Supply Chain Risk Management – Agri-Food Implications

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Abstract: Issues related to “good” governance of multiple risks (natural, technological, market, institutional, political, international) in various supply and distribution chains are among the most topical and posing serious challenges to sustainable development. This paper presents a holistic framework for analyzing the system of risk governance in agri-food supply and distribution chains, and give insights on major challenges and opportunities related to sustainable food security. Most risks management studies and practices in the agri-food chains predominantly focus on technical methods and capability to perceive, prevent, mitigate, and recover from diverse risks. In mainstream economic publications risks are usually studied as “another commodity” regulated by market supply and demand, and farmers and agribusiness agents “willingness to pay” for an insurance contract modelled. At the same time, risk management analysis largely ignore significant “human nature” (individual, agency, state) based risks (due to bounded rationality, opportunism, conflicting interests, bad management), and large risks related to food distribution and access, and critical factors for managerial choice (institutional environment, transaction costs), and diversity of alternative (market, private, collective, public, hybrid, international) modes of risk governance. We incorporate interdisciplinary New Institutional Economics (combining Economics, Organization, Law, Sociology, Behavioural and Political Sciences) and present a comprehensive framework for analyzing risk governance in agri-food supply and distribution chains. First, we specify diverse (natural, technical, behavioural, economic, institutional, policy, international) type of agri-food risks, and (market, private, public, hybrid, international) modes of their management. Second, we define efficiency of risk management and identify (personal, institutional, dimensional, technological, natural, transnational) factors of governance choice. Third, we present stages in analysis of risk governance and for improvement of public (state, international) intervention in risk management. Finally, we identify major opportunities and challenges for risk governance in agri-food supply and distribution chains at the current stage of development.

Keywords: Agri-Food Chain and Risk Management; Market, Private and Public Governance.

1. Introduction

Around the globe the issues of management of diverse (natural, technical, market, financial, criminal, policy, etc.) risks in agri-food supply and distribution chains agrarian are among the most topical for farm and business managers, consumers, economists, lawyers, interest groups, politicians, international organisations, academicians, and public at large (Babcock, 2004; Bachev, 2011a; 2012; 2013; 2016; Bonanomi, 2016; CIPS, 2012; Deep and Dani, 2009; EU, 2009; Hanschel, 2016; Kaufmann, 2016; OECD, 2008; Olsson and Skjöldebrand, 2008; Ramaswami et al., 2008; RPDRM, 2012; Schaffnit-Chatterjee, 2010; Shepherd et al., 2006; Tietje, 2016; Trench et al., 2011; Weaver and Kim, 2000). In the last decades, newly evolving uncertainty, risks and crisis associated with the progression of natural environment, products and technology safety, social demands, policies, economy, and globalization, all they have put additional challenges on existing system of risk management in agri-food sector. For instance, according to a global study one in 5 seafood is fake and it is likely that the average consumer has eaten mislabelled fish (International New York Times, 2016).

Most risks management studies in agri-food sector predominately focus on technical methods and capability to perceive, prevent, mitigate, and recover from diverse threats and risks (Barker, 2005; DTRA & IIBR, 2011; Hefnawy, 2011; Jaffee et al., 2008; Luning et al., 2006). In majority of economic publications a Neoclassical approach is applied, the risks is studied as other commodity regulated by market supply and demand, and farmers and agri-business agents “willingness to pay” for an insurance contract in relations to agents risk aversion, risk probability and magnitude of damages modelled.
(Gerasyenko and Zhemoyda, 2009; OECD, 2011). Nevertheless, market and private failures are acknowledged, and the needs for public intervention in risk management increasingly recognized. At the same time, risk management analyses largely ignore a significant “human nature” (bounded rationality, opportunism) based risks, and large risks related to food distribution and access, the critical factors for the managerial choice such as the institutional environment and the transaction costs, and the diversity of alternative (market, private, collective, public, hybrid) modes of risk management. As a result, the efficiency and complementarities of diverse agri-food risk management modes cannot be properly assessed and improved (Bachev, 2012).

Despite the significant advancement in the 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 agri-food sector (Dani and Deep, 2010; EU, 2009; Humphrey and Memedovic, 2006; Luning et al., 2006; OECD, 2008). Consequently, a 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, 2010a;2011b).

This paper incorporates the interdisciplinary New Institutional Economics (Coase, 1937;1960; Furuboth and Richter, 1998; North, 1990; Williamson O., 1981; Williamson O., 1996) and presents a comprehensive framework for analysing the risk management in in agri-food supply and distribution chains. 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 for the governance choice. Third, it presents stages in the analysis of risk management and for the improvement of public intervention in the risk governance. Finally, it specifies the contemporary opportunities and challenges for the risk governance in the in agri-food supply and distribution chains.

2. Framework for Analysing and Improvement of Agri-Food Risk Management

2.1. Agri-Food Risks and Modes of Their Governance

Risk related to agri-food sector is any current or future hazard (event) with a significant negative impact(s). It is either an idiosyncratic, accidental, low probability, unpredictable event/threat, or it is systematic - a high probability, “predictable” event/threat. The risk and threat could be of a natural origin - e.g. adverse weather, insect attract, catastrophic event etc. They may be of a technological origin - “pure” technical failures like tractor’s flat tire, engine disorder etc. They are often of human origin - individual or collective actions/inactions, “human nature”. Frequently, risks are a combination of previous three.

A great portion of risks in agri-food sector are caused or are consequences of a human actions or inactions. The individual behaviour and actions causing risks may range from: agent’s ignorance (“normal” human errors, lack of sufficient knowledge, information, and training); risk-taking (retention) strategy of individuals (accepting “higher than normal” risk); mismanagement (bad planning, prevention, recovery); deliberate opportunistic behaviour (pre-contractual cheating and “adverse selection”, post-contractual “moral hazard”); criminal acts (stealing property or yields, arson, invasion on individual safety); terrorist attacks (contamination of inputs and outputs aiming “mass terror”), etc.

The collective actions, which are source of risks are commonly related to: economic dynamics and uncertainty (changing industry and consumers demands, market price volatility, international competition, market “failures” and disbalances such as “lack” of labour, credit, certain inputs etc.); collective orders (“free riding” in big organizations, codes of behaviours, industry standards, strikes and trade restrictions, community rules and restrictions); public order (political instability and uncertainty, evolution in informal and forma 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, on a food processor, on a trader. The risk could also be caused by the agri-food sector - risk from farming, from food processing, from food-distribution etc. The risk could be internal for the agri-food chain such as hazards cased by one element to another, and staying in or mitigating within the sector. It could also be external associated with hazard coming from outside factors (such as natural environment, government policy, international trade), and/or affecting external components (consumers, residents, industries, nature).
Finally, the risks could be private, when it is taken by individuals, collectives, economic entities (households, firms, cooperatives), industries. The risk is often public affecting large groups, communities, consumers, society and future generations.

The risk is big when there is great likelihood of a risky event to occur and that is combined with substantial possible negative consequences. The later may take a great variety of forms – e.g. 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 eco-system services etc. Thus the “rational” agents maximizing own welfare will be interested to invest in risk prevention and reduction.

In a narrow (“technical”) sense the risk management comprises the individual, collective and public action(s) for reducing or eliminating risk and its negative consequences. In a broader sense the risk management is the specific system of social order (governance) responsible for a particular behaviour(s) of agents and determining the way(s) of assignment, protection, exchange, coordination, stimulation and disputing diverse risks, rights, resources, and activities (Bachev, 2011b). In the particular socio-economic, 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 (Bachev, 2012).

The generic forms and mechanisms of risk governance are (Figure 1):

- Private modes (“private and collective order”) - diverse private initiatives, and specially designed contractual and organizational arrangements tailored to particular features of risks and agents – e.g. private or collective codes of behaviour, diverse (rational, security, future etc.) private contracts, cooperatives, associations, business ventures etc.

- Market modes (“invisible hand of market”) - various decentralized initiatives governed by the free market price movements and the market competition such as risk trading (selling and buying insurance), future contracts and options, production and trade of special (organic, fair-trade, origins) products etc.

- Public modes (“public order”) - various forms of a third-party public (Government, international) intervention in market and private sectors such as public information, public regulation, public ban, public assistance, public funding, public assurance, public taxation, public contract, public provision etc.

**Figure 1.** Generic risks, factors, stages and modes of risk governance in agri-food sector

Sometimes, the risk management in agri-food sector could be effectively done though “self-management” – e.g. production management, adaptation to industry and formal standards, “self-insurance” though keeping stocks, financial reserves etc. For instance, primitive forms of on farm risk management through improving production management are widespread such as control and security enhancement, application of appropriate (pest, disease, weather resist) varieties, technology and production structure, product diversification, dislocation etc. Similarly, off-farm enterprise (and income) diversification is a major strategy for risk management in most of the European farms (Bachev and Tanic, 2011). However, very often, the risk management requires an effective governance of relations with other agents – exchange and regulations of rights, alignment of conflicts, coalition of resources, collective or
public actions at regional, national and transnational scales etc. Accordingly, a risk could be “managed” through a market mode (e.g. purchase of insurance, hedging with future price contingency contracts), a private mode (contractual or literal integration, cooperation), a public form (state regulation, guarantee, compensation), or a hybrid combination of other forms.

2.2. Efficiency of Risk Management

The individual modes of risk governance are with unequal efficiency since they have dissimilar potential to reduce the likelihood and the (negative) impact of risk, and command different costs (Bachev, 2010a). Principally, the market or the 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 consequences. 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 behaviour of counterparts or partners etc. Consequently, market and private sector “fail” to govern effectively the existing and likely risks in 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 (Coase, 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 governance. 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 between (exchanged, shared by) agents according to their will while the total costs for risk prevention, assurance, reduction, and recovery 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 totally decentralized (market) governance would optimize the risk-taking and minimize the “technological costs” for risk assurance and recovery exploring the entire potential for economies of size and scope at national and/or transnational scales. However, when property rights are not well defined or enforced and transaction costs are high then the type of governance is essential for the extent and costs of risk protection (Bachev, 2012). For instance, an internal (ownership) mode is often preferred because of the comparative protective and costs advantages for “standard” natural or behavioural risk management over the outside (market or contract) modes. What is more, frequently the enormous transaction costs could even block the development of insurance market or the emergence of mutually beneficial (collective) risk-sharing organization. It is well known that despite “common” interests and the huge potential for risk minimization the collective organization for risk sharing is not or hardly developed by stallholders.

Furthermore, the formal and informal institutional restrictions could make some modes of risk governance impossible - e.g. risk assuring monopolies and/or cartel arrangements are illegal in many countries while most entrepreneurial risk-taking is endorsed (the “low risk - low profit” principle). Thus, not all modes of risk governance are constantly feasible in any socio-economic settings. 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); the bigger enterprise can better perceive (hire expertise, collect information) and invest in protection of risks and/or take (absorb negative consequences) of a larger risk, etc. Besides, the individual agents have quite different interests for an effective management of a particular risk(s) since they get unlike benefits and costs from the risk management – e.g. effective environmental management often create costs for farmers while benefit the residents and other industries.

Last but not least important, there is no single universal form for the management of divers type of risks and according to the specific feature of each risk (origin, probability, likely damages) there will be different most effective form of governance. For instance, while a low probable “standard” (natural,

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1 Most studies on risk management in agriculture focus on modeling farmers “willingness to pay” for a risk contract in relations to risk’s probability and amount of likely damages e.g. Gerasyumenko and Zhensoyda (2009).
2 In such a word some kind of risks would not even exist or be of no importance - e.g. risks related to adverse human behavior (any opportunistic intention would be discovered at no costs and interests effectively safeguarded).
3 Transaction costs are the costs associated with the distribution, protection and the exchange of diverse rights and obligations of individual, groups, and generations (Bachev, 2010a).
4 Nevertheless, if costs associated with the illegitimate forms are not high (possibility for disclosure low, enforcement and punishment insignificant) while benefits are considerable, then the more effective governance prevails – large gray or black economies are widespread around the globe.
criminal) risk could be effectively governed by a classical market contract (e.g. purchase of insurance), most behavioural risks require special private modes (branding, long-term or interlink contracts, vertical integration), a high damaging risk from a terrorist attract necessities specialized public forms (intelligence, security enforcement) etc. Hence, depending on the kind and severity of 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 divers 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, communities, society) or practically impossible (when uncertainty associated with the future events is enormous, the transaction costs are very high etc.). For instance, certain natural risk will always exist despite the available system of risk management. Besides, it is practically impossible to write a "compete" contract (e.g. for insurance supply and trading risk) including all probable future contingencies, and the subsequent rights and obligations of each party. Consequently, some transacting risk will always retain. Therefore, an effective risk management is usually connected with the needs for some trade-off between the benefits from reducing a particular risk (saved costs, minimized negative impacts) and the related costs for the risk governance6.

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 exposure to a new type of risk/costs – e.g. the vertical integration eliminates the "market risk" but creates a risk from opportunisms of partners. Moreover, the level of the (overall) risk exposure is typically determined by the "critical" (most important) risk and the integral risk is rarely a sum of the individual risks. For instance, if there is a very high risk/threat for stealing the harvest, otherwise important risk for crop pest protection would not be added to the overall risk of the farm6.

Frequently, there are a number of possible (alternative) forms of governance of a particular type of risk – e.g. “risk to the 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. (Bachev, 2010a).

In certain cases, some forms of the risk management are practically impossible or socially unacceptable – e.g. insurance markets do not develop for many kind of agro-food risks and the private management is the only option; the management of many environmental risks and challenges require collective actions at local, eco-system, regional or transnational levels etc. In modern societies many type of risks management are publicly imposed – e.g. food safety risk is under public management and harmonized in the EU, there are strict regulations on GMC, “precaution principle” is mandatory for the 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, socially) feasible alternatives the most efficient one – that which would reduce the overall risk to “acceptable” level, and which would require minimum total (risk assurance and risk governance) costs (Bachev, 2012). The later must include all current and future costs associated with the risk management – the current technological and management costs (for adaptation, compliance, information, certification), risk insurance premium, contracting and coalition costs as well as the (current and future) long-term costs for adaptation and recovering damages including associated transaction costs (disputes, expertise, low suits etc.) for claiming experienced losses7. In any case an individual, group, community, sectoral, chain, national and international efficiency of the risk management has to be distinguished. It is often when elimination of a risk for one agent induce a (new) risk for another agent – e.g. the agri-food price fluctuation causes an income risk to the producers but benefits the speculators; the application of chemicals reduces risk for the farmers but produces significant negative effects (e.g. water, soil and air contamination) on the residents, consumers, affected industries etc. Furthermore, the risk management is only a part of the overall governance of divers (production, consumption, and transaction) activities of

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1 Thus some “uncovered” risk would normally remain.
2 That was the case in transitional Bulgarian conditions where due to ineffective low and security enforcement, the entire sub-sectors of agriculture (vineyards, orchards) has been abandoned by smallholders in certain regions of the country because of the extremely high risk/treat of stealing the harvest by organized or individual thieves.
3 Most analyses of the agri-food risk management usually ignore the current and likely long-term transaction costs associated with the risk management.
agents. That is why the total efficiency (benefits, disadvantages, costs saving and risk minimization potential) of the various modes for the individual agents and the public at large are to be taken into account.

According to the specific natural and socio-economic environment, the personal characteristics of individuals, and the social preferences, various structure 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, competition) would fail to provide 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, 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 governance. Consequently, a whole range of risks would be left unmanaged which would have an adverse effect on the size and the sustainability of agri-food enterprises, the markets development, the evolution of production and consumption, the state of environment, and the social welfare. Depending on the costs and the efficiency of the specific system of governance put 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, labour, environmental etc. safety standards (lack of political willingness or administrative capability) then enormous “grey” agrarian and food sector develops with inferior, hazardous and counterfeit components.

**2.3. Factors of Governance Choice**

The forms of risk management in agri-food sector would depended on the risk type and features, the personal characteristics of agents, the institutional environment, the progress in science and technologies, culture, the social education and preferences, the evolution of natural environment etc. (Figure 1). The risk features like origin, probability of occurrence, likely damages, scale etc. are important factor for the governance choice. For instance, local technical or behavioural risk could be effectively managed though a private mode while most of market and environmental risks require collective actions at regional, national or transnational level. For a high probability and harmful risks the agents will prefer more secure (and more expensive) mode – e.g. security investment, purchase of insurance, keeping reserves, taking hostages, interlinked organization. Nevertheless due to the lack of economic means many small size farmers cannot afford related costs and practice no or primitive forms of risk management – cash and carry deals, product diversification etc. Here there is a need for a third party (Government, international assistance) intervention though insurance, support, safety net etc. schemes to decrease farmer’s vulnerability.

The personal and behavioural characteristics of agents (such as specific interests, preferences, knowledge, capability, risk-aversion, reputation, trust, “contractual” power, opportunism) are important factor 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 at all; in some cultures, the cooperative is the preferred mode of agrarian organization; experienced and trained farmer could design and manage a bigger organization (based on hired labour) and more outside (credit, insurance, inputs supply etc.) contracts adapted to his specific needs; a risk-taking entrepreneur prefers riskier but more productive (specialized, high margin) ventures etc. The behavioural factors such as individuals’ bounded rationality and opportunisms have been identified as responsible for the transaction costs, and thus for the choice of organizational mode (Williamson O., 1996). They are widely studied in the insurance theory as a source for cheating by both sides of contract (Derrig, 2002). The agents do not possess full information about the economic system (risks, price ranges and dynamics, trade opportunities, policy development) since collection and processing of such information is very expensive or impossible (multiple markets, future events, partners intention for cheating etc.). In order to optimize decision-making they have to spent on

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

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

10 Principally, when market and private modes fail there is a strong need for a public intervention in agriculture Bachev (2011d).
increasing their imperfect rationality” (on data collection, analysis, forecasting, training, consultation) and selecting forms minimizing related risks/costs (internal organization, “selling out” risk etc.).

The agents are also given to opportunism and if there is an opportunity for some of the transacting sides to get non-punishably extra benefit/rent from the exchange he will likely to take an advantage of that\textsuperscript{11}. A pre-contractual opportunism (“adverse selection”) occurs when some of the partners use the “information asymmetry” to negotiate better contract terms. A post-contractual opportunism (“moral hazard”) occurs when some counterpart takes advantage of impossibility for full observation on his activities (by another partner, a third-party) or when he takes “legal advantages” of unpredicted changes in exchange conditions (costs, prices, formal regulations etc.). The third form of opportunism (“free ride”) occurs in development of large organizations where individual benefits are not-proportional to the individual efforts (costs) and everyone tend 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 the opportunistic from the non-opportunistic behaviour because of the bounded rationality - e.g. a farmer finds out that purchased seeds are not of high quality only during the harvesting time. Therefore, the agents have to protect their rights, investments, and transactions from the hazard (risk) of opportunism through: ex-ante efforts to find reliable counterpart and design efficient mode for partners credible commitments; and ex-post investments for overcoming (through monitoring, controlling, stimulating cooperation) of possible opportunism during the contract execution stage (Williamson O., 1996). In the agri-food sector the opportunism is widespread before signing an insurance contract (not disclosing the real information for possible risks) or during the contract execution period (not taking actions for reducing damages when risky event occurs; consciously provoking damages in order to get insurance premium etc.). That augments considerably the insurance prices and restricts the utilization of insurance contracts by small enterprises. On the other hand, insuree often “discover” the pre-contractual opportunism of the insurers only after the occurrence of harmful event finding out that not all assurance terms (protected risks, extend of coverage of damages, ways of assessing damages, extra hidden costs) had been well explained and/or adapted to farmers needs (Bachev, 2010b). For many kinds of farm related risks the markets evolve very slowly and/or the insurance services are practically inaccessible by the majority of small operators. What is more, for many important risks an insurance is not available “for purchase at all” – e.g. the risk of lack of market demands for farm products, the fluctuation of prices, possible opportunism of the counterparts etc. That is why farmers have to develop other (private, collective) modes to safeguard their investments and rights or lobby for a public intervention in the assurance supply.

The institutional environment (“rules of the game”)\textsuperscript{12} is important factor for the management choice. For instance, in many countries some forms of risk governance are fundamental rights (on food, labour, environmental security and safety) and guaranteed by the state; a 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 the impossibility to adapt to (invest for) newly introduced EU standards for quality, safety, environmental preservation, animal welfare, certification etc. Principally, in the conditions of stable and well-working public regulation (regulations, quality standards, price guarantees, quotas) and the effective mechanisms for laws and contract enforcement, a preference is given to the standard (spotlight and classical) market contracts. When rights and rules are not well defined or changing, and the absolute/contracted right effectively enforced, that lead to the domination of primitive form of risk management (subsistence farming, personalized and over-integrated forms) and the high vulnerability to diverse (natural, private, market, contractual, policy etc.) risks. The later was the case during the post-communist transition in East Europe characterized by the fundamental restructuring, the “rules change” and ineffective public enforcement, a high exposure to “new” (natural, market, entrepreneurial, private, contractual, institutional, international etc.) risks by the newly evolving private structures, unsustainable organizations, large grey economies, undeveloped or missing (agrarian credit, insurance, extension supply etc.) markets, individuals (e.g. thefts) and organized (e.g. providers of “security services”) risk introduction devastating the private businesses and the household welfare (Bachev, 2010a).

\textsuperscript{11} If there was no opportunism only risks related to the bounded rationality would remain (natural, technical) and consequences easily recovered with the cooperation and in a mutual benefit (risk sharing) of all parties.

\textsuperscript{12} That is formal and informal rights and rules, and the system(s) of their enforcement (North). They are defined by the (formal, informal) laws, tradition, culture, religion, ideological and ethical norms, and enforced by the state, convention, community pressure, trust, or self-enforcement.
The dimensional characteristics of the activity and transactions (the combination of uncertainty, frequency, assets specificity, and appropriability) are critical for the management choice. When recurrence of the 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 incentive, adjustment, and conflict resolution mechanisms). Here continuation of the relations with a particular partner/s and designing a special mode for transacting has a high economic value and the costs for its development could be effectively recovered by frequent exchange. When a transaction is occasional (incidental) then the possibility for opportunism is great since the cheating side cannot be easily punished by turning to a competitor (losing future business).

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

The transaction costs get very high when specific assets for the relations with a particular partner are to be deployed. Here a costless alternative use of the specific assets is not possible (loss of value) if the transactions fail to occur, are prematurely terminated, or less favourable terms are renegotiated (in contract renewal time before the end of the life-span of the specific capital). Therefore, the dependant investment/assets have to be safeguarded by a special form such as a long-term or tied-up contract, interlinks, hostage taking, joint investment, quasi or complete integration. Often, the later is quite expensive, investment in the specific capital not made, and the activity/transactions cannot take place or occurs without (or loss of) comparative advantages in respect to the productivity (Bachev, 2011d).

If a high symmetrical (risk, capacity, product, timing, location etc.) dependency of the asset counterparts exists (a regime of “bilateral trade”) there are strong incentives in the both parties to elaborate a special private mode of governance (e.g. interlinking the credit, inputs and insurance supply against the marketing of output). A special relational contract is applied when detailed terms of transacting are not known at outset (a high uncertainty), and a framework (the mutual expectations) rather than the specification of the obligations of counterparts is practiced. Here partners’ (self) restrict from opportunism and are motivated to settle emerging difficulties and continue relations (a situation of frequent reciprocal trade). When unilateral dependency exists (risk of unwanted “exchange”, quasi or full monopoly), then the dependent side has to protect the investments against possible opportunism (behavioural uncertainty/certainty) through integrating transactions (unified organization, joint ownership, cooperative); or safeguarding them with an interlinked contract, exchange of economic hostages, development of collective organization to outstand asymmetrical dependency (for price negotiation, lobbying for Government regulations) etc.

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

The progress in science and technologies significantly improves the risk management and facilitate the diversification of its form. For instance, the introduction of new (resistant) plant and livestock varieties; the mechanization and standardization of operations and products; the application of information, forecasting, monitoring, storage, and transportation technologies, all they improve significantly the risk management in agri-food chain (COST, 2009; Hefnawy, 2011). The modern application of the science and technologies is also associated with the production and/exposure to the new type of risks – e.g. greenhouse gas emissions, genetic contamination, natural resource depletion, technical over-dependency etc.

Finally, the natural environment and its evolution are critical factors for the management choice. For instance, certain geographical regions (mountainous, river beds, tropics, etc.) are more prone then others for natural menace and risks like soil erosion, soil and water contamination, frosts, droughts, floods, pest attacks, diseases, wild animal invasions etc. What is more, evolution of the natural environment associated with a global warming, extreme weather, plant and animal diseases, drought,
flooding and other natural disasters, is posing series of new challenges for the risk management in the agrarian and food sector (Hefnawy, 2011; OECD, 2011).

The identification of the “critical factors” of the risk management choice, the range of practically possible forms, and their efficiency (costs and benefits) for the individual agents, stages, subsectors, countries, food chains and public at large, is to be a subject for a special micro-economic study.

The 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 the risk governance are hardly to quantify – e.g. the individuals’ personal characteristics, the amount of the risk, the level of benefits and costs associated with each mode etc. That is why a qualitative (Discrete structural) analysis could be used. The later matches the features of a risk to be managed (the probability, significance, acceptance level, needs for collective action etc.) and its critical (institutional, technological, behavioural etc.) factors with the comparative advantages (the effective potential) of the alternative modes to inform, stimulate an appropriate behaviour, and align the interests of associated agents, and to overcome, reduce, control, share, dispute, and minimize the overall costs of that risk.

In a specific market, institutional, technological and natural environment the effective risk governance choice will depend on the combination of the risk features (probability of occurrence, likely magnitude of damages) and the critical dimensions of the activity/transactions (appropriability, assets specificity and frequency). Table 1 presents a matrix with the principle forms for the effective risk governance in agri-food sector.

### Table 1. Principle modes for risk governance in agri-food sector

| Critical Dimensions of activity | Appropriability |  |
|--------------------------------|-----------------|--
|                                | High            | Low          |
|                                | Low             | High         |
| Risk features                  |                 |              |
| Low                            |                 |              |
| High                           |                 |              |
| Appropriability                |                 |              |
| High                           | M/CC            | M/CC         |
| Low                            | SC              | VI           |
| Frequency                      |                 |              |
| Low                            | M/CC            | SC           |
| High                           | CO              | CO           |
| Low                            | na              | na           |
| High                           | M/CC            | TPI          |
| Appropriability                |                 |              |
| High                           | M/CC            | TPI          |
| Low                            | VI              | CO & TPI     |

M – free market; CC – classical (standard) contract; SC – special contract; VI – vertical (internal) integration; CO – collective organisation, TPI – needs for a third-party involvement; PO – needs for a public organisation

Source: Bachev (2012).

For instance, likely probable and low damaging risks combined with a small assets specificity and appropriability usually do not necessitate (motivate, economically justify) any risk management.

A high “standard” risk could be effectively managed through a free market mode such as a standard (classical) insurance, inputs supply, marketing etc. contracts. Highly probable and damaging risks with a good appropriability and frequency of transactions between the same partners require a special (e.g. relational) contract. The later form is also appropriate for the risks surrounding with low uncertainty, high assets specificity and appropriability, and occasional character of the relations between the counterparts.

Principally, risks combined with high specificity, appropriability and frequency could be effectively managed though a vertical integration (internal risk management, contract forward or backward

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14 The “measurement problems” associated with the transaction benefits and costs are well specified Bachev (2011d). They also prevent the utilization of the traditional (Neoclassical) models simply by adding a new “transacting”, risk management etc. activity Furuboth and Richter, (1998).

15 The operationalization of the Discrete Structural Analysis of the economic organization is done by Williamson (1981).
integration for risk sharing or mitigation). Highly likely and menacing risks combined with a high assets specificity and a good appropriability call for a collective organization (cooperation, collective action). Moreover, such risk/costs sharing organization could be easily initiated and maintained since the condition of a high risk and assets dependency is in place. A serious transacting risk exists when the situation of assets specificity is combined with a high uncertainty, low frequency, and good appropriability. The elaboration of a special governing structure for private transacting is not justified, the specific (risk reducing) investments not made, and the activity/restiction of activity fails to occur at an effective scale (“market and contract failure”). Here, a third-part (private, NGO, public) involvement in the transactions is necessary (assistance, arbitration, regulation) in order to make them more efficient or possible at all. The unprecedented development of the special origins, organic farming, systems of “fair-trade” are good examples in this respect. There is increasing consumer’s demand (a price premium) for the organic, original, and fair-trade products associated with some forms of (natural, poor household, labour, quality etc.) risk management. Nevertheless the supply of the later products could not be met unless effective trilateral governance including an independent certification and control is put in place. Similarly, for risks with a low appropriability a third party (public) intervention is necessary to secure the effective risk management. Moreover, while a high probability low danger risks need a collective organization assisted by a third-party (“quasi” public organization for risk sharing and mitigation), the high damaging risks necessitate a public organization.

2.4. Stages in the Analysis and Improvement of Risk Management

The analysis and the improvement of the risk governance in the agri-food chain are to include following steps (Figure 2): First, identification of existing and emerging threats and risks in agri-food chain. The persistence of certain risks is a good indicator for ineffective management (Bachev and Nanseki, 2008). The modern science offers quite reliable and sophisticated methods for assessing various risks to or caused by the agri-food chain (DTRA & IIBR, 2011; Trench et al., 2011).

![Figure 2. Analysis and improvement of risk management in agri-food sector](source: The author)

Second, specification of existing and other feasible modes of risks governance, and assessing their efficiency, sustainability and prospects of development. The efficiency of individual modes shows the capability for risks detection, prevention, mitigation and recovery at lowest costs while the sustainability reveals the “internal” potential to adapt to socio-economic, technological and environmental changes and associated threats and risks. A holistic framework for assessing the efficiency and the evolution of governing modes is suggested by OECD (2011) and Bachev (2010a). That stage is to identify the deficiencies of dominating (market, private, and public) modes to solve the existing and emerging risks, and to determine the needs for a (new) public intervention. For instance, when appropriability associated with the transaction/activity is low, there is no pure market or private mode to protect from associated
risks. Emerging of a special large-members organization for dealing with low appropriability to cover the entire “social” risk would be very slow and expensive, and they unlikely are sustainable in a long run (free riding). Therefore, there is a strong need for a third-party public intervention in order to make protection of such risk possible or more effective – 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).

Third, identification of the alternative modes for public intervention to correct (the market, private, public) failures, assessing their comparative efficiency, and selection the best one(s). The comparative assessment is to be made on (technically, economically, 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 the private and public transacting costs. The later often comprise a significant portion of the overall risk management costs and are usually ignored by analysts – e.g. costs for the coordination, stimulation, mismanagement of the bureaucracy; for the individuals’ participation and usage of the public modes (expenses for information, paper works, payments of fees, bribes); the costs for community control over and for the reorganization of the bureaucracy (modernization and liquidation of public modes), and the (opportunity) costs of public inaction, etc.

Initially, the existing and emerging problems (difficulties, costs, risks, failures) in the organization of market and private governance have to be specified. The appropriate pubic involvement would be to create institutional environment for: making private investments less dependent, decreasing uncertainty surrounding market and private transactions, increasing intensity of exchange, protecting private rights and investments etc. 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 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 activity/transactions into market and private governance, liberalizes market competition and induces private incentives (and investments) in certain agrarian risk management. In other instances, it is more efficient to put in place public regulations for risk minimization: for utilization of resources, products and services (e.g. standards for labour, product, and environmental safety); introduction of foreign species and GM crops, and for (water, soil, air, 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, etc. In other instances, using the incentives and restrictions of the tax system is the most effective form for intervention. Different sorts of tax preferences are widely used to create favourable conditions for the development of certain (sub)sctors and regions, forms of organization, segment of population, or types of activities. For instance, the environmental taxation on emissions or products (inputs, outputs of production) is applied to reduce use or emissions of harmful substances; tax reductions are used to assist overcoming the negative consequences of natural disasters by private agents 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 most countries around the world. Often providing public information, recommendations, and training to farmers, entrepreneurs, residence, and consumers in risk management is the most efficient form. In some cases, pure public organization (in-house production, 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 the natural catastrophe etc.

Usually, the 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: the complementarities (joint effect) of the individual forms; the restricted potential of some less expensive forms to achieve a certain (but not the entire) level of the socially preferred risk prevention and mitigation; the possibility to get extra benefits (e.g. “cross-compliance” requirement for participation in

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16 Respecting others rights or “granting” risk protection rights to others could be governed by the “good will” or charity actions (e.g. eco-sustainability movement initially evolved as a voluntary activity). In any case, the voluntary initiatives could hardly satisfy the entire social demand especially if they require significant costs.
the public programs); the specific critical dimensions of governed activity; the risk and uncertainty (little knowledge, experience) associated with likely impact of the new forms; the administrative and financial capability of the Government to fund, control, and implement different modes; and the 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 local (ecosystem, community, regional) level, while others require nationwide governance. And finally, there are risk management activities, which are to be initiated and coordinated at international (regional, European, worldwide) level due to the strong necessity for trans-border actions or the consistent (national, local) government failures. Very frequently the 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, inspecting) modes must have built mechanisms for increasing the competency (decrease the bounded rationality, powerlessness) of the bureaucrats, beneficiaries, interests groups and public at large as well as restricting the possible opportunism (cheating, interlinking, abuse of power) of the public officers and stakeholders. That could be made by training, introducing new assessment and communication technologies, increasing transparency, and involving experts, beneficiaries, and interests groups in the management of public modes at all levels.

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

If there is strong need for a third-party public involvement but the effective (government, local authority, international assistance) intervention in risk management is not introduced in a due time, then significant risks to individuals and public at large would persist while the agrarian “development” 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 later let improve the design of the (new) public intervention according to the specific conditions of the food-chain components in the particular country or region in terms of increasing security and decreasing costs.

Suggested new approach also let predict likely cases of the (new) public failures due to the impossibility to mobilize a political support and resources or ineffective implementation of otherwise “good” policies in the particular conditions. Since public failure is feasible, its timely detection permits foreseeing the persistence/rising of certain risks, and informing the local and international communities about the consequences.

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

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

3. Contemporary Opportunities and Challenges for Agri-Food Risk Management

The modern agri-food chains involve millions actors with different interests, multiple stages, and divers risks requiring a complex, multilateral and multilevel governance at a large scale. For instance, in
the EU the number of employed persons in the agri-food chain reaches 48 million working in almost 17 million different holdings and enterprises (Table 2) while final consumers comprises 500 millions.

Table 2. Number of enterprises and persons employed in EU agri-food chain (1000)

<table>
<thead>
<tr>
<th>Number</th>
<th>Agriculture Holdings and enterprises</th>
<th>Food and beverages activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EU - 28</td>
<td>Manufacturing</td>
</tr>
<tr>
<td></td>
<td>13 700.4</td>
<td>267.9</td>
</tr>
<tr>
<td></td>
<td>Bulgaria 493.1</td>
<td>5.1</td>
</tr>
<tr>
<td>Regular farm Labour force and persons employed</td>
<td>EU - 28</td>
<td>26 669.4</td>
</tr>
<tr>
<td></td>
<td>Bulgaria 950.0</td>
<td>106.5</td>
</tr>
</tbody>
</table>

Source: Eurostat

Various existing and emerging (natural, technological, health, behavioural etc.) threats and risks along with the modern agri-food chains are well identified (DTRA & IIBR, 2011; Eurostat, 2011a; Humphrey and Memedovic, 2006; OECD, 2011). Diverse market and private modes have emerged to deal with the specific risks driven by the ethics, competition, consumer demand, business initiatives, and trade opportunities – e.g. direct marketing, voluntary codes (professional and corporate social, labour, environmental etc. responsibility), industry standards, insurance schemes, guarantees, fair-trade, trade with brands, origins, organic and quality products etc. (Table 3). A good example for a successful imitative of multinational BSSF using market channels (“food fortification”) to overcome particular type of risk of under nutrition is presented by Bluthner (2016).

Table 3. Major risks and modes of governance along with modern agri-food chain

<table>
<thead>
<tr>
<th>Risks</th>
<th>Market</th>
<th>Private</th>
<th>Modes of Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural disasters and extreme weather;</td>
<td>Clientatrisation; Direct marketing; Informal branding; Insurance purchase; Organic production; Specific origins; Brands; Eco-system services; Special (quality, eco-) labelling; Outsourcing; Security services; Fair trade system; Standards insurance contract;</td>
<td>Improved inputs, technology, variety and structure of production; Product and income diversification; Self-insurance forms; Patronage and community insurance; Voluntary initiatives; Building (good) reputation; Guarantees; 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</td>
<td>Mandatory (products, process, labour, animal-welfare, environmental) quality and safety standards; Regulations/bans for using resources, inputs, technologies; Regulations organic farming; Quotas for emissions and using products/resources; Regulations for introduction 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 labelling and information; 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;</td>
</tr>
</tbody>
</table>

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17 figures get much bigger if we take into account the total number of the global agents involved in the EU agri-food chains – farmers, processors, importers etc. from around the world.
| 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 behaviour of counterpart, collation partner, a third party or public officer; Criminal intrusion; Terrorist attacks | Hedging with future price contacts | 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; Licensing; Third-party verification; Inputs supply integration; Integration into processing and marketing; Franchises; Risk pooling and marketing cooperatives; Vertical integration; Consumers cooperatives | 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 food reserves and buffer stocks; 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; 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 Centres); Bilateral and multilateral trading agreements/rules (WTO); National and international anticrime/antiterrorists bodies |

**Source:** The author

Furthermore, different bilateral and multilateral private forms are widely used to safeguard against the risks, explore the benefits, and facilitate the exchange – e.g. clientalisation, contractual arrangements, cooperation, complete backward or forward integration etc. Special trilateral forms have evolved to enhance security and partners and consumers confidence including an independent (a third-party) certification and inspection. Trade internationalization is increasingly associated with the collective private actions (standards, control mechanisms etc.) at a transnational and global scale (e.g. GLOBALGAP).

The property (security and safety) rights modernization, and the market and private “failures” brought about needs and modes for public interventions (assistance, regulations, provision) in the agri-food sector. Moreover, the scope and stringency of publicly imposed rules expend constantly embracing new products, methods, dimensions (human, animal, plant, eco-health), hazards (GMC, nanotechnology, terrorism), and information requirements. Furthermore, the globalization of exchange, and threats and
risks increasingly require setting up a transnational public order (e.g. ISO, WHO, FAO, WTO etc.). For instance, there are common (traceability, precaution, communication) principles, (food, veterinary, phytosanitary, feed, environmental etc.) legislation, and implementing and enforcing agencies (such as EFSA, ECDC, ECHA) for the agri-food chains in the EU (including for imported products). The process and challenges of modernization of human rights on “adequate” food and related legislations and implementing bodies at global, regional and national level have been well presented by Bonanomi (2016), Hanschel (2016), Kaufmann (2016), Tietje (2016).

Consumers concerns about the food-safety risks significantly have increased after the major food-safety “events”/crisis 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 etc.). For instance, since 2005 there has been an augmentation of the respondents “worrying about food-safety problems” in the EU and it comprise a significant share now (Figure 3); as much as 48% of the European consumers indicate that the consumed food “very or fairly likely” can damage their health etc. (Eurobarometer, 2010). In a new member state like Bulgaria this figure is 75%. The number of cases and incidence rates of various foodborne and waterborne diseases is significant even in developed countries. For example, in the USA yearly 1 in 6 or 48 million people gets sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases (CDC, 2011). In the EU there are also a number of confirmed cases of foodborne diseases having a high incidence rate, most notably Giardiasis (167,025), Campylobacteriosis (134,606) (ECDC, 2010).

Figure 3. Indicate if you are worried in relation with following food-safety problems (% of respondents)

Source: Eurobarometer (2010)

Consumers’ definition of safety reaches beyond industry’s narrow focus and changes all the time - in USA almost two-third expect their food to be “free from harmful elements” while other (not traditional) food safety concerns also gaining ground such as: “clear and accurate” labeling; clear information on ingredients and sourcing; fewer overall ingredients, no “artificial” ingredients and less processing; and nutritional content of foods (Figure 4). Safety is no longer strictly defined based on near-term risks and consumers’ traditional short-term food safety concerns about germs, aka pathogens, are now augmented with consideration for long-term health and wellness benefits, such as whether a food is free of carcinogens (Food Safety News, 2016). Consequently, agri-food companies operating under the old definition of safety feel ongoing pressure to address consumer concerns in a way that meets this evolving, long-term need.

It is well recognised that certain type of global risks (e.g. reduction of green gas emissions, waste management) would not be effectively deal with unless a large scale collective actions are taken such as change in consumer behaviour, dietary pattern, reduction of overall livestock and energy production, etc. (Melesse, 2016; Pirscher, 2016). Furthermore, there have been huge risks associated with persistent failure to secure access of necessary quantity and quality of food for a considerable portion of world population because of lack not of sufficient food supply (“availability of food”) but “unfair” food distribution (“access to food”) (Hanschel, 2016).

There are a number of (new) opportunities for the risk governance in the agri-food chain: First, the advances and the dissemination of the technical food-chain, training and risk-management methods (such
as microbiological, genetic, electrical, laser, robotic, immunological, chemical and biosensors, nanotechnology, ICT etc.), the integral and food-chain approaches, and the research, monitoring, testing, decision, and foresighting capability for the risk-detection, assessment, prevention, and mitigation (COST, 2009; Trench et al., 2011). For instance, the advancements in detection, assessment and mitigation methods and technologies associated with the biological and the chemical risks have been presented at a recent international conference (DTRA & IIBR, 2011).

**Figure 4.** Consumers’ criteria for food safety definition in USA (percent)

Second, the modernization and the international harmonization of the institutional environment (private, corporate, collective, NGOs, public food-safety and related standards, rules, enforcements etc.). For instance, the EU membership improves considerably the “rules of the game” in the new member states like Bulgaria; the market access rules, and/or the “corporate responsibilities” induce the agri-food sector transformation of exporting countries in Africa, Latin America and Asia etc.

Third, the considerable development of the specialization of activities (including in the risk-taking, monitoring, management) and the concentration of (integral) management in the food-production, processing, servicing, and distribution - centralized innovation and enforcement; time, scale, and scope economies; easy third-party control etc. For instance, the market share of the three largest food-retailers comprises between 27%-91% in the EU states (Eurostat, 2011a); the food-safety training, certification, inspection, and information are big international business (Humphrey and Memedovic, 2006), etc.

Forth, the quasi or complete integration of the food chain’s consecutive or dependent stages creating mutual interests, and the effective and long-term means for the risk-perception, communication, and management. For example, in Bulgaria the (raw) milk supply is closely integrated by the (dairy) processors through on-farm (collecting, testing) investments and interlink (inputs, credit, and service supply against milk-delivery) contracts with the stallholders, while the dairy marketing is managed by branding and long-term contracts – standards and bio-labels (Bachev, 2011c).

Fifth, the increasing consumers “willingness to pay” for the food-safety attributes such as chemical and hormone bans, safety and inspection labels, original and special products etc. (Trench et al., 2011). The later justify and make economically possible the paying-back of the costs for special governance. For instance, the recent trend is a growing consumer appetite for non-GMO goods which is met by leading producers like Cargill are responding (Wall Street Journal). Evolution of concept “from consumer rights to consumer duties” and diverse practices of “sustainable consumption” are well presented by Pirscher (2016).

Six, the growing consumers’ (representation, organizations) and the media involvement, and the national and transnational (information, technical, managerial, training, certification etc.) cooperation of partners and stakeholders improving agents choice, inducing public and private actions, enhancing risk-management communication, efficiency, and speed.

The modern development is also associated with a number of (new) challenges for the risk governance in the agri-food chain:
The emergence of new threats, risks and uncertainty associated with the evolution of natural environment (e.g. climate change, water stress, “new” plant, animal and human hazards etc.) as well as the new human induced economic, financial, food, food safety, water, environmental etc. crises at large (transnational, global) scales. For instance, in the EU the household waste associated with the food (packaging, animal and vegetal wastes) is quite significant as merely its animal and vegetal components amounts to 23.8 million tones and comprises almost 11% of the all household waste\(^{18}\), or 48 kg per capita (Eurostat, 2011b).

The 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 in Japan and beyond (Behdani, 2012); there are uncertainties and safety concerns associated with the growing application of nanotechnologies and GMCs etc. (Eurostat, 2011a).

The increasing specialization and concentration of activity and organizations which separates the “risk-creation” (incident, ignorance, opportunistc behaviour) and the risk-taking (unilateral-dependencies, quasi-monopolies, spill-overs, externalities etc.). That makes the risk-assessment, pricing, communication, disputing, and liability through the (pure) market and private modes very difficult and costly. For instance, cheating, misleading, and pirating are common in the food-chain relations - high information asymmetry, detection, disputing, and punishment costs (Bachev, 2010a). It is indicating that for the risk information consumers in the EU trust more to the “health professionals”, “family and friends”, “consumers associations”, “scientists” rather than the “food producers” and “supermarkets and shops” (Figure 5). Recent survey in UK also found that just one in three Britons trust the government to make sure food is safe to eat and consumers have low levels of trust in supermarkets and food manufacturers, while 70% trusted food inspectors to make sure food was safe and 60% said they trusted farmers (Daily Mail, 2016).

The widespread mass production, distribution, and consumption increases the vulnerability of the agri-food chain expending the scope and the severity of natural, incidental, opportunistc, criminal or terrorist risks. For instance, in the EU there has been a progressive number of the official notifications based on the market and non-member countries controls, food-poisoning, consumer complaints, company own-checks, border screening and rejections approaching 8000 in 2009 (Eurostat, 2011a).

The increasing adaptation and compliance costs (capital, training, certification, documentation etc.) for the rapidly evolving market and institutional environment which delay or prevent the reformation of smaller farms and food-chain enterprises (Bachev, 2010a; Trench et al., 2011). For instance, in Bulgaria the dairy and meat processors adaptation to the EU standards have continued 10 years while two-thirds of them ceased to exist before the country accession to the EU in 2007 (Bachev, 2011c).

Figure 5. In case a serious food-safety risk is found I would trust for risk information to (% of respondents)

Source: Eurobarometer (2010)

\(^{18}\) These levels and shares are believed to be underestimates.
vi. The public and private food quality and safety standards and the efficiency of their enforcement differ considerably between the industries, countries, and regions (Humphrey and Memedovic, 2006). That is a result of the unequal norms (e.g. GAPs, formal and informal rules) and the implementing and enforcing capability, and/or the deliberate policies or the private strategies (e.g. multinationals sell the “same” products with unlike quality in different countries). The “double/multiple standards” is responsible for the inequality of exchange, and the dissimilar threats and risks exposure of individual agri-food systems.

vii. The wide spreading “public failures” in the food-chain (risk) management – the bad, inefficient, delayed, under or over interventions; gaps, overlaps, infighting and contradictions of different agencies and rules; high bureaucratic costs; unsustainable and underfunding etc. For instance, the Bulgarian Food Agency and its Risk Assessment Centre were established with a 5 years delay after joining the EU (in 2011); the EU Acquis Communautaire are still not completely implemented in the country (capability deficiency, mismanagement, corruption); trust to the EU rather than the national institutions prevails (Bachev, 2010a). There are also numerous instances of the international assistance or governance failures when institutions are “imported” rather than adapted or designed for the specific local conditions (Bachev, 2010a).

viii. The production, marketing, and consumption traditions, the high food or governance costs, the will and capacity deficiency, all they are responsible for the persistence of a large risky informal/grey agri-food sector around the globe without an 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, 2011c).

ix. The multiplying new treats and risks associated with the adversary (e.g. by a competitor) and the terrorist attacks, and the emerging governing and exchange forms (e.g. street-sells; internet, phone and mail-orders; shopping-trips etc.). All they require specific non-traditional risk-management methods and modes such as guards; policing; intelligence; multi-organizational and transnational cooperation etc.

x. There would be further failure in securing effective food supply (food access) to all if a fundamental shift in the traditional model of governance has taken place. The later will require a new “social contract” and a novel public order as well as new theories and practices of distribution of wealth. In this sense a new emerging and discussed concepts of “universal income”, “unconditional basic income”, “Citizen's Income”, “basic income guarantee”, “universal basic income” or “universal demogrant” (BIEN, 2016) would likely give answer about prospects of dealing with persisting issues and future development and.

4. Conclusion

The analysis of the modes, efficiency and challenges of risk management in agri-food chain let us withdraw a number of academic, business and policies recommendations:

First, the governance (along with the technical, information etc.) issues are to take a central part in the risk management analysis and design. The type of threats and risks, and the specific (natural, technological, behavioural, dimensional, institutional etc.) factors, and comparative benefits and costs (including third-party, transaction, time) are to be taken into account in assessing the efficiencies, complementarities and the prospects of alternative (market, private, public and hybrid) modes.

Second, the system of the risk management is to adapt/improved taking advantage of the number of the new opportunities and overcoming/defending against the evolving new challenges summarized in the paper.

Third, more hybrid (public-private, public-collective) modes should be employed given the coordination, incentives, control, and costs advantages. The (pure) public management of the most agri-food-chain risks is difficult or impossible (agents opportunism, informal sector, externalities). Often the introduction and enforcement of new rights (on food security, risk-management responsibility etc.), and supporting the private and collective initiatives (informing, training, assisting, funding) is much more efficient.

Forth, a greater (public) support must be given to multidisciplinary and interdisciplinary research on (factors, modes, impacts of) the risk governance in the agri-food chain in order to assist effectively the national and international policies, the design of modes for public interventions, and the individual, collective and business actions for the risk management.
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