



UNIVERSITI PUTRA MALAYSIA

***ECONOMIC EFFECTS OF FLOOD DISASTER AMONG SMALLHOLDER
FARMERS IN KELANTAN, MALAYSIA***

ABDUSSALAM ADAMU JEGA

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**ECONOMIC EFFECTS OF FLOOD DISASTER AMONG SMALLHOLDER
FARMERS IN KELANTAN, MALAYSIA**

By

ABDUSSALAM ADAMU JEGA

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia
in Fulfillment of the Requirements for the Degree of Doctor of Philosophy**

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DEDICATION

This thesis is dedicated to the service of Allah towards earning his bountiful blessings and pleasures.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

ECONOMIC EFFECTS OF FLOOD DISASTER AMONG SMALLHOLDER FARMERS IN KELANTAN, MALAYSIA

By

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June 2018

Chairman : Associate Professor Norsida Man, PhD
Faculty : Agriculture

Out all natural disasters flood remained the most common and frequent in most part of the world constituting the largest economic and social effect. Smallholder farmers who solely depend on agriculture for their livelihoods are the major vulnerable group to its cascading effect. Hence, this demonstrated the importance of governments' policy responses in terms of mitigation and recovery to help in reducing flood damage and its social consequences. This study, therefore, investigates the economic effect of flood disaster among Kelantan state smallholder farmers and the level and/or extent of policy responses provided by governments in terms of mitigation and recovery, aimed at moderating/reducing flood disaster adverse effect on their livelihoods. The 2014/2015 flood disaster which was termed the most significant and largest recorded flood in the history of Kelantan state of Peninsular Malaysia, also declared as a 'tsunami-like disaster' by National Security Council (NSC) had affected about 70% of the villages who are mostly smallholder farming communities in the state.

This thesis therefore, was guided by an integrated conceptual framework predominantly developed from disaster impact model and incorporated with a construct "livelihood outcomes" from the sustainable livelihoods approach (SLA) to explain how smallholder farmers are socially affected by flood disaster. For this study the framework consist of five variables, flood disaster characteristics as independent variables, livelihood outcomes (food security and income) as dependent variable, direct and indirect effect on agriculture as mediating variables, mitigation strategies and recovery resources as moderating variables and finally socio-economic and demographic factors as control variables. A structured questionnaire was used to interview 385 affected smallholder farmers randomly selected from flood prone areas through a systematic sampling procedure. Descriptive analysis,

paired sample t-test, ordinal logistic regression, Lorenz curve and structural equation modelling were applied in analysing the data using SPSS, Microsoft Excel, STATA and AMOS respectively.

The descriptive findings of the flood disaster direct effect on smallholder farmers' agriculture, revealed that the output of almost all crops, the value of livestock and agricultural assets, declined after being affected by 2014/2015 flood disaster. Hence, despite this flooding effect, 60.8% of the affected smallholder farmers were found to be food secured during and after the disaster and their income was not adversely affected as indicated in the ordered logistic and Lorenz curve analysis. The structural equation modelling results also indicated that government policy response in terms of recovery has played a significant role in moderating the adverse flood disaster effect on smallholder farmer's livelihood outcomes. This indicates that prompt government response and other stakeholders in terms of food aid supply, cash transfer, provision of agricultural productive assets and inputs the flood victims contributed a lot in alleviating flood disaster effect on their livelihood outcomes. However, mitigation strategies provided by the government in form of dams' construction, embankments, levees etc. were found not sufficiently enough to prevent the flood disaster physical effect on their agricultural production activities and this indicates that government has paid more attention to reactive (recovery) than proactive (mitigation) measures. The mediation test results revealed that the flood disaster effect on smallholder farmer's agriculture through crop and livestock losses, consequently disrupt their livelihood outcome but on a short-term basis. Based on these results, therefore, it is important to enhance mitigation strategies as a proactive measure, so as to save millions of ringgit from flood disaster effect on agriculture. It was also observed that the level of smallholder farmer's pre and post adaptation strategies were almost moderately carried out, therefore it is important also to further enlighten smallholder farmers using their own resources to adequately undertake adaptation measures so as to complement government interventions against flood disaster. Finally, for study implications, first it could help policymakers to facilitate and improve on the flood disaster management practices to lessen/avoid future effects in the study area and also give an insight to academicians/researchers in applying and/or improving the model while assessing the effect of flood and other natural disasters in future research.

Keywords : floods disaster; agriculture; farmer's livelihood outcome; mitigation and recovery measures; flood economic effect assessment

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KESAN BENCANA BANJIR KEPADA EKONOMI PETANI KECIL-
KECILAN DI KELANTAN, MALAYSIA**

Oleh

ABDUSSALAM ADAMU JEGA

Jun 2018

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Daripada semua bencana alam, banjir terus kekal sebagai bencana yang paling biasa dan kerap berlaku di kebanyakan bahagian dunia yang menyebabkan kesan ekonomi dan sosial yang paling teruk. Petani dari kalangan pekebun kecil yang bergantung sepenuhnya pada pertanian sebagai mata pencarian mereka ialah kumpulan utama yang mudah terjejas akibat kesan yang menimpa. Ini menunjukkan pentingnya respons dasar kerajaan dari segi mitigasi dan pemulihan untuk membantu dalam mengurangkan kerosakan banjir dan akibat sosialnya. Oleh itu, kajian ini menyelidiki kesan ekonomi akibat bencana banjir terhadap petani dikalangan pekebun kecil Kelantan dan tahap dan/atau sejauh mana respons dasar yang disediakan oleh kerajaan dari segi mitigasi dan pemulihan, bertujuan untuk menyederhanakan / mengurangkan bencana banjir yang memberi kesan buruk pada mata pencarian mereka. Bencana banjir 2014/2015 yang dianggap sebagai banjir yang paling signifikan dan terbesar dalam sejarah negeri Kelantan di Semenanjung Malaysia, juga diisytiharkan sebagai bencana mirip tsunami oleh Majlis Keselamatan Negara (NSC) telah menjejaskan kira-kira 70% daripada kampung-kampung yang kebanyakannya masyarakat petani dikalangan pekebun kecil di negeri tersebut.

Oleh itu, tesis ini dilaksanakan mengikut satu rangka kerja konseptual bersepadu yang sebahagian besarnya dibangunkan daripada model impak bencana dan digabungkan dengan konstruk "hasil punca pendapatan" berdasarkan pendekatan punca pendapatan lestari (SLA) untuk menjelaskan cara petani dikalangan pekebun kecil terjejas secara sosial akibat bencana banjir. Untuk kajian ini, rangka kerja terdiri daripada lima pemboleh ubah, iaitu, ciri-ciri bencana banjir sebagai pemboleh ubah bebas, hasil punca pendapatan (keselamatan makanan dan pendapatan) sebagai pemboleh ubah bersandar, kesan langsung dan tidak langsung terhadap pertanian sebagai pemboleh ubah perantaraan, strategi mitigasi dan sumber pemulihan sebagai pemboleh ubah menyederhana dan akhirnya faktor-faktor sosio-ekonomi dan demografi sebagai pemboleh ubah kawalan. Soal selidik berstruktur

digunakan untuk menemuduga sejumlah 385 petani dikalangan pekebun kecil yang terjejas yang dipilih secara rawak dari kawasan mudah dilanda banjir melalui prosedur persampelan sistematik. Analisis deskriptif, ujian-t sampel berpasangan, regresi logistik ordinal, lengkung Lorenz dan pemodelan persamaan struktur, masing-masing digunakan untuk menganalisis data menggunakan SPSS, Microsoft Excel, STATA, dan AMOS.

Penemuan deskriptif kesan langsung bencana banjir kepada petani dikalangan pekebun kecil, mendedahkan bahawa pengeluaran hampir semua tanaman, nilai ternakan dan aset pertanian, merosot selepas terjejas oleh bencana banjir 2014/2015. Oleh itu, walaupun terdapat kesan banjir, 60.8% daripada petani dikalangan pekebun kecil yang terjejas didapati mempunyai makanan yang mencukupi semasa dan selepas bencana dan pendapatan mereka tidak terjejas teruk seperti yang ditunjukkan dalam analisis logistik dan lengkung Lorenz teratur. Keputusan pemodelan persamaan struktur juga menunjukkan bahawa tindak balas dasar kerajaan dari segi pemulihan telah memainkan peranan penting dalam menyederhanakan kesan buruk bencana banjir kepada hasil punca pendapatan petani dikalangan pekebun kecil. Ini menunjukkan bahawa tindak balas kerajaan yang segera serta pihak berkepentingan yang lain daripada segi bekalan bantuan makanan, pemindahan wang tunai, penyediaan aset dan input produktif pertanian kepada mangsa banjir banyak menyumbang dalam mengurangkan kesan bencana banjir terhadap hasil punca pendapatan mereka. Walau bagaimanapun, strategi mitigasi yang disediakan oleh kerajaan dalam bentuk pembinaan empangan, penambakan, permatang dan sebagainya didapati tidak mencukupi untuk mencegah kesan fizikal bencana banjir terhadap aktiviti pengeluaran pertanian mereka dan ini menunjukkan bahawa kerajaan telah memberi perhatian yang lebih kepada langkah-langkah reaktif (pemulihan) berbanding langkah-langkah proaktif (mitigasi). Keputusan ujian pengantaraan menunjukkan bahawa kesan bencana banjir ke atas sektor pertanian petani dikalangan pekebun kecil melalui kerugian tanaman dan ternakan, seterusnya menyebabkan terganggunya hasil punca pendapatan mereka, tetapi secara jangka pendek sahaja. Oleh itu, berdasarkan hasil ini, adalah penting untuk meningkatkan strategi mitigasi sebagai langkah proaktif, untuk menyelamatkan berjuta-juta ringgit yang disebabkan oleh kesan bencana banjir ke atas pertanian. Didapati juga bahawa tahap strategi pra- dan pasca-adaptasi petani dikalangan pekebun kecil hampir-hampir sahaja dijalankan, oleh itu adalah penting juga untuk menerangkan kepada petani dikalangan pekebun kecil supaya menggunakan sumber mereka sendiri untuk melaksanakan tindakan penyesuaian dengan secukupnya untuk melengkapi campur tangan kerajaan terhadap bencana banjir. Akhir sekali, untuk implikasi kajian, pertama sekali ia dapat membantu penggubal dasar untuk memudahkan dan memperbaiki amalan pengurusan bencana banjir untuk mengurangkan / mengelakkan kesan masa depan di kawasan kajian dan juga memberi wawasan kepada ahli akademik / penyelidik dalam memohon dan / atau memperbaiki model semasa menilai kesan banjir dan bencana alam yang lain dalam penyelidikan masa depan.

Kata kunci: bencana banjir; pertanian; punca pendapatan petani; langkah-langkah pengurangan dan pemulihan; penilaian kesan ekonomi banjir

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I certify that a Thesis Examination Committee has met on 7 June 2018 to conduct the final examination of Abdussalam Adamu Jega on his thesis entitled "Economic Effects of Flood Disaster Among Smallholder Farmers in Kelantan, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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LIST OF ABBREVIATIONS

AGFI	Adjusted Goodness of Fit Index
AIC	Akaike Information Correction
AMOS	Analysis of Moment Structures
AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CGE	Computable General Equilibrium
CR	Construct Reliability
CRED	Centre for Research on the Epidemiology of Disasters
DDMRC	District Disaster Management Relief Committee
DEA	Direct Effect on Agriculture
DID	Drainage and Irrigation Department
DRR	Disaster Risk Reduction
ECCM	Economics of Climate Change for Malaysia
ECCSEA	Economic of Climate Change for South East Asia
EFA	Exploratory Factor Analysis
EMDAT	Emergency Events Database
EPU	Economic Planning Unit
ETP	Economic Transformation Programme
FADT	Food Availability Decline Theory
FAD	Food Availability Disruption
FAMA	Federal Agricultural Marketing Authority
FAO	Food and Agriculture Organization
FDC	Flood Disaster Characteristics

FEI	Flood Effect on Income
FSAD	Food Stability and Accessibility Disruption
FSP	Food Security Policy
FUD	Food Utilization Disruption
GDP	Gross Domestic Product
IEA	Indirect Effect on Agriculture
IFI	Incremental Fit Index
IO	Input-Output Model
IPCC	Intergovernmental Panel on Climate Change
KMO	Kaiser Meyer Olkin
MI	Modification Index
MMD	Malaysian Meteorological Department
MPs	Malaysia Plans
MS	Mitigation Strategies
NAP	National Agricultural Policies
NAPs	National Agricultural Policies
NDMRC	National Disaster Management Relief Committee
NDP	National Development Plans
NDRM	National Disaster Risk Management
NEP	New Economic Policy
NFDRPC	National Flood Disaster Relief and Preparedness Committee
NSC	National Security Council
PNFI	Parsimony Normed Fit index
RM	Ringgit
RMSEA	Root Mean Square Error of Approximation

RRS	Recovery Resources
SAM	Social Accounting Matrix
SDMRC	State Disaster Management Relief Committee
SEM	Structural Equation Modelling
SLA	Sustainable Livelihood Approach
SPSS	Statistical Package for the Social Sciences
STLE	Short Term Livelihood Outcome Effect
TLI	Tucker – Lewis Index
UN	United Nations
UNISDR	United Nations International Strategy for Disaster Reduction
USD	United State Dollar
USDA	United State Department of Agriculture
WDR	World Disaster Report
WHO	World Health Organization
WMO	World Metereological Organization

CHAPTER 1

INTRODUCTION

This chapter starts by presenting the background of the study, flood incidences, historical background of flood disaster, its effects, and government policy responses against flood in Malaysia, need for flood economic effect assessment and an overview of livelihood outcomes in Malaysia. Finally, it discusses the statement of the problem, objectives of the study, significance and scope of the research at hand, conceptual definitions of terms and organization of the study.

1.1 Background of the Study

Floods are the most common and serious natural disasters occurring in most part of the world and it is considered to be one of the greatest weather-related natural disaster causing serious economic effect and negatively impacting on the livelihoods of the affected localities (Akasah and Doraisamy, 2015; Khan, Shaari, Achmad, Baten and Nazaruddin, 2014), it account for about 50% of all economic losses worldwide (Munich Re, 2015). The major harmful effects of flood include direct mortality, widespread damage/losses of crops, livestock and infrastructures, displacement of people and widespread of diseases (Dewan, 2015; Doocy et al., 2013). Several studies have revealed that the flood disaster effect/damage are unmatched among the all other natural disaster happening in the world (Kron, 2005). Both developing and developed countries are exposed to flood disaster effect, as no region in the world is safe from being flooded and affected (Kron, 2005), it poses great risk to advanced countries and sometimes bigger than what it does to developing and least developing countries, although the economic advancement of a country determines its efficiency in combating the flood disaster effects (Kron, 2005). WHO (2002) described flood as the most common and costly natural disaster in Europe in terms of economic damage, while Mileti (1999) argued that floods have become the most costly natural disaster with regards to dollar damage to properties and crops in the United States. However, in developing countries, the likely negative impact of a flood disaster on agriculture has important implications for smallholder farmers, since agriculture is the major contributor to their food production and income (Bandara & Cai, 2014; Gornall et al., 2010).

Malaysia as a very fast developing country aiming of becoming among the developed countries by the year 2020 is fortunate and relatively free from natural disasters such as volcanic eruptions, earthquakes, strong winds and hurricanes, tropical cyclones and typhoons, that are periodically occurring in its neighbouring countries, however, floods remain the only severe type of disaster frequently occurring with increasing intensity in most part of the country in recent decades

especially in east coast causing significant socioeconomic impact to the affected population (Mei et al. 2016). As also argued by Chan (2012) that flood is the most common and severe type of disaster experienced in Malaysia, causing loss of life, significant damage to crops, livestock and fisheries and seriously damaging effect on properties and public infrastructures. Despite massive expenditure by government on flood defense and protection, flood disaster in Malaysia has brought severe impacts on the people, affecting livelihoods and causing substantial financial losses as well as intangible damage (Chan, 2015; Lee and Mohamad, 2014). Without adequate measures, the occurrence of floods could cause displacement of people, damage to infrastructures and negative effect on agricultural production and livelihoods of the affected communities.

The country is prone to annual flooding while experiencing a major flooding event at least once every five years (Lim and Cheong, 2015). There are two (2) main types of flooding in Malaysia, flash and monsoon floods that are seriously impacting the lives and environment of Malaysians (Adnan, 2010). Flood disaster event usually occurs during the monsoonal season in the eastern part of Peninsular Malaysia causing considerable damages to mostly villages living along rivers or coastal flood plains, their agriculture and livelihoods (Alam et al. 2012; Jaafar et al., 2016; Nastis et al. 2012). Smallholder farmers' and unskilled laborers are the population most vulnerable, who also experience decreased incomes, lower food security and rising food prices (Doocy et al. 2013).

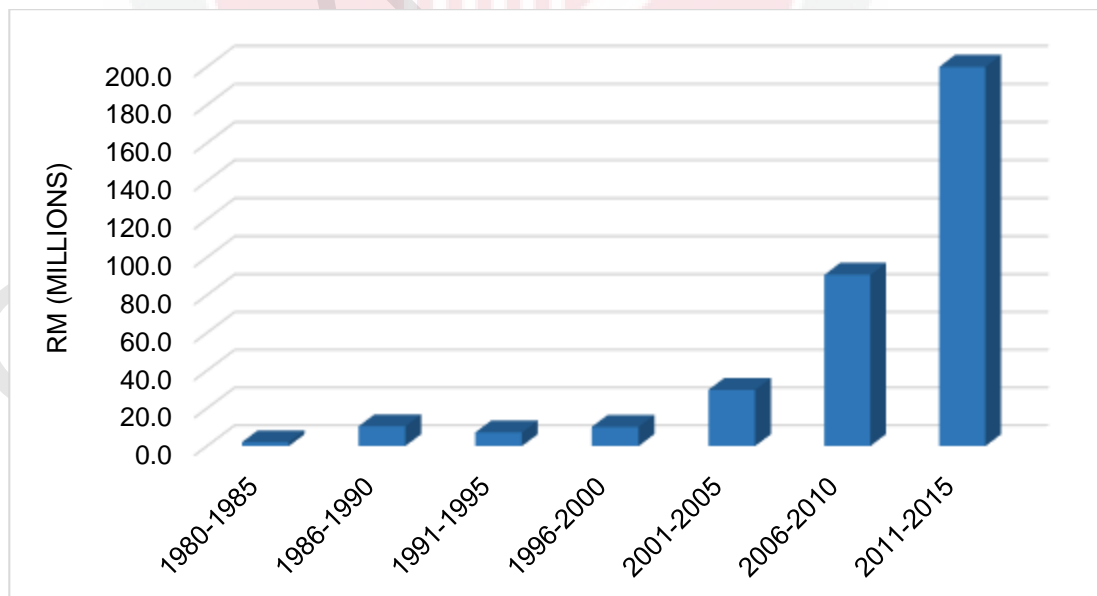
The 2014/2015 flood on a catastrophic scale hit Malaysia in almost 11 states with intense prolonged rainfall which displaced more than 250,000 people especially the East Coast Peninsula and East Malaysia (Sabah) causing an economic damage worth RM560 Million (Karim, Hazizan, Diah, Tajuddin and Mustari, 2016; Nordin, 2015). The impact left the nation with expensive and devastating damages that receive numerous support and assistance from national and international organizations (Akasah and Doraisamy, 2015). People in the affected areas lamented that it is the worst flood since 1932 and 1967 (Karim et al., 2016). The flood disaster is said to be the worst in 100 years (Manan and Geleta, 2007). Majority of the vulnerable and risk groups are farmers' communities settling around low lying/riverine areas having minimal income characterized by an inability to protect/cope themselves against flood impacts and improve their livelihood (Mahmudul Md. Alam et al., 2012).

Table 1.1 : Flood Impact in Malaysia (1965 – 2015)

Duration (Years)	Total Number of People Affected	Total Damage ('000 USD)
1965 – 1975	683,000	63,600
1976 – 1985	18,000	0
1986 – 1995	112,576	11,500
1996 – 2005	96,556	11,000
2006 – 2015	626,926	1,274,000

(Source : EM-DAT CRED 2016)

Among the affected states Kelantan was the worst hit and vulnerable by 2014/2015 flood and nearly all districts were affected (Azimi et al., 2016; Hua, 2015; Jaafar et al., 2016). The flood was unexpected, unusual and particularly the biggest and worst flood for the past 100 years (Wan Ahmad and Abdurahman, 2015). 2014/2015 flood disaster is the most significant and largest recorded flood in the history of Kelantan state and almost all its districts were enormously affected, also termed as a ‘tsunami-like disaster’ as revealed by Malaysia’s National Security Council (NSC) that “2014/2015 floods in Kelantan were the worst recorded in the history of the state”. 202, 000 victims were displaced (Baharuddin et al. 2014). It has caused a considerable economic damage to farmers and their livelihood (Tahir et al., 2015). The flood waters rose up to two meters above normal river levels, in some places, even more, destroying and damaging agricultural land and products, houses, infrastructures and other public buildings costing millions of ringgit (see Figure 1.1 below).

**Figure 1.1 : Flood Impact in Kelantan Total Damages/Losses (RM) 1980-2015)**

(Source : Based on Abd. Rashid et.al. (2007) and the Center for Public Policy Studies (CPPS) (2015)

Out of all natural disasters flood stands out to be the greatest natural disaster disrupting agricultural production and productivity which consequently affect the livelihood outcomes of small holder farmers across the globe (FAO, 2016; Sivakumar et al. 2005). However, Musah et al. (2013) argued that, flood have significant economic and food security disruption effect, especially on the smallholder farming households as it destroys critical agricultural assets, infrastructures and causes losses in the production of crops, livestock that amount to approximately 22% out of the reported economic effect caused by large and medium scale natural disasters in developing countries (FAO, 2015b). Large scale flood disaster often disrupts both domestic food production and consumption that could potentially lead to food crises in developing countries (Adediji et al., 2016). Understanding the distributional effects of flood disaster across the affected communities is critical for planning and also identifying the efficacy of mitigation and recovery measures in place (Fothergill and Peek, 2004; Masozera et al. 2006) in addition Masozera et al (2006) argued that, although response and recovery services have been very vital for humanitarian assistance they should be accompanied by adequate mitigation measures so that the enormous flood losses can be reduced.

Considering that, flood disaster effects are not uniform across societies the main problem is to accurately assess the cascading effect posed by the disaster, in which the information obtained can be crucial to relevant agencies to draw up policies for rational flood mitigation and alleviation based on cost-effective measures (Paul, 2011; Smith and Roy, 1998). Agricultural sector, therefore, is crucial to economic development, since it provides wage goods for industrial sectors, and in constituting the demand focal point for consumer goods produced by the industrial sector (Long, 2007), in terms of capital formation and social wellbeing of smallholder farming families, agriculture tends to be the basic sector for their livelihood survival (Long, 2007; Sivakumar et al., 2005) hence any fluctuation in agricultural productivity as a result of flood disaster shock could lead to a cascading effect on their livelihoods. The growing concern on the possible cascading negative effect of natural disasters (floods, cyclones etc.) on smallholder agricultural productions and livelihoods has created a new demands for information from assessment by researchers, as an important segment in supporting decision making processes towards an integrated flood risk management approaches (Sivakumar et al., 2005).

Flood economic effect on agriculture include direct and indirect effects on livelihoods Vis-a-Vis decline in agricultural production, cause unemployment and/or decline in wages, loss of income and lower availability of foods which eventually leads to food inflation (FAO, 2015b; Israel and Briones, 2013a; Kwari, Paul, and Shekarau, 2015). The primary flood problem is the damage to agricultural land, where floodwaters overflow the banks of low capacity channels and inundate or submerge thousands of acres of adjacent crop lands, human beings, and livestock got killed or injured, food stocks with the households got dwindled resulting in food shortages and were not able to feed themselves and their children sufficiently, added to this less responsive public distribution system, declining wages and increase in borrowing by the households which will eventually worsen the food security

situation (Kator, 2015; Mohamed, Othman, Suid, and Zaim, 2015; Posthumus et al., 2009). The rate of flood disasters, whether they occur in advanced, developing nations and less developed nations can destroy people's livelihoods (Sawada and Sothea, 2011) especially smallholder farmers living along the coastal areas of many countries of the world through inundation of coastal areas and island (Sarkar, Begum, Pereira, Jaafar and Saari, 2014). The direct physical effect caused by floods in rural communities is in agricultural production and livelihood of smallholder farmers with the serious implications of lower productivity, food shortages and lower income (FAO, 2015; Rana and Islam, 2015) Similarly the indirect impact as a consequence of direct impact summarized below in Figure 1.2.



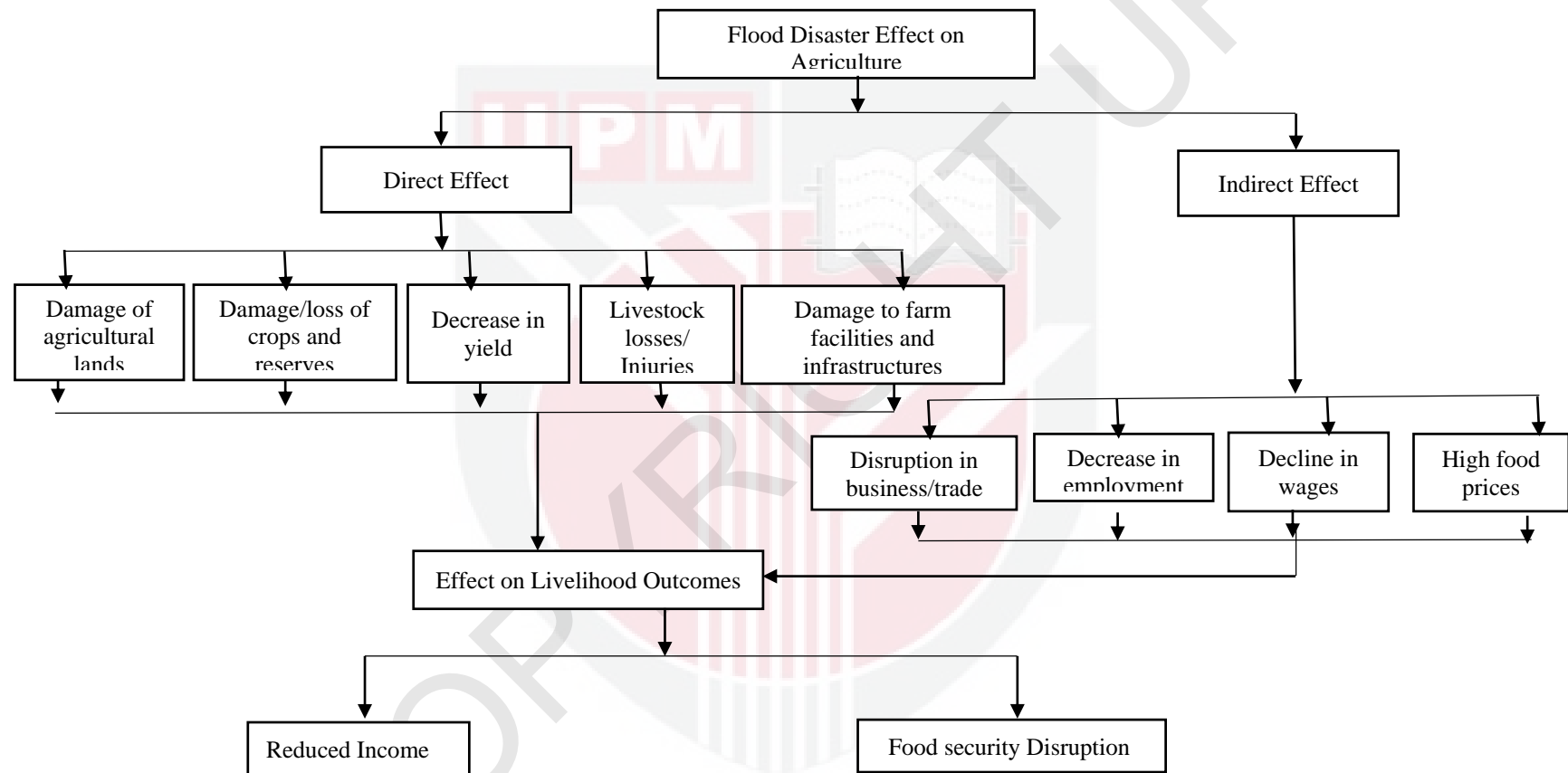


Figure 1.2 : The Impact of Flood Disaster on Agricultural Sector and Livelihood Outcomes of Smallholder Farmers
(Source : Based on FAO, 2015; Châu, 2014 and Alinovi et al. 2010)

Smallholders' agriculture is generally used to denote and describe rural farmers who constitute an estimated population of 400-500 million worldwide representing 85% of the world farms (Harvey et al., 2014; Morton, 2007a). They are considered highly dependent on agriculture for their livelihoods and for whom provides the principal source of income (Harvey et al., 2014). Farmers living across the coastal wetland and river banks are earnestly more vulnerable and face numerous risks to their agricultural production due to floods disaster which in turn undermine their household food and income security (Harvey et al., 2014; Siddiquee, 2012) and any reduction to agricultural productivity can ultimately have significant disruption effect on smallholder farmers food security, income and general well-being (Hertel and Rosch, 2010; Mcdowell and Hess, 2012).

Thus, since agriculture is the main occupation of rural people in developed and developing economies and also an important source of livelihoods (FAO, 2015b; Musah et al., 2013) its holistic and adequate loss and economic effect assessment should be considered as an essential part of improving flood risk management (Kreibich and Thielen, 2008). Lim and Cheong (2015) and Nafari (2013) argued that in order to minimize future flood effect in a sustainable manner, an integrated approach on flood risk management has to be built on sound analysis and assessment of flood hazard of peculiar sector or community, its flood losses and mitigation measures.

Majority of the scholars across the world have identified lack of available and/or adequate data to evaluate the effect/damage to different sectors especially smallholder agriculture in case of floods as the main obstacle for efficient risk management (Molinari et al. 2017; Dunja, 2016). Although flood effect assessment is regarded as a vital portion of flood risk management, it has not adequately received much scientific attention (Merz, Kreibich, Schwarze, and Thielen, 2010) and its consideration within the decision making process of flood risk management is relatively new (Messner et al., 2007).

1.2 Flood Incidences

Floods occurrence has greatly increased in recent decades mostly due to environmental degradation, heavy rainfall, deforestation and intensified land use as a result of increasing population (Tahir et al., 2015) invariably high and intense rainfall is the main factor causing flood disaster impact but other contributory factors might include duration, inundation/depth, and frequency of occurrence (Adnan, 2010; Dassanayake, Burzel, and Oumeraci, 2015; Noratqah, 2010; Tahir et al., 2015). One-third of the annual natural disasters worldwide is flood related, accompanied by direct physical effect, economic losses, related human health impact and economic well-being of the affected communities (Brody and Brody, 2007; Messner et al., 2007).

Coastal floods globally is becoming more frequent and expensive causing serious and devastating effect in the recent decades and is expected increase due to the effect of rising sea level, heavy rainfall, land degradation and storm surges (Dassanayake et al., 2015) and its consequences contain numerous types of damages which include economic damage on agriculture and landed properties, environmental losses, societal disruption and so on (Jonkman and Vrijling, 2008). The Economic of Climate Change for South East Asia (ECCSEA) reports in one of its study that, being a region with tropical climate, long coastlines, and small islands is geographically vulnerable to climate change risk, especially having high concentration of rural populations and economic activities in low-lying coastal areas where millions of poor people are trapped with disrupted food security and low adaptive capacity (ECCM, 2011). Southeast Asia (Malaysia inclusive) having a tropical climate is characterized by extreme flood that significantly contributed to a decline in the production in food and cash crops for industries, livestock, fish supply and other agricultural products produced in the region and it is predicted to have more critical and severe physical impact on the people, their livelihoods and environment in general (Alam and Siwar, 2010)

As also outlined in the World Disaster Report by IFRC (2016), that flood is the most frequent natural disaster in the world as indicated in Table 1.2 below.

Table 1.2 : Total Number of Reported Disasters by Type all over the World (2006 - 2015)

Disaster Type	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	Total
Floods	232	219	174	160	190	160	141	149	140	154	1,719
Droughts	20	13	21	31	27	24	31	13	22	33	235
Storms	77	105	111	87	95	86	90	106	99	114	970
Landslides	20	10	12	28	32	17	13	11	15	19	177
Earthquakes	24	21	23	22	24	30	29	28	26	21	248
Extreme Temperatures	32	25	11	26	34	19	52	17	18	11	245

(Source : World Disaster Report by IFRC, 2016)

In addition floods, droughts and tropical storms affect agriculture (crop) sector most, than all other natural hazards (FAO, 2015) which is vividly clear in Figure 1.3 below.

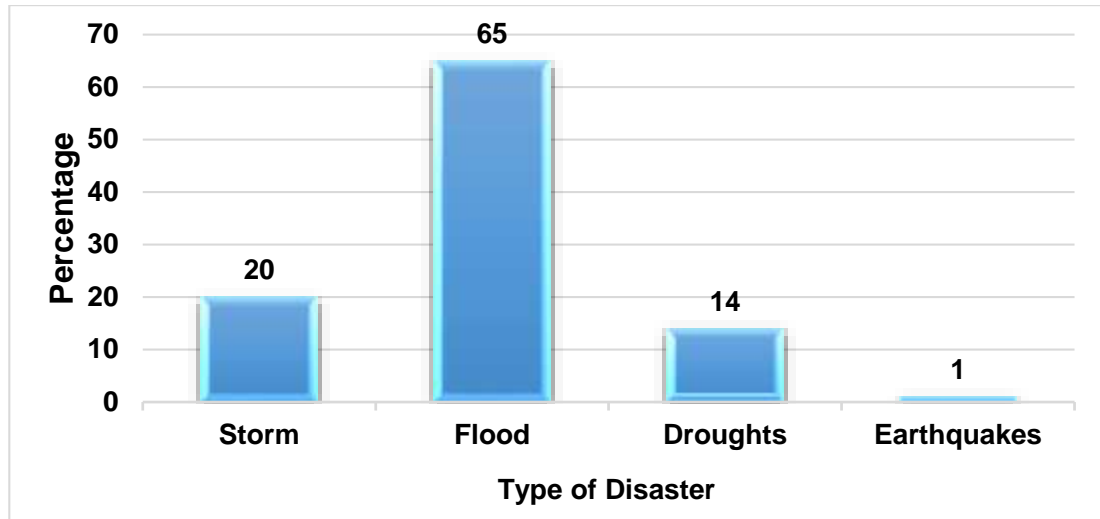


Figure 1.3 : Damage and Loss to Crops by Some Types of Disasters (2006-2016)
(Source : FAO based on data from Post-Disaster Need Assessments)

1.3 Historical Background of Flood Disaster in Malaysia

Historically, Malaysia experienced major floods in the years 1886, 1926, 1963, 1965, 1967, 1969, 1971, 1973, 1979, 1983, 1986, 1987, 1988, 1993, 1995, 1996, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006/2007, 2008, 2009, 2010, 2011, 2013 and recent 2014/2015. Amongst these flood events the 1926 flood was known as the storm forest flood accompanied by a very strong wind, and it destroyed hundreds of square kilometres of low land forests of Kelantan and Terengganu (Chan, 2015; Ernawati Hamdan, et al. 2013). Then in 1967, another devastating flood occurred across Kelantan, Terengganu, Perak and other east coasts communities, damaging agricultural lands, crops, and houses (Ngai Weng Chan, 2015; Nur, Wan, Nor, Zakaria, & Nazir, 2015). Report from DID revealed that about 29, 000 sq. Km or 9% of the total land area and more than 4.82 million people are affected by flood disaster annually (Khan et al., 2014). Four years later in 1971, another flood disaster escalated where it swept many parts of the country, Kelantan and Pahang were severely affected, in terms of crops and property losses and the death of 24 people (Nur et al., 2015). In the year 1996 floods triggered by tropical storm in Keningau (Sabah state) caused an economic damage worth more than RM300 million and claimed 241 lives, however another horrific flood occurred in the year 2000 caused by heavy rains in Kelantan and Terengganu where 15 people were killed and more than 10, 000 people flee their homes (Ngai Weng Chan, 2015). In 2010 flood destroyed an estimated 45,000 hectares of rice fields in Kedah and Perlis that are termed to the “rice bowls” of Malaysia.

1.4 Flood Incidences in Kelantan

Kelantan, on the other hand, has faced a number of severe floods over several past years. Historical data extracted from DID (2003) and EM-DAT (2018) has indicated that Kelantan specifically experienced flood incidences in the years of 1965, 1967, 1983, 1986, 1987, 1988, 1993, 2000, 2001, 2002, 2003, 2004, 2006, 2007, 2008, 2009, 2013, and 2014/2015 floods. Among these incidences, the 2014/2015 flood disaster was regarded as the worst ever in the history of Kelantan causing the significant effect to more than 70 per cent of Kelantan's 1.2 million people and paralysed its economic activities and the livelihoods, the worst hit districts include Guamusang, Machang, Pasir Mas, Pasir Puteh, Tumpat, Kota Bharu, Kuala Krai and Tanah Merah. The incidences of these floods can be connected to the geographical terrain of the state as argued by Syed Hussain & Ismail (2013) that, the total area of Kelantan River Basin is about 13,100 km or 85 percent of the state land area, coupled with natural factors such as heavy monsoon rainfall, intense convection rain storms, large-scale land clearing activities for developmental activities and commercial agricultural purposes such as for rubber and oil palm estates were also perceived to be the main reasons for the high incident of flood in the state (Ashikin & Shaari, 2016; Hussain, Nor, & Ismail, 2014). Data given by the EMDAT also indicated that monsoon flooding occurs almost every year in the state of Kelantan as shown in Table 1.3 below.

Table 1.3 : Incidence and Duration of flood in Kelantan

Year	Occurrence (No. of times/year)	Duration (days)
1965	1	-
1967	1	-
1980	1	-
1981	1	-
1982	1	-
1983	1	-
1984	1	-
1986	1	-
1987	1	-
1988	1	-
1990	1	-
1991	1	-
1992	1	-
1993	1	5
1994	1	-
1995	1	-
1996	1	-
1997	1	-
1998	1	-
1999	2	-
2000	2	10
2001	2	-
2002	1	-
2003	2	3
2004	2	8
2006	2	8
2007	2	-
2008	2	2
2009	2	3
2013	1	7
2014	1	14
2015	1	-
2017	1	-

(Source : The Emergency Events Database EM-DAT, 2018)

However, despite various efforts geared toward reducing the severity of flood disaster in Malaysia it is evident that such measures remain insufficient as experienced during the 2014/2015 flood, where closed to 250,000 people were displaced (Lim and Cheong, 2015) as also confirmed by Hussain et al. (2014) that, most communities in Kelantan are still confronted by the problem of the ineffectiveness of flood risk management systems despite government efforts to assists flood victims.

1.5 An Overview of Flood Disaster Effect in Malaysia and Kelantan State in Particular

Floods are the most severe of all disasters affecting Malaysia as it occurs every year (Chan, 2012b; Wan Ahmad and Abdurahman, 2015) with monsoon as the serious flood followed by a flash and tidal floods (Ngai Weng Chan, 2015). The monsoon which is the most serious flood occurs mainly from Northeast monsoon during the months of November to March with heavy rains to the east coasts states of the Peninsular Malaysia (Khan et al., 2014; Nur et al., 2015).

Based on the literature, Monsoon and flash floods are the most severe climate-related natural disasters in Malaysia, with a flood-prone area of about 29,000 km² affecting more than 4.82 million people (22 % of the population) and inflicting annual damage of USD 298.29 million (Wan Ahmad and Abdurahman, 2015). With annual heavy monsoon rains averaging more than 3,000 mm and such a large flood-prone area, flood risk is indeed high, most notably in riverine areas and coastal flat lands and with such a large population living in flood prone areas, flood exposure is high as well (Ngai Weng Chan, 2015). Since, the great 1967 floods, some notable factors were identified as the major contributors to flood disaster occurrence in Kelantan, these include intense and torrential rain, closing of estuary by sand bars, poor conditions of various drainage systems, low ground level along main river banks, indiscriminate felling of trees for logging and other developments (Jaafar et al., 2016).

Flood intensity in Malaysia is increasing rapidly in recent decades mostly due to the nature of the country's physical as well as human geography (topography, settlements, and land use patterns) (Islam et al., 2016). and have been having adverse impacts on food production (Alam et al., 2016). Climate change is real and its impact is being felt in Malaysia e.g. flood disaster, haze etc. which causes reduction and losses in revenue, productivity and health risk of the people (ECCM, 2011). Flood is the most frequent and costly natural disaster in terms of economic damage and socio-economic well-being of Malaysians and causes as much as 62.5% damage (see Figure 1.4) of all natural disasters occurring in Malaysia (Khan et al., 2014).

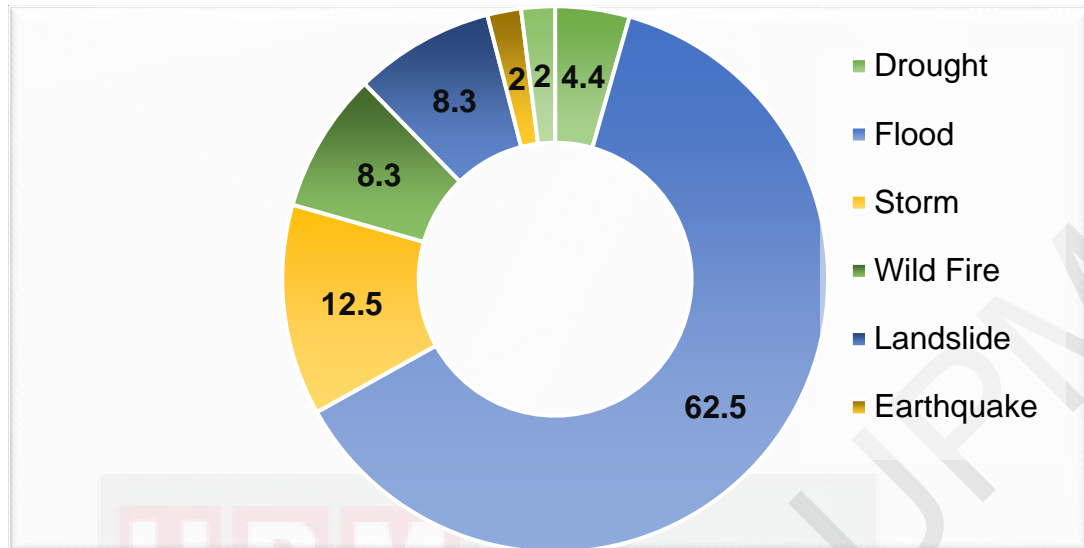


Figure 1.4 : Malaysia's Reported Losses from 1990-2014
(Source : Malaysia Disaster Reference Handbook, 2016)

It has become a common feature in the lives of a significant number of Malaysians, with a flood prone area of about 29,000 km² affecting more than 4.82 million people (22% of the population) and inflicting annual damage of USD 298.29 million (Iya, Gasim, Toriman, and Abdullahi, 2014). Of all the disasters in Malaysia, floods are most severe and frequent, that affects millions of people and exacerbate greatest economic damage which accounts for a significant number of casualties, property and crop damage and other intangible losses (Ngai Weng Chan, 2012a) and subsequently has negative impact on victims incomes, nutrition and food security (Ashraf, Iftikhar, Shahbaz and Khan, 2013). Malaysia had experienced in the last decades an increased damage and losses as a result of flood disaster e.g. in 2006 the losses are estimated at RM300 million with Johor recording the highest cost in damages at RM250 million followed by Kelantan with RM150 million (ECCM, 2011).

The reported cost of damages, caused by the recent 2014/2015 flood disaster in the most affected states, shows that the state of Kelantan, Pahang, and Terengganu are the largely affected (as shown in Table 1.4 below) in Peninsular Malaysia.

Table 1.4 : Total Amount of Estimated Damages in 2014/2015 Floods

Affected States	Cost of Damages (Millions RM)
Kelantan	204
Pahang	
Terengganu	
Johor	78
Melaka	
Negeri Sembilan	
Perak	55.6
Kedah	
Perlis	

(Source : Zainal Abidin et al, 2015)

The rising and increasing intensity of rainfall causing flood disaster serves as the major challenge for agriculture and rural livelihoods in Malaysia, as it is the economic sector most vulnerable and majorly practiced by rural poor compared to urban residents (Hamdan, Kari, Othman, and Samsi, 2012). In Malaysia, at least one third of the county's population depends on the agricultural sector for their livelihoods and the majority of the smallholder farmers live in rural areas with agriculture sector as the main source for their livelihood (Mahendra Dev, 2011; Syaheera and Shaari, 2017). The national aggregate effect of a flood disaster on agricultural production in Malaysia is likely to be small to moderate, however, regional, state or local effects could be significant as the flood disaster effects vary considerably across the regions, states or locals. Though National Agricultural Policies (NAP) and other plans have achieved a lot in transforming the Malaysian agricultural sector, but were constrained and not fully successfully achieved their stated objectives due to some certain challenges, one of which is climate change especially flood disaster that significantly affects the agriculture sector in term of production as well as impacting the social economics problem to the people involved in the sector and the nation as a whole (Devendra, 2012). Chang (2012) opined that floods are the single most severe of all disasters in Malaysia, it accounts for a significant number of casualties, property and crop damage and other intangible losses. Economic losses in Malaysia are projected to be the interruption of economic activities, principally agriculture production, along with vulnerable stretches of coastline as a result of direct inundation (Sarkar et al., 2014).

In general agricultural production is sensitive to climate change and food security is sensitive to agricultural production; floods, therefore, have devastating economic consequences for agricultural production and impact could be immediately transmitted to food security and livelihood. According to the United Nations (2010), many hundreds of millions of people throughout the world, particularly those living in the developing countries, are threatened by floods disaster and tropical storms.

The palm oil and rubber output in Malaysia have said to be dropped to at least 30% during 2014/2015 floods, prices escalated and their export to other countries disrupted (Akasah and Doraisamy, 2015). USDA (2015) argued that the recent floods on the East Coast Peninsular Malaysia may result in agricultural production declining up to 15% for the year 2015, daily harvest down by 50% and the three most affected states (Kelantan, Terengganu and Pahang) by flooding account for the 17% of the total national production and 35% of Malaysia's agricultural output. According to the Malaysia Agriculture and Agro-based Industry Minister, Datuk Seri I.S Yaakoob (2015), RM194 million were lost due to damage to agricultural produce in 2014/2015 floods, 15,403 farmers, livestock breeders, and fishermen were mostly affected, involving 16,342 hectares of agricultural land (Malaymailonline, 2015). From these assertions so far, it is apparent that agricultural sector in Malaysia is vulnerable to weather-related natural disaster, especially flood, that causes serious damage and losses to agricultural products, displacement of people, damage to infrastructures and the environment in general.

Kelantan State of Peninsular Malaysia is largely an agricultural state, where a majority of the households depend on smallholder agriculture as their primary source of livelihood, though high and prosperous socio-economic activities are in major towns of Kota Bharu, Pasir Mas, Tenah Merah and Kuala Krai with economic activities including industrial, commercial and service sectors. Flood occurrence is synonymous to the State (Kelantan) due to its significant intensity/frequency caused by heavy rainfall during the monsoon, which starts from November to March every year (Hussain et al., 2014; Khan et al., 2014). Kelantan is prone to annual flooding and experiencing a major flooding at least once in every five years due to its proximity to coastlines and rivers (Lim and Cheong, 2015). The 1927 and 1967 floods are considered as the major devastating flood ever witnessed in Kelantan history and it has been reported that at least 70% of the villages in Kelantan or nearly half of the State population were affected (Baharuddin et al., 2015) and about 50% of the total land area and 60% of the total population in Kelantan are threatened by flood (Jiang, Deng, Chen, Wu, and Li, 2009).

According to Minister of Agriculture and Agro-industry Datuk Seri Ismail Sabri Yaacob (2015), flood disaster has destroyed 11,099 hectares of agricultural land whereby more than 6,309 farmers, fishermen, and breeders were affected together with the destruction of agricultural assets and infrastructures. He argued that RM105 million losses were reported in an agricultural sector of Kelantan as a result of the devastating flood. The categorization of estimated losses involves paddy (RM35 million), livestock (RM2.02 million), fruits (RM2.1 million), aquaculture (RM20.1 million), agro-based industries (RM12.2 million) and assets (RM28.5 million).

Without adequate measures, the occurrence of floods could cause displacement of people, damaged infrastructures, and losses of agricultural production from eroded/inundated lands. Monetarily, it is difficult to estimate the quantum but a conservative figure of RM 100 million has been used to estimate the average flood

damage per year. In a major flood, people's coping mechanisms are totally ineffective and they are forced to rely on government relief for recovery and a flood depth of 3m is not uncommon, and hundreds of thousands of people are often evacuated.

1.6 An Overview of Malaysian Agriculture and Flood Disaster Effect

Agriculture has been the mainstay of Malaysian economy at the beginning of independence, as it contributed 43.72% to the GDP, generated 58.3% of the total employment and about 50% to export earnings, but this contribution of agriculture to the GDP declined from 43.72 percent in 1960 to 8.43 per cent in 2015 (Devendra, 2012). As a result of this declining trend, climate change factor is now becoming a key threat to agriculture and food security which is the major farmers' aspiration for a better livelihood (Devendra, 2012; Ngai, 1997).

Agriculture still remains the most important sector and backbone of the Malaysian economy as the actual value of output and productivity has continued to increase (as shown in Figure 1.5 below) despite its minimal contribution to Malaysia's GDP in the last two to three decades. In addition, it continues to supply food for an increasing population, create employment opportunities and increase income for rural people, deepen linkages with other sectors of the economy and provide foreign exchange for the government.

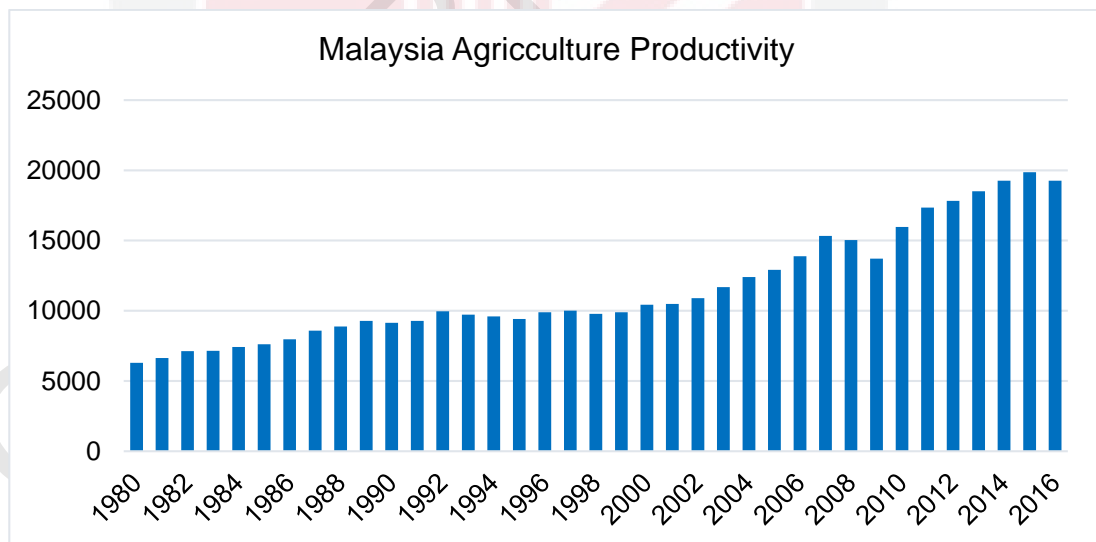


Figure 1.5 : Agriculture Value Added per Worker at Constant USD
(Source : Global Economy, 2017)

Agricultural sector remains one of the sectors greatly affected by flood disasters in terms of crop losses and livestock, damage to infrastructures and drop in agricultural productivity (Baharuddin, 2007; Jabin et al., 2015), it is not only critical for food supply, also remains a source of livelihoods across the planet (FAO, 2014). It has been reported from many previous studies that flood disaster as a result of climate change variability negatively affects agricultural production in Malaysia (Jabin et al., 2015; Lee and Mohamad, 2014; Alam et al., 2016; Sarkar et al., 2014). Flood agricultural losses/damage has increased in Malaysia despite local, state and local effort and encouragement to structurally mitigate the cascading effect of flood disaster, just as reported with similar trend in USA and other developed and developing countries in the world (Atreya et al 2013; Downton and Miller, 2002; IPCC, 2001). According to FAO (2015), flood disaster effect on agriculture can result to direct effect on livelihoods (food security and income) through unemployment, and/or decline in wages vis-à-vis high food prices, low household's purchasing capacity leading to non-affordability and accessibility of adequate food.

Kelantan State of peninsular Malaysia has become prone to flood disasters, and this is potentially due to climate change variability, rapid changes in land use in relation to conversion of agricultural land (rubber and oil palm) and logging activities have been reported, in addition to weaknesses in development planning and monitoring (Adnan, 2010). The major economic activities in Kelantan are agriculturally based, with paddy rice production as the major and important farming activity, rubber, oil palm, and tobacco, other important farming activities consist of fishing and livestock and livestock farming. Although rice production is the most important source of income to the smallholder farmers, the average yield is below the national average and over the years agricultural productivity is slowly decreasing (Ismail, 1996) attributed to the problems of proper maintenance of farms and crops and projects sites filled with sea water as a result of floods (Buang, 2009). According to Shamshuddin et al. (2016), the river levees were once fertile for the production of food and cash crops, but the 2014/2015 flood had destroyed not only the crops but also the land on the river bank. What was the immediate cause of this catastrophe? The farmers in the area seemed to believe that the damage could have been less if the land on the other side of the river was not disturbed by extensive development.

1.7 Policy Responses/Action of Government to Floods

According to Devereux (2006) policy responses to flood effect on agriculture are mitigation strategies used to mitigate/moderate the devastating impact of flood on agriculture, and provision of recovery resources which involve enhancing farmers' access to agricultural inputs such as improved seeds, farm tools, credits, and fertilizers to boost production and minimize crop losses as result of the disaster. While Dewan (2015) opined that policy responses to flood disaster are governmental and non-governmental efforts and programmes to aimed at minimizing the adverse effect of the flood.

In Malaysia mitigation in form of structural flood measures and recovery are the key component of government policy responses to flood disasters, in addition to recovery and response strategies (Chan, 2000). Although, the effect of large flood disaster cannot be avoided or eliminated, due to its' intensity and magnitude, Malaysian government have in the past established many institutions policies and programmes aimed at mitigating the impact of flooding. Notable among them is the Drainage and Irrigation Department (DID) which is saddled with the implementation of structural and non-structural flood mitigation strategies (Shah, Mustaffa, & Yusof, 2017). Structural involves the construction of artificial structures such as dams, reservoirs, embankments, levees, retention ponds, diversion channels, dredging and deepening major river channels. While the non-structural includes flood warning, flood forecasting, land use planning, flood insurance, resettlement, the creation of public awareness and educational programmes related to flood control (Mohd Yusoff, 2007; Shah et al., 2017). These mitigation strategies were implemented in order to reduce the effect of a flood disaster on the people and their economic activities living along the flood plain areas (Shafiai & Khalid, 2016). Based on the recovery resources needed to meet the flood victims recovery needs, on the other hand, National Disaster Management Relief Committee (NDMRC) was also saddled with the responsibility of planning, coordinating, distributing and supervising the disbursement of available recovery resources, such as food aid, financial assistance, relief materials and other recovery measures for restoring and improving the welfare and quality of life of the affected individuals and communities after a flood disaster (Shafiai & Khalid, 2016; Sukeri, Khalid, & Shafiai, 2015). Even though the effect of large flood disaster cannot be avoided or eliminated, due to its intensity and magnitude, as a developing country, Malaysia's National Disaster Risk Management can be attested to be commendable (Chan, 2012).

Due to the magnitude and intensity of flood disaster in Malaysia and the familiarity with the needs of the country to avoid the damages caused by floods. The government of Malaysia decided to allocate funds from the national budget for the flood mitigation measures in every of its Malaysia plan (five-year plan). And this is done to protect the citizens and their economic activities from the cascading negative effects of flood disasters (Shah et al., 2017). This has also been supported by the speech of the Deputy Prime Minister Tan Sri Muhyiddin Yassin at the Third United Nations World Conference on Disaster Risk Reduction (UNWCDRR, 2015) that, “Disaster Risk Reduction (DRR) has always been in the mainstream of Malaysia's development policy, where substantial resources has been provided to reduces the underlying risk factors and promote sustainable development through the five (5) phases of disaster prevention, mitigation, preparedness, response and recovery that has been given adequate consideration in the current 11th Malaysia plan to tackle the problem of floods and other emerging disasters in a structural and non-structural measures”. According to Lee and Mohamad (2014) within each Malaysia plan, millions of ringgit were budgeted on flood disaster management as shown in Figure 1.6 below.

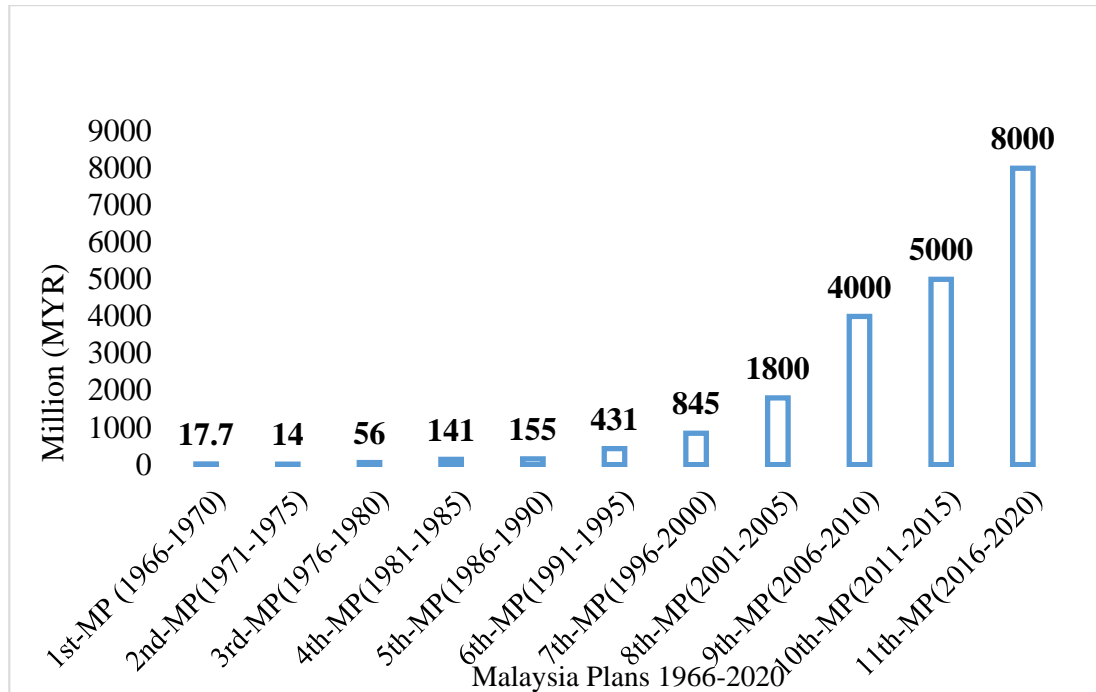


Figure 1.6 : Budget allocation for Flood Mitigation Expenditure in Malaysia, based on Malaysia Plans

(Source : Based on Drainage and Irrigation Department, Malaysia from Chan, 1997; Lee & Mohamad, 2014; Shah et al, 2017)

1.8 Review of Policy Natural Disaster Risk Management in Malaysia: The Case of Floods

National Disaster Risk Management (NDRM) is a concept and practice of reducing disaster risk through a systematic application of policies and strategies so as to analyze and reduce the causal factors of disasters (IPCC, 2001; UN, 2013). It encompasses the whole range of initiatives and actions such as policy promulgation, strategic planning, administrative, financial and decision making processes with particular reference to the entire disaster cycle (Bhandari, 2014). Immediate measures are undertaken with the priority to lessen the effect of the disaster through mitigation, preparedness, response and recovery activities (Thieken et al., 2007). Although, it is inevitable as reported from empirical literature that, all the negative effects emanated from a natural disaster can be counteracted and/or eliminated (IPCC, 2001; Lim and Cheong, 2015; Moe and Pathranarakul, 2006; Thieken et al., 2007) but effective disaster management can be made before, during and after disaster strikes through adequate mitigation, preparation, response and recovery measures (Alexander, 2000; Paul, 2011). As shown in Figure 1.7 below.

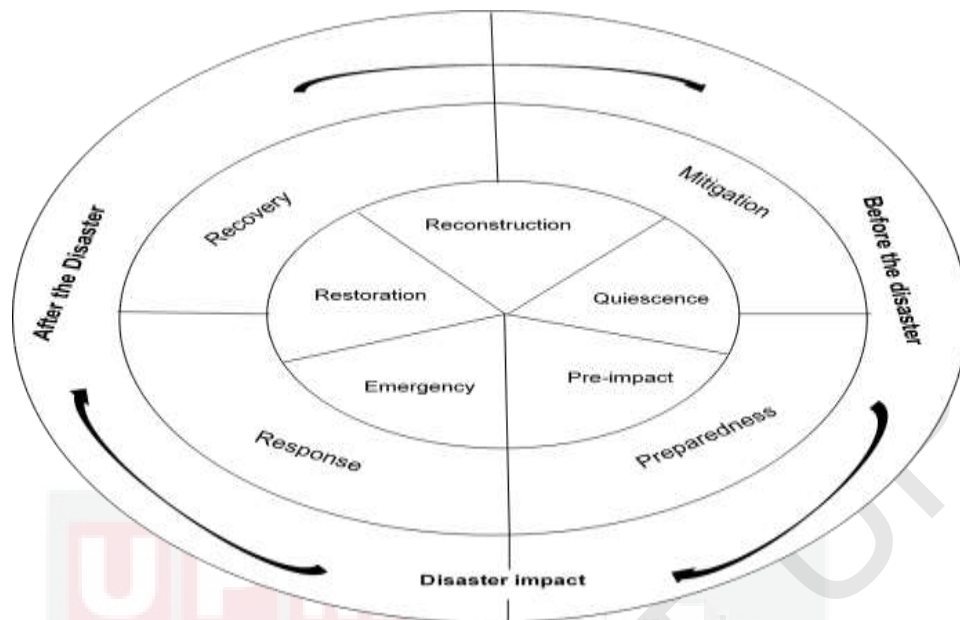


Figure 1.7 : Disaster Management Cycle
(Source : Alexander D, 2000)

Disaster management cycle provides a vital framework by showcasing the role of governments and relevant stakeholders in planning, organizing, coordinating and mobilizing resources for disaster management (Moe and Pathranarakul, 2006; Thieken et al., 2007).

Several studies and reports in Malaysia (ASEAN, 2015; CFE-DM, 2016; Chan, 2012a; Lim and Cheong, 2015) has proven that natural disaster management activities were and still undertaken by government and it's relevant agencies such as National Security Council (NSC) which determines policies and mechanisms for disaster prevention, mitigation and preparedness, response, recovery and reconstructions as enshrined in its directive 20; National Disaster Management Relief Committee (NDMRC) and its sister agencies, State Disaster Management Relief Committee (SDMRC), District Disaster Management Relief Committee (DDMRC) are responsible for organizing, coordinating and providing relief materials and operation before, during and after the disaster; National Flood Disaster Relief and Preparedness Committee (NFDRPC). Its main task is to ensure that all flood victims are adequately assisted especially in terms of aid; Drainage and Irrigation Department (DID) is responsible for flood management by monitoring river flow, oversee flood mitigation and giving real-time update on flood occurrence; Malaysian Meteorological Department (MMD) is responsible for providing adequate flood and storm warning to the public. Despite these numerous policies, strategies, and measures set in place, they have not been entirely successful, but as a developing country, Malaysia's National Disaster Risk Management can be attested to be commendable (Chan, 2012). As earlier stated that the effect of large flood disaster cannot be avoided or eliminated but reduced, since it's intensity and magnitude

cannot be perfectly forecasted and predicted accurately despite recent technological advancement. The organizational structure for the management and coordination of natural disaster in Malaysia is in top-down approach, which is from Prime Minister's office down to district officer (CFE-DM, 2016; Chan, 2012a; Sukeri et al 2015) where NSC under the Prime Minister office is responsible for policies and mechanisms aimed at disaster prevention, mitigation, and preparedness, response and recovery. The second level is the state followed by the district disaster management and relief committee. As shown in Figure 1.8 below.

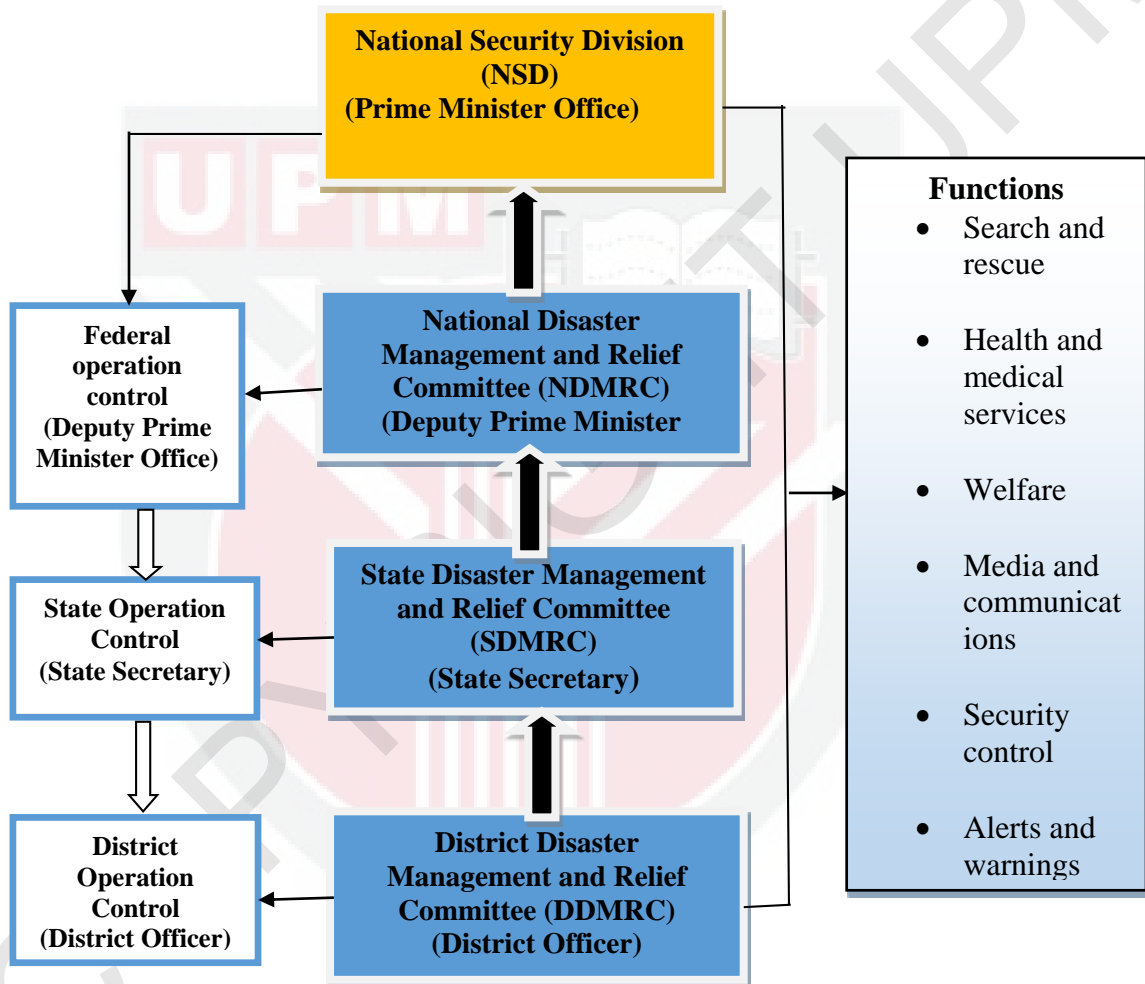


Figure 1.8 : Disaster Management Framework in Malaysia

(Source : Based on the Center for Public Policy Studies CPPS 2015 CFE-DM 2016 and Sukeri et al., 2015)

This framework outlines how government and other relevant authorities developed a disaster delivery system in terms of mitigation, preparation, response and quicker recovery from disaster effect in order to reduce losses and give a succor to the affected communities (Sukeri et al., 2015). In addition to having an integrated system of disaster management with emphasis on the concerted and coordinated

actions through combined and coordinated response of the various agencies to handle the disaster efficiently and bringing the situation back to normalcy.

1.9 Policy Action of Flood Disaster Management in Kelantan

Several flood mitigation initiatives have been undertaken by both the federal and state agencies, to sustainably reduce flood damage in Kelantan state in both short and long term basis, particularly the Department of Irrigation and Drainage, under the Ministry of Natural Resources and Environment. Among such projects are the construction of flood plains, river improvement and rehabilitation, river dredging cantilever walls, tidal barrages, tidal gates, river channels and levees, pumping stations, debris removal systems, monsoon drains, retention and detention ponds, and dams, as indicated in Table 1.5 below.

Table 1.5 : Major Flood Mitigation Projects Implemented by Department of Irrigation and Drainage (DID) In Kelantan, Malaysia

Flood Mitigation Project	Type of Mitigation Works	Project Completion	Nature of Flooding Mitigated		Remarks
			Localized	Wide spread	
Program Mencegah	Flood Mitigation				
Banjir Kemasin/Semerak	Agricultural Upgrading				
Kemasin Phase: 1		1991		✓	Commenced in 1982
Semerak Phase: 2		On - going			Flood Mitigation Component, Completed in RM7
Mengorek Sungai Jahajan Machang	River Improvement	RM7	✓		
Rancangan Menstabil Tebing Sg. Kelantan di Kg.kedai Buluh & Kg.laut	River Rehabilitation	RM7	✓		
Rancangan Menstabil Tebing Sg. Kelantan di Pasir Pekan	River Rehabilitation	RM7	✓		
RTB Kota Bharu	Urban Drainage Upgrading Bund Protection	On-going	✓		
Rancangan Menstabil Tebing Sg.Golok (KESBAN) Phase 1:	River Rehabilitation Bund Protection	1997	✓		
Phase 2:		1999			
Kelantan River Basin, Kelantan (13,000 sq. km)	Construction flood detention dam at Lebir, River improvement, and Dredging, Levee Construction, Bank protection works	1999		✓	

Sungai Kelantan Integrated River Basin Development Project (PLSB), Tumpat, Pasir Mas, Kota Bharu, Tanah Merah and Machang districts in Kelantan	Stabilization of river banks, River dredging works, Environmentally-Friendly Drainage, and construction of reservoirs			✓	Expected to be completed May 2021
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With regards to recovery need resources, various levels of government and non-governmental organizations have developed the relief machinery and emergency flood management, and for post-disaster, funding and aid delivery systems to help the victims recover after a disaster occurs (Sukeri et al., 2015). National Security Council (MKN), would provide compensation to the three groups of people whose agriculture produce were affected by the recent floods. He added that the rate of payment would be RM1,800 a hectare for paddy (with a maximum payment for three hectares only), RM700 per buffalo (maximum 10 buffaloes), RM600 for each head of cattle and deer (maximum 10 for both), RM150 per goat (maximum 20), and RM5 per chicken (maximum 100) and RM2 per quail (maximum 200). "Payment for the aquaculture industry will be RM1,500 per pond (maximum two ponds) and caged fish rearing at RM200 per section.

Despite the continuous increase of government financial assistance and subsidy for smallholder farmers, their agricultural land area is decreasing as the farmers often experience adverse impacts of climate variation. Until today, crop failure protection scheme against these risks still not available in Malaysia and farmers have to dig their pockets and rely on the government aids to overcome losses of the crop failure. The government has spent approximately US\$ 30 million from 2008 to 2012 to help farmers who were affected by adverse weather conditions by giving the financial aid to compensate their losses (Rahim, Hamid, Wahab, & Amin, 2016).

1.10 Smallholder Farmers' Adaptation in Agriculture

Adaptation strategies are proactive and reactive measures undertaken to prevent and/or reduce the climate change effects, smallholder farmers are always conscious in adapting climate variability. They are actions and adjustments undertaken to maintain the capacity to deal with disruptions and also alleviate the severity of climate change impacts on agriculture and food production (Alam et al., 2017; Banerjee et al., 2013). According to Asrat and Simane (2018), smallholder farmers can undertake adaptation strategies themselves (autonomous adaptation) or adaptation through government policies aimed at promoting appropriate and effective adaptation measures (planned adaptation). Some of the adaptation strategies on agriculture undertaken by smallholder farmers against the impacts of climate change include adjustments in planting dates, planting improved crop

varieties, drainage systems, and land management regimes to maintain yields and soil fertility (Banerjee et al., 2013). Besides long-term adaptation strategies, smallholder farmers experiences, knowledge and perceptions of extreme disasters and their impacts motivate them to follow some precautionary measures which can help to limit losses (Lwin et al., 2015; Thielen et al., 2007).

In Malaysia adaptation for climate change and agricultural production are closely linked in the country's climate change, impact on agriculture, vulnerability, and livelihoods of farmers (Robert, 2011). However governments and other stakeholders in flood disaster management have consistently built local awareness on climate change impacts, that is making climate change relevant to villagers, farmers and fisher folk so as to take proactive measures to adapt to its cascading effect (Hayrol et al., 2013; Robert, 2011). Though the need for smallholder farmers and communities adaptation strategy against flood disaster is rising, little has been discussed with regards to smallholder farmers undertaking adaptive measures against flood as argued by Afroz & Akhtar (2017) that, although the perception of flood disaster impact among smallholder farmers is high, majority do not undertake adaptation measures against it.

1.11 Agricultural Damage (Effect) Assessment

Flood damage refers to all varieties of harm caused by flood disaster (Messner and Meyer, 2006), it encompasses a wide range of effects on different sectors of the economy and human health and life specifically described as the total or partial destruction of physical assets, disruption of basic services and damage to sources of livelihood in the affected community. Flood damages are categorized into tangible and intangible damages, the tangible damages are those that can be measured directly into monetary terms while intangibles are that cannot be measured in monetary values, and tangible damages/effects can further be classified into direct and indirect damage/effects (Dutta et al. 2003; Merz et al., 2010; Messner and Meyer, 2006; Pauline, 2013; Romali and Sulaiman, 2015; Scawthorn et al., 2006). Direct damages are those that occur as a result of physical contact of flood waters with properties, humans, etc. while indirect effect occurs as a consequence of direct effect and it includes business interruptions and public services, example delay in transportation, unemployment etc. (Bremond, 2013; Dutta et al., 2003; FAO, 2015b; Merz et al., 2010; Posthumus et al., 2009).

Direct agricultural damage as a result of flood disaster includes damages/losses of crops and yield reduction, injuries and fatalities on livestock, fisheries and forestry, damage to soil others consist of primary farm infrastructures such as tube wells, store, animal sheds and farm stocks (fertilizer, seeds etc.) and other various agricultural equipment and machineries (Arshad, 2010; Bremond, 2013; Merz et al., 2010; Nafari, 2013; Posthumus et al., 2009). The indirect agricultural damages were reported as increased cost of production, reduced farm productivity, high market price of agricultural produce, decrease in supply of agricultural produce, wage

decline, unemployment, business disruption (Bremond, 2013; Carrera, Standardi, Bosello and Mysiak, 2013; Dutta et al., 2003; Hallegatte and Przyluski, 2010; Israel and Briones, 2013a).

A number of studies (Campbell et al. 2011; Hallegatte and Przyluski, 2010; Tanza, 2008) have categorized the economic effect/impact into direct and indirect effects. They argued that direct effects are usually quantified monetarily with market values, while indirect effects are not easily assessed due to large uncertainties on its costs (Châu, 2014; Hallegatte and Przyluski, 2010).

1.12 Need for Flood Economic Effect Assessment

As reported from different kinds of literature flood economic damage assessment has become a very crucial and important part of decision making process and policy development in flood risk management, and the dominant approach for flood control policies and strategies throughout Europe (Merz et al., 2010; Vetere-Arellano et al. 2003). Romali and Sulaiman (2015) argued that the success of any society's flood disaster management approach depends on the flood damage assessment of the affected economic sector and community concern. Lindell and Prater (2003) outlined four (4) reasons why flood damage assessment is important:

- 1) Identification of priorities during and after flood disaster and determine if there is a need for external assistance.
- 2) To identify specific of the communities that have been affected disproportionately.
- 3) Help policy makers to develop and/or improve an integrated flood risk management.
- 4) Understanding the fragilities of the affected areas and tailoring the required mitigation measures.

According to Carrera (2013), an assessment of flood disaster effect is essential, since it provides a basis for defining the financial needs to achieve full recovery and reconstruction, and it also helps to determine the type of public assistance needed by the affected community. Merz et al. (2010) argued that perhaps there are areas more susceptible to flood disaster effect than others, flood risk assessment should be taken into account during the planning process. World Meteorological Organization (WMO), (2013) opined that, assessment on the extent of flood disaster effect is essential for flood relief coordination to the affected communities in future flood emergencies, as policy makers in most countries based their planning process on flood disaster assessment on areas prone flooding, so as to ensure that future flood risk is avoided or be managed in a tangible manner.

Vetere-Arellano et al. (2003), stated that the results of flood risk assessment can be used in different areas by policy makers and a number of stakeholders in flood disaster management as summarized in Table 1.6 below.

Table 1.6 : Areas where Damage Estimation Results can be used

Area	Usage
Policy making	It could be used to assist policy makers in preparing, revising and updating legislations in order to ensure maximum protection.
Spatial and land use planning	To assist rural and regional planners to adopt proper prevention and mitigation measures in order to prevent and reduce the cascading effect of flood.
Disaster recovery/relief	It helps in prioritizing and better targeting the allocation of disaster recovery and relief resources.
Damage estimation practice	Helps to improve damage estimation techniques in carrying out damage assessment.
Damage estimation research	It could be used to identify areas of research where advances can be made, as well as providing a better understanding of flood disaster and its effect on the society.

(Source : Adopted and modified from Vetere-Arellano et al, 2003)

1.13 An Overview of Livelihood Outcomes in Malaysia

Malaysia had witnessed a rapid development in terms of socio-economic and demographic changes since independence and now tracking to become high income nation by the year 2020 (ETP, 2015) these developments are attributed to the stability in political and economic advancement in recent decades (Shariff and Khor, 2005), according to (Alinovi, Marco, and Erdgin, 2010) livelihood outcomes are capacities and goals to which people aspire such as improved food security and increased income to meet their survival and attain general wellbeing.

Malaysian government had come up with strong economic policies and programs in raising rural incomes and reducing rural poverty since independence (Abdelhak, 2013; Alam et al. 2016; Devendra, 2012), such policies and programmes include New Economic Policy (NEP); National Development Plans (NDP); Malaysia Plans (MPs); Food Security Policy (FSP) and the recent New Economic Model (2011-2015) which Malaysia seeks to achieve high income status by the year 2020. As a result of these continuous policies and programmes, the incidence of poverty/food insecurity has been dramatically and significantly reduced. As indicated in Table 1.7 below, the incidence of poverty in Malaysia as a whole fell to 0.6 in 2014 against 49.3% in 1970; in an urban area, it drops to 0.3 in 2014 as against 21.3 in 1970 while in rural areas it declined to 1.6 in 2014 as against 58.7 in 1970.

Table 1.7 : Incidence of Poverty and Mean Monthly Gross Household Income

	1970	1976	1979	1984	1987	1989	1992	1995	1997	1999	2002	2004	2007	2009	2012	2014
Poverty Incidence Malaysia (%)	49.3	37.7	37.4	20.7	19.4	16.5	12.4	8.7	6.1	8.5	6.0	5.7	3.6	3.8	1.7	0.6
Poverty Incidence Urban (%)	21.3	15.5	17.5	8.5	8.5	7.1	4.7	3.6	2.1	3.3	2.3	2.5	2.0	1.7	1.0	0.3
Poverty Incidence Rural (%)	58.7	45.7	45.8	27.3	24.8	21.1	21.1	14.9	21.2	14.8	13.5	11.9	7.1	8.4	3.4	1.6
Mean Monthly Gross Households Income Malaysia (RM)	264	505	678	1098	1083	1169	1566	2020	2606	2472	3011	3249	3689	4025	5000	6141
Mean Monthly Gross Households Income Urban (RM)	428	843	1045	1573	1488	1606	2032	2589	2032	3103	3652	3956	4356	4705	5742	6833
Mean Monthly Gross Households Income Rural(RM)	200	385	523	842	881	957	1024	1326	1704	1718	1729	1875	2283	2545	3080	3831

(Source : Economic Planning Unit (EPU) Prime Minister's Department, 2017)
Official website www.epu.gov.my

From the Table 1.7 above, it can also be seen that Malaysia has made a dramatic achievement in eradicating poverty and food insecurity to the bare-minimum and witness the rise in gross monthly income ill states within the last four decades, up to a stage where some states like Johor recorded 0% incidence of poverty in 2014, but yet there is income inequality, poverty and food security disruption among the rural households East Coast states of Peninsular Malaysia as reported from empirical literatures (Abdelhak, 2013; Mahmudul Alam et al., 2016; Siwar et al., 2013), in addition to what is reported from Malaysia Economic Planning Unit (EPU) that rural poverty is high in those states as indicated in Figure 1.9 below.

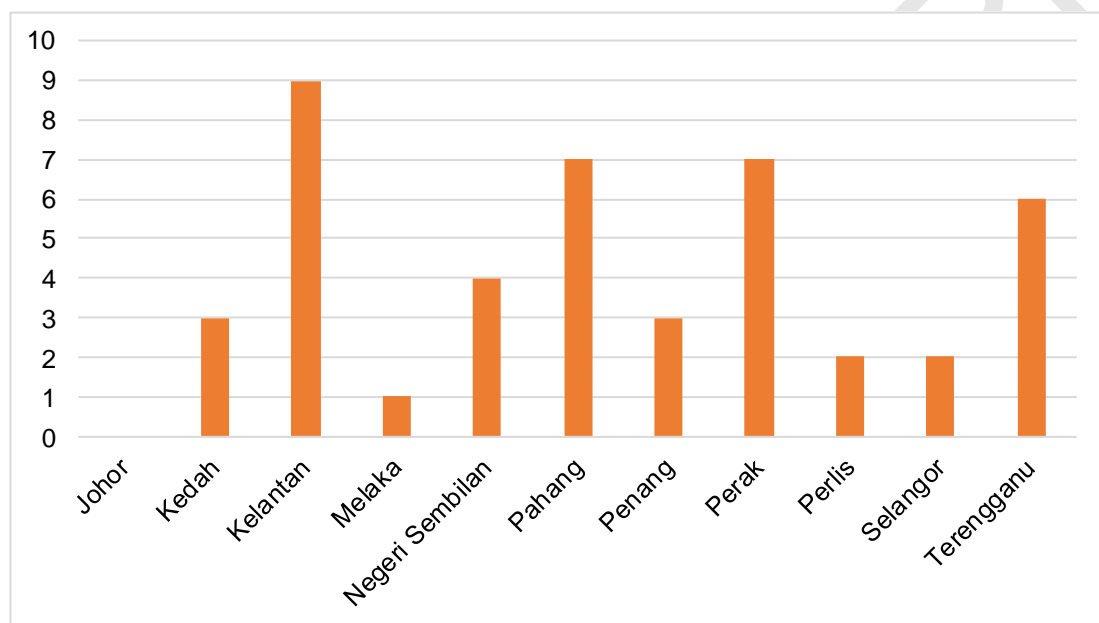


Figure 1.9 : Incidence of Poverty (%) by States in Peninsular Malaysia, 2014

(Source : Economic Planning Unit (EPU) Prime Minister's Department, 2017)

Official website: ww.epu.gov.my

With regards to rise in gross monthly income, there is a virtually significant increase in all states of Peninsular Malaysia, with Selangor having the highest monthly income of RM8,252 in 2014 as reported by EPU and Kelantan become the state with lowest gross monthly income of about RM3,715, as shown in the Figure 1.10 below.

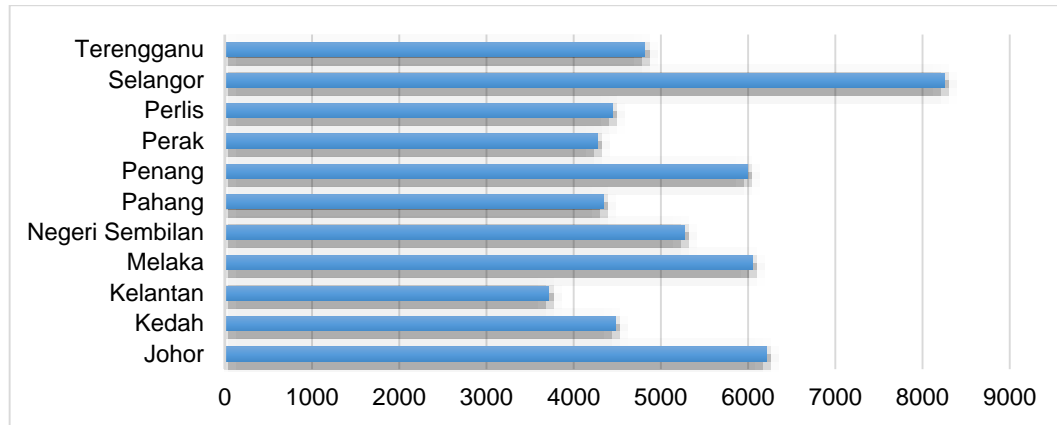


Figure 1.10 : Mean Monthly Gross Household Income by States in Peninsular Malaysia, 2014

(Source : Economic Planning Unit (EPU) Prime Minister's Department, 2017)
Official website www.epu.gov.my

This study argues that, despite all these onerous achievements in eradicating poverty among the rural populace, it is necessary to assess the flood disaster effect on smallholder farmers agriculture and livelihood, and the policy responses against disaster, since various empirical studies had opined that food security and income of rural households in disaster prone areas are not only threatened by the unavailability of food or inadequate government policies and programmes but the prevailing natural disasters in the area that caused substantial asset losses and damages, large income fluctuations and thus, leads to food insecurity (Abdelhak, 2013; Fothergill and Peek, 2004; Morduch, 1994; Masozera et al., 2006; Siwar et al., 2013). Rural households around the world both in developing and developed nations like United States of America (USA), suffer the greatest disaster losses and have the most limited access to public and private recovery assets (Blaikie et al. 2003; Fothergill and Peek, 2004) lack of formal mechanisms such as credits and insurance hinder the ability of smallholder farmers to cope with natural disaster impacts (Abdelhak, 2013). For the case of Malaysia, it has been reported that over 3.5 million people who are mostly living along flood prone areas in the coastal region are vulnerable to flood disaster, which occasionally destroys their agricultural produce, farm infrastructures, households properties and affects their general welfare (Ngai Weng Chan, 2012b).

1.14 Problem Statement

The 2014/2015 flood disaster due to its frequency and magnitude stands out to be the most devastating natural disaster in Kelantan state, disrupting various sectors of the economy and caused substantial economic losses by destroying and damaging agricultural land and products, houses, infrastructures and other public buildings costing millions of ringgit. It has been reported that at least 70% of the villages in Kelantan or nearly half of the State population were affected (Baharuddin et al.,

2015). It has caused a considerable economic damage to farmers and their livelihood (Tahir et al., 2015). According to Agriculture and Agro-Based Industry Minister Datuk Seri Ismail Sabri Yaakob, RM194mil was lost due to damage to agriculture produce and Kelantan recorded the highest number of livestock breeders, fishermen, and farmers who were affected by the floods. Being an agrarian State (Kelantan), the resulting losses, in the agricultural production sector would have negative effects on the livelihood outcomes of the victims, especially in rural communities, where a majority of households still depend on smallholder agriculture for survival. However, on the policy response to flood disaster, most studies have claimed that governments and other stakeholders put more efforts on reactive approaches such as response and recovery measures rather than mitigation that are proactive measures (Mojtahedi, 2015).

Although there are numerous studies on flood disaster effect in Kelantan (Wan Ahmad et al., 2015; Weng et al., 2016; Hussain et al., 2014). Few were carried out to assess its effect on agriculture and livelihood outcomes of smallholder farmers, and policy efforts used in reducing the effects. Several models such as IO Model, SAM, and CGE that were used to assess the impact of natural disasters hardly estimate individual livelihood disruptions. In addition, many of these studies have investigated the direct and indirect effect of natural disasters on socio-economic and livelihood conditions separately and few integrated frameworks were found to evaluate the natural disasters effects on both economic and livelihood conditions concurrently in the literature. There is the need for an integrated conceptual framework that would estimate flood disaster effect on agriculture and livelihood outcomes of the affected smallholder farmers, incorporated with policy responses as moderating factors to the flood disaster effect, so as to bridge the gap on the limitations of previous studies.

1.15 Research Questions

The research questions that are proposed and addressed in this study are as follows:

- 1) What is the extent of the 2014/2015 flood disaster effect on smallholder farmers' agricultural production activities?
- 2) What is the level of policy responses and smallholder farmers' adaptation strategies against flood disaster?
- 3) Does flood disaster affect the livelihood outcomes of the smallholder farmers?
- 4) Does livelihood outcomes of the smallholder farmers depend on the flood disaster effect and some socioeconomic variables?
- 5) Could direct and indirect effect on agriculture, mediates the relationship between flood disaster characteristics and smallholder farmers' livelihood outcomes?
- 6) Has mitigation strategies moderates the relationship between flood disaster characteristics and its effect on agriculture?
- 7) Has provision of recovery needs resources moderates the relationship between flood disaster effect on agriculture and its effect on livelihood outcomes?

1.16 Objectives of the Study

1.16.1 General Objective

The general objective of this study is to assess the economic effects of flood disaster among smallholder farmers in Kelantan state of Peninsular Malaysia. The specific objectives are:

1.16.2 Specific Objectives

The specific objectives are:

- 1) To evaluate the extent of 2014/2015 flood disaster effect on smallholder farmers' agricultural production activities.
- 2) Determine the level of government policy responses and smallholder farmers' adaptation to floods.
- 3) To examine the effect of a flood disaster on respondents' livelihood outcomes.
- 4) To develop a framework on how flood disaster affects agriculture and livelihood outcomes of smallholder farmers.
- 5) To determine the mediating role of direct and indirect effect on agriculture, on the relationship between flood disaster characteristics and smallholder farmers' livelihood outcomes.
- 6) To test the moderating role of mitigation strategies and recovery need resources within the integrated model.

1.17 Significance of the Study

This research contributes to the knowledge by assessing the economic effect of flood disaster on agricultural production and livelihood outcomes of smallholder farmers in Kelantan and identifying the role of policy measures such as flood mitigation strategies and recovery resources in preventing and/or alleviating the effects, while its importance is realised by the practical and theoretical significance discussed below.

1.17.1 Practical Significance

In Kelantan flood disaster has become an important research topic for various studies, however, there are limited empirical studies on the economic effect of flood disaster among smallholder farmers, therefore, assessing and understanding the economic effect of a flood disaster on agriculture and farmers' livelihood is important and necessary for the enhancement and holistic implementation of flood management policies in the best interest of all.

Therefore this study quite important as it will serve as a blueprint for local, state, national government and non-governmental organizations to in designing policies and action plans to address the flood disaster effect in the study area, so as to also reduce vulnerabilities and to unearth prioritizing requirement for future agriculture and farmers livelihoods.

1.17.2 Theoretical Significance

In terms of theoretical and academic contribution, this study therefore develops and operationalizes an integrated conceptual framework on flood disaster economic effect on smallholder among smallholder farmers, by depicting simultaneous relationship between flood disaster characteristics, direct and indirect effects of flood disaster on agriculture in explaining their effect on livelihood outcomes of smallholder farmers, at the same time determining the major role of policy responses in moderating flood disaster effect. The study also demonstrates that disaster impact model, the major theory of this study, is useful in investigating the economic effect of a flood disaster on the livelihood of smallholder farmers. Although, the findings of this study are limited to the study area and their generalizability to other states, countries and/or regions is limited, however, the theoretical framework of this study could be used and/or improved while assessing the effect of flood and other natural disasters in future researches. In addition, the outcome of this study provides an avenue for researchers to build on the limitations of this study and as relevant material for students.

1.18 Scope of the Research

This study is limited to cover only the Kelantan state of peninsular Malaysia. It focuses on the effect of 2014/2015 flood disaster on smallholder agriculture and their consequences to the farmers' livelihood outcomes (food security and income). Therefore the findings of this research may only be generalized on the population of Kelantan state due to the fact that, the flood disaster effect and the characteristics of the sampled respondents may differ from the populations of other states in Malaysia. Similarly, the study only covered smallholder farmers that are affected by 2014/2015 flood disaster on their agricultural production and livelihoods in Kelantan state, thus the study findings may not generalized on the population who are not smallholder

1.19 Conceptual Definition of Terms/Key Constructs

This section covers the definition and/or description of key terms consistently used in the body of this research work, which include natural disaster, flood, flood disaster characteristics, direct and indirect flood disaster effect on agriculture, livelihood outcomes i.e. food security and income, mitigation strategies and response/recovery needs to be used in lessening the effect of disaster.

1.19.1 Natural Disaster

A natural disaster is defined as a “serious disruption of the functioning of a community or a society involving widespread economic, human, material, and environmental losses and impacts which exceeds the ability of the affected community or society to cope using its own resources” (Jongman, Ward and Aerts, 2012).

Disaster is a sudden event which a society or its subdivisions undergoes physical harm or social disruption (Lindell, 2011) resulting in the death of ten or more people, one hundred or more people reportedly affected, necessitating a call for an international assistance or declaration of a state of emergency (Guha-sapir, Hoyois, & Below, 2011).

1.19.2 Flood

A flood is defined as a temporary condition of surface water (river, lake, sea), in which the water level and/or discharge exceed a certain value, thereby escaping from their normal confines (Mirza, 2003). Flood is also generally defined as “a natural phenomenon, event or occurrence, which involves rising and over flowing of a body of water beyond its normal limit resulting in its spilling over onto that, is normally dry”. Or as “an overflow of water where an area of land that is usually dry gets submerged under water”.

1.19.3 Economic Effect

According to Birkmann et al. (2014), it is an effect related with potential losses in an economic activity (like agriculture), which is considered through losses in production, income and/or jobs.

1.19.4 Flood Characteristics

These are triggering factors that define the nature of the flood event and they include occurrence, duration, inundation/depth, high and persistent rain, overflowing of river (Beksin, 2011a) and man-made factor which is deforestation/logging (Adnan, 2010), they are flood damage influencing characteristics, of which some may be more significant than others (Hammond et al. 2014). Berkman et al. (2015) opined that flood characteristics typically include flood extent, depth, duration and sometimes include flow rate and rise rate, which are linked to economic damages of structures more especially land.

1.19.5 Flood Effect on Agriculture

1) Direct Effect

This implies a physical effect on agriculture through loss of crops, Livestock, farm structures and damage to farmland area and soil (FAO, 2015b; Israel and Briones, 2013a; Lindell and Prater, 2003).

2) Indirect Effect

This is the loss of economic activity resulting from direct damages and includes disruption of business, a decrease in employment, the decline in wages and high food prices (FAO, 2015b; Israel and Briones, 2013a).

1.19.6 Flood Effect on Livelihood Outcomes

This is an effect on household capacity (food security and income) that are used to meet their survival threshold.

1) Flood Effect on Food Security

Food security exists “when all people, at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 2006; Wardell-Johnson et al., 2013).

Flood disaster affects all the dimensions of food security, food availability, accessibility, stability and utilization, where agriculturally-based farmers’ livelihoods living on the coasts and floodplains faced the immediate risk of crop failures, loss of livestock and farm structures (Alam et al., 2016; Wulf, 2008).

2) Flood Effect on Income

Income loss/reduced from agricultural production activities, as a result of damage to crops, loss of livestock, replacement of damaged assets, farm labor and disruption in agricultural trade flows (FAO, 2015b; Izevbuwa and Adeolu, 2015; Wulf, 2008).

1.19.7 Mitigation Strategies

These are proactive measures which include structural (physical construction measures such as dams, embankments, levees, reservoirs, etc.) and non-structural (land use planning, forecasting, and warning, insurance, etc.) measures undertaken to

reduce or limit the impact of a disaster (Moe and Pathranarakul, 2006; Weichselgartner, 2001).

1.19.8 Recovery Needs Resources

Refers to a provision of immediate assistance from a variety of governments, individuals and organizations to the affected communities and decisions taken after a disaster with a view to restoring pre-disaster living conditions (Moe and Pathranarakul, 2006; Mojtahedi and Lan, 2011).

1.20 Organization of the Thesis

This study is divided into five independent but related chapters. Chapter one discusses the general background of the study in which flood disaster effects on agriculture and livelihood outcomes of smallholder farmers were elaborated. It further introduces the problem statement and objectives of the study, significance, and scope of the research at hand and conceptual definitions of terms. Chapter two reviewed previous studies on the concept of flood disaster, theoretical and empirical literature related to the study, models, and techniques of analysis used in the previous literature. Chapter three discusses the general research methodology that covered research design, conceptual framework, the operationalization of the proposed theoretical framework on the flood disaster effect on smallholder farmers agriculture and livelihood outcomes. Data analysis consisting of analytical techniques was also discussed. Chapter four of this study present and discusses the findings of this study. Chapter five summarized the entire study, discussed the research policy implications and limitations, and make recommendations for future research were put forward and finally concluded based on the aim and findings of this research work

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