

Modes, Challenges and Opportunities for Risk Management in Modern Agri-Food Chains

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This paper presents a holistic approach for analyzing and improving risk management in modern agri-food chains. First, it specifies the diverse (natural, technical, behavioral, economic, policy, etc.) agri-food risks and the alternative (market, private, public and hybrid) modes of their management. Second, it defines the efficiency of risk management and identifies (personal, institutional, dimensional, technological and natural) factors of governance choice. Next, it presents the stages in the analysis of risk management for the improvement of public intervention in risk governance. Finally, it identifies contemporary opportunities and challenges for risk governance in agri-food chains.

Introduction

Around the globe, the issues of management of diverse (natural, market, criminal, policy, etc.) risks in the agrarian and food sectors are among the most topical in academic, business and policy debates (Weaver and Kim, 2000; Babcock, 2004; Shepherd *et al.*, 2006; OECD, 2008; Olsson and Skjöldebrand, 2008; Ramaswami *et al.*, 2008; Deep and Dani, 2009; Schaffnit-Chatterjee, 2010; EU, 2011; Trench *et al.*, 2011; CIPS, 2012; and RPDRM, 2012). In the last decades, newly evolving uncertainty, risks and crises associated with the progression of natural environment, products and technology safety, social demands, policies, economy and globalization put additional challenges to the existing system of risk management in the agri-food sector.

Risks management studies in the agri-food sector predominately focus on technical methods and capability to perceive, prevent, mitigate, and recover from diverse threats and risks (Barker, 2005; Luning *et al.*, 2006; Jaffee *et al.*, 2008; DTRA and IIBR, 2011; and Hefnawy, 2011). In most economic publications, a neoclassical approach is applied. The risks are studied as other commodity, regulated by market supply and demand and farmers' 'willingness to pay' for an insurance contract in relation to agents' risk aversion, risk probability and magnitude of damages modeled (Gerasymenko and Zhemoyda, 2009; and OECD, 2011). Market and private failures are acknowledged, and the need for public intervention in risk management is increasingly recognized. At the same time, risk management analyses largely ignore a significant 'human nature'-based (bounded rationality, opportunism) risk, critical factors for the managerial choice such as the institutional environment and transaction costs, and diversity of alternative (market,

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private, collective, public, hybrid) modes of risk management. As a result, the efficiency and complementarities of risk management modes cannot be properly assessed.

Despite significant advancement in risk management technologies and the 'menu' of risk reduction, mitigation and coping strategies, a great number of failures and challenges (production, supply chain, food and human safety, environmental, etc.) continue to persist in the agri-food sector (Humphrey and Memedovic, 2006; Luning *et al.*, 2006; Dani and Deep, 2010; EU, 2011; and OECD, 2011). Consequently, greater attention is directed to the system of governance which eventually determines the exploration of technological opportunities and the state of agri-food security (Bachev, 2010 and 2011c).

This paper incorporates the interdisciplinary new institutional economics (Coase, 1937 and 1960; Williamson, 1981 and 1996; North, 1990; and Furuboth and Richter, 1998) and presents a comprehensive framework for analyzing risk management in the agri-food sector. First, it specifies the type of agri-food risks and the modes of their management. Second, it defines the efficiency of risk management and identifies factors of governance choice. Next, it presents stages in analysis of risk management for the improvement of public intervention in risk governance. Finally, it identifies contemporary opportunities and challenges for risk governance in the agri-food chain. The ultimate goal is to improve the analysis of risk management in the agri-food sector, and to assist public policies and risk management strategies and collective actions of individual agents.

Agri-Food Risks and Modes of Risk Governance

Risk in the agri-food sector is any current or future hazard (event) with a significant negative impact(s). It is either idiosyncratic, accidental, low probability, unpredictable event, or systematic—high probability and 'predictable' event.

Risk and threat could be of natural (e.g., adverse weather, insect attack, catastrophic event), technological ('pure' technical failures), or human origin (individual or collective actions/inactions, 'human nature'), or a combination of them. The individual behavior and actions causing risks may range from: agent's ignorance (lack of sufficient knowledge, information and training); risk-taking (retention) strategy of individuals (accepting 'higher than normal' risk); mismanagement (bad planning, prevention and recovery); deliberate opportunistic behavior (pre-contractual cheating and 'adverse selection', and post-contractual 'moral hazard'); criminal acts (stealing property or yields, arson and invasion on individual safety); terrorist attacks (contamination of inputs and outputs aimed at 'mass terror'), etc.

The collective actions which are the source of risks are commonly related to: economic dynamics and uncertainty (changing demand, market price volatility, international competition, market 'failures' and disbalances such as 'lack' of labor, credit and certain inputs); collective orders ('free riding', codes of behavior, industry standards, strikes and trade restrictions, community rules and restrictions); or public order (political instability and uncertainty, evolution in the informal and formal social norms and standards), public

'failures' such as bad, delayed, under/over intervention, law and contracts enforcements, mismanagement, 'inefficiency by design'), etc.

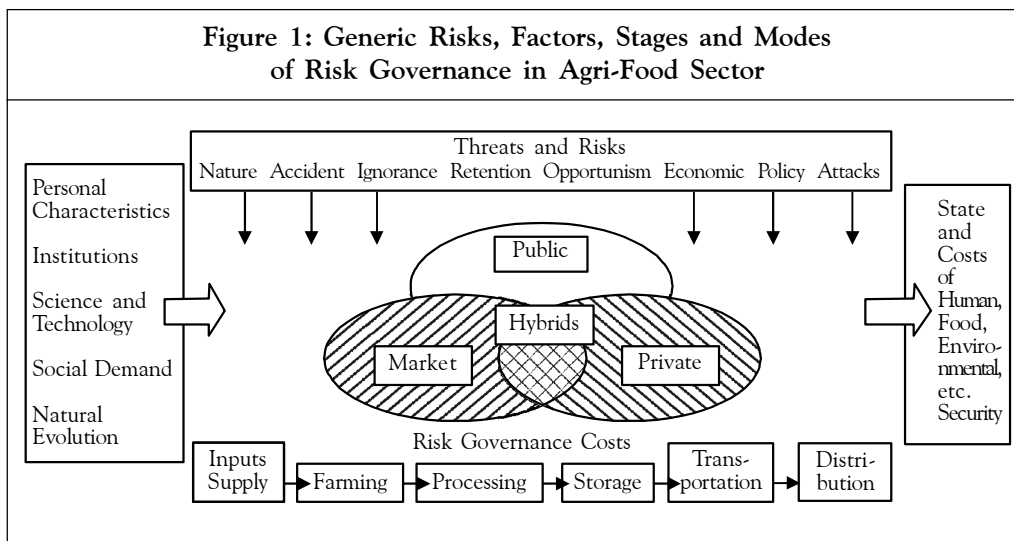
The agri-food sector risk could be faced by an agri-food sector component (e.g., risk on a dairy-farm, food processor, trader, etc.) or it could be caused by the agri-food sector (risk from farming, food processing, food distribution, etc.). Risk could be internal for agri-food chain such as hazards caused by one element to another element, and staying in or mitigating within the sector. It could also be external associated with the hazard coming from outside factors (such as natural environment, government policy and international trade), and/or affecting external components (consumers, residents, industries and nature). Finally, the risks could be private, when it is taken by individuals, collectives, entities, industries; or it is often public affecting large groups, communities, consumers, society and future generations.

The risk is big when there is a great likelihood of a risky event to occur and that is combined with substantial possible negative consequences. The latter may take a great variety of forms—damaged human and livestock health and property, inferior yields and income, lost market positions, food and environmental contamination, etc. When risk is considerable, it would likely be associated with significant costs which sometimes are hardly expressed in monetary terms—e.g., human health hazards, degraded soils, lost biodiversity and ecosystem services. Thus the 'rational' agents maximizing own welfare will be interested to invest in risk prevention and reduction.

In a narrow (technical) sense, risk management comprises individual, collective and public action(s) for reducing or eliminating risk and its negative consequences. In a broader sense, risk management is the specific system of social order (governance) responsible for a particular behavior(s) of agents and determining way(s) of assignment, protection, exchange, coordination, stimulation and disputing diverse risks, rights, resources and activities (Bachev, 2011c). In a particular socioeconomic, technological and natural environment, the specific system of risk governance 'put in place' is intimately responsible for the efficiency of detection, prevention, mitigation and reduction of diverse threats and risks and their negative consequences.

The generic forms and mechanisms of risk governance are (Figure1):

- Private Modes (Private and Collective Order): Diverse private initiatives, and specially designed contractual and organizational arrangements tailored to particular features of risks and agents—codes of behavior, diverse (rational, security, future, etc.) contracts, cooperatives, associations, business ventures, etc.
- Market Modes (Invisible Hand of Market): Various decentralized initiatives governed by free market price movements and market competition such as risk trading (selling and buying insurance), future contracts and options, production and trade of special (organic, fair-trade and origins) products.



- **Public Modes (Public Order):** Various forms of third-party public (government, international) intervention in market and private sectors such as public information, regulation, ban, assistance, funding, assurance, taxation and provision.

Sometimes, risk management in the agri-food sector could be effectively done through ‘self-management’—e.g., production management, adaptation to industry and formal standards, ‘self-insurance’ through keeping stocks, financial reserves, etc. For instance, primitive forms of on-farm risk management by improving production management are widespread such as control and security enhancement, appropriate (pest, disease and weather resistant) varieties, technology and production structure, product diversification, dislocation etc. Similarly, off-farm enterprise (income) diversification is a major strategy for risk management in most of the European farms (Bachev and Tanic, 2011).

However, very often, risk management requires an effective governance of relations with other agents—exchange and regulation of rights, alignment of conflicts, coalition of resources, collective or public actions at regional, national and transnational scales. Accordingly, a risk could be ‘managed’ through a market mode (e.g., purchase of insurance, and hedging with future price contingency contracts), a private mode (contractual or literal integration and cooperation), a public form (state regulation and guarantee, compensation), or a hybrid combination of other forms.

Efficiency of Risk Management

Individual modes of risk governance are with unequal efficiency since they have dissimilar potential to reduce likelihood and impact of risk and command different costs (Bachev, 2010). Principally, the market or collective governance has bigger advantages over the internal mode (own protection) since they allow the exploration of

economies of scale and scope in risk prevention and bearing (sharing) negative consequences¹. However, the risk trading and/or sharing is often associated with significant transaction costs for finding best partners, prices, formulating and disputing terms of exchange, coalition, safeguarding against new risk from opportunistic behavior of counterparts or partners, etc. Consequently, the market and private sectors 'fail' to effectively govern the existing and likely risks in the agri-food sector, and there is a need for a 'state intervention' in risk management (assisting farmers cooperation, public costs-sharing or provision, mandatory insurance regulation, etc.). Thus 'governance matters' and applying a proper structure of risk management is an important part of the overall process of the optimization (effective allocation) of resources.

Following Coase's logic (1960), if property rights were well-defined and transaction costs were zero, then all risks would be managed in the most efficient (socially optimal) way independent of the specific mode of governance². Then individual agents would either sell out their risk to a specialized market agent or safeguard against the risk through terms of a private contract, or join a risk-sharing organization of interested parties. The risk-taking would be distributed (exchanged or shared by) agents according to their will, while the total costs for risk prevention, assurance, reduction and recovery are minimized. The rational choice for an individual agent would be to get rid of a significant risk altogether—to sell the risk out to a specialized market agent (a risk-taker). Such market governance would optimize risk-taking and minimize the 'technological costs' for risk assurance and recovery, exploring the entire potential for economies of size and scope at the national or transnational scales.

However, when property rights are not well defined or enforced and transaction costs³ are high, then the type of governance is essential for the extent and costs of risk protection. For instance, an internal (ownership) mode is often preferred because of the comparative protective and cost advantages for 'standard' natural or behavioral risk management over the outside (market or contract) modes. What is more, frequently, the enormous transaction costs could even block the development of the insurance market or the emergence of mutually beneficial (collective) risk-sharing organizations. It is well known that despite 'common' interests and the huge potential for risk minimization, collective organizations for risk-sharing are not or hardly developed by stallholders.

Furthermore, the formal and informal institutional restrictions could make some modes of risk governance impossible—e.g., risk causing monopolies and/or cartel arrangements are illegal in many countries, while most entrepreneurial risk-taking is

¹ Most studies on risk management in agriculture focus on modeling farmers' 'willingness to pay' for a risk contract in relation to risk's probability and amount of likely damages (e.g., Gerasymenko and Zhemoyda, 2009).

² In such a world, some kind of risks would not even exist or be of no importance—e.g., risks related to adverse human behavior.

³ Transaction costs are the costs associated with the distribution, protection and exchange of diverse rights and obligations of individual, groups and generations (Bachev, 2010).

endorsed (the 'low risk – low profit' principle). Thus, not all modes of risk governance are constantly feasible in any socioeconomic setting⁴.

What is more, individual agents differ significantly in their capacity to recognize, take, pay for prevention, and manage a risk. For instance, a risk-taking farmer prefers risky but more productive forms, e.g., bank credit for a new profitable venture. Besides, individual agents have quite different interests for effective management of a particular risk(s) since they get unlike benefits and costs from risk management.

Last but not the least, there is no single universal form for management of diverse risks, and according to the specific feature of each risk (origin, probability, likely damages), there will be a different, most effective form of governance. For instance, while low probable 'standard' (natural, criminal) risk could be effectively governed by a classical market contract (purchase of insurance), most behavioral risks require special private modes (branding, long-term or interlink contracts, vertical integration), a high damaging risk from terrorist attack necessitates specialized public forms (intelligence, security enforcement), etc.

Hence, depending on the kind and severity of the risk and the interests and personal characteristics of individuals, and the specific natural, economic and institutional environment, there will be different (most) efficient forms of governing a particular kind of risk. Consequently, some governance mix will always exist to deal with diverse risks associated with the agri-food sector (Bachev and Nanseki, 2008).

In many cases, an effective risk management leads to a considerable reduction or removal of a particular type of risk. However, often complete risk elimination is either very costly ('unaffordable' by individuals or society) or practically impossible (when uncertainty associated with future events is enormous, the transaction costs are very high). For instance, certain natural risk will always exist despite the available system of management. Besides, it is practically impossible to write a 'complete' contract (e.g., for insurance supply and trading risk) including all probable future contingencies, and subsequent rights and obligations of each party. Subsequently, some transacting risk will always be retained. Therefore, an effective risk management is always connected with the need for some trade-off between the benefits from reducing a particular risk (saved costs and minimized impacts) and the related costs for risk governance⁵.

Furthermore, an individual mode of governance could offer an effective protection from different (multiple) risks. Besides, an effective management of one type of risk might be associated with the exposure to a new type of risk/costs—e.g., vertical integration eliminates the 'market risk', but creates a risk from opportunism of partners. Moreover,

⁴ Nevertheless, if costs associated with illegitimate forms are not high (possibility for low disclosure, insignificant enforcement and punishment) while benefits are considerable, then more effective governance prevails—large gray or black economies are widespread around the globe.

⁵ Thus some 'uncovered' risk would normally remain.

the level of (overall) risk exposure is typically determined by the 'critical' (most important) risk and the integral risk is rarely a sum of the individual risks.

Frequently, there are a number of possible (alternative) forms of governance of a particular type of risk—e.g., 'risk to environment' could be managed as voluntary actions of individual farmers, environmental cooperation, private contracts with interested parties, assisted by a third party organization, public eco-contact, public regulation, hybrid forms, etc. In certain cases, some forms of risk management are practically impossible or socially unacceptable—e.g., insurance markets do not develop many kinds of agro-food risks and private management is the only option; management of many environmental risks and challenges requires collective actions at local, ecosystem, regional or transnational levels. In modern societies many type of risks management are publicly imposed—e.g., food safety risk is under public management and harmonized in the European Union (EU); there are strict regulations on Genetically Modified Crops (GMC), 'precaution principle' is mandatory for environmental related projects and carried out by the state authority, 'safety nets' are organized as public projects, etc.

Therefore, a comparative analysis is to be employed to select among (technically, economically and socially) feasible alternatives the most efficient one—that which would reduce the overall risk to an 'acceptable' level, and which would require minimum total (risk assurance and risk governance) costs. The latter must include all current and future costs associated with risk management—the current technological and management costs (for adaptation, compliance, information and certification), risk insurance premium, contracting and coalition costs, as well as the long-term (future) costs for recovering damages, including associated transaction costs (disputes, expertise, law suits, etc.) for claiming experienced losses⁶.

In any case, an individual, group, community, sectoral, chain, national and international efficiency of risk management has to be distinguished. It is often when the elimination of risk for one agent induces a (new) risk for another agent—e.g., agri-food price fluctuation causes income risk to producers but benefits speculators; application of chemicals reduces risk for farmers, but produces significant negative effects (e.g., water, soil and air contamination) on residents, consumers, affected industries etc.

Furthermore, risk management is only a part of the overall governance of diverse (production, consumption, and transaction) activities of agents⁷. That is why the total efficiency (benefits, disadvantages, costs saving and risk minimization potential) of various modes for individual agents and public at large are to be taken into account⁸.

⁶ Most analyses of agri-food risk management usually ignore current and likely long-term transaction costs associated with the risk management.

⁷ E.g., most of the managerial innovations in farming and agri-food chain have been driven by transaction costs economizing reason (Sporleder, 1992).

⁸ Frequently, minimization of the risk-related costs is associated with an increase in production and/or transaction costs, and vice versa. Often risk elimination costs of one agent bring about a higher security for another agent in agri-food chain, etc.

According to a specific natural and socioeconomic environment, personal characteristics of individuals and social preferences, various structures of risk governance could evolve in different sub-sectors, industries, supply chains and societies. In one extreme, the system of risk management would work well and only the 'normal' (e.g., entrepreneurial) risk would be left 'ungoverned'. In some cases, market (free-market prices and competition) would fail to provide an adequate risk governance, but a variety of effective private modes would emerge to fill the gap—special contractual and organizational arrangements, vertical integration and cooperation. Often, both market and private governance may fail, but an effective public involvement (regulation, assistance, support and partnerships) could cure the problem.

Nevertheless, there are situations when the specific institutional and risk management costs structure would lead to failures of market and private modes as well as of the needed public (government, local authority, etc.) intervention in risk governance⁹. Consequently, a whole range of risks would be left unmanaged which would have an adverse effect on the size and sustainability of agri-food enterprises, market development, evolution of production and consumption, state of environment, and social welfare (Bachev, 2010). Depending on the costs and efficiency of the specific system of governance in a particular (sub) sector, region, country, supply chain, etc., there will be unlike outcome in terms of 'residual' risks and dissimilar state and costs of human, food, environmental, etc., security in different regions and period of time (Figure 1). For instance, when there is inefficient public enforcement of food, labor, environmental, etc. safety standards (lack of political willingness or administrative capability), then enormous 'gray' agrarian and food sector develops with inferior, hazardous and counterfeit components.

Factors of Governance Choice

The forms of risk management in agri-food sector depend on risk type, personal characteristics, institutional environment, progress in science and technology, culture, social education and preferences, evolution of natural environment, etc. (Figure 1).

Risk features like origin, probability of occurrence, likely damages, scale, etc. are important factors for the governance choice. For instance, local risk could be managed through a private mode while most of the market and environmental risks require collective actions at the regional, national or transnational level. For high probability and harmful risks, agents prefer more secure (more expensive) mode—security investment, purchase of insurance, keeping reserves, taking hostages and interlinked organizations. Nevertheless, due to lack of economic means, many small farmers cannot afford related costs and practice no or primitive forms of risk management—cash-and-carry deals, product diversification, etc. Here, there is need for a third party (government, and international assistance) intervention through insurance, support, safety net, etc. schemes to decrease farmers' vulnerability.

⁹ Principally, when market and private modes fail, there is a strong need for a public intervention in agriculture (Bachev, 2011b).

Personal and behavioral characteristics of agents (interests, preferences, knowledge, capability, risk-aversion, reputation, trust, 'contractual' power and opportunisms) are important factors for the choice of management form. For instance, some risks are not perceived (unknown) by private and public agents and therefore no risk management is put. In some cultures, the cooperative is the preferred mode of agrarian organization; experienced and trained farmers could design and manage bigger organizations (hired labor) and more outside (credit, insurance, inputs supply, etc.) contracts adapted to their specific needs; a risk-taking entrepreneur prefers riskier but more productive ventures, etc.

Behavioral factors such as individuals' bounded rationality and opportunism have been identified as responsible for the transaction costs and, thus, for the choice of organizational mode (Williamson, 1996). Agents do not possess full information about the economic system (risks, price ranges and dynamics, trade opportunities and policy development) since collection and processing of such information is very expensive or impossible (multiple markets, future events, partner's intention of cheating). In order to optimize decision making, they spend on 'increasing their imperfect rationality' (data collection, analysis, forecasting, training and consultation) and selecting forms minimizing related risks/costs (internal organization, 'selling out risk', etc.).

Agents are also given to opportunism, and if there is an opportunity for some of transacting sides to get non-punishably extra benefit/rent from exchange, they are likely to take advantage of that¹⁰. Pre-contractual opportunism (adverse selection) occurs when some of the partners use 'information asymmetry' to negotiate better contract terms. Post-contractual opportunism (moral hazard) occurs when some counterpart takes advantage of the impossibility for full observation on his activities (by another partner, or a third-party) or when he takes 'legal advantage' of unpredicted changes in exchange conditions (costs, prices and formal regulations). The third form (free ride) occurs in the development of large organizations where individual benefits are not proportional to individual efforts (costs) and everyone tends to expect others to invest in organizational development and benefit from the new organization in case of a success (Olson, 1969).

It is often costly or impossible to distinguish opportunistic from non-opportunistic behavior because of the bounded rationality (e.g., a farmer finds out that purchased seeds are not of high quality only during the harvesting time) and agents have to protect their rights, investments and transactions from the hazard of opportunism through: ex-ante efforts to find a reliable counterpart and design-efficient mode for partners' credible commitments; and ex-post investments for overcoming (through monitoring, controlling, and stimulating cooperation) of possible opportunism during contract execution stage (Williamson, 1996).

In agri-food sector, opportunism is widespread before signing insurance contract (not disclosing the real information for possible risks) or during the contract execution

¹⁰ If there is no opportunism only risk related to bounded rationality would remain (natural and technical) and consequences easily recovered with cooperation and mutual benefit (risk sharing) of all parties.

period (not taking actions for reducing damages when an event occurs; consciously provoking damages in order to get insurance premium, etc.). This considerably augments the insurance prices and restricts utilization of insurance contracts by small enterprises. On the other hand, an insuree often 'discovers' the pre-contractual opportunism of insurers only after the occurrence of harmful event, finding out that not all assurance terms (protected risks, extent of coverage of damages, ways of assessing damages and hidden costs) had been well explained and/or adapted to the farmers' needs.

For many kinds of farm-related risks, markets evolve very slowly and/or insurance services are practically inaccessible by a majority of small operators. What is more, for many important risks, insurance is not available 'for purchase at all'—e.g., risk of lack of market demand for farm products, fluctuation of prices, possible opportunism of counterparts, etc. That is why farmers have to develop other (private and collective) modes to safeguard their investments and rights or lobby for a public intervention in assurance supply.

The institutional environment (rules of the game)¹¹ is an important factor for the choice of management. For instance, in many countries, some forms of risk governance are fundamental rights (on food, labor, environmental security and safety) and guaranteed by the state; public income support to farmers is 'institutionalized'; environment and food safety standards could differ even between different regions in the same state, etc. Furthermore, the (external) institutional environment considerably affects the level of transaction costs—e.g., in recent years, tens of thousands of European farms and processors have been closed due to impossibility to adapt to (invest for) newly introduced EU standards for quality, safety, environmental preservation, animal welfare and certification.

Principally, in conditions of stable and well-working public regulation (regulations, quality standards, price guarantees and quotas) and effective mechanisms for laws and contract enforcement, a preference is given to standard (spotlight and classical) market contracts. When rights and rules are not well defined or changing, and absolute/contracted right effectively enforced, it leads to domination of primitive form of risk management (subsistence farming, personalized and over-integrated forms) and high vulnerability to diverse (natural, private, market, contractual and policy) risks. The latter was the case during post-communist transition in East Europe, characterized by fundamental restructuring, 'rules change' and ineffective public enforcement, high exposure to 'new' (natural, market, entrepreneurial, private, contractual, institutional, and international) risks by the evolving private structures, unsustainable organizations, large gray economies, undeveloped or missing (agrarian credit, insurance and extension supply) markets, individuals (e.g., thefts) and organized (providers of 'security service') risk introduction devastating private businesses and household welfare (Bachev, 2010).

¹¹ That is, formal and informal rights and rules, and the system(s) of their enforcement (North, 1990). They are defined by (formal, informal) laws, tradition, culture, religion, ideological and ethical norms, and enforced by the state, convention, community pressure, trust, or self-enforcement.

Dimensional characteristics of activity and transactions (combination of uncertainty, frequency, assets specificity and appropriability)¹² are critical for the management choice. When recurrence of transactions between the same partners is high, then both sides are interested in sustaining and minimizing costs of their relations (avoiding opportunism, sharing risk, building reputation, setting up incentives, adjustments and conflict resolution mechanisms). Here continuation of the relations with a particular partner/s and designing a special mode for transacting with a high economic value and costs for its development could be effectively recovered by frequent exchange. When a transaction is occasional (incidental), then possibility for opportunism is great since cheating sides cannot be easily punished by turning to a competitor (losing future business).

When uncertainty surrounding transactions increases, then costs for carrying out and securing transactions go up (for overcoming information deficiency and safeguarding against risk). Since bounded rationality is crucial and opportunism can emerge, agents will use a special private form of diminishing transaction uncertainty—trade with origins; providing guarantee; using share-rent or output-based compensation; obligatory collateral for providing a credit; participating in inputs-supply or marketing cooperative; and complete integration.

Transaction costs get very high when specific assets for relations with a particular partner are to be deployed. Here, costless alternative use of specific assets (loss of value) is not possible if transactions fail to occur, or are prematurely terminated, or less favorable terms are renegotiated (in contract renewal time before the end of the life span of a specific capital). Therefore, dependant investments/assets have to be safeguarded by special form such as long-term or tied-up contract, interlinks, hostage taking, joint investment and quasi or complete integration. Often, the latter is quite expensive. If investment in specific capital is not made, activity/transactions cannot take place or occur without (or loss of) comparative advantages with respect to productivity.

If a high symmetrical (risk, capacity, product, timing and location) dependency of assets of counterparts exists (regime of 'bilateral trade'), there are strong incentives in both parties to elaborate special private mode of governance (e.g., interlinking credit, inputs and insurance supply against marketing of output). A special relational contract is applied when detailed terms of transacting are not known at the outset (high uncertainty), and framework (mutual expectations) rather than specification of obligations is practiced. Here partners (self) restrict from opportunism and are motivated to settle emerging difficulties and continue relations (situation of frequent reciprocal trade).

When unilateral dependency exists (unwanted 'exchange', quasi or full monopoly), then the dependent side has to protect investments against possible opportunism (behavioral uncertainty/certainty) through integrating transactions (unified organization, joint ownership and cooperative); or safeguarding them with interlinked contract,

¹² First three factors are identified by Williamson (1996), and the forth added by Bachev and Labonne (2000).

exchange of economic hostages, development of collective organization to outstanding asymmetrical dependency (for price negotiation, lobbying for Government regulations, etc.).

Activity transacting is particularly difficult when appropriability of rights on behavior, products, services or resources is low. Because of the bounded rationality, the costs for protection, detection, verification, and a third-party (court) punishment of unwanted exchange is extremely high. Agents would either overproduce (e.g., negative externalities) or under-organize such activity (positive externalities) unless they are governed by efficient private or hybrid mode—cooperation, strategic alliances, long-term contract, trade secrets, or public order.

The progress in science and technology significantly improves risk management and facilitates diversification of its form. For instance, introduction of new (resistant) plant and livestock varieties; mechanization and standardization of operations and products; application of information, forecasting, monitoring, storage and transportation technologies—all improve risk management significantly in an agri-food chain (COST, 2009; and Hefnawy, 2011). Modern application of science and technology is also an application with production and/exposure to new type of risks—greenhouse gas emissions, genetic contamination, natural resource depletion and technical overdependency.

Finally, the evolution of natural environment—global warming, extreme weather, plant and animal diseases, drought, flooding and other natural disasters—poses a series of new challenges for risk management in agrarian and food sector (Hefnawy, 2011; and OECD, 2011).

Identification of the ‘critical factors’ of risk management choice, the range of practically possible forms and their efficiency (costs and benefits) for individual agents, stage, sub-sectors, countries, food chains and public are to be a subject for a special microeconomic study.

A comparative analysis is to be employed to select among the feasible forms the most efficient one, reducing the overall risk to an ‘acceptable’ level and minimizing the total (risk assurance and governance) costs. Most of the elements of the efficiency of risk governance are hard to quantify—e.g., the individuals’ characteristics, the amount of risk, the level of benefits and costs¹³ associated with each mode, etc. That is why a qualitative (discrete structural) analysis¹⁴ could be used. The latter matches the features of a risk to be managed (probability, significance, acceptance level and need for collective action) and its critical (institutional, technological, behavioral, etc.) factors with the comparative advantages (effective potential) of alternative modes to inform, stimulate appropriate behavior, and align interests of associated agents and to overcome, reduce, control, share, dispute, and minimize the overall costs of that risk.

¹³ E.g., ‘measurement problems’ associated with the transaction benefits and costs are well specified (Bachev, 2011b). They also prevent utilization of traditional (neoclassical) models simply by adding a new ‘transacting’, risk management, etc. activity (Furuboth and Richter, 1998).

¹⁴ Operationalization of discrete structural analysis of economic organization is done by Williamson (1981).

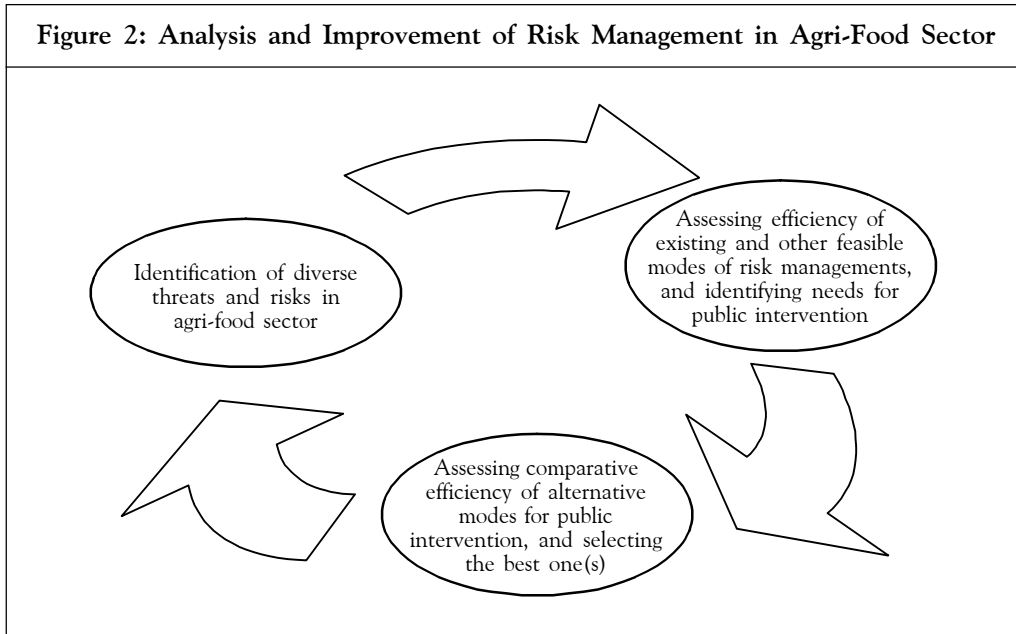
In a specific market, institutional, technological and natural environment, the effective risk governance choice will depend on a combination of risk features (probability of occurrence and likely magnitude of damages) and the critical dimensions of activity/ transactions (appropriability, assets specificity and frequency). Table 1 presents a matrix with the principal forms for effective risk governance in the agri-food sector. For instance, high 'standard' risk could be effectively managed through a free market mode such as a standard (classical) insurance, inputs supply, marketing, etc. contracts. However, serious transacting risk exists when condition of assets specificity is combined with high uncertainty, low frequency and good appropriability. Elaboration of a special governing structure for private transacting is not justified, specific (risk reducing) investments not made, and activity/restriction of activity fails to occur at effective scale (market and contract failure). Here, a third-party (private, NGO and public) involvement in transactions is necessary (assistance, arbitration and regulation) in order to make them as efficient as possible. The unprecedented development of special origins, organic farming, systems of 'fair trade' are good examples in this respect. There is an increasing consumer demand (price premium) for organic, original and fair-trade products associated with some forms of (natural, poor household, labor, quality, etc.) risk management. Nevertheless, their supply could not be met unless effective trilateral governance, including independent certification and control, is put in place.

Critical Dimensions of Activity				Appropriability				Low
				High				
				Assets Specificity				High
				Low		High		
				Frequency				
				Low	High	Low	High	
Severity of Damages	High	Probability/Uncertainty	Low	M/CC	M/CC	SC	VI	PO
			High	M/CC	SC	CO	CO	
	Low		Low	na	na	SC	VI	na
			High	M/CC	M/CC	TPI	VI	CO & TPI
Note: M – Free market; CC – Classical (standard) contract; SC – Special contract; VI – Vertical (internal) integration; CO – Collective organization, TPI – Need for a third-party involvement; PO – Need of a public organization.								

Stages in the Analysis and Improvement of Risk Management

The analysis and improvement of risk governance in agri-food chain is to include the following steps (Figure 2).

Figure 2: Analysis and Improvement of Risk Management in Agri-Food Sector



1. Identification of the existing and emerging threats and risks in the agri-food chain. Persistence of certain risks is a good indicator for ineffective management. Modern science offers quite reliable and sophisticated methods for assessing various risks to or caused by agri-food chain (DTRA and IIBR, 2011; and Trench *et al.*, 2011).
2. Specification of the existing and other feasible modes of risk governance, and assessing their efficiency, sustainability and prospects of development. Efficiency of individual modes shows capability for risk detection, prevention, mitigation and recovery at lowest costs, while sustainability reveals 'internal' potential to adapt to socioeconomic, technological and environmental changes and associated threats and risks. A holistic framework for assessing the efficiency and evolution of governing modes is suggested by Bachev (2010) and OECD (2011). That stage is to identify deficiencies of dominating (market, private, and public) modes to solve the existing and emerging risks, and to determine the need for (new) public intervention. For instance, when appropriability associated with transaction/activity is low, there is no pure market or private mode to protect from associated risks¹⁵. The emergence of a special large-member organization for dealing with low appropriability to cover the entire 'social' risk would be very slow and expensive, and it is unlikely that they can be sustained in the long run (free riding). Therefore, there is a strong need for

¹⁵ Respecting others' rights or 'granting' risk protection rights to others could be governed by 'goodwill' or charity actions (e.g., eco-sustainability movement initially evolved as a voluntary activity). In any case, voluntary initiatives could hardly satisfy the entire social demand, especially if they require significant costs.

third-party public intervention in order to protect against such possible or more effective risk—either pure public organization (e.g., public assurance for high damage natural or economic disasters) or ‘quasi public’ mode (collective organization assisted/ordered by a third party) for high probable lower damaging risks (Table 1).

3. Identification of alternative modes for public intervention to correct (market, private and public) failures, assessing their comparative efficiency, and selecting the best one(s). A comparative assessment is to be made on (technically, economically and politically) feasible forms as mode(s) minimizing the total risk management (implementing and transaction) costs selected. The analysis is to take into account the overall private and social costs—the direct and indirect (individual, third-party, tax payer, assistance agency, etc.) expenses, and private and public transacting costs. The latter often comprise a significant portion of the overall risk management costs and are usually ignored—e.g., costs for coordination, stimulation, mismanagement of bureaucracy; for individuals’ participation and usage of public modes (expenses for information, paperworks, payments of fees, bribes); costs for community control over and for reorganization of bureaucracy (modernization and liquidation of public modes), and (opportunity) costs of public inaction, etc.

Initially, the existing and emerging problems (difficulties, costs, risks and failures) in the organization of market and private governance have to be specified. The appropriate public involvement would be to create institutional environment for: making private investments less dependent, decreasing the uncertainty surrounding market and private transactions, increasing the intensity of exchange, protecting the private rights and investments. For instance, the state establishes and enforces quality, safety and eco-standards, certifies producers, regulates employment relations, transfers management rights on natural resources, etc., and all that increases the efficiency of the market and private risk management.

Next, practically possible modes for increasing appropriability have to be considered. The low appropriability is often caused by unspecified or badly specified private rights and obligations. In some cases, the most effective government intervention would be to introduce and enforce new private and groups (property) rights—on diverse type of risks and its trading; on natural and biological resources; on food safety and clean environment; tradable quotas for products, inputs, emissions; on intellectual property, origins, etc. That intervention transfers the organization of transactions into market and private governance, liberalizes market competition and induces private incentives (and investments) in certain agrarian risk managements.

In other instances, it is more efficient to put in place public regulations for risk minimization—for utilization of resources, products and services (standards for labor, product and environmental safety); introduction of foreign species and GM crops, and

(water, soil, air and comfort) contamination; ban on certain inputs, products or technologies; regulations for trading ecosystem service protection; trade regimes; mandatory risk and eco-training and licensing of operators.

In yet other instances, using incentives and restrictions of tax system is the most effective form of intervention. Different sorts of tax preferences are widely used to create favorable conditions for development of certain (sub)sectors and regions, forms of organization, segments of population, or types of activities. For instance, environmental taxation on emissions or products (inputs and outputs of production) is applied to reduce the use or emissions of harmful substances; tax reduction is used to overcome the negative consequences of natural disasters, etc.

In some cases, public support to private organizations is the best mode for intervention. Programs for modernization, enterprise adaptation, income support, environmental conservation, public risk-sharing, etc. are common in all countries. Often providing public information, recommendations, and training to farmers, entrepreneurs, residents, and consumers in risk management is the most efficient form.

In some cases, pure public organization (in-house production and public provision) is the most effective, as in the case of critical infrastructure; food safety inspections; research, education and extension; agro-meteorological forecasts; border sanitary and veterinary control; recovery from natural catastrophe, etc. Usually, specific modes are effective if they are applied alone with other modes of public intervention. The necessity of combined intervention (governance mix) is caused by: complementarities (joint effect) of individual forms; restricted potential of some less expensive forms to achieve certain (but not entire) level of socially preferred risk prevention and mitigation; possibility to get extra benefits (e.g., 'cross-compliance' requirement for participation in public programs); specific critical dimensions of governed activity; risk and uncertainty (little knowledge and experience) associated with likely impact of new forms; administrative and financial capability of government to fund, control and implement different modes; and dominating policy doctrine.

The level of effective public intervention (governance) also depends on the kind of risk and the scale of intervention. There are public involvements which are to be executed at the local (ecosystem, community and regional) level, while others require nationwide governance. And finally, there are risk management activities which are to be initiated and coordinated at the international (regional, European, worldwide) level due to strong necessity for transborder actions or consistent (national and local) government failures. Very frequently, effective governance of many problems and risks requires multilevel governance with a system of combined actions at various levels involving diverse range of actors and geographical scales.

The public (regulatory, provision and inspecting) modes must have built mechanisms for increasing competency (decreasing bounded rationality and powerlessness) of

bureaucrats, beneficiaries, interest groups and public as well as restricting possible opportunism (cheating, interlinking and abuse of power) of public officers and stakeholders. That could be made by training, introducing new assessment and communication technologies, increasing transparency and involving experts, beneficiaries and interest groups in the management of public modes at all levels.

Generally, hybrid modes (public-private partnership) are much more efficient than pure public forms, given the coordination, incentives, control and cost-sharing advantages. Involvement of farmers, beneficiaries and interest groups increases efficiency, decreases asymmetry of information, restricts opportunism, increases incentives for private co-investment and reduces management costs. For instance, enforcement of most labor, animal welfare and environmental standards is often very difficult or impossible. Stimulating and supporting (assisting, training and funding) private voluntary actions are much more effective than the mandatory public modes in terms of incentive, coordination, enforcement and disputing costs (Bachev, 2010).

If there is a strong need for third-party public involvement, but effective (government, local authority and international assistance) intervention in risk management is not introduced in due time, then significant risks to individuals and public at large would persist, while agrarian 'development' is substantially deformed.

Dealing with many problems and risks in the agri-food sector/chain would require multiform, hybrid, multilevel and transnational intervention and therefore, the appropriate governance mix is to be specified as a result of the comparative analysis. The latter improves the design of (new) public intervention according to the specific conditions of the food-chain components in a particular country or region in terms of increasing security and decreasing costs. Suggested new approach also predicts the likely cases of (new) public failures due to impossibility to mobilize political support and resources or ineffective implementation of otherwise 'good' policies in particular conditions. Since public failure is feasible, its timely detection permits foreseeing persistence/rising of certain risks and informing local and international communities about the consequences.

The risk management analysis is to be made at different levels—individual component (inputs supply, farm, processing, transportation and distribution), regional, sub-sectors, food-chain, national and international, according to the type of risks and scales of collective actions necessary to mitigate the risks. It is not a one-time exercise completing in the last stage with a perfect system of risk-management, but rather a permanent process which is to improve risk management along with the evolution of socioeconomic and natural environment, individual and communities' awareness, and modernization of technologies. Besides, public (local, national and international) failure often prevails, which brings us to the next cycle in the improvement of risk management in the agri-food sector.

For the application of the suggested new approach, besides the traditional statistical, and industry data, new type of data are necessary for diverse types of risks and forms of governance, their critical factors for each agent, level of related benefits and costs. Such data are to be collected through interviews with agri-food chain managers, stakeholders, and experts in the area.

Contemporary Opportunities and Challenges for Risk Governance in Agri-Food Chain

The modern agri-food chains involve millions of actors with different interests, multiple stages and diverse risks, requiring a complex, multilateral and multilevel governance on a large scale. For instance, the number of farmers in EU is several millions, different food-processors and retailers are several hundred thousands, while the number of final consumers is 500 millions¹⁶.

Various existing and emerging (natural, technological and behavioral) threats and risks along with the modern agri-food chains are well identified (Humphrey and Memedovic, 2006; DTRA and IIBR, 2011; and OECD, 2011).

Table 2: Major Risks and Modes of Governance Along with Modern Agri-Food Chain			
Risks	Modes of Governance		
	Market	Private	Public
Natural disasters and extreme weather; Pests and diseases; Improper use of pesticides and chemicals; Using contaminated water and soils; Improper animal health practices; Poor waste disposal; Using prohibited antibiotics; Using contaminated feeds; Animal-borne diseases;	Clientatli-zation; Direct marketing; Informal branding; Insurance purchase; Organic production; Specific origins; Brands; Ecosystem services; Special (quality, eco-) labeling; Outsourcing;	Improved inputs, technology, variety and structure of production; Product and income diversification; Self-insurance forms; Patronage and community insurance; Voluntary initiatives; Professional codes; Building (good) reputation; Guarantees;	Mandatory (products, process, labor, animal-welfare, environmental) quality and safety standards; Regulations/bans for using resources, inputs, technologies; Regulations for organic farming; Quotas for emissions and using products/resources; Regulations for introduction of foreign species/GMC; Regulations for plant and animal nutrition and healthcare; Licensing for using agro-systems and natural resources; Mandatory farming, safety, eco-training; Mandatory certifications and licensing; Compulsory food labeling and information;

¹⁶ Figures get much bigger if we take into account the total number of global agents involved in EU agri-food chain – farmers, processors, importers, etc., from around the world.

Table 2 (Cont.)

Risks	Modes of Governance		
	Market	Private	Public
Improper handling and storage; Poor cooling system; Poor sanitation and hygiene; Using unhygienic containers, processing units, and transport facilities; Improper grading and packaging; Using prohibited food-additives; Inputs, resources and output contamination; Chancing social demands; Market price fluctuation; Market failures; Political and institutional instability; Ignorance of agents; Opportunistic behavior of counterpart, collation partner, a third party or public officer; Criminal intrusion; Terrorist attacks	Security services; Fair trade system; Standards insurance contract; Hedging with future price contracts	Private producers labels and brands; Private traders labels and brands; Private and collective origins and specialties; Private products recalls; Long-term contracts; Interlink contracts (inputs and service supply against marketing); Inputs and service cooperatives; Production cooperation; Joint-ventures; Internal audits; NGOs; Professional and consumer associations; Good Agricultural Practice; Good Hygienic Practice; Good Manufacturing Practice; Good Transport Practice; Good Trade Practice; GLOBALGAP; Private and collective food quality and safety management systems; Certification;	Public accreditation and certification; Mandatory records keeping and traceability coding; Public products recalls; Public food, veterinary, sanitary, border control; Public price and income support; Public preferential crediting; Public funding farms and processors adaptation; Public safety nets and disaster reliefs; Financial support to organic production, traditional and special products, private and collective actions; National GAPs, cross-compliance requirements; Public education, information, advise; Designating vulnerable/dangerous zones; Tax rebates, exception, breaks; Eco-taxation (emissions, products, wastes); Public eco-contracts; Public food and security research/extension; Assistance in farmers, stakeholders, security cooperation; Public promotion/partnerships of private initiatives; Public food security monitoring, assessments, foresights; Public prevention and recovery measures; Public compensation of (private) damages; Disposal of (old) chemicals, degraded lands and water purification; Protected Designation of Origin, Protected Geographical Indication, Traditional Specialty Guaranteed; European Rapid Alert System for Food and Feed;

Table 2 (Cont.)

Risks	Modes of Governance		
	Market	Private	Public
		Licensing; Third-party verification; Inputs supply integration; Integration into processing and marketing; Franchises; Risk pooling and marketing cooperatives; Vertical integration; Consumers cooperatives	EU policies, support and enforcement agencies (EFSA, ECDC, ECHA, CFCA, OSHA, EEA); International Standardization Organization (ISO 22000); UN (FAO, WHO) agencies interventions (Codex Alimentarius; Early Warning Systems; Crisis Management centers); Bilateral and multilateral trading agreements/rules (WTO); National and international anticrime/antiterrorists bodies.

Diverse market and private modes have emerged to deal with specific risks driven by ethics, competition, consumer demand, business initiatives and trade opportunities—e.g., direct marketing, voluntary codes (professional, corporate, social, labor, environmental, etc. responsibility), industry standards, insurance schemes, guarantees, fair trade, trade with brands, origins, organic and quality products (Table 2).

Furthermore, different bilateral and multilateral private forms are widely used to safeguard against risks, explore benefits, and facilitate exchange—e.g., clientalization, contractual arrangements, cooperation and complete backward or forward integration.

Special trilateral forms have evolved to enhance security and partners and consumers confidence including independent (a third-party) certification and inspection. Trade internationalization is increasingly associated with collective private actions (standards, control mechanisms, etc.) at a transnational and global scale (e.g., GLOBALGAP).

Property (security and safety) rights modernization, and market and private ‘failures’ brought about the need and modes for public intervention (assistance, regulations and provision) in the agri-food sector. Moreover, the scope and stringency of publicly-imposed rules expand constantly embracing new products, methods, dimensions (human, animal, plant and eco-health), hazards (GMC, nanotechnology and terrorism), and information requirements.

Furthermore, globalization of exchange and threats and risks increasingly require the setting up of a transnational public order (e.g., International Organization for Standardization (ISO), World Health Organization (WHO), Food and Agriculture Organization (FAO) of the United Nations, and the World Trade Organization (WTO)).

For instance, there are common (traceability, precaution and communication) principles, (food, veterinary, phytosanitary, feed and environmental) legislation, and implementing and enforcing agencies (European Food Safety Authority (EFSA), European Center for Disease Prevention and Control (ECDC) and European Chemicals Agency (ECHA)) for agri-food chains in the EU (including imported products).

Consumers' concern about the food-safety risks significantly increases after the major food-safety 'events'/crises in recent years (e.g., Avian flu; Mad-cow and Foot-and-mouth diseases; poultry salmonella; contaminations of dairy, berries, olive oil; natural and industrial disasters impacts). For instance, since 2005, there had been augmentation of respondents 'worrying about food-safety problems' in the EU and it comprises a significant share now (Figure 3); as much as 48% of European consumers (in Bulgaria 75%) indicate that consumed food 'very or fairly likely' can damage their health (Eurostat, 2010).

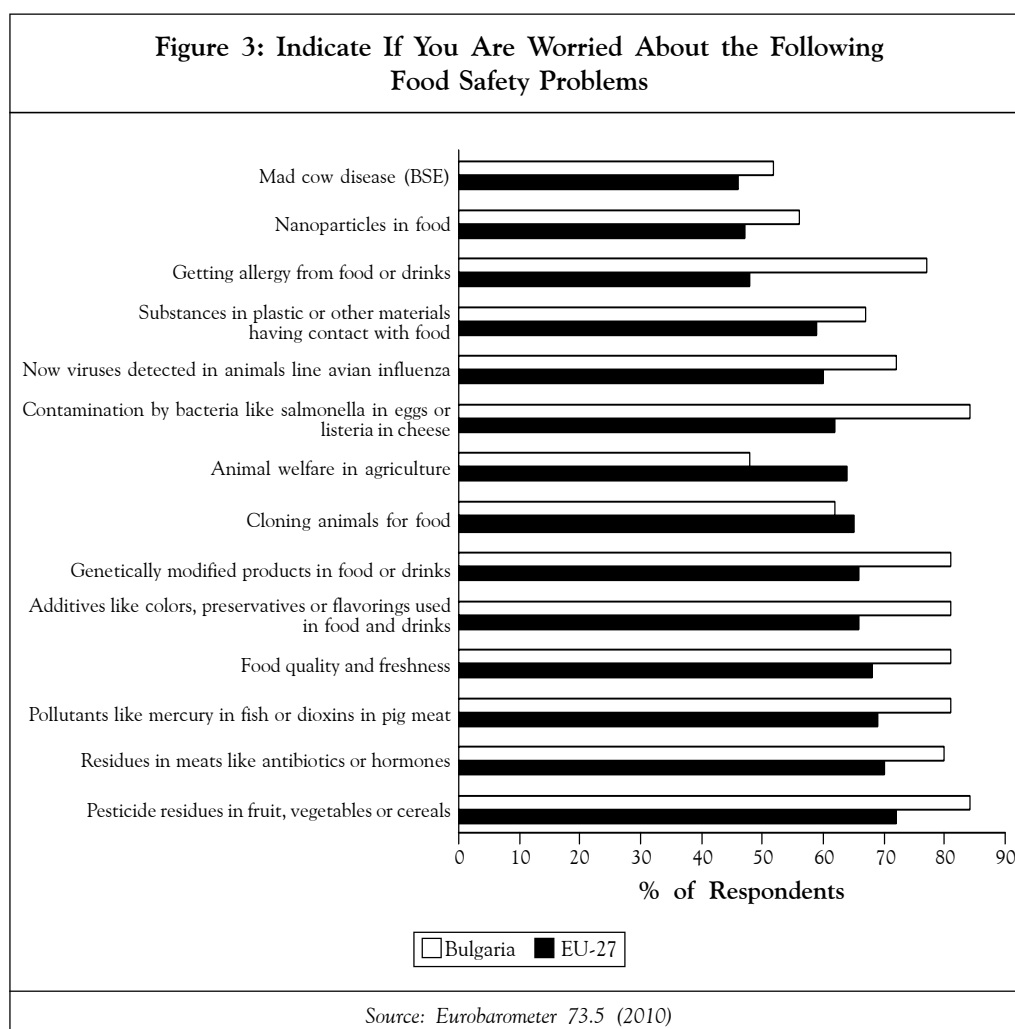
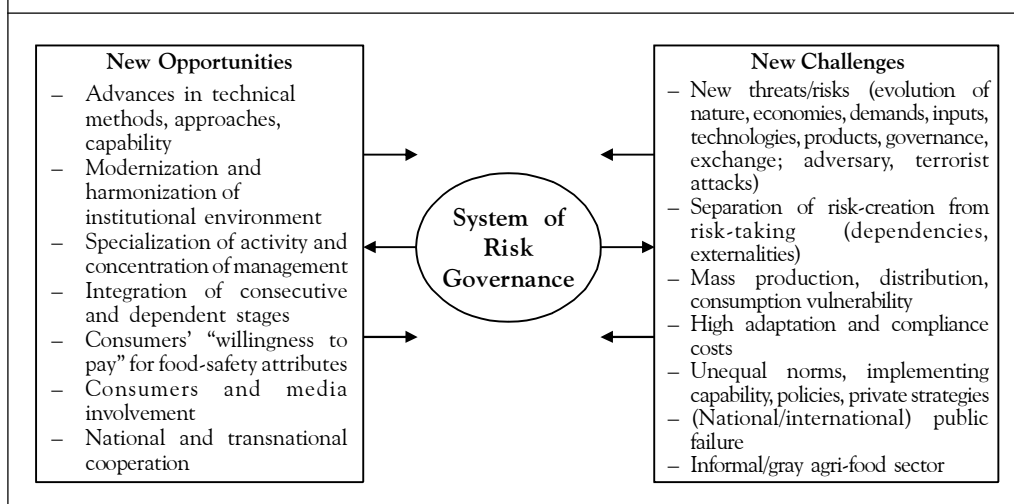


Figure 4: Opportunities and Challenges for Risk Governance in Agri-Food Chain



There are a number of (new) opportunities for risk governance in agri-food chain (Figure 4).

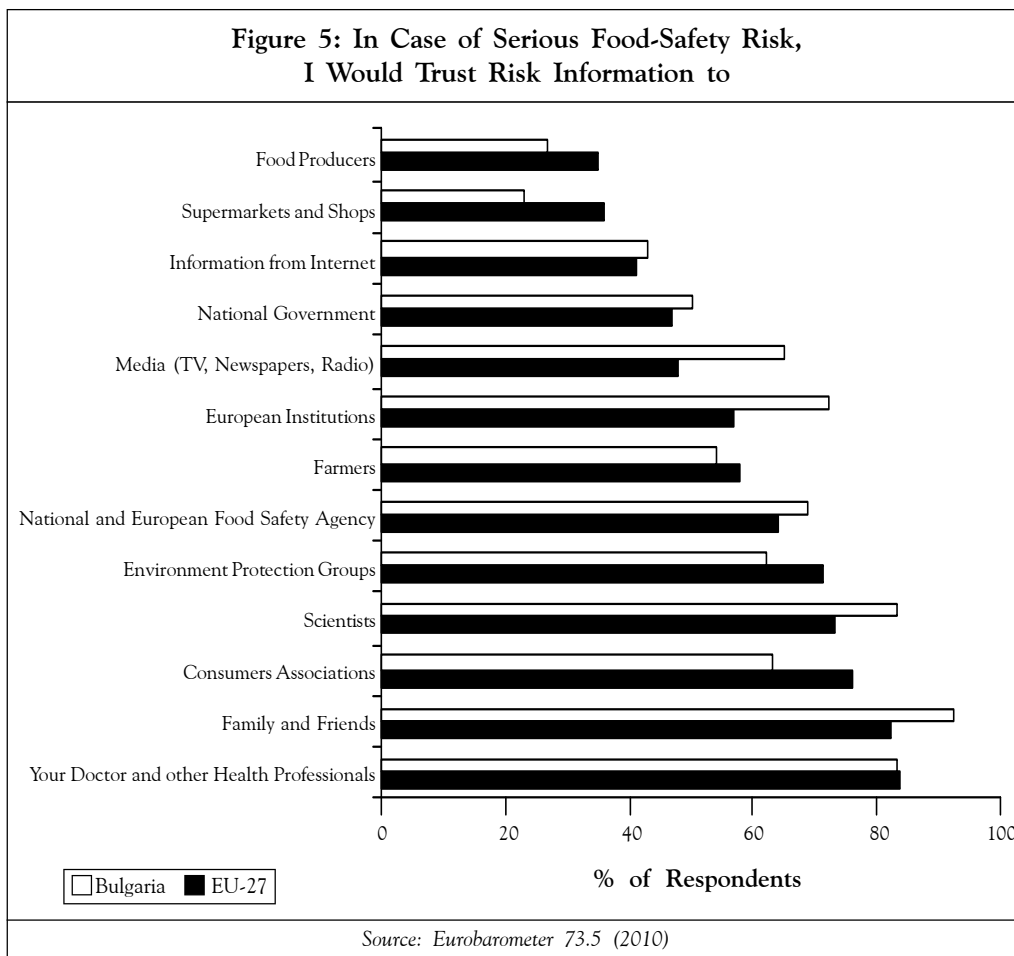
1. Advances and dissemination of technical food-chain, training and risk-management methods (microbiological, genetic, electrical, laser, robotic, immunological, chemical and biosensors, nanotechnology and ICT), integral and food-chain approaches, and research, monitoring, testing, decision, and foresight for risk-detection, assessment, prevention, and mitigation (COST, 2009; and Trench *et al.*, 2011). For instance, advancements in detection, assessment and mitigation methods, and technologies associated with biological and chemical risks have been presented at a recent international conference (DTRA and IIBR, 2011).
2. Modernization and international harmonization of institutional environment (private, corporate, collective, NGOs, public food-safety and related standards, rules, enforcements, etc.). For instance, EU membership improves considerably the 'rules of the game' in new member states; market access rules, and/or 'corporate responsibilities' induce agri-food sector transformation of exporting countries in Africa, Latin America and Asia.
3. Considerable development of specialization of activities (including risk-taking, monitoring and management) and concentration of (integral) management in food-production, processing, servicing and distribution—centralized innovation and enforcement; time, scale and scope of economies; easy third-party control, etc. For instance, the market share of the three largest food-retailers comprised between 27-91% in EU states (Eurostat); food-safety training, certification, inspection, and information are big international businesses (Humphrey and Memedovic, 2006).

4. Quasi or complete integration of food-chains' consecutive or dependent stages creating mutual interests, and effective and long-term means for risk-perception, communication and management. For example, in Bulgaria, (raw) milk supply is closely integrated by (dairy) processors through on-farm (collecting and testing) investments and interlink (inputs, credit and service supply against milk-delivery) contracts with stallholders, while dairy marketing is managed by branding and long-term contracts—standards and biolabels (Bachev, 2011a).
5. Increasing consumers 'willingness to pay' for food-safety attributes such as chemical and hormone bans, safety and inspection labels, original and special products, etc. (Trench *et al.*, 2011). The latter justify and make economically possible paying-back of costs for a special governance.
6. Growing consumer (representation and organizations) and media involvement, and national and transnational (information, technical, managerial, training and certification) cooperation of partners and stakeholders improving agents choice, inducing public and private actions, enhancing risk-management communication, efficiency and speed.

Modern development is also associated with a number of (new) challenges for risk governance in agri-food chain:

- Emergence of new threats, risks and uncertainties associated with the evolution of natural environment (e.g., climate change, water stress, 'new' plant, animal and human hazards, etc.) as well as new human induced economic, financial, food, food safety, water, environmental etc. crises on a large (transnational and global) scale.
- Increasing new threats, risks and uncertainty connected with the inputs, technologies and products differentiation and innovation—e.g., Fukushima nuclear accident severely affected the agri-food sector; there are uncertainties associated with the growing application of nanotechnologies and GMCs, etc. (Eurostat).
- Increasing specialization and concentration of activity and organizations which separate 'risk-creation' (incident, ignorance and opportunistic behavior) and risk-taking (unilateral dependencies, quasi monopolies, spillovers and externalities). That makes risk assessment, pricing, communication, disputing, and liability, through (pure) market and private modes very difficult and costly. For instance, cheating, misleading and pirating are common in food chain relations—high information asymmetry, detection, disputing and punishment costs (Bachev, 2010). It indicates that for food risk information, consumers in the EU trust more 'health professionals', 'family and friends', 'consumer associations' and 'scientists', rather than 'food producers' and 'supermarkets and shops' (Figure 5).

Figure 5: In Case of Serious Food-Safety Risk, I Would Trust Risk Information to



- Widespread mass production, distribution and consumption increase vulnerability of agri-food chain, expanding the scope and severity of natural, incidental, opportunistic, criminal or terrorist risks. For instance, in Europe, there is a progressive number of official notifications based on the market and non-member countries' controls, food-poisoning, consumer complaints, company own-checks, border screening and rejections (Eurostat).
- Increasing adaptation and compliance costs (capital, training, certification and documentation) for rapidly evolving market and institutional environment which delay or prevent reformation of smaller farms and food-chain enterprises (Bachev, 2010; and Trench *et al.*, 2011). For instance, in Bulgaria dairy and meat processors adaptation to EU standards had continued for 10 years, while two-thirds of them ceased to exist before the country's accession to the EU (Bachev, 2011a).
- Public and private food quality and safety standards and efficiency of their enforcement differ considerably between industries, countries, and regions

(Humphrey and Memedovic, 2006). That is a result of unequal norms (e.g., Good Agricultural Practices (GAPs), formal and informal rules) and implementing and enforcing capability, and/or deliberate policies or private strategies (e.g., multinationals sell the 'same' products with unlike quality in different countries). The 'double/multiple standards' are responsible for the inequality of exchange and dissimilar threats and risk exposure of individual agri-food systems.

- Widespread 'public failures' in food chain (risk) management—bad, inefficient, delayed, under or over interventions; gaps, overlaps, infighting and contradictions of different agencies and rules; high bureaucratic costs; unsustainable funding and underfunding, etc. For instance, the Bulgarian Food Agency was established after a five-year delay; the *Acquis Communautaire* are still not completely implemented in the country (capability deficiency, mismanagement and corruption); trust in the EU rather than the national institutions prevails (Bachev, 2010). There are numerous instances of international assistance or governance failures when institutions are 'imported' rather than adapted or designed for the specific local conditions (Bachev, 2010).
- Production, marketing and consumption traditions, the high food or governance costs, and the will and capacity deficiency are responsible for the persistence of a large risky informal/gray agri-food sector around the globe without effective control and substandard, fake and illegitimate products and activities. For instance, merely one-third of the Bulgarian dairy farms comply with the EU milk-standards; only 0.1% possess safe manure-pile sites; a half of produced milk is home-consumed, exchanged or directly sold (Bachev, 2010).
- Multiplying new treats and risks associated with the adversary (e.g., by a competitor) and terrorist attacks, and the emerging governing and exchange forms (e.g., street-sells; Internet, phone and mail orders; and shopping trips). All of them require specific/non-traditional risk management methods and modes—guards, policing, intelligence, multi-organizational and transnational cooperation, etc.

Conclusion

The analysis of modes, efficiency and challenges of risk management in the agri-food chain puts forward a number of academic, business and policy recommendations:

- The governance (along with the technical, information, etc.) issues are to take the center stage in the risk management analysis and design. The type of threats and risks and the specific (natural, technological, behavioral, dimensional, institutional, etc.) factors, and comparative benefits and costs (including third party, transaction and time) are to be taken into account in assessing the efficiencies, complementarities and prospects of alternative (market, private, public and hybrid) modes. The system of risk management is to adapt/improve, taking advantage of the number of new opportunities and overcoming/defending against the evolving new challenges.

- More hybrid (public-private and public-collective) modes should be employed, given coordination, incentives, control and cost advantages. The (pure) public management of most agri-food chain risks is difficult or impossible (agent opportunism, informal sector and externalities). Often, introduction and enforcement of new rights (on food security, risk-management responsibility, etc.), and supporting private and collective initiatives (informing, training, assisting and funding) are much more efficient.
- A greater support must be given to multidisciplinary and interdisciplinary research on factors, modes and impacts of risk governance in the agri-food chain in order to effectively assist the national and international policies, the design of modes for public interventions, and the individual, collective and business actions for risk management. ☞

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