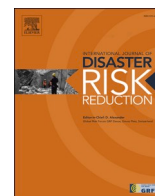


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Agriculture insurance for disaster risk reduction: A case study of Malaysia

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ABSTRACT

Malaysia is one of the countries in the Asia-Pacific region that is most vulnerable to hazards such as floods, landslides, droughts, and climate change. Disaster risk continues to grow as a result of unplanned urbanization, persistent poverty, and ecosystem degradation. In this context, insurance is a risk financing mechanism, part of a comprehensive disaster risk management strategy, which plays an important role in disaster risk reduction. Being an economy in transition, Malaysia is in a unique position in relation to agriculture insurance. Based on primary and secondary sources of information and literature review, the present study analyzed the potential effects of agriculture insurance for disaster risk reduction (DRR) in Malaysia. The proposed framework of agriculture insurance suggests the involvement of policy makers and implementers, marketing channels, and micro users for DRR in Malaysia. The study identified challenges for agriculture insurance in Malaysia, such as lack of experience from international practices, limited products, lack of necessary data, limited financial capacity, and high administrative operational costs. Suitable recommendations that aim to promote agriculture insurance and reduce disaster risk in agro-production are offered. These recommendations emphasize proper government initiatives and public-private partnership of insurance companies to assist the market and the designing of suitable insurance products.

1. Introduction

Insurance is an economical method to cope with the impacts of climate change on the economy [1–4]. Based on the ways in which the insurance products are developed, the insurance can address a wide range of risks brought about by both non-climatic and climatic inception [1,3,5–13]. Insurance, when present, is largely subsidized in developing countries, especially in the agriculture sector [14,15].

By contrast, insurance is not mandatory or is largely absent in the urban sector. Insurance also provides chances to build private-public partnerships and reduces dependencies on public resources during the post-disaster reconstruction and relief stages [1,8,12,16,17]. Communities can rapidly reestablish and restore their business and living

arrangements. Agricultural insurance has been shown to increase the rate of uptake of formal credit by farmers that enhance their agricultural operations and maximize profits [18]. By contributing to the regularity and security of income, insurance could lead to an increase in inputs, including investment, in croplands [19–22]. The availability of liquid capital after disasters also reduces the need for households to sell assets and reduces credit constraints. Such reduction helps farmers escape from a poverty-vulnerability cycle [23].

Although insurance premiums in the agriculture sector in the Asia-Pacific region have doubled in recent years, the total value of premiums in the region is less than 20% of the total global value [24]. Even in areas where insurance is available, the effectiveness of the current insurance products in terms of disaster risk reduction (DRR) and climate

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change adaptation (CCA) appears to be limited. DRR is “the process of reducing exposure, lessening underlying vulnerabilities, better management of resources and improved preparedness towards future hazards” [25]. Therefore, DRR is clearly relevant to CCA. These definitions show that both CCA and DRR address the underlying causes of vulnerability to a hazard or risk [26–31]. In addition to shocks, climate change also addresses the need for long-term adjustment to slow down the onset of changes. Traditionally, the insured are not required to invest pay-outs in better risk mitigation practices. As a result, every disaster and the resulting pay-outs can perpetuate the risk. Thus, the assessment of insurance effectiveness in the contexts of DRR and CCA requires consideration of appropriate indicators.

In Malaysia’s highly vulnerable state, insurance is an essential tool for managing risk at every level [8,32–34] because it, (a) accentuates mitigation of risk, which the present reaction-driven systems are not capable of; (b) provides a practical method for adapting to the financial effects of atmosphere- and climate-actuated perils; (c) covers residual risks to reinforce CCA schemes, which are not secured by other risk mitigation components, including establishing regulations, land use planning, and disaster management planning; (d) balances out provincial earnings and consequently decreases the hostile impacts of negative shocks on earnings and economic and social improvement; (e) opens opportunities to build private-public partnerships; (f) reduces dependencies on public resources at post-disaster reconstruction and relief; (g) assists groups and people to rapidly re-establish and restore their business and living arrangements; and (h) addresses a wide range of risks stemming from both non-climatic and climatic inception, based on the ways the insurance products are developed [35].

With the numerous disasters that Malaysia has been experiencing, the people continue to face various risks, such as flood, severe haze, and landslide. In this regard, knowledge, education, and practices have a positive and significant influence on the reduction of disaster risks [36]. The agricultural sector of Malaysia combines large-scale plantations with a huge number of small-scale manufacturers. However, large-scale enterprises are more concerned with buying insurance. Agriculture insurance coverage is accessible for oil palm, cocoa, rubber, and some types of timber trees, as well as tropical fruits like durian, mango, and mangosteen. Like many countries, Malaysia has several experiences with agriculture insurance [37–39]. However, insurance companies need skilled personnel and appropriate insurance policies, according to the risks [40]. Agriculture is the biggest sector in Malaysia, where agriculture insurance can cover existing hazards. Being a growing economy, agriculture insurance ensures probable risk reduction in crop production. However, most of the support comes from private insurance companies. Due to the competition among private insurance companies, a certain price advantage is given to plantation owners.

The impact of calamities on Malaysian farmers calls for some practical financial support, particularly for those who cultivate food and cash crops. The United Nations International Strategy for Disaster Reduction (now: UNIDRR) confirms that Malaysia is prone to natural disasters. The impact of natural disasters, i.e. events triggered by natural processes such as floods or landslides, has often severe consequences and often reveal people and assets vulnerability [41]. Natural disasters also entail storms, landslides, tsunamis, and floods [42]. In the past 30 years, floods have caused the most damage to the Malaysian economy [33,43,44]. During this period, the Malaysian agricultural sector also has suffered losses due to floods. Malaysian farmers are exposed to various losses associated with natural perils, such as drought, crop disease, floods, and hails, changes in weather, pest outbreak, and windstorm. Usually, the coverage provided by the private insurance sector is not sufficient due to the limited insurance products and packages. However, the majority of the policyholders is large-scale plantation companies [45].

1.1. Loss and damages from disasters in the ASEAN region

In the ASEAN region, an agricultural insurance program is generally

accessible either in a pilot structure or a completely developed national-level system. Table 1 shows the estimated damages and losses in the agricultural sector in several ASEAN countries. The degree of exposure of the agriculture sector to hazards differs from country to country [49]. Consequently, the amount of losses and damages incurred by this sector varies across the countries. For example, 4.57% of GDP is estimated to be lost in agricultural production annually in Vietnam. In Malaysia, USD 8.48 million of loss and damages were occurring due to calamities such as floods and landslides. Disaster in Malaysia is comparatively less than in other ASEAN countries, but the losses in agriculture need attention to ensure sufficient production (Table 1).

1.2. Loss and compensation in the agriculture sector

The Malaysian agricultural sector has suffered significant losses due to floods. The government has allocated huge amounts of compensation to cover the losses in agriculture due to flooding. In December 2006, flooding caused losses in the agricultural sector amounting to USD 18.9 million, which affected 6797 farmers and 8322 ha of arable lands. For these losses, the government spent USD 2.5 million in financial aid for farmers. In the December 2007 flood, the estimated losses amounted to nearly USD 18.4 million, 46% of which were covered by the government (Table 2). The trend shows that the Malaysian government spent more in 2007, compared with 2006. These losses are a growing burden on government revenues, which otherwise could have been invested in other development sectors.

Malaysia has one of the highest proportions of plantation crops in Asia. Most of these plantation crops need sufficient insurance coverage for overcoming major hazards. In particular, damages suffered by the paddy farmers in the Muda Agricultural Development Authority (MADA) area were estimated at 76,287 tons (on an average of 5.5 tons per hectare), with a total value of USD 13.8 million. The losses were due to the worst flood in 2005, in which 19,185 ha (20% of the area of MADA) were affected.

2. Issues related to agriculture insurance in Malaysia

There are six types of agricultural insurance, namely, greenhouse, crop, aquaculture, plantation, poultry, and livestock. Agriculture insurance aims to reduce the financial losses of the farmers due to the destruction or damage of crops caused by different risks of production [50]. Forest crops (timber, paper, and pulp for commercial use) and trees used in industries (tea, coffee, rubber, and palm oil) are insured by the forestry or plantation insurance. Various domestic animals like horses, cows, goats, sheep, swine, dogs, and, in some cases, wild animals are insured by the livestock insurance program [51]. Domestic birds, including turkeys, pheasants, geese, ducks, and chickens, which are raised for food and eggs, are covered by the poultry insurance. The aquaculture insurance product is developed to protect the growing of aquatic flora and raising of aquatic fauna. This product also covers crustaceans, molluscs, and seaweed cultivation for commercial purpose. Greenhouse insurance provides comprehensive coverage for infrastructures used in the nursery or greenhouse production, including

Table 1
Agriculture loss and damages in selected ASEAN countries.

Country	Related Disaster	Loss and Damages	Sources
Malaysia	Floods, landslides	USD 8.48 million in 2010	Prabhakar et al. [35],
Philippines	Typhoons, floods and droughts	USD 2234.21 million from 2000 to 2010	Israel and Briones [46],
Indonesia	Floods and droughts	USD 723 million during 2003–2008	Lassa [47],
Vietnam	Floods, droughts and tropical storms	Loss in annual agricultural production was 4.57% of GDP in 2000	Prabhakar et al. [48],

Table 2
Loss and compensation in the agriculture sector in the Malaysia Peninsula, 2006–2007.

State	Size of land (HA)		No of affected Farmers		Estimated Losses (USD million)		Compensation Paid (USD million)		Coverage of the compensation Paid for the losses (%)	
	Flood in 2006	Flood in 2007	Flood in 2006	Flood in 2007	Flood in 2006	Flood in 2007	Flood in 2006	Flood in 2007	Flood in 2006	Flood in 2007
Johor	4544	2791	3360	1843	14.8	2.5	1.2	0.7	8%	28%
Kedah	–	5621	–	4099	–	6.4	–	4.1	–	63%
Pahang	2728	5034	2445	5362	2.2	5.4	0.8	2.2	34%	41%
Melaka	930	–	790	–	1.7	–	0.5	–	29%	–
Negeri Sembilan	120	271	202	516	0.2	2.1	0.1	0.3	33%	14%
Kelantan	–	3791	–	4228	–	1.8	–	1.2	–	65%
Terengganu	–	41	–	47	–	0.1	–	0.02	–	17%
Perlis	–	8	–	25	–	0.01	–	0.01	–	97%
Total	8322	17,556	6797	16,075	18.9	18.4	2.5	8.5	13%	46%

Source: Prabhakar et al. [48].

material damage to structures, glass, equipment, stock, and other contents. A growing agreement among the community is that it is evident that the risk insurance can provide an effective risk management tool for climatic and non-climatic disasters. Several risk insurance initiatives have been executed in Malaysia (Table 3).

With the promulgation of the Third National Agricultural Policy, the agriculture ministry has worked closely with Bank Negara Malaysia and the insurance industry resulting in the National Agricultural Insurance Scheme [52]. This proposed scheme is designed to protect farmers in the event of losses due to natural, economic, and man-made disasters. The proposed agriculture insurance policy would increase the opportunities to raise capital because financial institutions will be more confident in dealing with insured farmers. The proposal to introduce crop insurance coverage for farmers has been submitted to the Cabinet for approval [53, 54]. The basis of this scheme is the provision of insurance coverage for farmers whose crops are destroyed by natural perils, such as floods and droughts. In the early phase, the insurance will be made available only to paddy farmers. Eventually, the insurance will be expanded to farmers cultivating other agricultural crops. The Ministry of Agriculture (MOA) has recruited consultants to help plan and implement the crop insurance in Malaysia. These consultants believe that the best agriculture insurance policy for Malaysia integrates crops, livestock, and other agricultural products under the same program. These efforts resulted in the budget allocation of USD 0.99 billion for the execution of the project launch, USD 0.49 billion of which was allocated to agricultural projects, such as palm oil, rubber, high-value herbs, and paddy products [55]. In addition, USD 1.9 billion was allocated to the MOA and agro-based industry to boost national income and to ensure the sustainability of food security [53,54]. USD 16.5 million was dedicated to the development of agricultural programs, which include the application of technology, increasing the supply of quality seeds, ensuring price stability, and creating and improving agricultural training institutions.

The price of insurance is often heavily subsidized in most developing and developed countries. The subsidies range between a producer loss ratio of 75% (Pakistan, China, and Japan) to as much as 350% (India) [24]. The real price signal is not conveyed by subsidizing premiums, leading to the continuation of existing practices with no net reduction in risk. Most of these issues are linked to the insurance design and support services (e.g., education on risk management) for insurance buyers [56]. Therefore, the cycle of risk continuation must be changed to a cycle of risk reduction. The design of and pay-outs from insurance should promote the long-term reduction of vulnerability to threats to provide DRR and CCA benefits [57]. The long-term risk reduction could be included as an insurance design criterion, and as such, the insured should be required to invest pay-outs in risk mitigation practices after every pay-out. In this way, pay-outs would lead to risk mitigation rather than business-as-usual practices, and accordingly would result in a net risk reduction. Pay-outs would no longer encourage high-risk profit-seeking

Table 3
Activities of agriculture insurance companies in Malaysia.

Companies	Growing Trees	Plant, Machinery and Equipment	Others
Sime Darby Insurance pte ltd	Fire and Lightning, Flood, Windstorm, RSMD, Aircraft Damage, Earthquake, Volcanic Eruption or other convulsion and nature,	Fire and Perils, Business interruption, Accidental, Theft, Machinery, Breakdown/Loss of Profit, Boiler	Human, Transportation
Sime darby lockton insurance	Plantation and flood risks	Property and Casualty, Marine, Energy and Infrastructure, Professional and Financial Risk.	Employee Benefits, Risk Management Services
Etika Takaful	It provides coverage and financial support to the farmers, calamities, pests and diseases.	Progressive farming practices, high value inputs and higher technology in agriculture and to help stabilize farm incomes, particularly in disastrous years.	The Workmen's Compensation
Allianz Malaysia Berhad	Plantation Risks	Boiler and Pressure Vessel Insurance, Civil Engineering Completed Risks Insurance	Foreign Workers Insurance, Employees Healthcare
AXA Affin General Malaysia Lonpac Insurance Bhd	Flood	Malicious damage	Domestic, foreign maids and foreign plantation workers
State Insurance Brokers Sdn. Bhd	Fire and Hazards, Business Interruption	Fire and Perils, Accidental, Theft, Machinery Breakdown/Loss of Profit, Boiler	Workmen's Compensations
Syarikat Takaful Malaysia Berhad	Risks Management	Industrial All Risks, Electronic and Engineering, Machinery Breakdown	Product Liability
	Plantation	General Liability and Others	

behavior. However, this could only happen if a proper risk price signal is conveyed to the insured. The present study analyzes the potential effects of agriculture insurance for disaster risk reduction in Malaysia. The study also identifies the possible barriers and provides recommendations in this regard.

Therefore, this study contributes significantly in various ways; firstly, there are several studies of Masud et al. [58]; Akhtar et al. [59]; and Alam et al. [36] are conducted in Malaysia about the impact of climate change on agriculture; climate change adaptation; and supporting community for disaster risk reduction. However, none of the studies considered the effects of disaster risk reduction based on insurance or protection scopes in the agriculture sector. Thus, this study gives some new insights (e.g. better financial mechanism) to the policymakers and end-users in Malaysia to formulate better policies to reduce risk by looking at limited scope for product diversification, and high administrative operational costs in the event of natural calamity. Secondly, the findings of this study also contribute to the existing literature of climate change risk reduction with the new insights by identifying possible barriers and importantly provides recommendations. Agriculture insurance considered in our study aims to reduce the financial losses of the farmers each year in Malaysia due to the destruction or damage of crops caused by different risks expositors in the production process. Thus, this study flesh out a new space on how an agriculture insurance policy uses direct and indirect channels in Malaysia in reaching to the end-users and how farmers and breeders can be useful from the insurance companies to assist the market and design of suitable insurance products. Last but not least, this study helps the Malaysian government to achieve the National Agri-Food Policy (NAP) 2011–2020 to increase the productivity and competitiveness of the entire agri-food industry value chain and to minimize food supply shortages in Malaysia.

Secondly, this study discussed the existing lack of experience to have a better financial mechanism, limited scope for product diversification, and high administrative operational costs.

3. Methods and materials

Both primary and secondary data were used for this study. A questionnaire survey was the main instrument for the primary source of data collection, while secondary sources were based on a detailed literature review.

3.1. Site selection and data collection

The questionnaire used in this study was based on a survey among farmers of the Integrated Agricultural Development Area (IADA), West Selangor, Malaysia, which covers approximately 100,000 ha, of which 20,000 ha is for paddy, 55,000 ha for palm oil, 20,000 ha for coconut and 5000 ha for fruits and vegetable. There are approximately 10,300 paddy farming families who reside within the IADA who are involved in rice production.

3.2. Survey design and sampling methods

The study was conducted through direct face-to-face interviews to obtain reliable responses from the respondents. The study area is in the IADA North West Selangor which consists of eight areas including Sawah Sempadan, Sg. Burong, Sekinchan, Sg. Leman, Pasir Panjang, Sg. Nipah, Panchag Bedena and Bagan Terap. Of the eight areas and using a random sampling method, 40 farmers were selected from each of the areas with a total sample size of 320 (40 × 8). The survey was conducted in September 2015. The survey was confined to within the IADA, as it is a prominent agricultural zone in Malaysia. The data were collected through interviews with heads of households who work as rice farmers.

3.3. Design of the questionnaire

The questionnaire consisted of sections A, B and C. Section A collected information on the farmers' socioeconomic characteristics (i.e. gender, age, household size, education level, income, and farm size of the respondents). Section B inquired as to farmers' perceptions towards crop insurance to avoid the risk of calamities. Section C consisted of

questions to know the farmers' willingness to pay for crop insurance and what are the motivational factors, risk management strategies etc. for natural disaster risk management.

3.4. Secondary sources of data collection

Literature and secondary sources were used to analyze the disaster risk reduction with insurance programs in the agricultural field in Malaysia. The study included literature from different sources, such as reports, journals, and other related documents. This study investigated the literary works, which included discourses and exhibited information, as well as discoveries and confirmations on catastrophe hazard, damage, loss, and provision of insurance in the agricultural sector. The study proposes an institutional framework of agriculture insurance in Malaysia for disaster risk reduction. The potential effects of agriculture insurance are highlighted based on the loss and compensation in the agro-sector, activities of agriculture insurance companies in Malaysia, and international best practices.

3.5. Institutional framework

Risk insurance can emphasize risk mitigation, especially when insurance is made mandatory and a proper insurance price signal is given. It can provide coverage for the residual risks not covered by other risk reduction mechanisms. Risk insurance can reduce the burden on government resources (i.e. subsidization) for post-disaster relief and reconstruction. Risk insurance also provides opportunities for the development of public-private partnerships [60].

In Malaysia, the MOA is the champion for formulating and regulating agriculture insurance. The insurance companies, reinsurers from home and abroad, and data management agencies - such as the economic planning units in the federal and state levels - are involved with agriculture insurance. The agriculture insurance policy uses direct and indirect channels for marketing and reaching clients. The final beneficiaries of this insurance policy are farmers and breeders as shown in Fig. 1.

4. Results and discussion

4.1. Socio-demographic characteristics of the respondents

The socio-demographic characteristics of the farmers help to improve their performance in adopting practices that manage disaster risks. They help to increase the entrepreneurial abilities of farmers in their decision process for managing the disaster risks, especially those relating to the agricultural enterprise system [61,62]. Based on this rationale, the relevant socio-demographic characteristics of the respondents were investigated to determine how they affect the willingness of the farmers to participate in crop insurance programs to adopt the disaster risk. Table 4 shows the socio-demographic characteristics of the respondents. The majority (88%) of the respondents were male while only 12% were female. The age of farmers ranges between 25 and over 75 years. The highest number of farmers (65%) was from the age group between 25 and 50 years. The second largest group of farmers (21%) was between 51 and 75 years.

This age distribution could have a positive impact on the adoption of new techniques of production. In traditional agricultural production, family labour plays a significant role in farm labour supply. The average household size of the respondents was approximately 8 persons. This suggests the availability of family labour for rice production activities. The farming experience of the farmers' shows that they have been in rice production for at least 10 years, with the majority having farming experience of 20–30 years. Only 9% of the respondents have farming experience for more than 40 years. Table 4 shows the educational status of the farmers. It is reported that 45% had secondary education, while 23%, 20%, and 12% had tertiary, primary, and no formal education. The

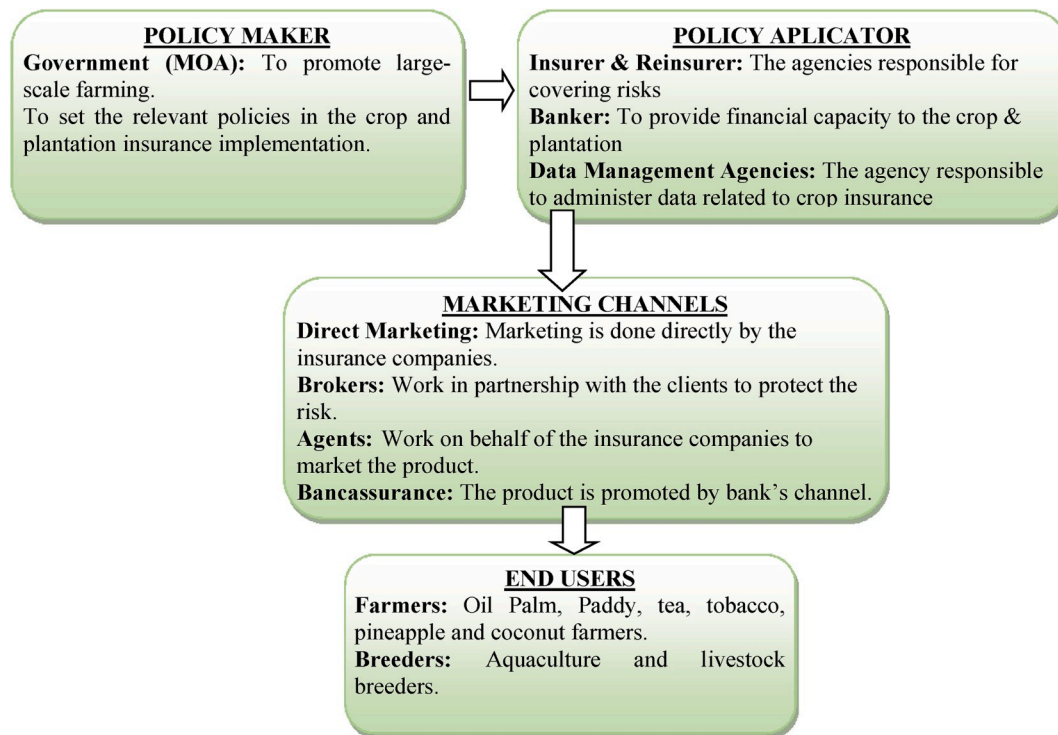


Fig. 1. Proposed Institutional framework of agriculture insurance for disaster risk reduction in Malaysia.

Table 4
Socio demographic characteristics of the respondents (N = 320).

Variables	Frequency	Percentage
Gender		
Male	280	88
Female	40	12
Age		
Below 25	20	6
25–50	207	65
50–75	66	21
Over 75	27	8
Household size		
1–5	64	20
5–10	235	73
>10	21	7
Level of Education		
No formal education	40	12
Primary	63	20
Secondary	143	45
Tertiary	74	23
Income (MYR)		
Less than 2000	36	11
2000–4000	140	44
4000–6000	95	30
>6000	49	15
Farming experience		
10–20	105	33
20–30	137	43
30–40	50	15
>40	28	9
Farm Size		
<1	109	34
1–3	112	35
3–4	66	21
4–5	16	5
5–6	9	3
>6	8	2

results of the study also indicate that the highest number (44%) of farmers has a net monthly income between RM 2000 to RM 4000 while 30% have between RM 4000 to RM 6000 and 11% have less than RM

2000 respectively. Table 4 also indicates that 34% of the respondents hold less than 1.0 ha of land area while 56% have between 1.0 ha and 4.0 ha of agricultural land and only 2% hold above 6 ha of agricultural land.

4.2. Perception of Crop Insurance by the farmers

The respondents were asked whether crop insurance is important to them or not. If the respondents answered yes, they were asked whether it was very important. If the respondents said no, they were asked whether it is not important at all. If the respondents remained quiet and answered, they did not know, or it is hard to say, this was defined as indifferent. According to the results shown in Fig. 2, 28% of the respondents thought that insurance was not important while only 8% of respondents mention that crop insurance is very important. On the other hand, 38% of the respondents were indifferent to crop insurance. Thus, the results suggest that crop insurance is a very new concept to them,

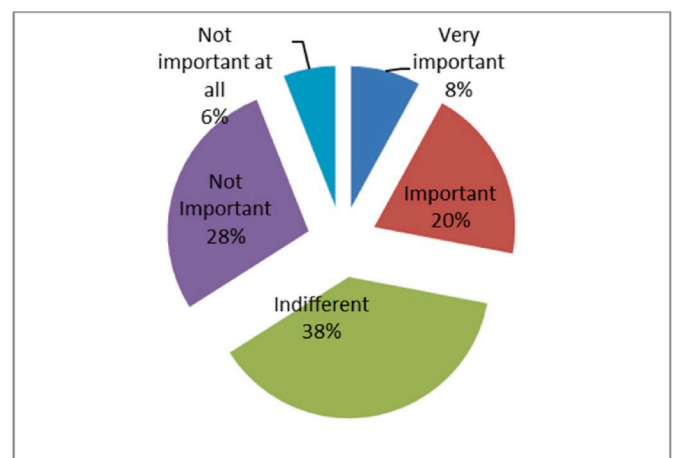


Fig. 2. Perception of crop insurance.

indicating that the social conditions are not favourable for implementing disaster prevention and mitigation through crop insurance.

4.3. Major sources of risk

Fig. 3 presents the sources of risk faced by the respondents. 19% of the farmers mentioned that climate change is the major source of risk. Crop diseases and floods were the second highest (16%) source of risk, while 12% of the respondents stated that open burning and loss of fertility of the soil was the major source of risk. Only 4% of the respondents mentioned that deforestation was the main source of risk.

4.4. Risk management strategies practiced by the farmers

The various risk management strategies practiced by the farmers are presented in Fig. 4. 19% of respondents practiced ‘delay sale of crops’ for higher risk strategies. Different planting dates and off-farm income was practiced by 14%, crop diversification or multi-cropping was practiced by 13% of the respondents to reduce the risk. Only 4% of the respondents have crop insurance. This is because crop insurance is a new concept for them to reduce disaster risk. In Malaysia, Ministry of Agriculture and Agro-Based Industry Malaysia introduce ‘‘crop insurance’’ to protect farmers from risks linked to climate change such as drought, diseases and floods. ‘‘In its first phase, the crop insurance will cover only padi. Later, it will include other agriculture activities such as livestock, agro-food commodities such as fruits and vegetables as well as the fisheries sector [52].

4.5. Farmers’ perception of government financial aid

Several statements were offered in the questionnaire to understand the farmers’ perception of government financial aid for farmers affected by calamities, shown in Table 5. The results showed that 67% of the farmers agree that they are satisfied with the amount provided by the government. More than 63% of the respondents agreed that the government provided a good mechanism for flood management and only a small percentage responded negatively. 73% of responded agreed that they received financial aid lately. 56% agreed that they received payments one or two months after incurring losses.

4.6. Willingness to have crop insurance and motivational factors

This study found that the majority of the respondents (70%) were willing to have crop insurance in North West Selangor, Malaysia, as shown in Table 6. The most important motivational factor for willingness to have crop insurance is to avoid the risk of losses from calamities. The second motivational factor is to reduce future economic cost, which

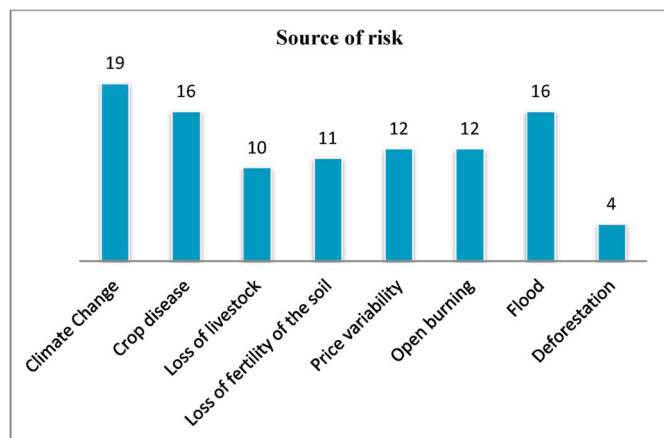


Fig. 3. Major sources of risk as perceived by the respondents.

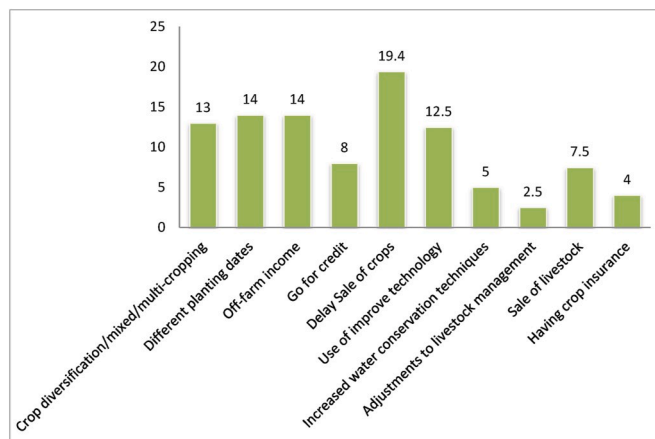


Fig. 4. Risk management strategies practiced by the farmers.

Table 5 Perception towards government financial aid (N = 320).

Perception towards government financial aid	(%)
We are satisfied with the amount arranged by the government	67
The government has provided a good mechanism for flood management	63
We have received the financial aid lately	73
We receive payments one or two months after incurring losses	56

is presented in Fig. 5.

Agriculture is among the most disaster-prone sectors in Asia. This sector is highly vulnerable to hazards. Floods have been one of the most frequent disasters recorded around the world (45% of the total number of disasters). Other disasters, which commonly occur, are windstorms, droughts, earthquakes/tsunamis, extreme temperatures, climatic vagaries, and insect pest infestations.

4.7. Insurance best practices by country

Some agriculture-based countries in the world have minimized the hazards in crop productions. The countries are focusing on several areas of concern such as crop type, agronomy practices, weather data, loan practices, and insurance product design in crop production. Table 7 shows the agriculture insurance best practice by country and type as well as mechanisms for agricultural insurance in selected countries. The findings also reveal that agriculture insurance is popular in India, Japan, and the Philippines, followed by aquaculture, livestock, and others.

5. Challenges and recommendations

There are several challenges confronted by insurance companies in Malaysia as follows (Fig. 6): (i) Lack of experience in international practices: Insurance companies in Malaysia have minimal exposure to international practices in agricultural insurance. They lack knowledge and experience in product design, selling, rating, and implementation of

Table 6 Willingness to have crop insurance.

Item	Frequency	Percentage
Yes	224	70
No	96	30
Motivational Factors to have crop insurance		
To avoid losing from disaster	243	76
It is mandatory to have crop insurance	00	00
To reduce future economic cost	48	15
It is one of the risk management strategies	29	9
Total	320	100

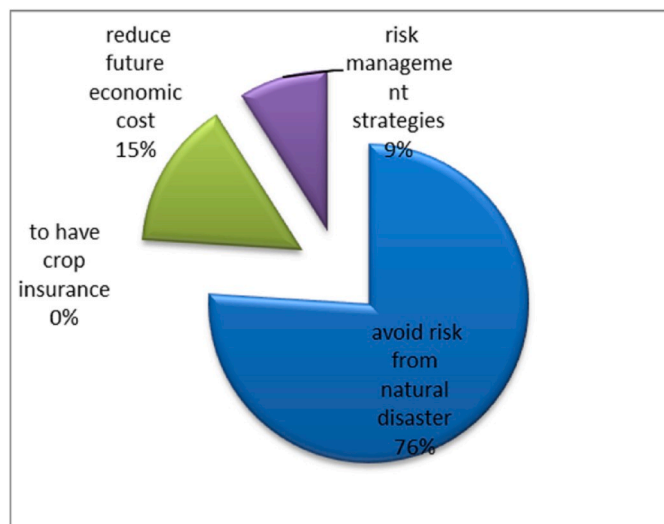


Fig. 5. Motivational Factors to have crop insurance.

Table 7
Agriculture insurance best practice by country.

Country	Concerning areas	Mechanisms
Australia	Agronomic practices, crop selection, conservation agriculture, crop type and variety, flexibility in crop showing activities	On-farm storage, value-chain development, off-farm investment, enterprise diversity
India	Crop cutting experiments, weather data, crop loan practices, insurance product design	Capacity building, awareness of farmers, crop insurance premium
Japan	Agro production-rice, sugarcane, wheat, barley, fruit; livestock	Multi-peril insurance, designation of the total loss area, practice 'Agriculture National Disaster Compensation Law-1947'
Philippines	Crop production-rice, corn crop; livestock, fisheries, high value commercial crop	Productivity enhancing, partnership with national and local authorities, government intervention to combat the climate change

Source: Malaysia [63].

farmers for disaster risk reduction. Moreover, these products have failed to maintain an international standard; (iii) Lack of necessary data: No common platform for data pooling or data management for agriculture insurance is present in Malaysia. Relatively high quality time-series production and yield data, as well as meteorological weather data, are needed to design effective agricultural insurance products; (iv) Limited financial capacity: Commercial insurance companies have limited financial capacity to invest in insurance staff training, policy design, and product development for agricultural insurance. They also have limited access to international insurance companies; and (v) High administrative costs: The costs of insurance delivery, underwriting, and claims administration are comparatively high in agricultural insurance. The insurance companies need risk classification and monitoring systems to identify opportunities for group sales and seasonal production loans.

Risk management is crucial to the investment and financing decisions of farmers in developing countries and transition economies. Although agricultural insurance is one of the most often quoted tools for risk management, it can play a vital role in managing the risks involved in farming. In practice, agricultural insurance is almost invariably adjunct to a whole set of risk management measures, among which, adequate farm management practices constitute an important element. The loss and damages from calamities are hampering agricultural production in the ASEAN region. Agriculture production in several states of the Peninsula Malaysia is also affected by calamities. Agriculture insurance policies can reduce disaster risks of the affected farmers. Several insurance companies in Malaysia have offered agriculture insurance products to reduce and minimize the agriculture production risk. The following recommendations can promote agriculture insurance in Malaysia and reduce the disaster risk in agro-production; (i) Government initiatives: the government could act as a reinsurer against agricultural losses. In this position, the government can provide protection for agricultural crop and livestock insurance initiatives, if local insurers and international reinsurers are unwilling to provide excess-of-losses; (ii) Public insurance companies: Public insurance companies could develop public-private partnerships with the domestic private insurance sector, NGOs, and other agriculture insurance schemes. These partnerships could provide financial and operational assistance to the local agricultural insurance market; and (iii) Agricultural insurance product design: Insurance companies could share their technical knowledge in designing and implementing agricultural insurance products. Within this partnership, they would be able to develop risk-assessment methodologies and loss-adjustment procedures as well as training insurance personnel and creating awareness among the farmers.

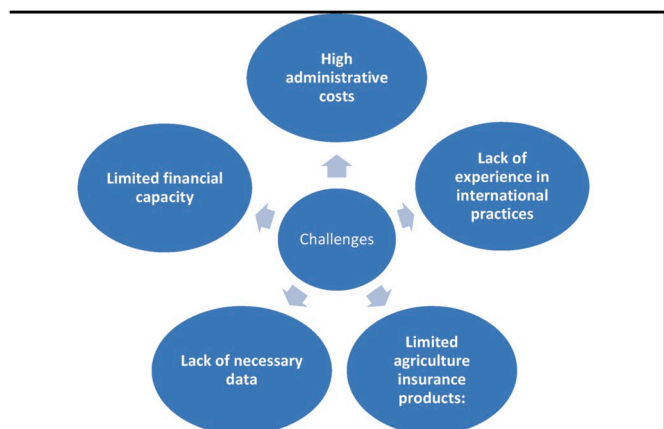


Fig. 6. Challenges of insurance companies in Malaysia.

agriculture insurance; (ii) Limited agricultural insurance products: insurance companies in Malaysia are offering limited insurance products for crops and livestock. These products are not fulfilling the needs of

6. Conclusions

The work performed in the context of this article allows two main conclusions to be drawn. Firstly, the study explored the potential effects of agriculture insurance for disaster risk reduction (DRR) because of unplanned urbanization, persistent poverty, and ecosystem degradation. The disaster risk reduction by financial strategies may play an important role in disaster risk reduction. Secondly, this study discussed the existing lack of experience to have a better financial mechanism, limited scope for product diversification, and high administrative operational costs. Consequently, this study recommends the strategies toward the risk reduction strategies for disaster risk reduction in Malaysia. This study may provide a basis for the design of suitable policies in Malaysia and other countries with similar economic conditions.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijdr.2020.101626>.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] G.E. Rejda, *Social Insurance and Economic Security*, Routledge, 2015.
- [2] M. Arena, Does insurance market activity promote economic growth? A cross-country study for industrialized and developing countries, *J. Risk Insur.* 75 (4) (2008) 921–946.
- [3] R. Chetty, A new method of estimating risk aversion, *Am. Econ. Rev.* 96 (5) (2006) 1821–1834.
- [4] M. Kugler, R. Ofoghi, Does insurance promote economic growth? Evidence from the UK, in: *Money Macro and Finance (MMF) Research Group Conference*, vol. 8, 2005, September.
- [5] C.C. Lee, C.C. Lee, Y.Y. Chiou, Insurance activities, globalization, and economic growth: new methods, new evidence, *J. Int. Financ. Mark. Inst. Money* 51 (2017) 155–170.
- [6] F. Mohagheghzadeh, A. Najafzadeh, S. Shirinbakhsh, A. Daghighiasli, The determinants of economic growth in developing countries with a special emphasis on insurance sector, *J. Econ. Manag. Perspect.* 11 (3) (2017) 1787–1799.
- [7] L. Han, D. Li, F. Moshirian, Y. Tian, Insurance development and economic growth, *Geneva Pap. Risk Insur. - Issues Pract.* 35 (2) (2010) 183–199.
- [8] K.S. Ching, M. Kogid, F. Furuoka, Causal relation between life insurance funds and economic growth: evidence from Malaysia, *ASEAN Econ. Bull.* (2010) 185–199.
- [9] Re Swiss, *Weathering Climate Change: Insurance Solutions for More Resilient Communities*, Swiss Reinsurance Company Ltd, Zurich, Switzerland, 2010.
- [10] M. Arnold, The Role of Risk Transfer and Insurance in Disaster Risk Reduction and Climate Change Adaptation, Commission on Climate Change and Development, Kräftriket, Sweden, 2008.
- [11] G.A. Gbetibouo, R.M. Hassan, Measuring the economic impact of climate change on major South African field crops: a Ricardian approach, *Global Planet. Change* 47 (2–4) (2005) 143–152.
- [12] D. Ward, R. Zurbrugg, Does insurance promote economic growth? Evidence from OECD countries, *J. Risk Insur.* (2000) 489–506.
- [13] A. Siamwalla, A. Valdes, Should crop insurance be subsidized? in: P. Hazell, C. Pomareda, A. Valdez (Eds.), *Crop Insurance for Agricultural Development: Issues and Experience* John Hopkins University Press, Baltimore, 1986.
- [14] V.H. Smith, J.W. Glauber, Agricultural insurance in developed countries: where have we been and where are we going? *Appl. Econ. Perspect. Pol.* 34 (3) (2012) 363–390.
- [15] P. Hazell, R. Sberro-Kessler, P. Varangis, When and How Should Agricultural Insurance Be Subsidized? Issues and Good Practices, World Bank, 2017.
- [16] G.C. Liu, C.C. Lee, C.C. Lee, The nexus between insurance activity and economic growth: a bootstrap rolling window approach, *Int. Rev. Econ. Finance* 43 (2016) 299–319.
- [17] P.F. Chen, C.C. Lee, C.F. Lee, How does the development of the life insurance market affect economic growth? Some international evidence, *J. Int. Dev.* 24 (7) (2012) 865–893.
- [18] N.K. Budhathoki, J.A. Lassa, S. Pun, K.K. Zander, Farmers' interest and willingness-to-pay for index-based crop insurance in the lowlands of Nepal, *Land Use Pol.* 85 (2019) 1–10.
- [19] T.N. Kostyuchenko, D.V. Sidorova, N.V. Eremenko, L.I. Chernikova, Insurance as a tool for managing risks in agriculture, *Mediterr. J. Soc. Sci.* 6 (5) (2015) 220.
- [20] B.K. Goodwin, V.H. Smith, What harm is done by subsidizing crop insurance? *Am. J. Agric. Econ.* 95 (2) (2013) 489–497.
- [21] G. Enjolras, P. Sentis, Crop insurance policies and purchases in France, *Agric. Econ.* 42 (4) (2011) 475–486.
- [22] O. Mahul, C.J. Stutley, Government Support to Agricultural Insurance: Challenges and Options for Developing Countries, The World Bank, 2010.
- [23] A. Aggarwal, Impact evaluation of India's 'Yeshasvini' community-based health insurance programme, *Health Econ.* 19 (2010) 5–35.
- [24] Food and Agriculture Organization of the United Nations, *Agricultural Insurance in Asia and the Pacific Region*, RAP Publication 2011/12, 2011.
- [25] N.J. Setiyadi, Birkmann, P. Buckle, Disaster Risk Reduction and Climate Change Adaptation: Case Studies from South and South East Asia, UNU-EHS, Bonn, Germany, 2010.
- [26] S.L. Cutter, The perilous nature of food supplies: natural hazards, social vulnerability, and disaster resilience, *Environm* 59 (1) (2017) 4–15.
- [27] X. Ming, W. Xu, Y. Li, J. Du, B. Liu, P. Shi, Quantitative multi-hazard risk assessment with vulnerability surface and hazard joint return period, *Stoch. Environ. Res. Risk Assess.* 29 (1) (2015) 35–44.
- [28] S.R. Isakson, Derivatives for development? Small-farmer vulnerability and the financialization of climate risk management, *J. Agrar. Change* 15 (4) (2015) 569–580.
- [29] S. Surminski, D. Oramas-Dorta, Flood insurance schemes and climate adaptation in developing countries, *Int. J. Disas. Risk Reduct.* 7 (2014) 154–164.
- [30] W.W. Botzen, *Managing Extreme Climate Change Risks through Insurance*, Cambridge University Press, 2013.
- [31] A. Garrido, M. Bielza, D. Rey, M.I. Mínguez, M. Ruiz-Ramos, 19 Insurance as an adaptation to climate variability in agriculture, in: *Handbook on Climate Change and Agriculture*, 2011, p. 420.
- [32] N. Thirawat, S. Udompol, P. Ponjan, Disaster risk reduction and international catastrophe risk insurance facility, *Mitig. Adapt. Strategies Glob. Change* 22 (7) (2017) 1021–1039.
- [33] N.W. Chan, Impacts of disasters and disaster risk management in Malaysia: the case of floods, in: *Resilience and Recovery in Asian Disasters*, Springer, Tokyo, 2015, pp. 239–265.
- [34] T.H. Ng, L.L. Chong, H. Ismail, Is the risk management committee only a procedural compliance? An insight into managing risk taking among insurance companies in Malaysia, *J. Risk Finance* 14 (1) (2012) 71–86.
- [35] S.V.R.K. Prabhakar, G.S. Rao, K. Fukuda, S. Hayashi, Promoting risk insurance in the Asia-Pacific region: lessons from the ground for the future climate region under UNFCCC, in: P. Schmidt-Thome, J. Knieling (Eds.), *Implementing Climate Change Adaptation Strategies*, Blackwell Publishers, UK, London, 2013, p. 327.
- [36] A.S.A.F. Alam, M.I.H. Reza, H. Begum, A.C. Er, J.J. Pereira, Promoting community for disaster risk reduction: a case of an enlightened community of UKM, *Adv. Sci. Lett.* 21 (2015) 1701–1704.
- [37] R. Afroz, R. Akhtar, P. Farhana, Willingness to pay for crop insurance to adapt flood risk by Malaysian farmers: an empirical investigation of Kedah, *Int. J. Econ. Financ. Issues* 7 (4) (2017).
- [38] M.A. Amin, G.A. Abdullahi, D. Suryani, R. Alias, Farmers willingness to pay for crop insurance in north west Selangor Integrated Agricultural Development Area (IADA), Malaysia, *J. ISSAAS (Int. Soc. Southeast Asian Agricult. Sci.)* 20 (2) (2014) 19–30.
- [39] A.P.A. Network, Promoting Risk Financing in the Asia Pacific Region: Lessons from Agricultural Insurance in Malaysia, Philippines and Vietnam, IGES, Hayama, Japan, 2013.
- [40] R.A. Roberts, *Insurance of Crops in Developing Countries*, vol. 159, Food & Agriculture Org, Rome, 2005.
- [41] K. Chmutina, J. von Meding, A dilemma of language: "natural disasters" in academic literature, *Int. J. Disas. Risk Sci.* 10 (2019) 283–292, <https://doi.org/10.1007/s13753-019-00232-2>.
- [42] UNISDR, Malaysia: risk profile. Geneva, Switzerland: united Nations for international strategies of disasters reduction, Available at: <http://www.unisdr.org/partners/countries/mys>, 2011. (Accessed 27 February 2013).
- [43] C.N. Weng, Addressing flood hazards via environmental humanities in Malaysia, in: J. Jahi (Ed.), *Ecology, Human Habitat and Environmental Change*, 2010, pp. 46–57.
- [44] I. Mohamed Shaluf, F.L.R. Ahmadun, Disaster types in Malaysia: an overview, *Disaster Prev. Manag.: Int. J.* 15 (2) (2006) 286–298.
- [45] A.R. Zuriah, H. Heizal, An Exploratory Study on the Loss Exposures and Risk Management Techniques Employed in the Local and Foreign Agricultural Sector: Malaysia vs. Spain and Morocco, Bureau of Research and Consultancy, UITM Malaysia, 2002.
- [46] D.C. Israel, R.M. Briones, Impacts of Natural Disasters on Agriculture, Food Security, and Natural Resources and Environment in the Philippines, Philippines Institute of Development Studies Discussion Paper Series, (2012–36), 2012.
- [47] J.A. Lassa, Emerging 'agricultural involution' in Indonesia: Impact of Natural Hazards and Climate Extremes on Agricultural Crops and Food System, Economic and Welfare Impacts of Disasters in East Asia and Policy Responses, 2012, pp. 2011–2018.
- [48] S.V.R.K. Prabhakar, A. Abu-Bakar, C. Claudio, H.V. Hung, Promoting risk financing in the Asia Pacific region: lessons from agriculture insurance in Malaysia, Philippines and Vietnam. Institute for global environmental strategies (IGES), hayama, Japan, Available at: www.asiapacificadapt.net, 2013, 1.
- [49] M. Hossain, L. Qian, M. Arshad, S. Shahid, S. Fahad, J. Akhter, Climate change and crop farming in Bangladesh: an analysis of economic impacts, *Int. J. Clim. Chang. Strat. Manag.* 11 (3) (2019) 424–440, <https://doi.org/10.1108/IJCCSM-04-2018-0030>.
- [50] J. Sunda, L. Ramakrishnan, A study on farmers' awareness, perception and willing to join and pay for crop insurance, *Int. J. Business Manag. Invent.* 2 (1) (2013) 48–54.
- [51] R. Iturriz, *Agricultural Insurance. Primer Series on Insurance*, Issue 12, November 2009, Global Capital Markets Development Department, World Bank, Washington, DC, 2009, pp. 1–29.
- [52] Ministry of Agriculture, 3rd National Agricultural Policy 1998 – 2010. Kuala Lumpur, Access online, Ministry of Agriculture, Government of Malaysia, Malaysia, 2010, <http://pmr.penerangan.gov.my>. (Accessed 9 March 2013).
- [53] The Star Online, Ministry plans crop insurance, in: Lim Yvonne (Ed.), 26th June 2012. (Accessed 26 September 2012).
- [54] The Star Online, Boon for agriculture sector, 2012. (Accessed 29 September 2012), 29th Sept.
- [55] Belanjawan Malaysia, Access online, <http://www.malaysiafreebies.com/belanjawan-2013-budget/>, 2013. (Accessed 15 March 2018).
- [56] S.V.R.K. Prabhakar, Insurance for long-term post-disaster recovery and adaptation, in: Paper Presented at the Session on Insurance and Risk Mitigation Strategies: Ensuring Recovery after Climate-Induced Loss, International Conference on Mountain People Adapting to Change: Solutions beyond Boundaries Bridging Science, Policy and Practice, Kathmandu, Nepal, 9–12 November 2014, ICIMOD, Kathmandu, Nepal, 2014.
- [57] S.V.R.K. Prabhakar, Insurance effectiveness: objectives and expectations, in: Paper Presented at Regional Consultation Workshop on Evidence for Disaster Risk Reduction and Climate Change Adaptation Effectiveness of Insurance: Challenges and Opportunities, Bangi, Malaysia, 4–5 July 2014, IGES-SEADPRI-eeMausam-IAFD-UPLB, Bangi, Malaysia, 2014.

- [58] M.M. Masud, M.S. Rahman, A.Q. Al-Amin, F. Kari, W. Leal Filho, Impact of climate change: an empirical investigation of Malaysian rice production, *Mitig. Adapt. Strategies Glob. Change* 19 (4) (2014) 431–444.
- [59] R. Akhtar, M.M. Masud, R. Afroz, Perception of climate change and the adaptation strategies and capacities of the rice farmers in Kedah, Malaysia, *Environ. Urbaniz. ASIA* 10 (1) (2019) 99–115.
- [60] S.V.R.K. Prabhakar, Insurance for long-term post-disaster recovery and adaptation, in: Presented at the 4th Asia-Pacific Climate Change Adaptation Forum 2014, at Kuala Lumpur, Malaysia. 1-3 October 2014, 2014.
- [61] U. Haruna, M. Garba, M. Nasiru, M.H. Sani, Economics of sweet potato production in Toro local government area of Bauchi state, Nigeria, in: J.N. Nmadu, M.A. Ojo, Mohammed (Eds.), *Proceedings of 11th Annual National Conference of National Association of Agricultural Economists (NAAE)*, U. S., Baba, K, 2010.
- [62] A.U. Shu'aib, Economic Analysis of Bee Keeping in Selected Local Government Area of Kano State. An M. Sc. Dissertation, Department of Agricultural Economics and Extension, Usmanu Danfodio University, Sokoto, Nigeria, 2009, p. 114pp.
- [63] Malaysia, in: Presentation at Workshop on 'Evidence for Disaster Risk Reduction and Climate Change Adaptation Effectiveness of Insurance: Challenges and Opportunities', Universiti Kebangsaan Malaysia (UKM), Bangi, Malaysia 4-5 July 2014, 2014.