



A SYSTEMATIC REVIEW OF MULTIFACETED RISKS IN PADDY FARMING: DEVELOPING A COMPREHENSIVE RISK FRAMEWORK

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Article History

Received : 19 April 2025; Revised : 20 May 2025; Accepted : 27 May 2025; Published : 30 June 2025

Abstract: Paddy farming is a cornerstone of the agricultural sector, significantly contributing to employment generation, food security, poverty alleviation in rural communities, and national economic growth. However, this vital sector is threatened by multifaceted risks that undermine its sustainability. While existing literature broadly addresses agricultural risks, it disproportionately focuses on climate, production, and market risks, leaving property, personal, financial and institutional risks underexplored. Furthermore, there is a lack of comprehensive studies specifically identifying the diverse risks faced by paddy farmers. This systematic review aims to consolidate knowledge on risks faced by farmers, identify research gaps, propose a comprehensive risk framework and provide insights for future studies and policy development. Employing the PRISMA methodology, the review analysed literature from 2013 to 2023, sourced from Science Direct, Emerald Insight, Wiley Online, and Google Scholar. From an initial pool of 125 articles, a rigorous screening process identified 17 key publications. The findings categorise risks into seven groups: weather and climate, production, financial, personal, property, price or market, and institutional risks, further classified into internal (within farmers' control) and external (beyond their control) categories. This study offers a novel framework for understanding these risks and emphasises the need for targeted research on personal, property and institutional risks faced by paddy farmers. The framework provides

To cite this paper:

Chandrarathne WRPK, Perera DAM, & Gamage SK (2025). A Systematic Review of Multifaceted Risks in Paddy Farming: Developing a Comprehensive Risk Framework. *Indian Journal of Applied Economics and Business*. 7(1), 133-157. [https://DOI:10.47509/IJAEB.2025.v07i01.06](https://doi.org/10.47509/IJAEB.2025.v07i01.06)

stakeholders with actionable insights to develop risk management strategies that strengthen the resilience of paddy farmers and the broader agricultural sector.

Keywords: Paddy Farmers, Risk Framework, Risk Management, Systematic Review

1. INTRODUCTION

Paddy farming plays a crucial role in the global agricultural landscape, particularly in developing countries where it is central to food security, poverty alleviation, and rural employment (Merry & Calderon, 2022). In Sri Lanka, for example, paddy cultivation is the backbone of the agricultural sector, employing a significant portion of the rural population (Department of Census & Statistics, 2022; Ministry of Agriculture, 2020). Despite its importance, paddy farming is increasingly vulnerable to a multitude of risks, namely weather-related and environmental shocks, family-related shocks, banditry and crime, economic shocks and negative political, social or legal events (Rambukwella *et al.*, 2020; Department of Census & Statistics, Sri Lanka, 2019; Wickramasinghe, 2019; Galappattige *et al.*, 2011). This range of risks makes it critical for farmers to implement effective risk management strategies and significantly affect their household's welfare and income (Raithatha & Priebe, 2020). Risk in agriculture is, therefore, a significant, almost overwhelming topic.

The existing literature on agricultural risks predominantly focuses on climate-related, production, and price risks, while comparatively less attention has been given to financial, personal, property, and institutional risks (Komarek *et al.*, 2020; Atta & Micheels, 2020; Jankelova *et al.*, 2017; Kuzman *et al.*, 2017). Consequently, there is a notable gap in understanding the full spectrum of risks faced by paddy farmers. This gap hinders the development of a comprehensive risk framework that addresses the diverse risk exposures and vulnerabilities experienced by paddy farmers. This systematic review aims to bridge these gaps by consolidating existing knowledge, identifying underexplored areas, and proposing a robust framework to better understand and manage the multifaceted risks encountered in paddy farming.

2. BACKGROUND OF THE STUDY

Agriculture, particularly paddy farming, is the lifeblood of many rural economies, particularly in Asia. In Sri Lanka, agriculture accounts for a significant portion of employment, with paddy farming being central to the

nation's food production. (Ministry of Agriculture, 2020). However, the sector faces a variety of risks that jeopardise the livelihoods of farmers. These risks are not limited to natural hazards such as floods and droughts, but also include market volatility, financial instability, and institutional barriers (Rambukwella *et al.*, 2020; Wickramasinghe, 2019; Department of Census & Statistics, Sri Lanka, 2019; Galappattige *et al.*, 2011). In many rural areas, the absence of formal social protection mechanisms forces farmers to rely on informal risk-sharing strategies, which are often inadequate in the face of frequent and severe shocks (Ranathunga, *et al.*, 2018).

While there has been extensive research on agricultural risks, much of the focus remains on weather-related risks and production challenges, with less emphasis on other critical areas such as personal, property and institutional risks (Komarek *et al.*, 2020). These underexplored risks, particularly in developing countries like Sri Lanka, often exacerbate vulnerabilities and contribute to cycles of poverty (Chow, 2022; The ICMIF Foundation, 2021; Zen *et al.*, 2021; Ranathunga *et al.*, 2018; Liu *et al.*, 2013). Furthermore, existing studies lack a unified framework for categorising and analysing risks comprehensively faced by farmers, hindering effective policy development and risk management interventions.

This systematic review addresses these gaps by presenting a comprehensive risk framework that categorises risks faced by paddy farmers into seven distinct groups: weather and climate, production, financial, personal, property, price or market, and institutional risks. The framework also distinguishes between internal risks (those within farmers' control) and external risks (those beyond their control), offering a nuanced understanding of the risks faced by paddy farmers. By consolidating existing knowledge and identifying under-researched areas, this review provides valuable insights for future research and policy development aimed at strengthening the resilience of paddy farmers and the broader agricultural sector.

The findings of this review underscore the importance of considering all dimensions of risk, particularly property and institutional factors, in developing comprehensive risk management strategies. By doing so, it offers stakeholders, policymakers, and researchers actionable insights to enhance the resilience of paddy farming systems, ensuring their sustainability in the face of increasingly unpredictable challenges.

3. METHODOLOGY

This study adopted the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology to systematically identify and categorise the major types and sources of risk in the agricultural sector, covering literature from 2013 to 2023. Initial searches were conducted in Science Direct, Emerald Insight, and Wiley Online databases using the search strings “types of risk in agriculture”, “agricultural risk”, and “risk and risk management in agriculture”. Then supplemented by Google Scholar due to limited results on specific agricultural risks in the primary databases. The search initially yielded 125 articles, which were then screened and refined through multiple stages. First, articles not in English were excluded, leaving 103. Next, only journal articles and reports were retained, further reducing the selection to 78. This set underwent a title and abstract review to eliminate irrelevant topics, narrowing the count to 42 articles. Following a full-text review focused on specific inclusion criteria relevant to agricultural risk types, language, and publication type, the final selection was reduced to 17 key articles that directly contributed to the study’s aims. Key information was systematically organised into a data extraction table capturing details like author, publication type, topic, and risk type, while a PRISMA flow diagram (Figure 01) illustrated each stage of article selection for transparency. This systematic PRISMA-based review addresses a gap in the literature by providing a thorough analysis of agricultural risks, establishing a replicable methodology and supporting the development of targeted risk management strategies.

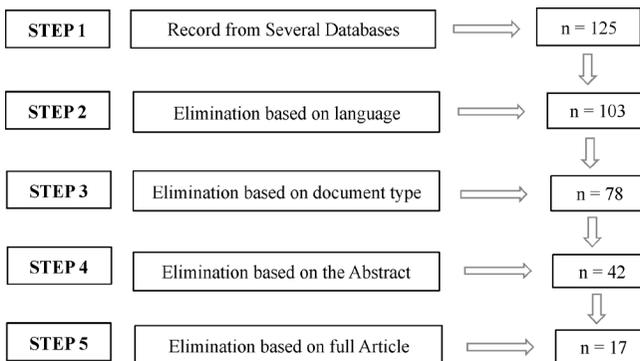


Figure 1: PRISMA flow diagram - Literature Elimination Process

Source: Developed by Author

4. TYPES AND SOURCES OF RISKS FACED BY PADDY FARMERS

The agriculture industry faces numerous recurring risks that disrupt production, financial stability, and the overall well-being of farming households. Agricultural risks refer to adverse events that negatively impact farming operations and livelihoods, often stemming from unpredictable sources such as climate variability, natural disasters, pests, and diseases. These risks are particularly pronounced in developing nations, where agricultural households are frequently exposed to shocks that lie beyond their control, leading to significant income losses and heightened vulnerability (Hardaker *et al.*, 2015). Given the multifaceted nature of agricultural risks, it is crucial to systematically categorise them to facilitate a better understanding and implementation of effective risk management strategies. Several studies have proposed classifications to organise these risks into distinct types and sources, providing valuable frameworks for policymakers and stakeholders to design targeted interventions.

Theuvsen (2013) identifies and classifies key agricultural risks into seven major categories: production, human resources, financial, production facility, market and price, political, and others. Figure 02 illustrates this classification of agricultural risks as outlined by Theuvsen (2013).

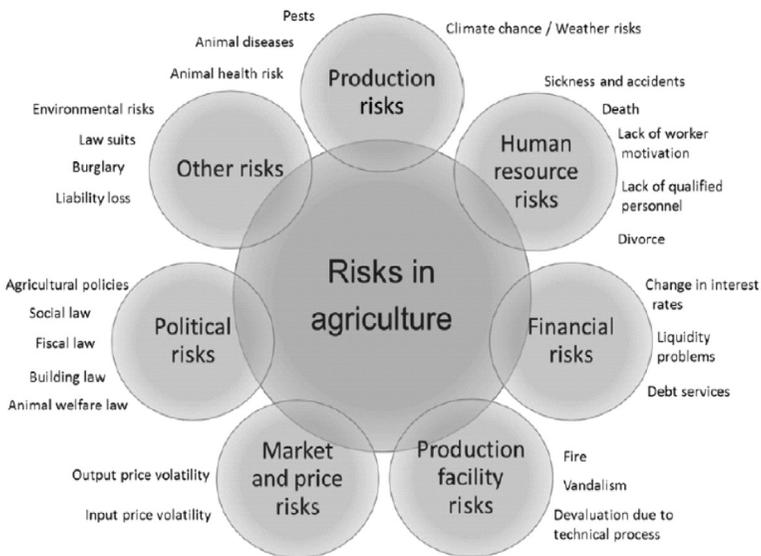


Figure 2: Risks in Agriculture

Source: Theuvsen (2013)

According to Kahan (2013), the main sources of risk in farming can be grouped into five categories: production, marketing, financial, institutional, and human. Climate change poses a serious threat to future food security, which makes it essential to discuss its implications for agriculture. Furthermore, Arias *et al.* (2015) in their report on *Risk Management for Family Agriculture in Latin America and the Caribbean*, grouped the main sources of risk in family farming into five categories: production, market, financial, institutional, and human.

According to the World Bank Group (2016), agricultural stakeholders face three primary categories of risk: production, market, and enabling environment risks. Each type of risk can vary in prominence depending on how the supply chain interacts with the market and its surrounding environment, potentially impacting specific segments or even the entire chain. Ullah *et al.* (2016) further expand on agricultural risks by identifying two major types: business risks and financial risks. Business risks encompass production, market, institutional, and personal risks, while financial risks stem from various approaches to financing agricultural operations.

Jankelova, *et al.* (2017) further classify risk factors into six groups: price risks (such as declines in output prices or increases in input costs), production or income risks (related to weather, animal diseases, output variability, crop diseases, and mechanical errors), institutional risks (involving policy changes, contract issues, and policy violations), financial risks (including capital costs, liquidity issues, share price declines, and exchange rate fluctuations), human or personal risks (from labour carelessness, life crises, and management proficiency), and property risks.

The European Commission (2017) identifies the primary risks faced by farmers as price risks, production risks, and income risks, each affecting different aspects of agricultural activities. Similarly, Polycarp and Jirgi (2018), in their literature review, highlight six key types of agricultural risks: production risk, market risk, financial risk, institutional risk, personal risk, and legal and environmental risk. Novickyte's (2018) article titled *Income Risk Management in Agriculture Using Financial Support*, offers theoretical insights on agricultural risks, risk management strategies, and the role of financial support in mitigating risks. She emphasises that agriculture is particularly risky due to its exposure to various external and internal conditions, with farmers facing multiple types of risk from production and market risks to financial

and institutional risks. According to Novickyte’s classification, production risks encompass climate conditions, biological and environmental hazards, and technological advancements. Financial risks include factors such as access to loans, insurance, credit stability, and capital structure. Institutional risks arise from political regulations, tax policy, trade regulations, and the broader legal framework. Lastly, market or price risks are attributed to fluctuations in agricultural product prices, interest rates, exchange rates, supply and demand shifts, and changes in income or profitability. Figure 03 illustrates the main agricultural risks identified by Novickyte (2018).

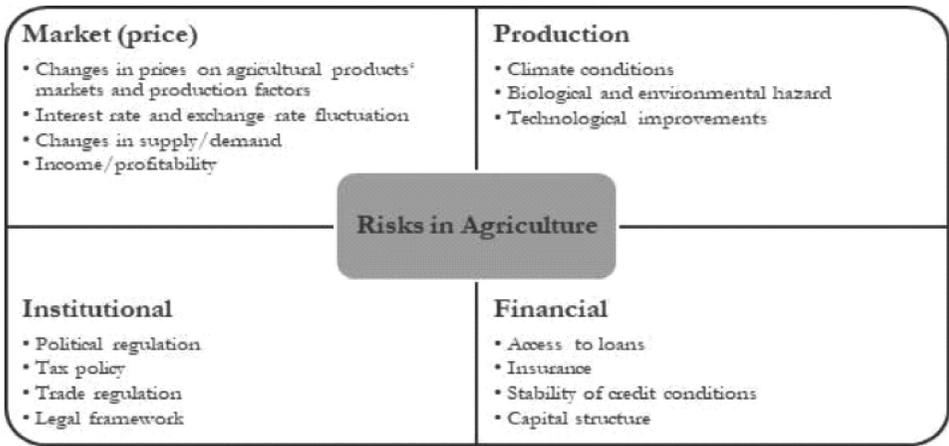


Figure 3: Risks in Agriculture

Source: Novickyte (2018)

A report by the Scottish Government highlighted the most common sources of risk in Scottish agriculture, using categories defined by the Organisation for Economic Co-operation and Development (OECD) in 2008. These categories include market/price risk, production/yield risk, institutional or regulatory risk, financial risk, and personnel risk (Thomas, 2018). Chavas (2019) contributed to this discussion by investigating the impacts of adverse shocks on agricultural production, with a focus on corn yield. His study finds that multiple sources of production risk—like weather shocks and unexpected pest damage—affect agriculture, and demonstrates how management practices and technology can mitigate exposure to adverse shocks and reduce the overall cost of agricultural risk.

In their study, Komarek *et al.* (2020) identified five primary types of agricultural risks: production, market, institutional, personal, and financial. They noted that relatively few studies have examined multiple sources of risk concurrently. Atta and Micheels (2020) used data from a 2017 survey of grain and oilseed farmers in Saskatchewan, employing best-worst scaling and latent class cluster analysis to assess farmers' perceptions of key risk sources and influencing factors. The study included 16 risk factors across marketing, production, financial, institutional, and personal domains. Among these, 'variations in product prices' and 'rainfall variability' emerged as the most significant risks, with other notable risks including changes in input prices, pest and disease outbreaks, accidents and health issues, natural disasters, and quality standards compliance. Through latent class cluster analysis, they classified risk factors into two clusters: financial and business risks, and production and marketing risks. Findings indicate that variations in product prices, input costs, and rainfall were the most prominent risks in the financial and business risk cluster, while rainfall variability, product price changes, and natural disasters led the production and marketing risk cluster. Vroege and Finger (2020) explored weather risks and potential insurance solutions to enhance the resilience of European agriculture to extreme weather, concluding that significant potential exists for new insurance options in crop and livestock production. Lastly, Bencova and Bohacikova (2021) reviewed the agricultural risk literature, discussing the main sources of risk, various quantification methods, and risk management strategies for agricultural enterprises. They categorised agricultural risks into five main types: production, credit, personal, political, and economic.

Dhillon and Moncur (2023) reviewed the literature to identify the major barriers faced by small-scale farmers and the potential opportunities offered by advanced technologies. Their review highlights key challenges, including economics, marketing, climate change, lack of awareness, limited educational resources, inadequate infrastructure, and insufficient information and technology. Abirami *et al.* (2023) conducted a study to identify the challenges farmers face in adopting farm mechanisation. Their research identified a wide range of obstacles, which they categorised into economic, environmental, extension-related, infrastructural, informational, operational, policy-related, situational, technological, and capacity-related issues.

4.1. Summary of the Literature

According to the literature, different authors and studies have their distinct categorisations of agricultural risk. Table 1 summarises the literature by using four columns, including author and year, type of source, research title, and types of risk.

Table 1: Summary of the Literature

<i>Author and Year</i>	<i>Type of Source</i>	<i>Research Title</i>	<i>Country/region</i>	<i>Types of Risk</i>
(Theuvsen, 2013)	Journal Article	Risks and Risk Management in Agriculture	Eastern Germany	production human resources financial production facility market and price political other
(Kahan, 2013)	Report	Managing Risk in Farming	Food and Agriculture Organisation of the United Nations (FAO)	production Marketing financial institutional human
(Arias, <i>et al.</i> , 2015)	Report	Risk Management for Family Agriculture in Latin America and the Caribbean	Latin America and the Caribbean	Production Market Financial Institutional human
(World Bank Group, 2016)	Report	Agricultural Sector Risk Assessment: Methodological Guidance for Practitioners	Niger, Ghana, Tanzania, Mozambique, Paraguay, Mongolia, Kenya, Senegal, Malawi, Rwanda, Kazakhstan, Tajikistan, Kyrgyzstan, Brazil (State of Paraiba), Brazil (State of Bahia)	production market environment
(Ullah, <i>et al.</i> , 2016)	Journal Article	Farm risks and uncertainties: Sources, impacts and management	Literature Review	Business risk Financial risk

<i>Author and Year</i>	<i>Type of Source</i>	<i>Research Title</i>	<i>Country/region</i>	<i>Types of Risk</i>
(Jankelova, <i>et al.</i> , 2017)	Journal Article	Risk factors in the agriculture sector	Slovakia	price production or income institutional financial human or personal property
(European Commission, 2017)	Report	Risk management schemes in EU agriculture: Dealing with risk and volatility	Europe	price production income
(Polycarp & Jirgi, 2018)	Journal Article	Dealing with risks and uncertainties in Agriculture: implications for the Central Bank of Nigeria interventions	Nigeria	Production Market Financial Institutional Personal Legal and Environmental
(Novickytė, 2018)	Journal Article	Income Risk Management in Agriculture using Financial Support	Europe	Production Market Financial Institutional
(Thomas, 2018)	Report	Risk management in agriculture	Scotland	Market/price Production/yield Institutional or regulatory Financial Personnel
(Chavas, 2019)	Journal Article	Adverse Shocks in Agriculture: The Assessment and Management of Downside Risk	US	Production risk
(Komarek, <i>et al.</i> , 2020)	Journal Article	A review of types of risks in agriculture: What we know and what we need to know	Literature Review	Production Market Institution Personal financial
(Atta & Micheels, 2020)	Journal Article	Identifying risk in production agriculture: an application of best-worst scaling	Saskatchewan	marketing, production, financial, institutional, and personal financial and business risk cluster, Production and marketing risk cluster

<i>Author and Year</i>	<i>Type of Source</i>	<i>Research Title</i>	<i>Country/region</i>	<i>Types of Risk</i>
(Vroege & Finger, 2020)	Journal Article	Insuring Weather Risks in European Agriculture	Europe	Weather risks
(Bencova & Bohacikova, 2021)	Journal Article	How to deal with the global concept of Risk in Agriculture? Comparative overview of the literature	Literature Review	Production Credit Personal Political economic risk
(Dhillon & Moncur, 2023)	Journal Article	Small-Scale Farming: A Review of Challenges and Potential Opportunities Offered by Technological Advancements	Literature Review	Economics Marketing climate change lack of awareness educational resources infrastructure Information and technology
(Abirami , <i>et al.</i> , 2023)	Journal Article	Pioneering Challenges: Exploring Multifaceted Obstacles in Agricultural Mechanisation in Tamil Nadu, India	India	economic, environmental, extension-related, infrastructural, informational, operational, policy-related, situational, technological, and capacity-related obstacles

Source: Developed by Author

Based on the literature review, the researcher categorised the multifaceted risks faced by farmers into seven main categories. Five of these categories, production risk, financial risk, human or personal risk, price or market risk, and institutional risk, are widely recognised in the literature (Komarek *et al.*, 2020; Thomas, 2018; Ratas & Nurmet, 2017; Pervez *et al.*, 2016; Arias *et al.*, 2015; Kahan, 2013; Hardaker *et al.*, 2004). Production risks mainly arise from unpredictable weather events, pest and disease attacks (biosecurity), technological constraints and wild animal attacks. Financial risk consists of loans and interest rates and relates to the financing of farms. Human or personal risk is associated with farmers in the event of death, illness, injury, disability,

or divorce. Price or market risk includes input and output price fluctuations and any market shocks. Institutional risk comprises unfavourable government-enforced changes in policy, rules, taxes, and regulations.

Weather-related risks are indeed among the main risks faced by farmers (Ankrah *et al.*, 2021). These risks can have a significant impact on agricultural productivity (Acharya, 2007), crop yields, livestock health, and food security (Duong *et al.*, 2019). Therefore, considering its importance, weather and climate risk are categorised as one group of risks. Another major type of risk in agriculture is property risk (Jankelova *et al.*, 2017). Therefore, it was also considered in this study, and a total of seven main categories of risk were identified. Then we separated these risks into two groups: internal and external, as shown in Figure 04. The first group is formed by the risks that farmers have the power to prevent or mitigate by themselves, and the second group is formed by the risks arising from factors of the external environment over which farmers have no control.

4.2. Internal and External Risk

Risks that households have the power to prevent or mitigate by themselves are grouped as internal, and they include production risk, financial risk, human or personal risk, and property or asset risk. The risks arising from factors of the external environment over which households have no control are categorised as external, and they include price or market risk and institutional risk.

4.2.1. Weather and Climate Risks

One of the main risks faced by farmers is weather and climate change (Arifah *et al.*, 2022; Duong *et al.*, 2019). Adverse weather and climate conditions are out of a farmer's control and also have significant importance not only among field crop farmers but also among livestock farmers. Agricultural producers might face different kinds of climate risks, namely drought, hail damage, flooding, frosts and unseasonal weather, such as changes in the rainfall pattern (Ratas & Nurmet, 2017). At the time of cultivation, farmers do not know how much rain will fall, or whether there will be a hailstorm or drought. Sometimes low rainfall or drought may lead to low yields. Hail or heavy rains could damage or even wipe out crops. Farmers face great pain as a result of these occurrences since they cannot manage the loss of produce and agricultural income. In

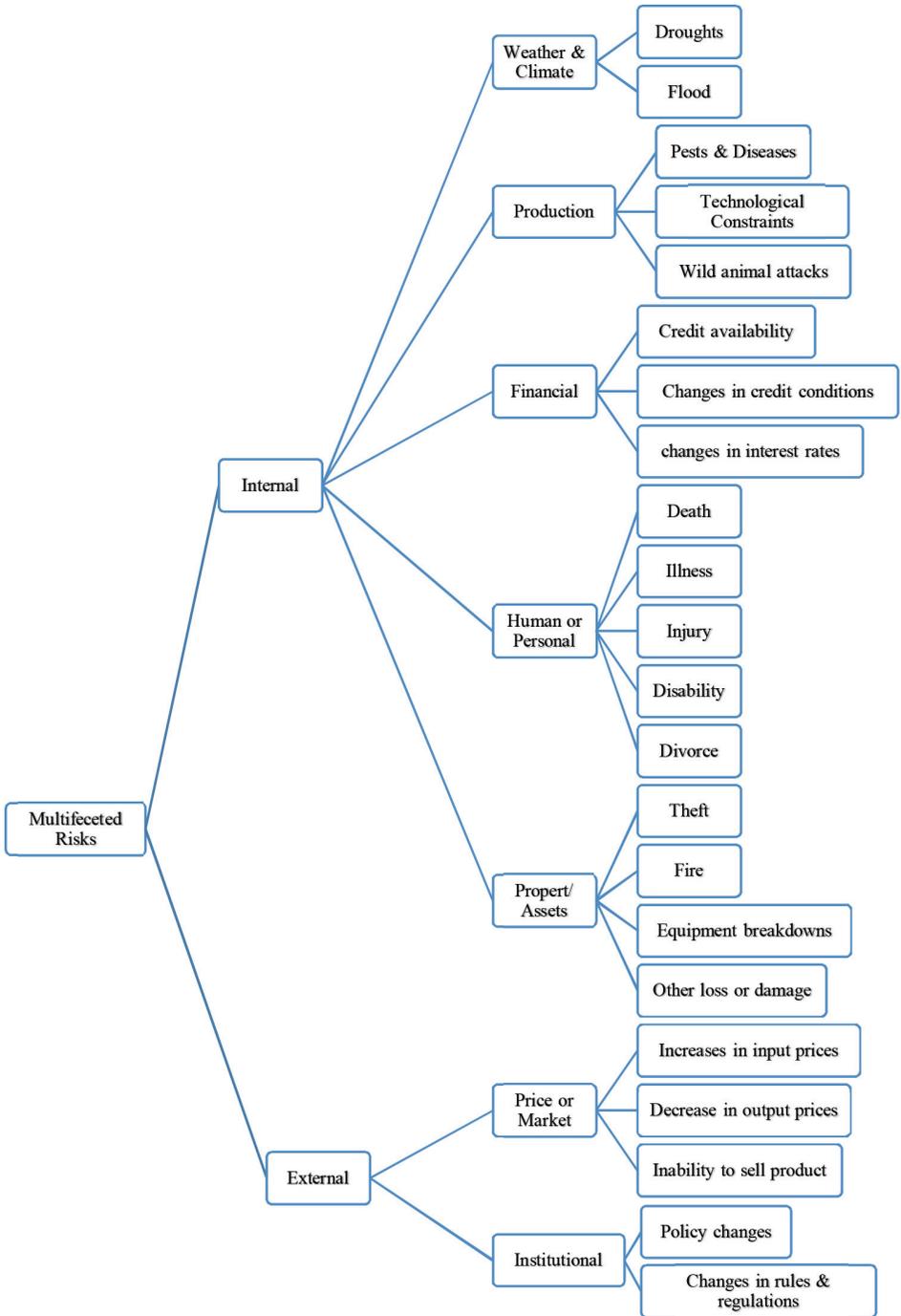


Figure 4: Framework for types and sources of risk faced by paddy farmers

Source: Authors developed based on literature review

Sri Lanka, climate change is rapidly occurring, and therefore, the country frequently faces more extreme weather conditions (Rambukwella *et al.*, 2020). Floods, excessive rainfall, lack of rain, and droughts are the major types of climate-induced risks in Sri Lanka. Further, drought is an almost annual phenomenon in many places in Sri Lanka, and it is seriously harming and financially depleting agricultural production as well as other economic and social activities like food consumption, the ability of farm households to invest, and rising healthcare costs (Prasanna, 2018).

4.2.2. Production Risks

Farmers, unlike most other business owners, cannot precisely predict the output of their production processes. As a result, agriculture is often characterised by high levels of production risk or fluctuations, which is considered one of the most significant risks affecting the sector (Atta & Micheels, 2020). Because of that, the majority of studies focused solely on production risk (Komarek *et al.*, 2020). Production risks are associated with factors that can impact crop yields and livestock production (Komarek *et al.*, 2020; Thomas, 2018). Accordingly, the production variability is mainly influenced by changes in pests and diseases (Atta & Micheels, 2020; Komarek *et al.*, 2020; Ratas & Nurmet, 2017), technological constraints (Duong *et al.*, 2019; Thomas, 2018), and wild animal attacks (Sumitha & Shaharban, 2022; Desai *et al.*, 2021; Ananya *et al.*, 2020; Kumar, 2018; Mehta *et al.*, 2018).

Outbreaks of pests or diseases could also cause major yield losses in crops and livestock (Tofu *et al.*, 2022; Hohl, 2018). Insects, worms, fungi, bacteria, viruses, birds, rodents, and occasionally other mammals are the numerous pests that can cause plant diseases (Polycarp & Jirgi, 2018). In general, pest infestations are less severe and more common during heading and ripening, although they can occasionally destroy an entire crop (Chatterjee & Oza, 2017). Therefore, farmers produce with uncertainty about their production.

Technology significantly influences the production risk in agriculture. New paddy seeds, chemical fertiliser, agro-chemicals, new farm machines, and developed irrigation systems are some of the new technological methods applied in the paddy sector. Paddy yield is mostly determined by these new production techniques, and implementing new technologies and innovations in rice cultivation offers potential to boost paddy production and farming

revenue for those who cultivate paddy (Bidzakin *et al.*, 2020; Awotide *et al.*, 2016). However, many reasons and barriers deter farmers from adopting the new farming innovations and techniques in cultivation (Karunathilaka & Thayaparan, 2016). These constraints hinder their ability to achieve optimal crop yields.

One of the main risks to lowering the crop yield in the field of agriculture is crop damage brought on by wild animal attacks (Sumitha & Shaharban, 2022; Desai *et al.*, 2021; Ananya *et al.*, 2020; Kumar, 2018; Mehta *et al.*, 2018). Farmers in the main agricultural districts of Sri Lanka face serious threats from wild animals. Compared to other wild animals, elephants are the most problematic. Additionally, animals, including monkeys, peacocks, wild boars, and rabbits, also harm crops (Sajla & Famees, 2021; Jayathilaka *et al.*, 2021).

4.2.3. Financial Risks

Financial risk is the probability of threats to the financial health and stability of the agricultural farm that stem from problems with liquidity (Jankelova *et al.*, 2017; Arias *et al.*, 2015; Kahan, 2013), leverage position (Atta & Micheels, 2020; Polycarp & Jirgi, 2018; Hardaker *et al.*, 2004), interest rate (Komarek *et al.*, 2020; Polycarp & Jirgi, 2018; Thomas, 2018; Kuzman *et al.*, 2017; Arias *et al.*, 2015), and asset control. Farmers do not need to depend on external sources to finance farm operations if they keep financial reserves. Therefore, financial risks are mostly incurred by farmers, who actually borrow money to finance production.

A lot of agricultural production cycles are lengthy, and farmers have to budget for anticipated expenses that they are unable to recover until the product is sold (Austin & Baharuddin, 2012). Consequently, in order to pay off debt and fulfil other financial commitments, farmers must finance their operations and maintain sufficient cash flow. Thus, a lack of liquidity creates financial risk (Jankelova *et al.*, 2017) and frequently appears as a precursor to financial issues. Short-term price drops or a one-year output glitch, such as a drought, can create liquidity issues. It means there is not enough cash for farmers to cover short-term expenses.

It is necessary to obtain loans to protect cash flow and productive assets. Therefore, financial risk is associated with leverage in addition to liquidity.

Excessive borrowing may create risk due to leverage (Polycarp & Jirgi, 2018). When debt levels are higher, the leverage becomes higher and can have a huge impact on overall financial performance. There is no financial risk owing to leverage if the farmer is not obtaining a loan and is 100% financed by himself. (Hardaker *et al.*, 2004).

Interest rate risk is another component of financial risk. When farmers borrow money at high interest rates, they may have to face particular difficulty in making debt repayments. Financial risk is exacerbated by this high cost of borrowing (Arias *et al.*, 2015).

Financial risk may arise, depending on the farmer's capacity to acquire or keep access to assets like land and equipment that are necessary to manage the business. Thus, asset control is also another factor contributing to financial risk. In addition, the unanticipated calling-in of a loan by the lender, restricted credit availability, higher cash demand for family needs, and lack of adequate cash or credit reserves are also aspects of financial risk (Hardaker *et al.*, 2004).

Production, marketing, and financial risks are interconnected, as the ability to repay debt relies on production levels and the price received for that production. Similarly, financing production and storing goods depend on access to capital (Kuzman *et al.*, 2017). However, the literature has paid less attention to financial risks compared to production and market risks, despite financial risks being of greater concern than personal risks (Komarek *et al.*, 2020).

4.2.4. Personal Risk

Personal risks are specific to an individual and relate to problems with human health or personal relationships that affect farm activity or the farm household's well-being. Personal or human risk mainly resulting from events such as death, disability, or serious illness of a family member, and injury (Komarek *et al.*, 2020; Polycarp & Jirgi, 2018; Kuzman *et al.*, 2017; Chatterjee & Oza, 2017; Jankelova *et al.*, 2017; Kahan, 2013; Girdziute, 2012). These health risks lead not only to higher medical costs or last-minute expenses but also to the need to hire outside labour, which can eliminate a farmer's profit margin. Nevertheless, farmers ignore these considerations, leaving them vulnerable to this rare but serious financial danger (Chatterjee & Oza, 2017). One of the most common causes of detrimental impacts on human health in family farming is the use of

pesticides (Komarek *et al.*, 2020). Due to the lack of information or the high prices, it is difficult for farmers to obtain less toxic products, and they also do not use safe pesticide equipment. As a result, they are exposed to pesticides, fertilisers, and other agrochemical products, and agricultural workers are affected by pesticide poisoning. Also, chronic kidney disease has become an endemic public health problem faced by farmers (Arias *et al.*, 2015). In addition, disease transmission between livestock and humans also affects the loss of health (Komarek *et al.*, 2020). Finally, these affect farm activity and the household's well-being.

Human or personal risks may result from divorce too (Komarek *et al.*, 2020; Polycarp & Jirgi, 2018; Girdziute, 2012; Hardaker *et al.*, 2004). Family quarrels or divorces can have a significant negative effect on the ongoing viability and profitability of an operation by changing the value of property, reducing funding, and also bringing businesses into the loss zone (Kuzman *et al.*, 2017).

Furthermore, the changing objectives of individuals involved in farming may have significant effects on the long-term performance of the operation (Hardaker *et al.*, 2004). Retirement or old age is another form of personal risk if there is not enough replacement available in the sector (Kuzman *et al.*, 2017).

Compared to production and price risk, farmers are less concerned about health and personal risks (Atta & Micheels, 2020; Jankelova *et al.*, 2017; Kuzman *et al.*, 2017). Furthermore, compared to production and market risk, personal risk has received less attention in the literature. Only a limited number of studies examined personal risk (Komarek *et al.*, 2020). However, it is obvious that, as with other types of risks, these personal or human risks must be recognised and managed if the farming activities are to be successful.

4.2.5. Property or Assets Risk

Agricultural households have various properties. Houses and contents, machinery and equipment (tractors, ploughs, harvesters), and vehicles are some of them. Farmers face various property or asset risks that are related to theft, fire, and other potential losses or damages. These risks can have significant financial implications and may impact the farmer's ability to sustain their livelihood.

Producers might have to contend with possible loss of production due to breakdown or unavailability of agricultural equipment. When agricultural

equipment, such as a tractor, breaks down during the production season, farmers may be unable to harvest in time, which negatively impacts yields. Additionally, if a farmer relies on shared or hired equipment, they face the risk of equipment being unavailable when needed, further exacerbating production delays and losses (Girdziute, 2012).

Compared to other types of agricultural risk, there is very little literature on property risk, which has less importance (Jankelova *et al.*, 2017).

4.2.6. Price or Market Risks

Price or market risks arise from uncertainties in agricultural commodity prices and market conditions. Therefore, input and output price volatility (Thomas, 2018; Chatterjee & Oza, 2017; Jankelova *et al.*, 2017) and market access are considered the key aspects of price or market risk in agriculture (Komarek *et al.*, 2020; Novickytė, 2018; Polycarp & Jirgi, 2018; Austin & Baharuddin, 2012; Schaffnit-Chatterjee, 2010), Acharya, 2007).

Farmers experience fluctuations in prices that they receive for agricultural commodities, such as grains, oilseeds, and livestock. These fluctuations can be influenced by factors such as changes in supply and demand, weather conditions, global economic trends, trade policies, and geopolitical events (Komarek *et al.*, 2020; Arias *et al.*, 2015). As well, fluctuations in the prices of agricultural commodities can affect the income and profitability of farmers.

Agricultural producers have uncertainty about the prices they pay for inputs such as seeds, fertilisers, pesticides, and fuel. Fluctuations in the prices of inputs can affect the cost of production for farmers. Sudden increases in input costs without a corresponding increase in commodity prices can impact the profitability of farming operations.

Accordingly, the price of agricultural products is influenced by supply, demand, and production costs, which are subject to unpredictable market trends. The supply of a product is impacted by a combination of farmers' collective production decisions and external factors like weather that affect yields. Demand, on the other hand, is shaped by consumer preferences, income levels, the overall strength of the economy, and the supply and price of competing products (Kuzman *et al.*, 2017). The cost of production per unit is determined by both input costs and yield. Although input costs are typically less variable than output prices, when combined with fluctuating yields, production costs

become a significant source of risk. Price fluctuations may sometimes follow predictable seasonal or cyclical trends, but more often, unexpected changes in supply or demand cause market prices to shift unpredictably.

Another kind of market risk arises in the process of delivering production to the marketplace. Producers may find their efforts hindered if they are unable to get perishable goods to the appropriate market at the right time. Absence of mature markets and infrastructure makes it a major source of risk (Austin & Baharuddin, 2012).

4.2.7. Institutional risk

Another significant source of uncertainty for farmers is institutional risk. Institutional risks arise from unexpected changes in policies, regulations, or institutional frameworks that affect farming activities. These changes can be introduced by the government or other formal and informal institutions, potentially disrupting agricultural operations and decision-making processes (Komarek *et al.*, 2020).

The government can introduce risks by making unpredictable changes to policies and regulations. For example, tax laws, regulations governing chemical use, animal waste disposal rules, and the level of price or income support payments are government decisions that can significantly impact agricultural production or trade (Polycarp & Jirgi, 2018). Farmers have limited control over these changes. Due to these changes in government policies and regulations, farmers might have to face issues in regard to obtaining seeds, other agrochemicals, and fertiliser on time. On the other hand, the quality of fertiliser also impacts their production. A recent example is the Import and Export Regulations No. 7 of 2021, implemented by the Sri Lankan government, prohibit the importation of chemical fertilisers and other agrochemicals. Because of that, cultivated paddy extent was reduced by 5%, and on average, there was a 53% yield loss of paddy per acre (Bandara *et al.*, 2022). Considering this paddy reduction and the recommendation of the Department of Agriculture on the usage of fertiliser, the fertiliser subsidy policy of the government for paddy cultivation has been changed to a “70% chemical and 30% organic fertiliser policy” in the 2022/23 Maha Season from a “100% organic fertiliser policy” (The Ministry of Finance, Economic Stabilisation & National Policies, 2022). The success and impact of such

policies often depend on factors such as adequate support mechanisms, farmer education, and the availability of alternative inputs.

Trade regulations represent another significant institutional risk for agricultural households. Shifts in both national and international trade policies can directly influence farmers' production decisions and the prices they receive for their goods. For instance, in response to rising rice prices, the Sri Lankan government reduced the Special Commodity Levy (SCL) on rice imports starting November 2, 2021, to ensure affordable rice availability in the market. However, in December 2022, the government suspended import control licenses for all rice types except Basmati, citing sufficient domestic rice stocks and an anticipated increase in production during the 2022/2023 Maha Season (The Ministry of Finance, Economic Stabilisation & National Policies, 2022). This back-and-forth illustrates how changes in trade regulations can disrupt planning for farmers.

5. CONCLUSION

This systematic review provides a comprehensive examination of the multifaceted risks faced by paddy farmers, addressing a critical gap in the literature that previously prioritised climate, production, and market risks while neglecting financial, personal, property, and institutional challenges. By consolidating research spanning a decade (2013–2023), this study categorised risks into seven distinct groups: weather and climate, production, financial, personal, property, price/market, and institutional risks and further classified them into internal and external risks.

A novel aspect of this review is its identification of under-explored risk areas, such as property risks, which are often overshadowed by the more extensively studied climate, production, and market risks. Highlighting these less-researched areas opens avenues for deeper, targeted inquiry into how property and institutional risks impact agricultural households differently across various contexts. Moreover, the distinction between internal and external risks adds nuance to risk management, suggesting that strategies should account not only for the types of risks but also for the degree of control that farmers can exercise over them.

The findings have significant implications for future research, underscoring the need to examine property risks and other specific factors more closely and

within diverse agricultural settings. By exploring how these risks interact with more commonly recognised issues like climate variability, future research can help shape more comprehensive and resilient agricultural policies. This gap also suggests that research on the interdependence of risks, such as how financial risks may be influenced by climate shocks, could yield actionable insights for a more integrated risk response.

Practically, this review provides stakeholders farmers, policymakers, financial institutions, and insurers with a refined framework to assess and prioritise agricultural risks. Recognising that some risks are more susceptible to mitigation through proactive measures, while others are influenced by external forces, allows for more effective risk management planning. For instance, insurers and policymakers could develop tailored risk management solutions, such as risk-transfer products for external risks and improved support systems for internal risks, to address the unique needs of agricultural communities.

In summary, the systematic approach and classification presented in this review not only advance the understanding of agricultural risks but also lay the groundwork for more resilient and adaptable risk management strategies in the agricultural sector. This refined framework and the identified research gaps provide a robust foundation for future studies and practical applications aimed at enhancing the sustainability and resilience of agricultural households worldwide.

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