Integrating Indigenous Knowledge with Modern Knowledge for Early Warning System

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Keywords:
- Disaster Risk Reduction
- Indigenous Knowledge
- Modern Technology
- Knowledge Integration

CHAPTER I
INTRODUCTION

Keywords:
- Disaster Risk Reduction
- Indigenous Knowledge
- Modern Technology
- Knowledge Integration

RO1, RQ1 and RH1

Research Objective 1 (RO1)

To identify the classification and ranking of indigenous knowledge.

Research Question 1 (RQ1)

How should indigenous knowledge be classified and ranked?

Research Hypotheses 1 (RH1)

H.1-1 Indigenous knowledge can be classified based on their aspect, practiced and how it is gained;

H.1-2 Indigenous knowledge could be ranked based on their likelihood integrated with modern technology.

RO2, RQ2 and RH2

Research Objective 2 (RO2)

To find out the impact of modern technology on indigenous culture.

Research Question 2 (RQ2)

To what extent does modern technology have an impact on indigenous culture?

Research Hypotheses 2 (RH2)

Some technology has a positive impact, while others may have a negative impact on culture.

H.2-1 Television has negative impact to culture;

H.2-2 Mobile phone has no impact to culture;

H.2-3 Vehicle has positive impact to culture;

H.2-4 Radio has negative impact toward Indigenous culture.

RO3, RQ3 and RH3

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Research Objective 3 (RO3)

To probe the integration of indigenous knowledge with modern technology in community disaster risk reduction.

Research Question 3 (RQ3)

How does the integration of indigenous knowledge with modern technology affect community DRR?

Research Hypotheses 3 (RH3)

H.3-1 Knowledge integration will be time effective;

H.3-2 Knowledge integration will be cost effective;

H.3-3 Knowledge integration will have good acceptance from the community.

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Table 1.2
Definition of Keywords
(Page 13)

Keywords	Definition
Disaster Risk Reduction	The concept and practice of lowering disaster risk through systematic efforts to analyze and reduce the causal factors of disasters (UNISDR, 2009)
Indigenous Knowledge	The knowledge that people in a given community has developed over times, and continues to develop. It is based on experience, often tested over centuries of use, adapted to local culture and environment, dynamic and changing. (IIRR, 2006)
Modern Technology	The advancement of the old **technology** with new additions and modifications. **Technology** itself is the application of knowledge and science (Oxford Dictionary)
Knowledge Integration	Process of synthesizing multiple knowledge model into a common model, the process of **incorporating new information into a body of existing knowledge**. (Bohensky and Maru, 2011)
Natural Hazard	**Natural** processes or phenomena that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. (UNISDR, 2009)
Risk	The susceptibility of a society or group of people to the **impact of hazard** (UNISDR, 2009)
Disaster Mitigation	The wide array of actions that can be taken **to reduce vulnerability** (Haque, C.E. & Burton, I, 2005)

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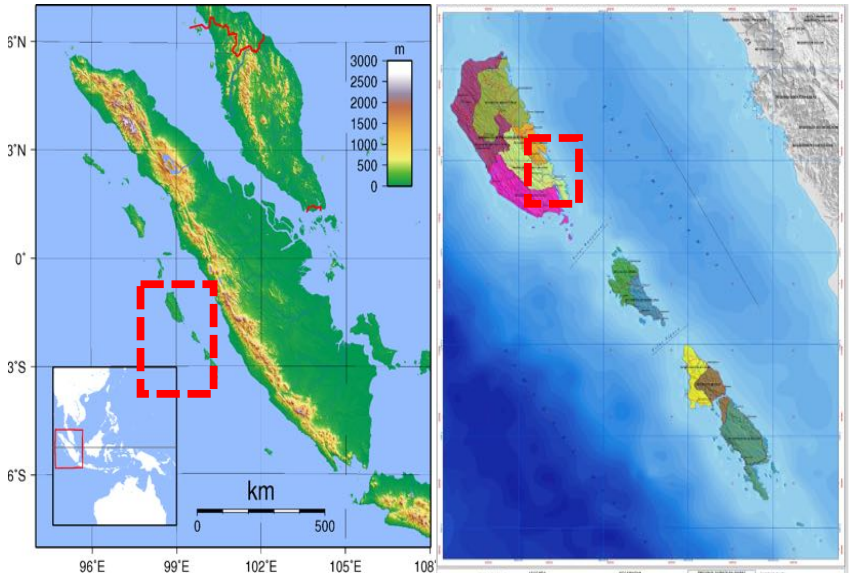

Figure 1.1
Case Study Area

Source: Gispedia (2019)

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Table 1.3
RATIONAL REASON FOR STUDY AREA
(Page 16)

No.	Rational Reason for Choosing of Study Area
1.	In Indonesia over the last 30 years, there have been an average of 289 significant natural disasters per year.
2.	Average annual death toll of approximately 8,000 (GFDRR, 2017).
3.	Mentawai is one of the oldest indigenous community in Indonesia.
4.	The ancestors of the Mentawai tribe is inhabited since the year 500 BC. (Rosa, 1994).
5.	Great earthquakes and tsunamis are to be expected in near future in west coast of Sumatera, Sieh et al. (2000, 2006, 2007).
No.	**Rational Reason for Choosing Indigenous Knowledge**
1.	Indigenous Knowledge has capacity in disaster risk reduction which **cost-effective, using participatory and in sustainable ways** (Hiwasaki, et al., 2014).
2.	Indigenous **already exist** in the community.

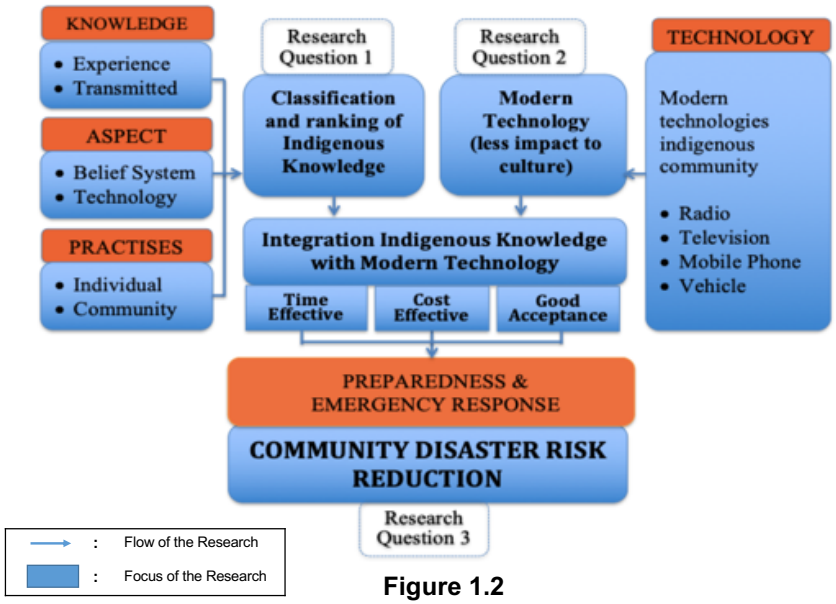


Figure 1.2
Research Framework

Source: The Author, 2019

Table 1.5
Scope of the Research

No.	Scope of The Research
1.	Disaster risk reduction in this study may not cover all area or aspect on disaster management cycles, Resilience in this research mainly focus on **Preparedness and Emergency response** by proposing Early warning system from knowledge integration.
2.	Knowledge integration find in this research only limited to *incorporation between modern technology with indigenous knowledge.*
3.	Knowledge integration on this study only used for **tsunami disaster early warning system**.

Source: The Author, 2019

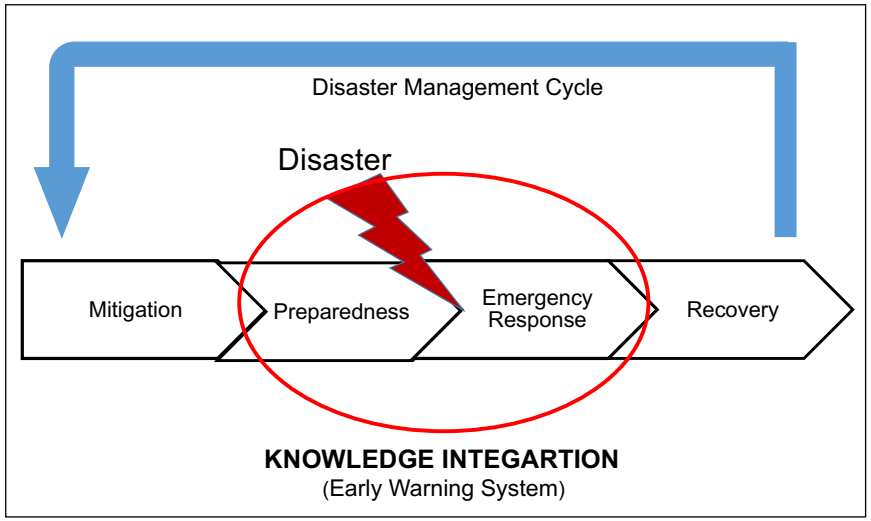


Figure 1.3
Scope of the Research

Source: The Author, 2019 adapted from Alexander (2002)

Research Gap

1. Little of the knowledge integration **literature** engages substantially with disaster risk reduction, and where it does the relation between indigenous knowledge, integration and disaster risk reduction **is not particularly clear** (Bohensky and Maru, 2011).
2. The link between knowledge integration and disaster risk management concept is often **tenuous** and mostly **theoretical** or **hypothetical** rather than **empirical** (Bohensky and Maru, 2011).

CHAPTER II
CLASSIFICATION OF INDIGENOUS KNOWLEDGE

Research Objective 1

Identifying the classification and ranking of indigenous knowledge.

Research Question 1 (RQ1):

How should indigenous knowledge be classified and ranked?

Research Hypotheses 1 (RH1):

H.1-1 Indigenous knowledge can be classified based on their aspect, practiced and how it is gained;

H.1-2 Indigenous knowledge could be ranked based on their likelihood integrated with modern technology.

INDIGENOUS KNOWLEDGE	FEATURES	INDIGENOUS KNOWLEDGE	FEATURES
SAGO STORING For food storing technique		**TUDDUKAT/ DRUM**	
UMA Traditional house of Mentawai		**USE OF MEDICAL PLANTS**	
PANAKI Mutual assistance		**OBSERVE CLOUD, WAVE AND WIND**	
FORECASTING		**OBSERVE CELESTIAL BODY**	

Figure 2.1
Indigenous Knowledge in Mentawai

Source: Henry, R (2017)

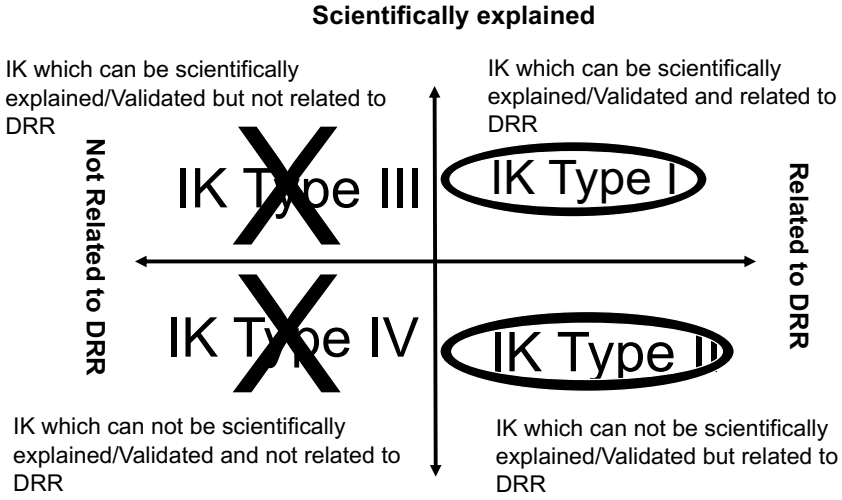


Figure 2.2
Validation of Indigenous Knowledge

Source: The Author, Analysis, 2019

Table 3.1
Classification of Indigenous Knowledge

Type	How it is gained (X) (Mercer, 2010)	Aspect (Y) (Shaw, 2008)	Practiced (Z) (Batisde, 2008)
Type a	Transmitted (X_a)	Technology (Y_a)	Common (Z_a)
Type b	Experienced (X_b)	Belief System (Y_b)	Specialist (Z_b)

Source: The Author, 2019

Table 2.2
Classification of Indigenous Knowledge

Combination	Type of knowledge	Code	Indigenous knowledge	Type
X_a, Y_a, Z_a	Transmitted, Technical, Common	C1	Sago storing	IK Type 1
X_a, Y_a, Z_b	Transmitted, Technical, Specialist	C2	*UMA* / Traditional house	IK Type 1
X_a, Y_b, Z_a	Transmitted, Belief System, Common	C3	*PANAKI*/ Mutual assistance	IK Type 1
X_a, Y_b, Z_b	Transmitted, Belief System, Specialist	C4	Forecasting	IK Type II
X_b, Y_a, Z_a	Experience, Technical, Common	C5	*TUDDUKAT* / Drum	IK Type 1
X_b, Y_a, Z_b	Experience, Technical, Specialist	C6	Use of medicinal plants	IK Type 1
X_b, Y_b, Z_a	Experience, Belief System, Common	C7	Observe cloud, wave and Wind	IK Type 1
X_b, Y_b, Z_b	Experience, Belief System, Specialist	C8	Observe celestial body	IK Type 1

Source: The Author, 2019

Focus Group Discussion for Ranking of Indigenous Knowledge Based on their Likelihood Integrated With Scientific Knowledge

No.	Attribute	Description	Number of Participant
1.	Time	August 30th 2017	
2.	Location	Muaro Siberut, Mentawai	
3.	Technique	Focus Group Discussion	
4.	Participant (57 people)	Non Government Organization	(8 persons)
		Local Expert / From University	(5 persons)
		Government Official	(3 Persons)
		Community Leader	(6 persons)
		Religious Leader	(5 persons)
		Community member	(30 persons)

Source: The Author, 2019

Table 2.3
Result of Focus Group Discussion using Pair-Wise Ranking

CODE	C1	C2	C3	C4	C5	C6	C7	C8
C1	N/A	C1	C1	C1	C5	C6	C7	C8
C2	C1	N/A	C2	C2	C5	C6	C7	C8
C3	C1	C2	N/A	C3	C5	C6	C7	C8
C4	C1	C2	C3	N/A	C5	C6	C7	C8
C5	C5	C5	C5	C5	N/A	C5	C5	C5
C6	C6	C6	C6	C6	C5	N/A	C6	C6
C7	C7	C7	C7	C7	C5	C6	N/A	C7
C8	C8	C8	C8	C8	C5	C6	C7	N/A
Total	**6**	**4**	**2**	**0**	**14**	**12**	**10**	**8**

Remarks

C1	Transmitted, Technical, Common	C5	Experience, Technical, Common
C2	Transmitted, Technical, Specialist	C6	Experience, Technical, Specialist
C3	Transmitted, Belief System, Common	C7	Experience, Belief System, Common
C4	Transmitted, Belief System, Specialist	C8	Experience, Belief System, Specialist

Pair-wise ranking is a process of comparing alternatives in pairs to judge which entity is preferred over others

Source: FGD on August 2017

Table 2.4
Ranking of Indigenous Knowledge Based on Their Likelihood Integrated With Scientific Knowledge

Ranking	Code	Combination	Type of Knowledge	Indigenous Knowledge
1	C5	X_b, Y_a, Z_a	Experience, Technical, Common	Use of *Tuddukat* / Drum
2	C6	X_b, Y_a, Z_b	Experience, Technical, Specialist	Use of Medicinal plants
3	C7	X_b, Y_b, Z_a	Experience, Belief System, Common	Observe cloud, wave
4	C8	X_b, Y_b, Z_b	Experience, Belief System, Specialist	Observe celestial body
5	C1	X_a, Y_a, Z_a	Transmitted, Technical, Common	Food storing
6	C2	X_a, Y_a, Z_b	Transmitted, Technical, Specialist	*Uma* / Traditional house
7	C3	X_a, Y_b, Z_a	Transmitted, Belief System, Common	*Panaki* / Mutual assistance
8	C4	X_a, Y_b, Z_b	Transmitted, Belief System, Specialist	Forecasting event

Source: The Author, 2019

FINDINGS

H.1-1 is confirmed

Classification of indigenous knowledge can be done based on how it is gained (Transmitted and Experience Knowledge), based on their aspect (technology and belief system) and based on practiced (Common and Specialist)

H.1-2 is confirmed

Ranking of indigenous knowledge based on their likelihood integrated with modern science are established through FGD and using Pair-Wise Rank method, where "*tuddukat"* *(*Experience, Technical and Common Knowledge) more likely to be integrated with modern technology.

(Radio)

Source: https://www.panasonic.com/middleeast/en/consumer/home-entertainment/audio/other-radio-products/rf-562dd.html

(Television)

Source: https://id.wikipedia.org/wiki/Televisi

(Mobile phone)

Source: https://id.wikipedia.org/wiki/handphone

(Vehicle)

Source:https://www.modifikasi.net/modifikasi-becak-motor-dari-motor-roda-tiga/

Figure 3.1
Modern Technology for Disaster Risk Reduction in Mentawai

IMPACT OF MODERN TECHNOLOGY TO INDIGENOUS CULTURE

Research Objective 2

Finding out the impact of modern technology on indigenous culture.

Research Question 2 (RQ2):
To what extent does modern technology have an impact on indigenous culture?

Research Hypotheses 2 (RH2):
Some technology has a positive impact, while others technology may have a negative impact on culture.

H.2-1 Television has negative impact on indigenous culture;

H.2-2 Mobile phone has negative impact on indigenous culture;

H.2-3 Vehicle has negative impact on indigenous culture;

H.2-4 Radio has negative impact on indigenous culture.

Internet

Source: https://spectrum.ieee.org/tech-talk/aerospace/satellites

Cable and Satellite Television

Source:https://spectrum.ieee.org/tech-talk/aerospace/satellites

Mobile Phone

Source:https://id.wikipedia.org/wiki/handphone

Vehicle (Car)

Source: https://www.liputan6.com/otomotif/read/3572445/harapan-komunitas-soal-generasi-baru-toyota-avanza

Figure 3.2
Modern Technology In Modern Community

Figure 3.3
Study Area

Source: Gispedia (2019)

Table 3.1
Survey of Impact of Technology on Indigenous Culture in Mentawai

No.	Attribute	Explanation
1.	Time	August 27th – September 13th 2018
2.	Location	Muntei and Muaro Village, South Siberut District
3.	Number of Population	Muntei village : 398 Household
		Muaro Village : 503 Household
4.	Number of Sample	Muntei village : 39 Household
		Muaro Village : 50 Household
5.	Sampling Method	Simple Random Sampling

Source: The Author, 2019

Table 3.2
Technology Penetration in Muntei and Muaro based on Ownership of Television, Radio, Cellphone, and Vehicle

Area	Number of Sample	Television (Household)		Radio (Person)		Mobile phone (Person)		Vehicle (Household)	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%
Muntei	39	13	33	10	26	20	51	18	46
Muaro	50	25	50	10	20	34	68	29	58
Total	89	38		20		54		47	

Source: The Author, 2019

Table 3.3 Variables

NO.	INDEPENDENT VARIABLE	X_i
	CHARACTERISTICS	
1.	Location	X_1
2.	Ethnic group	X_2
3.	Age	X_3
4.	Education	X_4
5.	Length of study	X_5
6.	Religion	X_6
7.	Number of household	X_7
	TECHNOLOGY	
8.	Television ownership	X_{11}
9.	Radio ownership	X_{12}
10.	Mobile phone ownership	X_{13}
11.	Vehicle ownership	X_{14}

INDEPENDENT VARIABLE

1. Characteristics included in independent variable because this variable were often as cofounded factors (Mishra, et al., 1999). Moreover In the social impact assessment, population characteristics play a significant role in determining sociocultural factors (ICGPSIA, 1995).
2. Technology Variable based on researcher's survey conducted in August 2017

Note : Variable number 8 till 10 (X_8 – X_{10}) are absent, to differentiate Characteristic variable and Technology variable

Source: The Author, 2019

Table 3.3 Variables

NO.	DEPENDENT VARIABLE	Y_i
1.	Knowledge	Y_1
2.	Kinship	Y_2
3.	Tools	Y_3
4.	Beliefs	Y_4
5.	Language	Y_5
6.	Arts	Y_5

DEPENDENT VARIABLE
Culture as patterned ways of thinking, feeling, and reacting (Kluchohn,1954) Based on Kluchohn's categorization, there are seven elements of culture, namely religious system, kinship, knowledge, economics, technology and tools, language, and arts.

Note: Dependent Variable for Economic is analyze in different page since it use different model (multinomial logistic) regression

Source: The Author, 2019

Table 3.5
Binary Logistic Regression

	KNOWLEDGE (Y_1)			KINSHIP (Y_2)			TOOLS (Y_3)			BELIEFS (Y_4)			LANGUAGE (Y_5)			ARTS (Y_6)		
	N R^2 = 0.692			N R^2 = 0.441			N R^2 = 0.413			N R^2 = 0.228			N R^2 = 0.403			N R^2 = 0.359		
	Sig. = 0.000			Sig. = 0.000			Sig. = 0.000			Sig. = 0.016			Sig. = 0.000			Sig. = 0.000		
	α = - 0.491			α = 0.908			α = -1.188			α = 0.416			α = 1.161			α = -0.286		
	β_1	SE_1	OR_1	β_1	SE_1	OR_1	β_1	SE_1	OR_1	β_1	SE_1	OR_1	β_1	SE_1	OR_1	β_1	SE_1	OR_1
Location (X_1)	3.108*	0.831	22.386	-1.511*	0.622	0.221				2.308*	1.148	10.052				1.733*	0.709	5.658
Ethnic Group (X_2)				-1.405	1.258	0.245	-2.370	1.300	0.093	-1.746	1.027	0.175				-3.383*	1.215	0.034
Age (X_3)							1.933*	0.785	6.911	1.830	0.912	6.237	1.234	0.859	3.435	1.816	0.717	6.146
Education (X_4)	-2.518*	0.873	0.081	0.667	0.648	1.948												
Length of study (X_5)																		
Religion (X_6)							-1.054	1.097	0.349									
Number of household (X_7)				-0.220	0.176	0.110	0.543	0.270	1.721				0.479	0.275	1.615			
Television ownership (X_{11})				-2.209*	0.766	0.110	-1.458*	0.745	0.233				-2.963*	1.166	0.052			
Radio ownership (X_{12})	3.729*	1.118	41.627	2.285*	0.799	9.825												
Cellphone ownership (X_{13})	2.055*	0.789	7.809				-0.504*	0.837	0.604				-0.760	1.201	0.467			
Vehicle ownership (X_{14})																-0.286	0.755	0.751

□ = Significant Value (* = p < 0.050)

Source: The Author's Analysis, 2019

TABLE 3.4 VARIABLES

NO.	INDEPENDENT VARIABLE	X_i
	CHARACTERISTICS	
1.	Location	X_1
2.	Ethnic group	X_2
3.	Age	X_3
4.	Education	X_4
5.	Length of study	X_5
6.	Religion	X_6
7.	Number of household	X_7
	TECHNOLOGY	
8.	Television ownership	X_{11}
9.	Radio ownership	X_{12}
10.	Mobile phone ownership	X_{13}
11.	Vehicle ownership	X_{14}

INDEPENDENT VARIABLE

1. Characteristics included in independent variable because this variable were often as cofounded factors (Mishra, et al., 1999). Moreover In the social impact assessment, population characteristics play a significant role in determining sociocultural factors (ICGPSIA, 1995).
2. Technology Variable based on researcher's survey conducted in August 2017

DEPENDENT VARIABLE

7. Economic (Y_7)

DEPENDENT VARIABLE

Culture as patterned ways of thinking, feeling, and reacting (Kluchohn,1954) Based on Kluchohn's categorization, there are seven elements of culture, namely religious system, kinship, knowledge, economics, technology and tools, language, and arts.

7. ECONOMY

No significant value in final model however, statistically there are 6 variables that have significant value in likelihood ratio test.

Likelihood Ratio Tests

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	87.285[a]	.000	0	
X_5 (Length of study)	104.040[b]	16.755	6	0.010
X_7 (Number of household member)	103.995[b]	16.711	6	0.010
X_1 (Location)	98.340[b]	11.056	6	0.087
X_3 (Age)	122.360[b]	35.075	6	0.000
X_4 (Education)	128.831[b]	41.546	6	0.015
X_{11} (Television ownership)	94.540[b]	7.255	6	0.298
X_{12} (Radio ownership)	102.497[b]	15.212	6	0.019
X_{13} (Cellphone ownership)	116.510[b]	29.225	6	0.000
X_{14} (Vehicle ownership)	92.350[b]	5.065	6	0.536

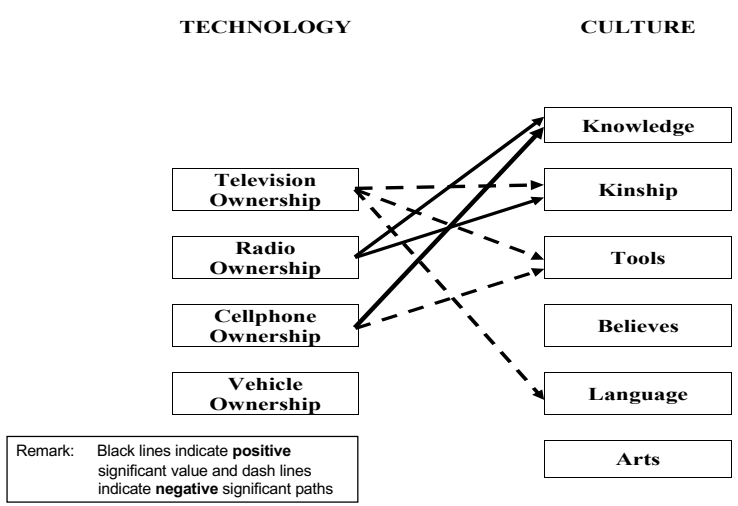


Figure 3.5
Diagram of Result Analysis
(Impact of Technology on Indigenous Culture)

Source: The Author, Analysis, 2019

FINDINGS CHAPTER III

From the analysis it can be seen that technology has positive impact, while other technologies may have negative impact and another technology did not show any significant impact on indigenous culture.

H	VARIABLE	NEGATIVE	POSITIF	NO IMPACT
H 2-1	Television	√		
H 2-2	Mobile phone	√	√	
H 2-3	Vehicle			√
H 2-4	Radio		√	

Source: The Author, Analysis, 2019

FINDINGS

H.2-1 is confirmed

Television has negative impact on culture in terms of kinship, tools and language.

H.2-2 is not fully confirmed

Mobile phone has negative impact on culture in terms of tools and positive impact in terms of knowledge.

H.2-3 can not be confirmed

Vehicle has no impact on culture.

H.2-4 can not be confirmed

Radio has a positive impact on culture in terms of knowledge and kinship since radio is broadcasted using local language which makes indigenous people acquired new information and enrich their knowledge.

INTEGRATING INDIGENOUS KNOWLEDGE WITH MODERN KNOWLEGDE

Research Objective 3:

Probing the integration of indigenous knowledge with modern technology in community disaster risk reduction.

Research Question 3 (RQ3):

How does the integration of indigenous knowledge with modern technology affect community disaster risk reduction?

Research Hypotheses 3 (RH3):

Integration of indigenous knowledge with modern technology can improve community disaster risk reduction.

H.3-1 Knowledge integration will be time effective;
H.3-2 Knowledge integration will be cost effective;
H.3-3 Knowledge integration will have good acceptance from the community.

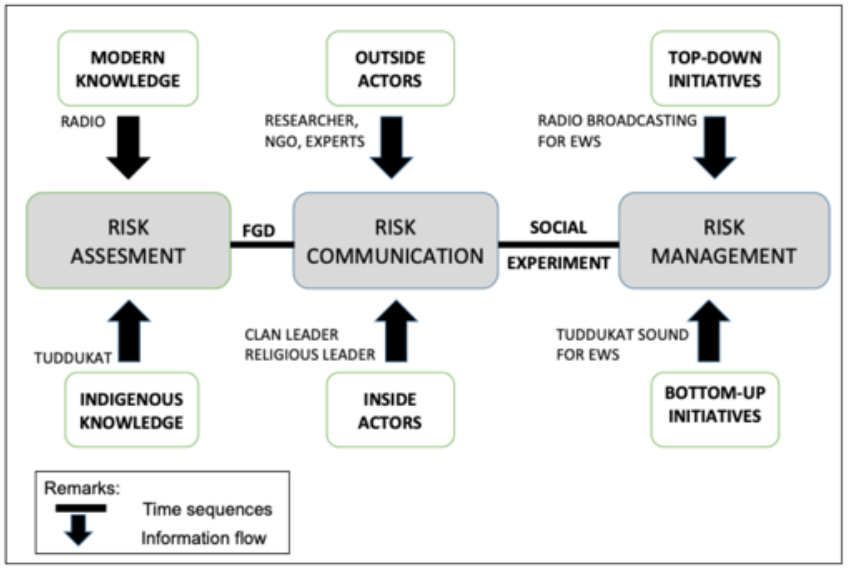


Figure 4.1
Roadmap Of Knowledge Integration In Disaster Risk Reduction.

Source: The Author Adapted from Gailard and Mercer (2012)

Table 4.1
Roadmap of Knowledge Integration in Mentawai

Risk Assessment	Risk Communication	Risk Management
• Hazard (Earthquake and Tsunami) • Indigenous Knowledge (*Tuddukat*) • Modern Technology (Radio)	• Outside Actors (researchers, NGO, Experts) • Inside Actor (Religious and Community Leader, Community Member)	• *Tuddukat* (Tone and Beat) • Radio (Which Radio, What Information) • Experiment (Live Exercise)

Figure 4.2 Risk Communication *(Page 95)*

Figure 4.3 Risk Management

Sources: Author March 20th 2019

Table 4.2
Simulation Experiment

LOCATION	PARTICIPANT	COMMITTE
• Muntei Village Siberut Island • Muaro Village Siberut Island	• 50 People from Muntei Village • 50 People from Muaro Village	• Local disaster Management Agency Official • NGO (YCCM and ASB) • Clan Leader and Religious Leader

Process

- An earthquake occurred on March 22nd 2019 off the western coast of Sumatra at 09.45 local time (02.45 UTC) with a moment magnitude of 7,7. The earthquake occurred around 90 miles (144 Km) North west of Mentawai islands, the USGS reported the hypocenter of the quake at 8,8 miles (33.o KM). The intensity is MM V in TuaPeijat and MM IV in Padang.
- At 09.47 Meteorological agency enacted tsunami warning for coastal area in Mentawai Island.
- At 09.48, Sura' Radio station broadcasted about the early warning to all the area in Mentawai.
- At 09.49, People in Muntei and Muaro struck the Tuddukat telling about the tsunami approach.
- People who heard the sound of tuddukat telling about tsunami, run to the higher place (evacuation site) near to their place.

Source: The Author, 2019

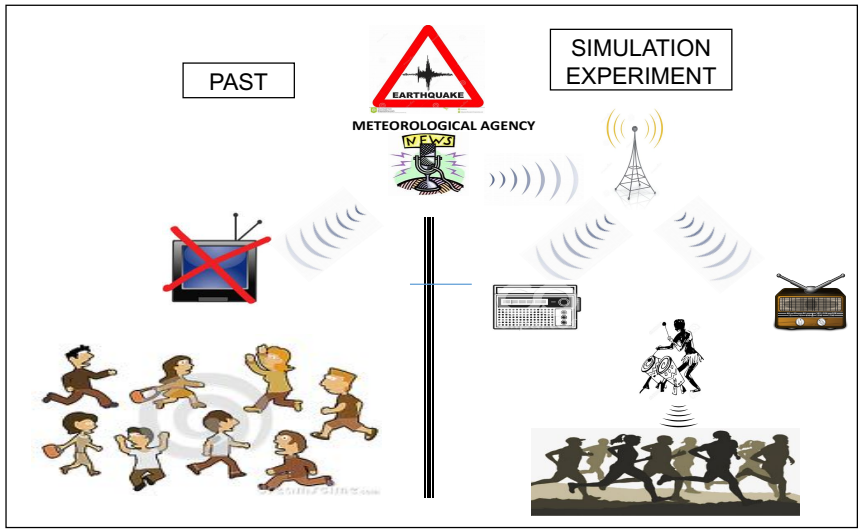


Figure 4.4
Illustration of Early Warning in Indonesia

Source: The Author, 2019

Table 4.3
Process of Simulation Experiment

	1st Simulation With Tuddukat (Drum)	2nd Simulation Without Tuddukat (Drum)
Tools	Radio Broadcast and Tuddukat Sound	Radio Broadcast
Time	9.45 AM (Local time) March 22nd 2019	11.30 AM (Local time) March 22nd 2019
Participant	100 person	100 person
Location	Muntei and Muaro	Muntei and Muaro

**The exercise was conducted 2 times*

Figure 4.5
Tuddukat

Source: The Author, taken on March 22nd 2019

Figure 4.6
***Sikebukat Uma* Struck Tuddukat**

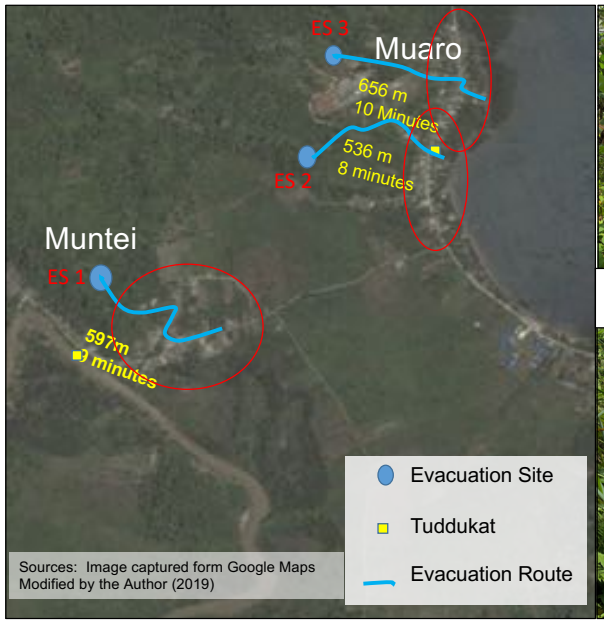
Source: The Author, taken on March 22nd 2019

Table 4.4
Results: Causalities of Community With and Without Tuddukat as EWS

Type	With Tuddukat Sound 1st Simulation		Without Tuddukat 2nd Simulation	
	Save (≤ 10 minutes)	Victim (> 10 minutes)	Save (≤ 10 minutes)	Victim (> 10 minutes)
Kids (≤ 10 yo)	10	0	9	1
Teens (10-20 yo)	13	0	10	3
Adult (20-50 yo)	32	0	28	4
Elder (≥ 50 yo)	45	0	31	14
Total	100	0	78	22

*Golden time (time between earthquake and tsunami arrived) in Mentawai based on previous experiences is 10 minutes.

Source: Live Exercise in Siberut conducted by the author (March, 2019)



Live Exercise
Source: The Author, March 22nd 2019

Figure 4.7 Evacuation Routes and Evacuation Sites

Table 4.5
Results of Exercise

NO.	INDICATOR			RESULT
1.	Early warning time (time from the earthquake occurred to the time of tuddukat struck)		:	1 minute
2.	Reaction Time: (Time from the tuddukat struck to people evacuate)		:	1 minute
3.	Range of area for early warning: Range of tuddukat sound		:	3-4 Km
4.	Percent of people could save their live (Percentage of people came to evacuation site in less than 10 minutes from earthquake occurred)*	• With Tuddukat	:	100 % (N= 100)
		• Without Tuddukat	:	78 % (N= 100)
5.	Percentage of people who knows the tuddukat sound		:	60 % of participant know the meaning of tuddukat sound. (N:100)

Source: The Author, Analysis, 2019

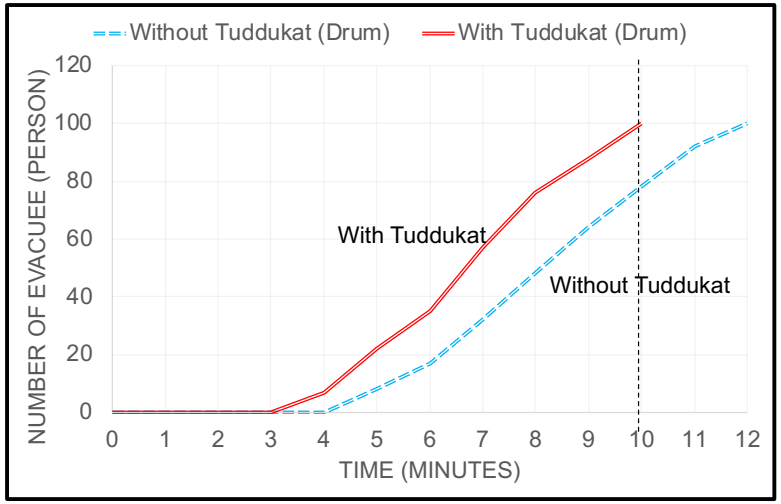


Figure 4.4
Number of Evacuee with and without Tuddukat (Drum)

Source : Live Exercise in Siberut (March, 2019)

Table 4.6
Advantages of using Tuddukat Compare to Sirens

Attribute	Tuddukat	Sirens (Modern EWS)
Construction cost	Rp 10.000.000,-**	Rp 200.000.000,-*
Maintenance cost (per year)	Rp 0,-**	Rp 100.000.000,-*
Range (at night)	7-8 Km**	2-3 Km*
Range (daylight)	3-4 Km**	2-3 Km*
Power Supply	Human power**	Electricity / Battery*
Product	Warning	Alert

As per March 2019

*Source: National and local disaster management agency (BNPB 2012)
**Source: Interview with community leader (March, 2019)

Table 4.7
Acceptance from the Community
(Page 102)

Element of the Community	Number	Acceptance
Religious Leader (*Sikerei*)	5 people	Approved
Clan Leader	6 people	Agree and Accept
Community member	80 % * (n=100)	Satisfied

** 20 % give no answer*

Source: The Author, Questionnaire (2019)

FINDINGS

Integration indigenous knowledge and modern technology is an useful tool to undertake natural disaster such a tsunami. Simulation experiment revealed that integrated knowledge saved more lives on disaster event.

H.3-1 is confirmed

Knowledge integration proved to be time effective, using integrated knowledge demonstrate the evacuation can be done in a short time (under 10 minutes)

H.3-2 is confirmed

Knowledge integration proved to be cost effective, initial and maintenance cost is lower than advanced technology such as sirens

H.3-2 is confirmed

Knowledge integration proved to have good acceptance from the community. It is verified that acceptance from community is better since 80% of participant satisfied with this integration, all the clan leader and religious leader approved using this integration

CONCLUSION

CONCLUSIONS

- Experienced knowledge, technical knowledge and common knowledge has potential to integrated with Modern science and knowledge compare to Transmitted knowledge, Belief system and specialist knowledge. Moreover in the process the validation of indigenous knowledge are needed to establish scientific base of indigenous knowledge.
- Modern technologies such as Television and Mobile phone may have negative impact to culture of indigenous community while other technologies like Radio have less negative impact to culture.
- Integration of indigenous knowledge and modern technology in disaster risk reduction proved to be time effective, cost effective and good acceptance from the community.

CONTRIBUTIONS

- **Academic Contribution**
  - This study contributes on discussion of policy science society regarding the effectiveness of integration of indigenous knowledge and modern knowledge not only in theoretical but with empirical evidence. Moreover, the integration itself should consider the impact to the indigenous culture.

- **Practical Contribution**
  - Integration of Tuddukat and Radio can be used as an early warning system toward tsunami disaster. This integrated knowledge more effective in terms of time and cost while it also has better acceptance from the indigenous community

FUTURE RESEARCH

- Need more research regarding using knowledge integration in other type disaster rather than tsunami hazard.
- The classification of indigenous knowledge in this study may not comprehensive yet, needs more study to make a comprehensive classification of indigenous knowledge.
- Regarding indigenous community, each of indigenous community may have a different characteristic and different knowledge, therefore need further study in another area for knowledge integration.
- In terms of simulation conducted in this study area, future research should be conducted to explore more the possibility of transferable indigenous knowledge.

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Thank you

APPENDICES

TIME	LOCATIONS	METHOD	NUMBER OF SAMPEL	OUTCOME
February - March 2017	TuaPeijat, Mentawai	interviews	4 Disaster management agency official 4 NGO	Data Analysis Chapter 3
August – September 2017	Siberut island	Interviews	2 Community Leaders 2 Religious Leaders 1 District leaders	Data analysis chapter 3 and 5
		FGD	6 Community Leaders 5 Religious Leaders 30 Community member, 8 NGO 5 Expert (from university & practitioners) 3 Official government	Ranked of indigenous knowledge Chapter 3
June – July 2018	Tuapeijat, Mentawai	interviews	3 Disaster management agency official 6 NGO	Data Analysis Chapter 4
September 2018	Siberut island	Questionnaire	89 Household	Data analysis Chapter 4
February - March	TuaPeijat and Siberut	interviews	2 Disaster management agency official 2 NGO	Data Analysis chapter 5
		Simulation & Questionnaire	5 Religious and 6 community leader 100 peoples	Data Analysis chapter 5

NO	Category	Value	TOTAL Frequency	%
1	Relation with household	husband	21	23,60
		wife	28	31,46
		children	33	57,89
		brother/sister in-law	2	3,51
		son/daughter in law	1	1,12
		grand son/ grand daughter	1	1,12
		parent	1	1,33
		relative	2	2,67
		Total	89	
2	sex	male	57	64,04
		female	32	35,96
		Total	89	
3	Religion	Catholic	75	84,27
		Islam	9	10,11
		Christian	3	3,37
		Arat Sabalungan	2	2,25
		Total	89	

NO	Category	Value	TOTAL Frequency	%
4	tribe	Mentawaian	82	92,13
		Minangnesse	4	4,49
		Javanesse	2	2,25
		Bataknesse	1	1,12
		Total	89	
5	Education level	No school	38	42,70
		Not pass the elementary	12	13,48
		Elementary School	12	13,48
		Junior High School	21	23,60
		Senior High School	2	2,25
		Diploma/higher	4	4,49
		Total	89	
6	Location	Muntei	39	43,82
		Muaro	50	56,18
		Total	89	

INDEPENDENT VARIABLE		60
1. LOCATION (X_1)	0 = MUNTEI	1 = MUARO
2. ETHNIC GROUP (X_2)	0 = MENTAWAIAN	1 = OTHER ETHNIC
3. AGE (X_3)	0 = > 30 YO	1 = < 30 YO
4. EDUCATION (X_4)	0 = No School	1 = have school
5. LENGHT OF STUDY (X_5)	Real Data, Year of school length	
6. RELIGION (X_6)	0 = Christian	1 = OTHER RELIGION
7. NUMBER OF HOUSEHOLD (X_7)	Real data from respondents	
8. TELEVISION OWNERSHIP (X_{11})	0 = NO	1 = YES
9. RADIO OWNERSHIP (X_{12})	0 = NO	1 = YES
10. CELLPHONE OWNERSHIP (X_{13})	0 = NO	1 = YES
11. VEHICLE OWNERSHIP (X_{14})	0 = NO	1 = YES

DEPENDENT VARIABLE			
1. KNOWLEDGE (Y_1)	Knowledge about disaster and forecast	0 = No	1 = Yes
2. BELIEFS (Y_2)	Believes in sikerei	0 = No	1 = Yes
3. TOOLS (Y_3)	Ability to interpret tuddukat sound	0 = No	1 = Yes
4. KINSHIP (Y_4)	Live in the same uma/house with relatives	0 = No	1 = Yes
5. ARTS (Y_5)	Know the meaning of traditional symbol	0 = No	1 = Yes
6. LANGUAGE (Y_6)	Ability to speak local language	0 = Less Fluent	1 = Fluent
7. ECONOMY (Y_7)	Acupation sector	0 = Not Working	1 = Agriculture
		2 = Fisheries	3 = Service
		4 = Commerce	5 = Industry
		6 = Others	

1. KNOWLEDGE

The equation for this variable is as follow:

- **Logit Y_1 = $\alpha + \beta_1 X_1 + \beta_4 X_4 + \beta_{12} X_{12} + \beta_{13} X_{13}$**
- **Logit Knowledge = -1.723 + 3.108 location - 2.518 education + 3.137 radio ownership + 2.055 mobile phone ownership**

This shows that:
1. People who live in Muntei are more likely to be aware disaster risk compared to those who live in Muaro.
   - Because people in Muntei village had experienced tsunami disaster in 2010 while Muaro has not.
2. People with education are less likely to be aware of disaster risk compared to those without education
3. Those who own radios are more likely to know about disaster risk compared to those who do not own a radio.
   - This tendency appear because local radio broadcasting information about disaster at least once a week and use native language.
4. Those who own mobile phone are more likely to know about disaster risk compared to those who do not own mobile phone.
   - This appear because mobile phone also being used as radio.

2. KINSHIP

The equation for this variable is as follow:

- **Logit Y_2 = $\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$**
- **Logit Kinship = 0.416 + 2.511 location - 1.405 ethnic group + 0.667 education - 0.220 number of household member - 2.209 television ownership + 2.285 radio ownership**

This finding predicts that:
1. People who live in Muaro are less likely to live in an *Uma* than those who live in Muntei
2. Those who own a television less likely to live in *Uma* compared to those who do not have television.
   - Television in only owned by wealthy people which means they already own house separated to *Uma*. Which effect the transformation of indigenous knowledge since it transferred orally. inline with Becker et al (2008) stated that particular information dispersed within family member through oral tradition.
3. People who own a radio are more likely to live in *Uma* compared to those who do not own a radio.
   - Radio is essential information technology in Mentawai, since Radio more affordable to local people and they were using local language in their program which is more understandable to indigenous people.

3. TOOLS

The equation for this variable is as follow:

- **Logit Y_3 = $\alpha + \beta_2 X_2 + \beta_3 X_3 + \beta_6 X_6 + \beta_7 X_7 + \beta_{11} X_{11} + \beta_{13} X_{13}$**
- **Logit Tool = 0.112 - 2.370 ethnic group + 1.933 age - 1.054 religion + 0.543 number of household member - 1.458 television ownership - 0.504 mobile phone ownership**

This finding predicts that:
1. People older than 30 are more likely to know the meaning of *Tuddukat* compared to those under 30.
2. Those who own a television are less likely to know the meaning of *Tuddukat* compare to those who do not have a television.
3. Those who own a mobile phone are less likely to know the meaning of *Tuddukat* compare to those who do not own a mobile phone.

This is in line with Muhaimin (2009), who stated that televisions and cell phones contribute to cultural change in the community, mostly among teenagers and the younger generation.

4. BELIEFS

The equation model can be formed as follow:

- **Logit Y_4 = $\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$**
- **Logit Beliefs = 0.416 + 2.308 location - 1.746 ethnic group + 1.830 age**

This finding suggests that people who live in Muntei are more likely to believe in *Sikerei* compared to those who live in Muaro.

- Most of the people who live in Muntei are indigenous people of Mentawai that still attached with local culture while in Muaro some of them are outsider.

5. LANGUAGE

The equation model can be formed as follow:

- **Logit Y_5 = $\alpha + \beta_3 X_3 + \beta_7 X_7 + \beta_{11} X_{11} + \beta_{13} X_{13}$**
- **Logit Language = 1.161 + 1.234 age + 0.479 number of individuals in household - 2.963 television ownership - 0.760 mobile phone ownership**

This finding predicts that:
Those who own a television are less likely to speak Mentawai language fluently than those who do not own a television.

- Television program is using Indonesian and English language which make their ability to speak Mentawaian is reduced moreover Muhaimin (2009) stated that Television contributed to cultural change in indigenous community. mostly to teenager and young generation.

6. ARTS

The equation for this variable is as follow:

- **Logit Y_6 = $\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_{14} X_{14}$**
- **Logit Arts = -0.286 + 1.733 location - 3.383 ethnic group + 1.816 age - 0.286 vehicle ownership**

This finding predicts that

1. People in Muntei are more likely to know about local arts compared to those who live in Muaro.
2. Mentawaians are more likely to know about local arts compared to non-Mentawaians.
   - Most of the people who live in Muntei are indigenous people of Mentawai while in Muaro some of them are outsider.
   - In Muntei they have an NGO that work to promote local culture.

- ECONOMY

In this variable, a multinomial logistic regression was used to examine the impact of technology and population characteristics on economic aspects of the indigenous communities. Before conducting the multinomial logistic regression, every independent variable was examined using the crosstab method in descriptive statistics. All variables with $p < 0.50$ were considered candidates. All the candidate was used in the multinomial logistic regression.

Based on the results of the likelihood ratio test in Table 2.1, 6 of 8 variables have significant p value, namely ethnic group, education, length of study, number individuals in household, radio ownership, and mobile phone ownership. These variables have an impact on the occupations of indigenous communities in Mentawai. However, in parameter estimates, there is no single variable with significant values when the reference occupation is agriculture.

Bivariate and multivariate

- To resolve multicollinearity in binary logistic regression, simple binary logical regression is used to specify and inspect which predictors contribute to predicting the dependent variables and exclude those that do not.
- This process is conducted by made a simple logistic regression or bivariate regression for each predictor, wherein the predictors with significance of less than 0.250 are analyzed in a multivariate regression.
- In this step, all candidates undergo binary logical regression.

SIGNIFICANCES OF THE RESEARCH

This study contributed to a policy science community regarding the effectiveness of integration of indigenous knowledge and modern knowledge in building community resilient not only in theoretical but with empirical evidence. Moreover, the integration itself should consider the impact to the indigenous culture.

- Provide indigenous knowledge classification and ranking of this knowledge based on their likelihood to integrated with modern science based on focus discussion group with indigenous community, expert and government official.
- Provide discussion on how modern technology effect indigenous culture using quantitative method.
- Provide empirical evident on how integrated knowledge can be implemented and have more advantage compared to implementation of modern technology alone in terms of time effectiveness, cost and better acceptance from the indigenous communities.

FINDING CHAPTER III

No	Variables	Knowledge	Kinship	Tools	Beliefs	Language	Arts	Economy
1	Television		−	−		−		
2	Mobile phone	+		−				
3	Radio	+	+					
4	Vehicle							

Source: Author analysis