

The Management of Agricultural Risk in Bangladesh: A Proposed Process

ABSTRACT

Farmers' life in the developing world is full of risks. Yet risk management has been a science for companies and industrial process management. This study has tried to develop a process for managing the agricultural risks. In doing so, the study has amply defined the major agricultural risks and pinpointed the consequences of them on farmers' life in Bangladesh. Government policy failures in managing the agricultural risks and lack of known management strategies have inspired the researchers to develop a process of dealing the agricultural risk. In this article, the risks have been broadly organized into five categories concerning production, financial, marketing, institutional, and personal factors. All those agricultural risks have chronic and far-reaching negative impacts on farmers' life. The agricultural risks in peasant farming systems of Bangladesh deserve adequate attention of extension systems for sustainable management. In addition, the ways farmers do cope with the situations are still concealed. Therefore, the study proposed a framework for effective risk management in agriculture of Bangladesh. However, much more work will be needed to create an effective risk management environment in Bangladesh agriculture, to build on the outlines laid out here.

Keywords: *Agricultural extension, climate change, food security, man-made risk, risk management strategies*

1. PART I: INTRODUCTION

The agriculture sector is a key industry in the national economy of Bangladesh. Agriculture brings in a lot of foreign currencies through export and increases the foreign exchange reserves of the country by reducing imports. The sector presently employs about 47.5% of the total labor force and contributes 16.33% of total GDP [1]. Agriculture employs almost 70% of rural dwellers in Bangladesh [2]. Agriculture supplies raw materials for industries and household materials for everyday necessities. Moreover, the sector is incrementally contributing to national food and nutritional security.

Agricultural land in Bangladesh, per person, has declined over the years. According to the World Bank the per capita arable land of the country was 0.173 hectares in 1961 but in 2013 it was only 0.048 hectare [3]. As population is also growing, food security is in danger.

Actually, agriculture is a risky business in Bangladesh. Crop production of farmers is badly affected by a diverse range of risks [4]. Although farmers struggle to produce food for the nation, little attention is paid in finding a sustainable way of managing those risks. Agricultural production in the north of the world is now safer than that in the south. Appropriate management strategies have lessened agricultural risks to a great extent. However, identification of hidden risks and developing sustainable management strategies depends on exploration and experiences. Therefore, this study would try to pool data on causes and consequences of agricultural risks in Bangladesh. In addition, this study reviewed for recommending suitable management strategies in addressing agricultural risks of Bangladesh.

1.1 Conceptual Framework of the Study

The word 'risk' generally comes from the Italian word '*risicare*', which means 'to dare' [5]. The notion of risk relates to the Greek navigation term '*rhizikon*', describing the need to avoid 'difficulties on the sea' [6]. Risk is completely associated with uncertainty and damage. Symbolically, it can be present as [7]:

Risk = Uncertainty + Damage

Risk can be defined as the probability of loss; it depends on vulnerability, hazard and exposure [8]. "Risk (i.e. 'total risk') means the expected number of lives lost, persons injured, damage to property and disruption of economic activity due to a particular natural phenomenon, and consequently the product of specific risk and elements at risk" [9]. Total risk can be measured as [9]:

$\text{Risk}_{(\text{total})} = \text{Hazard (Elements at Risk)} + \text{Vulnerability}$

Risk and vulnerability are related to each other. Vulnerability is the plight of a commodity, system or asset that makes it susceptible to damage in the face of a hazard. Hazard on the other hand, is an unavoidable event that brings dangers. Vulnerability may arise from various sources including physical or socio-economic, and/or environmental factors for example poor design, inadequate protection facilities, lack of awareness etc. According to Downing et al. [10] vulnerability is the different exposure of stresses experienced by an exposure unit. Risky events can be characterized by their degree, the scope, rate, duration and the history, all of which form vulnerability. Kirilenko et al. [11] and Soussan & Arriens [12] expressed the mathematical relationship among the risk (R), vulnerability (V), and hazard (H), which is as follows:

$$R = f(H, V). \text{ [f indicated a function]}$$

Thus, risks can be explained by the probability of occurrence and the severity of its consequences on a farm. It is possible to calculate risks of a farm by the likelihood of risk, risk exposure and the severity of risky events. Researchers and practitioners have been examining the extent of risk by identifying a set of key factors: *inherent commodity characteristics, inherent production characteristics, political boundaries, and infrastructure conditions* [13]. A farmer may be vulnerable to certain events which may not be risky to him or may be less vulnerable but loss may occur catastrophically.

Baquet et al. [14] identified five separate risks in agriculture e.g. production risk, marketing risk, credit risk, personal risk, and environmental risk. Later, Hardaker et al. [15] added political and business risks in this list. Hazell & Norton [16] reported that the types of risks depend on the types of farming system, climate, policy and the institutional environment.

In general, the agriculture sector is affected by five major risks e.g. production, financial, marketing, institutional and personal risks. In this paper, the researchers review diverse agricultural risks in Bangladesh and the management process along with some effective management strategies.

Table 1. Expected loss scenarios (Probability × Severity) of an event

		Potential severity of negative impact	
		Low	High
Occurrence probability of event	High	High probability Low impact	High probability High impact
	Low	Low probability Low impact	Low probability High impact

Source: Adapted from Jaffee et al. [13]

1.2 Role of State Agricultural Extension and Advisory Services in Addressing the Agricultural Risk in Bangladesh

Globally, in combating hunger, the need for quality extension services has now been widely recognized [17, 18]. Evaluating 294 studies of the world, International Food Policy Research Institute (IFPRI) found that the rate of return on extension investments was 79 (Alston et al. 1999 in Swanson [19]).

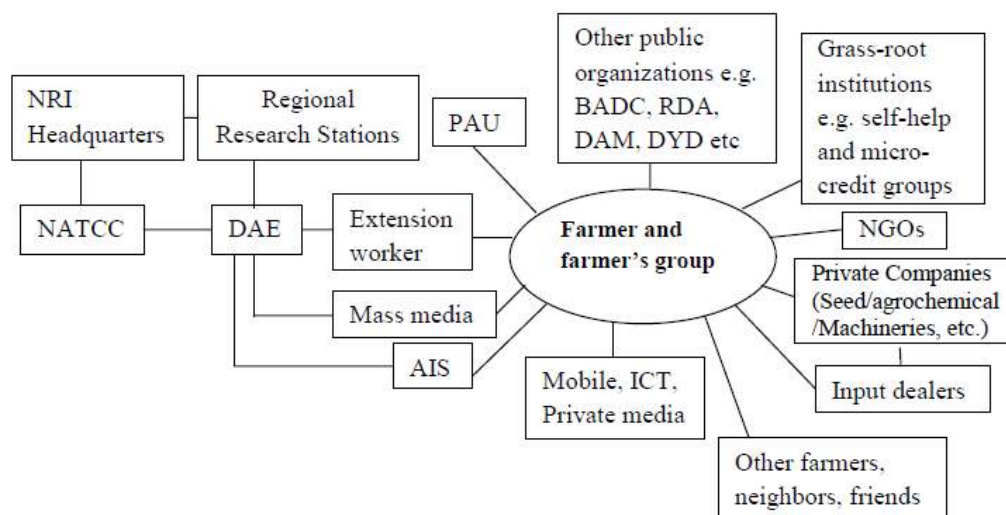
Haq [20] in a Bangladeshi study, found that extension contact has a positive significant contribution in improving farm income. Uddin [21] found that extension visit has significant effect in reducing ranges of farm vulnerabilities. Although, South Asian Agricultural Extension Services of late 1990s became weak due to reduced budget [22], it again valued essential during the world food crisis of 2008 [21].

After the Washington Consensus, various private funding and delivery arrangements were also made in reducing the agricultural risk (Rivera and Carry (1997) in Uddin [21]). As an agricultural country, the Government of Bangladesh has sufficient policy focus and strong interest in combating the risk. Ideally, the State agricultural extension and advisory systems of an agrarian country can be like the national fire brigade. Moreover, agricultural extension is considered as a pillar of research and development [23].

Regrettably, agricultural risk management is limited by widespread corruption and poor performance of the state agricultural extension service [17]. State extension, at present, is neither client-responsive nor demand driven. State extension of Bangladesh is usually criticized for absenteeism of officers, limited skill, unwillingness to respond to farmers' calls, poor accountability and inadequate physical facilities to respond to emergency calls [17, 21].

Many issues, such as market failure, climatic hazard, health hazard etc. are out of control of the State agricultural extension. However, research on extension problems in Bangladesh is also very limited.

The research centers and the universities have little budget to conduct research for risk reduction [24]. The linkage among the research centers, universities and the extension systems are very poor [25]. "An agricultural knowledge and information system (AKIS) itself is within risk of becoming defunct". As agricultural information is traded in a complex system, all components of AKIS (Figure 1) should work harmoniously to fight against the risks to farmers. However, identifying risk and developing management strategies are the prerequisites to initiate a rigorous risk management program.



Legend: Information flow is the line between boxes, AIS= Agricultural Information Service, BADC= Bangladesh Agricultural Development Corporation, DAM= Department of Agricultural Marketing, DYD= Department of Youth Development, NATCC= National Agricultural Technical Coordination Committee, NRI= National Research Institute, PAU= Public Agricultural Universities, RDA= Rural Development Academy

Fig. 1. Agricultural Knowledge and Information Systems in Bangladesh

Source: Rashid and Gao, [26]

2. PART II: THE RISKS

In comparison with other livelihoods, the extent of risk in agriculture is very high. The agricultural production process is exposed with high probability to many dangerous natural disasters and the number of risks is increasing day-by-day. Along with natural risks, a lot of man-made risks are imperiling the livelihoods of farmers in rural Bangladesh. Here we review risks associated with the agriculture sector of Bangladesh and their consequences. We further consider the risk management process and strategies

2.1 The production risks

Production risks in Bangladesh are associated with pests and environmental hazards like drought, cyclone, and extreme salinity interruption [27]. Coastal and offshore areas of the country are heavily affected by different levels of soil salinity. The fertility of these lands is 50% less than that of most agricultural land in the country [28].

On the other hand, the north-western part of the country is heavily affected by drought. Drought generally reduces crop yield and income for farmers. During the dry season, approximately 2.32 million hectares of transplanted *Aman* rice area becomes affected [29]. Each year, seasonal floods destroy crops, animals, properties, and even many lives. In the rainy season, it rains continuously for several days (*Barsha*), which affects the settlement of agriculture for a long time. Then the abnormal flood (*Bonna*) destroys crops, animals, village infrastructure and other properties [30]. Other risks are extreme events like cyclones, storm surge, tornadoes etc.

The coastal region is frequently slapped by cyclones. A report mentioned that a severe cyclone generally strikes Bangladesh's coast once in every three years [31]. In 2007, Cyclone *Sidr* caused a loss of around 1,675 million USD (2.6% of the total GDP of the country [32].

Other important risks in agricultural production in Bangladesh are diseases and insect attack during crop seasons. It is estimated that an average farmer loses 37 per cent of his rice yield due to crop disease and pest attack [33]. Further risk is related to seed quality. Due to low seed quality,

farmers get a low yield in Bangladesh. Crop failures due to lack of knowledge about hybrid seeds, unavailability of fertilizers, low quality pesticides/chemicals are common in Bangladesh.

2.2 Financial/credit risks

Agricultural production is a function of inputs application. Inputs, on the other hand, involve cost. Farouque & Takeya [34] found that 'financial inability to buy fertilizers in time' brings risk of uncertain yield. Agricultural financing has a significant positive relationship with the economic growth of a country [35]. During seed sowing period, if farmers do not have enough resources to buy seeds, both quantity and quality of yields will fall drastically. Generally, crop price goes up during early harvesting time and therefore late harvesting is less profitable. Therefore, delay in crop cultivation may bring a risk of unprofitability. Financial risks may affect the entire cropping system, if financial institutions are unable to provide adequate loans to farmers [36]. Crop loan allocation in Bangladesh is unnecessarily lengthy. On the contrary, timely planting increases crop yields. In the case of maize, yield may increase up to 11-19 per cent if planted timely. Early planting also reduces the costs of cultivation, conserves soil moisture, and reduces erosion losses [37].

Government incentives in agriculture are inadequate in Bangladesh. Furthermore, government incentives are normally given to those connected with the governing party. Farmers need to spend money to get agricultural credit. If they fail to borrow money from a bank, they either go to NGOs for microcredit or to *mohajon* (the village economic leaders who provide money with very high interest). Both sources normally demand high rates of interest. Getting loans from NGOs also needs some extent of formal procedure: for example, the recipient must be a member of the lending NGO. If a farmer is not a member of the group, he/she will not get credit from them. A number of studies have found that micro-credits are not reaching the extreme poor [38]. NGOs normally offer a very high rate of interest. Thus microcredit in Bangladesh nowadays is a costly means of getting finance and not for those who need money.

2.3 Price/ market risks

Farmers of Bangladesh are always under pressure to offer a low price for their products. The gap between farmers' selling price and consumers' purchasing price is very high in Bangladesh [39].

Poor farmers growing crops which are only sellable at a particular time of the year have an especially difficult life. In a particular season, a particular crop floods the market: the market price may drop below cost of production and the farmer will lose his investment. On the other hand, farmers need to repay credit immediately after harvesting. Otherwise; they have to pay more interest for each day. Those who cannot do so sell their yields at a low price and repay the credit at 1.5 or 2 times of the loan amount. (Which is locally called 'dera shud' – 150% interests - and 'duna shud' – double repayment - respectively [40]. Of course, such farmers become, and remain, poor.

Other important reasons for low prices are limited storage facilities for the crops, poor marketing structures, inadequate transport facilities and little accessibility of rural farmers to urban markets. The plight of the farmers offers a suitable space for the middlemen [41, 42]. For perishable crops, farmers are bound to sell the product immediately with extremely low price.

Matin et al. [43] found that, if the farmers can sell their mango directly to the ultimate consumers, it is possible to get more profits. But unfortunately, the middlemen get involved in the process and grab the greater share of the profit [24]. When farmers do not get adequate support from any organization to sell their products, they, normally, go to the *mohajons*, *arotder* (the wholesale businessmen in rural market) and other intermediaries. Consequently, profit goes to the middlemen.

Hortal (a kind of strike action, mass protest often involving a total shutdown of workplaces, offices, shops, courts etc.) is another great obstacle to the farmers in marketing their products. As a result of this political turmoil, farmers get a very low price for their production. At the same time, people in cities are forced to expend much higher amounts of money for food due to limited supply. In this case, the profits go to the middlemen and the farmers lose out.

2.4 Institutional/ policy/ legal risks

Legal or institutional risks are also responsible for potential loss to farmers through political unrest, suddenly-applied rules/regulations, conflict, institutional collapse, and policy changes [44]. Institutional risks are multidimensional [45] having a direct links with financial and market risks. Trade liberalization and privatization are blamed for adverse effects on the poor and marginal farmers [46]. Import liberalization had a significant effect on food import costs.

Government normally sells subsidized fertilizer through the input dealers. The authorization procedure of the input dealers is highly political and controlled by the mighty government officials.

A survey on fertilizer demand and usage in Bangladesh [47] shows that about 40 percent of households suffer from extreme deficit of fertilizers of all kind and around 60 per cent of farmers suffered from urea deficit. The policy regarding fuel for irrigation is not friendly to small farmers. Poor irrigation management systems disperse excess agro-chemicals, posing threats to fish habitats and other flora and fauna of the environment [48]. It destroys eco-system stability and soil quality.

Policy failure regarding the standard of agro-inputs causes moral hazard and economic loss. Weak organization and policy cannot effectively address the diverse risk factors in agriculture. Ahmed et al. [49] mentioned that the Department of Agricultural Extension (DAE) itself appears lack the capability to learn about new technologies, due to the poor quality and inadequate training of staff.

2.5 Human/ personal risks

Human or personal risks are the uncertain changes that may cause death, divorce, injury or may bring asset losses: for example, loss or damage of farm equipment, buildings, livestock etc. Sometimes, increasing or fluctuating interest rates may create these types of risks and affect farmers greatly [15]. Furthermore, rural farmers have little access to health care facilities [50]. Farmers cannot afford the sudden cost of a health problem, either of themselves or their family members. In this case, farmers sell their land at a very low price because of their immediate needs. Failure of credit repayment is common among rural poor farmers. For this reason, numerous farmers are losing their land, animals or even their houses every year. Therefore, landlessness is increasing in Bangladesh. The Agricultural Census [51] reported that, out of around 28.67 million families, nearly 4.48 million, or 15.62 % of all households were completely landless.

Every year, a huge number of farmers are becoming migrant workers in the cities. Sometimes, they borrow money from the moneylenders or *Mohajons* at very high interest rates, mortgaging their small pieces of land [52]. Thus they become servants on their own land. This kind of deprivation compels them to sell their land to moneylender at a very low price.

Other significant human or personal risks in rural Bangladesh are dowry to be given to the son-in-law, accident of family members, death of family head etc. are very much inter related with poverty. Each risk can lead farmers to poverty (Figure 2). Strong and effective management strategies can help farmers to build their assets. Therefore, we describe below a detailed procedure of risk management in agriculture, with management strategies development.

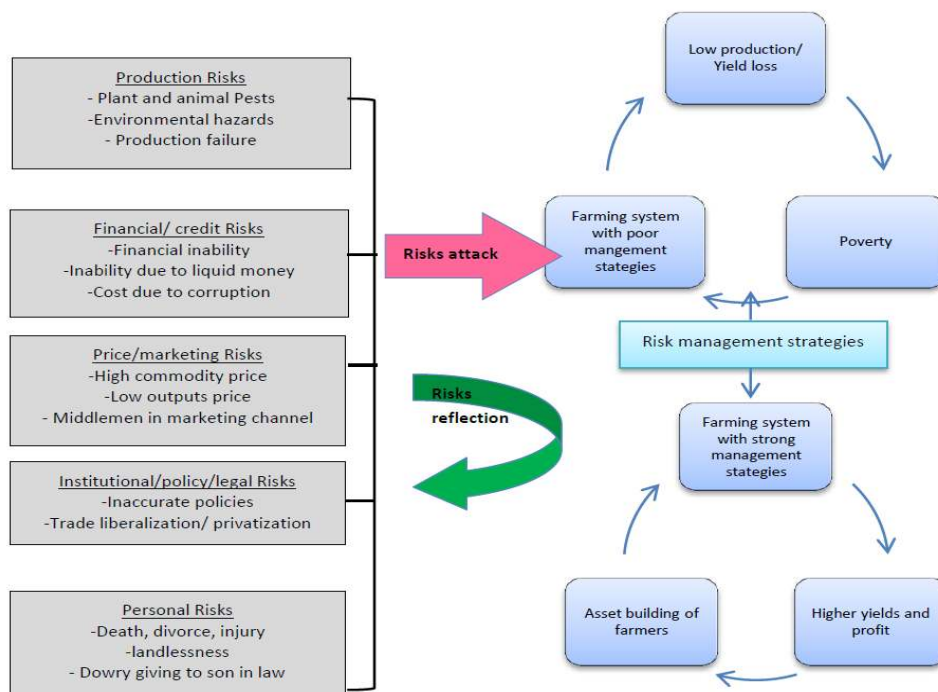


Fig. 2. Risks in agriculture and poverty
Source: Original material of the study

3. PART III: MANAGING THE RISKS

Risk management is a complex procedure. It involves a number of steps, including identification and organization of risky events [53].

Risk management includes five steps: i) establishing the context; ii) identifying the risks; iii) analysis of the risks; iv) risk assessment; and v) risk management [54, 55].

Establishing a context refers to identifying the farms' capabilities: the strengths, weaknesses and opportunities, as well as the overall environment. The context of a particular risk can be found by asking different questions, for example: i) what might happen? ii) why and how it might happen? iii) Finally, how the organization might be affected? [56]. **Identifying the risks** can be implemented by taking interviews with different actors who are playing roles in the particular context. After identifying risks it is needed to **analyze the risks** by classification of the risks into low or high probability and its consequences [56]. Different qualitative and quantitative research methodologies are relevant to examine the risks in agriculture: for example, checklists risk map, risk ranking and simulations [53]. Bahrs (2002) in Schaper et al. [57] has introduced profit or loss statements or balanced sheet. Risk map is recognized as the standard methodological tool which is applicable to assess the risk in different sectors [58]. Risk mapping is the presentation of risks in a two-dimensional graph where different risks are placed to represent the extent of severity of risks.

Risk management can be possible only after proper **assessment of the risks** and then applying different treatment options for example ignorance, acceptance, reduction, avoidance and transfer of risks. Different options can be applicable on the basis of the target risk, and the treatment, if a particular strategy can provide more benefits in comparison with others [56]. Nguyen [59] confirmed that *the successful implementation of the risk management plan requires an effective management system which specifies the methods chosen, assigns responsibilities and individual accountabilities for actions, and monitors them against specified criteria*. Hoag & Hewlett [60] described ten steps in risk management under three broad heads. The steps are a) SRMP strategic stage; i) determine the financial health ii) determine risk preference iii) establish risk goals b) The SRMP tactical stage; iv) determine the risk sources v) identify management alternatives vi) estimate likelihoods, vii) rank management alternatives c) The SRMP operational stage viii) implement plans, ix) monitor and adjust, x) re-plan.

The Institute of Risk Management (IRM), in the UK, provided their own standard for **risk management**. The Institute considered the views of different bodies and expert's opinions. The model of risk management also considers the positive and negative opinions from the different contexts [61]. The model identifies the uncertainty and depth of knowledge of both internal and external contexts. The IRM risk management process is especially valuable for an organization. In PMBOK (Project Management Body of Knowledge) the process of risk management includes six steps [62] i) planning of risk management ii) identification of the risks iii) qualitative risk analysis iv) quantitative risk analysis v) planning of risk responses and vi) controlling risks. PRINCE 2 risk management procedure includes five steps [63] these are i) identification of risk, ii) assess the risks iii) planning for management iv) implementing decision and v) communication. Another renowned risk management standard is called Australian/ New Zealand Standard [64]. Their risk management process is widely accepted. All the risk management frameworks are based on organizational needs and not suitable for small scale farming like peasant farming in Bangladesh. Therefore, we suggested a framework that can be applicable small scale agriculture farming in Bangladesh or other similar situations.

Patrick & Musser [65], Patrick & Ullerich [66], Martin [67] described production, marketing and financial risk management practices. Production practices include purchasing farm equipment, storing farm output for several months, introducing plant protection programs, crop diversification etc. Marketing strategies include gathering market information frequently managing overall sales, managing the construct and so on. Financial strategies include engagement with off-farm activities, reduction of debt levels, and increasing cash asset.

OECD [68] recommends five important roles for government to minimize the risks in agriculture. These are i) government should take necessary policies regarding risk management and a holistic approach to maintain the overall risks, ii) risk management policies of a country should be on the basis of the identification of the catastrophic risks, iii) subsidy based insurance policy can mitigate the disaster risk, iv) government should have adequate facilities for free information database regarding risks, regulation authorities and adequate training facilities to mitigate the risks, and v) normal risks should not be controlled by the government, it can be managed by the farmers themselves, and therefore, minimum intervention should be applied to price and payments.

To design a risk management policy one needs to understand the risk management process, strategies and mechanism of the farmers to cope with the risks, including the distinction between

informal and formal risk management mechanisms and between *ex ante* and *ex post* strategies [69]. Arrangement of an individual's management options or organizations of risks by a community or a group are regarded as informal strategies. Whereas, formal strategies include market-based policies introduced by Government or other Government policies [70]. The *ex ante* strategies include the necessary action harm occurs prevalence. *Ex ante* strategies are divided into two categories [71]: i) on farm risk management strategies ii) risk sharing with others. Table 2 summarizes these classifications.

Table 2. Risk management strategies in agriculture

Ex Ante Strategies	On farm	Informal Mechanism	Formal Mechanism	
		-Avoiding exposure to risk -Crop diversification and intercropping -Pilot diversification -Diversification of income sources -Buffer stock accumulation of crops or liquid assets -Adoption of advanced cropping techniques (fertilization, irrigation, resistant varieties) Crop sharing informal risk pool	Market based	Publicly Provided
	Sharing risk with other		Contract marketing and future contracts insurance	
Ex post Strategies	Coping with shocks		Credit	-Social assistance -Social funds -Cash transfer

Source: World Bank [70]; Anderson [71]; Townsend [72]

Crop and income diversification are the most important risk management strategies in Bangladesh because they are effective and easy for the farmers to adopt. Other important strategies include adoption of suitable crop production technologies, pest-resistant and drought-tolerant crop varieties. Income skewing, precautionary saving and production or marketing are not so common in Bangladesh.

4. DISCUSSION

To manage the risks efficiently, the researchers have emphasized especially to identify and study the risks on a case basis. For this reason, the farmer needs to identify risks of particular aspects: for example, hybrid rice cultivation, through discussion with different level of actors who are involved with the matter.

After identification of the risks, it is needed to survey to prioritize the risks and identify the catastrophic risk sources. Both external and internal opinions are extremely important to prioritize the risks. Research and extension risks should prioritize with research and extension experts' views, while production risks are well known by the farmers. Therefore farmers' opinion is very much important to find out the risk in the production process.

Proper methodologies are important in risk prioritizing. As risk has two dimension (e.g. probability and consequences), so use of single dimensional scale for prioritization is quite illegitimate to measure the risks. Renn [73] defined "risk" as *the multiplication of the probability of an event's occurrence and its significance level of potentially unfavorable condition*. People sometimes mistakenly use Likert scale in measuring risk. Likert scale is a single-dimensional and gives only 5 to 9 different options of choice to the respondents. Thus, it is difficult to measure a real attitude of participants, particularly in risk measurement. Many of us believe that the scale has equal differences between two consecutive points (for example strongly agree=5, agree=4, no comment=3). However, Cohen et al. [74] argued that this is illegitimate to assume the same difference between two consecutive scale points (for example between 'strongly agree' and 'agree' as well as between 'agree' and 'no comment'). Another problem of Likert scale is that it is based on a closed format for the responses [75], therefore the scale forced to the respondents to choose from a given options [76].

Hodge and Gillespie [75] proposed another method of analyzing a ten point scale. In this scale, the values are defined as 0-10 and the respondents select according to their own judgments. Almadani [58] used this kind of scale to measure the risks sources in agriculture. To overcome the limitation of existing Likert scale, Li [76] suggested Likert scale based on fuzzy sets. Therefore, inclusion of scale with probability and consequences is very important to risk prioritization and fuzzy-Likert scale can be a suitable alternative for this. Rivza and Rivza [77] have applied a fuzzy-Likert scale to measure the risks.

All the risks are not equally important to control because catastrophic risk should be controlled immediately. Catastrophic risks can be obtained through periodization values. After identification of catastrophic risks, expert views are important to build the strategies. Finally suitable/ effective strategies can be obtained with another expert survey. Monitoring is important as the effectiveness of the strategies changes with time. Figure 3 presents the risk management framework in agriculture.

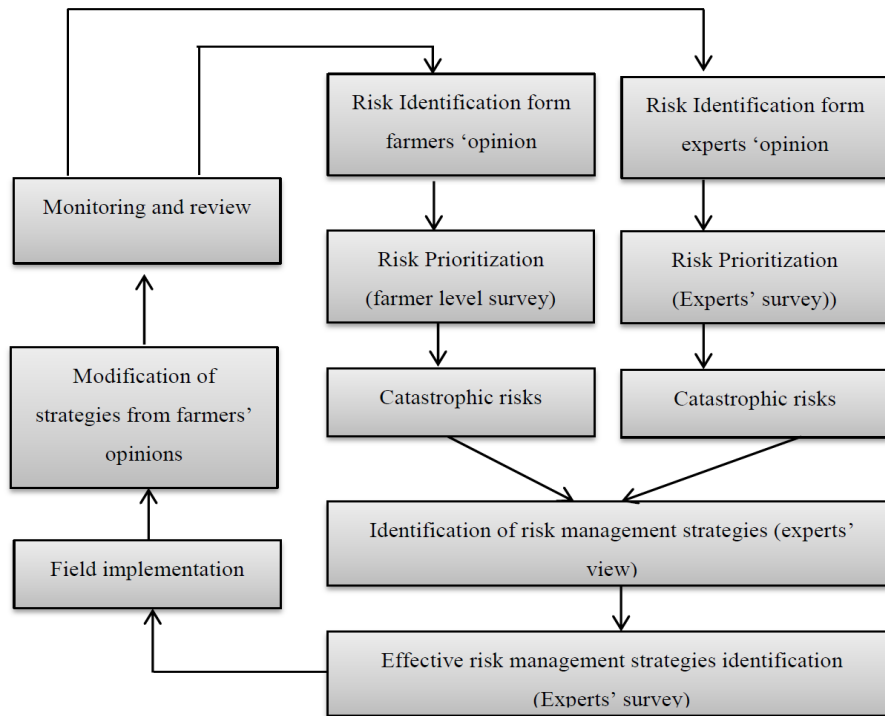


Fig. 3. The risk management framework
Source: Original material of the study

5. CONCLUSIONS AND RECOMMENDATIONS

Agricultural sectors play a vital role in the economy of Bangladesh. Due to diverse risks the sector is suffering hugely at different levels. Along with man-made risks the natural disaster and climate change-induced risks are matters of concern for Bangladeshi agriculture. These kinds of risks directly affect farmers' income as well as the national economy of the country. Therefore, effective strategies are needed to cope with the risks. The risk management strategies are very specific to a particular area and each risk needs very specific and well-defined management strategies.

A single management strategy is not equally applicable to all crops or all areas. Therefore, it is important to identify catastrophic risks first and then to develop situation-based management strategies. For these reasons, we need to follow a suitable risk management process.

Detailed study is needed for each and every risk. An appropriate risk management process must include opinions of all levels of actors. Policy makers, scientists and development specialists need to think about different risks those farmers are facing frequently. A wide range of research and appropriate policy are needed in this regard. The current study recommends a risk management framework that can be applicable to assess the diverse risks in agriculture and to manage them. Government should pay more attention to these risks and extension and field services should take their responsibilities to manage the risks in agriculture.

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