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Bachev, Hrabrin

Institute of Agricultural Economics, Sofia

1 May 2011

Online at <https://mpra.ub.uni-muenchen.de/30905/>

MPRA Paper No. 30905, posted 13 May 2011 17:35 UTC

Management of Chemical and Biological Risks in Agri-food Chain

Hrabrin Bachev

Institute of Agricultural Economics, 125 Tzarigradsko shose, Blok 1, 1113 Sofia, Bulgaria, tel/fax (359)29713913, e-mail: hbachev@yahoo.com

Abstract: Paper presents diverse modes of governance of chemical and biological risks in agri-food sector, assesses their efficiency, complementarities, and challenges, and suggests recommendations for public policies improvement. It defines governance as system of social order responsible for particular behavior of agents; specify various (institutions, market, private, public) mechanisms of risk governance and (natural, technological, behavioral etc.) factors of efficiency; and suggest a framework for analysis and improvement of risk governance. New opportunities for risks governance relate to: modernization of technologies and institutional environment; specialization, concentration, and integration; “willingness to pay” and consumers and media involvement; national and transnational cooperation. Risk management challenges are associated with: new threats and risks; separation of risk-creation from risk-taking; vulnerability of mass production, distribution and consumption; high adaptation and compliance costs; unequal norms, implementing capability, policies and private strategies; public failures; and informal sector. Policies improvement is to incorporate governance issues taking into account type of threats and risks, specific factors, and comparative benefits and cost (including third-party, transacting, time); employ more hybrid modes introducing and enforcing new rights, and supporting private and collective initiatives; give greater support to multidisciplinary and interdisciplinary research on factors, modes, and impacts of risk-governance.

Key words: risk management; market, private, public governance; agri-food chain

Introduction

Most risks management studies in agri-food sector focus on technical methods and capability to perceive, prevent, mitigate, and recover from diverse threats/risks. Despite technological advancements there are numerous failures in different industries and countries[1]. Consequently, attention is directed to *system of governance* which eventually determines exploration of technological opportunities and state of food security. *Paper presents diverse modes of governance of chemical and biological risks in agri-food sector, assesses their efficiency, complementarities, and challenges, and suggests recommendations for public policies improvement.*

Modes of risks governance

Governance is a specific *system of social order* responsible for particular *behavior(s) of agents* determining way(s) of assignment, protection, exchange, coordination, stimulation and disputing rights, resources, and activities[2]. Generic governing mechanisms are: *institutional environment* (formal and informal rights and rules, and system(s) of their enforcement; “*invisible market hand*” (price movements, competition); *private order* (voluntary, contractual and organizational modes); *public order* (interventions in market and private sectors) (Figure1).

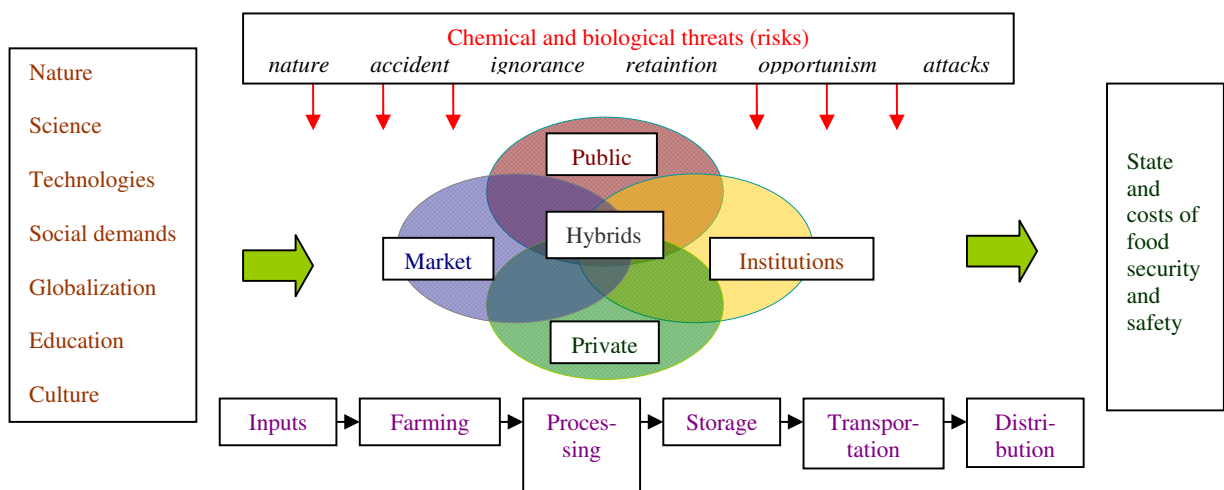


Figure 1. Factors, stages and modes of governance of chemical and biological risks in agri-food chain

Modern agri-food chains involve millions actors with different interests, multiple stages, and divers risks requiring complex, multilateral and multilevel governance at large scale. Various (natural, technological, behavioral) chemical and biological *threats/risks* (e.g. food-borne pathogens/zoonoses, natural toxicants, environmental and externally introduced chemical pollutants); accidental, ignorance, deliberate risk-taking, opportunistic, attack *causes*, and (inside, outside) *contamination sources* along agri-food chains are well-identified[3,4].

Diverse *market* and *private* modes emerged to deal with specific risks driven by ethics, competition, consumer demand, business initiatives, and trade opportunities - direct marketing, voluntary codes, industry standards, insurance schemes, guarantees, trade with brands, origins, organic and quality products (Figure2). Furthermore, different *bilateral/multilateral private* forms are widely used to safeguard against risks, explore benefits, and facilitate exchange - clientalisation, contractual

arrangements, cooperation, complete backward or forward integration. Special *trilateral forms* evolved to enhance security and partners and consumers confidence including independent (third-party) certification and inspection. Trade internationalization is increasingly associated with *collective private* actions (standards, control mechanisms) at transnational scale (GLOBALGAP).

Property (security/safety) rights modernization, and market and private “failures” brought about needs and modes for *public interventions* (assistance, regulations, provision) in agri-food sector. Scope and stringency of publicly-imposed rules expand constantly embracing new products, methods, dimensions (human, animal, plant, eco-health), hazards (GMC, nanotechnology, terrorism), and information requirements. Globalization of exchange and threats/risks increasingly require setting up *transnational public order* (ISO, WHO, FAO, WTO). For instance, there are common (traceability, precaution, communication) principles, (food, veterinary, phytosanitary, feed, environmental) legislation, and implementing and enforcing agencies (EFSA, ECDC, ECHA) for agri-food chains in EU (including import).

Risk management commands growing *technological* and *transaction* (adaptation, compliance, information, certification) costs. Benefits and costs of individual governing modes depend on *specific* (natural, technological, socio-economic etc.) *conditions* and *agents’ characteristics* (preferences, capacity). According to efficiency of system of governance put in place, the state and costs of food security in particular country and/or food chain are different. For instance, when there is inefficient public enforcement of safety-standards (lack of willingness or capability) enormous “gray” sector develops with inferior, counterfeit and hazardous components.

Analysis and improvement of risk governance include following steps (Figure3):

1. Identification of *existing* and *emerging* threats and risks along agri-food chain. Persistence of certain risks is indicator for ineffective governance. Modern science offers sophisticated methods for assessing various chemical and biological risks *to* or *caused* by agri-food chain[3].
2. Specification of *existing* and *other feasible modes* of risks governance, and assessing their efficiency and sustainability. *Efficiency* of individual modes shows capability for risks detection, prevention, mitigation and recovery at lowest costs while *sustainability* reveals “internal” potential to adapt to socio-economic, technological and environmental changes and associated threats/risks. Holistic framework for assessing efficiency and sustainability of governing modes is developed[2].

Chemical and biological risks	Modes of governance		
	market	private	public
Improper using pesticides/chemicals; Using contaminated water; Using contaminated soil; Improper animal health practices; Poor waste disposal; Using prohibited antibiotics; Using contaminated feeds; Animal-borne diseases; Improper handling/storage; Poor cooling system; Poor sanitation/hygiene; Using unhygienic containers; Unhygienic transport facilities; Improper grading/packaging; Unhygienic processing units; Using prohibited food-additives; Unhygienic cooking environment; Inputs/resources/output contamination	Clientatli-sation; Direct marketing; Informal branding; Insurance purchase; Organic production; Specific origins; Brands; Eco-system services; Special (quality, eco-) labeling; Outsourcing; Security services	Voluntary initiatives; Professional codes; Building (good) reputation; Guarantees; Private producers labels/brands; Private traders labels/brands; Private and collective origins/specialties; Private products recalls; Long-term contracts; Interlink contracts (inputs/service supply against marketing); Inputs/service cooperatives; Production cooperation; Joint-ventures; Internal audits; NGOs; Professional/consumer associations; Good Agricultural Practice; Good Hygienic Practice; Good Manufacturing Practice; Good Transport Practice; Good Trade Practice; GLOBALGAP; Private and collective food quality/safety management systems; Certification; Licensing; Third-party verification; Inputs supply integration; Integration into processing/marketing; Franchises; Consumers cooperatives	Mandatory (products, process, labor, animal-welfare, environmental) quality/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/animal nutrition and healthcare; Licensing for using agro-systems/natural resources; Mandatory farming, safety, eco-training; Mandatory certifications/licensing; Compulsory food labeling/information; Public accreditation/certification; Mandatory records keeping/traceability coding; Public products recalls; Public food, veterinary, sanitary, border control; Public funding farms/processors adaptation; Financial support to organic production, traditional/special products, private/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/water purification; Protected Designation of Origin, Protected Geographical Indication, Traditional Specialty Guaranteed; European Rapid Alert System for Food and Feed; EU policies, support/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

Figure 2. Chemical and biological risks and modes of governance along agri-food chain

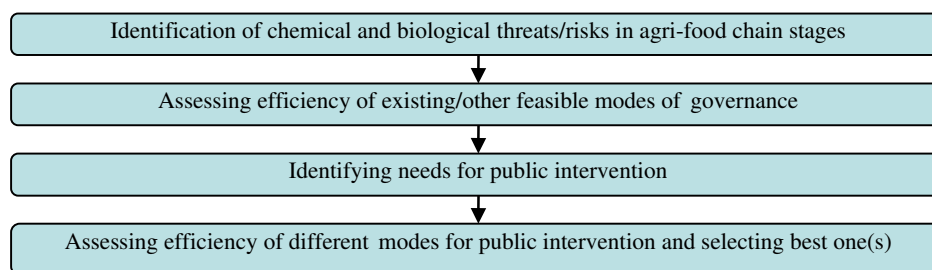


Figure 3. Improvement governance of chemical and biological risks in agri-food chain

3. Specification of *deficiencies* of dominating (market, private, public) modes to solve existing and emerging risks, and determination the *needs for (new) public intervention*.

4. Identification of *alternative* modes for public intervention to correct (market, private, public) failures, assessing their *comparative efficiency*, and *selection* the best one(s). Comparative assessment is made on (technically, socially) *feasible* forms as mode(s) minimizing *total* (implementing *and* transaction) *costs* for achieving food security goals is to be selected. Dealing with many problems and risks requires *mix, multilevel, and transnational* intervention[2].

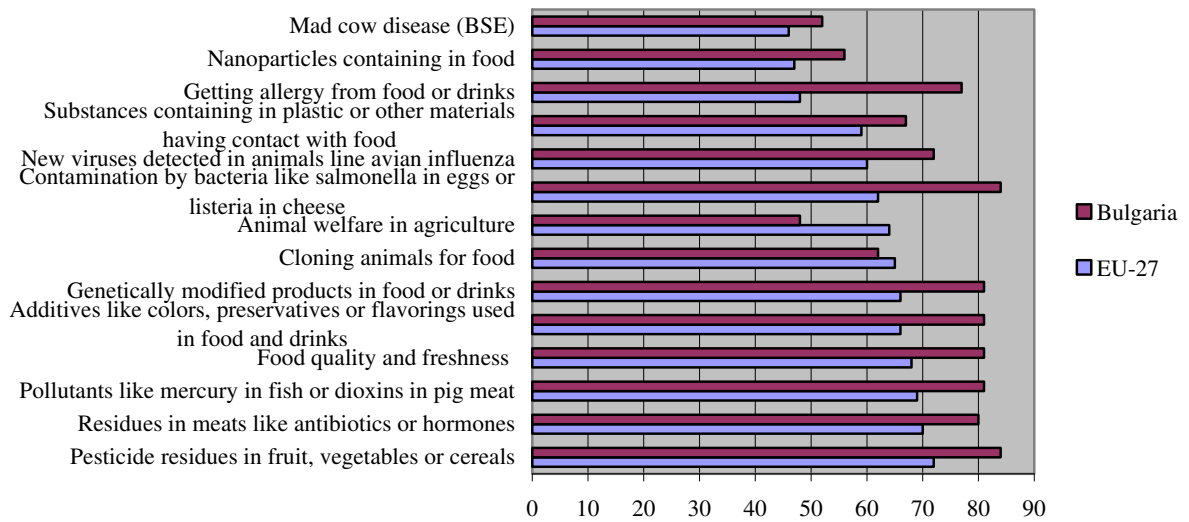
Comparative analysis let improve design of (new) public intervention according to specific conditions of food-chain components in particular country or region in terms of increasing security and decreasing costs. It also let predict likely cases of (new)public failures due to impossibility to mobilize political support and resources or ineffective implementation of “good” policies in particular conditions. Since public failure is feasible, its timely detection permits foreseeing persistence/rising certain risks, and informing local and international communities about consequences.

Opportunities and challenges for risk governance

Consumers concerns about food-safety risks significantly increase after major food-safety “events”/crisis in recent years (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 is augmentation of respondents “worrying about food-safety problems” in EU and it comprise a significant share now (Figure4); 48% of European consumers (Bulgarian 75%) indicate that consumed food “very or fairly likely” can damage their health[4].

(*New*) *opportunities* for risk governance relates to (Figure5):

i) Advances and dissemination of *technical* food-chain, training and risk-management *methods* (microbiological, genetic, electrical, laser, robotic, immunological, chemical and biosensors, nanotechnology, ICT), integral and food-chain *approaches*, and research, monitoring, testing, decision, and foresighting *capability* for risk-detection, assessment, prevention, and mitigation[3].



Source: Eurobarometer 73.5, 2010

Figure 4. Indicate if you are worried in relation with following food-safety problems (% of respondents)

ii) Modernization and *international* harmonization of *institutional environment* (private, collective, public food-safety and related standards, rules, enforcements). For instance, EU membership improves considerably “rules of the game” in Bulgaria; market access rules induce agri-food sector transformation of exporting countries.

iii) *Specialization* of activities (including risk-taking, monitoring, management) and *concentration of (integral) management* in food-production, processing, servicing, and distribution (centralized innovation and enforcement; time, scale, and scope economies; easy third-party control). For instance, market share of three largest food-retailers comprise 27-91% in EU states[4]; food-safety training, certification, inspection, and information are big international business[1].

iv) Quasi/complete *integration* of food-chain’s consecutive or dependent stages creating mutual interests and effective/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, 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[5].

v) Increasing consumers “willingness to pay” for food-safety attributes (e.g. chemical and hormone bans, safety and inspection labels)[3] justifying (paying-back costs for) special governance;

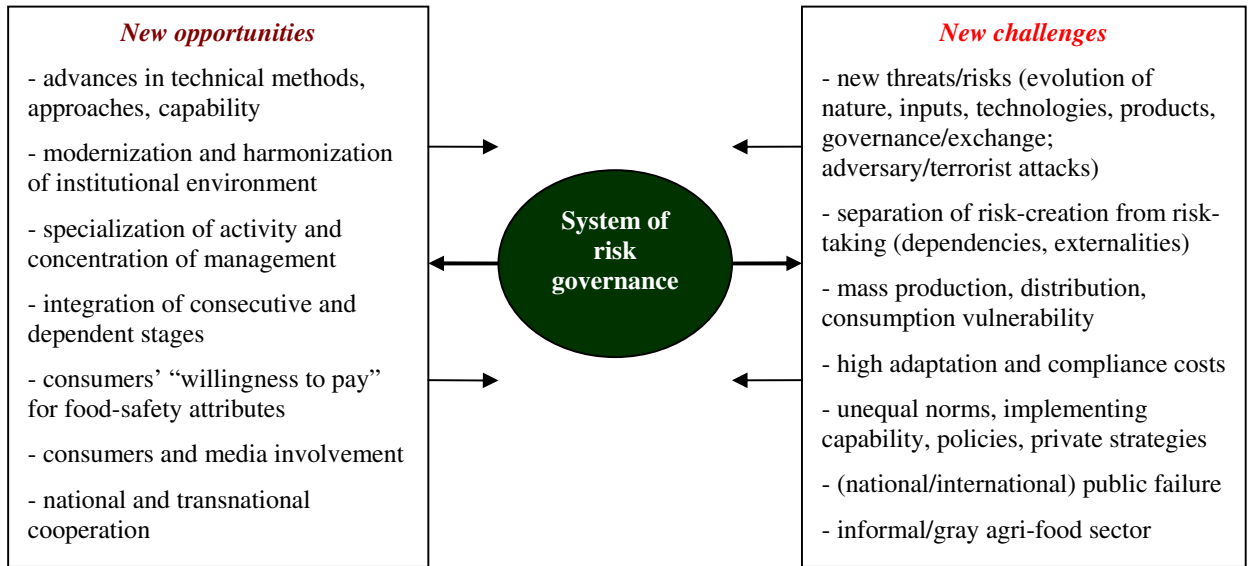


Figure 5. Opportunities and challenges for chemical and biological risks governance in agri-food chain

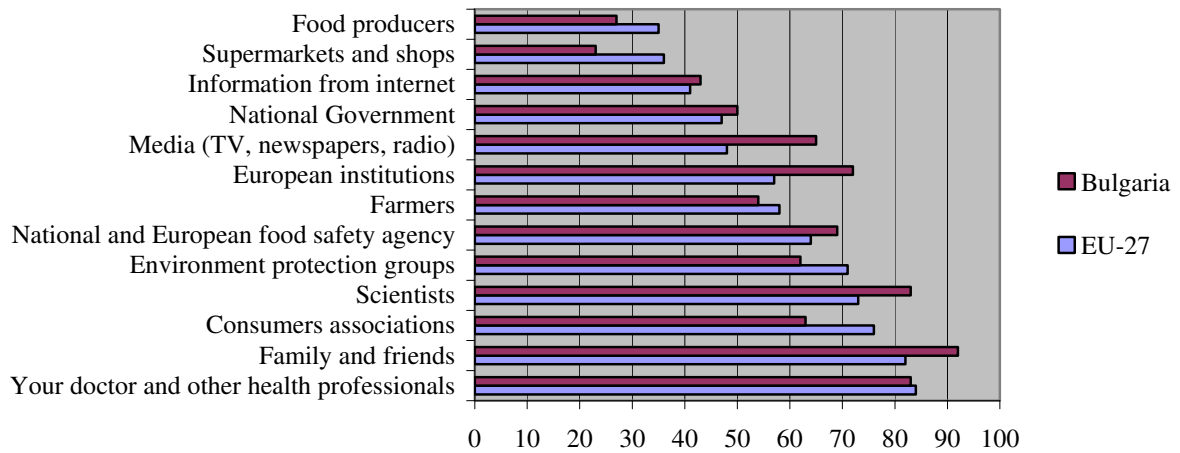
vi) Growing *consumers'* (representation, organizations) and *media* involvement, and *national* and *transnational* (information, technical, managerial, training, certification) *cooperation* of partners and stakeholders improving agents choice, inducing public and private actions, enhancing risk-management communication, efficiency, and speed.

(*New*) *challenges* for risk governance relates to:

a/ New threats, risks and uncertainty associated with evolution of *natural environment* (climate change, "new" plant, animal, human hazards).

b/ New threats, risks and uncertainty connected with *inputs, technologies, and products* differentiation and innovation – e.g. Fukushima nuclear accident severely affected agri-food sector; there are uncertainties associated with growing application of nanotechnologies, GMCs[4].

c/ Specialization and concentration of activity and organizations *separate "risk-creation"* (incident, ignorance, opportunism) and *risk-taking* (unilateral-dependencies, quasi-monopolies, spill-overs, externalities) making risk-assessment, pricing, communication, disputing, and liability through (pure) market and private modes very difficult/costly. For instance, cheating, misleading, and pirating are common in food-chain relations (high information asymmetry, detection, disputing, and punishment costs)[2]. For food risk information consumers in EU trust more to "health professionals", "family and friends", "consumers associations", "scientists" rather than "food producers" and "supermarkets and shops" (Figure6).



Source: Eurobarometer 73.5, 2010

Figure 6. In case a serious food-safety risk is found I would trust for risk information to (% of respondents)

d/ Mass production, distribution, and consumption increases *vulnerability* of agri-food chain expanding scope and severity of natural, incidental, opportunistic, criminal or terrorist risks. In Europe, there is progressive number of official notifications based on market and non-member countries controls, food-poisoning, consumer complaints, company own-checks, border screening and rejections[5].

e/ Increasing *adaptation* and *compliance costs* (capital, training, certification, documentation) for rapidly evolving market and institutional environment delaying or preventing reformation of smaller farms and food-chain enterprises[2,3]. For instance, dairy and meat processors adaptation to EU standards in Bulgaria continued 10 years while two-thirds of them ceased to exist[4].

f/ Public and private food quality and safety standards and efficiency of their enforcement differ considerably between industries, countries, and regions[2]. That is result of *unequal norms* (GAPs, rules) and *implementing* and *enforcing capability*, deliberate *policies* or private *strategies* (e.g. multinationals sell “same” products with unlike quality in different countries). “Double/multiple standards” is responsible for inequality of exchange, and dissimilar threats and risks exposure of individual agri-food systems.

g/ “*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 and underfunding. For instance, Bulgarian Food Agency established with 5 years delay; Acquis Communautaire still not completely implemented (capability deficiency,

mismanagement, corruption); trust to EU rather than national institutions[2]. There are instances of *international* assistance or *governance failures* (institutions are “imported” rather than adapted/designed for specific local conditions).

h/ Production, marketing, and consumption tradition, high food or governance costs, will and capacity deficiency, are responsible for persistence of a large risky *informal/gray* agri-food sector without effective control, and substandard, fake, and illegitimate products and activities. For instance, merely one-third of Bulgarian dairy farms comply with EU milk-standards, 0.1% possess safe manure-pile sites, half of produced milk is home-consumed, exchanged or directly sold[2].

j/ New treats and risks associated with *adversary* (e.g.competitor) and *terrorist* attacks, and emerging *governing* and *exchange forms* (e.g. street-sells; internet, phone and mail-orders; shopping-trips) which require specific/non-traditional risk-management methods and modes (guards; policing; intelligence; multi-organizational and transnational cooperation).

Policy recommendations

First, governance (along with technical) issues are to take a central part in chemical and biological risk management analysis and design. Type of threats and risks, and specific (natural, technological, social etc.) factors, and comparative benefits and costs (including third-party, transaction, time) are to be taken into account in assessing efficiencies, complementarities and prospects of alternative (market, private, public) modes. System of risk-governance is to adapt/improved taking advantage of specified (new) opportunities and overcoming/defending (new) challenges.

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

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

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