VIABILITY OF INSURANCE IN THE MANAGEMENT OF EXTREME WEATHER RELATED RISKS IN AGRICULTURE: A METHODOLOGY APPROACH

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Climate change and its consequences pose a significant risk to economies and societies as well. This study is focusing on the insurance industry as one of the major players in risk management. Its aim is to present a possible method to examine the potential for introducing a new insurance product, namely, an agricultural flood insurance scheme. The investigation included the mapping of the current compensation systems in Hungary and in the United Kingdom, the calculation of agricultural flood damage costs, and farmers’ interests in insurance. In a small scale survey (2009), farmers with flood experience were asked about their willingness to pay (WTP) for flood insurance using a contingent valuation method. Using statistical analysis, it was found that the insurance demand is positively correlated with the damage cost predicted, and association is likely between farm types and WTP for insurance. Linear regression model suggests that the demand for flood insurance is low amongst farmers in the present risk level. The findings of this research also highlight that agricultural compensation systems have different aims in countries investigated, and state involvement is often necessary to provide suitable environment to companies to develop agricultural insurance products covering extreme weather events.

Keywords: climate change, insurance, agriculture.

JEL classification: Q54, Q18

Introduction

The efforts to confront the prospect and impacts of anthropogenic climate change present human kind with one of the major challenges. While it has several consequences (including sea level rise and extreme weather events), the scientific uncertainty attached to this phenomenon is significant. Due to the complexity of climate system and the linkage between the increase of GHG emissions and extreme weather events, it is really difficult to predict the exact long-term implications. However, the latest IPCC special report on the risk management of extreme events and many other statistics available suggest that the annual number of weather-related disasters and their adverse economic and financial impacts are increasing but with large interannual and regional variability (IPCC, 2011). Focusing on the past six decades, the average annual number of these major weather related extreme events has increased worldwide from about 1.5 in the 1950s to 3.7 over the past 10 years (CEA, 2008). During 2011, 820 natural disaster events were recorded and they caused around USD 380 billion economic losses recorded worldwide (Munich Re, 2012). Increased losses are associated with increasing population densities and higher concentration of values (The Geneva Association, 2009; CEA 2009). The higher concentration of people in urban areas increases their opportunities as well as their vulnerabilities to natural hazards and climate change impacts in general (Djordjevic et al., 2011). There is no country that is not affected. The earthquake and tsunami in Japan, the floods in Australia and Thailand, and the drought in Somalia are well-known events from 2011. It is also true that extreme events have a great impact on economic sectors in particular those with close link to climate, for instance, agriculture, health, and tourism (IPCC, 2011).

Agriculture is extremely vulnerable to changing climate, since it is directly affected by weather conditions. The problem could be even more serious if one takes into account the fact that agriculture plays a significant role in food security and the likely increase in food consumption suggested by the current population growth patterns. The two often mentioned hazards in the context of agricultural sector are drought and flood. Both of them are causing significant damages in each year and according to the predictions they will likely be more frequent in the future (IPCC, 2011). However, farmlands could have a special role due to the nature of flooding as natural hazard. Besides being negatively affected, they could also contribute to flood defence, for instance, by taking pressure off flood defences that protect urban property and infrastructure (Morris et al., 2003). This article puts a special focus on the complex relationship between agricultural land and flooding.

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The knowledge of coherence between agriculture and flood risk is necessary to determine the role of land use management in flood defence and the potential losses in agriculture associated with floods. The relationship between agricultural land and flood risk can be analysed with the Source – Pathway – Receptor (SPR) model. This framework is based upon the linkages between cause (“source”) of the environmental risk followed the route (“pathway”) to the environmental entry (“receptor”) of flooding. As the most recent OECD report about the issue describes agricultural land, it is potentially important from three aspects (Morris and Hess, 2008):

- agricultural land is a pathway as land management practices play a significant role in mitigating flood generation through determination both the amount of water and the speed at which that occurs (Morris and Hess, 2008);
- agricultural land located in floodplain areas is a receptor as it is often exposed to flood risk. These lands can be adapted to reduce risk;
- in agricultural land, flood water can be stored temporary, thereby, mitigating the risk elsewhere.

For this reason, rural land could play a significant role in the high-level strategic planning process that seeks policies for sustainable flood risk management.

Insurance industry is a major player in risk management. According to the report of the LMF (2009), climate change presents the insurance industry with new challenges in two different aspects: firstly, it is necessary to adapt the changing weather patterns and other environmental effects which generate risks. Secondly, insurance has a significant role in the mitigation of climate change as it can put incentives to their policymakers to reduce their carbon footprint.

It is clear that the insurance industry has a strong interest in addressing the problems of climate change for different sectors, households, and businesses. The report by The Geneva Association (2009) highlights the need for effective and integrated risk management taking into account the different social, economic, and environmental factors. It also emphasises that the transition towards a low-carbon economy that could become reality in the medium-term future, will change risks and opportunities for the insurance industry. It involves the opportunity of a closer partnership between governments and insurance companies in order to provide better/more efficient safeguards to the society and businesses.

This study is focusing on the role of insurance in agricultural flood risk management. It analyses the insurance system in two countries (the UK and Hungary), and presents a possible method to estimate the viability of climate change insurance schemes.

**Compensation schemes available in the UK**

Different compensations schemes are available for farmers, mainly from national and the EU sources. Their common attribute is the voluntary measures, supported by economic incentives (Morris and Hess, 2008). Private sources can appear in the forms of funds and insurances, while in the UK, they are less developed from the view of agricultural flood damage compensation. In the context of this study, those below should be highlighted:

- **CAP – Single Payment Schemes:** the objectives of the Common Agricultural Policy have never contained flood management policies but some elements of the current Single Payment Scheme (SPS) related with the flood risk management as secondary objectives. The scheme refers to the phenomenon of cross compliance that means that farmers have to meet three sets of requirements to get financial compensation. The three types of cross compliance are i) Good Agricultural and Environmental Condition; ii) Soil Management and Protection; and iii) Maintenance of Habitats and Landscape Features (DEFRA, 2005). Therefore, SPS provides financial incentives to basic but widespread land management practice changes that could deliver associated flood risk benefits alongside other environmental benefits (DEFRA, 2005);

- **England Rural Development Programme (Environmental Stewardship):** it is the major national agri-environment scheme in the UK (Natural England, 2009). Similar to the SPS, it does not either contain flood risk management as a first objective but actions promoted by the scheme have flood management benefits such as creation of wet grasslands (Higher Level Stewardship) or management practices of drainages, cultivated lands, and uplands (Entry Level Stewardship);

- **England Catchment Sensitive Farming Delivery Initiative:** it differs from the earlier schemes as it is rather an advisory than a financial mechanism to deliver land use changes; although, limited funds are available for small scale works. Its primary purposes either do not involve flood risk management but many of its promoted activities have flood management benefits (Environment Agency, 2008). However, it is worth to note that the ECSF DI is voluntary based, thereby, farmers are less likely to implement changes in long run unless it is financially viable;

- **Government Flood Management Funding Structure:** current funding structure in the UK was designed to provide financial sources to meet the purposes of the flood management strategies. The current flood funding structure applied in England is based on Exchequer-origin sources (approximately 94% of total) and involves many policies/activities. It is significant from agricultural aspects because farmers are influenced directly/indirectly by many activities funded by the government and the contribution of agricultural sector in the form of drainage charges and rates (DEFRA, 2009);

- **Insurances:** there is a special situation in the UK regarding the relationship between the insurance sector and the agricultural risks. The United Kingdom has a
private non-subsidised agricultural insurance system with one dominant company that covers 75% of the market (Bielza and Conte, 2006). Coverage for flood risk is available only for farm buildings and machinery but not for growing crops. It might be a surprise, since 42000 hectares of agricultural field were affected by the serious flooding in 2007, and the costs constituted about 1% of the Gross Value Added of the agricultural industry in England in 2007 (Posthumus and Morris, 2008).

Compensation schemes available in Hungary

The revision of the domestic agricultural risk management system in Hungary was conducted during 2011, the new system entered into force on 1 January 2012. Until 2011, it was not obligatory to farmers to take out market-based insurance policy; however, after 2008 as a minimum they had to participate in the National Crop Damage Compensation System (it was not obligatory only for primary producers) that provided coverage against inland flood damages but not flashfloods.

a) National Crop Damage Compensation System (NAR). The Act LXXXVIII of 2006 laid down the principles of the National Crop Damage Compensation System that started its operation at the beginning of 2007. At the beginning, it was a voluntary system and the principle of common effort sharing was applied, which meant that the state contribution to the fund was equal to the amount paid by farmers who voluntarily joined the fund. The volume of compensation was not allowed to exceed the loss of yield value.\(^3\) Risks covered by the fund included drought, flood, inland waters, and frost. However, the system at that time failed to provide enough financial resources to cover damages after bigger/larger events. Already in 2007, after a serious spring frost in the Eastern-Hungary, the government had to take extraordinary actions, since there was no sufficient compensation available from the national fund. In 2008, many changes were introduced to increase the efficiency of the system; however, they did not lead to significant improvements. Estimations showed that 5 billion Hungarian forints (around EUR 17 million) would be necessary for the efficient functioning of the system. That would have required 2.5 billion payments by the farmers and equal amount of support by the government annually. The main problem was the low participation rate, so the system became obligatory for farmers after the revision of the legislation in 2008 (Act CI of 2008) with the exception of primary producers. At the same time number of risks covered by the system also increased. Though, the compensation available to farmers did not cover all the losses of farmers (MOSZ, 2011).

b) Insurance system. Agricultural insurances are not compulsory for farmers in Hungary. Currently, there are four dominant companies on the agricultural insurance market that provide coverage for both flood and standing water damages in arable and horticulture crops. According to the latest available data of the Research Institute of Agricultural Economics (Kemeny et al., 2010), the proportion of insured farms among individual enterprises is around 30% for horticulture and arable crops, while this ratio is significantly lower (20.1%) for pastures. Calculations also highlight that farmlands used by bigger enterprises are more likely insured, for instance, the proportion of insured cropland is almost 80% (Kemeny et al., 2010). In principle, the reason behind relates with the different nature of these enterprises. Generally, it is true that bigger producers more often apply for credits and in that case (application for some credits) agricultural producers have to have agricultural insurance, although, as it was highlighted earlier, there are no general obligations in the country to conclude such insurances.

Changes introduced in 2012

The new legislation entered into force on 1 January 2012 with the aim of increasing the efficiency of farmers’ protection against environmental damages. Natural disasters and extreme weather events caused significant damages to the producers, and as it was mentioned previously, those damages were not covered sufficiently by the damage mitigation system. After serious weather events, it often happened that the government provided compensation from ad hoc funds even to those farmers who had no insurance and did not participate in the national compensation fund. Obviously, under those circumstances, farmers had no real interest to pay any extra money for risk management policies. This situation is often referred as the lack of self-provision and it characterises the Hungarian society in general (MABISZ, 2010).

The new system is built on a two-pillar risk management approach. The first pillar is very similar to the above mentioned damage mitigation system. Deposit paid by the farmers varies between different land-uses. The sum, thus, accumulated from farmers’ deposits is supplemented by the government in an equal amount from the budgetary sources. However, only those producers will receive full damage compensation under the new system which provides motivation for farmers to become self-providers, who have acquired insurance from a business insurer with regard to at least 50% of their activities, while those with no insurance may receive only 50% of the maximum possible damage mitigation allowance (Ministry of Rural Development, 2011).

The second pillar comprises a supported, private agricultural insurance construction for those producers who wish to decrease their production risks to a higher level than the protection provided by the central damage mitigation fund. Farmers can take out insurance policy on a voluntary basis; however, as it was said earlier without insurance the

\(^3\)The calculation of yield value is done by comparing the actual yield of the year of damage with the average yields of the preceding three years, and the loss of revenue is then quantified in HUF, using prices set in a separate provision.
level of compensation that they can get from national fund is significantly lower.

According to the plans of the government, support for farmers (to pay their insurance premiums) will be available from both national and the EU sources for up to 65% of the insurance premiums. However, since the related regulation has not yet been finalised, currently those are only plans and not official numbers.

It is easy to see that the above mentioned two pillars are closely connected. With the combined use of them, higher level of protection will be available to more farmers, because of the fact that affected farmers may receive both damage mitigation support and insurance damage compensation payments with regard to the same damage event.

**Methodology**

Different methodologies have been used in the two countries. In both cases, literature review was the main source to describe the current compensation systems; though, since Hungarian farmers already have access to flood insurance, the viability of a flood insurance scheme research was conducted in the UK, where no such product exists for the purpose of estimate.

There are two significant variables in the estimation of demand for insurance: the risk of an undesirable weather event and individuals’ willingness to pay (WTP) to cover against that risk. Risk was defined as the probability of event occurrence multiplied by the consequences (Penning-Rowsell and Chatterton, 1977). Consequences or economic losses are different in each case but using a general formula they can be expressed as the loss in gross margins (total output less the variable costs) plus additional – such as cleaning up – costs. Combining these loss values with the probability of event occurrence risk can be got. Individuals’ WTP for an insurance product can be estimated by using contingent valuation (CV) instrument. After the hypothetical market has been set up, the elicitation method chosen respondents’ WTP bids can be obtained through a survey (Garrod and Willis, 2001). Survey as a method is often used because it provides a simple approach to study the attitude; it is cheap and it can be carried out within a relatively short time period (Robson, 2002). Although, the dichotomous choice approach represents the preferred method for CV (Sherrick and Barrey, 2001; Garrod and Willis, 2001), open-ended questions were used in the present research, which means no values were suggested to the respondents; yet, to make it easier to state their bids the average damage costs per year were represented in every case. Apart from the CV instrument, questions on respondents’ (personal) background and experiences associated with insurance and risks could be very useful as they make it possible to examine variables that might influence the individuals’ decisions. All participants were affected by the floods in 2007, so they already had experience with flooding. Survey on the agricultural flood insurance in the UK had three main parts (1 - general information on farmers’ background; 2 - risk attitude; 3 - insurance preferences). It was sent out by post and self completed. The main limitations of the research were related with: the respond rate was around 40%, which made the statistical investigation of the data difficult. The small number of responses probably is in association with the timing of the survey as farmers had a busy period due to the harvest. Apart from this, those who filled in the survey did not answer all the questions in every case; thereby, the sample size became smaller (final sample size is 13). During the research, data analysis was done through both descriptive (to show incidence) and analytical (to show relationships) statistics. Descriptive data were going to be analysed by frequency tables and percentages. It is a valuable method to describe the sample characteristics – such as distribution of different farm types, flood risk exposures, and use of fields where flood is a subject.

Correlation and regression models were used to find association and dependency between variables. Table 1 provides a summary on the analysis made. However, the most difficult part was to estimate farmers’ WTP. As a statistically significant correlation was found between WTP bids and damage cost predicted, it was decided that a sample linear regression was going to be conducted. As it was suggested (Frew et al., 2001) that the use of positive WTP values only in regression usually can yield better estimates than those in which zeros are included, zero bids were excluded in the regression analysis. Linear regression method requires some assumptions; thus, the test of the variables was necessary. This included the analysis of residuals in order to investigate their performance - such as their distribution. If some of their parameters are not matched with the requirements (assumption column in the table) transformation of the data will be necessary. After the residual analysis, it was found that the application of box cox transformation is required in order to reduce the number of outliers and improve the distribution of residuals, thereby, to get a better, more significant regression model (Lewis and Mathieu, 1999).

**Results**

**Estimation of flood damage costs**

The theoretical background of agricultural flood loss estimation (Penning-Rowsell and Chatterton, 1977) says that the cost of an infrequent flood event can be defined as the loss of gross margins adjusted by the savings, while costs could be higher as the harvest is coming. As a conclusion, it can be assumed that a flood event of high consequence but low probability can have a similar risk value to a flood of low consequence but high probability (Table 2). Table 3 is based on gross margin calculations and shows the estimated flood damage costs in different land uses. The magnitude of costs is influenced by many factors; this is just a broad framework of estimation with several limitations, thereby, it should be treated with cautions.
### Table 1. Summary of data analysis used during the research

<table>
<thead>
<tr>
<th>Variables</th>
<th>Purpose</th>
<th>Method used</th>
<th>Assumption of the method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk tolerance, farm type, land uses, flood frequencies</td>
<td>Determine the sample characteristics</td>
<td>Descriptive statistics, frequency tables</td>
<td>-</td>
</tr>
<tr>
<td>Summer and winter risk tolerance</td>
<td>Determine any significant difference</td>
<td>Paired t test</td>
<td>the variables are paired or match each other someway</td>
</tr>
<tr>
<td>WTP, damage cost</td>
<td>Identify any association</td>
<td>Bivariate correlation (Pearson)</td>
<td>normally distributed variables</td>
</tr>
<tr>
<td>WTP, damage cost</td>
<td>Investigate how well damage cost (independent variable) predicts farmers’ WTP bids (dependent variable)</td>
<td>Simple linear regression</td>
<td>1) the errors of the observations are independent errors are normally distributed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2) the mean of the distribution of the errors is 0, that implies: $y = \beta_0 + \beta_1 x_1$, where $y$ is the dependent variable, $x$ is the independent and $\beta$ is the constant</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3) the variance of the errors is equal to a constant for all independent values ($x$)</td>
</tr>
</tbody>
</table>

**Source:** based upon Morgen et al., 2007; Marques de Sa, 2007

### Table 2. Flood risk levels

<table>
<thead>
<tr>
<th>Flood frequency (number of floods per year)</th>
<th>Flood damage rate(^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td>0.01</td>
<td>0.0001</td>
</tr>
<tr>
<td>0.05</td>
<td>0.0005</td>
</tr>
<tr>
<td>0.1</td>
<td>0.001</td>
</tr>
<tr>
<td>0.2</td>
<td>0.002</td>
</tr>
<tr>
<td>1</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**Table 3.** Gross margins (GBP/ha) for selected crops to estimate the flood damages in different land uses

<table>
<thead>
<tr>
<th>£, 2009 values Winter cereal</th>
<th>Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oilseed rape</td>
</tr>
<tr>
<td>Yield t/ha</td>
<td>8.25</td>
</tr>
<tr>
<td>Price GBP/t</td>
<td>135</td>
</tr>
<tr>
<td>Output GBP/ha</td>
<td>1113.75</td>
</tr>
<tr>
<td>Straw by product GBP/ha</td>
<td>40</td>
</tr>
<tr>
<td>Gross output GBP/ha</td>
<td>1153.75</td>
</tr>
<tr>
<td>Variable cost GBP/ha</td>
<td>511</td>
</tr>
<tr>
<td>Other crop cost GBP/ha</td>
<td>2.7</td>
</tr>
<tr>
<td>Total variable cost GBP/ha</td>
<td>513.7</td>
</tr>
<tr>
<td>Gross margin GBP/ha</td>
<td>640.05</td>
</tr>
</tbody>
</table>

**Source:** based upon Nix, 2008

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\(^4\) Flood damage rate expresses the severity of impacts. For instance if the damage rate is equal to 0.1, it means that 10% of the crops are completely damaged/lost.
The highest gross margins can be found in horticultural cropping and vegetables (potatoes) that forecasts that the highest losses can be expected in these land types. Figure 1 combines the gross margin values with different flood frequency levels and demonstrates the estimated cost of agricultural damages in some cases. Curves demonstrate the costs of total damages (100% loss in gross margins) at the flood frequency given, while the area under the curves demonstrates the risks of flooding in different land uses and flood frequencies. It can be seen that costs are proportionately lower for grassland, winter wheat, and oilseed rape than for horticulture and potatoes. It might influence the farmers’ land management practices as if they are growing potatoes on a field where flood is more frequent; they can suffer higher losses than if that field would be used for wheat production or as pasture (grass).

It is essential to analyse both the supply and demand side to better understand the reasons behind the less developed agricultural system. The interest of insurance companies is to make profit. They offer insurances in those situations where the conditions of insurability (Skees, 1999) are met and the risk/reward ratio is favourable for them. The interview with the dominant insurance company highlighted the lack of sufficiently large pool of risks and/or customers with the propensity to buy insurance and the existence of adverse selection. It was also confirmed that it is unlikely in the near future that without the involvement of government profit-orientated insurance companies will provide wider flood coverage to farmers.

Focusing on the other side of the market Gene (2011) provides three explanations for low demand: 1) price; 2) liquidity constrains of farmers; and 3) lack of trust towards insurance companies. Besides all these, the level of risk should be also mentioned as the fourth reason. If the risk level is lower than farmers’ risk tolerance, it is unlikely that they will voluntarily pay for any insurance products. Statistical analysis was conducted to define this relationship between the risk level (flood damage cost predicted) and farmers’ WTP. The correlation between the variables was found to be positive and significant at the 0.001 level which means that there is usually a higher WTP at higher predicted damage costs and vice versa. After the confirmation of association between the variables, the next step was to investigate how well damage costs predicted farmers’ WTP bids. Linear regression was conducted to do this. Based on the outcome, positive association between the expressed WTP and expected damage cost was evident: R Square =0.4272, F = 33.556, p<.001 (Table 4). According to Cohen (1988), r square value indicates a large or larger than typical effect. It means that, although, damage cost is not the only factor that influences farmers’ decisions, their WTP bids can be estimated quite well from the loss values (it is consistent with the high B value of the damage cost in the model). The equation found is WTP = 0.0237 + 0.4255*Damage Cost (Figure 2).
However, it is worth to note that large part (around 41%) of farmers’ WTP bids were zero, which indicates that farmers would not pay for insurance in almost half of the cases (most likely when the damage costs were below GBP 60), while their highest bid was GBP 200. They are willing to pay GBP 20.03 on average. According to farmers’ responses, the reason behind the low demand relates with the low risk level compared with their risk tolerance (see above). Respondents’ view is that following good agricultural practices, some additional measures could provide a sufficient protection against flood damages. When farmers refer to low flood risk, it should be kept in mind that until recent years floods seemed to be isolated incidents in the UK (Guide to Floods, 2011).

**Discussion**

Experience above suggests that the reason behind the less developed agricultural flood insurance system relates with both the supply and demand sides of the market. Referring back to the mitigation, potential of agricultural lands is also necessary here. It should not be forgotten that farmlands can play a significant role in mitigating the risk from the potentially vulnerable urban areas where costs could be significantly higher. Recently many studies focus on the use and benefits of agricultural land in flood risk management (Morris and Hess, 2008; Morris et al., 2008, Hess et al., 2004).

Studies also approved that farmers’ decisions on taking out insurance policy were more likely influenced by factors such as cultural attitude, credit availability than their income. This is quite similar experience as it was in the UK. However, the income and price factors in that context are still relevant, and thereby, they should be taken into account.

Extreme weather events including floods cause significant damages in agriculture at both national and global levels. However, the agricultural sector is not only the “victim” of these events but it also provides an opportunity to temporary store flood water in agricultural land, thereby, it becomes possible to mitigate the risk elsewhere, for instance, from the more developed urban areas.
There are many different approaches and methods in agricultural flood risk management. Even though in principle it can be assumed that each system involves three different stakeholder groups, namely, farmers, public sector, and insurance companies, and relies on the collaboration among them.

Current trends in the UK suggest an increasing focus on the potential use of farmlands in flood risk management. Flood risk threatening urban areas can be mitigated by the flooding of agricultural land where potential damage is usually lower than in the highly populated urban areas. This tendency might provide an explanation why the agricultural flood insurance companies play a less significant role in the compensation of agricultural flood damages in the country. However, it is also true that the current flood risk level is still tolerated by farmers even though the recent serious floods.

The new two-pillar risk management system has just entered into force in Hungary. However, it can already be seen that the mitigation potential of agricultural land gets less attention compared with the situation in the United Kingdom. The aim here is to develop more an efficient compensation system with the fair contribution of all stakeholders. The previous system failed in that context, the new one has no time to demonstrate its ability, yet. However, due to the special characteristics of the sector and agricultural producers, it can be assumed that public sector has a significant role in the compensation of extreme weather related agricultural damages and state involvement is often necessary to provide suitable environment to companies to develop agricultural insurance products that cover damages caused by extreme weather events.

Conclusions

Agriculture is one of the sectors that is highly affected by the changing climate due to its vulnerability to weather conditions. During the past decades, flooding proved to be one of the major risks to farmland. Therefore, the investigation of the insurance industry’s role (as a key player in risk management) is essential and has implications for the development of future agricultural risk management practices.

The compensation of agricultural flood damages has significance from two aspects: 1) floods can cause large damages on farmlands, which might have adverse impact on farmers’ income; 2) flood water can be stored on agricultural land, mitigating the risk from urban areas, thus, farmers provide public services.

The research outlined above highlighted that even though insurance companies are considered as major players in risk management, their role in the compensation of agricultural flood damages is not that clear. Reasons behind that relate with the economic situation of farmers (usually lower income) and the complex relationship between flooding and farmland. As a consequence of that each country whose agricultural sector is affected should develop its own risk management system that might less involve the insurance sector and put more emphasis on public (flood defence) services by farmlands and compensated by the governments through agri-environmental schemes for instance.

Bibliography


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