Risk perception of rice farmers in the Mekong Delta, Vietnam

Investigating rice farmers' risk perception in relation to contract farming schemes

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Abstract

Rice plays an important role in the Asia-Pacific region, being a key source of income and also the most important staple food for the diets of many people. Vietnam has been a key player in the rice industry and is together with Thailand and Cambodia the largest export of rice in Southeast Asia. The achieved rice surplus was a result of an increased number of rice production cycles per year, which took place in Vietnam's Mekong Delta region. For the past decades farmers were mainly focused on high yields, and the main attention was economic gain, which had negative implications for the environment. However, the Vietnamese Ministry of Agricultural and Rural Development introduced agricultural development programs to address the emerging challenges related to the intensified rice production practices. These development programs are in place to sustain livelihoods of the rice farmers in the Mekong Delta. The focus of the present study is on the small farmers, large field program, which has been implemented in Long An Province, Mekong Delta. It has been shown that risk perception plays in important role in technology adoption for the aquaculture industry; and that risk perceptions plays a significant role in relation to (sustainable) rice straw management practices. However, there is limited knowledge about the types of risks rice farmers perceive and the factors influencing rice farmers risk perception. The objective of the present study is to investigate what types of risks rice farmers in the Mekong Delta perceive and to gain a better understanding of what factors shape farmers risk perception. 258 farmers participated in the study. Results show that farmers who are part of a contract farming scheme rate risks factors lower in comparison to non-contract farmers. Furthermore, female farmers have a higher risk perception in comparison to male farmers. The second part of the study investigates the factors that shape farmers' risk perceptions. Mediation analysis indicates that risks related to (chemical) farming inputs are significantly influenced by trust in non-commercial institutions. The perception of this relationship is a key element for future development programs. When farmers' risk perception is low the adoption of development projects increases. Thus, lowering farmers' risk perception by engaging them in contract farming or increasing their institutional trust, could mean an improved implementation of development projects.

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1. Introduction

Rice is considered to be one of the most important staple foods in the world. More than 90% of the world's rice is produced and consumed in the Asia-Pacific region and over 4 billion people in Asia consume rice daily (Stuart et al., 2018, van Kien et al., 2018). Rice plays such an important role in that region because it is a key source of income for small-holder farmers; additionally, it is used as a way to improve the food supply for many nations in this region. Rice is an income source and also the most important staple – it is part of many Asian diets (van Kien et al., 2018). Approximately 90% of the rice is produced in the Asian region, whereas China and India are the largest producers (Kea et al., 2020). In Vietnam much attention has been given to increase rice production over the past 30 years, especially in the low-lying delta regions. Since 1995, Vietnam's annual rice production has almost doubled, increasing from 20 million tons in 1995 to 45 million tons in 2014 (Stuart et al., 2018). Vietnam is exporting 16% of its annual rice production and is together with Thailand and Cambodia the largest exporter of rice in Southeast Asia (Kea et al., 2020; Stuart et al., 2018).

1.1 Doi Moi economic reforms

Vietnam became a leading rice exporter after the country implemented the Doi Moi economic reforms in the 1990s. The Doi Moi reforms concerned an economic renewal campaign that intended to facilitate the transition from a centralized economy to a socialist-oriented market economy (Kokko, 1998). A surplus of rice, which could be exported to other countries, was achieved by changing from the production of an annual rice crop, to two and three rice crops per year in Vietnam, and more specifically in Vietnam's Mekong Delta region (MKD) (van Kien et al., 2018). The Doi Moi reforms in Vietnam resulted in a rapid intensification of rice production and in an over reliance on agrochemicals (Nguyen, 2018; Stuart et al., 2018). Farmers were mainly focused on high yields and the main attention was economic gain, which had negative implications for the environment (Stuart et al., 2018).

1.2 The Mekong Delta

The Mekong Delta is the world's third largest delta, responsible for 57% of Vietnam's rice output (Stuart et al., 2018). A map of the Mekong Delta and its location is presented in Figure 1 below. The achieved rice surplus was a result of changing from producing an annual crop of rice to two and three crops of rice per year. An Giang, Kiên Giang, Đồng Tháp and Long An, the areas were three rice crops per year are cultivated increased from 53.500 hectares in 2000 to 403.500 hectares in 2012 (Tong, 2017). In the area around the Mekong Delta, annual flood events provide fish and other aquatic animals and provide a range of other environmental and agricultural services for rural communities (Nguyen, 2018). In terms of wild fish, the Mekong Delta produces about 700.000 tons of inland fish per year. This amount accounts for one third of the overall Mekong fish catch, which is viewed as an exceptionally important source of dietary protein (Tong, 2017). While the process of intensification took place in the Mekong Delta, flood control projects were developed using high dikes that prevent flooding of the rice paddies. The decision makers mainly focused on irrigation development for rice intensification and paid less attention to the benefits created by the annual flooding (Nguyen, 2018). The ongoing rice intensification process required further modification of floodplains and water flows which decreased wild fish stocks and the presence of other aquatic animals. Moreover, high inputs of chemicals polluted the water and contributed to a disturbance of the wild fish stocks (Nguyen, 2018). The further construction of dams for hydro-power generation in the Mekong basin is estimated to eliminate the catches of wild fish that supply up to 2.1% of all dietary protein and 2.4% of lysine in the Mekong Delta (Nguyen, 2018). Losing these sources of dietary protein and lysine would mean that other land and resource intensive production systems are needed to be in place to fill this gap in diets. By not having the wild fish as a dietary input, the farmers have a dietary deficit in terms of the aforementioned protein and lysine (Nguyen, 2018).

There are also consequences on farmers' fields that occur with the changes in the hydraulic management. Since the Mekong Delta is part of a mixed system in which both agriculture and fisheries take place simultaneously, changes in water management influence the rice farmers directly. The intensification of annual rice cropping and the introduction of high yielding rice varieties increase the need for a range of agronomic inputs (Nguyen, 2018). These agronomic inputs also have economic effects on the farmers and their rural livelihoods. According to Tong (2017), a study in the Mekong Delta indicated that a two rice crop farming system with one natural flood capture system with low dikes would mean favorable economic and environmental outcomes for the farmers in comparison to the intensive rice-cropping systems with closed high dike compartments.

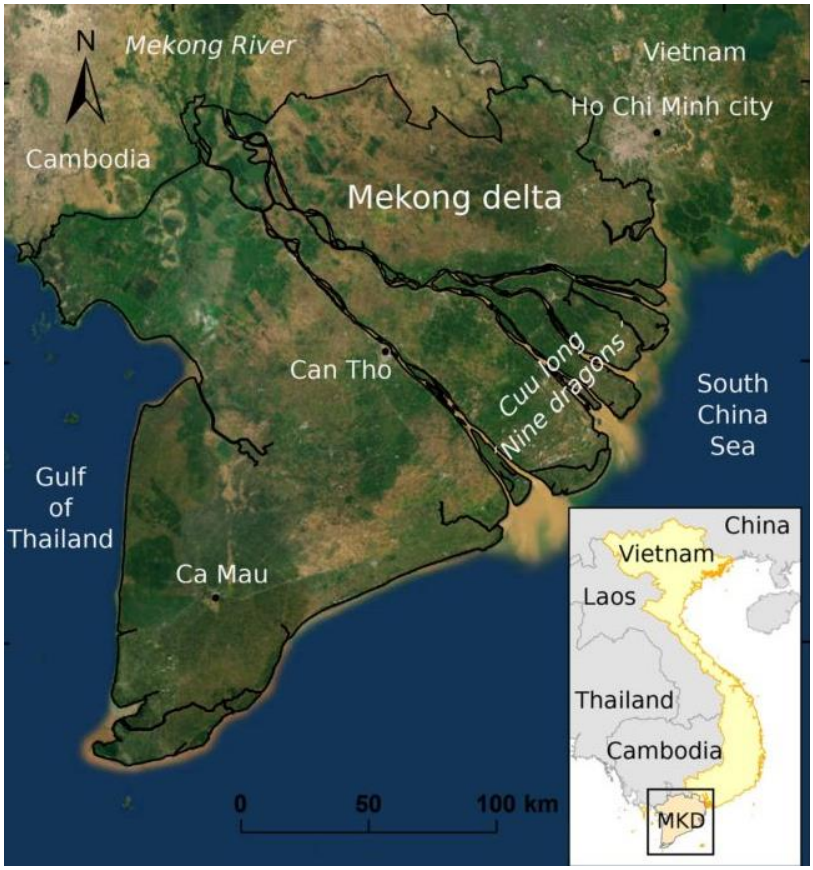


Figure 1. Map of the Mekong Delta

1.3 Intensification

For rice farmers in the Mekong Delta the focus on intensifying agricultural practices has substantially increased the local and national supply of rice. However, the consequences of intensive input- and high natural resource use are increasingly noticeable (Nguyen et al., 2018). The environmental consequences include increased greenhouse gas emissions, biodiversity loss and degradation of agricultural resources. These environmental consequences pose a threat to the long-term sustainability of food production (Stuart et al., 2018). The aforementioned issues are not the only problems in relation to the intensification of rice production in Vietnam. An overuse of inputs such as seed rates and nitrogenous fertilizer resulted in rising production costs, which caused nominal increases of producer paddy prices. The increase in prices makes it more difficult for smallholder rice farmers to remain economically sustainable (Stuart et al., 2018). According to the Vietnam Development Report (2016), Vietnam must generate more economic value, farmer and consumer welfare, while using less natural and human capital, and less harmful intermediate inputs (World Bank Group, 2016).

1.4 Small farmers, large field program

Since 2003, the Vietnamese Ministry of Agricultural and Rural Development introduced programs for further development of the agricultural sector and to sustain the livelihoods of the rice farmers in Vietnam (Stuart et al., 2018). One of these programs is the small farmers, large field model, which aims to encourage horizontal coordination among farmers. With this program farmers pool their land, adopt uniform rice varieties and production techniques for their fields. In addition, farmers also synchronize planting and harvesting of their rice crops, meaning that they plant and harvest the rice at the same time as other farmers (Ba et al., 2019). Through participating in the program, it was expected that farmers' production costs would decrease, and it would also enable them to create economies of scale (cost advantages that farmers achieve due to their scale of operation). Another expected effect of the small farmers, large field program was the increase in bargaining power for the farmers in contractual arrangements with buyers (Ba et al., 2019). Furthermore, the program was also expected to attract investors in contract farming from large export companies, which were interested in monitoring one large field rather than several fragmented plots of land. For the investors this also meant a reduction of costs by signing one single contract with lead-farmers instead of dealing with large numbers of small farms. In the Mekong Delta, the Department of Agriculture and Rural Development takes the lead in establishing and organizing the program areas. The farmers are selected based on their willingness to participate in the program and the distance of their rice plots to other plots (Ba et al., 2019).

1.5 Contract farming and risk perception

The Vietnam Development Report, published by the World Bank Group (2016), stressed that contract farming has the potential to address traditional as well as emerging challenges related to food production and marketing. These include, increasing demand for quality, sustainability, traceability, and certification, as well as the growing competition for agricultural land and labor (World Bank Group, 2016). The Vietnamese government perceives contract farming as an excellent opportunity to boost rural economic development (Ba et al., 2019). Having government support in development incentives such as the small farmers, large field program, can contribute to meeting broader policy objectives such as inclusive growth, food security and the protection of natural resources. Since 2013 an emerging trend was observed in the adoption of contract farming by the Vietnamese rice exporters. However, Ba et al. (2019) addressed that promotion of contract farming on a large scale requires information about the determinants that affect farmers' participation in contract farming. Moreover, Wehmeyer et al. (2020), described that adoption of a new agricultural practice depends on how applicable the practice is to fulfill farmers' needs and demonstrates its profitability since farmers' risk aversion is considered the most crucial factor for non-adoption. Therefore, the objective of this paper is to provide, through an exploratory data analysis from a farmer survey, insights into farmers' risk perception. The present research contains two main goals, firstly investigating what types of risks rice farmers in the Mekong Delta perceive; and secondly to gain a better understanding in what factors shape farmers risk perception.

2. Literature review

In the introductory section of this paper the Mekong Delta was described in relation to its agricultural intensification process and the development programs that are in place. These development programs are in place to sustain the livelihoods of the rice farmers in the MKD. The small farmers, large field program aims to encourage horizontal coordination among farmers by engaging them in contract farming arrangements. The present study will, therefore, investigate if engaging in contract farming has an influence on farmers' risk perception. This section will provide an overview of the challenges the MKD is facing, the efforts in agricultural development and the factors influencing farmers' risk perception.

2.1 Mekong Delta and climate change

The Mekong Delta is seen as one of the most vulnerable regions to climate change in the world (Tong, 2017). Climate change can be related to increases in temperature, rainfall variations, and an increasing frequency and intensity of extreme weather events, such as monsoons (Ho & Shimada, 2019). Vietnam's vulnerability to climate change is enhanced by its very long coastline, its high dependence on agriculture, and the limited development experienced in rural areas (Cullen and Anderson, 2017). Moreover, the Mekong Delta region has one of the highest population densities in Vietnam; 466 people per km^2 (Dinh et al., 2012). Hence, when a flood occurs it results in a loss of life and property, damage to agriculture, and disruption of social and economic activities for a large amount of people (Dinh et al., 2012). The threat of having more frequent flooding in future rainy seasons, accompanied by increasing drought conditions in dry seasons, presents a serious challenge for agricultural planning. In many areas of the Mekong Delta farmers have three harvest cycles per year, and the aforementioned climate trends are predicted to have a disproportionately negative effect on rice yields, with an estimated decrease in yield of 15% or more. (Cullen and Anderson, 2017). Throughout the agricultural literature, emphasis is placed on the environmental problems that emerge with agricultural intensification. Agriculture globally generates about 19% - 29% of total greenhouse gas (GHG) emissions (Ho & Shimada, 2019). Rice paddies account for 11% of the planet's arable land, and they also have the highest GHG emission of all staple crops. Based on data from the United States Environmental Protection Agency (2006), rice production is responsible for 20% of the total agricultural GHG emissions.

2.2 Agricultural development programs

Due to the concerns about the future of rice farming in the Mekong Delta several programs have been introduced for further development of the agricultural sector. One of the first steps was taken when The Vietnam Ministry of Agricultural and Rural Development collaborated with the Irrigated Rice Research Consortium and launched a program in 2003, which included amongst other things, the protection of the environment. The program is called three reductions, three gains, and was aiming to reduce seed rates, nitrogen fertilizer and insecticides, while maintaining yield, improving farmers' health and protecting the environment (Stuart et al., 2018). This program remained a priority for agriculture in Vietnam and was also the basis for a new program launched in 2006. This program is named, the one must do, five reductions program, which is an integrated technology package to promote best management practices in lowland rice cultivation. The focus of this new program is to use good-quality seeds, reduce seed rates, pesticide use, fertilizer inputs, water use, and post-harvest losses. The one must do, five reductions program was again extended to a new government model with a larger focus on rice quality and adding value, rather than only on the quantity of rice produced. The name of this program is the small farmers, large field model (Stuart et al., 2018). The next step in becoming more involved with the environmental concerns in relation to rice production was taken by the formation of the sustainable rice platform. This is a multi-stakeholder partnership to promote resource efficiency and sustainability on the farm and throughout the rice supply chain. This platform was co-convened by UN Environment and the International Rice Research Institute in 2011. Recently the sustainable rice platform developed a standard based around a framework for economic, social and environmental sustainability (Stuart et al., 2018).

The small farmers, large field program, initiated by the Vietnamese Department of Agriculture and Rural Development, was the follow-up program of the one must do, five reductions technology package (Ba et al., 2019). The small farmers, large field program is encouraging horizontal coordination among farmers. With the this program farmers get involved in contractual arrangements with buyers. The Department of Agriculture and Rural Development is also trying to create a supportive institutional environment, next to the encouragement of farmers (Ba et al., 2019). With these incentives, several stakeholders such as the government, private sector and research institutes are brought together by not only wanting to achieve environmental sustainability, but also for improving the livelihood of the farmers. When buyers and traders, engage in vertical coordination and integration, the linkages between them and the farmers becomes stronger and by that more governance of the value chain and market power shift downstream to the farmers (Demont and Rutsaert, 2017). One of the largest traders in the private sector rebranded itself as Loc Troi ("God's Gift") and aims to establish a "world-class sustainable value chain", with the "mission of serving farmers" (Demont and Rutsaert, 2017, p.12). However, the findings of the effects of contract farming are mixed, both negative and positive results are present which shows the diversity in how this topic has been previously researched (Ba et al., 2019). In the next section these effects from contract farming are described in further detail.

2.3 Contract farming

Bellemare and Bloem (2018), identified several positive socio-economic effects from contract farming. Firstly, participating in contract farming could enhance farmers' productivity because of the provision of high-yielding seeds and extension services, this could result in higher income for the farmers. Additionally, contract farming could improve the overall value chain performance by increasing production, lowering transaction costs and boosting the quality of the produce. Lastly, by reducing input and output price risks, farmers can use resources more efficiently (Ba et al., 2019). Moreover, negative results from contract farming are also present. Primarily with the aspect of inclusion of farmers. The contracts offered do not always include poor small-scale farmers and are mainly profitable to large companies, this could lead to an increase in rural inequality (Glover, 1987; Key and Runsten, 1999; Simmons et al., 2005; Guo et al., 2007; Miyata et al., 2009). Furthermore, Little and Watts (1994), explained that buyers are exploiting farmers under a contract farming arrangement by paying them less than the minimum wage. Ba et al. (2019), described that contract farming had a negative impact in Senegal due to lower selling prices compensating for the implicit cost of interest and insurance. The monopoly position that the contractors will obtain by offering the contracts can also have negative consequences for the farmers, with buyers not being transparent in price and quality control. The final point made about the increased exposure to risk that farmers might endure, due to having to comply to unknown production techniques used (Ba et al., 2019).

2.4 Development initiatives in the Mekong Delta

In addition to the development programs and initiatives described in the previous sections, there are also initiatives that are studied specifically for the present research problem. The first initiative to promote sustainable rice cultivation is the sustainable rice platform. This platform developed standards along with performance indicators based around a framework for economic, social and environmental sustainability. The standard provides direction on how to achieve sustainable rice cultivation and the performance indicators are used to assess improvements in sustainability and the adoption of best management practices. The 12 sustainable rice platform performance indicators consist of grain yield, profitability, labor use, food safety, water-use efficiency, nitrogen use efficiency, phosphorus use efficiency, pesticide use, greenhouse gas emission, child labor, worker health and safety, and women empowerment (Stuart et al., 2018). In 2015 the Vietnam sustainable agricultural transformation project was launched in collaboration with the International Rice Research Institute and the Ministry of Agricultural Rural Development. One of the main project objectives includes improving rice farming practices and value chains in the MKD by scaling out adoption of the programs one must do, five Reductions and small farmers, large field. To assess the adoption of improved farming practices, the project proposes to set standards for the application of one must do, five reductions and establish key performance indicators, which are the same as the performance indicators of the sustainable rice platform (Stuart et al., 2018). The strategic orientation of the Vietnam sustainable agricultural transformation project is to support the process of agricultural modernization in Vietnam and the related processes of institutional and regulatory strengthening and reform.

Furthermore, under the Vietnam sustainable agricultural transformation project, greenhouse gas measurement and monitoring activities will be expanded to cover different agro-ecological zones within the MKD, with the objective of developing standardized baseline on greenhouse gas emissions (World bank, 2015). The Vietnam sustainable agricultural transformation project is very similar to another development initiative, closing rice yield gaps in Asia with reduced environmental footprint. This project focused on six intensively cropped areas in Asia, in order to improve food security and sustainability in systems that are already highly productive. In the Mekong Delta this project is taking place in the province Can Tho (Devkota et al., 2019). Moreover, the scientific know-how and exchange program, is also active in the Mekong Delta. This program focuses on research areas that are part of the global rice science partnership mission (CGIAR, 2011). This partnership is initiated by the Consultative Group on International Agricultural Research and is a collaboration between different private companies and organizations, rather than a development program. In the scientific know-how and exchange program, international centers and organizations have active partnerships with over 110 private companies or organizations representing different areas of the private sector. These partnerships can focus on joint research and capacity building. The global rice science partnership will extend such collaboration with the aim of providing farmers with more and better hybrids, quality seed and knowledge and services provided by both the private and public sector (CGIAR, 2011). These programs and projects have been implemented in the Mekong Delta for a longer period of time and reached a variety of farmers over the years. Therefore, close collaborations between project and governmental partners were established and used to determine the sample of the present study.

2.5 Factors influencing risk perception

The relation between contract farming and risk is central in this research, more specifically the role that risk perceptions play in farmers' decision making. Exposure to risk, either market risks, production risks, disease risk, and climate risks, play an important role in the adoption of new technologies (Joffre et al., 2019). The paper describes, amongst other topics, risk perceptions in relation to the adoption of aquaculture practices in the MKD. The results show that risk perception and knowledge and information acquisition of aquaculture farming risks are significant drivers during the technology and adoption process. Joffre et al. (2018), explained that shrimp farming is a risky business and considered as a gamble by many farmers. However, it is still a widespread production system and therefore, the question arises of how farmers perceive and manage the risks related to this system. Furthermore, Connor et al. (2020), described rice farmers' risk perception in relation to the adoption of different rice straw management. Results of this study showed that farmers often burn their straw even though they perceive high risks, few benefits and expressed low levels of acceptance for burning their rice straw. Thus, both aquaculture and rice farming perceive high risks for practices within their production systems. The present research referred to rice farmers in the MKD. Rice farming is likewise a widespread production system in the Mekong Delta, and interest occurred on how farmers perceive and manage the risks in relation to rice farming.

However, it is important to recognize that there is a variation among the study group of rice farmers. Differences exist in agroclimatic conditions, historical experiences and demographic factors. Cullen et al. (2018), stresses the need to disconnect heterogenous perceptions of risk across subpopulations in order to enlighten efforts aimed at reducing the risks for farmers. Additionally, recent work on farmer populations analyzes biophysical, sociodemographic, psychological and social factors set out to influence risk perceptions and farmers' decision making (Cullen et al., 2018). Predictors of farmers' risk perceptions include exposure to risk factors (influenced by geography, economic status, and access to mitigation strategies), knowledge and understanding of risk sources (influenced by experience, education, culture), and individual and community attitudes towards risk (Cullen et al., 2018). Much of the existing research on farmers focuses on individuals, rather than considering that in many smallholder farming household's adults of both genders are farmers. Adding to that, it has been previously researched that males and females perceive risks differently; social roles, power and trust differentials, and their interplay, could all contribute to gender-associated differences (Cullen et al., 2018). The progress in this area has been slow, because often the datasets were too small to research heterogeneity in risk perception by domain, and across individual characteristics, for instance gender. According to Cullen et al. (2018), an improved understanding of risk perception, and specifically gender-based differences in farm households, could enlighten the theory around intrahousehold decision making, and household willingness to take risks and engage in new activities, which could possibly influence the likelihood of successful development strategies.

Besides gender-based differences in risk perception, the influence of trust on risk perception is researched as well. A study by Siegrist (2005) hypothesized that general trust and general confidence would negatively influence the risks perceived. A few examples provided by Siegrist (2005) are, social trust (trust in specific entities) strongly influences the perception of particular technologies. Furthermore, people having trust in authorities and the management responsible for the technology perceived fewer risks than people not having trust in institutions. Additionally, significant associations have been found between trust and risk-indexes based on risk assessments of different hazards (Siegrist, 2005). It has been shown that trust is especially important when knowledge is absent, since most people do not possess knowledge about hazards and new technologies (Siegrist, 2005). A way for people to cope with this lack of knowledge is to rely on social trust to reduce the complexity that they are faced with (Siegrist, 2005). Furthermore, trust depends on relationships, both past and present, that are the result of previous relational experiences. Carolan (2006) describes the situation of trust for agriculture in Iowa, The United States. In this region a culture is present with a deep trust in science and technology, and it is not surprising that the knowledge and social relations most trusted are those of scientists. The Mekong Delta in Vietnam has a history of intensified agricultural practices, agrochemical companies have been involved in this process and portray an important role in the agricultural industry (Stuart et al., 2018). By drawing on the agricultural intensification in the MKD it is interesting to research whether they follow the example of the agricultural industry in Iowa, in the matter of trust in agrochemical companies. Moreover, several development projects are also proposing more sustainable farming practices, rather than solely focusing on maximizing rice yield. The uptake of these practices could be influenced by the trust that rice farmers have in the institutions that are active in the agricultural industry. Therefore, the level of trust in different institutions in relation to rice farming was researched in the present study.

Cullen et al. (2018), mentioned that socio-demographic, psychological and social factors have shown to influence risk perceptions and farmers' decision making. A research performed by Saqib et al. (2016) described farmers risk attitudes in flood-prone areas of Pakistan. Since the Mekong Delta is also a flood prone area, it seemed of interest to explore the influence of socio-demographics on risk attitudes of Pakistani farmers to our region of interest. Farmers' risk attitudes are critical in the adoption of modern agricultural technologies, for instance production and investment decisions, in agriculture. Special consideration needs to be given to the risk attitudes of farmers in this process because risk-averse farmers are less likely to adopt new practices, due to uncertainty about the costs and returns of their strategy (Saqib et al., 2016). The present study researched how contract farming influences risk perception. Therefore, the aforementioned theoretical implications about farmers attitudes towards risk are of interest for this study. Additionally, farm household characteristics such as farming experience and education also affect risk attitudes and risk perceptions. Saqib et al. (2016) stated that educated farmers perceive crop diseases as less risky, which resulted in a negative relationship with risk aversion, this while farming experience was found to be positively associated. Similarly, other studies also reveal that the risk attitudes of farmers differ with income and with age (Lucas & Pabuayon, 2011; Harrison et al., 2007). Likewise, farm size, land ownership status, off-farm employment, farm size, and farmers' risk perception greatly affect the risk attitudes of farmers (Saqib et al., 2016).

2.6 Conceptual model

The literature reviewed in this section displayed that farmers' socio-demographics, trust and contract farming have been shown to influence risk perception. The conceptual model is shown in Figure 1 below. The risk perception is the dependent variable for the study and is connected to farmers, because it is about their risk perception. Furthermore, the relationship between contract farming and risk perception is indicated in the model, the present study will explore this relationship. Trust is present in the model, by cause of exploring a possible relation farmers' risk perception and trust. Finally, the conceptual model indicates that there might be a relationship between trust and contract farming, since adoption literature emphasized the role of trust in the uptake of new technologies. The current study considers the case of rice farmers in the Mekong Delta to investigate their risk perception in relation to contract farming arrangements. Furthermore, we will research the aspect of institutional trust, farmers' socio-demographics and gender-based differences to explore whether this influences the involvement in contract farming arrangements and farmers' risk perception.'

The next chapter will describe the research aim and the research questions in further detail. Chapters 4 and 5 describe the methods and results of our study. The discussion of the findings is described in chapter 6 and is followed by a conclusion in chapter 7.

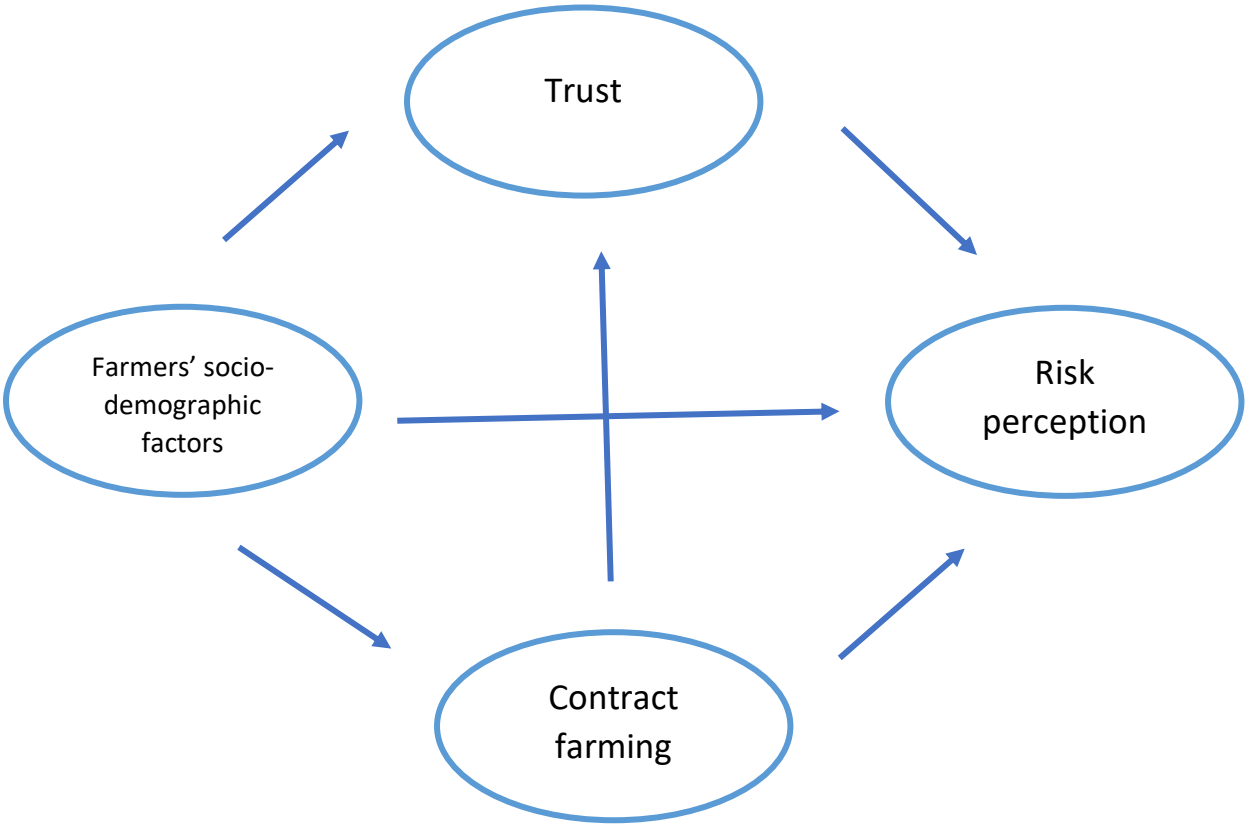


Figure 2. Conceptual model farmers' risk perception

3. Research aim and research questions

In the Mekong Delta farmers have been using intensified agricultural practices for rice production for an extended period of time. The Vietnamese Ministry of Agricultural and Rural Development introduced agricultural development programs to address the emerging challenges related to rice production and marketing. Contract farming is part of a development program that has been implemented in Long An Province, MKD. It has been shown that risk perception plays an important role in technology adoption for the aquaculture industry in the MKD (Joffre et al., 2019). Furthermore, Connor et al. (2020), researched farmers' perception of risks, benefits and the acceptance of eight different rice straw management practices in relation to (sustainable) rice straw management. However, there is limited knowledge about the types of risks rice farmers perceive and the factors influencing rice farmers risks perception. Therefore, the overarching research aim of this paper is to investigate what types of risks rice farmers in the Mekong Delta perceive and to gain a better understanding in what factors shape farmers risk perception.

Additionally, limited knowledge is present about the role that contract farming schemes play with regard to rice farmers risk perceptions. Therefore, the present study will firstly investigate what types of risks rice farmers in the Mekong Delta perceive. For the first aspect of this researched we hypothesized that contract farmers rate risk factors lower than non-contract farmers. In detail, three specific research questions are investigated. The first question is, (1) how do farmers evaluate different types of risks? Moreover, the present study investigated, (2) if there are differences in risk perceptions between contract and non-contract farmers? The final specific research question is, (3) Do risk perceptions differ between male and female farmers?

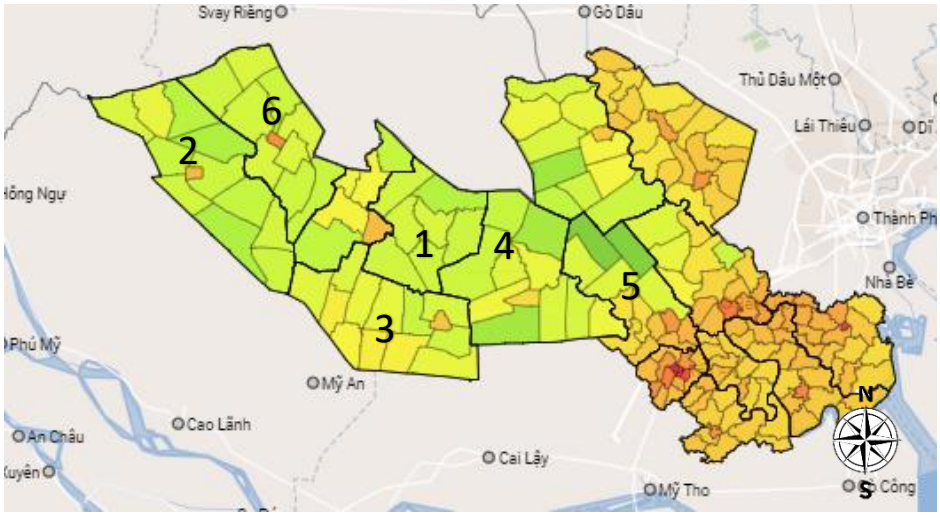
Next, the present study will investigate the factors influencing farmers' risk perception. Cullen et al. (2018), emphasized the need to recognize the aspect of heterogeneity across subpopulations when studying risk perception. Progress in gender-based differences for risk perception has been slow, because the datasets were often not large enough to tackle this angle. Therefore, the aspect of gender-based differences in risk perception will be an additional element of this study. Furthermore, farm household characteristics such as farming experience and education also influence farmers risk attitudes and risk perceptions (Saqib et al., 2016). Moreover, research identified that social trust (trust in specific entities) influences the perception of particular technologies (Siegrist, 2005). Trust is important when knowledge about a technology is absent. This study concerns a heterogenous group of rice farmers, and consequently we cannot assume that all the farmers have sufficient knowledge about contract farming schemes to understand the possible risks. Siegrist (2005, described that people deal with a lack of knowledge by relying on (social) trust to reduce the complexity that they are confronted with. For the second part of the study again specific research questions were created. Hence, the next research question is, (4) How are demographic factors associated with farmers' risk perception? Finally, the present research studied, (5) How institutional trust is associated with farmers' risk perception?

4. Materials and methods

4.1 Participants and design

The participants of the present study were farmers from the province Long An in the Mekong Delta, Vietnam. The intended number of participants of the study was 255, but the actual number of farmers was slightly higher, 258 farmers participated in the study. Geographic purposive sampling was chosen in terms of selecting the province Long An, Figure 3. This province was chosen because it is the province were the 2 projects, the Vietnam sustainable agricultural transformation program and scientific know-how and exchange program took place; and where the sustainable rice platform standards have been implemented. The 6 districts indicated in Figure 4, were purposively chosen as well. However, within each district the farming communes were randomly selected. Within these communes all the farmers who had been involved in one of the earlier mentioned projects were identified. The farmer respondents were randomly selected, from each project. For the sample size a simple random sampling estimation was used. With a target of 85 farmers per project. For each project, the number of farmers participating was identified, this amount was used for the sample size determination. Both male and female farmers were included in the sample, however no stratification for equal gender distribution was applied. Due to the random sampling method, no particular requirements were asked other than being a farmer over the age of 18 and the involvement in one of the aforementioned projects. In addition, there was also a group of replacement farmers randomly identified before recruitment using the same sampling method. These farmers replaced the originally sampled farmers who could not be located or did not join when farmers had been invited for the interviews.

Figure 3. Location Long An in Vietnam



1. Mộc Hóa
2. Tân Hưng
3. Tân Thạnh
4. Thạnh Hóa
5. Thủ Thừa
6. Vĩnh Hưng

Figure 4. Districts in Long An Province

4.2 Questionnaire

A questionnaire was created using CommCare (Dimagi), a commonly used mobile data collection platform. The survey used for the present study can be found in Appendix 1. The survey began with an informed consent where participants were introduced to the study. Withdrawal from the study was possible at any time without a penalty and all data were kept strictly anonymous.

The questionnaire used for the present study was part of a larger questionnaire, in this section only the parts relevant for this research are explained in further detail. Other topics included in the complete questionnaire were Integrated Pest Management, farmers' cultivation practices, nutrient management, pesticide use, production practices, and marketing. Furthermore, the final part of the questionnaire consisted of questions related to the earlier mentioned development projects and the sustainable rice platform standard. Since this research is not referring to earlier projects that took place in the area, this section will not be discussed in more detail.

Introduction and socio-demographics.

The first part of the questionnaire consisted of a short introduction about the present study. Secondly the farmers were asked questions in relation to their socio-demographic characteristics such as district, commune, and village. Further, the farmers were asked about their gender, civil status, age, education level, number of farming years, and if they were the household head.

Farm characteristics

The second part of the questionnaire consisted of questions related to the farm characteristics of the rice farmers. The farmers answered this for two different seasons, autumn-summer and winter-spring (2019). They were asked about the crops grown for the past three years, the options were rice only or rice and other crops. If farmers mentioned that they cultivated multiple crops, it was asked whether they practiced inter-cropping or crop rotation. Furthermore, farmers had to indicate the size of their fields in hectares. Additionally, the farmers were asked if they planted and fallowed the rice synchronously (within one month of other farmers in the area). The final question was related to the harvesting methods used, if the farmers used manual or combine harvesting for their paddy.

Farmers' perception of risks and trust

After the sections about socio-demographics and farm characteristics, the survey consisted of questions related to farmers' perception. Farmers' perception of risk was evaluated by rating 24 risk factors, created specifically for this survey. The following risks were rated by the farmers: insecticides, herbicides, fungicides, rodenticides, molluscicides, chemical fertilizer, floods, droughts, typhoons, earthquakes, increase in temperature, diseases (water), diseases (mosquito), leaching, soil erosion, salinity, straw burning, water pollution, air pollution, phone radiation, unemployment, genetically modified (GM) rice, political conflict, and land use change. The risk factors were rated on a six-point Likert scale, ranging from 1 = no risk at all to 6 = very high risk.

Trust in institutions was the final aspect of this section. The farmers had to indicate on 6-point Likert scale, how much they trusted 8 different institutions. Trust was rated on a six-point Likert scale, ranging from 1 = no trust at all to 6 = very high trust. The following institutions were rated:

- Institutions that regulate the legal aspects of agriculture
- Other rice farmers (non-family members)
- Other rice farming family members
- Research (i.e. Universities and Research Institutes)
- Agrochemical companies
- Non-governmental organizations (NGO's)
- Agricultural retailers
- Rice traders

Contract farming

The final section of the questionnaire consisted of questions about contract farming. The farmers were asked under which scheme they were currently operating, and could choose between contract farming with a buyer, contract farming with a cooperative/association, non-contract farming and other. Furthermore, the farmers had to specify the duration of the contract farming arrangement in months. Additionally, the farmers answered what contract farming provided them, the options were technical assistance, financial/credit assistance, provision of inputs, access to inputs, marketing support and other. The follow up question was which farming scheme the farmers preferred and why they preferred that scheme.

4.3 Procedure

The survey was completed within 11 days with assistance from staff members of the Department of Agriculture and Rural Development in Long An. The first day consisted of meeting the department staff and ensuring that the interviewers understood the relevance and meaning of each question. Due to the use of an app it was important that the interviewers were aware of the flow of questions in order to have smooth survey implementation, and to cause no disruption of the interview process. The second day was used to determine how applicable to survey app was to the local condition in which the interviews would take place. It was important to identify possible challenges to the interviewers that needed to be addressed before implementing the surveys. When the survey app and the interviewers were ready, it was time to conduct the interviews. Within each commune there was a central interview location. Travel to the interview locations was made more convenient for the farmers this way. They also received compensation for the travel costs . The interviewers were requested to sent their data every day, so there was enough time to review the data that were collected. After two days of data collection there was a day to review the data followed by another day to validate the data. The next two days consisted again of data collection, and were followed by a day of data review and a final day of data validation.

4.4 Analysis

Descriptive statistics

Data was exported from the CommCare dashboard and imported to Excel (version 2010). The raw data was organized by farmer ID and imported to the statistical package SPSS (version 26) for data analysis. Firstly, descriptive statistics were conducted to provide insights on the basic features of the study. This included information on the demographic, socioeconomic and agricultural situation of the farmers. Moreover, data about farm and farmers' characteristics was organized in a table and presented for contract farmers and non-contract farmers.

Analyzing farmers risk perception

After discovering basic features of the sample, the next step was to derive the means from all the risk factors, and by that answering the first research question, "*do farmers evaluate different types of risk?"* The means of all risk factors are displayed by using a bar graph, such that it becomes clear which risk factors were rated highest and lowest. In order to investigate if the different types of risks are perceived as different groups or dimensions of risks, for example environmental risks or risks posed by climate change, an exploratory factor analysis was conducted. The exploratory factor analysis displayed different dimensions for the risk factors. The method of extraction was principal component, based on eigenvalues >1. Oblique rotation was used as the rotation method, to streamline the dimensionality further. Additionally, as a preparation for the factor analysis a Kaiser-Meyer Olkin test was used, high values (close to 1.0), indicate that the data is suitable for factor analysis. In order to determine the reliability and the unrelatedness of the Likert scale measures, Cronbach's alpha and Bartlett's test were used. Statistical significance was set to $p = 0.05$.

The present research also aimed to investigate the role that contract farming schemes have with regard to rice farmers' risk perception. Firstly, basic information about the farming schemes was presented. It was described how many farmers were involved in contract farming, in which districts, and the duration of the contract farming arrangements. Secondly, the relationship between contract farming and risk perception was further investigated. To investigate the differences between contract and non-contract farmers (research question 2), an independent sampled t-test was performed.

Next to investigating the relation between farming schemes and farmers' risk, the present study aimed to research additional factors that could influence farmers' risk perception. More specifically, comparing the outcomes of the exploratory factor analysis to the gender of the farmers. Thus, to investigate gender differences in farmers' risk perception (research question 3), again an independent sampled t-test was used. Furthermore, the gender aspect was elaborated upon by investigating whether there was a significant relation between contract farming and gender. This was researched by performing a chi-square test.

Understanding what factors influence farmers' risk perception

The second research aim is to investigate the factors that influence farmers risk perception. Socio-demographics and institutional trust are the variables that were researched in relation to farmers' risk perception. Firstly, the socio-demographic variables were chosen, thus age, gender, education and farming experience. These variables are used to investigate relation between socio-demographics and farmers' risk perception (research question 4). In order to investigate whether different dimensions of institutional trust influences farmers' risk perception an exploratory factor analysis was conducted. The variable trust is a Likert-scale variable ranging from 1 (no risk at all) to 6 (very high risk). For the variable trust an exploratory factor analysis was performed to investigate the different dimensions of trust. The rotation method was a Varimax rotation, and the method of extraction was principal component, with eigenvalues >1. As a preparation for the factor analysis a Kaiser-Meyer Olkin test was performed. The reliability and the unrelatedness of the Likert scale measures were tested by using Cronbach's alpha and Bartlett's test of Sphericity. Statistical significance was set to $p = 0.05$.

The second part of understanding what factors influence farmers' risk perception was researched by conducting a mediated hierarchical regression. By performing this regression, the present study aims to investigate whether (institutional)trust is a mediating variable for farmers' risk perception. The mediated hierarchical regression is based on the analytical framework of Williams and Kotrlik (2004). Firstly, the demographic variables were entered into the regression as control variables. The second step in this analysis was to include the farming scheme into the regression, thus whether the farmers are involved in contract farming. The variable contract farming was the independent variable in this analysis. The final step is to enter the mediating variable which is institutional trust. After performing the mediated hierarchical regression, the present study will answer how institutional trust is associated with farmers' risk perception (research question 5). After conducting the mediated hierarchical regression, a Sobel test was performed to test the significance of the mediation effect, based on the theory of Baron and Kenny (1986).

5. Results

5.1 Sample description

Out of the 258 farmers who participated in the study, 87.2% were male (n = 225). The percentage of female farmers was 12.8 (n = 33). The age of the participants ranged between 21 and 75 years old, with a mean age of 47 years old (SD) = 11 years). Farmers in this study had farming experience between 2 and 55 years, with a mean of 23 years (SD = 10.6). For the education level of the farmers, the lowest option was primary incomplete, this was answered by 7.8% of the farmers (n = 20) and 4.3% of the farmers (n = 11) completed university, which was the highest answering possibility. The most frequently chosen educational options were secondary incomplete, with 22.9% (n = 59) and secondary complete, with 24.4% (n = 63). The percentage of farmers in this study that were household heads was 86.4% (n = 223).

The area under cultivation for the wet season (WS) and the dry season (DS) ranged from 0.7 to 22 hectares of land. The mean of land under cultivation in WS is 3.50 hectares (SD = 2.72), the mean of land under cultivation in DS is 3.51 hectares (SD = 2.73). Almost all farmers plant synchronously with other farmers, within one month, 95.3% (n = 246). The synchronous fallowing practices with other farmers are lower, 89.5% of the farmers used this on their farm (n = 231). Almost all farmers were solely cultivating rice, 96.5% (n = 249). Furthermore, farm and farmer characteristics for the two farming schemes, contract and non-contract farmer, are presented in Table 1.

Table 1. Farm and farmer characteristics for the farming schemes. Values in columns are mean, standard deviation (SD), percentage (%) and number of observations (N).

Predictor	Farming scheme			
	Contract farmer		Non-contract farmer	
	n	Mean (SD)	n	Mean (SD)
Age (years)	135	45.61 (10.45)	117	48.27 (11.71)
Farming experience	135	22.01 (10.10)	117	23.95 (11.18)
Gender	n	%	n	%
Male	113	83.70%	106	90.60%
Female	22	16.30%	11	9.40%
Education	n	%	n	%
Primary incomplete	9	6.7%	10	8.5%
Primary complete	14	10.4%	13	11.1%
Secondary incomplete	31	23%	27	23.1%
Secondary complete	41	30.4%	21	17.9%
High school incomplete	13	9.6%	13	11.1%
High school complete	21	15.6%	27	23.1%
Vocational college	1	0.7%	0	0%
University	5	3.7%	6	5.1%
Household head	n	%	n	%
Yes	110	81.50%	107	91.5%
No	25	18.50%	10	8.5%
Area cultivated (ha)	n	Mean ha (SD)	n	Mean ha (SD)
Area wet season (2019)	132	3.83 (3.11)	113	3.12 (2.19)
Area dry season (2019)	131	3.86 (3.11)	115	3.12 (2.20)
Synchronous Planting	n	%	n	%
Yes	128	97.%	112	97.4%
No	4	3.%	3	2.6%
Synchronous Fallowing	n	%	n	%
Yes	106	80.3%	79	68.7%
No	26	19.7%	36	31.3%
Member of cooperative	69	51.1%	61	52.1%
Harvest methods	n	%	n	%
Manual harvesting	2	1.5%	2	1.7%
Combine harvesting	130	98.5%	114	98.3%

5.2 Understanding farmers risk perception

5.2.1 Risk perception

Risk factor rating

In Figure 5 the means of all risk factors are shown. The five risks with the highest means are all chemical inputs. The risk with the highest mean is rodenticides m = 5.01 (SD = 1.23). Followed by insecticides with m = 4.95 (SD = 1.18) and molluscicides with m = 4.84 (SD = 1.26). Continuing with herbicides, with m = 4.79 (SD = 4.79) and fungicides with a mean of 4.62 (SD = 1.24). The other two risk factors with a mean above 4 are, water pollution, m = 4.14 (SD = 1.43) and diseases related to mosquitos with m = 4.04 (SD = 1.38). The lowest rated risk factors are phone radiation with m = 3.07 (SD = 1.66) earthquakes m = 3.28 (SD = 1.40), and genetically modified rice m = 3.28 (SD = 1.60).

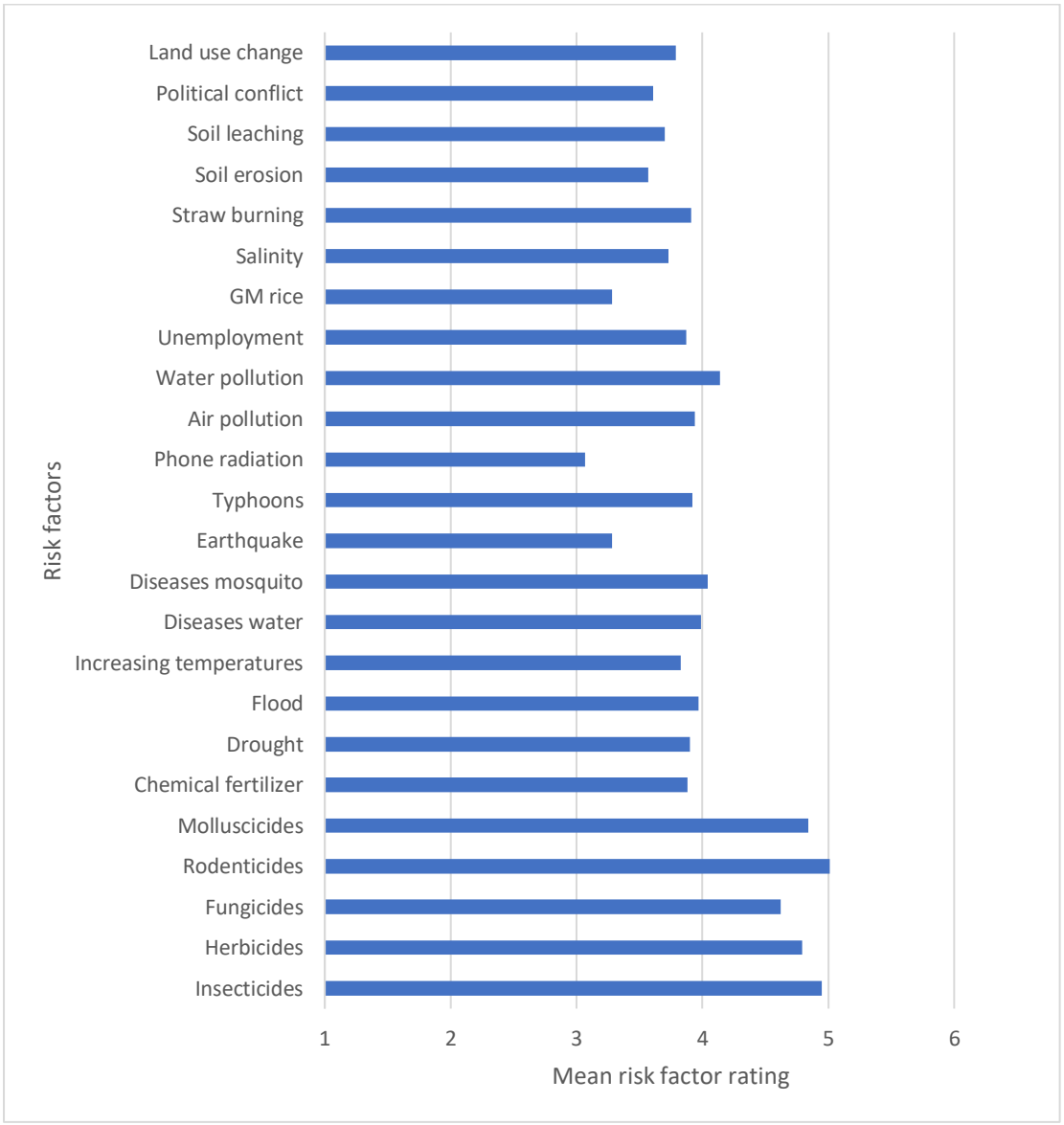


Figure 5. Risk factors mean rating. Items sorted by mean factor rating, error bars show standard deviation. Likert scale rating from 1 = "no risk at all" to 6 = "very high risk".

Risk factor analysis

An exploratory factor analysis was conducted with the 24 risk factors that the farmers rated in the survey. The following risks were included in the questionnaire: insecticides, herbicides, fungicides, rodenticides, molluscicides, chemical fertilizer, floods, droughts, typhoons, earthquakes, increase in temperature, diseases (water), diseases (mosquito), leaching, soil erosion, salinity, straw burning, water pollution, air pollution, phone radiation, unemployment, genetically modified (GM) rice, political conflict, and land use change. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.96.

The principal component extraction, with oblique rotation (direct oblimin), resulted in two principal components with eigenvalues greater than 1.0. Principal component 1 explains 61.7% of the variation, while principal component 2 explains 16.5% of the variation. The two factors combined explain 78.2% of the variation.

The factor loadings greater than 0.4 explained the different dimensions of the principal components (Table 2). Principal component 1 (m = 3.76, SD = 1.37, n = 19), described the risks related to abiotic stresses and socio-politics. The reliability analysis of this factor resulted in a Cronbach's alpha of 0.98 (n = 19). Principal component 2 consisted of risk factors related to (chemical) farming inputs (m = 4.84, SD = 1.15, n = 5). Cronbach's alpha of 0.93 (n = 5) was observed for this factor.

Table 2
Factor loadings Risk (Oblimin with Kaiser Normalization to streamline dimensionality)

Risk factors	Mean	SD	Principal component risk 1	Principal component risk 2
Increasing temperature	3.83	1.66	**0.936**	-0.039
Water pollution	4.14	1.43	**0.920**	0.021
Air pollution	3.94	1.60	**0.915**	-0.005
Soil erosion	3.57	1.41	**0.914**	-0.065
Salinity	3.73	1.68	**0.908**	0.017
Genetically modified rice	3.28	1.60	**0.908**	-0.078
Soil leaching	3.70	1.33	**0.895**	-0.033
Political conflict	3.61	1.96	**0.891**	-0.031
Earthquake	3.28	1.94	**0.879**	-0.118
Drought	3.90	1.59	**0.878**	0.116
Land use change	3.79	1.67	**0.860**	-0.043
Straw burning	3.91	1.41	**0.860**	-0.039
Floods	3.97	1.56	**0.852**	0.048
Unemployment	3.87	1.71	**0.849**	0.055
Diseases water	3.99	1.53	**0.846**	0.179
Phone radiation	3.07	1.66	**0.810**	-0.151
Typhoons	3.92	1.68	**0.799**	0.122
Diseases mosquito	4.04	1.38	**0.725**	0.264
Chemical fertilizer	3.88	1.42	**0.459**	0.388
Insecticides	4.95	1.18	-0.036	**0.963**
Herbicides	4.79	1.22	0.002	**0.955**
Molluscicides	4.84	1.26	0.009	**0.930**
Rodenticides	5.01	1.23	0.018	**0.928**
Fungicides	4.62	1.24	-0.014	**0.906**

Principal component extraction was used with oblique rotation

Factor scores > 0.4 indicated in bold.

Principal component 1: risks related to abiotic stress and socio-political risks.
Principal component 2: risks related to (chemical) farming inputs

5.2.2 Risk perception and contract farming

Contract farming

To the question under which farming scheme the farmers were currently operating, almost half of the farmers, 49.6% (n = 128), answered that they were operating under a contract farming scheme with a buyer. Only a small part of the farmers, 2.7% (n = 7), answered that they were operating under a contract farming scheme with a cooperative or association. The remaining part of the farmers, 45.3% (n = 117), was not involved in a contract farming arrangement. The mean amount of years for the contract farming arrangement was 0.4, so between 4 and 6 months (SD = 0.43). The survey included 6 different districts in the Long An province. In District 2 the highest percentage of farmers were involved in a contract farming arrangement with 79.5% (n = 62), followed by district 6, which had 68% of the farmers involved in a contract farming arrangement (n= 34). The district with the lowest amount of contract farmers was district 4 with 4.2% (n = 1).

T-test contract farming and risk perception

In the previous section of the results a factor analysis was performed to identify the principal components with eigenvalues greater than 1.0. This resulted in the extraction of two components. These principal components of risk perception are now tested with a two-sample t-test, to discover whether there is a difference between the means of risks for contract farmers and non-contract farmers.

The T-test which includes risks related to abiotic stresses and socio-politics, shows that non-contract farmers perceive risks higher than contract farmers (Table 3). The T-test for risks related to (chemical) farming inputs, also shows that non-contract farmers perceive risks higher than contract farmers (Table 3).

Table 3
Two-sample t test between contract and non-contract farmers

Group	N	Mean	Std. Dev.	T-statistic	p-value
Mean risks related to abiotic stresses and socio-politics					
Non-contract	119	3.95	1.40		
Contract	134	3.59	1.31	-2.120	0.035*
All	253	3.76	1.37		
Mean risks related to (chemical) farming inputs					
Non-contract	119	5.23	0.93		
Contract	134	4.50	1.22	-5.243	< 0.01**
All	253	4.84	1.15		

5.2.3 Gender

Risk perception and gender

There was only a small difference among means for the two types of risk perceptions and gender of the farmers. Female farmers (m = 4.2, SD = 1.3) perceive higher risks in comparison to male farmers (m = 3.7, SD = 1.4), for risks related to abiotic stresses and socio-politics. Furthermore, risks related to (chemical) farming inputs, also showed a slight difference for female farmers (m = 4.5, SD = 1.1) in comparison to male farmers (m = 4.7, SD = 1.1). In order to investigate whether there is a difference between the risk perception of male and female farmers an independent samples t-test was used. The t-test showed that there is a statistically significant difference between groups for risks related to abiotic stresses and socio-politics, (t (251) = 2.2, p = 0.030). There was no statistically significant difference between groups for risks related to (chemical) farming inputs, (t (251) = -1.1, p = 0.278).

Contract farming and gender

To determine whether there is a difference between contract/non-contract farming and gender, a chi-square test was performed. The number of females under contract farming was 22, and for non-contract farmers n was 11. For male farmers n is 113 for contract farmers and the number of non-contract farmers is 106. No significant difference was found between gender and contract farming $\chi^2 = 2.62$, p = 0.106.

5.3 Factors influencing risk perception

5.3.1 Demographics

The demographic variables that are included in the mediated hierarchical regression are age (n = 258, m = 47.02, SD = 11.13), gender (n = 258), education (n = 258), and farming experience (n = 258, m = 22.95, SD = 10.58).

5.3.2 Trust

For the variable trust an exploratory factor analysis was performed to investigate different dimensions of trust. To test the suitability of the data for the Principal Component Analysis (PCA), both a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of Sphericity were used. The value of the KMO test was 0.81, suggesting that the adequacy of input variables for the PCA is good. Additionally, the test of the null hypothesis, that the correlation matrix is an identity matrix has a p-value of < 0.001. This suggests that there is a relationship between the input variables. That is why principal component analysis was a suitable method for analyzing the institutional trust of the farmers.

Principal component extraction, with Varimax rotation resulted in two principal components with eigenvalues > 1.0. The first principal component explained 56.8% of the variance while the second principal component explained 15.9% of the variance. The two principal components combined explained 72.7% of the variance.

The factor loadings greater than 0.4 explained the different dimensions of institutional trust (table 4). Principal component trust 1 (m =3.85, SD = 0.95, n = 5), described the trust in non-commercial parties. The reliability analysis of this principal component resulted in a Cronbach's alpha of 0.86 (n = 5). Principal component trust 2 (m = 3.44, SD = 0.86, n = 4), described the trust in commercial parties. For this principal component a Cronbach's alpha of 0.87 (n = 4) observed.

Table 4

Factor loadings trust (Varimax rotation with Kaiser Normalization)

Trust items	Mean	SD	Principal component trust 1	Principal component trust 2
1. Institutions that regulate the legal aspects of agriculture	3.93	1.226	**0.875**	0.112
2. Other rice farmers (non-family members)	3.74	1.172	**0.649**	0.470
3. Other rice farming family members	4.12	1.152	**0.768**	0.345
4. Research (i.e. Universities and Research Institutes)	4.05	1.171	**0.907**	0.187
5. Agrochemical companies	3.44	0.977	0.304	**0.845**
6. Non-governmental organizations (NGO)	3.43	1.192	**0.541**	0.237
7. Retailers	3.42	0.959	0.293	**0.891**
8. Rice traders	3.16	0.964	0.160	**0.877**

Principal component extraction was used with varimax rotation

Factor scores > 0.4 indicated in bold

Principal component 1: Trust in non-commercial parties

Principal component 2: trust in commercial parties

5.3.3 Hierarchical regression

The final part of our study aims to investigates whether trust is a mediating variable for the two principal components of risk perception, (1) risks related to abiotic stresses and socio-politics, and (2) risks related to (chemical) farming inputs. Therefore, two separate hierarchical regression analyses were performed, each focusing on one of the dependent variables. For the first step the control variables, age, farm experience, education, and gender of the farmers were entered; in the second step the independent variable, contract farming (coded as 0 = no contract, 1 = contract) was included; and in the final step the mediator trust (both trust components were entered simultaneously in the last step) was included in the regression. Results of the hierarchical regression are shown in Table 5 below. Step 1 controlled for demographic variables of the farmers; it showed that age, farm experience and gender are significant predictors for risks related to abiotic stresses and socio-politics. Step 2 showed that contract farming negatively predicted risks related to abiotic stresses and socio-politics. When entering both principal components of trust, contract farming remained significant. However, both principal components of trust did not show a significant relationship with risks related to abiotic stress and socio-politics. Moreover, the R^2 increased from 8.2% to 15.4% in the model, thus an increased amount of variance is explained by the model for the dependent variable.

The second analysis regressed risks related to (chemical) farming inputs on the predictor variables, visible in Table 6. The process is similar to the first hierarchical regression analysis described above. Four socio-demographic variables were controlled for in the first step; this indicated that farm experience was the only predictor for risks related to (chemical) farming inputs. The second step presented that contract farming negatively predicted risks related to (chemical) farming inputs. While entering trust 1 and trust 2, contract farming was significant for trust 1, suggesting that trust in non-commercial institutions explains the association. Furthermore, the R^2 increased from 3.7% to 27.1%, thus the model now explains a substantially increased proportion of the variance for the dependent variable.

Table 5: Results of hierarchical regression analysis on farmer's risk perception 1 (risks related to abiotic stress and socio-politics)

Steps	Model 1	Model 2	Model 3
Step 1: Control variables			
Age	-0.239*	-0.257**	-0.275**
Farming experience	0.392***	0.395***	0.426***
Education	0.014	0.014	0.005
Gender (male)	-0.140*	-0.154*	-0.137*
Step 2: Independent variable			
Contract farming		-0.146*	-0.230***
Step 3: Mediator variables			
Trust in non-commercial institutions			-0.146
Trust in commercial institutions			-0.118
Observations	253	253	253
R^2	0.082***	0.102***	0.154***
ΔR^2	-	0.021*	0.051**

Note: Standardized beta coefficients
* p<0.05, ** p<0.01, *** p<0.001

Table 6: Results of hierarchical regression analysis on farmer's risk perception 2 (risks related to (chemical) farming inputs)			
Steps	Model 1	Model 2	Model 3
Step 1: Control variables			
Age	-0.089	-0.128	-0.139
Farming experience	0.229*	0.235*	0.218*
Education	-0.041	-0.039	-0.028
Gender (male)	0.062	0.033	0.02
Step 2: Independent variable			
Contract farming		-0.305***	-0.160**
Step 3: Mediator variables			
Trust in non- commercial institutions			0.450***
Trust in commercial institutions			-0.063
Observations	253	253	253
R^2	0.037	0.127***	0.271***
ΔR^2	-	0.090***	0.143***
Note: Standardized beta coefficients * p<0.05, ** p<0.01, *** p<0.001			

5.3.4 Mediation analysis

Mediation is indicated when the relationship between an independent variable and a dependent variable runs via a mediating variable (Joffre et al., 2020). Thus, the mediator provides insight into the underlying process of the relation between the independent and the dependent variable. The results from the Sobel test were performed according to the Baron and Kenny approach (1986). The SEM diagram, shown in Figure 6 below, generate that a, b, and c path coefficients are significant at < 0.001 levels. Furthermore, a Delta and Monte Carlo test also returned significant at < 0.001.

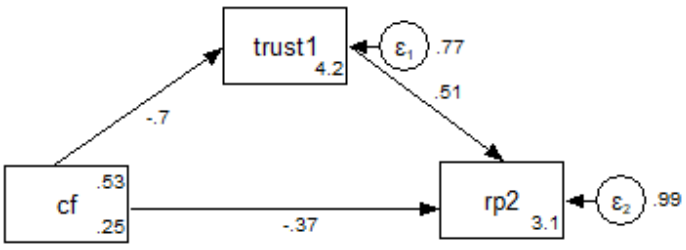


Figure 6. SEM diagram of trust (1) partially mediating contract farming and risks related to (chemical) farming inputs

6. Discussion

The current study aimed to investigate what types of risks rice farmers in the Mekong Delta perceive and to gain a better understanding in what factors shape farmers risk perception. Therefore, contract farming and trust were investigated as possible factors influencing farmers' risk perception.

6.1 Farmers risk perception

Results of the present study showed that farmers perceive the highest risks in relation to chemical farming inputs. Rodenticides were rated highest out of the 24 risks studied. Stuart et al. (2011), described that rodents are important pre-harvest pests of crops, and cause significant yield loss among smallholder rice and coconut farmers in the Philippines. As a consequence, farmers use chemical rodenticides, for instance acute poisons and anticoagulants. The disadvantage of using chemical rodenticides is that they are potent vertebrate toxicants and when they are applied as a method of control for a pest rodent, non-target species of rodents are at risk. Furthermore, farmers are also at risk by using chemical rodenticides, because these acute poisons are often poorly labelled in developing countries and there are often no antidotes available (Stuart et al., 2011). The present study showed that farmers perceive high risks in relation to rodenticides. This is in line with the aforementioned study of Stuart et al. (2011), which described that the majority of rice and coconut farmers in the Philippines recognized that using rodenticides was harmful for their health. However, almost half of the rice farmers believed that killing rats was more important than the environmental risk (Stuart et al., 2011). Due to the earlier described process of intensification, farmers in the Mekong Delta have been exposed to chemical farming inputs, such as rodenticides, for an extended period of time. These farmers might have noticed the negative effects of these chemical farming inputs and have therefore rated the risks of chemical farming inputs higher in comparison to other risks.

Furthermore, factor analysis derived two principal components of risk. The first principal component of risks concerned risks related to abiotic stresses and socio-politics; and the second component is risks related to (chemical) farming inputs. Previously, the present study already discussed the risks related to rodenticides and briefly discussed the intensification practices in the Mekong Delta in terms of health implications for the rice farmers. These intensified agricultural practices increased the supply of rice for a long period of time (Nguyen et al., 2018). However, an overuse of inputs such as pesticides and nitrogenous fertilizer resulted in rising production costs, which caused nominal increases in paddy prices (Stuart et al., 2018). Additionally, the Mekong Delta is currently facing environmental consequences from their long history of intensified rice production (Nguyen et al., 2018). The present study shows that farmers that are involved in contract farming arrangements rate risks in relation to (chemical) farming inputs lower than farmers who are not involved in a contract farming arrangement. Riwthong et al. (2017), stretches the importance to better understand sources of risk to which farm operations are exposed. Furthermore, risk sources and management are strongly associated with the level of agricultural commercialization for farmers in Thailand. Market-oriented farmers are more concerned with crop pests and diseases, but also with low crop prices and the ability to hire enough outside labor for their farm (Riwthong et al., 2017). Farmers who engage in contract farming arrangements have a secured output market for their produce (Ba et al., 2019). Therefore, these farmers might be less market oriented. Since the results of the current study showed that contract farmers rate risks related to (chemical) farming inputs lower in comparison to non-contract farmers, a possible explanation might be the degree of commercialization and market orientation of the rice farmers in the Mekong Delta. This degree of market orientation is related to the proportion of agricultural production that is for sale in the market, thus the amount of rice that is sold to commercial buyers in the MKD.

Furthermore, the present study underlined that contract farmers rate risks related to abiotic stresses and socio-politics lower than non-contract farmers. Farmers involvement in a contract farming arrangement means that they receive a stable price for their produce and lower their transaction costs (Ba et al., 2019). This stability could result in farmers choosing for contract farming, because they value it as the save option. Risk and uncertainty are inherent to agricultural production and mitigation of either market risks, production risks, disease risk and climate risks could be determinants for adopting rural innovations (Greiner et al., 2009; Joffre et al., 2019). However, a study of contract farming in China described that farmers with a higher risk perception tend to use contracts while risk averse farmers do not. Which meant that Chinese farmers' primary motivation of engaging in contract farming is not market price risk management, but rather seeking higher price and lower transaction costs). Chinese farmers merely consider contract farming as a way to access demand and high price prices instead of risks reduction (Wang et al., 2011). On the contrary, Ba et al. (2019), describes that farmers receive a stable price for their products rather than a higher price, thus this might be a difference between contract farming schemes in China and Vietnam. Thus, the relationship between risks related to abiotic stresses and socio-politics, requires more in-depth research on whether contract farmers are actually risk averse or seeking higher prices and lower transaction costs.

6.2 Risk perception and gender

The relationship with gender was also explored in the present study. Since the research aim is to investigate what types of risks rice farmers in the Mekong Delta perceive and to gain a better understanding in what factors shape farmers risk perception. It was of interest to include the gender aspect in this study. The reason for this interest was that Cullen et al. (2018), conducted previous research on differences in risk attitudes of male and female farmers; due to having these different risk attitudes men and women see different value propositions in response to new opportunities. Results of the present study showed that there was a significant difference between male and female farmers for risks related to abiotic stresses and socio-politics. Furthermore, studies have variously described women as being more nurturing and concerned with health and well-being, interested in the fate of society as a whole, with a desire to limit damaging technologies. In the past this meant more concerned about industrial hazards, and more against military spending, military intervention and war (Cutter et al., 1992). On the other hand, men are described as self-interested, subject to more aggressive behavior, and more willing to gamble and take risks. Based on the aforementioned factors, men may be viewed as risk-takers and women as risk-avoiders (Cutter et al., 1992). By also testing gender differences for contract farming schemes, the current study hopes to improve the understanding of gender differences in farming households. However, the risks related to (chemical) farming inputs were not perceived differently for male and female farmers. This is in contrast with other studies performed, which showed that females experienced significantly increased risks of pesticides (Wang et al., 2017). Research on gender differences in pesticide use in China, showed conflicting results in comparison to the present study in Vietnam. The aforementioned study in China showed that men had a better awareness of the associated health risk of pesticide use. One possible explanation is that men have more ways to access information and resources. Moreover, men are better educated, and they have a better knowledge of possible impacts of pesticide use on human health (Wang et al., 2017). Another explanation would be that men are often applying pesticides on the rice paddies, and therefore have an increased risk perception of (chemical) farming inputs (Salazar & Rand, 2020). Therefore, the results of the present study show no significant difference in risk perception.

Moreover, in our research the sample consisted of 33 female farmers and 225 male farmers. From these 33 female farmers 11 were household heads. For the male farmers 212 out of 225 were household heads. This means that for the present study also females responded on behalf of households. Most of the literature related to risks in agriculture investigated male farmers as being the head of the household (Cullen, 2018). Nevertheless, many smallholder farming households consist of both genders being farmers. Although, our study provided limited information regarding further household decision making in relation to risk perception, further research can be conducted for this field of study. However, present study consisted of unequal distribution for male and female farmers in the sample. The number of female farmers participating was large enough to provide significant results, however results need to be interpreted in light of the unequal distribution.

6.3 Factors influencing risk perception

Demographic factors

Results from the present study showed that the demographic variables age, gender and farming experience have a significant relationship with risks related to abiotic stresses and socio-politics. Previously, the current study discussed the significant relationship between gender and risk perception. Consequently, it is important to distinguish that there are other variations among the group or rice farmers that were studied. Differences exist in agroclimatic conditions, historical experiences and demographic factors; the latter was also included in researching possible factors influencing farmers' risk perception. When predicting farmers 'risk perception, it is important to look at their exposure to risk factors, which can be influenced by farming experience, age, level of education, amongst other things (Cullen et al., 2018). Furthermore, farming experience also showed a significant relationship with risks related to (chemical) farming inputs. Based on this relationship our interpretation is that farmers with more experience have been exposed longer to chemicals and might show health implications, due to the usage of these (chemical) farming inputs. However, we did not ask the farmers whether they showed any health implications, thus we refer to a study on risk perceptions and management in relation to pesticides in Thailand (Riwthong et al., 2017). This study highlights that an increased use of pesticides, under conditions of poor pesticide handling practices, exposes farmers to health risks, which are often not fully recognized by farmers. However, a research among Pakistani Cotton farmers, contradicts the study of Riwthong (2017), This study showed that neither age nor risk perception had any significant effect on pesticide overuse behavior. Nevertheless, the study did report that high levels of risk perceptions of unsafe use of pesticides were associated with a level of farming experience among Pakistani farmers (Khan et al., 2015). The latter supplements our findings that farming experience showed a significant relationship with risks related to (chemical) farming inputs.

Institutional trust

Factor analysis derived two principal components for institutional trust. The first principal component represents trust in non-commercial institutions. While the second principal component represents trust in commercial institutions. Siegrist (2005) hypothesized that general trust and confidence would negatively influence the risks perceived. Furthermore, social trust (trust in specific entities) strongly influences perception of particular technologies. Additionally, people having trust in authorities and management responsible for the technology, perceive fewer risks than people who did not have trust in those institutions (Siegrist, 2005). The theoretical implications provided by Siegrist (2005), were the foundation of testing trust in relation to risk perception and contract farming. Trust consisted of two principal components. Trust in non-commercial institutions (legal, other rice farmers, NGO's & research), did not have a significant relationship with risks related to abiotic stresses and socio-politics. When trust in non-commercial institutions was tested in relation to risks related to (chemical) farming inputs, a significant relationship was observed. Additionally, the second component of trust, consisted of trust in commercial parties (agrochemical companies, agricultural retailers and rice traders) and other rice farmers. However, when this component was tested in relation to risks of abiotic stress and socio-politics and (chemical) farming inputs, no significant relationship was observed. A research in Iowa, The United States, examined relationships between farmer beliefs about climate change, risk perceptions, trust in key institutions , and attitudes toward adaptive and mitigative actions (Arbuckle Jr et al., 2015) Literature described that perceptions of the seriousness of risks depend in large part on the degree to which we trust actors in expert systems to manage them appropriately. The study in Iowa described two types of institutions in relation to climate change, agricultural and environmental oriented organizations (Arbuckle Jr., 2015). The farmers in the aforementioned study expressed trust in environmentally oriented organizations as sources of information of climate change and that climate change poses threats to agriculture. On the other hand, farmers that expressed higher levels of trust in agricultural oriented organizations were less likely to believe in climate change (Arbuckle Jr et al., 2015). The results of the present study showed that a significant relationship was present between risks related to (chemical) farming inputs and trust in non-commercial institutions. Additionally, farmers rated these non-commercial trust factors also higher, implying an increased amount of trust in these institutions. These non-commercial institutions are research institutes, legal institutions, NGO's and other farmers. Farmers could value these organizations as sources of information regarding the use of (chemical) farming inputs, thus explaining the relationship between these two variables.

6.4 Trust as a mediating variable

The relationship between trust and risk perception was discussed in the previous section of the study. For the last part of the present study, a mediated hierarchical regression was performed. The aim of this test was to explore whether trust would act as a mediating or partial mediating variable between risk perception and contract farming. Joffre et al. (2020), highlighted the importance of trust during the adoption process for aquaculture technologies. In relation to adaption of new practices, their study underlined the need to be more specific when discussing trust; especially relational trust between actors that fosters the adaptation of new agricultural practices, but also calculative trust that plays a key role in evaluating specific product information. Our study concerned rice farmers in the Mekong Delta and contract farming arrangements as a new agricultural practice for the farmers. Additionally, our study was rather exploratory and concerned only one Likert-scale question in relation to trust. The results of our study showed that the relationship between risks related to (chemical) farming inputs and contract farming was partially mediated by trust in non-commercial parties. Thus, farmers have a higher level of trust in non-commercial institutions A research performed in the Philippines studied institutional trust in relation to rice farming, but then for the variety golden rice. In this research was stated that people who have social trust in the institutional actors involved in deploying, managing or regulating risky technologies perceive more benefits and fewer risks than people not having social trust in those actors (Chong, 2003). The findings of the current study are in line with the aforementioned perceptions on trust in relation to rice farmers' risk perception. When rice farmers in the Mekong Delta have trust in the institutional actors of the agricultural industry, they might perceive risks lower and increasingly adopt new technologies or practices, such as contract farming, on their farms. On the contrary, we must be cautious to not see trust as a fixed, stable entity, but rather as changeable and discursively contested (Carolan, 2006). It might even be that in some cases expressions of trust may prove to be more a condition of convenience than something genuinely felt. Furthermore, Giddens (1990) describes that individuals are often compelled to act "as if" they trust experts and institutions because they feel there is no other choice and therefore, significant doubts are not expressed. Thus, trust has to be understood in the context of the broader social relations and what trust means at the local level of the farmers (Giddens, 1990; Carolan, 2006). Moreover, Carolan (2006) mentions that a possible solution for this contested view of trust, would be to gain a better understanding of how trust relations change over time. Therefore, a suggestion of further research would be to perform a longitudinal study of how institutional trust of contract farmers in relation to risk perception changes over time.

6.5 Future implications

The present study researched farmers' risk perception and their engagement in contract farming schemes. Farmers that are part of a contract farming arrangement rate risks lower in comparison to farmers who are not involved in contract farming. Risk perception was also significant in relation to gender, it was shown that female farmers have a higher perception of risk. Moreover, trust in non-commercial parties was a partial mediator of risks related to (chemical) farming inputs. While this research mainly focused on engagement in contract farming rather than farmers fully adopting contract farming arrangements on their farm, our findings aligned with the adoption of aquaculture technologies of Joffre et al. (2020). Since the present study was exploratory in terms of researching the relationship between contract farming and risk perception, future research could be aimed towards a more in-depth study of the aforementioned relationship. The present study also aimed to include differences within the farmers that we studied. Consequently, acknowledging differences in, gender, farming experience, age.

However, we feel that this could be further stretched to increase the aspect of heterogeneity within risk related studies. Earlier performed research already emphasized that risk attitudes of farmers are affected by farm size, land ownership status, off-farm employment, age, education (Saqib et al., 2016). The fact that our study showed a significant relationship between risk perception and gender, is also implying further research in this field of study. Since this research did not have a main focus on gender-based differences, we could not make too many assumptions on variables other than risk perception and contract farming. However, a research with as main focus gender-based differences in risk perception of rice farmers in the Mekong Delta, would supplement the already existing risk literature. This is accompanied by the view of Cullen et al. (2018), who mentions that progress in this area has been slow, because datasets often were too small to research heterogeneity in risk perception by domain and across individual characteristics, such as gender.

Furthermore, our results showed that contract farmers perceive risks lower and that trust is a significant partial mediator for risk perception. When farmers' risk perception is low, the adoption of new technologies, for instance development projects increases. Lowering farmers' risk perception by engaging them in contract farming or by increasing their institutional trust could lead to an improved implementation of development projects. However, due to the exploratory nature of the present study it is difficult to make specific recommendations for the actors active in development projects. Implications for future research would be to research farmers' trust in institutions further and to research how institutional trust can be increased for rice farmers in the Mekong Delta. When risk perception lowers and institutional trust increases, more development projects could be implemented to improve the sustainability and sustain the livelihoods of rice farmers in the Mekong Delta.

7. Conclusion

This study aimed to examine farmers' perception of risk and their engagement in contract farming. The overarching research aim was to understand risk perceptions of contract and non-contract farmers and discover what factors influence farmers' risk perception. Farmers' perceive the highest risks in relation to chemical farming inputs. This could have been caused by farmers showing health problems due to the usage of pesticides (Stuart et al., 2011). Further findings of this study showed that farmers who are part of a contract farming scheme rate risks lower than farmers who are not part of a contract farming scheme. This knowledge is essential in studying risk perceptions in relation to development projects for rice farmers in the Mekong Delta. Furthermore, researching gender differences is also of importance when studying farmers risk perception. The results of the study showed that female farmers have a higher risk perception in comparison to male farmers. These findings show that there is an opportunity for a more gendered perspective in terms of studying rice farmers' risk perception. With regard to investigating factors influencing farmers' risk perception, the present study recognized heterogeneity across subpopulations. The findings showed that the demographic variables age, gender and farming experience have a significant relationship with risks related to abiotic stresses and socio-politics. Moreover, farming experience was significantly related to chemical farming inputs. This complements the earlier finding of farmers' perceiving the highest risks in relation to chemical farming inputs and the explanation of farmers' showing health problems. Thus, farmers who have more farming experience rate risks related to (chemical) farming inputs higher, because they have been using pesticides for a longer period of time. In the Mekong Delta intensified agricultural practices were used on a large scale by rice farmers and this influences farmers' perspective (Stuart et al., 2011). The final aspect of the present study was that trust in non-commercial institutions partially mediated the relation between contract farming and risk perception. When rice farmers in the Mekong Delta have trust in the institutional actors of the agricultural industry, they might perceive risks lower and increasingly adopt new technologies or practices, such as contract farming, on their farms. The present study has shown how rice farmers perceive risks and how these risks are related to contract farming and institutional trust. For successful implementation of development projects in the Mekong Delta it will be important to include farmers' risk perception and to review other significant predictors for farmers' risk perception.

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Appendix 1 Questionnaire

Introduction and socio-demographic characteristics

1. District
2. District name
3. Commune
4. Commune name
5. Village
6. Sex
    a. Male
    b. Female
7. Civil status
    a. Married
    b. Divorced
    c. Widower
    d. Never married
8. Age (years of last birthday)
9. Education level
    a. Primary incomplete
    b. Primary complete
    c. Secondary incomplete
    d. Secondary complete
    e. Highschool incomplete
    f. Highschool complete
    g. Vocational college
    h. University
10. Number of full years farming
11. Are you the household head?
    a. Yes
    b. No

Farm characteristics

12. What were the crops grown for the past 3 years?
    a. Rice only
    b. Rice + other crops
    c. Specify
13. If multi-crops, select if practiced:
    a. inter-cropping
    b. crop rotation
14. Field size (ha)
15. Did you plant synchronously (within one month) with other farmers in your area?
    a. Yes
    b. No
16. Did you fallow synchronously (within one month) with other farmers in your area?
    a. Yes
    b. No
17. Is there a problem with water regulation or distribution?
    a. Yes
    b. No
18. What are the harvesting methods being used for your field?
    a. Manual harvesting
    b. Combine harvesting

Farmers' perception of risks and trust

19. Please indicate on a 6-point scale, where 1 means no risk at all and 6 means very high risk, how much risk do you perceive from the following hazards for you and your immediate family.
    a. Insecticides
    b. Herbicides
    c. Fungicides
    d. Rodenticides
    e. Molluscicides
    f. Inorganic/ chemical fertilizer
    g. Drought
    h. Flood
    i. Increasing temperatures
    j. Diseases spread through water
    k. Diseases spread through mosquitoes
    l. Earthquake
    m. Tropical cyclones / typhoons
    n. Mobile phone radiation
    o. Air pollution
    p. Water pollution
    q. Unemployment
    r. Genetically modified rice
    s. Salinity
    t. Straw burning
    u. Soil erosion
    v. Soil leaching
    w. Political conflicts (e.g. war)
    x. Land use changes
20. Please indicate on a 6-point scale, where 1 means no trust at all and 6 means a lot of trust, how much trust you have in the following institutions.
    a. Institutions that regulate the legal aspects of agriculture
    b. Other rice farmers (non-family members)
    c. Other rice farming family members
    d. Research (i.e. Universities and Research Institutes)
    e. Agrochemical companies
    f. Non-governmental organizations (NGO's)
    g. Agricultural retailers
    h. Rice traders

Contract farming

21. Under what farming scheme do you currently operate?
    a. contract farming with a buyer
    b. contract farming with a cooperative / association
    c. non-contract farming
    d. other
22. For how long? (months)
23. What does contract farming provide you? (Select all that apply)
    a. technical assistance
    b. financial / credit assistance
    c. provision of inputs
    d. access to inputs
    e. marketing support
    f. other
24. Which one do you prefer?
    a. Under contract farming scheme
    b. Under non-contract farming scheme
25. Why?
    a. Access to/assistance on technical know-how
    b. Access to/assistance on inputs
    c. Access to/assistance on credit
    d. Access to/assistance on services
    e. Assured market
    f. Linkage to market
    g. Higher buying price
    h. Stable income
    i. Flexibility in growing different crops
    j. Flexibility in selling to alternative buyers
    k. Bargaining power on selling price
    l. Fear of indebtedness
    m. Fear of meeting the requirements (quantity or/and quality)
    n. Others