prohibition in the local Matbat language (local language). Samsom is a regulation to manage the marine resources in order to be sustainable. Samsom is
applied every year during the six to seven months of the windy west monsoon (Mansoben, 2003).

The concepts of the sustainability have been also practiced in the southern lowland of Papua such in the Asmat Regency. Asmat People have a concept of sustainability called ja asamanam apcamar and jo bakat fakar and capinmi fakar (seen in Chapter 7).

These concepts should be involved in the decision making which related to their territory.

The sustainability is measured by four dimension of wellbeing; economic, social, cultural and environmental dimensions.

In cultural aspect, Papua has numerous tribes with their living local languages. Probably, Papua has more local languages, but they have disappeared because of lack of regular users. This condition happens since, with a lot of languages, in order to communicate with each other Papuans have to use Indonesian as an official language. So, it is important to protect indigenous languages and cultures in Papua and make them sustainable. Some indigenous cultural communities are diluted by the transmigration of people from Java. Since the 1960s approximately 75,200 families have migrated to Papua. Previously, this government programme was instigated to minimise a gap in development between Papua and the Java Islands. It succeeded in developing the area where migrants live, but it is not good for indigenous Papuans. For trans-migrants their economic conditions improve. Inversely, Indigenous peoples are increasingly in a worst off condition. The programme does not care about the rights of indigenous Papuans.

In social dimension, several areas of Papua are not be dominated by Papuan. In many of the big cities the population of indigenous people is now low, such as in Jayapura where only around 30 % are Papuan (BPS 2010).

A lot of development has been done in Papua resulting in mining (Hisada, 2007, Howard, 1994, Korwa and Djazuli, 2014, Magal, 2014), deforestation, infrastructure developments, and changing land uses (Tohari, 2013) which are unsustainable. Exploitation of natural resources has negative impacts on the environment. Not only is there exploitation, but there is also a transmigration programme (Fearnside, 1997) which is moving landless people from Java to Papua forcing indigenous people into smaller and smaller areas. For example, a good forest of around 160,000 hectares belonging to Indigenous Papuans has been used for this programme, and the majority of indigenous Papuans dependent on the forest have been dispossessed of their lands (Sumule, 2002).
Previously, Papua was the largest Province in Indonesia with the lowest population. The Central Government has divided the province into Papua and West Papua. West Papua province was formed in 2004. Papua also lags behind other provinces in terms of development and quality of life, even though Papua is the most resource rich province.

To address the lagging development the Central government passed a special autonomy Bill for the Papuan province, based on regulation Indonesian Law UU, No 21 in 2001 (Indonesian Government, 2001), and another for West Papua, based on regulation UU, No 35 in 2008. In Article 43 of Indonesian Law stated that the Papuan have to have their own right. Both regulations parallel the United Nations Declaration of Rights of the Indigenous Peoples which gives the Indonesian Government the autonomy to govern the area.

Thus, over the last 10 years, Central government has tried to close the gap by giving special attention to Papua.

However, this programme has not answered the problems in Papua (Tebay, 2005). The regulations are good but the implementation is not working well, such that there is no transparency and the distribution of the funding is inequitable (McGibbon, 2004).

The Freeport Mining and mega project Merauke Integrated Food and Energy Estate are two examples that have created controversy because of the impact on the Indigenous People (Lamonge, 2012).

Thus, even though the Indonesian Government has given special autonomy to Papua, it does not ensure the rights of Papuans to be involved in the decision making regarding the development of the areas, so the developments may fail to achieve the benefits they are designed to achieve.

2.7. Conclusion

The understanding provided here about the concepts of sustainability and sustainable development, and also the rights of Indigenous Peoples, establishes the basis for a new conceptual approach to reducing the impact of development in Papua and empowering the traditional knowledge that is related to sustainability. This conceptual starting point will be used to identify and tailor a suitable framework for the Papua context. This can also be used to ensure the implementation of the rights of the indigenous people to be involved in decision making.
Figure 2. The negotiation process between the Asmat People and Local Government in a Jew in the Asmat Regency (photo by Wambrauw, 2012)

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Chapter 3
The Water and Wetland Management

3.1. Introduction

Chapter 3 establishes an understanding of the concept of water and wetland management which will be analysed in this thesis. This chapter gives a definition of the water resources, wetlands and river basin management used in this thesis. Then it explains several aspects of traditional knowledge related to the management of water and wetlands. Lastly, it describes approaches to the water and wetland management.

3.2. Water Resources Management

Water is a basic need for all living beings. Water is used for domestic purposes, in the agricultural sector, for industry purposes and for cultural and religious purposes. Water becomes a big issue if there is an unbalance between the supply and the demand, as it can create social and environmental problems. Even worse, it can generate conflict. An increasing population, and agricultural and industry sector requirements have an effect on the demand for water (Pawitan and Haryani, 2011) so it is important to use water wisely. The activity for controlling the balance between the availability of water supply and its usage so that it benefits human beings and the environment is water resource management (Grigg, 1996). The implementation of water resource management can be in the planning, developing, or distribution of activities such as water supply, sewerage systems, flood control and hydropower.

3.3. Wetlands

The wetlands are areas which are temporarily or permanently inundated by water, and the wetland ecosystems can occur in low lands or up lands (Louwe Kooijmans, 1993) and be either naturally formed or human made. Internationally, the Ramsar Convention, in Article 1.1 (Russi D., 2013, Spiers, 1999), give a definition of wetlands as following:

“areas of marsh, fen, peat land or water, whether natural or artificial, permanent, or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which does not exceed six meters”

The wetlands are categorised (Chatterton, 2004) as inland, marine or coastal, and human-made (Russi D., 2013). The wetlands are also classified based on the characteristics of the vegetation and hydrology such as marine (coastal wetland), estuary (delta, tidal marshes,
and mangrove swamps), lacustrine (associated with lakes), riverine (along the rivers), and palustrine (marshes, swamps, and bogs).

Their values and functions include their hydrology, ecology, social and economic outputs (Assessment Millennium Ecosystem, 2005, Barbier, 1994, Barbier, 2011, Ruitenbeek, 1992), including the availability of water, richness of biodiversity, abundancy of natural resources, and cultural values (Adger and Luttrell, 2000, Finlayson et al., 1999, Halls, 1997, Matthews, 1993). Peat land has an important role in the storage of carbon (Jaenicke et al., 2008) and water (Wösten et al., 2008, Wösten et al., 2006). They also have a significant function for livelihood security (Dixon, 2003). Thus, decision making about developments in wetlands should consider the sustainability of the whole including the ecosystem and the people. Changing the land use will significantly influence climate change, global warming and sea level rise and even the cultural values of the indigenous people. Thus, the stakeholders who are decision makers should understand how to develop the wetlands in a wise way.

The Ramsar Convention mentions (Russi D., 2013) the wise use of the wetland as following

“The maintenance of their ecological character, achieved through the implementation of ecosystem approaches within the context of sustainable development “

It also is explained in the definition of the ecological character as following:

“The combination of ecosystem components, processes and services that characterize the wetland at any given point of time”

3.3.1. The value of water and wetlands

Water, as a part of a wetland, is a basic need for all living organisms, for domestic purposes (e.g. drinking and washing), for irrigation (agricultural purpose), and industry.

A wetland has a significant function (Assessment Millennium Ecosystem, 2005, Barbier et al., 2011, Barbier, 2011) in the water cycle and an important role in the availability and quality of local water.

The Millennium Ecosystem Assessment described Ecosystem services as (Costanza et al., 2011)

“the benefits people derive from functioning ecosystems, the ecological characteristics, functions, or processes that directly or indirectly contribute to human well-beeing “
The Millennium Ecosystem Assessment also states that wetlands have functions (Russi D., 2013, Costanza et al., 2011) as follows:

a) Wetlands provide supply for the ecosystem including fresh water, food, fuel, biochemical, and genetic resources.

b) Have an important role in the ecosystem including acting as a buffer area and climate regulator.

c) Have a cultural function with a positive non material impact for the people including traditional knowledge, cultural diversity, social relationships and recreation.

d) Providing supporting services such as water cycling, and erosion regulation.

The ecosystem support and the function of a wetland can be seen in Table 3.1

**Table 3.1 The Ecosystem Services and functions of wetlands**

<table>
<thead>
<tr>
<th>No</th>
<th>Ecosystem services</th>
<th>The function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coastal protection</td>
<td>Attenuates and dissipates waves, buffers wind</td>
</tr>
<tr>
<td>2</td>
<td>Erosion control</td>
<td>Provides sediment stabilisation and soil retention</td>
</tr>
<tr>
<td>3</td>
<td>Flood protection</td>
<td>Water flow regulation and control</td>
</tr>
<tr>
<td>4</td>
<td>Water supply</td>
<td>Ground water recharge/ discharge</td>
</tr>
<tr>
<td>5</td>
<td>Water purification</td>
<td>Provides nutrient and population uptake, as retention, and particle deposition</td>
</tr>
<tr>
<td>6</td>
<td>Carbon sequestration</td>
<td>Generates biogeochemical activity sedimentation, biological productivity</td>
</tr>
<tr>
<td>7</td>
<td>Maintains temperature and, precipitation</td>
<td>Climate regulation and stabilisation</td>
</tr>
<tr>
<td>8</td>
<td>Raw material and food</td>
<td>Generates biological productivity and diversity</td>
</tr>
<tr>
<td>9</td>
<td>Maintains fishing, hunting and foraging</td>
<td>Provides suitable reproductive habitat and nursery grounds, sheltered living space</td>
</tr>
<tr>
<td>10</td>
<td>Tourism, recreation, education and research</td>
<td>Provide a unique and astatic landscape, suitable habitat or diverse fauna and flora.</td>
</tr>
<tr>
<td>11</td>
<td>Cultural, spiritual, religious and bequest values.</td>
<td>Provides unique and ascetic landscape of culture, historical and spiritual meaning.</td>
</tr>
</tbody>
</table>

Resources are modified and cited from (Russi D., 2013, Barbier, 2011, Braat and Ten Brink, 2010, Costanza et al., 2011)
3.3.2. The management of wetlands

The wetlands are vulnerable ecosystems which are changing rapidly, and it is estimated that approximately 50% of the world’s wetlands have been lost or degraded since the 1990’s (Russi D., 2013). This may impact on humans and the environment including the change in the availability of water, flooding, and climate change. For example, unsustainable development of peatlands in Indonesia releases CO2 emissions and creates a forest fire risk in the dry season related climate change and its global impacts. Global weather patterns such as El Nino can exacerbate the situation further as experienced in 1997-1998 (Page et al., 2002, Buizer et al., 2000) when Indonesia faced the big problem of fire which covered all areas of Indonesia (Occasional CIFOR, 2003, Santilli et al., 2005, WWF of Indonesia, 2008). Thus, the management of wetlands should consider reducing unsustainable development, and decision makers play a role here (Turner et al., 2000) because mostly the ecosystem loss and degradation is due to the conversion of wetlands for agriculture, reclamation purposes and economic activity, which may also result in pollution. In an agricultural example, the wetlands in Malaysia have been used for rice cultivation (Turner, 1991) and palm oil plantations which has happened as well as in Sumatra and Kalimantan in Indonesia (Posa, 2011, Campbell, 2014), especially in Kalimantan the Mega Rice Project encompassed 1 M Ha of the wetlands of the area from 1996 to 1999 (Suyanto et al., 2009, Wösten et al., 2008). In Brazil the coastal areas have experienced degradation because of pollution from mining activities (Turner, 1991).

So the decision makers should consider the function of an ecosystem before development in the areas (Turner et al., 2000). Some countries have even developed and restored wetlands in a sustainable way. This improves the values of the wetland especially for the economic aspect. There are several case studies of the benefits of restoring wetlands such as; the Waza flood plain in Cameroon; the Manalana wetland in South Africa; Hail Haor wetland in Bangladesh, and the restoration of wetlands in central Asia (Russi D., 2013).

To get better governance in the management of wetlands, assessment or and measurement techniques are being developed around the globe. These include qualitative analysis, quantitative data, geospatial mapping and monetary evaluation. Qualitative analysis is information that cannot be accounted for numerically such spiritual values, and cultural values. Quantitative data is numerical information such as the debit or volume of water. Geospatial mapping uses geographical data, and also quantitative data, while monetary evaluation consists of biophysical information such carbon storage (Russi D., 2013).
This information can be used as indicators for assessing the water and wetlands which are related to ecosystem services, such as sustainability of food, water quantity, climate change, water regulation, water purification and waste water control, erosion control, landscape and amenity values, ecotourism, and cultural values and inspirational values (Ibid 2013).

3.4. River Basin Management

River basins are also called drainage basins or catchment areas. They are described as a geographical area in which all surface run off flows to a sequence of water bodies before exiting in an estuary or delta (Jaspers, 2003, Nilsson et al., 2004). A River Basin District is an area of land and sea which consists of several river basins including the ground water and coastal water (Nilsson et al., 2004). It is an international river basin if the river basin is located in more than one country. The management of river basins is complex and changes rapidly, (Molle, 2009, Shmueli, 1999). Management combines historic land management, river basin modifications, climate change associated sea level rise and storm ferocity events all of which create engineering challenges that have not been previously recorded. Understanding the wider implications of infrastructure developments in river basins must then be an essential area of further investigation as these engineering interventions add to the complexity being created.

3.5. Integrated water Resources Management

Integrated Water Resources Management is conducted to manage the water including in the qualitative, quantitative and environmental sense which involves a multi-disciplinary and participatory perspective to obtain better results (Jaspers, 2003, Al Radif, 1999, Jønch-Clausen, 2004).

Integrated Water Resources Management (IWRM) is an approach to water resource management which has been defined by the Global Water Partnership Committee (Global Water Partnership, 2000, Biswas, 2004) as the following:

“A process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems”

IWRM was developed based on the four Dublin principles (Global Water Partnership, 2000), which describe the essential value of the water, the importance of a participatory approach from all stakeholders, the participation of women and the economic value of
water. IWRM depends on nature which is the availability and the quality of the resources and the human interaction which is related to use, waste and development priorities.

3.6. Traditional Knowledge in Water and Wetland Management

The indigenous people and their natural surroundings are inseparable, including water, the landscape, the forest and the wetland. Besides being an economic resource, indigenous people value water and wetlands in a spiritual way. They consider water (Nikolakis et al., 2013, Morgan 2005), and water bodies such as rivers and swamps as having their own spiritual dimension. They have their own ways of maintaining, respecting and using nature to support their daily lives. It has been proven that indigenous people have survived for hundreds of years with their ways. Thus the traditional knowledge of the indigenous people should be involved in the wetland management (Russi D., 2013)

3.6.1. Traditional knowledge in legislation

Several countries have recognised the importance of using traditional knowledge in their legislation associated with natural resources management. The United Nations Declaration on the Rights of Indigenous People (UNDRIP) states that the Indigenous People have their own right to participate in impact assessments regarding their territory (International Association for Impact Assessment, 2012). This provides for the inclusion of knowledge in the assessment using scientific methods. Basic principles include equality, uniqueness, rights, sovereignty, cultural heritage and free prior informed consent. Implementing these principles would include; providing an open and transparent impact assessment process; agreeing on the degree of participation; providing meaningful participation and reassurance; ensuring gender equality; allowing mediation; include native customs; providing interpretation and translation; safeguarding against exploitation; using Traditional Knowledge responsibly; using Traditional Knowledge only within its context, and planning ahead. These principles ensure the rights of the Indigenous People involved in the decision making (ibid 2012).

In Australia, the board of Land Water Australia (LWA) have considered involving indigenous knowledge in their programmes (Jackson et al., 2005, Jackson and Patrick, 2006), and also the Australia National Water Commission have identified the indigenous rights to water, (Jackson et al., 2012). The indigenous people there declared their rights to water in 2003 to protect and maintain the availability of water and aquatic resources to support their lives (Jackson et al., 2012). The indigenous people of Australia have their
own knowledge about managing water and, in Australia, the Water Planning Tool has been developed to involve the cultural values of the Tiwi Island people in Northern Australia (Hoverman and Ayre, 2012).

Similarly, the Māori People, the indigenous people in Aotearoa, New Zealand, believe there is a connection between the land, water, and the people (Tipa and Nelson, 2008, Morgan 2005, Morgan 2006b). The Māori people maintain their cultural values in their daily lives. Several concepts of life for this tribal people are related to sustainability such as mauri, or the life force, which is a key to sustainability and kaitiakitanga, which is guardianship of the environment (Robert et al., 1995, Morgan 2008, Morgan 2005, Morgan 2006b, Morgan 2006a, Morgan et al., 2012). This principle of sustainability is acknowledged in the Resource Management Act, 1991, in New Zealand Legislation.

3.6.2. Agricultural traditional knowledge in wetlands

There are examples of traditional knowledge practised in the agricultural sectors in wetlands.

a) In Northeast Thailand, in the Mekong delta and in the Mun-Chi river basin the farmers have used the natural flood cycle to grow their paddy field rice (van Liere, 1980).

b) In Niigata City, Japan, traditional lagoon management is called katabushin. It uses debris, which is the result of dredging ponds, reed cutting and rubbish, to add to the banks to fertilise the paddy rice (Russi D., 2013).

c) In Bali, Indonesia, the Balinese, the indigenous people of Bali, have their traditions of water management with irrigation which is called Subak” (Sarwan et al., 2005, Spiertz, 1991, Roth, 2014).

d) The Wambad system is the traditional agriculture of the Malind Anim in the Merauke Regency in lowland southern Papua, with a drainage system called apata (YASANTO, 2012).


f) In Brazil, in the Guaporé Valley, the indigenous people who live in the area have their own ways of using natural resources. They are rubber-tappers and nut gatherers so they depend on the forest to support their daily lives and their livelihood. They use more than 30 different products from the forest without logging (Diegues, 1991).
3.6.3. Traditional management in Fisheries

Beside their agricultural practices, the indigenous people have their own roles in fishery management. The following are several examples of this;

a) The Tagbanua people of Coron Island, Palawan in the south western Philippines, have their own role the community fishery rights which are related to the ancestral domain and access to their natural resources. They believe in the dwelling spirit called “panyain” which is in natural features such lakes, trees and seas. The application of this culture is demonstrated by the conservation of areas of water as scared places (Capistrano, 2010, Capistrano and Charles, 2012).

b) In Papua and Western Indonesia, the local wisdom about the conservation of using natural resources, including in the fisheries, is generally called “sasi” as explained in Chapter 2. However, sometimes the tribal people have their own names. Sasi dictates that it is forbidden to take natural resources, in this case natural resources from the sea, for a certain time to control the exploitation of the natural resources (Mansoben, 2003, MCLeod et al., 2009, White et al., 1994, Harkes and Novaczek, 2002, Mantjoro, 1996, Pido et al., 1997, Akimichi, 1995, Glaser et al., 2010, Henley, 2008).

c) In Marituba, a lowland area near the San Francisco River, in Brazil, the indigenous people of this area have their own local knowledge on conservation when using natural resources, especially for fisheries because they know the behaviour of the fish so they know when it is the time for fishing, or not (Diegues, 1991, Diegues, 1992).

3.7. The Regulations for Water and Management in Wetlands in Indonesia

The Indonesian Constitution, 1945, is the foundation for producing all the regulations and laws in this nation state. The implementation of the constitution is supported by Laws, national government regulations, regional regulations, and also decrees from the ministries. The laws are produced and ratified by the Indonesian Parliament (DPR), while government regulations are decided by the president. Regional regulations are enacted by the regional house representatives (DPRD) (Al'Afghani, 2006). Article 33 of the Indonesian Constitution, 1945, establishes the regulations which are related to water and natural resources. It has been translated in several papers, and it is cited here from this resource (Sumule, 2002);

Clause 2: “Branches of the production which are important for the state and which affect the life of most of the people shall be controlled by the state”. 

31
Clause 3: “Land and water, and the natural resources found therein, shall be controlled by the state and shall be exploited for the maximum benefit of the people”.

It means that all the natural resources including water should be controlled by the government to benefit the people. To regulate the water resources in Indonesia, the Parliament enacted the water regulations in Indonesian Water Law, No 11, in 1974 (Sarwan et al., 2005, Al'Affgani, 2006). It consists of only 17 articles which explain the utilisation of water resources (Sarwan et al., 2005). At the time, the development of Indonesia focused on the agricultural sector, so the management of water was mainly concerned with irrigation. To support the programme of managing water resources, President Soeharto announced Government Regulations No 22 and 23, in 1982, which are about water resources management, and irrigation and drainage systems, respectively (Sarwan et al., 2005).

In February 2004, the Indonesia Government replaced Water Law No 11, 1974, with a new National Water Law No 7, 2004, (Indonesian Government, 2004, Sarwan et al., 2005, Al'Affgani, 2006) which is more complex as there are 100 articles with a total of 18 chapters. The first chapter of the law gives general information such the definitions for water resource and water resource management, as well as exploitation and water conservation (ibid 2004, 2005, and 2006). In this new water law, water resource management is defined as: an action to plan; to monitor; to evaluate the conservation of water resources; the use of water resources; and the control of pollution (Sarwan et al., 2005). It also mention the opportunity to use water for commercial purposes or the privatisation of water resources. In the previous law, there was only the use of water, but the new water laws are also concerned with the utilisation and management of water resources including the conservation and protection of water. The second chapter of the law describes the distribution of the institutions involved in water management including when the water resources cross boundaries between regional, provincial and even country boundaries. Water conservation principles are in Chapter Three of the law followed by Chapter Four which regulates the exploitation of water resources. In Chapter Four of the law, it is also explained that exploitation of any water resource should follow spatial planning which considers the pattern of water resources management according to the particular river basin. The privatisation of water is also in this chapter. The regulations for the control of the negative impacts of water resources on the environment are in Chapter Five of the law. The sixth chapter is the regulations for the water resource plan,
and the following chapter is regulations for infrastructure, the operations and maintenance. The eighth chapter describes the information systems for the water resources and the ninth chapter is about the empowerment of the stakeholders and supervision. The tenth chapter mentions the financial aspects, and continues on to the eleventh chapter which is about the rights, the duties and participation of the community. The twelfth chapter of the law explains the coordination processes between institutions, and the thirteenth chapter of the law has the regulations for solving problems in the case of conflicts over water. The fourteenth chapter of the law explains the legal process if there is a complaint by society regarding water management in their environment. Chapter Fifteen of the law explains the legal processes or investigation of criminal activity in water resources and continues to chapter sixteen which is about the fines. Chapter Seventeen explains that all the regulations are under this law until any new law supersedes it. Chapter Eighteen contains the conclusion.

To implement the Water Law for water resources management in Indonesia, there are several institutions which are responsible for managing water resources, from central government to the local government. At National Government level, The Directorate General of Water Resources (DGWR) of the Ministry of Public Works (PU) is responsible for making decisions related to managing surface water resources. Ground water resource management is under the authority of the Ministry of Mining and Energy. The national planning bureau, BAPPENAS, plans the water resource management, which can be seen in Figure 3.1. So there is a collaboration between the Ministry of Public Works and BAPPENAS. At the Provincial level, the Governor, as the head of the region, has the responsibility regarding water resource policies. The Regional Planning Bureau in the provinces is called BAPPEDA and this body plans the water resources in collaboration with Balai Wilayah Sungai Papua (the bureau which is concerned with river basin management) under the Directorate General of Water Resources of the Ministry of Public Works. Similarly, at the regional level, the decisions are made by the head of the Regency (bupati), where BAPPEDA has the responsibility for planning, and the Public Works Department is responsible for infrastructure and construction work.
Other regulations which are related to water supply are Government Regulation, Indonesia, No 416, in 1990, and Health Ministry Decree No 907, in 2002. Government Regulation, Indonesia, No 416, in 1990 (Indonesian Government, 1990) defines clean water as water that can be used for daily needs and can be drunk after boiling. Drinkable water is defined as water with or without treatment which has qualified to the health standard which is regulated by the government (Indonesian Government, 2002).

3.8. The Regulation of Wetland Management in New Zealand
This country signed the Ramsar Convention (Convention on Wetlands of International Importance especially as Waterfowl Habitat) in 1976 (Gerbeaux, 2002-2003) and directly protected two sites; the Waituna Lagoon and Awarua Wetland in the Southern Conservancy and Farewell Spirit in Nelson. In 1989, in the Waikato conservancy, the
Whangamarino, Koputai Peat dome and the Firth of Thames were added. In 2005, the Manuwatu Estuary was declared a Ramsar Sites. Jones et al. (1995) stated that New Zealand has experienced significant loss of wetlands. Ausseil et al (2007) and Gerbeaux (2002-2003) added that the wetlands in New Zealand has reduced around 90% since 1840. The government of New Zealand is concerned about the issues of degradation. Several policies and legislation have been established to manage the wetland in sustainable manner and a national policy on wetland established in 1986 contributed a lot to the management wetlands. The Conservation Act, 1987, and the Resource Management Act (RMA), 1991 (Gerbeaux, 2002-2003, Myers et al., 2013) are also used to managed the environmental. The RMA, 1991, contributes to managing wetlands in New Zealand and involves the cultural values of the Māori People.

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Chapter 4
Papua Lowland Management Resources

4.1. Introduction
Papua is the largest province in Indonesia. It has an abundant biodiversity (Wilujeng, 2010) and a unique ecosystem including a glacier (Allison and Kruss, 1977, Hughes-Freeland, 1989) alpine meadows, cloud forests, lowland forests, savannah, mangrove forests, coral reefs and sea grass beds (Marshall and Beehler, 2007, Hughes-Freeland, 1989). Most lowlands in Papua are in the southern part (Mimika Regency, Asmat Regency, Mappi Regency and Merauke Regency), while in the northern part they are located around the Mamberamo Basin (Mawdsley and Houterman, 2010) in Bintuni Bay between Bird’s Heads Peninsula and Bombarei Peninsula (Prasetya, 2013). According to Indonesian Government Law No 45, 1999, Papua Province was separated into Papua and Irian Jaya Barat Provinces (Wambrauw, 2013) to accelerate the development of the area. This chapter will discuss the value of the wetland as part of the lowlands, the existing condition of the lowlands in Papua, especially on its southern side, which are used as case studies in the following chapters. A general description of the lowlands in southern Papua will be helpful to develop the research.

4.2. The Lowlands of Papua
The lowlands in Papua Province (the white areas belong to Irian Jaya Barat or Papua Barat) can be seen in Figure 4.1. The lowlands of Papua are depicted as the light green areas of the map. They stretch along the southern coastal areas and inland in Merauke, Mimika, Asmat, and Mappi Regencies, and in the north lie in the Mamberamo Basin. The lowlands in Papua include mangroves, freshwater swamps, peat land and seasonally flooded savannas, creating a unique ecosystem (Giesen and Houterman, 2009).

The Lorentz National Park in Asmat Regency bordering with Mimika Regency and other regencies (Papua Government, 2013) provides the only “continuous transect from snow cap to tropical marine environment (Hawkins*, 2004). The park is one of the UNESCO World Heritage Parks (Papua Government, 2013, Asmat Government, 2011), which is the largest protected area in Southeast Asia. The Wasur National Park is one of the Ramsar Convention Sites (Choowaew, 2007) bordering with the Tonda National Park in Papua New Guinea (Chatterton, 2004). This park is also rich in biodiversity (BOWE, 1995).
Figure 4.1 Map of the lowlands in Papua Province (Giesen and Houterman, 2009)
Figure 4.2 The two lowland systems in Papua (Houterman, 2010)
There are two major lowland systems in Papua: recent alluvia-marine tidal lowland systems and weathered old lowland terraces. The area the systems cover can be seen in Figure 4.2. As shown in Figure 4.2, Asmat, Mappi, Mimika Regencies and Kimaam Island (part of Merauke Regency) are built on the recent alluvial marine land, young in geological terms, while the weathered old lowland terrace is on the Orimo plate (PNG) and the Fly-Digul Shelf in Merauke and Boven Digul Regencies. The uniqueness of each area of the southern Papua lowlands has shaped its ecosystem. The differences between lowlands in Mimika, Asmat and Merauke Regencies (Mawdsley and Houterman, 2010) are shown in Figure 4.3.

![Figure 4.3 Schematic Diagram of the Transition from Coast to Uplands in the lowlands in Papua (Mawdsley and Houterman, 2010)](image)

The lowlands in the Mimika Regency are made up of a coastal area, with mangrove and peat land with a 10 to 25 km wide mangrove zone. For its part the Asmat Regency is a delta area of tropical forest with meandering rivers with a total of area is 23,745 Km2. Asmat is the largest tidal lowland area of Papua, and one of the largest peat lands in the world. The tidal range affects the delta up to 140 km inland from the ocean creating a 25 to 50 km wide mangrove zone. A mixed swampy forest of Nipa palm and Sago dominates the riparian margins in this area. The vegetation covers shallow to deep peat lands, which are intersected by many rivers and streams, creating the unique biophysical attributes of Asmat (Giesen and Houterman, 2009, Tommaseo and Lucchetti, 1992). The vast fluvial plain consists of more than 100 waterways: Asmat has a deep peat land. Adapted management
zones have been applied in this area. The Casuari coast, a district of the Asmat Regency, is an extensive tidal lowland. The Digul estuary, located in the Boven Digoel Regency, is suitable for agriculture. Kimaam Island is formed by sedimentation. This area consists of mangrove, saline wetland, savannah swamp and some woodland. Some parts of this district can be developed for agriculture. Merauke is covered by sandy beach savannah, and grassland (Bowe et al., 2007). In Merauke is the conservation area of Wasur National park (Hitchcock, 2006, Choowaew, 2007). Figures 4.2 and Figure 4.3 explain the distribution of the two very different types of land system in the three areas of Mimika, Asmat and Merauke. A previous study (Mawdsley and Houterman, 2010) identified key features upon which to base an approach to wetland management in southern Papua, as in Table 4.1.

Table 4.1 Key Features of the Sub-systems of the Tidal Lowlands of southern Papua

<table>
<thead>
<tr>
<th>Alluvia-Marine Lowland Sub-system</th>
<th>Key Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mimika Regency</strong></td>
<td>The Mimika tidal lowlands consist of a 10 to 25km wide mangrove zone, beyond which a zone of mixed forests and sago complexes on deep peat, intersected with small mineral soil strips along the many streams. The underlying soils and cobbles are generally considered not suitable for agriculture. In the Greater Timika area, much has been opened associated with the growth of Timika, PT Freeport and transmigration.</td>
</tr>
<tr>
<td><strong>Asmat Regency</strong></td>
<td>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 5000mm per year. Deep peat deposits between the rivers are identified, presumably existing as peat domes, 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.</td>
</tr>
<tr>
<td><strong>Casuarina Coast</strong></td>
<td>This area is located in the transition from the extensive tidal lowland areas of the Asmat – Agats to the old lowland terraces of the South. Beyond a narrow mangrove strip and/or beach formations, a complex of mineral soils and peat lands is found with mixed swamp forest, sago stands and open swamp.</td>
</tr>
<tr>
<td><strong>Digul Estuary</strong></td>
<td>This complex area of the Digul mouth and the Mappi and Kuti rivers is expected to be the most suitable for agricultural development, with the least risk for environmental damage. The latter is confirmed for the Digul mouth by WWF 2009.</td>
</tr>
<tr>
<td><strong>Kimaam Island</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Merauke</strong></td>
<td>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 (swampy forest)’.</td>
</tr>
</tbody>
</table>

Source: adopted and modified from the previous study (Mawdsley and Houterman, 2010)
4.3. The Management of Lowland

The management of wetlands in Papua is extremely important because of their relevance to global environmental changes, climate change and sea level rise, and concern about the indigenous people of Papua. Indonesia has in total more than 20% of the world’s mangroves (Spalding et al., 2010, Valiela et al., 2001, Adeel and Pomeroy, 2002, UNDP_Almamater, 2005), and Papua has approximately 70% of Indonesia’s 20%, mostly in the Bintuni Bay area (Jack Ruitenbeek, 1994, Soegiarto, 1984). Indonesia has 48 mangrove species of the total 52 species in the Southeast Asia and 40 species of the Indonesian total are in diversity rich Papua (Giesen and Houterman, 2009). Mangroves provide buffers in riparian areas, preventing the intrusion sea water, maintaining biodiversity and protecting against sea erosion. Papua also has one third of the peat land area of Indonesia. The peat land has an important role in the storage of carbon (Jaenicke et al., 2008) and water (Wösten et al., 2008, Wösten et al., 2006). Thus, the wetlands are a significant influence on climate change, global warming and sea level rise. Unsustainable development of the peat land in Indonesia releases CO2 emissions and creates forest fire risk in the dry season related the climate change and global impacts. Global weather patterns (El Nino) can exacerbate the situation further as experienced in 1997-1998 (Page et al., 2002) when Indonesia faced the huge problem of fire which covered all areas of Indonesia (Occasional CIFOR, 2003, Santilli et al., 2005).

The Indigenous Peoples of Papua depend on the forest (Sumule, 2002b, Boissière et al., 2004). The deforestation has an immeasurable impact on the Indigenous Peoples in Papua. Azis and Salim (2005), Rifai-Hasan (2009), Hidayat et al (2014), Hisada (2007) and Paull et al (2006) discuss the impacts of deforestation on the Indigenous People who live around the mining area. While, Hope (1998), Haberle et al (1991) and Stronach (Stronach, 1999) discuss the impact of climate change in Papua. Asmat Regency has also experienced some severe impacts of climate change and global warming (Bobi and Mampioeper, 2010). Recently, “Suara-Pembaharuan” (2013) noted that local government and the WWF (World Wildlife Fund) have introduced a programme for mangrove plantation rejuvenation in several critical areas in coastal Asmat (Mawel, 2013). Those areas include Yepem village, Peer village and Syuru Vilage, which are part of Agats District. Agats is the capital of Asmat, a muddy tidal area which is inundated with water. Traditional stories (Sonokos, A.T, personal interview, 11 Dec 2012) say that Agats was once a sandy land but has changed to a muddy area. This change coincided with the ‘shooting of Pastor Jan
Smith’ on 28 January 1965 (Arsdale, 1975). He was murdered by KPS Fimbaij because of conflict over the educational system. Due to the high rate of deforestation that has occurred over subsequent decades, there is strong a possibility that climate change and sea level rise have influenced the changed environment in Agats, Asmat.

In 1999, a new paradigm for the administration system was introduced in Indonesia moving from a centralised to a decentralised administrative process with Laws No 23 and 25. Previously, the Indigenous Peoples of Papua could share the benefit derived from their natural resources (Sumule, 2002b), but changes supported by Law No 21 in 2001 gave Special Autonomy to Papua.

4.4. The Development of Lowland in Papua

A lot of development has been undertaken in Papua resulting in mining, deforestation, and infrastructure developments which are unsustainable. Exploitation of natural resources (Pasveer, 2003) has negative impacts on the environment. The management of wetlands in Papua is clearly important because it has wide ranging and not fully understood effects on cultures and on the global environment. Development of wetlands in the agriculture sector in Papua is limited, mostly to the highlands in Wamena. Rice planting has been developed in the lowlands only in one area in Merauke, namely Kumbe. Other wetlands in Papua are targeted as mining and logging areas such as Mimika (Hisada, 2007, Howard, 1994, Magal, 2014) (PT Freeport). Recently, lowland in the south of Papua has been the focus of investment, not only by government, but also private companies. Both national and international investors are interested in the agricultural development of this area especially for rice, oil palm, sugar cane and biofuel (Ito et al., 2014, Lamonge, 2012, Tohari, 2013). Under the Merauke Integrated Food and Energy Estate (MIFEE), those companies have opportunities to invest in the Merauke area. However, at the same time, some of those areas are involved in a programme called Reducing Emissions from Deforestation and Forest Degradation (REDD) (Murdiyarso et al., 2011). Changing land use from peat land to agricultural purposes in Merauke creates conflict because the majority of the indigenous Papuans depend on the forest (Sumule, 2002a), especially the swamp areas, for gathering sago as the staple crop and also for hunting and fishing. If the government develops the area to produce rice, what about the locals who consume sago and sweet potato as their staple diet? Indigenous people who live in lowland areas are more dependent on the forest, and not only for sago and sweet potato. They use the forest as sources of both of food and of medicine and it plays an important role in their lives and
culture (Giesen and Houterman, 2009, Moiwend, 2010a, Moiwend, 2010b, Moiwend, 2011). Lowlands, moreover, include mangroves and their coastal area provides abundant resources and biodiversity in mammals, fish and shellfish. Thus, the MIFEE can alter the indigenous livelihood including using sago as a biofuel (alternative renewable energy). The conversion of peat land for rice fields and other agriculture leads to a further environmental problems through the release of CO2 and emissions that impact on climate change and natural hydrology. In addition its reason is to a rice production in Merauke whose farmers can only harvest one a year because of limited water resources. In the dry season it is really difficult to obtain water (Ginting and Pye, 2011, Manikmas, 2010, Mawdsley and Houterman, 2010). For its part Asmat, previously under the Merauke government, has restricted agricultural development because of flooding and heavy rain. Asmat people have a traditional knowledge about wetland management. They know what kind of plant is suitable for absorbing water in their muddy area (Personal Interview 2012). Asmat is almost 80 % a swampy area. In Asmat Regency the development potential of the area is in fisheries. In addition, Kimaam Island is a part of Merauke which has been developed as a conservation area, and for agriculture. The southern part of Kimaam is a protected area, not to be developed except for indigenous activities. The northern and central parts of Kimaam are unsuitable for agriculture. Drainage restrictions and flood hazards are problems for developing Kimaam Island. However, Kimaam Island’s people have their own traditional knowledge, Ndambu (Manembu, 1995), in cultivation (Serpenti, 1977)

4.5. Conclusion
At present most areas of Papua are still not developed. They are in the process of developing, especially the lowland areas in the southern part of Papua. If the government implements development in an unsustainable way, that will lead to complex problems with land and water management. It is hoped the results of this research can assist decision makers with their actions affecting land and water management and so make a significant contribution to development in this area.
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Chapter 5
The Mauri Model Decision Making Framework

5.1. Introduction

Assessment tools are used widely by researchers to assess in the analysis of data. Chapter 5 introduces tools which associated with water resource management and traditional knowledge. One of assessments which promotes the socio-culture aspect in its framework is the Mauri Model Decision Making Framework. This chapter has a further five sections; Section 5.2, which introduces the Natural Resources Management in New Zealand; Section 5.3 explains the concept of mauri; Section 5.4 describes the characteristics of the Mauri Model (MMDMF); Section 5.5 explains the processes of the Mauri Model Decision Making Framework; and Section 5.6 concludes this chapter.

5.2. The Natural Resources Management in New Zealand

The Treaty of Waitangi is an agreement, signed on the 6 February 1840, between the British Crown and the Māori chiefs to recognise the rights of the Māori in their lands. The principles of the Treaty of Waitangi are partnership, active protection, and consultation which consider the participation of Māori in sustainable development (Jollands and Harmsworth, 2007, Morgan, 2008). However, the Māori people were not given legal recognition in New Zealand law until 135 years after the signing of the Treaty of Waitangi. In 1975, the Treaty of Waitangi Act created processes that ensured the inclusion of indigenous rights in the decision making of the state which was followed by the recognition of these concepts in subsequent laws. The Environment Act (1986) identified the protection of the intrinsic values of ecosystems as its primary focus, and the Māori term for this, kaitiakitanga (Kawharu, 2000, Roberts et al., 1995), was included in the Resource Management Act (RMA) 1991.

Kaitiakitanga is an act of the guardianship of the environment (Roberts et al., 1995, Morgan 2008, Kamira, 2003) and is of the principles underlying the resource management of the Māori People (Kawharu, 2000, Wright et al., 1995). Beside the guardianship principle, the cultural value of the Māori People important in sustainability (Hikuroa et al., 2011) is mauri. Both principles are key in sustainable management in Aoteora, New Zealand.

5.3. Mauri

Mauri is an important element in Māori culture. It is an essence or life force (Hikuroa et al., 2011, Morgan, 2006), the spark of the life (Panelli and Tipa, 2007) and a central concept
that informs sustainability (Morgan, 2008, Kawharu, 2000). It is a life force or an essence which comes from Ranginui (the god of the sky) and Papatuanuku (the god of the earth) to their offspring and down to all living things including land, forest, and water (Morgan, 2006). It is also described as the spark of life (Panelli and Tipa, 2007), and part of all things including the resources and the natural phenomena (Kawharu, 2000). Mauri also is defined as the binding force between spirit and substance to enhance life and wellbeing (Morgan 2005, Morgan 2006b, Morgan 2006a), and if the bond is extinguished, it creates death or loss capacity of the material to support life (Morgan, 2011). For example, the pollutant in water in a lake diminishes the mauri of the water, the lake can no be longer support the people. Thus, the concepts of mauri and kaitiakitanga are used to develop a sustainable framework which called the Mauri Model Decision Making Framework (MMDMF). In this framework, the mauri of each dimension related to case studies are analysed to determine the result of the mauri, either the negative or positive. The result can be fully restored, enhanced, maintained, diminished, or denigrated /destroyed.

5.4. The Mauri Model Decision Making Framework

The Mauri Model Decision Making Framework (MMDMF) is a unique sustainability assessment approach that was developed in and for Aotearoa, New Zealand (Morgan 2008) by Te Kipa Kepa Morgan (Hikuroa et al., 2010a). This assessment approach uses the concept of ‘mauri’. It was introduced for the first time at the Lake Roturua Conference in 2003 (Morgan, 2011). The framework has been applied to engineering and environment case studies such the impact of the disaster caused by the Rena oil spill in New Zealand (Platia, Fa'aui and Morgan, 2014), water management (Morgan 2006b, Morgan, 2006, Morgan 2008, Morgan et al., 2012, Peacock et al., 2012), infrastructure (Morgan, 2003), geothermal (Hikuroa et al., 2010a), and other implementation (Hikuroa et al., 2011, Hikuroa et al., 2010b, Kawerau, 2012, Pikiao et al., 2010, Nelson and Tipa, 2012, Sardelic and Waretini, 2012). The framework measures four dimensions of wellbeing as the basis of the sustainability assessment: the mauri of community (social), the mauri of the family unit (economic), the mauri of the ecosystem (environment), and the mauri of the tribe (culture).

This framework is developed based on the Resource Management Act and Local Government Act, 2002, and based on the mātauranga (Māori knowledge) (Hikuroa et al., 2010a, Morgan 2006a).
The parallel between the dimensions of the Local Act 2002 and the Mauri Model Decision Making Framework can be seen in Figure 5.1

![Figure 5.1: The Parallel dimensions of the LGA 2002 and The Mauri Model Decision Making Framework (Morgan, 2011).](image)

The MMDMF is unique because it uses a traditional value, which is mauri. It makes this framework suitable to be applied in studies involving Indigenous People.

The relationship of the four dimensions is described in Figure 5.2
Figure 5. 2 the Venn Diagram which shows the relation of the four dimension in the Mauri Model (Morgan, 2006)

This diagram shows that the mauri of whanau, the mauri of community and mauri of hapū are part of the mauri of the ecosystem. So if the mauri of the whanau is good, it enhances the mauri of the community. If the mauri of the community good, it enhances the mauri of the hapū and establishes the good condition of the mauri of the environment. Thus, the dimensions of the mauri integrates with others.

Since 2009 the Cawthron Institute in New Zealand have conducted a study to develop the measurement of sustainable indicator sets which are related to the principles of the Bellagio STAMPS (see Chapter 2), and to examine existing indicators including; the Boston Indicator Project, the Dashboard of Sustainability, Earth Check (Kaikoura Green Globe), Ecological Footprint, Environmental Performance Index, the Mauri Model Decision Making Framework, Human Development Index, New Zealand’s progress using a Sustainable Development Approach, Sustainable Society Index, Wellbeing Index, Whistler2020. As a result, the Cawthron Report 2224 (Challenger, 2013) established that the Mauri Model is one of only three sustainability indicator sets which fully meets the eight principles of the BellagioSTAMP criteria (Pintér et al., 2012) including the Boston Indicator Project and Whistler2020. The Cawthron Report found that the Mauri Model was the only sustainability framework that is relevant regardless of the community. (This suggests that the framework could be appropriate for use within contexts outside Aotearoa, New Zealand.)
The MMDMF is inclusive because it uses the mauri concepts that have been a part of the Māori People and their ecosystem. This framework also involves the indigenous values, so it may be of use to other areas that have indigenous people. The characteristics of the MMDMF can be seen in Table 5.1

**Table 5.1 the Characteristics of the Mauri Model Decision Making Framework**

<table>
<thead>
<tr>
<th>The characteristics</th>
<th>Inclusive</th>
<th>Indigenous</th>
<th>Holistic</th>
<th>Eco-centric</th>
<th>Equitable</th>
<th>Legally relevant</th>
<th>Integrated</th>
<th>User friendly</th>
<th>Transparent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>effective, incorporation and representation of Māori perspectives because it uses cultural values</td>
<td>adopts several key element of the sustainable concept from the perspectives of traditional knowledge</td>
<td>demonstrates ecological integrity</td>
<td>adopts a sustainability measure from indigenous thinking</td>
<td>delivers intra- and inter-generational equity</td>
<td>effects focussed and promotes social, economic, environmental and cultural wellbeing</td>
<td>demonstrates interconnectedness between the criteria chosen</td>
<td>flexible yet easy to understand in its application and definitive (clearly determines whether a practice is or is not sustainable)</td>
<td>clearly identifies applied bias</td>
</tr>
</tbody>
</table>

Source: (Morgan 2006a)

**5.5. The process analysis of the Mauri Model Decision Making Framework.**

There are several steps to the Mauri Model Decision Making Framework (Morgan, 2011).

- The relationship between the MMDMF to the local Sustainable Development legislation
- Do the Analytic Hierarchy Process (AHP) and Likert Scales determine dimensions ranking (from -3 to +3)
- Do a ranked result assessment and convert to percentage weights
- Choose the indicators
- Performance indicators for economic, environmental, social and economic should be selected
- Each performance indicator is assessed for sustainability (Mauri-ometer)
- Scores for each mauri dimension are determined
- The sensitivity of each result to different priorities is analysed
- Options for solutions are evaluated
A preferred option is selected or new options are generated.

The Mauri Model Decision Making Framework consists of two parts; a quantification of world views and measurement in mauriOmeter.

1) Process for part one:

Part one of the Mauri Model Decision Making Framework weights the priorities of each stakeholder using AHP (Analytical Hierarchy Process). AHP is a decision making tool used to help in decisions that face complexity (Saaty, 1988, Saaty, 1990). This tool consists of three steps: those identifying the criteria, alternative or objective and arranging them in a hierarchy; continuing to compare pair wise each level of the hierarchy; and using the algorithm to determine the relative importance of each criteria (Saaty, 1988)

These tools can help in several ways (Saaty, 1988):

a) Design a form when the decision relates to a complex problem.
b) Measure the priorities and choose alternatives
c) Measure the consistency
d) Do predictions
e) Make a formula of cost/benefit analysis
f) Design forward and backward
g) Analyse complex resolution
h) Develop resource allocation from cost/benefit analysis

For the pairwise comparison the AHP uses a 1 to 9 scale, as shown in the Table 5.2, while the AHP-Mauri Model’s scale can be seen in the Table 5.3

Table 5.2 The Scale Priorities of AHP (Saaty, 1988)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal importance</td>
</tr>
<tr>
<td>3</td>
<td>Moderate importance</td>
</tr>
<tr>
<td>5</td>
<td>Essential or strong importance</td>
</tr>
<tr>
<td>7</td>
<td>Very strong importance</td>
</tr>
<tr>
<td>9</td>
<td>Extreme importance</td>
</tr>
<tr>
<td>2,4,6,8</td>
<td>Intermediate between the judgement</td>
</tr>
</tbody>
</table>
Thus, for organising the priorities in a hierarchy, the Mauri Model is simpler. The Mauri Model Decision Making Framework uses the AHP process to scale the priorities of each stakeholder. This evaluation will use in the sensitivity analysis to see the decision with the perspective or world view of each stakeholders.

2) MauriOmeter
MauriOmeter can be used to assess dimension indicators and determine the sustainability of infrastructure development options. Analysis using the Mauri Model Decision Making Framework involves several steps, described in Figure 5.1.

![Diagram](image)

**Figure 5.3 the steps of the Mauri Model Decision Making Framework**

The diagram of the process of the Mauri Model Decision Making Framework shows that after identifying the issue, or the case study, the stakeholders have to be chosen based on those who are influenced and affected by the study area. The next step is to decide the time frame for the issue, and the options for alternative solutions for the issue or problems. Then, the worldview dimension priorities of the stakeholders are calculated using a modified pair-wise comparison, based on the Analytic Hierarchy Process (Saaty, 1980). The comparative importance between the mauri dimensions ranges between -3 to +3 where the maximum
score shows the most important of the mauri dimensions from the particular stakeholder’s perspective. If the stakeholder weights the priority value 0, it means they weight similarly between the two comparisons of the mauri dimensions. Thus, the result of the calculation of the Analytic Hierarchy Process (AHP) Mauri Model shows the priority of the stakeholder in each dimension of wellbeing. The result also will be used to weight the sensitivity analysis. The next step is the choice of the indicators for each dimension and their inclusion in the ranking assessment analysis. The ranking shows the impact of the mauri on each indicator. The impact can be full or partial and either negative or positive (see Fig 5.4.)

![Diagram of Ranking Assessment of the mauri indicators]

**Figure 5.4** the ranking of the Assessment of the Mauri Model Decision Making Framework

The next step is to calculate the average of all dimensions as the actual mauri, which is displayed in the mauriOmeter. The mauriOmeter can be seen in Figure 5.5.
Figure 5. 5 mauriOmeter

5.6. Conclusion

The Mauri Model Decision Making Framework is developed for and in New Zealand and involves the cultural values. It may suitable to use in the research.
References


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PLATIA, O. Using the Mauri Model to Assess the Impact of the Rena Grounding on the Mauri of the Bay of Plenty, New Zealand.


Chapter 6
Methodology

6.1. Introduction

Water resource management in the lowlands of southern Papua needs to take several approaches because of complex problems, uncertainty and dynamic problems such as the changing land use for agricultural purposes (Ito et al., 2014, Lamonge, 2012, Silvius and Suryadiputra, 2005, Hisada, 2007). Management which involves the environment, economics and the Indigenous People (Giesen and Houterman, 2009, Mawdsley and Houterman, 2010) is needed in this area. This research will combine engineering approaches based on scientific and traditional knowledge because a quote which was taken from a workshop in 2001 stated that management of the resources of Papua can be done in a sustainable way only if it involves the customary community (Sumule, 2002). The integrating of the approaches is expected to handle the complexity of the environmental issues in the lowlands of the province. Therefore qualitative and quantitative research will be engaged in this study.

The qualitative research is done to understand the epistemology and ontology of the Indigenous Peoples around the study areas and to address the ecological problems in those areas. The research used the Participatory Action Research (PAR) method. Participatory Action Research is chosen to empower the community. The participants are chosen based on interested groups such as the community, Local Government, NGOs, the Catholic Church, NGOs from the Church (including the museum of Agats), the Indigenous Peoples and the trans-migrants. To collect the data I conducted interviews and small group discussions, and distributed questionnaires. To maximise the results, a key person was chosen from each group. The chosen participants included the elders, local government officials, the NGOs and the community. The elders and the Catholic Church of this area contributed a lot in the epistemology and ontology of the case study areas. The community and the local government and NGOs contributed to the issues regarding the injustice and inequity of the distribution of the development of the areas. The qualitative approach of this research is to collect the information regarding the water supply in Asmat Regency and the MIFEE in Merauke Regency. The combination of the data is used to analyse the research using the Mauri Model Decision Making Framework. Section 6.2 revisits the research question to address the problem and whether the hypotheses are
6.2. Research Question

As explained in Chapter 1, the objectives of the research are to assess the sustainability of water management in the southern lowlands using a socially just decision making tool which integrates traditional indigenous knowledge, so the research questions correlated to the objectives are listed below.

1) What are the similarities and differences in the practice of wetland management in the Asmat and the Merauke Regencies?

Chapter 3 establishes an understanding of wet lands, their values and their importance to the ecosystem (Gilvear and Bradley, 2000). Chapter 4 also describes the existing condition of the wetlands in Papua. Those chapters can be used to address the differences and similarity of the practices in Asmat and Merauke Regencies. The literature also contributes to addressing suitable management for those areas because an appropriate method can restore degraded wet land and enhance the biodiversity (Gilvear and McInnes, 1994).

2) Can the indigenous knowledge of these areas assist in identifying the least destructive options for development?

Chapter 2 establishes the concept of sustainability and sustainable development. This chapter also gave an example where the Indigenous People of Papua have practised their traditional knowledge in a sustainable manner. Chapter 3 also describes the sustainable management of the wet lands around the world which are related to sustainability. Chapter 4 explains the development of low land in Papua. The combination of those literatures can help to address the issue of development in
the areas of study to minimise its negative impacts. To identify the traditional knowledge of those areas, I took a qualitative approach with the community and the Indigenous People, and the Catholic Church which has made a lot of contribution to the development of the Asmat and Merauke Regencies.

3) What kind of model is needed to identify or develop an assessment approach that is consistent with this unique context of the ecology and the culture of the Asmat and Merauke Regencies?

Chapter 5 explains an assessment which was developed in and for Aotearoa, New Zealand called the Mauri Model Decision Making Framework. It could be used as an option to apply in the Asmat and Merauke Regency.
6.3. Research Framework

The contextual research framework can be seen in Figure 6.1.

![Research Framework Diagram]

6.4. Choosing Participatory Action Research

Participatory Action Research (PAR) is defined as a cooperative approach between study, learning and action that can alter a community positively (Kindon et al., 2007, Kindon et al., 2009, Khanlou and Peter, 2005, Pain et al., 2011) by engaging the people on whom any changes will have the most impact (Kindon et al., 2008, Montero, 2000). This approach can also address the complex relationships between society and the environment (Parkes and Panelli, 2001). The methodology is used for research which involves humans and the
environment, such as in health research (Cornwall and Jewkes, 1995, Khanlou and Peter, 2005, Baum et al., 2006), climate change (Mapfumo et al., 2013, Chevalier and Buckles, 2013), water management (Mackenzie et al., 2012, Baggett et al., 2006), natural resources (Pound, 2003) and decision making and research which involve indigenous people (Castleden et al., 2008, Cochran et al., 2008). Thus this method can be useful if it is combined with indigenous methodology (Evans et al., 2009) because the ontological and epistemological, ethical and politic can be included in it (Montero, 2000, Heron and Reason, 1997, Khanlou and Peter, 2005).

PAR methodology benefits the local people of the study areas in many ways if it is compared to the conventional study (Cornwall and Jewkes, 1995). It leads to an action which uses the local knowledge; where the topic is chosen according to the local priorities; where the problem is identified by the locals so they are also involved in the data collection, analysis and the framing concept. This methodology is chosen for empowered mutual learning and is driven by the locals (Pain et al., 2011). Conventional research methodology is posited on understanding and on using scientific knowledge, all done by the researchers and using a disciplinary framework. Lastly, PAR is concerned more with the process of the research rather than outcomes, as in the conventional research methodology. Thus PAR is a methodology which works with and for the community not only on them.

As stated in (Montero, 2000) participation in PAR can be shown in several ways: participating in the choice of the object of the research; participating in the decision making strategy; participating during the action; and socialisation of knowledge. During the process of PAR, the participation of the local people will benefit their society because it produces knowledge (Hall, 1985), and can also express the perspectives of the local people.

It is important to understand the characteristics of PAR before it is used as a methodology for research. Table 6.1 shows the key characteristics of Participation Action Research.
Table 6.1 The Key characteristics of Participation Action Research (PAR)

<table>
<thead>
<tr>
<th>No</th>
<th>Key Characters of Participatory Action Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aims to change practices, social structures, and media which maintain irrationality, injustice, and unsatisfying forms of existence.</td>
</tr>
<tr>
<td>2</td>
<td>Treats participants as competent and reflexive agents capable of participating in all aspects of the research process</td>
</tr>
<tr>
<td>3</td>
<td>Is context-bound and addresses real-life problems</td>
</tr>
<tr>
<td>4</td>
<td>Integrates values and beliefs that are indigenous to the community into the central core of interventions and outcome variables</td>
</tr>
<tr>
<td>5</td>
<td>Involves participants and researchers in collaborative processes for generating knowledge</td>
</tr>
<tr>
<td>6</td>
<td>Treats diverse experiences within a community as an opportunity to enrich the research process</td>
</tr>
<tr>
<td>7</td>
<td>Leads to the construction of new meanings through reflections on action</td>
</tr>
<tr>
<td>8</td>
<td>Measures the credibility/validation of knowledge derived from the process according to whether the resulting action solves problems for the people involved and increases community self-determination</td>
</tr>
</tbody>
</table>

Source: (Kindon et al., 2009)

With these characteristics, PAR research can lead to several typical changes, which can be the view of the world or the actual conditions, the perspectives of society and political perspectives (Montero, 2000). This type of approach needs several stages including inquiry (identification the issues); action (partnership and collaboration); and reflection, which is the stage that shows the findings and makes recommendations (Mackenzie et al., 2012).

Durham University and the Luna Rivers Trust have produced more detail (Pain et al., 2011) as a guide to using PAR. Their report mentions seven themes connected with this approach: collaboration, knowledge, power, and ethics, building theory, actions, emotions and well-being. It explains that PAR is used to gather data and information which is of benefit to the participants, and follows a typical cycle of planning, action, reflection and evaluation. The report also develops typical stages, which are described in Table 6.2.
### Table 6. The typical stages of Participatory Action Research

<table>
<thead>
<tr>
<th>Stage</th>
<th>Action</th>
<th>Reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Action</strong></td>
<td>Establish relationships and common agenda with all stakeholders. Collaboratively decide on issues</td>
<td>On research design, ethics, knowledge and accountability</td>
</tr>
<tr>
<td><strong>Reflection</strong></td>
<td>Build relationships Identify roles and responsibilities Collectively design research processes and tools Discuss potential outcomes</td>
<td>On research questions, design, working relationships and information required</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Work together to implement research and collect data Enable participation of all members Collaboratively analyse findings Collaboratively plan future actions</td>
<td>On working together Has participation worked? What else do we need to do?</td>
</tr>
<tr>
<td><strong>Reflection</strong></td>
<td>Begin to work on feeding research back to all participants and plan for feedback on process and findings</td>
<td>Evaluate both the action and reflection processes as a whole</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Collectively identify future research and impacts</td>
<td></td>
</tr>
</tbody>
</table>

Source: (Pain et al., 2011)

### 6.5. Epistemology and Ontology approach

The research used mixed method qualitative and quantitative research. To frame an qualitative research, the participatory inquiry paradigms are positivism, postpositivism, critical theory, constructivism and participatory (Heron and Reason, 1997, Lincoln et al., 2011). Basic beliefs can be used as alternative inquiry paradigm, those are epistemology, ontology and methodology. Kesby (2000) discusses how participatory research used epistemology action research in a developing country. So the basic belief can be applied in Indonesia as developing country. Epistemology is way of knowing and participating in worldview which involves subjectivity. The epistemology uses four ways of knowledge, those are; experimental knowing, presentational knowing, propositional knowing, and practical knowing (Heron and Reason, 1997). Experimental knowing means having experience with the knowledge; presentational knowing is developed based on experimental knowledge; propositional knowing is a conceptual term or based on theory;
and practical knowing is the skill or ability to apply the knowledge. Ontology is primordial reality (given cosmos), it combines subjectivity and objectivity because it only can be understood thought the mind-set, and the mind engages with the given cosmos. Methodology in participatory research uses experimental, dialog and quantitative methods.

Therefore I am positioning this research as in Table 6.3. I use the critical theory and participatory research which is engaged with ontology, epistemology, and methodology.

**Table 6.3 the position of the research**

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical theory</th>
<th>Participatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontology</td>
<td>Historical Realism based on Social, political, cultural, economic, ethnic</td>
<td>Participative reality; subjective - objective, co-created by mind and given cosmos</td>
</tr>
<tr>
<td>Epistemology</td>
<td>Subjectivist, value mediated findings</td>
<td>Extended of epistemology, practical knowing; co created finding</td>
</tr>
<tr>
<td>Methodology</td>
<td>Dialog</td>
<td>Participation of the all stakeholders</td>
</tr>
</tbody>
</table>

Sources: (Lincoln et al., 2011, Heron and Reason, 1997)

Kincheleo (2008) discusses how importance indigenous knowledge is to sustain the people in the area. It establishes the concepts of life of the people which have created their knowledge, epistemology and ontology. In this resource it also states that the indigenous knowledge can be used to counter western science which is not sustainable. Thus, in my research, I looked for the epistemology and ontology of these tribal people that are related to sustainability.

**6.6. The implementation of the PAR in the case studies**

Based on the theory of PAR the participants are involved to identify and define the object of the research. The participants participate in addressing and solving their problems. In the context of this research in the southern lowlands of Papua, this approach was considered suitable because it involves the actors affected by the problems, and it also includes the epistemology and ontology of the people who are affected to obtain a better understanding of their world views. Kesby (2000) discusses that the participatory method may use the epistemology research action, because the participants will share the knowledge and the researcher will encourage them to empower their knowledge. In this research, I use epistemology action research in interviews and small focus groups to understand the knowledge. This knowledge can involve the police makers to achieve better solution options in their areas. The worldview of each stakeholder can be involved in
assessment. This is especially true for water and wetland management where the world view of the indigenous people should be included as it has been practised for inter-generations and survived. The research thus will assess the epistemology and ontology of the indigenous peoples. There are differences in the participation processes used each of the two areas studied (see Fig 6.2)

![Diagram of the implementation of participatory action research]

**Figure 6.2 The Implementation of Participatory Action Research**

6.7. Adapting the Mauri Model Decision Making Framework

As explained in Chapter 5 the Mauri Model Decision Making Framework (MMDMF) is a unique sustainability assessment approach that was developed in New Zealand. The steps
of the Mauri Model also were explained in Chapter 5. To make this model applicable for the areas, there were several steps, as following:

a) I compared the similarities between the Asmat People, the Malind Anim and the Māori People.

b) I learnt the cultural values of the Māori People with a Literature Review and also engaging with conferences and a symposium during my study time in New Zealand.

c) I learnt the cultural values of the Asmat People and the Malind Anim from a Literature Review.

d) I did a field trip to Papua to collect data in Jayapura, Merauke and Asmat Regencies.

e) I did interviews, small focus groups and questionnaires to address the issues of wetland and water resources management in Asmat and Merauke Regencies.

f) During the interviews with the elders and the community of the Asmat People and the Malind Anim, I could identify the concepts of life of those tribes which have similarity to the Maori People. It makes it possible to transfer the Mauri Model Decision Making Framework to Papua.

g) The indicators of the four dimensions of the mauri are chosen based on the literature review, and data from field study.

6.8. Research Location

The location of the research is in southern Papua using two case studies in Merauke Regency and Asmat Regency (see the Figure 6.3 and 6.4.), because both of the areas have unique ecosystems and still practice their own culture for sustaining the environment. Water and wetland management in these areas also has an important role for the Indonesian wetlands (as explained in Chapter 4).

Most of the lowlands are in the southern part of Papua, and have recently been focused on for development (Ginting and Pye, 2011, Ginting and Pye, 2013, Ito et al., 2014).

I know the areas, especially Merauke, because I used to live there, so this makes it easier to gain the data and information needed for the case studies. The Asmat Regency, was previously part of the Merauke Regency, so I still have a network in the regency to be able to access the data. The only obstacle to researching in the Asmat Regency is transportation.
6.8.1. Case study: Asmat Regency

Asmat Regency is located in southern Papua, with a total area of 23,745 km². This regency is a delta area of tropical forest with meandering rivers; the tidal range affects the delta up to 140 km inland from the ocean creating a 25 to 50 km wide mangrove zone. A mixed swampy forest of Nipa palm and Sago dominates the riparian margins in this area. The vegetation covers shallow to deep peat lands, which are intersected by many rivers and streams, creating the unique biophysical attributes of Asmat (Giesen and Houterman, 2009, Tommaseo and Lucchetti, 1992).

The development of this area is happening fast. When it was still under the Merauke Regency, Asmat was only a district. The district changed to a Regency in 2002, largely to enable development. In 2010, there were only 8 districts, which increased to 10 districts in 2012, and significantly increased to 19 districts in 2014.

Due to limited time and funding the research area was only in the Agats Township. Agats town is the capital of the Asmat Regency, with the population exceeding 15,000 (BPS, 2012). This township is also called “the muddy town” as it is around Flamingo Bay, an exotic place with no dry land to stand on and all roads are constructed on elevated wooden structures. All construction is a minimum of two to three meters above ground level as Agats is between 0 to 5m above sea level, with a slope of less than 2% (RTRW, 2011, BAPEDA, 2012, 2011). All buildings, roads, fields, and schools are constructed from timber, giving the town a distinctive character.

6.8.2. Case study Area: Merauke Regency

Merauke is the easternmost regency of Indonesia which encompasses a vast territory in the southern lowlands of Papua, bordering with Papua New Guinea. The capital is Merauke Town. The ecosystem of the Merauke Regency is savannah, grassland, reeds, and monsoon forest (BOWE et al., 2007, Hitchcock, 2006, Dwi Nur Cahya, 2000). This regency consists of 20 districts.

The area of study can be seen in the following pictures.
Figure 6.3 Map of Papua Province (BAPPEDA-Papua)
Figure 6.4 Map of Asmat Regency (BAPPEDA-Asmat)
Figure 6.5 Map of Merauke Regency (BAPPEDA – Merauke Regency)
Figure 6.6 The Map of Agats District (Local Government, 2012)
Figure 6. 7 The Reservoir for rainwater in Agats Township (photo: Wambrauw, 2012)
Figure 6. 8 Syuru Village, Agats District (photo: Wambrauw, 2012)
Figure 6. 9 Ramsar Sites in Merauke Regency (photo: Wambrauw, 2014)
Figure 6. 10 Agats Township (photo: Wambrauw, 2012)
6.9. Field Study

To support this research, I did the field study in my home town in Papua. The field work was done in Merauke and Asmat Regencies for primary data, and also I gathered supporting data in Jayapura. I did the field study twice; the first trip took three months (from the end of October 2012 to January 2013), and the second one took only one month and two weeks (September 2014 to November 2014). The first field trip’s purpose was to observe, and collect data. I went to Jayapura, Asmat and Merauke Regencies. However, I was not able to get certain data on that trip and so needed to do the second trip, especially in Merauke Regency.

6.9.1 Ethical approval

Ethical Approval is needed if the study uses human participants. The Participatory Action Research methodology used in this research needs the involvement of stakeholders as human participants. At the University of Auckland, I applied to the ethics committee UAHPEC (the University of Auckland Human Ethics Committee). I could only gather data after I had their approval which was granted: ethics approval Reference Number 8655 for 3 years (24 October 2012 to 24 October 2015).

6.9.2. Preparation

A researcher doing research in Papua should get prior permission from the Regional Executive Development Board of Papua, locally known as BAPPEDA-Papua, in Jayapura (Badan Perencanaan Pembangunan Daerah). A copy of the letter should be sent to the Provincial Police Office and Papuan Military Office and the social and politics department of Papua Province, and the Papua Governor.

To apply for this permission, I attached the letter from my employer, the Engineering Faculty of the Cenderawasih University (UNCEN) in Jayapura, Papua.

Both the letters, from (BAPPEDA-Papua and UNCEN, must be given to BAPPPEDA at a regional level in Merauke and Asmat and to the Social and Political Departments.

In Asmat, after giving the letter to Assistant 1 of the Asmat Regency and BAPPEDA-Asmat, I was able to gain data from several government offices: w BAPPEDA-Asmat, Public Works Department, Fisheries Department, and Forestry Department. I also contacted non-Government organisations such as the WWF (World Wildlife Fund) in Asmat, the Agats Bishop, and also the Asmat Museum in Asmat.

In Merauke, after giving in the permission letters, I contacted several departments and non-government organisations to gather the data and information: the BAPPEDA-Merauke,
Agricultural and Horticultural Department, Forestry Department, Geophysical and Meteorology Department, and PT Wendu-Water Supply Company. I also contacted the Indonesian Navy in Merauke to gather tidal data for Asmat and Merauke. I also contacted the non-Government Organisation WWF (World Wildlife Fund) Sahul-Merauke, the YASANTO, SKP (Sekretariat dan Keadilan Perdamaian) and LMA (Lembaga Masyarakat Adat Malind/the Malind Customary Organisation).

6.9.3. Choosing participants

Stake holder participants are important for assessing the uncertain and complex problems of water management (Carmona et al., 2013). As explained before PAR (Participation Action Research) methods are chosen in this research. Due to the limitation of the time during the field trips, I only chose the key person who was related to the issues.

In Asmat Regency, the stakeholder participants came from the local government, the non-government organisation, the elders of the Asmat people, the Catholic church (Agats Bishop and Asmat Museum), and community. While in Meruake Regency the stakeholder participants came from the local government, the non-government organisation, and the head of the Malind Anim Customary organisation, the trans-migrants, and the local communities. Even the former head of the Merauke Regency who initiated the Merauke Integrated Food and Energy Estate (MIFEE) project was consulted. The total respondents included 62 people from three different areas: Jayapura, Merauke and Asmat Regencies. The respondents are divided into two case studies areas, as explained in Table 6.4

Table 6.4 The Composition of the Respondents (Participants)

<table>
<thead>
<tr>
<th>Respondents</th>
<th>For Asmat Regency</th>
<th>For Merauke Regency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous People of the Area</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>(including Elders and those who work with government)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NGOs</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Local Government</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Community</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Catholic Church including NGOs, Museum</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Water Company</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Trans-migrants</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>22</td>
</tr>
</tbody>
</table>
These respondents gave the information related to the research to determine the issues, the epistemology and ontology, which will be used to choose indictors and weighting.

6.9.4. Collecting Data in Jayapura, Asmat, and Merauke

Gathering data was done in three places; Jayapura, Asmat, and Merauke Regency. In Jayapura Regency, the data gathered was associated to Papua in general such as the map of Papua and spatial planning. The interviews in Jayapura were with several staff from the local government and NGOs. In Asmat, the data was collected from the Catholic Church and the local government. In Merauke, the data was collected from YASANTO, the Catholic Church (SKP), NGOs (WWF, Papua Lestari) and the LMA (the Malind Anim Association).

6.10. The Mauri Model Decision Fit to Papua

Before transferring the Mauri Model Decision Making Framework to the context of Papua I checked the feasibility of adopting the model using an impact assessment in the Asmat and Merauke Regency. I assessed parallels between the Asmat People and the Māori People. The results of this study are explained in Chapter 7, especially for the concepts of sustainability and guardianship of environment. If similarities were found between those tribes, the MMDMF can be transferred to Asmat. Similar to the Malind Anim, I compared Asmat, Malind Anim and Māori People, so if there were also similarities between them it means the MMDMF can be adopted for Merauke Regency. The results of this comparison can be seen in Chapter 9.

6.11. Conclusion

In this research, I conducted a literature review to investigate problems which are related to water and wetlands in the southern lowlands of Papua. Due to the limited time and findings, only Asmat and Merauke Regency were chosen for the case studies. I chose a method and framework which is suitable for Papua, and decided to use the MMDMF, and followed this with a field trip to gather data and check the feasibility of using the framework, and also analysed the sustainability of wetland and water management in Sothern Lowland Papua.
References


Chapter 7
Concept Alignment for Sustainability Analysis in New Geo-cultural Contexts: Relevance of the Mauri Model in Asmat, Papua

(The content of this chapter has been published in AlterNative: an International Journal of Indigenous People Volume 10, issue 3, 2014)

7.1. Introduction

This chapter analyses the feasibility of transferring the Mauri Model Decision Making Framework from Aotearoa New Zealand to Asmat, Papua, Indonesia. Section 7.2 describes the Asmat Regency in general. Section 7.3 lays out the objectives of the research. Section 7.4 explains the ontology and epistemology of the Asmat Peoples. Section 7.5 explores the ontology and epistemology resonance between Asmat people and the Māori People. Section 7.6 concludes the chapter.

7.2. Introduction of Asmat

Asmat is a geographically-defined region epitomising a sustainable and vibrant ecosystem within which the Asmat peoples co-exist in accordance with traditional lore. This has evolved to a state of internal sustainability and balance, called ja asamanam apcamar. The unique identity of the Asmat has evolved from the specific social structures and survival techniques developed to allow long-term uninterrupted occupation of the unique Asmat ecosystem. A study of the impact of human culture on the environmental is called a geo-cultural landscape. (Krek and Evelopidou, 2008, Vassilopoulos et al., 2008). In Asmat the relationship between humans and landscape in two directions, the Asmat people maintain the environment with their culture. The ecosystem also shapes the culture such as their houses are built on stilts and the canoe is a part of their daily life. Inevitably, the development cannot be avoided; the Asmat should face the change. After the contact with the outsiders, a new technology and changes in life style entered this areas. For example, they used to have only canoes, but now use both speed boats and canoes. Even though the expeditions from outside started with Cartenz (1623), James Cook (1770), and Lorenz (earlier 1990s), the Asmat have experienced the huge changes since the Dutch Government placed their permanent post, Catholic Mission, in Agats in 1953 (Mansoben, 1995, Arsdale, 1978) which include culture (Dobratz, 2008), social and infrastructure. A social justice assessment is needed to minimise the unfairness of distribution of benefits of
the development in this area. This paper will determine the feasibility of applying a decision making tool which was developed in Aotearoa, New Zealand to the context of Asmat.

Asmat, a delta area of tropical forest with meandering rivers, is located in Southern Papua, on the Pacific Rim of Fire, with a total of area is 23,745 Km² (see Figure 7.1).

Asmat is the largest tidal lowlands area of Papua, with a globally unique ecosystem and significant cultural diversity. Asmat Regency together with other regencies (Yahukimo, Puncak Jaya, Jayawijaya and Wamena) are located of the National Lorenz Park, one of the World Heritage Sites (Hawkins*, 2004), which is the largest protected area in Southeast Asia and one of three in the world which have glaciers in the tropics. The tidal range affects the delta up to 140 km inland from the ocean creating a 25 to 50 km wide mangrove zone. A mixed swampy forest of Nipa palm and Sago dominates the riparian margins in this area. The vegetation covers shallow to deep peat lands, which are intersected by many rivers and streams, creating the unique biophysical attributes of Asmat (Giesen and Houterman, 2009, Tommaseo and Lucchetti, 1992). The vast fluvial plain consists of more than 100 waterways including significant rivers such as the Lorenz River (250 km in length with widths of 350 to 1500 m), Aswets, Sirets (Eilanden River), Friendship River and the Bets River (180 km length with widths of 200 to 900 m) (BPS, 2012). The indigenous people of this muddy area are the Asmat.

The Asmat people who live along the rivers are divided into twelve clans, or Far; Aramatak, Becembub, Bismam, Bras, Emari Ducur, Joerat, Kenakap, Safan, Simai, Unir Epmak, Unir Sirau, and Yupmakcain. Their languages are classified into three geographic groupings; those from the northwest coast, the Casuarine coast, and the upstream Asmat (Konrad et al., 2002, Rumkorem et al., n.d., Hoogerbrugge, 1977). The Asmat people are well known for the production of cultural artefacts, wooden carvings in particular. These cultural artefacts include shields (jamasj), ancestor poles (mbis), the sago hammer (amosus), paddles (po), rope costume masks (dorae, manimar, jiwawoka, dato, dat jumo), drums (tifa or em), and canoe prows (ci cemen) (Konrad et al., 2002, Project, 1974, Smidt, 1993). The arts of the Asmat are influenced by the Far, with every Far having their own unique characteristics, whether resident in the coastal zone or the interior. Even though the Far have their own uniqueness, they have to have a Jew, a traditional house, which not only physical construction but having a spiritual meaning as centre place of the community and identity of kin ground.
Figure 7.1 the location of Asmat in Southern Papua (Asmat Government, 2012)
A Jew, Yew Jeu, Yai is the rectangular Long narrow traditional house which is built on stilts (see Figure 7.2). A Jew has several fireplaces (wair/wir/) according to the number of the families who live there, and a central fireplace which is called a mboijir (Smidt, 1993).

![Figure 7.2 a Jew in Syuru Village, Agats, Asmat (Wambrauw, 9 Dec 2012)](image)

Figure 7.2 a Jew in Syuru Village, Agats, Asmat (Wambrauw, 9 Dec 2012)

Generally the Jew is built along the rivers (Arsdale, 1978) as a centre-point of the village, with other houses (tsyem) built beside or behind the Jew. The Jew has two concepts; as a building and as a community of a kin group. Genealogically, a Jew is divided into two parts (two aypem or aipmu) which face toward the headwaters (cewi), and the uripis which faces towards the creek. The cewi belongs to those who established the Jew, and the uripis is genealogically from the younger brothers of those who built the Jew. The aypem section is headed by the tesmaypit, or a leader. As explained, the Jew is not only a physical structure but also has significant spiritual values for the Asmat (Schneebaum, 1988, Schneebaum, 1990, Schneebaum, 2000). All of the pole structural supports for the building have a spiritual name and function. The functional role of the Jew is to educate the young men about the traditional knowledge and lore that perpetuates the unique Asmat identity, and includes inter-clan relationship management and dispute resolution, clan leadership, and wood carving, all making up a traditional means of archival knowledge (Rumkorem et al., n.d.). The Jew facilitates the sharing of knowledge and traditional stories, and is the place that negotiations occur between the clan leaders and others. Only men can enter the Jew, with the exception that women are invited to enter for a particular special feast. While the tseyem is a wooden house on stilts with Sago or Nipa palm as roof and walls (see Figure 7.3). A tseyem usually has a garden, and a place for daily activities. Usually, 10 to 15 tseyem surround the Jew.
Recently, the delta ecosystem and the Asmat themselves have been experiencing ever-increasing impacts from external sources that primarily originate in the developed western world. These are made manifest as the pervasive consequences of the ‘anonymous’ actions and decisions of the western world such as climate change, sea level rise, global warming, and also as the direct consequences of third party development within the Asmat. These forces now threaten the future survival of Asmat and the Asmat peoples, yet little consideration is given to the unavoidable consequences that these development plans pose for future generations. The economic development of Asmat has diminished the traditional life and the environment because of both colonial and national government actions (Koentjaraningrat, 1989). Assessment frameworks are now in use that facilitate more holistic understandings of the distribution of benefits and impacts resulting from physical resource extraction and development, and the drivers for the decisions that allow such progress to occur. Thus, the decision making should consider all aspects include environmental and social aspects. To make fair decisions on development and achieve social justice, the local government has discussed issues with the elders, the indigenous people, and the leader of the community and NGOs.
7.3. Objectives

The objective of this research is to determine the feasibility of transferring a decision making framework, created specifically for the Aotearoa, New Zealand context, to the geographically, politically and culturally distant context of Asmat, Papua, and also to consider its specific use in developing sustainable water management practices in the region, using a survey done in Agats town as an example. The research requires the identification of worldview priorities in decision making regarding the proposed development of the Asmat region. Therefore, the research focuses on decision making in relation to the concept *ja asamanam apcamar*, which means to keep in balance. Conclusions will be drawn on the feasibility of the adaptation of the Mauri Model to the Asmat context and its potential to encourage water management.

7.4. Ontology and Epistemology of the Asmat Peoples

Within the Asmat ontology, the universe is divided into three parts, a place for living or Asmat ow capinmi, a temporary or transitional place called dampu ow capinmi, and after-life or Safan or Safar (Konrad et al., 2002, Rumkorem et al., n.d.). The identity of Asmat is related to the myth of the creation of the people and is based on the folklore of the Fumeritpits, the Supreme Being. The story tells about the first people of Asmat who were created by Fumeripits from wooden statues (Koentjaraningrat, 1989, Jimanipits, n.d.).

An axiom of the Asmat is the belief that the universe contains the good spirits and evil spirits. The spirits of ancestors, or yi-ow, who fertilise the Sago also protect the people from calamity. Ancient protocols are adhered to, ensuring the appropriate respect, in order to avoid potential misfortune. The Asmat respect their ancestors through the physical activities of wood carving and traditional feasts, while protocols are acknowledged and guide day to day activities to ensure greater community resilience and sustainability. The representation of ancestors in wooden artefacts is believed to imbue the work with an ancestral spirit. The spirit dim nibir represents the spirit *yi* of those people recently dead, while the spirit mbwi hampers the *yi* of the dead, frustrating the journey to the after-life or Safan, breaking the life cycle of reincarnation. Asmat believe that the *yi* journeys to Safan (a heaven) whence reincarnation is facilitated by Mbiwiripitsy (the spirit of rebirth) thence a new cycle of life (Mansoben, 1995). Other spirits such as buyi bi inject the spiritual forces of the forest and specific practices are observed to ensure balance is maintained and
the malevolent spirit (osbopan), which lives in dark caves, trees, big stones, or inside animals should be pleased to avoid the calamity (Koentjaraningrat, 1989).

Asmat also believe that a person has four spirits or souls; yuwus (the spirit imbued when a human is born, it is related to the emotional state, and is located beneath the navel); ndamud (wandering spirit, as when a person is sleeping, the spirit can wander. It is associated with dreams, and if the spirit wanders too far and cannot return, the person can enter a coma or die). The two other spirits are ndet and samu. Ndét (or mbi in several areas) is a spirit which comes inside the child after its first birthday and gives personality and uniqueness. Finally, samu is a spirit of unusual behaviour, if it is seen it can cause death or disease (Schneebaum, 2000, Dobratz, 2008).

In terms of the place for living, the Asmat people are an inseparable part of nature, and call themselves Amat-ow or As-amat. Amat-ow, which means a true human, while As-amat means tree people. The Asmat identify themselves as a tree, in metaphoric terms, with their feet being associated with the root of the tree, the body is a trunk, the hand is a branch and the fruit is a head (Konrad, 1981). The Asmat believe that the Sago tree (Amos) is akin to a mother who gives life when she delivers the baby, similarly, Sago, is the bountiful source of food as nourishment to support life. The Asmat also acknowledge Ironwood as akin to the women of Asmat, which influences decision choices regarding the timber selected for construction, including the ability to differentiate between suitable characteristics based on a metaphoric gender attribution. The Asmat invest significant community resources into understanding the application of timber for certain purposes such as making a canoe (ci), a house or a bridge, within which the Asmat exist, an inappropriate timber choice may have a negative impact and potentially life-threatening consequences.

A canoe (ci) is used for fishing, hunting, and gathering. If they say “ci opak, jis opak” it means no canoe, no firewood. They need the canoe to go to the dusun (forest) which provides all their needs including firewood, food, and the components for feasts. Thus, a canoe (ci) is a basic tool for the Asmat (Daeli, 2012). The canoe (ci) is also used as the main transportation because the primarily saturated and inundated condition of the geographic area, an example is the condition in Agats town, the capital of Asmat Regency (see Figure 7.4).
Besides ci, the Asmat and their cultural identity are also inseparable from traditional dance, the traditional feast, and wooden art carving. The traditional dance is called Di which literally means shaking. Traditional feasts take on different meanings such as Pirpokmbuy, or the feast of the Sago grubs, which is prepared by women by filling a long hollow cylinder with grubs or larva from Sago palm which becomes the main meal. At the feast women dance on the transverse beam of the Jew. Ndatpokmbuy is a feast of spirits with costume masks to represent the return of dead people to the village, Cipokmbuy is a feast for a new canoe, and Mbispokmbuy is a feast of Mbis poles associated with Jew construction (Hoogerbrugge et al., 1976). The wooden art carving is also an important role in the Asmat daily life. Carvers (see Figure 7.5) are thought to be guided by the spirits of ancestors who enhance the balance: the central role of wooden art carving is to maintain the balance of Asmat’s life, the physical expression of underlying traditional lore.

The Asmat respect their ancestors through the physical activities of wood carving and traditional feasts, while protocols are acknowledged and guide day to day activities to
ensure greater community resilience and sustainability. The representation of ancestors in wooden artefacts is believed to imbue the work with an ancestral spirit. Within the Asmat ontology is the fundamental belief that their arts, an integral part of the Asmat culture, have an important role to sustain the world. Thus the Asmat peoples perpetuate their culture to maintain the balance in the universe. They believe in the symbiotic relationship between humanity and the ecosystem, and maintaining the spiritual integrity of the environmental and ancestral spirits. There exists fluidity between life and death that is real, and obligates the Asmat to facilitate harmony and balance. The leadership has obligations and the responsibility to maintain the cultural norms of their society, responsibilities which include sustaining nature as the heritage for the next generation. These concepts are *jo bakat fakar and capinmi fakar*, which ensure the rivers, the forests, and the lands are passed on to the next generation in a good condition. Therefore, Asmat people have practiced a sustainable concept in their culture. Their worldviews relate to the forest as a place for herbal medicine, carving, shelter, food, income, to protect animals, and to be sustained for the next generation (Personal Interview, 11 Dec 2012).

Asmat leadership in arts or cescu ipits, includes the capacity to create balance between the physical and spiritual worlds which is called damer apcam cescu ipit, while the role of imu fahet cescu ipitj uses humour as a means to influence and sustain the balance and harmony in life. The leaders or respected elders share roles as carvers, or wow cescu ipits, and as singers and drummers, or sobenak cescu ipit and em cescu ipitjs, respectively. They are the holders of traditional knowledge and lore, the tareatakam cescu ipitsj. The tesmaypits, a leader of an aypem, is categorised as big man (authority) because of his braveness and magical powers (Mansoben, 1995). In preparation for these roles a wow ipitsj studies the arts and traditional knowledge and lore acting as a mediator between the place of life and spiritual realms. Time is required to become a wow cescu ipitj and to earn the privilege to learn the sacred stories from the elders. A woman can take part in the arts, such as in designing the craft of feasting, and she is called cescu cepes. Wow ipitjs is a designer of all arts such as mbis poles, or ancestor poles, and wuramon or a spirit canoe.

A wuramon is the ‘soul ship’, a canoe without a bottom and with several carvings, which is a supernatural vessel. It used in feasting for the spirits of the dead and also the initiation rite of boys into adulthood. A carving of a turtle (*mbu*) that symbolises fertility is placed in middle of the canoe. Next to the *mbu*, is a singular Z shape creature called an okom (sea
monster spirit) and another part will be carved with a bird like head called an ambirak or amirak (water spirit) or etsjo (like a human being) (Konrad, 1981, Goldbarth, 2006, Smidt, 1993).

7.5. Ontology and Epistemology Resonance with Māori

Aspects of the Asmat identity, defined by their cultural values and traditions, resonate with those of the Māori. Māori are an indigenous people (Tangata Whenua) of Aotearoa, New Zealand (hereafter referred to as New Zealand). The word Māori has the literal meaning of normal or usual; a human being. Māori are Polynesian peoples who migrated south from Hawaiki on large ocean swells, which originated in the northern hemisphere, aboard specially designed canoes (waka) around the 10th century (Morgan 2012, Reed 1963). Māori are the Tangata Whenua (people of the land) of New Zealand and define their clan identities (Hapū) in terms of genealogy and geographic connection in pepeha (Panelli and Tipa, 2007) such as that relating to Ngāti Pikiao, which is a sub-branch of the Te Arawa tribe (Morgan, 2006). The landscape, including land, forests, mountains and waterways are inseparable from the people who live in it. The people know how to manage the ecosystem with their traditional knowledge. The geographic areas of origin, rohe, are defined by watersheds, and a strong focus on sustaining the water quality within the watershed provides the basis for resource management. The ethic of resource management is embodied in the concept kaitiakitanga (Kawharu, 2000, Roberts et al., 1995), which is understood as the proactive enhancing of the ecosystem and all its parts. The active expression of kaitiakitanga is the maintaining and enhancing of mauri, or life supporting capacity. Mauri is the binding force between spirit and substance that enhances life and wellbeing (Morgan 2006a, Morgan 2008). Nature, including river or forest must be respected to enhance the mauri. Traditional rituals and practices regarding mauri provide an indication of the broad extent of the concept’s relevance in Māori life and a deeper understanding. The concept of mauri is embodied within beliefs regarding carving (Patterson, 1998). The carver Rangi Hetet stated that using raw timber rather than milled timber helps the carver to give his work mauri (Patterson, 1992, Patterson, 1998). The metaphysical message being that processes such as felling trees without appropriate ritual, sawmilling, and the large scale conversion of a living forest into lumber for sale, damages the life forces (mauri) of the timber. It is possible to establish a mauri for some creations,
such as a meeting house. When a house is built, the mauri is established as the sacred heart of the building. This mauri is the power obtained through a covenant with the gods to take care of the house and to fulfil the wishes, desires, and hopes of the people who will use it for noble purposes (Barlow, 1991). The relationship between Māori and the environment is specifically provided for in several places in the New Zealand Resource Management Act (RMA) which is the parliamentary act governing the sustainable management of natural and physical resources in the country and which was promoted in 1991 (1991). Section 6 sets out matters of national importance and refers to the relationship of Māori and their culture and traditions, with their ancestral lands, water, sites, wāhi tapu, and other taonga. Roberts asserts that the recognition of Māori relationships includes intangible aspects such as the spiritual dimension and that everything in the natural world possesses mauri (Roberts, 2002). Māori people have a rich corpus of art and wooden carving with their traditional meeting house, the wharenui, which is located on the marae. Manaia and Taniwha are evident in carvings adorning the wharenui, symbolising the protective aspects of the spiritual dimension that aid the traditional activities and obligations of the people. Figure 7.6 amply demonstrates the similarity between the carvings of manaia in Māori compared to ambirak in Asmat.

Figure 7.6 pictures of manaia (left) (photo: Morgan, TKKB, 2014) and ambirak or amirak (right) (photo: Allan Bryan, June 2014)
7.6. Parallels Resonate in Both Cultures

The indigenous beliefs of the Māori were not given legal recognition in New Zealand law until 135 years after the signing of the Treaty of Waitangi in 1840. The Treaty of Waitangi is an agreement between the British Crown and the Māori chiefs to recognise the rights of the Māori in their lands. In 1975, the Treaty of Waitangi Act created processes that empowered indigenous rights in decision making in New Zealand, resulting in the recognition of these concepts in subsequent laws. The Environment Act (1986) identified the protection of the intrinsic values of ecosystems as its primary focus, and the Māori term for this, kaitiakitanga, was included in the Resource Management Act (RMA) 1991. The principles of the Treaty of Waitangi are partnership, active protection, and consultation which consider the participation of Māori in sustainable development (Jollands & Harmsworth, 2007; Morgan, 2008). To produce a socially just decision making, the people consider their values and knowledge. The Indigenous People have their own concepts of life. Several concepts of Māori are whakapapa (ancestral lineage), mana whenua (status, authority), kaitiakitanga (guardianship), the concept of mauri, tau utuutu (the principle of reciprocity), mātāuraunga Māori (Māori knowledge) and atua (deities) (Jollands & Harmsworth, 2007; Reed, 1963). The concept of the Mauri which is the binding force between spirit and substance to enhance life and wellbeing is applied in the Mauri Model Decision Making Framework.

The Mauri Model Decision Making Framework is a unique sustainability decision making model that was developed in New Zealand (Morgan 2008). The framework has been applied to engineering case studies to assess problem-solving in complexity (Morgan 2006b, Morgan 2006a, Morgan, 2011, Morgan et al., 2012, Peacock et al., 2012). The framework measures four dimensions of wellbeing as the basis of sustainability: the mauri of community (social), the mauri of whanau or family unit (economic), the mauri of the ecosystem (environment), and the mauri of hapū (culture). The characteristics of this Aotearoa decision making support can be seen in Chapter 5. The final result of the assessment will be applied in the diagram, the mauriOMeter (see Figure 5.5), which shows the impact of the assessment, either positive or negative impacts (see Figure 5.4). Transferring the Aotearoa framework is acceptable in the context of the Asmat condition given the assumption that almost indigenous peoples have a similar concept of life which is inseparable from the earth. Even though there are some differences between the Māori and Asmat, such as the concept leadership between the big man in Asmat and mana in Māori, it is still feasible to transfer the framework because, for
some principles of life, both tribes are quite similar in the notions of ancestral spirits, sacred places, guardianship and the relationship between nature, human beings and participation. The environmental guardianship of Māori (kaitiakitanga) parallel the Asmat belief of the yi-ow spirit who has guardianship of Sago grounds. Asmat also have the sustainable concept, \textit{jo bakat fakar and capinmi fakar}, which means that they have to protect and care for the river or water and the land for the next generation. Similarly, \textit{whatuamongaro te tangata toitū te whenua} in Māori means ‘people pass on, but land remains”, which explains that indigenous people have their own views of laws to protect the nature. The belief in ancestral spirits makes both tribes respect nature to respect and please the ancestors. The Asmat are really rich in culture and knowledge, however a lot of changes have occurred, especially in urban environments. The author believes that a lot of traditional knowledge has not been explored. Some concepts are still not explored such as the concept of gods in Asmat compared to the concept of atua in Māori. It also because after the Asmat became Catholic and Christian some culture changed, but they still believe that each place has a spirit.

This research is only conducted the Agats town, which is the capital of the Asmat Regency. Due to the limitation of resources in time and cost, the field of study was only conducted in an urban environment in Asmat (see Figure 7.7.).

\textbf{Figure 7.7} the field study area in 2012 in an urban environment (left) and Syuru Village (right) in Agats, the capital of Asmat

Asmat believe that every feature of the landscape like a river or forest, has jungle spirits or wasan’dat (De Hontheim, 2010) and trees have a spirit who lives inside. It is also explained
by carving in wuramon; okom and ambirak (amirak) which are malevolent water spirits. The female spirit of the Ironwood tree, or pas, is called Paskamoraout (the spirit of beautiful women inside the Ironwood tree) (Jimanipits, n.d.). If they go to dusun (a place in forest for gathering Sago) they put leaves or stone axes there as offerings when they pass such a sacred place (Personal Interview, 11 Dec 2012).

The Asmat represent the ancestral spirits in their artefacts. The concept of keeping balance (ja asamanam apcamar) makes development in sustainability possible. In the same manner as mauri as the life force to balance the physical and spiritual and enhance well-being, the Asmat, too, make a balance. Both of them also utilise traditional knowledge in sustaining nature, such as when choosing a tree to make a canoe. Both also believe the traditional house is not only a physical building but has the ancestor spirits living inside. Jew is also spirit in Asmat language, thus, the building is also a life spirit for the whole community. Both the Māori and the Asmat have sacred places which have to be protected. Thus, using the Mauri Model has the potential to explore cultural indicators in Asmat to include the indigenous people to decide the policy of their region. Even though Asmat have retained much traditional knowledge in relation to sustainability, which is understood by local government, it may not be used in practice or be included in local or National government policy, which marginalises the indigenous people. They can easily become victims of conventional western style development. Generally, the notions of sustainability only consider social, environmental and economic factors. Indigenous people’s values and beliefs are merged with those of the community at large and the cultural wellbeing is assumed as social wellbeing. The community at large places greater emphasis on social considerations and cultural (indigenous) issues are neglected. The Mauri Model encourages policy that is cognisant of the cultural values and beliefs. Specifically it gives consideration to cultural values and beliefs separately, allowing the considerations of sustainability from the indigenous perspective, which is measured. If the assessment of the policies shows a diminishing of the cultural indicators of the indigenous people, the government could consider alternative solutions for better decision outcomes. This will reduce adversarial conflicts in the society, particularly over the use of natural resources such as in Merauke (MIFEE project) (Ginting and Pye, 2011, Zakaria et al., 2011, Ginting and Pye, 2013, Ross, 2008) and Gold mining nearby the Lorenzt National Park. This research is a bridge to further analysis of the sustainability of development in Papua, including Asmat. Subsequent articles are planned to
test the hypothesis of the successful transfer of the Mauri Model which is being used in assessing water management in Agats, the capital of Asmat. Moreover, the Mauri Model will be applied in other case studies in other areas in the context of Papua, and shared in future articles.

Even though the two cultures are not identical, it still is possible to transfer the Mauri Model framework. The Māori have kaitiakitanga to enhance the mauri to sustain life. The Asmat do carving and feasting to please yi-ow and other spirits to keep the balance the in universe. The Asmat also have a Jew as a life spirit of the community.

Therefore, the Mauri Model Decision Making Framework is applicable in the context of Asmat, because of the similarities in the conceptualisation of life. To summarise, the parallel concepts between the Māori and Asmat can be seen in the Table 7.1.

<table>
<thead>
<tr>
<th>The concepts</th>
<th>The Māori</th>
<th>The Asmat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guardianship</td>
<td>Kaitiakitanga (guardianship environment, enhancing mauri)</td>
<td>yi-ow (guardian sago)</td>
</tr>
<tr>
<td>Leadership</td>
<td>mana (authority)</td>
<td>big man (authority)</td>
</tr>
<tr>
<td>Land and water for the next generation</td>
<td>Whatuangularo te tangata toitū te whenua</td>
<td>jo bakat fakar and capinmi fakar</td>
</tr>
<tr>
<td>The balance of life</td>
<td>mauri (life force), kaitiakitanga (guardianship environment)</td>
<td>concept of ja asamanam apcamar (concept of balance), jew (life spirit)</td>
</tr>
<tr>
<td>Ancestral spirits</td>
<td>ancestral spirits in carvings</td>
<td>ancestral spirits in carvings</td>
</tr>
<tr>
<td>Deities</td>
<td>atua</td>
<td>Fumeripits (supreme being)</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>mātauranga Māori</td>
<td>traditional knowledge</td>
</tr>
</tbody>
</table>

### 7.7. Conclusion

It must be acknowledged that the adoption of the Mauri Model, developed for use in Aotearoa, New Zealand, could be perceived by some a future mechanism of colonisation. However, while this is a possibility, it is unlikely, given the indigenous origin of the Mauri Model and its purpose as empowering Indigenous Knowledge on decision making. An assessment of the potential contextual relevance of the Mauri Model Decision Making Framework for Asmat, Papua has been conducted which established that;
1) Asmat can be described as a geographically defined region epitomising a sustainable and vibrant ecosystem within which the Asmat peoples co-exist in accordance with traditional lore that has evolved to a state of internal sustainability and balance, called ja asamanam apcamar.

2) In the more recent history of Asmat, the delta ecosystem and Asmat peoples are experiencing ever increasing impacts from external sources that are primarily originating from the developed western world. These impacts are experienced as the pervasive consequences of the ‘anonymous’ actions and decisions of the western world such as climate change, sea level rise, and global warming and also as the direct consequences of third party development within Asmat. These impacts now threaten the future survival of Asmat and the Asmat peoples, yet little consideration is given to the unavoidable consequences that these development plans pose for future generations of Asmat.

3) Assessment frameworks are now in use that facilitate more holistic understandings of the distribution of benefits and impacts resulting from physical resource extraction and development, and the drivers for the decisions that allow such progress to occur. The Mauri Model is one such framework that has been created for the Aotearoa, New Zealand context.

4) Aspects of the Asmat identity, defined by their cultural values and traditions, resonate with those of the Māori, the Indigenous Peoples of Aotearoa, and New Zealand. Therefore the basis for contextual relevance is reasonable and, once adapted to incorporate the Asmat terminologies associated with ja asamanam apcamar, the Mauri Model is considered a useful fit for holistic impact assessments in Asmat, Papua.

Glossary

1. Asmat

Aipmu or aypem : a half section of building in Jew
Amat-ow : we, the tree people
Ambirak : a water spirit with a beak -like a head
Amosus : sago hammer
Amos : Sago tree
As-amat : we, the tree people
Asmat ow capinmi : a place for living
Big man : one of the kinds of leadership in Papua.
Capinmi : land
Cewi: a part or section of a Jew which toward to headwater
Ci: canoe
Ci pokmbuy: feast of new canoe
Ci cemen: canoe prow
Dampu ow capinmi: a temporary or transitional place
Dat jumo, bunmar: rope costume mask from the clan of Simai
Dato, Biu: rope costume mask from the clan of Safan
Di: traditional dance
Doro, jiwawoka: rope costume mask from the clan of Emari Ducur
Em: drum or tifa (general in Papua)
Em cescu ipitjs: drummers
Etsjo: a human -like figure carving
Far: clans
Fumeripits: the supreme being who created the first people of
Imu fahet cescu ipitj: a person who tells a humour
Ja asamanam apcamar.: the concept of balance.
Jamasj: shields
Jew: a house for men (a long traditional house) or spirit
Jo bakat fakar and capinmi: a concept which ensure the rivers, the forests, and the
fakar, land are passed on to the next generation in a good
condition
Manimar: rope costume mask from the clan of Emari Ducur
Mbis: ancestor poles
Mbispokmbuy: feast of mbis pole
Mbi: water, it is also called bu
Mbu: a carving turtle in wuramon
Mboijir: a central fireplace in a Jew
Ndamud: wandering spirit when a person is sleeping
Ndapotokmbuy: feast of spirit mask
Ndet: mbi in several areas, is a spirit which comes inside the
child after its first birthday and gives personality and
uniqueness.
Okom: a singular Z shape creature (represented sea monster
spirit)
Osbopan: the malevolent spirit which lives in dark caves, trees, big stones, or inside animals
Pirpokmbuy: the feast of the Sago grubs which is prepared by
women by filling a 2.7m long hollow cylinder with grubs or larva from Sago palm as the main meal. At
the feast women dance on the transverse beam of Jew.
Po: paddle
Safan: heaven or home of ancestors
Sobenak cescu ipit: singers
Tareatakam cescu ipitsj: a person who tells traditional knowledge and lore
Tesmaypits: a leader of an aypem
Tsyem: a nuclear family house
Yuwus: the spirit imbued when a human was born
Yi-ow: the spirit of ancestor
Uripis: a part section of a Jew which toward to creek
Wair/wir: fireplace
Wuramon: a spirit canoe
Wow cescu ipits: carver

2. Indonesian

Dusun: a place in forest for gathering Sago
Kabupaten: Regency (see figure 1)

3. Māori

Atua: deities
Hapū: clans
Kaitiakitanga: guardianship environment
Mana: authority, power
Manaia: Bird headed man which is a symbolising the protective aspects of spiritual dimension.
Mātāruaunga Māori: Māori knowledge
Mauri: life force
Ngāti Pikiao: a sub branch of Te Arawa (naming tribe)
Taniwha: being who live in rivers, sea or dark caves
Tangata Whenua: People of the land
Tau utuutu: the principle of reciprocity
Waka: canoe

References


MANSOBEN, J. R. 1995. Sistem politik traditional di Irian Jaya, LIPI_RUL.


Chapter 8
Understanding the Differing Realities Experienced by Stakeholders Impacted by the Agats Municipal Water Supply, Papua

8.1. Introduction

This chapter analyses the sustainability of the municipal water supply in Agats Township, Asmat Regency. The introduction is in this section. Section 8.2 introduces the Agats Township and the problem of water supply. Section 8.3 explains the issues with the Local Government water infrastructure project implementation. Section 8.4 explains the methodology. Section 8.5 is an analysis of stakeholder value and quantification of worldview priorities. Section 8.6 is about the holistic sustainability assessment indicators and analysis and this continues to the conclusion in Section 8.7.

8.2. Agats Township

River Basin Management is one of the most complex and rapidly changing contexts of Resource Management today (Molle, 2009, Shmueli, 1999, Barrow, 1998, Downs et al., 1991). The combining impacts of historic land management, river basin modification and climate change associated sea level rise and storm event ferocity are creating engineering challenges that have not been previously recorded. Understanding the wider implications of infrastructure developments in river basins must then be an essential area of further investigation as these engineering interventions add to the complexity being created. This chapter shares a unique new evaluation framework that unravels this complexity and provides a means of integrating the myriad interconnected facets of knowledge required to understand the problem. The results are then portrayed as they are perceived by stakeholders holding opposing, views illustrating the influence of worldview bias in engineering decision making.

Agats Township located in the Asuwetz River Delta (Asmat Regency) of Papua. Agats Township is the capital of the Asmat Regency in south-western lowland Papua Indonesia (see Fig 8.1). Asmat is the largest tidal lowlands area of Papua and one of the largest alluvial swamplands in the world (Kar, 2013) having the attributes of a globally unique
ecosystem (Mawdsley and Houterman, 2010) because it stretches from the coast of the Arafura sea to about 200 Km inland to reach the first mountainside (Tommaseo and Lucchetti, 1992, Paoletti, 1995) and with significant cultural diversity (Giesen and Houterman, 2009). One of the UNESCO World Heritage Parks, the Lorentz National Park (Davidson, 1990, Asmat Government, 2011b, Asmat Government, 2012b), which is the largest protected area in Southeast Asia, is also located in this area together with other regencies (Papua-Government, 2013). The park is also the only “continuous transect from snow cap to tropical marine environment (Hawkins*, 2004). The tidal range of Asmat affects the delta up to 140 km inland from the ocean with a 25 km to 50 km wide mangrove zone (Giesen and Houterman, 2009, Mawdsley and Houterman, 2010) and a wetland that covers 80% of the total area (Asmat Government, 2011b). A water height with a minimum of 50 cm inundates this area at least three months in a year. A mixed swampy forest of Nipa and Sago Palms dominates the riparian margins in this area. The vegetation covers shallow to deep peat land, intersected by many rivers and streams (Paoletti, 1995, Simon, 1977, Smidt, 2013), creating the unique biophysical attributes of Asmat. The vast fluvial plain consists of more than one hundred waterways and several big rivers of over one hundred kilometres in length (BPS Asmat, 2013). The indigenous people of this muddy area are the Asmat People who are inseparable from water and rivers, as each clan lives around the river basins (Konrad et al., 2002) which influences their culture and life style, in such that a canoe is a daily part of their life, and they use the river waterways to manage the border of the “dusun” which is the ancestral domain of the Asmat People and it can also be a forest which provides food, and wood, etc. (Daeli, 2012). They also build their houses on stilts or in trees (Tommaseo and Lucchetti, 1992). The Asmat People have a culture of sustaining the balance in the universe; they believe in a consistency between human beings, the environment and the spirit of the environment (Schneebaum, 1990, Schneebaum, 2000, Schneebaum, 1988, Jimanipits, 2012, Koentjaraningrat, 1989, Konrad, 1981, Konrad et al., 2002, Goldbarth, 2006, Mansoben, 1995). Infrastructure development in Asmat is expected to proceed rapidly resulting in a population growth of 22.04% in Agats District due to immigration between 2005 to 2011 (BPS, 2012). As a consequence of the increase in population, the demand on natural resources and water has increased, especially in Agats Township.
Figure 8.1 The Location of Asmat Regency (BAPPEDA - Papua, 2012)
Figure 8.2 Asmat Regency (BAPPEDA-Asmat, 2012)
Agats Township is a part of Agats District (see Fig. 8.2) which is located along the coastal area of the Arafura Sea in the Flamingo Bay and along the Asuwetz River Delta (see Fig. 8.3).

![Image of Agats Town](image)

**Figure 8.3 Agats Town (Asmat Government, 2012)**

According to the Asmat Master Plan (Asmat Government, 2011a, Asmat Government, 2012b), tidal swamps in this region are divided to 4 zones; zone 1 (permanently inundated by water and influenced by high tide), zone 2 (seasonally inundated by water), zone 3 (the area used to be inundated), and zone 4 (no influence from tide). Agats Township is located in zone 1, so it is covered by water during tide rise, especially the areas along the rivers which are below the sea level. The tide rise is approximately 3 to 4 meters above sea level (Latief, 2005) and, according to local information, even up to 5 meters above sea level (AgatsBishop, 2014, Indonesian Government et al., 2011, Bigourdan, 2006) and 1.5 meters above ground level (AgatsBishop, 2014). Thus, this township is also known as the muddy town, and is an exotic place with no land to stand on and all roads are constructed using...
elevated wooden structures (Lubis, 2012). All construction is at least one or two meters above ground level. All houses, roads, fields, and schools are made from timber, giving the town a distinctive character (see Fig.8.4).

Figure 8.4 Geographical characteristics of the Agats Township (Wambrauw, 2012)

Recently a composite concrete bridge was built in this tidal zone, replacing several wooden bridges, showing how new ideas and methods of construction are arriving in the area. The only land transport is electric motor bikes and bicycles. The tidal range normally covers this area, and getting fresh water is a problem for residential occupancy. People cannot use surface water or ground water due to its brackish tasting character and, due to a lack of waste management for the area, it is polluted by solid waste and sewage.

A scoping survey (2012) established that the Asmat People used to take water from rivers or swamps for domestic purposes however, the spread of water pollution has made these resources inappropriate. Now, people depend primarily on rainwater from roof catchments which is supplemented by bottled water which is relatively expensive.
due to the difficulties associated with transportation. The Asmat People also maintain traditional practices that involve paddling canoes into the Nippa or Sago forest, called *dusun* sago, to collect fresh water from under the root systems.

Recently, assessments have developed around the world to assist decision making regarding the equitable distribution of benefits associated with infrastructure development. Societies face complex problems if only considering economic, technical, and environmental issues without considering the social-cultural context. Socially just decision making has developed around the world such as; in the UK where it is associated with climate policy (Bell and Rowe, 2012); and in urban planning in Portugal (Cardoso and Breda-Vázquez, 2009). The decision making approaches developed for complex socio-cultural contexts may be suitable for Papua which is rich in cultural diversity with more than 375 ethnic groups (Wambrauw, 2013) and more than 250 local languages (Mansoben, 2006).

An approach that includes cultural aspects is the Mauri Model Decision Making Framework (MMDMF) which is a unique sustainability decision making model that was developed in New Zealand (Morgan, 2006a). It has been used to assess some engineering contexts such as in water and environmental issues (Fa'aui and Morgan, 2014, Morgan et al., 2012b, Morgan, 2004, Morgan, 2006c, Peacock et al., 2012, Kawerau, 2012, Platia).

This paper will apply the Mauri Model Decision Making Framework in Asmat, Papua, to evaluate the water supply infrastructure decision making for the Agats Township.

### 8.3. Issues with the Local Government water infrastructure project implementation

The Papuan Government plans to improve the services of water supply in Papua as part of “*Spatial Planning Infrastructure, Papua Province*” (RIPI) between 2011 to 2031 (Papua Government, 2013), which divides the area into seven zones including the Asmat regency as part of Zone 6. In Asmat, the Local Government has developed the water supply in several areas including Agats Township (Agats District), Atjs District and Omor Village (Sawa Erma District). These districts have contributed to the Master plan of the Asmat regency, within which water issues have been considered by the Local Government at both regency and provincial levels.

The Local Government conducted a study analysing the water quality of several big rivers (Asmat Government, 2011a) including the Asuwetz River which is 122 Km length and 450 m wide at the estuary (BPS Asmat, 2013). The study concluded that there were two viable alternatives. The first was to pipe brackish water from the Asuwetz River which would require expensive treatment. The report (Asmat Government, 2012c) identified that water from the Asuwetz River would need advanced treatment due to the high levels of salinity. The second was to use the nearest potable fresh water source, the Yomot River (also known as Yombot or Yomat River/Swamp/Spring), which had been investigated since 2006. The alternative to source water from the Yomot River (see Fig 8.5) from near Yepem Village was considered more reasonable due to its proximity to Agats and the quality of the water available.

Figure 8. 5 the Clearing area to access the Yomot River (Asmat Government, 2012)
Figure 8.6  the intake from the Yomot River, in Yepem Village (Asmat Government, 2012)

Potable water supply infrastructure provision in Agats is difficult due to the combined challenges of transportation of materials, access, appropriately skilled workforce, and cost. Never-the-less, the project is proceeding. The project, involves two sources of funding, one from the national budget (Anggaran Pendapatan Belanja Negara/APBN) and one from the regional budget (Anggaran Pendapatan Belanja Daerah/APBD). The budgets which are allocated to the project which is scheduled to take from 2006 to 2031, can be seen in Table 8.1 along with the operating and maintenance costs estimated to be approximately IDR 400 to 500 million annually.

The water supply system has operated since 2010 with a water take of 10 litres per second (Hendrawan, authorised staff from Local Government, Personal Interview, 2012 and 2014). There are, however, issues with the current infrastructure solution and its implementation. These issues include; intermittent supply; availability of connections; plumb-out of housing and inconsistent distribution of benefits from the scheme. The water supply is planned to operate 6 hours/day during the long-term dry
season. In fact, the region has a high rainfall of 3000 to 4000 mm annually (Asmat Government, 2011c), even a previous study said the average rainfall reaches 4600 mm annually (Ponzetta and Paoletti, 1997) and, according to a field study (Wambrauw, 2012), the local people said at least every 2 or 3 weeks once in the dry season, they have a rainy day. However, the operation of the water service is normally only every two days, and does not flow during the rain. The distribution system for the water supply uses a branch system which is divided into 3 zones (see Fig.8.7) due to the capacity of water debit. Each zone flows for 2 hours.

![Figure 8.7 the three zones of water supply service (Asmat Government, 2012)](image)

Although the infrastructure has been in operation for several years, it still does not service the whole population of the township of Agats. In 2012, the water supply only serviced 25% of the Agats’s population, as reported by Kompas, a national newspaper (Daeng, 2012). By 2014 the service level was approaching 40% (Hendrawan, 2014). According to spatial planning from the Development Infrastructure of Papua (RIPI), the Local Government expects to service up at 50% of the population of Asmat by 2028 (Papua Government, 2013). The Local Government
had installed plumbing for 560 houses by 2012 (personal communication, 2012) and had increased the service to 1300 houses with 8 public hydrants in 2014 (Hendrawan, Personal Interview, 2014).

A picture of the water supply treatment plant can be seen in Figure 8.8
A study in 2012 identified that political issues has arisen and the plant had shut down due to unresolved land issues regarding the water source. A specific dispute involves compensation for customary land rights. The dispute showed that further negotiation between Local Government and the community was needed as inequities were evident in the project’s implementation including service levels, and which Agats communities were connected to the water supply. These political issues reflect a lack of alignment between the project implementation and the context within which the project was being carried out. Thus, the aim of this research is to assess the holistic sustainability of the solution for water supply in Agats, when using water from the Yomot River.
### Table 8.1 The Budget for the Project of Water Supply in Agats Township

<table>
<thead>
<tr>
<th>NO</th>
<th>Information</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
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<th>2014</th>
<th>2016-2020</th>
<th>2021-2026</th>
<th>2026-2031</th>
<th>Budget in IDR (Billion)</th>
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<td>Planning &amp; Infrastructure intake in Yepem Village &amp; reservoir in Agats</td>
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<td>(Hendrawan, Personal Interview, the authorised Local Government, 2012 and 2014)</td>
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</table>
8.4. Methodology

8.4.1. Research Approach

Earlier research (Morgan, 2006b) investigated the appropriateness of water treatment alternatives using the Mauri Model Decision Making Framework. The Mauri Model measures the sustainability of alternative infrastructure technologies incorporating indigenous people’s perspectives. When there is alignment between the traditional values and government policy this ensures the long term sustainability of the project. However, modernisation, changing power dynamics due to immigration, and gradual changes in ecosystems sometimes limit the influence of the indigenous people.

The economic and technology based approaches of engineering problem solving sometimes face insurmountable complexity in practice, when indigenous perspectives must be accommodated, especially in the areas where those indigenous peoples still live. Traditional and scientific knowledge understand and describe the infrastructure solutions in different ways. The research will use the Mauri Model Decision Making Framework to assess the sustainability of the solution, and provide a deeper understanding of the complexity inherent in this challenge.

As explained in Chapter 6 the research used PAR (Participation Action Research). Due to the limitation of resources and the time, to get the participation of the communities, only a key person was chosen to be involved in the research (the respondents can be seen in Chapter 6). The respondents were interviewed based on their interest, for example, if it was an issue that is related to the cultural sector, the interview was conducted with the elders of Asmat, several Asmat People and Catholic church members such Asmat’s Bishop, and pastors. To collect data relating to the development of the Asmat Regency, the researcher discussed this with the local government staff related to water management such as the Public Works Department, BAPPEDA (Regional Development Agency), the Forestry Department and the Cultural Department. Based on the interviews, small group discussions and questionnaires, the research could address the issues which are related to the water problem. The communities became involved in the research as resources of information. For example, the elders informed the researcher about the changes in life style or cultural values. This helped the research to identify and rank the indicators. An example how the data was collected can be seen in Figure 8.9
8.4.2. The Mauri Model Decision Making Framework

The Mauri Model Decision Making Framework (MMDMF) is a unique sustainability assessment approach that was developed in and for Aotearoa (New Zealand). The detailed explanation of this assessment is in Chapter 5.

8.4.3. The feasibility of using the MMDMF in Asmat

Previous research has established that aspects of the Asmat identity (Wambrauw and Morgan, 2014) defined by their cultural values and traditions, resonate strongly with those of the Māori, the Indigenous Peoples of Aotearoa, New Zealand. Both Indigenous Peoples have concepts of the environmental guardianship; kaitiakitanga (enhancing mauri of the ecosystem) (Morgan et al., 2012a, Robert et al., 1995) and yi–ow (guardian of sago) of the Asmat People (Koentjaraningrat, 1989, Mansoben, 1995). Māori have takarangi, the concept of balance and complementarily, while ja asamanam apcamar is the concept of maintaining the balance of life for the Asmat.
Asmat people also have a concept of land and water conservation for future generations called *jo bakat fakar* and *capinmi fakar* which parallels the belief *whatungarongaro te tangata toitū te whenua* for Māori. These parallels demonstrate reasonable alignment of thinking in relation to the environment indicating that the conceptual underpinning of the MMDMF can be substituted with Asmat ontology and epistemologies.

8.5. Analysis of stakeholder value and quantification of worldview priorities

To analyse the project, two stakeholders were chosen to represent those engaged with the project; Local Government and the Asmat People. In this case study, the worldview dimension priorities are calculated using a modified pair-wise comparison based on the Analytic Hierarchy Process (Saaty, 1980). The comparative importance between mauri dimensions ranges between -3 to +3 where the maximum score shows the most important of the mauri dimensions from the particular stakeholder’s perspective.

The weighting of the priorities uses assumptions based on the observation study (Wambrauw, 2012), the literature reviews, the primary data (questionnaire and interview). Table 8.2 shows the worldview priorities of the two stakeholders.

<table>
<thead>
<tr>
<th>Worldviews</th>
<th>The Local Government</th>
<th>The Asmat People</th>
</tr>
</thead>
<tbody>
<tr>
<td>The mauri of the ecosystem</td>
<td>14%</td>
<td>33%</td>
</tr>
<tr>
<td>The mauri of the tribe</td>
<td>17%</td>
<td>33%</td>
</tr>
<tr>
<td>The mauri of the community</td>
<td>44%</td>
<td>12%</td>
</tr>
<tr>
<td>The mauri of the economy</td>
<td>25%</td>
<td>22%</td>
</tr>
</tbody>
</table>

The results indicate that the community takes highest priority in the Local Government decision making followed by economic considerations. These two dimensions account for more than two thirds of the weighting in terms of priority. The ecosystem and cultural considerations are lower priorities. The result is consistent with the stated priorities of the development of the infrastructure of water
supply at provincial level which is focused on the community and economic purposes (Papua Government, 2013).

These priorities are reflected in the behaviour of Local Government. The Local Government always attempts to solve the water problems in Agats town with some alternatives, even though the cost of the infrastructure is expensive due to the difficulty of mobilising material. As there are no heavy vehicles human power was used to carry everything. The distribution pipes have been installed around the government offices and the houses of the staff who work for the government and the houses of the community in some areas. Some areas have not been installed because of waiting for the state budget and the lack of water debit. The Local Government have made a plan to install an area around Agats Township according to the annual allocation of the regency budget (Asmat Government, 2012a, Asmat Government, 2012b, Papua Government, 2013), this places economics as the next consideration.

At the same time, the Local Government has to share the budget for other infrastructure such as the water supply in District Omor (debit 2 litre/second) and District Atjs (4 litre/second), and the construction of the concrete bridge which was the replacement for the wooden bridge. The release of the customary land rights also have been paid for at IDR 3 Billion (approximately 0.3 Million US dollar).

Even though culture and the ecosystem are put down as the two last priorities, those dimensions are still involved in the Master Plan of the Regency which states there is consideration for the sustainability, balance and harmony in its development to enhance the peoples’ wellbeing and security. As explained that the motto of ja asamanam apcamar, or keep in balance influences the local policies. The Local Government also supports the Cultural Festival every year and is keeping some of the wooden bridge town as its unique identity. For the ecosystem, the government are collaborating with the WWF to restore some critical areas (Mawel, 2013).

From the Asmat people’s perspective, the culture and the ecosystem are the most important priorities and this high priority is reflected by their two thirds combined weighting. The economic and the community considerations are lower priorities. As the indigenous people, the Asmat People are an inseparable part of nature. The Ecosystem shapes their culture and the culture respects the environment. For example, due to the primarily saturated and inundated condition of the geographic area, the Asmat people use canoes as a basic tool of life. A canoe (ci) is used for
fishing, hunting, and gathering. If they say “ci opak, jis opak” it means no canoe, no firewood. They need the canoe to go to the dusun (forest) which provides all their needs including firewood, food, and the components for feasts (Daeli, 2012). This defines how the same importance is given to the environment and the culture from the Asmat People’s perspective. Water (mbu, local language) possesses cultural attributes that are essential in facilitating the growing of the child to become an adult (Personal Interview, 2012). The Yomot River location for the water supply has traditional value for its people; it is a sacred place, called Cifa Bambu.

Inevitably, the increase of the population of Agats town affects the demand on the water resource. The people whose livelihoods are located within the Yomot River Ecosystem have allowed sharing of their water resource with the consequence that there is compensation in the form of a payment for the land right. However the way of life of the Indigenous People is changing in that they cannot depend to the same extent upon nature because they now have to compete with other outsiders in order to survive. Thus, while the economic and community dimensions are still considered to be the lesser priorities, the historical underpinnings of the Asmat way of life, the Yomot River Ecosystem, are under threat of significant denigration. This is the level of denigration that could lead to a change in the way of life of the Asmat People including their food storage systems and diet.

8.6. Holistic sustainability assessment indicators and analysis

To analyse the project indicators related to impacts on the mauri the four dimensions of sustainability are chosen which will be considered in the context of Asmat Regency. The Local Government proposed the provision of a water supply infrastructure for Agats Township using water from the Yomot River (Asmat Government, 2011b, Asmat Government, 2012b, Daeng, 2012), and the construction commenced in late 2006. Five year time intervals are used in this analysis, starting from 2006, to align them with the Regency Master Plan 2011 to 2031, and the Spatial Planning of the Development Infrastructure of Papua (Penyusunan Detail Rencana Induk Pembangunan Infrastruktur Propinsi Papua (RIPI) 2011 to 2031)) (Asmat Government, 2011b, Papua Government, 2013).

The economic indicators are the cost which is related to project construction and maintenance, and the contribution of the project to the economic sector. The community indicators are chosen to reflect the social conditions including
happiness, which is adopted from the study of Melanesian indicators (Tanguay, 2012).

The ecosystem indicators are chosen to best reflect ecosystem attributes affected by the project. The cultural indicators are chosen based on the local conditions including the concept of balance, the concept of sustainability and traditional values. These indicators are applied in Figure 8.10. The indicators are ranked using the mauriOmeter on an integer scale from -2 to +2. Scores are determined using an assessment sequence that determines the impact on mauri (zero result if no impact), as positive or negative, and partial (1) or full (2), with a positive result implying a sustainable outcome. The integer scale is deliberately coarse providing a universal measurement approach for all indicators. Indicator scores are based on research data including interviews, the literature survey, field observations (2012) and the existing conditions during the research. After averaging the indicator scores within each dimension, the trends can be determined over time (5 year intervals) and plotted on two axes. The vertical axis represents the average dimension mauri score while the horizontal axis is time. The plot of the mauri score over time for each dimension provides an understanding of the trajectory for that dimension and helps identify long-term trends.

The mauri against time plot also provides the opportunity to measure areas confined by either the curve or the x axis or alternatively the area confined between the curve and the initial mauri score for that dimension (or a target or policy threshold established independently). The area confined between the mauri curve and the horizontal axis (x = zero) represents the net cumulative impact on mauri; the areas below the horizontal axis measure negative cumulative impact; the areas above the horizontal axis measure positive cumulative impact. This net quantification of mauri-years represents the inherent resilience change that occurs over time. The quantification of the real cumulative impact, the area confined between the curve and the horizontal line with the initial mauri dimension score is the real cumulative impact and represents the total impact accrued or, conversely, the total mauri-years that must be accrued over and above the initial mauri state to return the system to its original mauri state. For this analysis the net impact upon mauri is being determined, that is the diminished resilience or conversely the enhanced capacity within any particular dimension. To simplify the calculation of these areas of the impact on
mauri, the area is divided into sections as interval time (5 years), and the integration result of the linear function of the curve shows the impact area. The equations below (Eq. 8.1 and Eq. 8.2) are used to determine the area of the impact on mauri.

\[
A = \sum_{n=1}^{n} A_n 
\]

(8.1)

\[
A_n = \int_{x_1}^{x_2} f(x)n 
\]

(8.2)

Where:

- \(A\) : the total area of the impact on mauri
- \(A_n\) : the area each section
- \(n\) : sections
- \(f(x)n\) : the linear function of each section
- \(x_1\) : the beginning year
- \(x_2\) : the last year

**The mauri of the whanau (economic dimension)**

- Survey and planning
- Scheme construction cost
- Distribution system (connection to household)
- The cost of increasing the capacity of intake
- Operation and maintenance
- Growth Domestic Regional Product
- Job opportunity
- Trade and economic activities
- Income from payment for water services

**The mauri of the ecosystem (environment dimension)**

- Ecosystem changing
- Reducing biodiversity - number of fish, and crocodiles.
- Pollution in water column
- Land use change
- Protected forest area (conservation)

**The mauri of the community (social dimension)**

- Potable water supply
- Health and sanitation
- Consuming of bottled water
- Population of migrants (population increase)
- Happiness

**The mauri of the tribe (cultural dimension)**

- Ancestral spirits and sacred places
- Jo bakat fakar and capinmi fakar (lands and rivers belong to the next generation)
- Asmat Language (relevance)
- Customary land rights
- Sanitation and housing for villagers
- Relevance of traditional values and belief
- Life style

Figure 8. 10 The Chosen Indicators
The results of overall assessment of the impact upon all dimensions can be seen in Table 8.3.

**Table 8.3 The Ranking Assessment of the Mauri Indicators**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators</th>
<th>2006</th>
<th>2011</th>
<th>2016</th>
<th>2021</th>
<th>2026</th>
<th>2031</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey and Planning</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Construction Cost of the intake and the reservoir</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Distribution system (connection to household)</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>the cost of increasing the capacity of intake</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Operation and Maintenance</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>GDPR (Growth Domestic Regional Product)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Trade and economic activities</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Payment for water service</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>-0.22</td>
<td>-0.11</td>
<td>-0.11</td>
<td>-0.11</td>
<td>0.00</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Potable water supply</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Personal within household</td>
<td>-1</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Consuming of bottled water</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>population of migrant people</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Happiness (water availability for washing)</td>
<td>-1</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>0.2</td>
<td>0.4</td>
<td>0.2</td>
<td>0.6</td>
<td>1</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Ancestral spirits and sacred places</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Jo bakar fakat and capnim fakat</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Asmat Language practised in Agats</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>Customary land rights</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Traditional values</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Sanitation and housing for villagers</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Life style</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>0.86</td>
<td>0.71</td>
<td>0.29</td>
<td>0.29</td>
<td>0.29</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>Ecosystem integrity</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Reducing number of fish, crocodiles</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Pollution in water column (increase in waste water)</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Protected forest area – modification for access</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Land use change (Urbanisation, expansion of Agats Township)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>1</td>
<td>0.4</td>
<td>0</td>
<td>-0.4</td>
<td>-0.8</td>
<td>-1.2</td>
<td></td>
</tr>
<tr>
<td><strong>Total Average</strong></td>
<td>0.159</td>
<td>0.151</td>
<td>0.084</td>
<td>0.084</td>
<td>-0.011</td>
<td>-0.087</td>
<td></td>
</tr>
</tbody>
</table>
8.6.1. The mauri of the economic dimension

The economic dimension shows (see Fig. 8.11) that at the beginning of the project, the area of mauri is negative at 2.23 mauri years, and, in 2026, it turns to be positive at 0.5505 mauri years, with the total of negative 1.6725 mauri years over the 25 years period. The trend reflects the government decision to put significant investment into infrastructure construction and customary land rights as well as operations and maintenance costs. This shows the commitment of the Local Government to develop the area of the District of Agats. Based on the master plan (RTRW) of the Asmat Regency (Asmat Government, 2011b, Asmat Government, 2012b), the District of Agats is one of the areas which is to be developed as an economic zone. So the infrastructure, including the water supply, is necessary to support the goal. The spatial planning for Papua’s Infrastructure also has included the water supply project in Agats Township (Papua Government, 2013). Even though the water supply has not contributed directly to the economic sector yet, according to the GRDP of the Asmat regency, the economic growth rate of Asmat fluctuated during the period of 2007 to 2011, but is now showing signs of growth. Based on the statistical data (BPS, 2012) in 2011 from the subsector, water supply and electricity contributed only 1.27% of GDRP, and only from the electrical sub sector. Nasution (2013) discusses how the economic growth of the Asmat regency is positive, except for the sectors of

\[ \Delta \text{area (A)} = -1.6725 \text{ mauri years} \]
electricity, gas and water. If the water service improves the Local Government can get the customers to pay for water they use but they have not decided yet when the payment will be collected. If the water supply infrastructure works well, it modifies the impact of the sector to being nett positive. If the water supply can operate continuously, many water problems can be solved, and this will result in increased immigration to Asmat.

The infrastructure can also enhance the tourism opportunities of Asmat. As of now, the economic activities are dominated by outsiders (Asdiana, 2013, Hardanto, 2012), which proves that the population increase has meant that the economic activity has also improved. So, even though the total area of mauri years over 25 years is negative, but the turn to be positive after that shows it will foster the achievement of Agats as an economically strategic zone of the Asmat regency.

8.6.2. The mauri of the community dimension

![The mauri of the community](image)

**Figure 8.12 the mauri of the community**
The projected impact on the mauri of community is greater (see Fig.8.12). Based on the calculation, the total area of enhanced mauri for the community is +7.5 mauri years. It shows the overall impact of the mauri is positive. Although, at the beginning of the project, the mauri of community was negative due to the delay in the project implementation and inequities regarding access and service availability, the potable water supply should reduce the need to buy the bottled water or reduce total dependence on the rainwater catchment. The project enhances the happiness of the people. The water supply was limited; such that if there is no rain, there is no water. The government has done its best to implement the infrastructure project to provide water; however the service still has not met the needs of the entire community. Journalists such Hariyadi (2013), Mambor (2009) and a journalist in Radar-Merauke (2008) noted the availability of the water is still a problem; and that the community still depends on rainwater. However, once the water supply infrastructure can operate properly, the project may impact positively on the community. Several benefits will be improved sanitation, reduced costs associated with bottled water, and an increased the quality of life due to increased time for other activities. Based on the analysis, the social dimension turns positive after, approximately, 2014, because the Local Government are planning to increase the quantity of the water supply and distribution (see Table 8.1). The population of Agats increased significantly, during the period of 2005 to 2011, and the population growth rate of the Asmat regency overall was 2.99 %, with the highest rate in Agats at 22.04 % (BPS, 2012). It shows that Agats Town has attracted outsiders to live there. Thus, the population will increase if the water service in Agats is improved.
8.6.3. The mauri of the environmental dimension

The ecosystem mauri is impacted negatively. The area impacted by the project is protected forest. The demand for water from the river causes a changing land use. To minimise the destruction of the forest, the Local Government needs to manage this well. The mauri of the ecosystem is shown as continuing to decrease after 2016. The construction of the project diminishes the forest, including vegetation. Disturbance of the natural vegetation had an influence on other species like fish and shrimps.

The increase in the number of fibreglass boats causes water pollution and over-exploitation of the springs can foster the intrusion of salt water. To anticipate and avoid this condition, the water demand and consumption has to be calculated properly as the planned that water debit will be increasing gradually. Kamun, (2010) stated that the Yomot River which 3 meters in depth has a capacity of 2,302,140 m$^3$. So the service has to consider the balance between the water demand of the Agats people and the capacity of the swamp. Changing the land use and hydrology will affect the natural habitat of the species around the fresh swampy forest. The analysis calculates -4.5 mauri-years of resilience are diminished over the project analysis timeframe. This can cause more negative impacts to the ecosystem. These days Asmat areas have faced the impact of climate change and global warming (Bobi and Mampioper, 2010). Some effort has been made by the WWF and the Local Government to assist the recovery of the ecosystem in critical areas of the Asmat Regency, including Yepem.
Village, by planting mangroves, which is documented in the Suara-Pembaharuan (2013). Informed by traditional stories (Sonokos, A.T, personal interview, 11 Dec 2012) Agats’ once sandy land has changed to be a muddy area, and the community (the Asmat People and outsiders) believe that this change coincided with the ‘shooting of Pastor Jan Smith’ on 28 January 1965 (Arsdale, 1975). This shows that there is a change in Agats ecosystem, which is related to deforestation and opening the forest for settlement.

8.6.4. The mauri of the tribal dimension

![Graph of mauri of the tribal dimension](image)

**Figure 8.14 the mauri of the tribal dimension**

Although the mauri of Asmat Peoples is the most positively impacted when considered in terms of total impact, the trend is negative. The net cumulative impact is determined as more than 5 mauri years, which is only because at the beginning of the project the compensation and facilities were provided by the Local Government. The actual change is a delayed one and the impact will be more enduring than that upon the ecosystem which has a greater inherent capacity to accommodate the changes that have taken place. The real change, as experienced by the Asmat, is significant (Arsdale, 1978, Dobratz, 2008, van der Zee, 2010) and is not recovered over time.
At the commencement of the project the mauri dimension is positive due to the continued practices and relevance of the traditional values. Asmat people who live in the Yepem Village believe that the place of water is a sacred place called Cifa Bambu. There is a traditional story behind the Yomot River which describes the love of a mother for a daughter, and the river is named for the first spirit, Yombotsimbit (Kaspar Manmak, 2008). The appropriate respect of the ancestors impacts positively toward the maintenance of the cultural dimension. The position of the intake in that sacred place is considered to negatively impact upon the value and integrity of the sacred place. The forest will be logged which also impacts on the cultural dimension. The Asmat believe water, or ‘mbu’ in local language, is an integral part of the culture and ecosystem. Asmat people believe the landscape and nature like rivers, trees, animals are associated with humans in an interdependent way (Jimanipits, 2012, Kaspar Manmak, 2008).

Inevitably, the consequence of the water supply infrastructure development has positive and negative impacts. One of the negative impacts is the denigration of the traditional values of the indigenous people. The intrinsic value of the place will decrease if all stakeholders do not act to maintain the intrinsic values embodied in the past management of the site. As explained, nature and the Asmat people are inseparable. The people believe that they can drink directly from the river without thinking of the health aspects because they believe that their ancestors will give them immunity (Personal Communication, 2012), but the increase of population has related increased water pollution, so people have no confidence in using the water anymore. The increasing population also contributes to changing practices impacting upon the traditional Asmat values. Several activities which replace traditional values such as the replacement of bamboo by plastic buckets and the use of fibreglass boats replacing traditional canoes (Hardanto, 2012), all erode the integrity and, as known, canoes have important meaning for the Asmat people (Daeli, 2012). Previously, the river sustained 142 families, who lived in Yepem village, however now they have to share with others. The concept of *jo bakar fakat* and *capinmi fakat* means the land and river belong to the next generation and if this cannot be honoured the mauri of the ecosystem will be diminished. The analysis shows that the reduction happens after 2023. To measure the impact of the project the areas above and below the calculated axis are determined. The net area is + 5.718 mauri years, and means the
impact is positive, however, the long-term period may bring a reduction of the cultural values. There is a lot of potential for the culture to develop in the Asmat Regency (Prasetya, 2013) including the economic value of carvings (Risser, 2014). Thus it is important for the Local government to maintain the culture to develop the area.

8.6.5. The average of the mauri dimensions

![The average of the mauri dimensions](image.png)

\[ \Delta \text{area (A)} - \text{thresholds 0.2 = +2.04543 -0.28418 -0.1*25 years =-0.73875 mauri years} \]

**Figure 8.15 the average of the mauri dimensions**

Based on the analysis, the areas of the tribal and the community dimensions have positive impacts, while the mauri of the economic and the ecosystem dimensions are the antithesis for these results. Figure 8.15 plots the curve for the average of the equally weighted dimensions which calculates the cumulative impact upon the four dimensions. The positive impacts on the mauri of the community and the mauri of the cultural dimension show the relevance of the project to the provincial government’s (2013) concept of the development of water supply infrastructure, and that the water supply infrastructure should meet the basic needs of the community and foster the economic growth of the area. However, the cumulative impact for all dimensions illustrates a reduction of mauri, specifically – 0.73875 mauri years. The negative impact on the averaged mauri dimensions shows the project is unsustainable over the period of 25 years giving a negative trend. This is even for the cultural dimension which shows positive because of the effect of the customary land rights. However, this only benefits this generation, if it is evaluated longer the result will be negative. It is shown by the negative trend from Figure 8.15. The result of the evaluation of the
project does not achieve the goal of the Indonesian Water Law No 7, 2004, (Indonesian Government) which states that the water management should be integrated and sustainable. The analysis should be evaluated for sensitivity to worldview bias using the quantifications of worldview determined earlier. The results of the impacts of the mauri adjusted for stakeholder perceptions are plotted in Figure 8.16. The result shows the average combined mauri remains negative until almost the end of the analysis period of 25 years. The Local Government and the Asmat People understand this gradual negative trend differently, as can be seen in Figure 8.16. The worldview quantification in Table 8.2 is used to modify the gradual negative trend to better represent the understanding of the different stakeholders shown in Figure 8.16. The two plots in Figure 8.16 illustrate the validity of the decision made by the Local Government to implement the water supply infrastructure solution. The average mauri during the analysis period diminishes from 0.040 to -0.087. As explained, the trends modified for the sensitivity analysis of the two stakeholder worldviews show opposing trends. The trend understood by the Asmat people is more pronounced in a negative direction and the trend for the Local Government is positive. For the Asmat People, there a decrease of the mauri from 0.459 to –0.408 equal to –0.967, while, the Local Government perceives an enhanced mauri from -0.218 to 0.327, equal to 0.545. Therefore the perceived cumulate impact of the water supply infrastructure scheme can be represented as the area (perceived) diminished or enhanced over 25 years analysis from the calculation below (Eq.8.3 and Eq.8.4).

\[ \text{Area of the Asmat People} = \sum_{t=0}^{25} (\text{mauri}_t \times 25) \text{mauri years} \]  \hspace{1cm} (8.3)

\[ = (-0.967 + -0.127) \text{mauri} \times 25 \text{years} = -24.8324515 \text{mauri years} \]

\[ \text{Area of the Local Government} = \sum_{t=0}^{25} (\text{mauri}_t \times 25) \text{mauri years} \]  \hspace{1cm} (8.4)

\[ = (0.545 + -0.127) \text{mauri} \times 25 \text{years} = 10.45634921 \text{mauri years} \]

The mauri of the tribal dimension and the mauri of the community dimensions are affected positively during this time frame. However, after doing the sensitivity analysis, the infrastructure project will diminish the mauri of the Asmat People while it enhances the mauri of the dimensions most important to the Local Government.
This represents a transfer of “well-being” / mauri over 25 years. The calculation shows almost 50% of the period of 25 years, the Asmat people lose the mauri, and it worse over the longer time line, not only the for the culture but the ecosystem has been changed too which is shown in such as previously Agats Township was sandy and has now turned into a muddy town.

Figure 8. 16 Sensitivity Analysis for both Stakeholders

The Asmat People have been experiencing a fast change since contact with outsiders during the Dutch Colonial period, and this has continued under the Indonesian
Government (Arsdale, 1978, Asdiana, 2013, Dobratz, 2008, Hardanto, 2012, Konrad et al., 2002, Risser, 2014, UNDP_Almamater, 2005, Stanley, 2007) for both positive and negative changes. The changes include the cultural values and the ecosystem. They have change how they dress (van der Zee, 2010), their carvings have come to serve economic purposes and their way of life is changing. They now prefer using fibreglass boats rather than canoes (Hardanto, 2012). Agats Township has changed dramatically since Asmat became a new regency (n/a, 2002), as a study done in 2010 states (de Hontheim, 2010) that in 2001 the area was still a remote village, but by 2004 a lot had changed in the landscape, especially with a new settlement area for government officers. In the same year, approximately 23 Ha of customary land area was released to the Local Government (ibid 2010). Local people also cannot compete with outsiders in economic activities nor are they able to work as government officers, so there is controversy with the migrants (Asdiana, 2013, UNDP_Almamater, 2005).

Inevitably, development of the Asmat Regency should be done to catch up with other regencies, and change cannot be avoided. The main purpose of the water supply project is to provide a social welfare benefit for the whole community, however, it still has to be achieved with equitable distribution for all people. As explained before, the zones in the urban centre of Agats, divide the town into 3 parts in which most of the population are migrants or are areas with government officer’s houses, while most the Asmat People live in suburbs in Syuru Village (see Fig 8.17) which is 10 to 15 minutes’ walk from the centre town and they do not get a water supply. Even with this, there is a positive impact upon mauri according to the Local Government perspective, although the actual outcome is not positive because water cannot be available all of the time for all of the community (Hariyadi, 2013). Thus, the Local Government has to complement the infrastructure using other solutions. For example, the Asmat area has huge potential for rainfall harvesting, so the government could develop methods to maximise the collection of rainwater, as has happened in other places (Jha et al., 2014, Mbilinyi et al., 2005, Wilbers et al., 2013). To increase the mauri Local Government can take contributions from the community which influences the GRDP but this not being done in Agats. To offset the lost mauri-years of impact upon the Asmat People, the Local Government should consider the Indigenous people who live around the Syuru Village, the village between Yomot
River and Agats Town, because the main distribution pipe passes by this village but the pipes for distribution to Syuru Village still had not been installed (see Fig. 8.7) when the observation of this research was conducted in 2012. The observation also showed that there is no adequate sewerage system, as the waste water discharges straight to the ground which pollutes the surface water. Thus the Local Government should improve the sewerage system too in order to enhance the mauri of the ecosystem. The final analysis of the Mauri Model Decision Making Framework is to display the results on the mauriOmeter in the following figure.

**Figure 8.17 the mauriOmeter result**

So the mauriOmeter analysis of the Asmat people's perspective is consistent with the equally weighted analysis and shows a negative trend, which means the infrastructure project is unsustainable. The MMDMF assessment shows that the project is not sustainable from the Asmat People’s perspective, but it is considered sustainable by the Local Government.

**8.7. Conclusion**

The result of the Mauri Model Decision Making Framework shows that taking water from the Yomot River for water supply in Asmat is not sustainable and this is most emphatically understood from the Asmat People’s perspective, but it is considered sustainable by the Local Government. The project benefits the social and cultural dimensions, while the environmental and economic dimensions are diminished. For a better solution, it is important to involve the indigenous people in any decision making which impacts on their land in the future. Further negotiations between the
Asmat People and the Local Government are required to ensure the sustainability of the culture and ecosystems of Asmat Regency.

To uphold the principle of natural justice and duty, it is necessary to recognise the legal obligations placed upon the Local Government and future effort is necessary to ensure the benefits are equitably distributed, as an example, providing public hydrants. Finally a monitoring process should be established that evaluates the impacts of the water supply infrastructure project in 2014 and 2016 when decisions to increase the water take are to be confirmed. This evaluation could be undertaken using the Mauri Model and the indicator set created for this analysis.

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Chapter 9
The Feasibility of Transferring the Mauri Model Decision Making Frame Work to the Merauke context

9.1. Introduction
The purpose of Chapter Nine is to explain the feasibility of transferring the Mauri Model Decision Making Framework (MMDMF) to the context of the Merauke Regency because this framework will be used to assess water resources management in the regency. The process will be explained in Chapter 10. This chapter consists of eight sections. After the introduction the second section describes the background to the importance of transferring this framework to the context of the Merauke Regency. Section 9.3 explains the objectives of this chapter. Section 9.4 introduces the Malind Anim, the majority tribal people of this regency, with Section 9.5 describing the geo-cultural landscape concepts of the Malind Anim. Section 9.6 examines the epistemology and ontology of the tribe, followed by the seventh section which discusses the parallels between the Asmat People and the Māori People from New Zealand. The last section will conclude this chapter.

9.2. The Background
Papua is the largest province in Indonesia having an abundant biodiversity (Wilujeng, 2010) and unique ecosystem, and is rich in cultural diversity. Papua has a minimum of 269 ethnic groups and 269 living local languages (Mansoben, 2006) and has 1,068 clans (BPS 2010). Probably, Papua has had more local languages, but they have disappeared because of a lack of users. To accelerate development of this area, Papua Province was divided into Papua and Irian Jaya Barat Provinces, based on the Indonesian Government Law no 45 1999 (Wambrauw, 2013), and, officially, the Irian Jaya Barat (West Papua) province was formed in 2004. Since integrating into Indonesia 1963, there have been a lot of changes in Papua, especially in the spheres of culture and the rights of the Indigenous People of the Land of Papua (Sumule, 2002). The special autonomy Bill for the Papuan province, based on regulation UU, No 21 in 2001 (Indonesian Government, 2001), and another for West Papua, based on regulation UU, No 35 in 2008, were passed by the Central Government to develop the area and give rights to the Indigenous People to their own land. Thus the cultural aspect of the society
should be considered in all the policies for this area. The Provincial Government produced a map (see Fig. 9.1) which shows the five cultural zones of Papua Province (Papua Government, 2013) based on the geographical areas, which are: Mamta, Saerari, Ha Anim, LaPago, Mee Pa Go. The third zone, Ha Anim, is located in the southern lowland of Papua, and encompasses Merauke, Asmat, Mappi, Boven Digul Regencies. This area is the focus of this research.

![Figure 9.1 the Cultural zones of Papua Province](image)

The majority tribal peoples of the Merauke Regency are the Malind Anim who live together with other tribes including, the Muyu, Yagai, Mandobo, and Asmat (Boelaars, 1986, Meteray, 1972). As the major tribe, the Malind Anim have been faced with changes since the their first contact with outsiders in the 1900s (Overweel, 1993, Corbey, 2010, Meteray, 1972, Kuruwaib, 1993) when the Dutch established Merauke Town on 14 February 1902. Other major changes include the influence of the catholic missionaries (Pusat Katolik, 1969, Pusat Katolik, 1967), and the transmigration programme of the 1960s (Obidzinski et al., 2014, Gietzelt, 1989, Fearnside, 1997). Recently, there has been significant interest in the potential of the lowlands in Papua which have been focused on development, especially for agricultural purposes (Ginting and Pye, 2013, Ginting and Pye, 2011, Manikmas, 2010, Obidzinski et al., 2013,
Lamonge, 2012). However, if the government proceeds with development in an unsustainable way, it will create complex and potentially irreversible problems. The problems will be not only to the environment but also the impact on the Indigenous People of this area. To minimise unsustainable development, an assessment of local conditions should be applied in this region.

Earlier work has shown that significant aspects of Asmat Culture (Agats Indigenous community) resonate with the Māori of Aotearoa, New Zealand (Wambrauw and Morgan, 2014) which has found that the Mauri Model Decision Making Frame Work can be applied in Asmat, Papua. These findings indicated that it is feasible to transfer an evaluation tool, which was created specifically for the New Zealand context, to other places like Papua.

The Mauri Model Decision Making Framework is a unique sustainability decision making model developed in New Zealand (Morgan 2008) which involves the concept of Māori culture, the Indigenous people of that Nation. The decision making tool was developed based on the concept of “mauri “which is the binding force between spirit and substance to enhance life and wellbeing (Morgan 2005, Morgan 2006b, Morgan 2006a). The framework has been applied to engineering case studies to assess problem-solving in complexity. The framework measures four dimensions of wellbeing as the basis of sustainability: the mauri of the ecosystem (environment), the mauri of community (social), the mauri of whanau or family unit (economic), and the mauri of hapū (culture).

It is important to develop an assessment process to measure sustainability based on the Indigenous People’s perspective and which involves their culture. Therefore, this research will focus on the feasibility of transferring a decision making support process which was developed in Aotearoa, New Zealand and which has been applied to Asmat to Merauke.

9.3. The Objectives
The purpose of the research is to compare in parallel the Asmat Tribe and the Malind Anim in southern Papua, in order to check the feasibility of using the Mauri Model Decision Making Framework (MMDMF), which was developed in and for Aotearoa, New Zealand. The MMDMF has been applied to measure the sustainability of a project, the supply of water to the Agats Township. If it is feasible, the MMDMF will apply to
measure the sustainability of the mega project the Merauke Integrated Food and Energy Estate (MIFEE) project.

9.4. The Malind Anim

The Malind Anim, a traditional hunter gatherer tribe from southern Papua (Boelaars, 1986) which occupy the Trans-Fly Region, is also known by several names, as explained in Table 9.1.

**Table 9.1 Name variations for the Malind Anim tribal peoples**

<table>
<thead>
<tr>
<th>Name</th>
<th>The Explanation</th>
<th>Resources use the names of the tribe</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Malind Anim</td>
<td>The original name of the tribe</td>
<td>(Wattimena, 2013)</td>
</tr>
<tr>
<td>Tugeri</td>
<td>This is used in the eastern neighbourhood (Ernst, 1979). The British used this name for the transfly people and the Torres islanders</td>
<td>(Ernst, 1979, n/a, 2004, Prasetya, 2013),(Hitchcock, 2009)</td>
</tr>
<tr>
<td>Kaya kaya</td>
<td>This name was given by the outsiders who come with a ship in 1902. At the time the Malind Anim came out to the ship in the Maro river to welcome them, saying “kaya kaya”, which means friends, but the outsiders thought that their name was kaya kaya</td>
<td>(Woosnam, 1907, Frazer, 2013, Frazer, 1995),(Hitchcock, 2009, Meteray, 1972, Kuruwaib, 1993)</td>
</tr>
</tbody>
</table>

The name Malind Anim is the most popular with the name the Marind Anim being used in scholar reports. Even the Malind Anim accept it if people call them the Marind. This originally occurred because of how outsiders, especially the Dutch during the colonisation period, heard the word and transliterated it. However, this tribe call themselves the Malind Anim. The word anim means men or people, and in the Malind language the word for a man is anem and anum is for a woman (Jan van Baal, 1966). Malind is originally from the word “mayo” or “maloh” which means important or sacred, so the Malind Anim are people who have “Mayo” culture, and who inhabitant the Ha Anim area (see Fig 9.1) (Wattimena, 2013). Based on local information (Personal Interview, 2014), Malind also means real human, and when any outsiders
come they are called Pu Anim which means strangers, or straight hair (Kameubun et al., 2013), and those who bring a gun (Personal Interview, 2014), or the voice of gun (Meteray, 1972).

The Malind Anim tribe occupy a vast territory in Merauke in southern Papua at the border of Indonesia and PNG (Papua New Guinea), meaning that both of these countries are their traditional lands. In the area which belongs to Indonesia, the Malind Anim, including their sub tribes, occupy almost the area of the Merauke Regency. According to an unpublished paper “Marind dahulu dan sekarang (The Marind in the past and present) the coastal area of the Malind Anim starts from Kondo Village in the district of Naukenjerai and stretches to Toor Village in the District of Waan, while in northern border is from Bupul Village in Elikobel district to Wanam Village in the district of Ilwayah. (See the map, Fig 9.2, which uses arrows to show the villages). The popular main resource for the Malind Anim is Jan van Baal (Jan van Baal, 1966) who describes the territory of the Malind Anim very clearly (see the Fig. 9.3). Thus it can be seen that the area of the Malind Anim in Indonesia’s territory starts with the sub tribe Kanum Anim at the eastern border (see Fig. 9.3) with the first village in Kondo (see Fig 9.2 and the arrow at the lower right side). All the coastal area in the regency belongs to the Marind Anim (see Figure 9.2 and 9.3). At the western side, the boundary starts from the southern entrance of the Marianna Straits (Muli Straits) and stretches approximately 15 miles eastward, around 24 kilometres (Overweel, 1993, Jan van Baal, 1966). Other sources state the boundary is up to 30 miles. (Kooijman, 1960, Verschueren, 1970). In the north they occupy an area up to the Bian River Basin (see Figure 9.3 and 9.4). In the hinterland (see Figure 9.3 and 9.4) they occupy areas along the big rivers including the Maro (Merauke) River, Bulaka River, Kumbe River, Bian River, Fly River and to the east of Kimaam Island (Indah and Didi, 2013, Kameubun et al., 2013, Johns et al., 2007).
Figure 9. 2 the Administration Map of the Merauke Regency (Merauke Government)

= the key points of the Malind Anim
Figure 9.3 The territory of the Malind Anim, is from (Jan van Baal, 1966).

This resource shows the area and the sub tribes clearly.
Figure 9.4  the River Basins in the Merauke Regency showing the hinterland areas for the Malind Anim who mostly live along the big rivers
9.5. The Concept of the Geo-cultural Landscape of the Malind Anim

The Geo-cultural landscape describes the relationship between humans and the geography (Vassilopoulos et al., 2008), and mostly indigenous people have relationship with the landscape and environment such as in Australia (Taçon, 2010) and in New Zealand (Stephenson, 2008). The ecosystems of the Merauke Regency are grass lands, savannah (Bowe et al., 2007), monsoon forests and wetlands as part of the Trans Fly region ecosystem. The Merauke area is mostly in the big river basins, so the geographical territories of the Malind Anim (see Fig 9.3), are along the Fly River, along the Mbian, Maro, Bulaka and the eastern Digul Rivers, with the coastal area of the Arafura Sea, along the south eastern border, and also Kimaan Island (Samkaikai, 2009, Kameubun et al., 2013, Jan van Baal, 1966). Historically, the distribution of Malind Anim as a part of the Trans fly People was understood by mostly using a canoe as a symbol where the sequence of the position of the seat showed the moiety, the clan and the sub clan. The distribution of the different tribes around the territory also used the canoe symbolism including other tribes such the Boadzi, Yeinan, Qouji, Kanum, Aloba, Maklew, Bobanim, Asmat, Kamoro, Yaghay, (Samkaikai, 2009).

The ecosystem divides into geographical areas, which influence the names of this tribe. Different sources use both the Malind and Marind spellings so both are used here, as in Table 9.2.

<table>
<thead>
<tr>
<th>No</th>
<th>Name in Indonesian</th>
<th>The Explanation in Malind Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Marind Pantai (Marind Duff, Malind Duh)</td>
<td>Duh means sea in the Malind Language, so this name is given to people who live along the coastal areas.</td>
</tr>
<tr>
<td>2</td>
<td>Marind Rawa (Marind Bob)</td>
<td>Bob means swamp in the Malind Language. The Malind Bob are those who live inland</td>
</tr>
<tr>
<td>3</td>
<td>Marind Deg</td>
<td>People who live along the rivers</td>
</tr>
<tr>
<td>4</td>
<td>Wakatikam</td>
<td>The Malind Anim who live around the Bian River where they have biogeographical name of “wakati”.</td>
</tr>
<tr>
<td>5</td>
<td>Ghalahikam</td>
<td>Malind Anim who occupy the magrove area (ghalahbak/ghalah means mangroves) (Samkaikai, 2009).</td>
</tr>
</tbody>
</table>

The names of types of ecosystem in the Malind language is shown by Table 9.3.
Table 9.3 Ecosystem terms in the Malind Language

<table>
<thead>
<tr>
<th>No</th>
<th>The ecosystem</th>
<th>Malind language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>coastal ecosystem</td>
<td>sambduh, in duh, dese, nggasinggas</td>
</tr>
<tr>
<td>2</td>
<td>the tidal zone</td>
<td>duh, kahghanadduh</td>
</tr>
<tr>
<td>3</td>
<td>the riparian vegetation</td>
<td>watamat, isikla</td>
</tr>
<tr>
<td>4</td>
<td>the mangrove</td>
<td>ghalahbak/ibul</td>
</tr>
<tr>
<td>5</td>
<td>river</td>
<td>aliki, ahatra, haheka</td>
</tr>
<tr>
<td>6</td>
<td>&quot;dusun” Sago and Coconut</td>
<td>aghakbak, dabak, onggathak, wambadla, poya (dusun in Indonesian is a forest which provides all their needs including fire and food)</td>
</tr>
<tr>
<td>7</td>
<td>the swampy areas</td>
<td>bob, bobbob, dahudla</td>
</tr>
<tr>
<td>8</td>
<td>bambo forest</td>
<td>subabak</td>
</tr>
<tr>
<td>9</td>
<td>savanna</td>
<td>mamui, pale</td>
</tr>
<tr>
<td>10</td>
<td>rottan forest</td>
<td>tupbak</td>
</tr>
<tr>
<td>11</td>
<td>forest bushes</td>
<td>busbak</td>
</tr>
</tbody>
</table>

Resource: (Samkakai, 2009)

Malind Anim also believe the landscape is related to their totem (totem will be explained in the next section) such these swamps; the Yaluta, Mbalolet, Sakor, Mayo, Ghayug, Hyabug, Yamuli, Ndadihal, Yelinged, Ghobghob, Mbarta, Yagawa, Iramunda, and dan Warama Swamps. Today the Yaluta swamp area is known as Rawa Biru (the Blue Lake) (ibid 2009). Therefore, if there is a change to their ecosystem it will also influence the cultural values of the tribe. Traditionally, the Malind Anim have their place own names for their area (Samkaikai, 2009), which are represented by this following poem which traditionally was recited and has only recently been written down;

This poem describes the territory of the Malind Anim and the connections to things that can be part of the ecosystem, the history of the area and the identity. Several of these names and places have now been identified such as *Deahatin* means forest and trees and *Balawa* is now called Bambu Pemali, but approximaely 48 names from the poem have not been identified yet. This shows that the names and their sequence, while still relevant today, are threatened by the impact of development as their relevance and continued use are being undermined.

9.6. The Ontology and Epistemology of the Malind Anim

The Malind Anim have four groups based on the cult system, those are: Zosom, Ezam, Mayo (which consists of Mayo Bodol, Mayo Ndaan and Wlamol) and Imo. Zosom (Sunrise) is the group in the eastern Kumbe River. Zosom is described as a giant come from the east every year when the swamps has dried up by the east monsoon (Jan van Baal, 1966). Mayo is the group for the whole area between the Kumbe river and the Bian River, and Imo (Sunset) is the group for the western Bian River area (Meteray, 1972). Ezam is the cult from the upper Bian River which means husband, and is also given to bull roars. If they call Ezam Uzum it means husband and wife (Jan van Baal, 1966). These names for the cult system, which follow the direction of the compass, are attributed in the logo of the Customary Association of the Malind Anim (Lembaga Masyarakat Adat/LMA) with the word of “Anim-Ha” in the centre. Anim-Ha means real human or true human (manusia sejati) with full of wisdom, masculinity, power, good morals and attitudes (LMA Malind Anim, 2007). These days, to accommodate the interests of these tribal peoples. The LMA has set up offices in three different places according to the geographical zones, which are: Malind Sendawi- Anim, Malind Muli Anim, and Malind Kolepoman Anim, each of which has a manager or leader for the area to represent the tribe. This leader is the person with authority to authorise any work with the tribe. The Malind Anim also have their own flag, as the following picture (ibid, 2007) (Fig.9.5), dominated with the colours, black, white, red, yellow and green and the compass directions of the cult system. Black represents land as the mother nurturing life with milk and honey, white describes a strong determination to achieve their goal. Red represents the sun (bringing power and braveness), and yellow describes the greatness and the power of God who gives life with sunrise and sunset showing hope for tomorrow. Green represents the fertility of the land providing life with the plants Aggin, Kondonini, Buah sirih, Daun Sirih, Bitter nut and Wati (kava) (ibid, 2007).
The flags of each group are shown in Figure 9.6

Every group claims their own dominant colour in their own associated flags; the Mayo Bodol Group claims them with white, and the Mayo Ndaman Group claims them with red, while the Zosom and the Imo Group have their majority colours as yellow and black. The Ezam Group’s main colour is black, with red, yellow and green (ibid, 2007).
These tribal people follow the social network system of both moieties and the phratries (Corbey, 2010, Jan van Baal, 1966), which consists of the clans (boan), and sub clans (boan).

According to the Oxford English Dictionary moieties and phratries are defined respectively as following:

“Either of two primary social or ritual groups, usually exogamous, into which a society is divided; spec. one among a tribe of Australian Aborigines” and “any of various analogous clans or kinship divisions found in other societies; (esp. in Cultural Anthropos) a descent group or kinship group in some tribal societies”

Figure 9. 7 Traditional Clothing of the Malind Anim (photo: Wambrauw, E 2014)
Figure 9.8 The Social framework of the Malind Anim (modified from (Corbey, 2010, Jan van Baal, 1966, LMA Malind Anim, 2007)
The Malind Anim have several concepts of worldview and beliefs, so this paper discusses the concepts of the dema, the totem and the *wih*.

The Malind Anim have a world view which is related to their belief, called “dema”, which is intergenerational. The Dema (Jan van Baal, 1966, Kapferer, 1979, Mansoben, 2006), is described as a spiritual being or mythical being (Ernst, 1979) which lived in ancestral times and has been transformed into animals, plants and the landscape or nature (Personal Interview, 2014).

At first, there were two dema which were Dinadin (a male sky dema) and Nubog (a female earth dema) (Jan van Baal, 1966, Ernst, 1979). They were husband and wife, and had two sons, Geb and Sami. From the sons, they developed the world of the Malind Anim. They are seen as the ancestors of the boan of this indigenous people because they are the dema which is also related to the totem. In several areas Sami is also known as Mahu.

There are several concepts associated with the dema (Ernst, 1979, Jan van Baal, 1966, Corbey, 2010):

1. The dema have experienced the transformation from mystical beings or humans into landscapes, animals or plants since their inception. For example, a dema, Teimbre, changed into reeds and swamp grass after he died in a swamp.
2. The dema can transform from one shape to another shape. Ganguta is the tree dema who lived in a place called onggar, and when the leaves fall into the sea they transform into fish. So the Ganguta-rek clan has a totem of a fish.
3. The dema can also can be associated directly with specific species, for example: Bir is the snake dema; Wonatai is the stork dema who can change to men and storks; Samanimb is the wallaby dema; Ndik is the stork dema; Ngus is the female crab dema.
4. The dema are also associated with all the universe, and they are: Yorma (sea dema) who can destroy any housing with his big waves. He is a son of the depths (*desse*) and dawena who provides the ground water; Mandow-kuper sav is the moon dema; Muli is the dema which is related to the west monsoon; Sendawi is related to the east monsoon. Sendawi is a son of Yamiwa. Yamiwa is the dema of the thunder maker; Uaba is the fire dema
5. They have a companion, a female mythical being called a nakari or dema nakari.
If the dema nakari transforms to a human being, she is described as a young and beautiful women called iwag, or a fairy with long hair. A Dema nakari also is recognised as a spirit helper. An example of the dema and nakari is in the relationship between the yoma dema with his two yorma nakari which are named turbid or clear, which describes the quality of seawater.

Every clan and sub clan has their own dema, and the places where the dema live are called dema miráv (see Table 9.4).

The Malind Anim also believe in totem, which is the relationship between humans and nature, landscape, and the phenomenon of the universe.

The dema have a relationship with the totem and clans and sub clans. Totem is explained as the link between humans and nature. Some studies have been conducted to understand the concept of the totem (Leach, 1965) which is its ambiguity and timelessness, and consists of elements which are established in human history but with a main concept that cannot explained by science (Kroeber, 1939). It is rules of human kinship, for example not eating or killing animals (Stanley, 1899). The Totem concept is also explained as an association between the kinship system and moiety the tribal people (McConnel, 1933).

The Malind Anim are one of the tribal peoples who believe in totemism like the indigenous peoples of Australia (Kolig, 1988), and North Asia (Lamonge, 2012). The Malind Anim believe that there is a connection between human-beings and animals, plants, nature and the universe. The relationship with the universe is shown by the connection between the clans with the universe and natural phenomenon, such as the Gebze Clan is related to the sun (katane) and the darkness of night (dino), while the Kaize clan is related to Wiku (southern wind) and the Muli (western wind), and also the Balagaize clan is related to the maliko (thunderstorm). One resource (Jan van Baal, 1966) also explains that the relationship between totems and clans can be like amai (grandfather or grandmother) or brother (namek). Amai is used to originate the speaker’s own dema, while namek is another dema of the pathry. For example the Mahu-zé-ha clan calls the dog his amai, but the sago his namek, which is the sago made by another sub clan but which is still part of the same main clan (see Table 9.5).
<table>
<thead>
<tr>
<th>Clans</th>
<th>Prominent Dema</th>
<th>Main specific relation</th>
<th>Specific relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaize</td>
<td>Aramemb</td>
<td>Cassowary and fire</td>
<td>East monsoon and the sunlight (pig), the broad beach and the open plain savannah,</td>
</tr>
<tr>
<td></td>
<td>Sosom</td>
<td></td>
<td>rivers valley, Sosom ritual, bullroarer, bamboo piped, sago making, rattan, birds,</td>
</tr>
<tr>
<td></td>
<td>Uaba</td>
<td></td>
<td>magic of medicine-men (messav), alisan mayub (water plants)</td>
</tr>
<tr>
<td></td>
<td>Dawi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Samkakai</td>
<td>Aramemb</td>
<td>wallaby</td>
<td>Sugar cane, rattan, all things relative to the wallaby</td>
</tr>
<tr>
<td></td>
<td>Samanimb</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yano</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ndiken</td>
<td>Wonotai</td>
<td>white stork</td>
<td>Tortoise, magic of rain making, west monsoon (Muli), east Monsoon (Sendawi), craw fish.</td>
</tr>
<tr>
<td>(Ndiken –ha</td>
<td>Aramemb</td>
<td>black stork</td>
<td></td>
</tr>
<tr>
<td>and Kuna-hi</td>
<td>Yamiwa</td>
<td>wati (plant)</td>
<td></td>
</tr>
<tr>
<td>Ndikend)</td>
<td>(Dongam-anem)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mer</td>
<td>crocodile sperm</td>
<td>Waterlily (tare- tare/peewit), swar canoe, yamara fish, worm of the betel nut, bow,</td>
</tr>
<tr>
<td></td>
<td>(Opeka anem)</td>
<td></td>
<td>adultery (kiw-anem).</td>
</tr>
<tr>
<td></td>
<td>Mongumer-anem</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Mangu/Ugn mau)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balagaize</td>
<td>Yorma Fish</td>
<td>sea</td>
<td>Ser (tree), ray, sea and swamp (wokraved) big waves, tidal bore, river valley, west</td>
</tr>
<tr>
<td>(sea clan)</td>
<td></td>
<td></td>
<td>monsoon, rovrov (saw fish)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidub-boan</td>
<td>Bau Fish</td>
<td>sago</td>
<td>Coral fragments and small crabs on sandy beaches, ripples on the beach, making of</td>
</tr>
<tr>
<td></td>
<td>Sangar-anem</td>
<td>anda-fish</td>
<td>coconut oil and body paint, stone axe, white heron (yowi).</td>
</tr>
<tr>
<td></td>
<td>Kidub (eagle) sangar</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>anem (fish-eagle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basik-basik</td>
<td>Narz sapi</td>
<td>pig</td>
<td>Pig, and anything related to pig, thunder, thunderstorm, lightning, rainbow, kapiog</td>
</tr>
<tr>
<td></td>
<td></td>
<td>head hunting sorcery</td>
<td>(black cockatoo), mumu-mussel.</td>
</tr>
<tr>
<td>Diwa-rek (</td>
<td>Yugil al Diwa</td>
<td>penis</td>
<td>Cut-off penis of extra ordinary size castration, wok raved (age-grade), hara (fish),</td>
</tr>
<tr>
<td>Uvik-boan)</td>
<td></td>
<td>diwa-canoe</td>
<td>karamba (a fish, puntius-spec), frogs, meteor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mahu-zé</td>
<td>Mahu</td>
<td>dog</td>
<td>Sami snake, head hunting, batend (bower bird), shark (sésai), haupra (fish-trap).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wokabu-rek</td>
<td>Wokabu Wife Sangon</td>
<td>sago</td>
<td>Bamboo, banana skin, mother of pearl (kuper-sav), obab (a swamp bird), sun, earth,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>anda-fish</td>
<td>sail shell.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(catfish)</td>
<td></td>
</tr>
<tr>
<td>Zohé</td>
<td>Uari Wokubu</td>
<td>Anda (catfish) loam, mud</td>
<td>Mud, mud skipper (gudéwai), mangrove (harav), pelican, big crab (ngus), mussel shell,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sail shell.</td>
</tr>
<tr>
<td>Geb-zé-ha</td>
<td>Geb</td>
<td>banana</td>
<td>Bamboo, banana skin, mother of pearl (kuper-sav), obab (a swamp bird), sun, earth,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sand, stone.</td>
</tr>
<tr>
<td>Uaba-rek</td>
<td>Uaba</td>
<td>coconut sun</td>
<td>Mayo and rapa ritual, bir-snake, yellow bird of paradise, turtle.</td>
</tr>
<tr>
<td>Moyu-rek</td>
<td>Moyu Mérue</td>
<td>méri-coconut flying fox</td>
<td>Mayo ritual</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uga-boan</td>
<td>Palmyra palm</td>
<td></td>
<td>Imoh ritual, bamboo, galena fish.</td>
</tr>
</tbody>
</table>

Resources: modified from (Jan van Baal, 1966)
<table>
<thead>
<tr>
<th>No</th>
<th>The Family Name</th>
<th>Totem in local language, Indonesian, English, and Latin</th>
</tr>
</thead>
</table>
| 1  | Gebze          | • Waref (Kanguru pohon, wallaby, *Darcopsis muelleri*)  
|    |                | • Kayor (Cendrawasih raggiana, *Paradiseae*)          
|    |                | • Onggat (Kelapa, coconut, *Cocos nucifera* L)        
|    |                | • Koloso (Arwana, Sceloropages)                       
|    |                | • Mbuti (pisang, banana)                              
|    |                | • Kwe-Kwe (burung Kelapa)                             
|    |                | • Baba (kura-kura, turtle)                            |
| 2  | Mahuze         | • Nggat (Anjing, *Canis familiaris*)                  
|    |                | • Mahuk (Mambruk, *Gaura*)                            
|    |                | • Da (Sagu Metroxylon Sp.)                            
|    |                | • Adka (burung kuning, cenderawasih, bird of Paradise)  
|    |                | • Kabi (elang hitang, black eagle)                    
|    |                | • Singgu bus (bus rawa, swamp bush)                    
|    |                | • Palala (ikan kakap, snapper)                         
|    |                | • Mbambit (aquarium Fish)                             |
| 3  | Balagaize      | • Kidub (Elang laut perut putih, *Haliaeutis sanfordi*)  
|    |                | • Qu Bob (Buaya Hitam /Buaya, crocodile, *Crocodileus*)  
|    |                | • Etoh (Air garam, salt water)                        
|    |                | • Air (water)                                         
|    |                | • Kiw (buaya, crocodile)                              |
| 4  | Samkakai       | • Yano (Kanguru dada putih/saham, *Macropus agilis*)  
|    |                | • Kuskus (Phalenger orientalis)                       
|    |                | • Wati (Wati buku pendek, *Piper methysticum*)        |
| 5  | Kaize          | • Kay (Kasuari, *Casowary, Cassuarius casuarius*)      
|    |                | • Yag (Cendrawasih, Bird of Paradise, *Paradisaea raggia*)  
|    |                | • Ake (Gambir, Endiandra fulva)                       
|    |                | • Takop (Api, fire)                                   |
| 6  | Ndiken         | • Wal/Ndik (Jenjang brolga, brolga *Grus rubicund*)   
|    |                | • Od (Tebu merah, *Saccharum Sp*)                     
|    |                | • Maupa/Alangi /Alib-alib (ikan sumpit, sumpit Fish). |
| 7  | Basik-basik    | • Basik (Babi, *Sus scrofa*)                          
|    |                | • Banati (Babi tanah/landak, *Zaglosas*)               
|    |                | • Kapiog (Kakatua raja, *Probosciger*)                
|    |                | • Kidup (big eagle)                                   
|    |                | • Kanis (pinang, bitter nut)                          
|    |                | • Adika (air, water)                                  
|    |                | • Kiu-haya (crocodile)                                |

Resources are modified from: (Wattimena, 2013), (LMA Malind Anim, 2007), and field study (Personal Interviews, 2013 & 2014).
Another concept of the Malind Anim is called \textit{wih}. One resource (Jan van Baal, 1966) mentions that if the Malind Anim say \textit{wih mendaka-huyanav}, it means \textit{my wih} shaking, or “I was in fear”. So they used this word to show an expression which is related to the circumstance of their soul. The \textit{wih} is also explained as a concept of the life principle of all things (ibid 1966). During the Dutch period, the pastors stated that the description of \textit{wih} was life principles with connections to fertility, life force, and blessings (Corbey, 2010). The \textit{wih} is also the living part of the animals, for example the part of crab that can be eaten. The yolk of the egg is also mentioned as \textit{wih}. Thus, the word shows a substance of living. The \textit{wih} also can live inside the dead, stones, and people (\textit{wih} Anim). \textit{Wih} is also a magical quality that can have a life of its own. For example \textit{wih} is ascribed to the sago, but when the women extract the sago, they say \textit{wokabu wih annmakap koamin} (\textit{wokabu}, is the dema of the sago) to pour out the \textit{wih} to the sago flour. So the \textit{wih} is sign of life, a significant element of living things (Jan van Baal, 1966), but not being alive as this is called \textit{bekai}, physical life, which denotes that the spirit of the person is still living even after the person has died. \textit{Bekai} also means heart. Today the word \textit{bekai} is being using in the moto of the Merauke regency as \textit{“Isakod Bekai Isakod Kai “}, or “one heart to achieve one goal”. Lastly “\textit{wih} Anim represents the dema. Another explanation is; (Jan van Baal, 1966), with a person’s death, their \textit{wih} is gone from the body, the spirit breaks away from navel and disguises itself as a big green fly, which is called \textit{gova}. The \textit{wih} of the people can also travel while they are sleeping. The \textit{wih} is not only in living things but also in inanimate objects like a drum, which, if it is broken, there is no \textit{wih} anymore.

The Malind Anim also have knowledge of stars and constellation (Vertenten, 1921) and believe that the stars are living beings, like Tanami anim, a dema.

The constellations of the Malind Anim are:

\begin{itemize}
\item[a)] Poeno
\end{itemize}

The poeno (the Pleiades) appears in the sky in the northern hemisphere around June. There is a legend about little boys and their mother, patoer dema, who gives every boy a basket for his back as they go travelling. If they start in the evening it is the beginning of the dry season (the samb pig), the time for new gardening, time for hunting, no mosquitos. The ages of the children are also related to the dry season, so using an example from one resource (Vertenten, 1921), the age of a three year old child is similar to three dry seasons.
b) Kīwētē
Kīwētē (Hyades) is the constellation in a V shape

c) Ko-ésaman anim
Ko-ésaman anim, or when the belt of Orion, appears it is time for the boys to take their arrows and bows and go shooting fish. They also respect the three great stars which they call kaëde, dajo and worîw.

d) Ngoes
Ngoes is the Cancer constellation, because the Malind Anim word ngoes is crab

e) Dangoi,
Dangoi is the constellation like a crown (corona Australia constellation)

f) Ka-anem and epani,
When the Ka-anem and epani, or the the Dephinus constellation, appears it is when the Malind Anim say Malind Anim Ka-anim which means time for fishing, so when the women go fishing using nets they will see the epani in the sky

g) Ambata and tat
Tat is an arrow made with cane stalks and bamboo peel used to shoot ambata (fish). So today they call the ambata (Centaurus) which is the two stars in the first magnitude between the Southern Cross and the altar

h) Ongtapali
Ongtapali is all red stars

i) Goem
Goem is the situation which is like the galaxy with white ashes

j) Patare
Patare are a few big stars in the southern hemisphere.

k) Ovom.
Ovom is the planet Venus

Another concept for the Malind Anim are the east monsoon and west monsoon which relate to climate and which distinguish the dry and the wet seasons (Jan van Baal, 1966), and the life of the Malind Anim is also influenced by the monsoon climate (NW monsoon and SE monsoon), so they have their own calendar which is a lunar calendar (Kooijman, 1960). The first east moon relates to the dry season. This season is described by the cool weather which is brought by south-easterly winds. There will be no water in the swamps, and the is a reduction in the population of mosquitoes. The
grass can be burnt to get new growth for animals, and there is time for hunting and fishing because the fish are trapped in creeks. So this is also the time for feasts and ceremonies. The wet season is also the hot period, with a lot of rain, a lot of mosquitoes, and difficulty in travelling due swampy areas, so they do not hunt or feast (Jan van Baal, 1966). The system of communal hunting is called *ohan* (Kooijman, 1960). Coastal people will hunt during the dry season with their community, while the dry also benefits interior people for catching fish using an *itip* (a fish trap made from bamboo and rattan). The changing seasons influence their way life and their diet, so they estimate the season with their lunar calendar, which is called *balé tang*, as the shape is like a wavy wooden spatula. Each side of the *balé tang* has six or seven prominences that represent moons. If it is more traditional one side consists of seven moons and other five moons which represent the dry season and the wet season. Each area has their own name, for thisso, according to historical data (ibid 1960), there are six versions of the names of the calendar. *Pig* is general name of the dry season, and this changes to *wep* (there is no data when the change occurred)

**Table 9.6 The Lunar Calendar of the Malind Anim**

<table>
<thead>
<tr>
<th></th>
<th>IVb</th>
<th>IVa</th>
<th>III</th>
<th>II</th>
<th>I</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IVa</th>
<th>IVb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ngopa</td>
<td>-</td>
<td>samani</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>naleg</td>
<td>bakembaku</td>
<td>halwojam</td>
<td>aukau</td>
<td>samani</td>
<td>Ioi hara</td>
<td>hara</td>
<td>hara</td>
<td>halwojam</td>
<td>hukow</td>
<td></td>
</tr>
<tr>
<td>haru</td>
<td>rujam</td>
<td>itip</td>
<td>aukau</td>
<td>hara</td>
<td>doga</td>
<td>doga</td>
<td>samani</td>
<td>samani</td>
<td></td>
<td></td>
</tr>
<tr>
<td>heiti wep</td>
<td>heiti wep</td>
<td>Samb wep</td>
<td>Iisi doga</td>
<td>malea</td>
<td>abkuku</td>
<td>samani</td>
<td>-</td>
<td>-</td>
<td>jahwokum</td>
<td></td>
</tr>
<tr>
<td>Samb wep</td>
<td>Samb wep</td>
<td>heiti wep</td>
<td>Samb wep</td>
<td>Hetu wep</td>
<td>Iisi doga</td>
<td>adagu</td>
<td>karguban</td>
<td>-</td>
<td>hamkuku</td>
<td></td>
</tr>
<tr>
<td>Ko-ahip</td>
<td>ogomandau</td>
<td>nareg</td>
<td>kimopa</td>
<td>wep</td>
<td>doga</td>
<td>hamkuku</td>
<td>bakembuku</td>
<td>-</td>
<td>wakalbuba</td>
<td></td>
</tr>
<tr>
<td>kimopa</td>
<td>Doga pig</td>
<td>kimopa</td>
<td>Ko-angbo (heiti wep)</td>
<td>kemopa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dakembaku</td>
<td>hamkuku</td>
<td>hamkuku</td>
<td>wakalbuba</td>
<td>adagu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Resource is modified from (Kooijman, 1960)

The Malind Anim have a lot of feasts in their culture; their dances are called *zamb-zi* and *gad-zi* (Meteray, 1972). Several feasts are not practised anymore due to being prohibited by government and religion (church). The Malind Anim experience several

165
stages in their life from the time they were born to becoming adults, and every phase has own ceremony. The names of the periods of their life are described in Table 9.7.

<table>
<thead>
<tr>
<th>No</th>
<th>For Males</th>
<th>For Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>patur is a period until a boy becomes a teenager and enters the gotad (men’s house)</td>
<td>kivasom is a period until a girl becomes an adolescence</td>
</tr>
<tr>
<td>2</td>
<td>aroi patur after entering the gotad, his hair is shaved to bald, and after the hair grows and is enough to be plaited into a hairdo, and he will advance to next level</td>
<td>walu ku the ages of ten or eleven</td>
</tr>
<tr>
<td>3</td>
<td>wokraved next two or three years</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>éwati an adolescent young man. It is approximately 3 years, before he leaves the gotad. This time young men are like a sosom (sunrise).</td>
<td>kivasom-iwag adolescent young woman</td>
</tr>
<tr>
<td>5</td>
<td>miakim marriageable man or adult man</td>
<td>iwag marriageable woman</td>
</tr>
<tr>
<td>6</td>
<td>amnangib married men</td>
<td>sav married woman</td>
</tr>
<tr>
<td>7</td>
<td>mes-miakim old man. If the person is full of wisdom and respected by the society he is called samb-anim</td>
<td>mes-iwag old woman</td>
</tr>
</tbody>
</table>

Resources: (Jan van Baal, 1966, Meteray, 1972)

9.6.1. The social network and the concept of sustainability of the Malind Anim

The Malind Anim live in a men’s house (otiv) which includes one to three women per house (sav-aha) (Verschueren, 1970). In a men’s house there are approximately 20 people. A hamlet consists of several men’s houses. The hamlet makes a village which establishes their territory (Jan van Baal, 1966).

The system of leadership in the Malind Anim is called pakes anim (Wattimena, 2013, Jan van Baal, 1966, Meteray, 1972, Overweel, 1993, Suradisastra, 2006), it is a synonym of samb anim, a great or important person, or full of wisdom (Jan van, 1966). Every clan has their own pakes anim and their own autonomy, but in 1914 there was the introduction of the head of the village, in Bahasa Indonesian “kepala kampung”(Meteray, 1972).

In this leadership system (pakes anim system), the people who make the decisions have experienced life including being initiated into and educated about their cultural heritage. The hierarchy of the stages of the decision making process from bottom to top are anim, mburaro, mitawal, kuunam and last one is wadikasi which is the level of the
decision maker (Wattimena, 2013). These days, the pakas anim (kepala Kampung) still have an important role in making decisions about the customary land.

In the current situation, after experiencing a lot of the changes (Overweel, 1993, n/a, 2004, LMA Malind Anim, 2007, Meteray, 1972), such as a reduction in the population caused by disease (Corbey, 2010), it is important to maintain the culture and the identity of the Malind People. The World Wildlife Fund and the local government have done some cultural mapping to protect and sustain the existing cultural values of this tribe. They have mapped several places (Wattimena, 2013), such as:

- the path of the ancestor (dema kay)
- the place the ancestors stop over (Demadap Mir)
- scared places (Dema Say), the ancestral graves (Amayen sai)
- ritual places (Pungga Sai)
- the place (forest) for gathering Sago and food (dusun Sagu or Dah Nanggaz)
- water resources (awamdka)
- resources for hunting (Aweawe say)
- the place for maintaining the culture or Pungga (Wattimena, 2013).

The Malind Anim have their own local wisdom and mechanisms or customary laws for using natural resources which are related to their identity (nakali), such as how and when they should go hunting. The ways of using their identity (nakali) influences the balance of nature. If they wisely maintain the nakali, it will produce plenty of resources (Wattimena, 2013).

Most indigenous people have their own roles to play in nature. One role which common in Papua is sasi where there is control of the natural resources such as the forest or river, sea, or swamps at specific times or for specific reasons (Mansoben, 2003, MCLeod et al., 2009). The reason could be because of a period of mourning or providing for a special feast. These days sometimes they do sasi for church activities. This is the kind of sustainable action that controls the use of natural resources. The Malind Anim also practise sasi, for example, forbidding fishing in a swamp at certain times so the population of fish can increase, so there is a continuing supply for the people. Another example is where the sasi for sago or coconut is harvested for church purposes or feasts, so the resource can be used to provide food during the event. If
people do not obey the sasi, they will be punished by society or worse there is a belief that a calamity will happen to them.

Wambad and apata are the traditional agricultural knowledge of the Malind Anim (see Figure 9.8). The Wambad system is to dig and make a high garden bed which is complemented by a drainage system called apata. The main purpose of making the garden higher is to avoid water during the wet season. The wambad system should be considered as using topography to drain the water as these gardens are usually close to a water body such as tributary or swamp. The apata is to control the water around the beds, and the canals between the beds are used to create ponds for fish. In the garden, they have sago palms, coconut trees, banana palms, wati (kava) and other plants to support daily life. The bed is called a topa, and is 1.5 to 2m in height and 6 to 7m in length. The advantages of using the apata are that they do not use machines and are without chemical fertilizers. It is also good for the community because they have to do together in a group, and they use their own knowledge and techniques (YASANTO, 2012). A detailed explanation of wambad and apata can be found in Chapter 2.

Figure 9.9 Wambad system (photo by Konny Kameubun, 2013)
9.7. Discussion

Today sustainable development is a concern around the globe (Gibson, 2006, Lélé, 1991, Sneddon et al., 2006, Redclift, 1992, Mannan, 2014, Koundouri et al., 2015, Hopwood et al., 2005, Pope et al., 2004, Ness et al., 2007, Ciegis et al., 2009, Rebitzer et al., 2004, Stevenson, 1996, de Groot, 2006, Giddings et al., 2002, Holden et al., 2014, Langhelle, 1999), with several popular publications establishing the concepts of Sustainable Development such as the “Our Common Future “1987 and “Earth Summit” 1992 (Mannan, 2014, Holden et al., 2014). The concept of development should include improving well-being, equitable distribution, and the integration of the ecological concepts which pass from generation to generation and across time (Sneddon et al., 2006). Sustainable ways of life have actually been practised by indigenous people intergenerationally. The indigenous people have similarities around the world in that they are inseparable from nature, and use their knowledge to maintain their ecosystems. Examples are where fire is used to maintain savannah in Fiji (Clarke, 1990) and similarly, the Kanum use fire to maintain savannah in the Merauke Regency. Another example is the management of wetlands in Ethiopia (Dixon, 2003), and the traditional agriculture which is practised in the Merauke Regency, including on Kimaam Island (Serpenti, 1977, Jan van Baal, 1966, YASANTO, 2012). This shows that traditional knowledge has proven ability to sustain the environment and help the people survive. This increases the motive for considering involving indigenous knowledge when making decisions and assessing the environment and development (Morgan 2005, Morgan 2006a, Rahman, 2000, Johannes, 1993) including development in the agricultural sectors (Lwoga et al., 2010, Wambrauw, 2013, YASANTO, 2012).

One of the environmental assessments which integrates traditional values is the Mauri Model Decision Making Framework (MMDMF). A detailed explanation of this framework can be seen Chapter 5.

The first step before transferring the framework of one tribal people to the context of another is the importance of understanding the concept of the indigenous people of those tribes. According to a previous study (Wambrauw and Morgan, 2014), also Chapter 7 of this thesis, there are some similarities between the Asmat People and the Māori of Aotearoa, New Zealand so the MMDMF has been applied to assess water supply for Agats Township in Asmat (Case study in Chapter 8).
Both the Asmat People and the Malind Anim are part of the Trans Fly people who live along the rivers and are part of Anim Ha in Papua’s cultural zone in southern Papua (see Figure 9.4). Previously, both tribes were officially in Merauke Regency because Asmat was one of the districts. The management of the wetlands in these areas is important because of the contribution to national and international wetlands, such as Lorenz National Park, one of UNESCO’s heritage sites (Hawkins*, 2004, Asmat Government, 2012) and The National Wasur Park in Merauke which is a Ramsar wetland management site (Choowaew, 2007). Asmat’s ecosystem is mostly covered by water (80 % swampy areas), but the Malind Anim area also has sandy ridges and savannah so they have more of an agricultural sector such as wambad, apata and ndambu in Kimaam or Kolepom Island (Manembu, 1995). Thus the ecosystems shape their culture, and both of those tribal people respect nature and their culture. The Asmat people produce carvings to show respect for their environment, while the Malind Anim have their beliefs about dema and totems where they respect the environment, including animals and plants, as their ancestors, and decorate themselves for festivals to show their respect.

The Malind Anim also have a concept of astronomy recognising constellations and using a lunar calendar. This knowledge determines their lifestyle including setting times for hunting or fishing or gardening. This knowledge has been told to the author by the Asmat People, but, because the limited time for the observation and field study it could not be observed in detail over time, and so the knowledge may not actually be practised anymore. It still needs more study in this area. When compared with the Māori People, they also have knowledge of the lunar calendar, which is called Maramataka (Smidt, 2013) and constellations (Best, 1910). Besides astronomy, the Māori People and the Malind have similarities in the concept of deities. The Māori People believe that in the beginning there was a god of the sky (Ranginui) and a god of the earth (Papatuanuku) (Solomon, 2004), while the Malind People have Dinadin (the sky dema) and Nubog (the earth dema). The Malind Anim also have the concept of wih as a life force.
Table 9.8 The Parallels between these Tribal People.

<table>
<thead>
<tr>
<th>The concepts</th>
<th>The Māori</th>
<th>The Asmat</th>
<th>The Malind Anim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guardianship</td>
<td>Kaitiakitanga (guardianship environment, enhancing mauri)</td>
<td>yi-ow (guardian sago)</td>
<td></td>
</tr>
<tr>
<td>Leadership</td>
<td>mana (authority)</td>
<td>big man (authority)</td>
<td></td>
</tr>
<tr>
<td>Land and water for the next generation</td>
<td>Whatuanganongaro te tangata toiū te whenua</td>
<td>jo bakat fakar and capinmi fakar</td>
<td></td>
</tr>
<tr>
<td>The balance of life</td>
<td>mauri (life force), kaitiakitanga (guardianship environment)</td>
<td>concept of ja asamanam apcamar (concept of balance), jew (life spirit)</td>
<td>(Wih) life force</td>
</tr>
<tr>
<td>Ancestral spirits</td>
<td>ancestral spirits in carvings</td>
<td>ancestral spirits in carvings</td>
<td>Dema and Totemism</td>
</tr>
<tr>
<td>Deities</td>
<td>atua</td>
<td>Fumeripits (supreme being)</td>
<td>Dema</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>mātauranga Māori</td>
<td>traditional knowledge</td>
<td>traditional knowledge</td>
</tr>
<tr>
<td>Constellations</td>
<td>Yes</td>
<td>n.d.</td>
<td>Yes</td>
</tr>
<tr>
<td>Lunar Calendar</td>
<td>Yes</td>
<td>n.d</td>
<td>Yes</td>
</tr>
</tbody>
</table>

9.8. Conclusion
Currently the Malind Anim face a lot problems such as a decreasing population and cultural adjustments which makes it important to assess any development using a framework which involves the cultural aspects. The Asmat People and The Malind Anim are inseparable from nature and have some similarities, and, even more, the Malind Anim have resonance with the Māori People, which makes the MMDMF transferable to Merauke. Further study is needed to explore the similarities between those tribes in greater detail. However there is the feasibility of transferring the MMDMF to other tribal people in Papua.

References


WATTIMENA, M. C. 2013. Wisdom Perspective of Malind Tribe Important Sites as Referrals in Detailed Land Use Plan Preparation of Merauke Regency.


Chapter 10

The Merauke Integrated Food and Energy Estate (MIFEE)

10.1. Introduction

The purpose of the land use in a certain area will impact on its ecosystem and particularly, in the case of agriculture, on the availability of water and on climate change. This chapter explores the use of the Integrated Management Water Resources tools to evaluate the mega project Merauke Integrated Food and Energy Estate (MIFEE) in the Merauke Regency in the southern low lands of Papua. This chapter is divided into seven sections. It starts with this introduction and continues to the description of the Merauke Regency and the MIFEE. Section 10.3 is a summary of the previous study of the Integrated Water Management Resources in the Merauke Regency. Section 10.4 explains the interpretation of data using the Mauri Model Decision Making Framework (MMDMF). The details of the analysis are explained in Section 10.5 and, Section 10.6 analyse using adding indicators, Section 10.7 discusses the results, and Section 10.8 provides the conclusions of the analysis.

10.2. Description of the Merauke Integrated Food and Energy Estate (MIFEE)

Merauke is the easternmost regency of Indonesia and encompasses a vast territory in the southern lowlands of Papua bordering with Papua New Guinea. The capital is Merauke Town. This town was established by the Dutch Government on 14 February 1902. The original name “Maro Ka ehe “ meaning “this is the Maro River “ was changed to Merauke (Meteray, 1972, Kuruwaib, 1993). The Malind –Anim, the majority tribal people in the area mention the town as Yalmasu or Yelmasu (Samkaikai, 2009) which means river bend in their language. Most of area of the Merauke Regency is located in the Eilanden Digul BIKUMA (Bian, Kumbe, Maro) River Basins system (Merauke Government, 2012) which is the largest river basin in Papua and one of the 5 cross boundary river basins in Indonesia which extend across the regencies and the border with the Papua New Guinea (Boccalon et al., 2012,

Previously, the total area was approximately 119,749 Km$^2$. However, in 2002, according to Government Regulation No 26, Merauke was divided into 4 new regencies, Merauke, Asmat, Mappi and Boven Digul Regencies. Even after being divided into 4 regencies, the Merauke Regency still covers a vast territory and is the largest regency in Indonesia with a total of 46,779.3847 Km$^2$ (Papua Government, 2013). Within that total area more than half of the total land area (approximately 2,491,822 Million ha) has potential for the agricultural sector including 1,937,291 ha of wetland and 554,531 ha of dry land (Merauke Government, 2013b).

Historically, this area was developed as the Kumbe Rice Estate along with Kimaam District in 1939, by the Dutch Government, to provide food for the Asia Pacific area in World War II (Manikmas, 2010). The Merauke Regency was also a targeted area of the transmigration programme (Sumule, 2002, Gietzelt, 1989, Fearnside, 1997) since the 1960s after Papua (Irian Jaya) was integrated into Indonesia in 1963. Transmigration is a programme to move people from Java Island to other provinces due the pressure of population and poverty, and to develop the agricultural sector in new areas. Earlier in the 2000s, the regional Government of the Papua Province decided to discontinue the transmigration programme because of political issues (Mollet, 2011, Pona, 2012). Even though, there is no longer a transmigration programme, the Merauke regency is the location of a new agricultural development scheme, called the Merauke Integrated Food and Energy Estate (MIFEE).

The MIFEE, a national programme to develop the regency as a national and local granary, was launched on 11 August 2010 by the Agricultural Ministry of the Indonesian Government in Sirapu Village, the Kurik District, Merauke Regency (Zakaria et al., 2011). An earlier project introduced by the regent at the time, John Gluba Gebze (2005-2010), and named MIRE (Merauke Integrated Rice Estate) in 2007 was changed to MIFEE (Merauke Integrated Food and Energy Estate) to respond to the opportunity to develop more after the global crisis in food and energy. This earlier programme, supported by the Government Regulation No 20, 2008 National Land Allocation that stated that Merauke would be developed for agricultural purposes (Biwangko, 2010). Mr Gebze noted that agricultural development was not a new idea for Merauke Regency. The Dutch Government had decided earlier on the commodity of
each area and that because of its plain area, the Merauke Regency was suitable for paddy rice. He also said that there was an opportunity to develop agriculture in Merauke to respond to the global food crisis at that time, and that that would not use all the potential areas of the regency (Personal Communication, John Gluba Gebze, 2013).

Data from the 2013 field study shows that in the two years after the 2010 launch 53 national companies have shown interest and registered for investing. However, they have to follow certain steps before investing, such as doing an environmental assessment and economic feasibility studies, and also negotiate with the Indigenous People who own the customary land. The negotiation is needed to ensure the Indigenous People have their rights either as individuals or for community ownership. Indonesian Law No 21, 2001 (the special Autonomy for Papua), especially in article 43 ensures their rights to the land. This law states that the provincial government should protect and empower the Indigenous People in Papua (Indonesian Government, 2001). The Indonesian Government also signed the UNDRIP 2007, this also ensures the rights of the tribal people of Indonesia to their territory (Anderson et al., 2012, Lamonge, 2012, Rachman, 2013).

The negotiation sometimes takes time, but to develop the programme, the Local Government have set up three zones according to priority: short, midterm and long term priority over the period 2010 to 2030 and divided the area for development into 10 clusters (KSPP). The first zone (the short term priority) 2010 and 2014 consisted of cluster 1st to cluster 4th. The second zone (mid-term priority) for development from 2015 and 2019 covers cluster 5th to cluster 8th. The last zone (long term priority) for development from 2020 and 2030 has only two clusters: cluster 9th and cluster 10th. The Local Government allocates an area of 120,000 Ha for each cluster, and out of the total each sub-cluster covers 5000 Ha which consist of paddy rice (4000 Ha), short term plants (100 Ha), long term plants (100 Ha), fresh water fishery (100Ha), composting sites (100 Ha), infrastructure (200 Ha), housing and social facilities (100 Ha), agro industry (200 Ha) and livestock (100 Ha). The detail of the zones and clusters can be seen in Figure 10.1 and Table 10.1.
Figure 10.1 Areas of the clusters of the MIFEE project (Indonesia Government, 2011, Boccalon et al., 2012)

Table 10.1 the clusters of the MIFEE

<table>
<thead>
<tr>
<th>MIFEE Phase</th>
<th>KSPP</th>
<th>Area (Ha)</th>
<th>Commodities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zone I Total area: 228,022 ha</strong></td>
<td>KSPP-1 Greater Merauke</td>
<td>44,239</td>
<td>rice, corn</td>
</tr>
<tr>
<td></td>
<td>KSPP-2 Kali Kumbe</td>
<td>50,140</td>
<td>sugarcane, corn, ground nut, soybean, cows</td>
</tr>
<tr>
<td></td>
<td>KSPP-3 Yeinan</td>
<td>80,717</td>
<td>corn, ground nut, fruits, cows</td>
</tr>
<tr>
<td></td>
<td>KSPP-4 Bian</td>
<td>52,926</td>
<td>ground nut, oil palm, fruits, cows</td>
</tr>
<tr>
<td><strong>Zone II (2015-2019) Total area: 751,350 ha</strong></td>
<td>KSPP-5 Okaba</td>
<td>27,705</td>
<td>rice, cows</td>
</tr>
<tr>
<td></td>
<td>KSPP-6 Wanam</td>
<td>112,599</td>
<td>fisheries, corn, sago, rice, cows</td>
</tr>
<tr>
<td></td>
<td>KSPP-7 Tubang</td>
<td>295,904</td>
<td>rice, sago, animal husbandry, cows</td>
</tr>
<tr>
<td></td>
<td>KSPP-8 Tabonji</td>
<td>315,142</td>
<td>animal husbandry, rice, sago</td>
</tr>
<tr>
<td><strong>Zone III (2020-2030) Total area: 239,251 ha</strong></td>
<td>KSPP-9 Nakias</td>
<td>173,971</td>
<td>corn, ground nut, soybean, rice, cows</td>
</tr>
<tr>
<td></td>
<td>KSPP-10 Selil</td>
<td>65,280</td>
<td>oil palm, cows</td>
</tr>
<tr>
<td>Total area</td>
<td>1,218,623</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: the table modified from (Boccalon et al., 2012) and the Local Government (Merauke Government, 2013b, Merauke Government, 2011, Merauke Government, 2013a)
The MIFEE project has created a lot of controversy between the stakeholders including the NGOs, the Local Government and the Indigenous People (Moiwend, 2010b, Moiwend, 2010a, Moiwend, 2011, Zakaria et al., 2011, Ginting and Pye, 2013a, Ito et al., 2011, Ito et al., 2014, Lamonge, 2012). The negotiation between the Indigenous People, as the land owners, and the companies sometimes does not work well, especially when the company does not keep the promises to those people. This leads the raising of human rights issues as they have their own perspectives regarding the MIFEE. Independent activists called “Awas MIFEE” in 2013 stated that;

“Now MIFEE has reached its third birthday……Certainly not on the ground: the forests of Merauke only echo with worry as tragic stories of deception, intimidation, inter-community conflict, forest destruction and even starvation pass from village to village………..”

The inter-community conflict occurs due to the Indigenous People who own this territory having different worldviews about selling their lands. Murdiyarso et al. (2011) stated that the Indonesian Government announced the Forest moratorium to reduce the carbon emissions, but there is an exemption when converting the land for food security, which demonstrates the conflict between the environmental and economic purposes. Ito et al (2014) discuss how the challenge for the MIFEE was the availability of land because the land is owned by the Indigenous People and smallholders, but, with the moratorium, the land can be converted from customary land and conservation forests to agricultural land.

The majority tribal peoples are the Malind-Anim together with other tribes including, the Muyu, Yagai, Mandobo, and Asmat (Boelaars, 1986, Meteray, 1972).

The Malind Anim majority tribe in this area have been faced with changes since the first contact with outsiders in the 1900s when the Dutch established Merauke Town and again with the Transmigration programme in 1960 (Overweel, 1993). Merauke is one of the towns of Papua where the population of non-Papuans is higher than that of the Indigenous Papuans, in 2010 the percentage of them was under 40 % (BPS, 2011a).

10.3. Previous study of Water Resources Management in the Regency

An increase the population, of the agricultural and of the industry sector affects water demand (Pawitan and Haryani, 2011). To use water wisely and to ensure sustainability of water supply, management of the resource has to balance its availability and its use (Grigg, 1996). This will impact on the ecosystem, wild life and the land. To ensure a
balance between the use of water and the protection and the conservation for the resources there needs to be a framework for analysing problems.

An approach to water management called Integrated Water Resources Management (IWRM), was defined by Global Water Partnership Committee (Global Water Partnership, 2000, Biswas, 2004) as:

“A process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems”

The IWRM was developed based on the four Dublin principles (Global Water Partnership, 2000): the essential value of water, the importance of participatory approach from all stakeholders, the participation of women, and the role and the economic value of water. The Integrated Water Resource Management in Indonesia is based on Water Law no. 7 in 2004 (Kusmulyono et al., 2009). This law regulates the main water sector areas: water resources management, water for agriculture, water supply, dams, swamps and river basin management. The management of river basins as part of the Integrated Water Resource Management is complex because they can cross boundaries of countries, provinces, regencies or smaller administrative areas. Indonesia has four river basins which cross international borders and 26 which cross provincial borders. The Papua land (both provinces: Papua and Irian Jaya Barat) has 5 River basin areas, the largest of which is the Einlanden – Digul – Bikuma (Bian, Kumbe and Maro) Rivers Basin.

River basin management must include the management for medium and long-term planning for the use of water resources which involves the socio-economic (SES) sector, the administrative and institutional (AIS) sector and the natural resource (NRS) sectors of water. The relationship between the basic principles of the plan is described in Figure 10.2
Figure 10. 2 The elements of water planning (Boccalon et al., 2012)

The engineering approach faces complex problems if it does not consider the social and environmental issues. Thus, the decision making process which takes those sectors into account will influence the success of the water resources management plan. The different perspectives and understanding will produce a better decision.

The Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers basin is located in South Eastern Papua. The total area of the Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers is 133,000 Km² and encompasses eight regencies including Merauke Regency. The area of the river basin can be seen in Figure 10.3 and Figure 10.4. The Figure 10.5 explains the names of the river basin.

The management of this river basin is regulated by the Decree of the Ministry of the Public Works because the basin lies across regencies and countries (Indonesian Government, 2014). As explained in Section 10.2 the Merauke Regency will be developed for agricultural purposes, and the project will consume a lot of water. A study (Boccalon et al., 2012) used the Multi Criteria Analysis Approach to analyse the MIFEE project and the relationship with the water management of the Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers basin. The evaluation strategy determined for the policy makers their future planning, the criteria for each strategy and the impact of the project. According to the study there are four schemes of the MIFEE project: the actual planning (extensive agro-industry development with a total area of 1,200,000 Ha), moderate agro-business development (total area only 250,000 Ha)
focuses on sustainability, and autonomous development. The Decree of the Public Work Ministry of the Republic Indonesia No 295/KPTS/M/2014 details the scenarios but does not mention the focus on sustainability. It assumes for the second scenario that the area of MIFEE for food is only is 250,000 ha (Indonesian Government, 2014).

The first scenario is the extensive agro-industry development with a total area of 1,200,000 ha, fits with the plan of the MIFEE project. Economic growth is the main purpose of this scenario, and is related to an increase in population, in water demand, and in water pollution, thus accelerating the degradation of the ecosystem. The next scenario: moderate agro-business development (total area only 250,000 ha), is quite similar to the first scenario, assuming that the area will be developed only for food. The third scenario; the focus on sustainability, could generate ecotourism and promote nature and culture. This scenario could benefit the indigenous people of Merauke Regency. The last scenario is the current situation where the agricultural sector is developed by transmigration, which has been continuing in Merauke since the 1960s.
Figure 10.3 The Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers basin (Aditdya Engineering Consultant, 2008)
Figure 10. 4 The Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers basins and their drainage systems (BAPPEDA Merauke Regency)
Figure 10.5. The Einlanden-Digul-Bikuma (Bian, Kumbe, and Maro) Rivers basins and their drainage systems.
The indicators of the analysis from the previous study are described in the Table 10.2, and these are used to further analysis in this chapter.

**Table 10.2 The selected criteria for the multi criteria analysis**

<table>
<thead>
<tr>
<th>Social Aspects</th>
<th>Economic Aspects</th>
<th>Environmental Aspects</th>
<th>Technical Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>- equity and social inclusion</td>
<td>- level of economic growth</td>
<td>- sustainable resources use</td>
<td>- water availability</td>
</tr>
<tr>
<td>- preservation of cultural integrity and values of indigenous people</td>
<td>- poverty alleviation</td>
<td>- conservation of ecosystem services</td>
<td>- water quality</td>
</tr>
<tr>
<td></td>
<td>- financial feasibility of the intervention</td>
<td>- climate change mitigation</td>
<td>- technical, feasibility of the intervention</td>
</tr>
</tbody>
</table>

Source: (Boccalon et al., 2012)

Based on the scale evaluation from -2 to +2, which show the cumulative impacts, the results of the study can be seen in the Table 10.3

**Table 10.3 The results of decision analysis**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>MIFEE 1.2M Ha</th>
<th>MIFEE 250,000 Ha</th>
<th>Focus on Sustainability</th>
<th>Autonomous developments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Equity and social inclusion</td>
<td>-2</td>
<td>-2</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>2. Preservation of cultural integrity and values of indigenous people</td>
<td>-2</td>
<td>-2</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>3. Level of economic growth</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. Poverty alleviation</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5. Financial feasibility of the intervention</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6. Sustainable resources use</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>7. Conservation of ecosystem services</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>8. Climate change mitigation</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>9. Water availability</td>
<td>-2</td>
<td>-2</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>10. Water quality</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>11. Technical feasibility of the intervention</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Resources: (Boccalon et al., 2012)

Based on the results the first scenario creates considerable negative impacts as shown by frequent conflicts between the companies and local people (Biwangko, 2010, Ginting and Pye, 2011, Ginting and Pye, 2013b), and also among the local people due to different opinions of the MIFEE, some indigenous people agree to sell the land but
other disagree to do it. The second scenario develops MIFEE only for food crops. The third scenario develops the project of MIFEE in sustainable way. It is the best option. The fourth scenario is the reality without the MIFEE Project. The actual condition shows that there is a social problem especially in the gap between the Indigenous People and the outsiders.

10.4. The Interpretation of the data using Mauri Model

The scenario above (Section 10.3) will be analysed using the Mauri Model Decision Making Framework with similar indicators. The indicators are categorised based on the dimensions of the mauri. They are the mauri of the community, the mauri of the ecosystem, the mauri of the economy, and the mauri of the hapū (Morgan, 2008, Morgan, 2006) as shown Fig.10.6

<table>
<thead>
<tr>
<th>Social Aspects</th>
<th>Economic Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>- equity and social inclusion</td>
<td>- level of economic growth</td>
</tr>
<tr>
<td>- water availability</td>
<td>- poverty alleviation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Aspects</th>
<th>Cultural Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>- sustainable resources use</td>
<td>- preservation of cultural integrity</td>
</tr>
<tr>
<td>- conservation of ecosystem services</td>
<td>and values of indigenous people</td>
</tr>
<tr>
<td>- climate change mitigation</td>
<td></td>
</tr>
<tr>
<td>- water quality</td>
<td></td>
</tr>
</tbody>
</table>

Figure 10.6 the indicators that have been modified from the former study (Boccalon et al., 2012).

After grouping the indicators into the mauri dimensions, all the scale rankings are put in the ranking assessment of the Mauri Model Decision Making Framework. After scaling the scores of each indicator (the scores are the same as in Table 10.3), the average scale of the data can be calculated. The average of each scenario shows the actual impact of each wellbeing. The result of the assessment is provided in Table 10.4.
Table 10. 4 the Result of the Ranking Assessment of the Previous study (Boccalon et al., 2012)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Indicators</th>
<th>MIFEE 1.2 M Ha</th>
<th>MIFEE 250,000 Ha</th>
<th>Focus on sustainability</th>
<th>Autonomous Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>The mauri of economic dimension</td>
<td>level of the economic growth</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>poverty alleviation</td>
<td>1</td>
<td>1</td>
<td>2.05</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>financial feasibility</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>technical, feasibility of the intervention</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>The mauri of social dimension</td>
<td>equity and social inclusion</td>
<td>-2</td>
<td>-2</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>availability of water</td>
<td>-2</td>
<td>-2</td>
<td>0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>The mauri of cultural dimension</td>
<td>preservation of cultural integrity and values of indigenous people</td>
<td>-2</td>
<td>-2</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>sustainable resources use</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>conservation of ecosystem services</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>climate change mitigation</td>
<td>-2</td>
<td>-1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>water quality</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
</tr>
</tbody>
</table>

Note: the dimension average is shown in the second for each dimension.
So the result of the average of the four dimensions of mauri are shown the result of the actual mauri. It means the real condition of the mauri be and it is implied in the mauriOmeter which measures sustainability. Each scenario is represented by a letter of the alphabet. The result of the assessment of the dimensions is shown in Table 10.5 and Figure 10.4

Table 10.5 the result of the actual mauri based on previous research.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>MIFEE 1.2 M Ha</th>
<th>MIFEE 250.000 Ha</th>
<th>Focused on Sustainability</th>
<th>Autonomous Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>The actual mauri</td>
<td>-1.4375</td>
<td>-1.125</td>
<td>1.25</td>
<td>-0.375</td>
</tr>
</tbody>
</table>

Table 10.5 shows that only the third scenario will be sustainable. The other three scenario have similar negative trends. Scenario one which is the main programme of the Indonesia Government (2011) to accelerate development seems to be failing because it achieves close to -2 which destroys the mauri, the life force. Even if it produces economic benefits it creates conflict and impacts negatively on the indigenous people and the environment. The second scenario has less problems than the first scenario because the area of development is smaller than the first scenario’s. The agricultural development focuses solely on the food crops, especially on paddy rice. The fourth scenario seems to have negative impacts but is still maintains the mauri. This result is applied to the mauriOmeter in Figure 10.7

Figure 10.7 the Result in mauriOmeter
10.5. Detailed Analysis Using the Mauri Model Decision Making Framework

To analyse the project, certain stakeholders associated with the project were chosen: the agribusiness companies, the small holder (trans - migrant), the Malind Anim (the major indigenous people of this area) and the Local Government. The perspective of the stakeholders were weighted using a modified pair-wise comparison based on the Analytic Hierarchy Process (Saaty, 1980). The comparative importance between mauri dimensions ranges between -3 to +3 where the maximum score shows the most important of the mauri dimensions from the particular stakeholder’s perspective.

The calculation of the priorities uses assumptions based on the observation study (Wambrauw, 2012 and 2014), the literature reviews (including books, newspapers and news), the primary data (questionnaire and interview), and the personal experience of the writer. For the agribusiness companies, the priorities are assumed to be purely economic which puts the priority of the agribusiness companies 100 % in the economic dimension. This assumption is supported by the report of the Franciscans International (2011) which stated that while the project is directed at the food and energy estate, actually it seems to the purely economic since most of the area is planned to be used for industrial timber plantations. According to a report (ibid, 2011) the MIFEE which covers 1.2 M Ha, consists of a total of 970.000 Ha for industrial timber plantation, a total of 300.000 Ha for oil Palm plantation and only 69.000 Ha for food crops. The project thus has a purely economic purpose (ibid, 2011). The report also states the social impacts: social cultural gap, migration, food and energy estate but pure economic interest, environmental impact and impact on sustainable livelihood.

The AHP- Mauri Model Result which involves the perspectives of the stakeholder can be seen in Table 10.6

Table 10.6  AHP-Mauri Model showing the worldview priorities of the four stakeholders.

<table>
<thead>
<tr>
<th>Mauri</th>
<th>Ecosystem</th>
<th>Tribe</th>
<th>Community</th>
<th>Whanau</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellbeing</td>
<td>environmental</td>
<td>cultural</td>
<td>Social</td>
<td>Economic</td>
</tr>
<tr>
<td>The Local Government</td>
<td>19%</td>
<td>17%</td>
<td>31%</td>
<td>33%</td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>22%</td>
<td>8%</td>
<td>31%</td>
<td>39%</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>36%</td>
<td>36%</td>
<td>17%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Resources: analysis
Measuring the sustainability of the project from the perspectives of the stakeholder called for a sensitivity analysis to be conducted. As a result Table 10.7 shows the mauri of each stakeholder for those four scenarios.

**Table 10.7 the results of the sensitivity analysis**

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>MIFEE 1.2 M Ha</th>
<th>MIFEE 250,000 Ha</th>
<th>Focus on sustainability</th>
<th>Autonomous Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Actual</td>
<td>-1.44</td>
<td>-1.13</td>
<td>1.25</td>
<td>-0.38</td>
</tr>
<tr>
<td>The Local Government</td>
<td>-1.25</td>
<td>-0.97</td>
<td>1.11</td>
<td>-0.28</td>
</tr>
<tr>
<td>The Agribusiness Companies</td>
<td>0.25</td>
<td>0.50</td>
<td>1.00</td>
<td>0.25</td>
</tr>
<tr>
<td>The Trans migrant</td>
<td>-1.125</td>
<td>-0.8</td>
<td>1.04</td>
<td>-0.19</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>-1.75</td>
<td>-1.36</td>
<td>1.46</td>
<td>-0.51</td>
</tr>
</tbody>
</table>

Source: Analysis.

![Diagram](https://via.placeholder.com/150)

**Figure 10.8 The result of the mauriOmeter of the Local Government’s perspective**

This result shows that only scenario C is superior to the others; it benefits the Local Government.
Figure 10. 9 the result of the mauriOmeter of the Agribusiness companies’ perspective

This result shows that based on the perspective of Agribusiness companies the project impacts the mauri positively. The best option for this stakeholder is also in the Green Scenario.

Figure 10. 10 The result of the mauriOmeter of the trans-migrant perspective
According to the result only the Green Scenario enhances the mauri. Based on the worldview of the trans-migrant’s perspective only the green scenario have benefit to enhance the mauri. Even though the existing condition, the trans-migrant is the main actor in agriculture in Merauke Regency, the mauri impact is negative because the supply water is still problem for them.

Figure 10.11 the result of the mauriOmeter of the Malind Anim's perspective
Similarly, based on the Malind Anim perspectives only the best option is Scenario C, the Scenario A and B impact negatively to them. Scenario D shows the condition that the mauri of their perspective still maintain even in negative way.

10.6. Detail Analysis with Adding Indicators of mauri
Based on the previous study, the indicators in Figure 10.6 are developed into Figure 10.12, the indicators are chosen based on the literature review and field study. In the field study, interview was done with key persons such the previous head of the regency who introduced the MIFEE and the local government which has direct connection to the issues like the Agricultural Department and Forestry Department. The interviews also were done with the Malind Anim customary institution (LMA) and NGOs to address the problems. During the interview, the respondents shared information regarding the MIFEE, thus the indicators are chosen. The ranking assessments are done by reading from literature review, interview and personal experience as I used to live in
Merauke Regency. The data from the Catholic Organisation helped to rank the indicators for the pre MIFEE time frame.

The mauri of the cultural dimension:
- demographical (marginalisation)
- sacred place
- language
- traditional value
- lifestyle
- traditional knowledge

The mauri of the social dimension:
- the increase of population of migrants
- the availability of water
- job opportunity
- food security
- new technology
- the equity and social inclusion

The mauri of the economic dimension:
- poverty alleviation
- economic growth
- clearing area
- infrastructure

The mauri of the ecosystem:
- the area of the forest
- reduction of the biodiversity
- water quality
- sustainable resources use
- climate change mitigation

Figure 10.12 The indicators of the mauri dimensions

10.6.1. The mauri of the cultural dimension

The Malind Anim have experienced change in their culture because of colonisation and globalisation. They were known as the Tugeri tribe by the British in 1890 and were part of the Dutch colonisation in New Guinea which attacked the eastern sides under the British (Meteray, 1972). The Dutch then tried to expand their territory in this area by establishing their base Sarira Village (the location can be seen in Figure 9.3 from Chapter 9) in 1892 but that failed because the Malind Anim attacked them. Finally, on 12 February 1902, the Dutch Government arrived and succeeded in establishing their base in the area along the Maro River, which is Merauke Town now. The purpose of the base at that time was to control the head hunting raids on the territory of the British on the eastern side (Kuruwaib, 1993). On 26 February 1902, the Malind Anim tried to resist and attack the Dutch troops, but this tribal people failed (Kuruwaib, 1993, Meteray, 1972, Overweel, 1993, n/a, 2004). This was the beginning of the change for the Malind Anim (Belton and Stewart, 2002, Mendoza and Martins, 2006). The population of the Malind Anim declined during the period. In 1902, there were approximately 8000 Malind Anim in the coastal areas and approximately 6000 in the hinterland (Corbey, 2010, Jan van Baal, 1966, Overweel, 1993). Another resource noted
in 1908 the population of this tribe was approximately 12,900 (Meteray, 1972). In 1918 their population declined significantly by 18% within 2 weeks because of an influenza epidemic (Meteray, 1972) and by 40% in the five years period. After the Dutch opened their base in Merauke migrants came to the area including Indonesians, and Chinese (Meteray, 1972). As a result it is difficult to count the real population of the Malind Anim at that time. Migrants came because of the natural of resources of Merauke, especially in hunting the bird of paradise. After integrating into to Indonesia in 1963 and the referendum of 1969, the population of migrants increased significantly. The transmigration programme also contributed significantly to the increase of the population. In the early 1970s, the population of the area of the Merauke Regency was approximately 25,000, including the Malind Anim. With the MIFEE programme, the condition of the Malind Anim population has become even worse. In 2010, BPS (the Statistical Bureau of Papua’s Province) stated that the population of the Merauke regency was 195,716 and the percentage of Papuans was only 37.34% of that (BPS, 2011b). Since the 37.34% was the percentage of all Papuan tribes in that area clearly the Malind Anim are an even smaller percentage. The MIFEE programme needs approximately 4.8 million labourers (Ito et al., 2014, Zakaria et al., 2011) with this demographic the population of all Papuans in Merauke will be around 2%. The Malind Anim must be only a small number, so they will be more marginalised. The Malind Anim have also experienced great changes in their culture. Catholic missionaries came this area 1905 and some the Malind Anim traditional feasts and dances were prohibited by the Church and the Dutch government.

This mauri of the cultural dimension has experienced the degradation, as the population of their territory is dominated by the outsiders. As know tribes will have identity if they have their territory. So, with the new scheme to develop Merauke, it can diminish the mauri of the Malind Anim.

As explained that the Malind Anim belief in totem and dema (see Chapter 9), the changing land use can extinguish their identity. Scenario A and B accelerate the change of land use and ecosystem. This also changes the hunter gathering and traditional farming to mechanisation farming, which means there a transformation of the life style. This condition is against the rights of the indigenous people to be protected and empowered. Thus the issues of human right are raised that are related to the rights of the Malind Anim (Franciscans International, 2011, Hadiprayitno, 2014a, Hadiprayitno,
Table 10.8 The Ranking Assessment of the mauri of the culture

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Pre MIFEE</th>
<th>MIFEE 1,200,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demography compared to migrants</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>Sacred place</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Traditional Value</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>2</td>
<td>1.167</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario B</th>
<th>Pre MIFEE</th>
<th>MIFEE 250,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demography compared to migrants</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>Sacred place</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Traditional Value</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>2</td>
<td>1.167</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario C</th>
<th>Pre MIFEE</th>
<th>Focus on sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demography compared to migrants</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>Sacred place</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Traditional Value</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>2</td>
<td>1.167</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario D</th>
<th>Pre MIFEE</th>
<th>Autonomous development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demography compared to migrants</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>Sacred place</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Traditional Value</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>2</td>
<td>1.167</td>
</tr>
</tbody>
</table>
Based on the result from Figure 10.13 inherent resilience within the cultural dimension is 100 mauri years (1910 to 2040). However this resilience in this dimension is relatively fragile as the cultural aspects are closely tied to the lived lifetime of the Malind Anim. If the Malind Anim cannot sustain the culture, they will lose their identity (Moiwend, 2010b, Moiwend, 2010a, Moiwend, 2011). With the current situation Scenario A and Scenario B denigrate the mauri of the Malind Anim culture.
(Zakaria et al., 2011). For the scenario analysis Scenario C is superior to all others with only positive cumulative impacts on mauri. The impact is determined as 12.5 mauri years which is \((12.511\pm19.136 =31.6)\) mauri years better than A and approximately 16 mauri years better Scenario B and D.

Thus, to avoid the extinction of the Malind Anim, only Scenario C should be chosen.

10.6.2. The mauri of the social dimension

Since the establishment of the Merauke town (Meteray, 1972), outsiders came to this areas because of the natural resources, Kuruwaib stated they interested on the bird of Paradise (1993). This town was also used as food storage for the US during War World Two (Manikmas, 2010).

The MIFEE project increases the population of migrants, and this will increase significantly by about 20 times from the current number. Thus, it creates competition in use of the natural resources, especially water and land. It has potential to create conflict in the society and with the indigenous people for the use of natural resources (Lamonge, 2012, Ito et al., 2014). The management of water is more complex, between domestic and agricultural purposes. So there are several studies to check the availability of the water (Boccalon et al., 2012) The project is also a benefit for the society in transferring new technology and skills to society. However the mechanisation of the agricultural sector is also potential to change human power to machine power too. The ranking assessment can be seen in Table 10.9
Table 10.9 The Ranking Assessment of the mauri of the social dimension

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Indicators/Time</th>
<th>Pre MIFEE</th>
<th>MIFEE 1,200,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>The increase of population of migrant</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>the availability of water</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Food Security</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New technology</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The equity and social inclusion</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>0.33</td>
<td>0.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario B</th>
<th>Indicators/Time</th>
<th>Pre MIFEE</th>
<th>MIFEE 250,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>The increase of population of migrant</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>the availability of water</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Food Security</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New technology</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The equity and social inclusion</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>0.33</td>
<td>0.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario C</th>
<th>Indicators/Time</th>
<th>Pre MIFEE</th>
<th>Focused on Sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>The increase of population of migrant</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>the availability of water</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Food Security</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New technology</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The equity and social inclusion</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>0.33</td>
<td>0.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario D</th>
<th>Indicators/Time</th>
<th>Pre MIFEE</th>
<th>Autonomous Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>The increase of population of migrant</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>the availability of water</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Food Security</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New technology</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The equity and social inclusion</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>0.33</td>
<td>0.33</td>
</tr>
</tbody>
</table>
The result shows 40 mauri years resilience, also fragile, but less directly linked to the lived lifetimes of each generation, and social capital is not only linked to people (see Fig. 10.15). It also can be knowledge systems such as libraries, books, data bases on computers, and repositories such as museums. While social dimension mauri all demonstrate cumulative impact, Scenario C remains the better option when compared to others. Scenario C is better, 20.589 better, than Scenario B. and better approximately 20 mauri year than A, and 12 better than Scenario D (see Fig 10.16).
10.6.3. The mauri of the economic dimensions

The purpose of this project is to accelerate the economy of this area (Indonesia Government, 2011). This parallels with the policies of the Local Government to developed the Merauke Regency as agricultural area (Merauke Government, 2011, Merauke Government, 2013b, Merauke Government, 2013a). Based on the economic corridor of Indonesia, Papua is developed as resources of food, energy, mining and fisheries (Ito et al., 2014), so the Merauke Regency is focused on as an agricultural development. Even though the purpose of the project to provide food security it seems to be purely economic (Franciscans International, 2011), and is focused on palm oil plantations (Agrindo) so it enhances the mauri of the economic dimension.

In this ranking assessment, the starting point of economic dimension is assumed to be in 1970 when the trans-migrants arrived in the area. The agriculture was started by the Dutch, but only in a certain area (Vollema, 1960, Manikmas, 2010) so the mauri impact started at time forward.

Infrastructure and clearing areas are indicators that can reduce the mauri of the economic dimension. The companies spend a lot of money on this the work because of the opening up the forest.

Other indicators, are that the MIFEE project can employ a huge number amount of labour, almost five million people are needed. The increase population also influences the economic activities in this areas.

The ranking assessment and the result of the mauri of the economic dimension can be seen in the Table 10.10 and Fig.10.17 and Fig 10.18.
Table 10. 10 the Ranking Assessment of the mauri of the economic dimension

<table>
<thead>
<tr>
<th>Indicators/Time</th>
<th>Scenario A</th>
<th>Pre MIFEE</th>
<th>MIFEE 1,200,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty alleviation</td>
<td>0 0 0 0 0 0 0 0 0</td>
<td>0 0 0 1 2 2 2</td>
<td></td>
</tr>
<tr>
<td>GRDP(Growth Regional Domestic Product)</td>
<td>0 0 0 0 0 0 1 2 2 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearing area</td>
<td>0 0 0 0 0 0 0 -1 -2 -1 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0 0 0 0 0 0 0 -1 -2 -1 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>0 0 0 0 0 0 1 1 2 2 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic Activities</td>
<td>0 0 0 1 1 1 2 2 2 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>0 0 0 0.17 0.17 0.33 0.33 0.33 0.83 1.33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scenario B

<table>
<thead>
<tr>
<th>Indicators/Time</th>
<th>Scenario B</th>
<th>Pre MIFEE</th>
<th>MIFEE 250,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty alleviation</td>
<td>0 0 0 0 0 0 0 0 0</td>
<td>0 0 0 0 0 1</td>
<td></td>
</tr>
<tr>
<td>GRDP(Growth Regional Domestic Product)</td>
<td>0 0 0 0 0 0 0 1 1 1 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearing area</td>
<td>0 0 0 0 0 0 0 -1 -1 0 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0 0 0 0 0 0 0 -1 -1 0 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>0 0 0 0 0 0 0 1 1 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic Activities</td>
<td>0 0 0 1 1 1 1 1 1 1 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>0 0 0 0.17 0.17 0.33 0.33 0.33 0.83 1.33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scenario C

<table>
<thead>
<tr>
<th>Indicators/Time</th>
<th>Scenario C</th>
<th>Pre MIFEE</th>
<th>Focused on sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty alleviation</td>
<td>0 0 0 0 0 0 0 1 1 1 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRDP(Growth Regional Domestic Product)</td>
<td>0 0 0 0 0 0 0 1 1 1 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearing area</td>
<td>0 0 0 0 0 0 0 0 0 0 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0 0 0 0 0 0 0 0 0 0 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>0 0 0 0 0 0 1 1 1 1 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic Activities</td>
<td>0 0 0 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>0 0 0 0.17 0.17 0.33 0.5 0.67 0.67 1.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scenario D

<table>
<thead>
<tr>
<th>Indicators/Time</th>
<th>Scenario D</th>
<th>Pre MIFEE</th>
<th>Autonomous development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty alleviation</td>
<td>0 0 0 0 0 0 0 0 0 0 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRDP(Growth Regional Domestic Product)</td>
<td>0 0 0 0 0 0 0 1 1 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearing area</td>
<td>0 0 0 0 0 0 0 0 0 0 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0 0 0 0 0 0 0 0 0 0 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>0 0 0 0 0 0 1 1 1 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic Activities</td>
<td>0 0 0 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>0 0 0 0.17 0.17 0.33 0.5 0.67 0.67 0.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As a result, the economic area reflects, from some perspectives, the ineffective use of these resources providing the impetus for development as wetland seen as wasteland. The scenario shows enhanced mauri however the issue is the distribution economic gains with more concentrated on fewer stakeholders in the scenarios A and B. This means the impetus to developed also results in different improvements across the economic indicators.

Figure 10. 17 the mauri of the economic part 1

Figure 10. 18 the mauri of the economic dimension part 2
10.6.4. The mauri of the ecosystem

The ecosystem of Merauke is savannah, grassland (BOWE et al., 2007) and monsoon forest. The Wasur National Park is located in this area which one of Ramsar Convention sites (Choowaew, 2007). The land changes in this area will impact significantly on the ecosystem. (Biwangko, 2010, Ito et al., 2011). The wetland of the Merauke Regency has an important role in climate change, and rising sea levels. The demand for water due to the high population will influence the availability of water and the land. Based on the field study (Wambrauw 2012, 2013 and 2014), there is a lot a change in this area where swamps have changed to settlements or housing compared to 20 years ago when I was lived there. Thus, the increased population will load more pressure to the environmental. The transmigration programme has also had a negative impact on deforestation.

Therefore, open access to the clusters of MIFEE will accelerate the deforestation. It impact on the biodiversity. There will be a reduction of the number of species or biodiversity due to exploitation of resources because of the deforestation. For example, research on fishing in the border area with PNG show that, an the Indonesian side the fish are smaller in number than on the PNG side. This due to greater exploitation in Indonesia (Hitchcock, 2006).

Beside the deforestation, the increase of population will exploit more of the natural resources of the area.

Today, water is still problem for the Merauke Regency, the water supply is taken from The Rawa Biru (Blue Swamp) which is located in same river basin as the Wasur National Park. The exploitation of water can reduce the water table, which influences of the biodiversity of the area. It is more complex because it is a border are with Papua New Guinea in the Tonda National Park (Chatterton, 2004, Hitchcock, 2005, Hitchcock, 2006, Iskandar and Jong, 2008).

Actually, the Malind anim have developed their own traditional agricultural system, called wambad system which is sustainable (YASANTO, 2012).

The ranking assessment can be seen in the Table 10.11 and the Fig 10.19 and Fig.10.20
Table 10. The mauri of the ecosystem dimension

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Pre MIFEE</th>
<th>MIFEE 1,200,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators/Time</td>
<td>191 0</td>
<td>193 0</td>
</tr>
<tr>
<td>The area of the forest</td>
<td>2 2 2 1 1</td>
<td>0 -1 -2 -2 -2</td>
</tr>
<tr>
<td>Reduction of the biodiversity</td>
<td>2 2 2 1 1</td>
<td>0 0 -1 -2 -2</td>
</tr>
<tr>
<td>Water quality</td>
<td>2 2 2 2 1</td>
<td>1 0 -1 -2 -2</td>
</tr>
<tr>
<td>Sustainable resources use</td>
<td>2 2 1 1 0</td>
<td>0 0 -1 -1 -2</td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>2 2 2 1 0</td>
<td>-1 -1 -1 -2 -2</td>
</tr>
<tr>
<td>Average</td>
<td>2 2 1.8 1.2 0.6</td>
<td>0 -0.4 -1.2 -1.8 -2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario B</th>
<th>Pre MIFEE</th>
<th>MIFEE 250,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators/Time</td>
<td>191 0</td>
<td>193 0</td>
</tr>
<tr>
<td>The area of the forest</td>
<td>2 2 2 1 1</td>
<td>0 -1 -1 -1 -2</td>
</tr>
<tr>
<td>Reduction of the biodiversity</td>
<td>2 2 2 1 1</td>
<td>0 0 0 -1 -1</td>
</tr>
<tr>
<td>Water quality</td>
<td>2 2 2 2 1</td>
<td>1 0 0 -1 -1</td>
</tr>
<tr>
<td>Sustainable resources use</td>
<td>2 2 1 1 0</td>
<td>0 0 -1 -1 -1</td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>2 2 2 1 0</td>
<td>-1 -1 -1 -1 -2</td>
</tr>
<tr>
<td>Average</td>
<td>2 2 1.8 1.2 0.6</td>
<td>0 -0.4 -0.6 -1 -1.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario C</th>
<th>Pre MIFEE</th>
<th>Focused on sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators/Time</td>
<td>191 0</td>
<td>193 0</td>
</tr>
<tr>
<td>The area of the forest</td>
<td>2 2 2 1 1</td>
<td>0 0 1 1 1</td>
</tr>
<tr>
<td>Reduction of the biodiversity</td>
<td>2 2 2 1 1</td>
<td>0 0 0 1 1</td>
</tr>
<tr>
<td>Water quality</td>
<td>2 2 2 2 1</td>
<td>1 0 0 0 0</td>
</tr>
<tr>
<td>Sustainable resources use</td>
<td>2 2 1 1 0</td>
<td>0 0 1 2 2</td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>2 2 2 1 0</td>
<td>-1 1 1 1 2</td>
</tr>
<tr>
<td>Average</td>
<td>2 2 1.8 1.2 0.6</td>
<td>0 0.2 0.6 1 1.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario D</th>
<th>Pre MIFEE</th>
<th>Autonomous development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators/Time</td>
<td>191 0</td>
<td>193 0</td>
</tr>
<tr>
<td>The area of the forest</td>
<td>2 2 2 1 1</td>
<td>0 0 0 0 -1</td>
</tr>
<tr>
<td>Reduction of the biodiversity</td>
<td>2 2 2 1 1</td>
<td>0 0 0 -1 -1</td>
</tr>
<tr>
<td>Water quality</td>
<td>2 2 2 2 1</td>
<td>1 0 0 -1 -1</td>
</tr>
<tr>
<td>Sustainable resources use</td>
<td>2 2 1 1 0</td>
<td>0 0 0 0 0</td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>2 2 2 1 0</td>
<td>-1 -1 -1 -1 -2</td>
</tr>
<tr>
<td>Average</td>
<td>2 2 1.8 1.2 0.6</td>
<td>0 -0.2 -0.2 -0.6 -1</td>
</tr>
</tbody>
</table>
For the accumulative mauri years to 1990 the trend is negative toward to zero on the mauri axis in the direction of scientific tipping point. Ecosystem resilience is calculated as 126 mauri years. Comparing the four scenarios, Scenario C is superior and the only option that continues to enhance mauri. Scenario C is (27+41=68) mauri years better than A, and 39 better than Scenarios B and D.

### 10.7. The Sensitivity analysis

Sensitivity analysis indicates that identifying trends go to positive and negative. It also adds weighting according to the stake holders.
10.7.1. Scenario A (MIFEE with 1.2 M Ha)

**Table 10.12 The mauri of the Scenario A**

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>Pre MIFEE</th>
<th>MIFEE 1,200,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The mauri of ecosystem</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The area of the forest</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Reduction of the biodiversity</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Water quality</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sustainable resources use</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>The mauri of culture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demography compared to migrants</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>Sacred place</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Traditional Value</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>2</td>
<td>1.17</td>
</tr>
<tr>
<td><strong>The mauri of community</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The increase of population of migrant</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>the availability of water</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Food Security</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New technology</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The equity and social inclusion</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td><strong>The mauri of economic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty alleviation</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>GRDP(Growth Regional Domestic Product)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clearing area</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Employment</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Economic Activities</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Table 10. 13 The sensitivity analysis based on the stakeholders’ perspectives

<table>
<thead>
<tr>
<th>Scenario A</th>
<th>MIFEE 1,200,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1990</td>
</tr>
<tr>
<td>The Actual mauri</td>
<td>0.5</td>
</tr>
<tr>
<td>The Local Government</td>
<td>0.5</td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>0.2</td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>0.1</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Based on this analysis, the world view of the Malind Anim goes to negative and the agribusiness companies get greatest benefit representing a transfer of mauri. The trends of the mauri of each stakeholder are shown in Figure 10.21 and the areas are seen in the Table 10.14 which are calculated using the Simson rule.

Table 10. 14 The area of the mauri of the Scenario A

<table>
<thead>
<tr>
<th>The areas</th>
<th>Positive (mauri years)</th>
<th>Negative (mauri years)</th>
<th>Total (mauri years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual mauri</td>
<td>5.875</td>
<td>-7.67</td>
<td>-1.79</td>
</tr>
<tr>
<td>The Local Government</td>
<td>7</td>
<td>-0.96</td>
<td>6.03</td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>25.83</td>
<td>0</td>
<td>25.83</td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>0.67</td>
<td>-9.34</td>
<td>-8.66</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>3.4</td>
<td>-24.3</td>
<td>-20.9</td>
</tr>
</tbody>
</table>

Thus, there is a 20.9 (approximately 21 mauri years) diminishing of the mauri based on the perspective the Malind Anim, while, based the worldviews of the Agribusiness companies, there is an increase of 25 mauri years of the MIFEE project.
Figure 10. The result of sensitivity analysis with the weighting of the stakeholders
10.7.2. Scenario B (the MIFEE with 250,000 Ha)

The ranking assessment of the mauri with the Scenario B is shown in Table 10.15.

### Table 10.15 the mauri of the Scenario B

<table>
<thead>
<tr>
<th>Indicators /time</th>
<th>Pre MIFEE</th>
<th>MIFEE 250,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>The area of the forest</td>
<td>2 2 2 1 1</td>
<td>0 -1 -1 -1 -2</td>
</tr>
<tr>
<td>Reduction of the biodiversity</td>
<td>2 2 2 1 1</td>
<td>0 0 0 -1 -1</td>
</tr>
<tr>
<td>Water quality</td>
<td>2 2 2 2 1</td>
<td>1 0 0 -1 -1</td>
</tr>
<tr>
<td>Sustainable resources use</td>
<td>2 2 1 1 0</td>
<td>0 0 -1 -1 -1</td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>2 2 2 1 0</td>
<td>-1 -1 -1 -1 -2</td>
</tr>
<tr>
<td>Average</td>
<td>2 2 1.8 1.2 0.6</td>
<td>0 -0.4 -0.6 -1 -1.4</td>
</tr>
<tr>
<td>Demography</td>
<td>2 -1 0 1 0</td>
<td>-1 -1 -1 -1 -2</td>
</tr>
<tr>
<td>Sacred place</td>
<td>2 2 2 2 2</td>
<td>1 0 0 -1 -1</td>
</tr>
<tr>
<td>Language</td>
<td>2 2 2 2 2</td>
<td>1 0 0 -1 -1</td>
</tr>
<tr>
<td>Traditional Value</td>
<td>2 1 1 1 1</td>
<td>0 0 -1 -1 -1</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2 1 1 0 0</td>
<td>0 -1 -1 -1 -1</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>2 2 2 1 1</td>
<td>0 0 0 -1 -1</td>
</tr>
<tr>
<td>Average</td>
<td>2.0 1.2 1.3 1.2 0.7</td>
<td>0.0 -0.3 -0.5 -1.0 -1.2</td>
</tr>
<tr>
<td>The increase of population of migrant</td>
<td>0 0 1 1 1</td>
<td>2 2 2 2 2</td>
</tr>
<tr>
<td>the availability of water</td>
<td>2 2 2 1 1</td>
<td>0 0 -1 -1 -1</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>0 0 0 1 1</td>
<td>1 1 1 1 2</td>
</tr>
<tr>
<td>Food Security</td>
<td>0 0 0 1 1</td>
<td>1 1 1 1 1</td>
</tr>
<tr>
<td>New technology</td>
<td>0 0 0 0 0</td>
<td>0 1 1 1 1</td>
</tr>
<tr>
<td>The equity and social inclusion</td>
<td>0 0 0 0 0</td>
<td>0 0 -1 -1 -2</td>
</tr>
<tr>
<td>Average</td>
<td>0.3 0.3 0.5 0.7 0.7</td>
<td>0.7 0.8 0.5 0.5 0.5</td>
</tr>
<tr>
<td>Poverty alleviation</td>
<td>0 0 0 0 0</td>
<td>0 0 0 0 1</td>
</tr>
<tr>
<td>GRDP(Growth Regional Domestic Product)</td>
<td>0 0 0 0 0</td>
<td>0 1 1 1 2</td>
</tr>
<tr>
<td>Clearing area</td>
<td>0 0 0 0 0</td>
<td>0 -1 -1 0 0</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0 0 0 0 0</td>
<td>0 -1 -1 0 0</td>
</tr>
<tr>
<td>Employment</td>
<td>0 0 0 0 0</td>
<td>0 1 1 1 1</td>
</tr>
<tr>
<td>Economic Activities</td>
<td>0 0 0 1 1</td>
<td>1 1 1 1 2</td>
</tr>
<tr>
<td>Average</td>
<td>0.0 0.0 0.0 0.2 0.2</td>
<td>0.2 0.2 0.2 0.5 1.0</td>
</tr>
</tbody>
</table>

The sensitivity analysis of the stakeholders can be seen in the Table 10.16
Table 10.16 The Sensitivity Analysis of the mauri of the Scenario B

<table>
<thead>
<tr>
<th>Scenario B</th>
<th>Pre MIFEE</th>
<th>MIFEE 250,000 Ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Actual mauri</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>The Local Government</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>1.5</td>
<td>1.2</td>
</tr>
</tbody>
</table>

The actual mauri shows that Scenario B impacts negatively on the mauri, while the agribusiness still has the benefit of the project, and the Malind Anim have negative impact.

Table 10.17 The area of mauri of the Scenario B

<table>
<thead>
<tr>
<th>The areas</th>
<th>Positive (mauri years)</th>
<th>Negative (mauri years)</th>
<th>Total (mauri years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Actual mauri</td>
<td>5.0417</td>
<td>-4.375</td>
<td>0.67</td>
</tr>
<tr>
<td>The Local Government</td>
<td>6.56</td>
<td>0</td>
<td>6.56</td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>15.8</td>
<td>0</td>
<td>15.8</td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>8.51</td>
<td>0</td>
<td>8.51</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>3.58</td>
<td>-18.99</td>
<td>-15.4</td>
</tr>
</tbody>
</table>

The result shows Scenario B impacts the mauri negatively at 15.4 mauri years. The most benefit in this scenario is the agribusiness companies. The Local Government’s perspective seems to be positive, but the actual condition of the mauri is in a negative trend. The area and trend of the sensitivity can be seen in the Figure 10.22.
Figure 10. 22 the Sensitivity Analysis of the Scenario B
10.7.3. Scenario C (focus on sustainability)

The ranking assessment of Scenario C can be seen in the Table 10.18

**Table 10.18 The result of the scenario C**

<table>
<thead>
<tr>
<th>Indicators/Time</th>
<th>Pre MIFEE</th>
<th>Focused on sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>The mauri of ecosystem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The area of the forest</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Reduction of the biodiversity</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Water quality</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Sustainable resources use</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Average</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Demography</td>
<td>2.0</td>
<td>-1.0</td>
</tr>
<tr>
<td>Sacred place</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Language</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Traditional Value</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Average</td>
<td>2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>The mauri of community</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The increase of population of migrant</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>the availability of water</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Food Security</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>New technology</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>The equity and social inclusion</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Average</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Poverty alleviation</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>GRDP(Growth Regional Domestic Product)</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Clearing area</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Employment</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Economic Activities</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Average</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Next, the sensitivity analysis which combines the results of the ranking assessment and the worldviews of the stakeholders that can be seen Table 10.19.
Based on the result all scenarios enhance the mauri, and the area of the mauri can be seen in Figure 10.23

### Table 10. 19 the sensitivity analysis of the Scenario C

<table>
<thead>
<tr>
<th>Scenario C</th>
<th>Pre MIFEE</th>
<th>Focused on sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Actual mauri</td>
<td>1.1  0.9  0.9  0.8  0.5  0.3  0.3  0.7  0.8  1.0</td>
<td></td>
</tr>
<tr>
<td>The Local Government</td>
<td>0.8  0.7  0.7  0.7  0.5  0.3  0.4  0.7  0.8  1.0</td>
<td></td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>0.0  0.0  0.0  0.2  0.2  0.3  0.5  0.7  0.7  1.2</td>
<td></td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>0.7  0.6  0.7  0.6  0.5  0.3  0.4  0.7  0.8  1.1</td>
<td></td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>1.5  1.2  1.2  1.0  0.6  0.1  0.1  0.6  0.8  1.0</td>
<td></td>
</tr>
</tbody>
</table>

Thus all the scenarios enhance mauri for more than 25 mauri years.

### Table 10. 20 the area of the mauri of the Scenario C

<table>
<thead>
<tr>
<th>The area</th>
<th>Positive (mauri years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Actual mauri</td>
<td>28</td>
</tr>
<tr>
<td>The Local Government</td>
<td>29.9</td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>28.333</td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>31</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>25.26</td>
</tr>
</tbody>
</table>

Thus all the scenarios enhance mauri for more than 25 mauri years.
Figure 10. 23  the Scenario C  (focused on sustainable)
The last scenario is autonomous development which is an existing condition. The ranking assessment can be seen in Table 10.21

**Table 10.21 The ranking assessment of the Scenario D**

<table>
<thead>
<tr>
<th>Scenario D</th>
<th>Pre MI EEE</th>
<th>Autonomous development</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicators/Time</strong></td>
<td>191/0</td>
<td>193/0</td>
</tr>
<tr>
<td>The area of the forest</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Reduction of the biodiversity</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Water quality</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sustainable resources use</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Climate change mitigation</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Demography</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>Sacred place</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Traditional Value</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Lifestyle</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Traditional knowledge</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>The increase of population of migrant</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>the availability of water</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Job opportunity</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Food Security</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New technology</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The equity and social inclusion</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Poverty alleviation</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>GRDP(Growth Regional Domestic Product)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clearing area</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Employment</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Economic Activities</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Table 10.22 the sensitivity Analysis of the mauri of the Scenario D

<table>
<thead>
<tr>
<th>Scenario D</th>
<th>Pre MIFEE</th>
<th>Focused on sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Actual mauri</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>The Local Government</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>1.5</td>
<td>1.2</td>
</tr>
</tbody>
</table>

This result shows that with the autonomous development, the Malind Anim have a negative trends of the mauri. The impact of mauri are represented in the area of the mauri, which described in the Table 10.23. Even though the trend for the Malind Anim, is negative they still have some positive mauri years with this scenario. The trend can be seen in the Figure 10.24

Table 10.23 the area of the mauri of the Scenario D

<table>
<thead>
<tr>
<th>The area of the mauri</th>
<th>Positive (mauri Years)</th>
<th>Negative(mauri years)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Actual mauri</td>
<td>6.583</td>
<td>-0.63</td>
<td>5.958</td>
</tr>
<tr>
<td>The Local Government</td>
<td>12.64</td>
<td>0</td>
<td>12.64</td>
</tr>
<tr>
<td>The agribusiness companies</td>
<td>17.5</td>
<td>0</td>
<td>17.5</td>
</tr>
<tr>
<td>The trans-migrants</td>
<td>14.53</td>
<td>0</td>
<td>14.53</td>
</tr>
<tr>
<td>The Malind Anim</td>
<td>4.028</td>
<td>-3.51</td>
<td>0.514</td>
</tr>
</tbody>
</table>
Figure 10. The sensitivity analysis of the Scenario D
10.8. Conclusion

Mauri Model analysis provides graphical representation of change in mauri caused by scenarios over time. The Analysis clearly indicates Scenario C is superior. The decision to proceed with Scenario A/B reflects an inadequate consideration of the impacts upon the Malind Anim.

Figure 10. 25 Savannah in Merauke (Photo: Wambrauw, 2015)
References

AGRINDO, P. B. I. 3.3 Papua as focus of palm oil plantation investors. Human Rights In Papua, 31.


GRIGG, N. S. 1996. Water resources management, Wiley Online Library.


Chapter 11
Conclusion

11.1. Introduction
Research has explored the application of the Mauri Model Decision Making Framework (MMDMF) in a context outside Aotearoa, New Zealand. The Mauri Model Decision Making Framework has been adapted to the context of Papua where a municipal water supply project and the MIFEE (Merauke Integrated Food and energy Estate) have been evaluated. The results indicate that the MMDMF can be adapted to international contexts and can provide superior understanding of the complex situations investigated. Sec 11.2 summarises the findings of the research. Section 11.3 explains the limitations of the study. Section 11.4 describes the associated outputs produced during my doctoral time research study time. Section 11.5 suggests future work, and Section 11.6 describes the contribution the research makes to field to impact assessment and evaluation.

11.2. Summary
Two case studies have been analysed, one in in Agats Township in the Asmat Regency and one in Merauke Regency. Agats Township, population 15,000, is the capital of the Asmat Regency in southern Papua, Indonesia. The tidal range normally inundates the urban area, and fresh water supply is a problem for residential occupancy. A solution implemented to address the water supply requirements for Agats has introduced inequalities for the regional community. Issues beyond equitable access to the water supply such as cultural transgressions raise further questions regarding sustainability. The objective of this research is to evaluate the Agats water supply solution to determine the sustainability of the local government project supplying potable water to Agats Township. The analysis reveals the high level of complexity posed by this problem. It shows that the project is not sustainable from the Asmat People’s perspective, but could be considered sustainable by the local government. The analysis shows that the predominant benefits are for social and economic well-being, while environmental and cultural well-being are diminished. The differences in worldview values and therefore the perception of an infrastructure project’s sustainability stem from the different values of the stakeholders effected. The findings demonstrate the international applicability of the Mauri Model Decision Making Framework in other cultural contexts. In the Merauke Regency, the research focused on the change in land use from wetland to agriculture purposes with four scenarios which are: the MIFEE project with 1.2 M Ha, MIFEE project with 250,000 Ha; focus sustainability, and autonomous development
These case studies offer insights at different levels of understanding:

a) The MMDMF is effective at empowering the important issues for indigenous people in decision making

b) In both case studies the development resulted in a transfer of mauri from Aotearoa, New Zealand to other parties

c) The graphical representation of accumulative change in mauri years. It a useful conceptualisation of altered future sustainability.

d) The sensitivity analysis assists understanding by framing the result from the perspective of each stakeholder. In some case illustrating clearly why the developers and the indigenous people understand the duplication of decision made in opposite ways. Example in water supply in Agats Township. Another example is Scenarios A and B in the change land use in Merauke.

11.3. Limitation of the Research

The research faces several limitations. The first limitation recognised that the process is intended to empower the research participants, however this result will be realised over a period of decades despite the completion of this research requiring a shorter time frame of three years. Next, there is the possibility that there are a lot of traditional knowledge and cultural values that have not been explored in remoter areas of the Asmat and Merauke Regencies. Lastly, mostly Indigenous People have their own rules; either they can share their cultural values and traditional knowledge with outsiders or they cannot. Thus the participants sometimes cannot share the knowledge because it is sacred and only the person who has the authority is allowed to do it.

11.4. Out Put

Even though there are limitation of the research, it has several outcomes during the time frame of the study (2012 to 2015).

11.4.1. Conferences, Symposia, Posters

a) A paper was presented in Panel 1 of the 4th International Graduate Students Conference in Indonesia, 30 October 2012. Titled: Can a decision framework from Aotearoa (New Zealand) be transferred to Papua Indonesia? Changing land use from peat land to agricultural purposes in Merauke (sole author of paper in proceeding).

b) A paper was presented in Panel 17 of The 4th International Graduate Students Conference in Indonesia on 31 October 2012, titled: Water Resource Management in
the Lowlands of Southern Papua Using a Decision Support System and Integrating Traditional Ecological Knowledge (sole of paper in proceeding).

c) A poster was participated on the EPS Poster Competition in 2012 which was in Top 20 of the Engineering Faculty so it entered the Exposure 2012 of the University of Auckland (Co-author).


e) A posters was participated on the EPS Poster Competition in 2013 (Co-author).

f) A paper was presented on the Symposium SPEAR (South Pacific Education Advance Research) of the University of Auckland, 10 September 2013,” Indigenous Knowledge and sustainability.

g) A paper was presented on the Symposium SPEAR (South Pacific Education Advance Research) of the University of Auckland, 10 September 2014(Co-author of paper in Presentation).

h) A poster was participated on the EPS Poster Competition in 2014 which was in Top 20 of the Engineering Faculty so it entered the Exposure 2014 of the University of Auckland (Co-author).


11.4.2. Sharing the Mauri Model in Indonesia

a) Sharing Knowledge about the Mauri Model Decision Making Framework in Master Disaster Management in The Civil and Environmental Engineering, Gadjah Mada University, Yogyakarta, Indonesia 01 November 2012.
b) Sharing knowledge titled: Applikasi Mauri Model decision making framework di Agats Asmat (General Lecturing) at the Urban Planning Department of The Cendewasih University, Jayapura, Papua, 24 October 2014

11.4.3. Journals

a) Concept Alignment for Sustainability Analysis in New Geo-cultural Contexts: Relevance of the Mauri Model in Asmat, Papua on Alternative Journal September 2014 (Wambrauw and Morgan, 2014)

b) Understanding the Differing Realities Experienced by Stakeholders Impacted by the Agats Municipal Water Supply, Papua, was accepted in Water Utility Journal (Wambrauw, E and Morgan, K, forthcoming)

c) The Sustainability of the Merauke Integrated Food and Energy Estate (MIFEE) (have acceptance for a proposal article for a conference, on The International Conference on Environmental, Cultural, Economic, and Social Sustainability (submitted)

11.5. Future Works

The doctoral research allowed full investigation of two cases studies; the Asmat and Merauke Regencies. As a result, the Mauri Model Decision Making Framework has been shown to be applicable in those areas. Papua encompasses a vast territory which consists of numerous tribes in the region. The MMDMF includes a cultural dimension in its assessment, which means that it fits in Papua. Most, recently the Mauri Model has been applied in Jayapura Selatan Districts especially to assess the Hamadi Hotel camp bridging (9,058.60 metres) and alternative road (12 Kilometres) under a Jayapura regency Development Agency contract from 2015 to 2016. The bridge connection is in the tidal zone in close proximity to two cultural islands (including sacred places) and places on the alignment are through mangrove forest. My role is expert advisor regarding project impact and sustainability (BAPPEDA-Jayapura, 2015). The MMDMF is being applied to other four further districts of Jayapura Regency. As explained in Section 11.3 the purpose of the research is to empower the participants and so, for future research, the participants have to be more involved in decisions about the selection of indicators and ranking impact assessments. Contracts progressing to assess infrastructure in Jayapura includes three public consultation (See Fig.11.1 and Fig.11.2) exercises during a period of five months. Thus, the MMDMF can apply in other areas in Papua and Indonesia.
11.6. The Contribution of the Research

The Mauri Model Decision Making Framework empowers the concepts intrinsic to the traditional ecological knowledge. The Mauri Model Decision Making Framework examines the sustainability of the four dimensions of wellbeing; the economical dimension, the cultural dimension, the social dimension, and the environmental dimension. Traditional Ecological Knowledge has not been integrated into decision processes very well in the past. Now it will be included more effectively in the decision making because the perspectives of the Indigenous Peoples will be acknowledge for development in their own territory. The Mauri Model will help the policy makers in their decision making to achieve social justice and equality, especially for the Indigenous Peoples.

![Focus Group with the community in Jayapura Selatan District (Vina Kambu, 2015)](image1)

Figure 11. 1 Focus Group with the community in Jayapura Selatan District (Vina Kambu, 2015)

![Focus Group with the Local Government (Vina Kambu, 2015)](image2)

Figure 11. 2 Focus Group with the Local Government (Vina Kambu, 2015)
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