



DRINKING WATER QUALITY MANAGEMENT IN LATVIA: INTEGRATIVE AND ADAPTIVE APPROACH

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Abstract. The paper aims to develop a drinking water quality management model in country comprising integrative and adaptive management principles. A large part of problems are connected with institutional structure, including the dispersed drinking water quality supervision system, inadequate overall coordination of functions and responsibilities, insufficient capacity of institutions, lack of regularity in drinking water quality supervision. Another problem group is related to communication and collaboration issues: insufficient collaboration between target groups in different levels, inadequate way of information. The current research is based on sociological research methods: interviews and questionnaires involving respondents from principal target groups: state institutions, water management enterprises, municipalities, experts and population. The contribution of integrated approach leads to the management model, which involves: drinking water protection, water safety, public health and local planning issues. Accordingly, the adaptive approach leads to operative and flexible decisions and solutions, more effective planning, efficient provision of water resource infrastructure, learning from shortcomings and indicating a need for overall environmental assessments and research, as well as, comprehensive environmental communication. The adaptive water management has an important role for water-based infrastructure systems development, especially in rural municipalities.

Key words: *drinking water management, integrative management, adaptive management*

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Introduction

Drinking water safety framework

Freshwater resources for drinking water supply are nature resources, which have an important role for public health, environmental quality, economical development and ecosystems health. Drinking water safety is an important issue; that depends on water escalating abstraction, increasing pollution and urgency of various kind of security risks (Status Report..., 2008).

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The World Health Organization (WHO) Guidelines outline a preventive management for “framework for safe drinking water” that comprises the following principal components:

- health based targets consequent on an evaluation of health concerns;
- water supply system assessment for the whole water supply cycle: from the catchment and its source through treatment to the point of consumption;
- operational monitoring of the control measures in the drinking water supply;
- management plans regarding to system assessment, monitoring and actions to be taken (Guidelines for..., 2011).

Drinking water safety should be ensured by development of institutional framework, where:

- a competent coordinating national level authority provide a framework of health based targets and legislation,
- water management institutions ensure the operation of properly managed water supply systems comprising adequate infrastructure, regular water quality control, operational monitoring and good operating practice and
- supervision institution who is responsible for external surveillance through periodic audit of all aspects of safety (Foster, 2012; The Bonn Charter..., 2004).

The most effective means for providing the safety of a drinking water supply are comprehensive risk assessment and risk management approaches that comprises all steps in water supply from catchment to consumer – such approaches have been applied in Water safety plans (WSP). There are following principal components to any WSP:

- a supply system assessment ensuring the supplying water meets regulatory targets;
- provision of operational monitoring and control measures, identification of risks in a drinking water system;
- management plans, which describe actions taken during various operational conditions and define monitoring and communication plans (Guidelines for..., 2011).

In most countries, the national body responsible for the supervision of drinking-water supply is the Ministry of Health (or public health) and its regional or departmental offices. In some countries, it may be an environmental protection agency; in others, the environmental health departments of local government.

Applied management approaches

Water resource management have been expressed in various dimensions, striving improvement in nature environment, economic efficiency and social equity. Therefore the application of various environmental management approaches in drinking water supply sector are issues which attracted attention (Engle et al, 2011; Pahl-Wostl et al, 2007).

For the past two decades integrated approaches to water management have been developed and are being implemented. Integrated water resource management involves: integration of various aims and the corresponding products/results (economic effectivity, social justice, ecological protection), integration of all water resources (surface, ground waters, estuaries), multi users – a variety of water use (Integrated water..., 2000).

Current approaches to realizing integrated water management build on a command and control paradigm that has been dominating the water management community for decades. Such a paradigm requires that system behavior be highly predictable (Engle et al, 2011; Pahl-Wostl, 2007a). The increasing awareness of the complexity of water quality and safety problems has encouraged the development of new management approaches based on the insight that there is increasing rate of complexity and more



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unpredictable issues in water management (Kwasniak, 2010; Pahl-Wostl, 2007). Rogers (Rogers et al, 2003) stressed the need for more flexible governance systems and to take uncertainty into account. Rees (Rees, 2002) addresses the need for new strategies to manage risks in integrated water resource management and emphasizes the need to consider economic, social, and political uncertainties, which are often of more importance than environmental uncertainties. Adaptive management could be defined as a systematic process for improving management policies and practices by learning from the outcomes of management strategies that have already been implemented (Armitage, 2005; Tyler, 2008).

Complex social-ecological systems cannot be predicted and controlled, and a more adaptive approach is required; various researchers focused to adaptive management approach taking into account wide range of processes in ecological, economic, and socio-political dimensions (Pahl-Wostl, 2002; Stankey et al, 2005). The comprehensive research of the combination of management frameworks had been done is the NeWater project (New Approaches..), which underscores the need for both: adaptive and integrated water resources management (Pahl-Wostl et al, 2007). Adaptive management promotes flexible decision making that can be adjusted in the face of various uncertainties. The best known type of uncertainty is a lack of knowledge due to the limited availability and the variability of data in water management. Another type of uncertainties relates to socioeconomic issues and human behavior (different stakeholder perceptions and understanding about caused problems and appropriate solutions) (Lee, 1999; Williams, 2011).

Adaptive capacity is a principal term, which refers to the ability of social or ecological system to adapt to change and respond to impacts (Armitage, 2005); in most cases in water management adaptive capacity describes the social and institutional relationships and extent in which social stakeholders are able to avoid current management problems.

The following adaptive capacity aspects could characterize some water management problem solutions: actors must be able to process the necessary information and draw meaningful conclusions and they must combine different types of knowledge's (Armitage, 2005; Lee, 1999). The level of communication and cooperation that is required to manage the current information for adaptive management indicates that different stakeholders first of all need to maintain a commitment to the learning process (Williams, 2011).

The current problems in drinking water management requires, that improved groundwater management and protection needs to be multidisciplinary and strongly participatory (Foster et al, 2012). Besides, according the well known strategic principles (Dublin Principles,1992) „water development and management should be based on a participatory approach involving users, planners and policy makers at all levels”. Therefore in a socio-institutional context adaptive capacity depends on individuals and institutions that could fasten learning process. In that sense Community based natural resource management (CBNRM) performance have been recognized as a principal driving force for adaptive capacity. In last years CBNRM performance model have been applied to management issues, which demonstrated the performance of communities or community based institutions in nature resource management sectors, including water management (Armitage, 2005; Gruber, 2010).

Abovementioned literature review confirms that although integrative water management have benefits, this approach have also some shortcomings. In these respects, the earlier – integrative water management regimes were not sufficiently adaptive. Therefore only relatively recently the adaptive management approach became a major player in water resources management (Pahl-Wostl et al, 2007; Stankey et al, 2005).

Last years most researchers concluded on the growing trend to combine integrated and adaptive approaches into single framework, as well as, that IWRM is fully compatible with adaptive management considering about the necessary preconditions for such framework (Engle et al, 2011).



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Research methodology

The current research is based on literature studies and sociological research methods. Literature studies contained analysis of academic publications composing theoretical framework, publications regarding the best practices in water management, as well as, strategic and legal documents. Sociological research included deep interviews and questionnaires. 23 respondents had been involved in deep interviews represented principal target groups: state institutions (Ministry of Health, Ministry of Environment and regional development, Ministry of Agriculture, Health inspectorate of Latvia, Food and veterinary service of Latvia, The State Environmental Service), municipalities, water management enterprises and experts. The specialists from water management enterprises and municipalities (totally 102 persons) and inhabitants from town and rural municipalities (totally 471 persons) had been involved in questionnaires (Muceniece, 2011; Ozola, 2011).

Research results and discussion

Questionnaires involving the specialists from water management enterprises and municipalities (totally 102 persons) indicated the recognized drinking water management problems, which could be allocated in state and municipality levels; respectively in external and local scopes.

The main drinking water management problems at state level (external scope):

- insufficient state support for investments (227 grades in 3 grade system);
- insufficient public awareness on drinking water quality and pollution risks (215);
- insufficient research/ survey in water management in state level (204);
- insufficient feasibility studies for technical and economic substantiation (202);
- lack of strategic aims regarding water management in national level documents (200);
- overlarge centralization of supervision and control (198);
- ineffective and uncoordinated operation of state institutions regarding water quality supervision issues (195);
- insufficient attention to Water protection in another policies (186);
- shortcomings in policy of water service tariffs (180);
- shortcomings in single legal acts (179) (Muceniece, 2011; Ozola, 2011).

The main drinking water management problems at rural municipality level (local scope):

- out of date water supply technical equipment, mostly in rural municipalities (264);
- insufficient available finance resources for water management at municipality level (263);
- use of out of date technologies for water quality ensuring (220);
- lack of strategic approach in local planning (193);
- shortcomings in fixing of water service tariffs (188);
- lack of necessary competence in water supply enterprises (187);
- insufficient assessment of water resources in municipalities (169);
- insufficient water protection of water supply wells (166);
- insufficient information about water resource quality for population (163);
- shortcomings in administrative management (151) (Muceniece, 2011; Ozola, 2011).

Population from town and rural municipalities involved in questionnaires confirmed that 33% are satisfied with drinking water quality in tape, 44% – partly satisfied and 23% – did not satisfied. The most important reasons for disaffection were water taste (42%) and sediments (38%), as well as water color (10%) and odor (7%). The point is, that a large part of population (45%) is not informed about drinking



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water supervision system issues in country; 37% of population are satisfied with current system, but 13% are not satisfied.

Deep interviews involving state institutions, municipalities, water management enterprises and experts confirmed that most popular drinking water quality problems cover the insufficient water quality according to legal requirements, insufficient corrective actions, noncompliance of protective zone requirements, lack of necessary prevention measures. Therefore a principal step for drinking water supervision development could be scheduled in future the implementation of Water safety plans, which includes risk assessment and planning of adequate monitoring actions. Questionnaires indicated about low awareness on planned implementation of water safety plans in country: only 18% from specialists in water management enterprises and municipalities had been informed about that. A minor part of them recognized water safety plans as a benefit for public health (43%), as a tool for better information for population (41%) and a tool for better water supply inspection (26%). It should be pointed that water management enterprises and municipalities awake their role in the planned implementation of water safety plans.

Drinking water quality management system comprises the following principal target groups:

- a) institutions for water supply – water supply systems (WSS),
- b) water users (food enterprises and population),
- c) supervision institutions (inspectorates, services) and
- d) coordinating institutions on national level (corresponding ministries).

There are more than 1300 water supply systems in Latvia comprising drinking water to population from small rural territories till cities. The practical activities of WSS in the area of technical provision and monitoring very depend of enterprise scale and capacity; the support of more powerful municipalities often ensure the successful preconditions for water enterprise development.

Supervision institutions ensure control for the whole water supply systems and food enterprises according sanitary inspection requirements. Health inspectorate of Latvia and Food and veterinary service of Latvia are two principal supervision institutions in country, which are responsible on regular controls and complaint reviews, are acting according elaborated specific monitoring programmes and are elaborating corresponding regular surveys/ reports about drinking water supervision issues.

The point is, that Health inspectorate of Latvia and Food and veterinary service of Latvia have different subordinations: for first supervisory authority is Ministry of Health, but for second one – Ministry of Agriculture. Besides, different distribution of responsibilities take place on national level:

- Ministry of Agriculture is responsible on Food turnover (including prepacked drinking water issues) and on implementation of EU Drinking water Directive (due to responsibilities on food issues),
- Ministry of Health is responsible on drinking water supply to consumer (on water abstraction source protection and on consumer tape, provision of drinking water harmlessness), but the
- Ministry of Environment and regional development is responsible on water resource abstraction, drinking water treatment according legal requirements, realization of drinking water technical supply to consumer. Besides, Ministry of Environment and regional development on policy level is responsible on overall Water resource management policy (Muceniece, 2011).

Respondents from principal target groups (state institutions, municipalities, water management enterprises and experts) involved in deep interviews confirmed that there is lack of regularity in drinking water quality supervision. A need for responsible body (institution) for coordination of water quality and safety issues in state level have been recognized. The major part of respondents (15 from 23) stated that the Ministry of Environment and regional development could be the main coordinator of drinking water quality supervision system in country, 5 respondents indicated Ministry of Health, but 3 respondents indicated both ministries.



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Results of interviews gave evidence that there is a lack of effective collaboration and communication activities between supervision system institutions. Insufficient collaboration among different institutions had been recognized as one of main shortcomings in emergency situations; that lead to impermissible slow operations for identification of pollution spill source. State institutions in drinking water supervision system have no principal cooperation with science and research institutions. The contribution of scientific potential have not assessed yet (Muceniece, 2011; Ozola, 2011).

Sociological research using questionnaires confirmed a principal role of various environmental communication issues in drinking water quality management. Such environmental communication issues, as participation of public, enterprises and NGO, environmental awareness of consumers had been evaluated as unsatisfactory. It should be noted that the horizontal communication between supervision institutions should be more active ensuring the necessary water quality information flow (Muceniece, 2011; Ozola, 2011).

Proposals and recommendations

The drinking water quality management model have been proposed, based on sociological research and literature analysis. The model comprises:

- a) institutional structure including the principal institutions and their responsibilities,
- b) applied management approaches featuring the essence of management model and
- c) main actions – directions regarding to principal target groups.

Institutional structure

Drinking water quality supervision system is based on existing institutions, improving supervision system by following necessary functions and responsibilities (*Muceniece, 2011*).

- formation of one supervision coordination institution ensuring more effective and coherent action of all involved institutions and drinking water supervision from water abstraction till consumer, taking into account the existing political responsibility and public health strategic statements; here could be two options:
 - a) Ministry of Environment and regional development could fulfil coordination functions, because institutes under the supervision of mentioned Ministry are directly responsible on various important executive operations at municipality level;
 - b) both Ministries – Ministry of Environment and regional development and Ministry of Health are forming Coordinating Council, but this option requires very close collaboration between Ministries.
- implementation of Water safety plans, ensuring prevention oriented supervision, selfassessment, incl. risk assessment, planning of adequate monitoring actions;
- implementation of a new tool: drinking water data base, thus facilitating drinking water related information flow between various institutions (Health inspectorate of Latvia, Environment, Geology and Meteorology Centre, water enterprises and municipalities); such data base could ensure the direct input of corresponding drinking water information from information source/institution, as well as, application of data for corresponding information user;
- strengthening of collaboration between supervising institutions, putting emphasis to horizontal communication.



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Applied management approaches

The integrated water management approach should ensure the regularity of drinking water quality supervision system. The contribution of integrated approach leads to the management model with:

- integration of various aims, concerning water resource protection, water safety, public health, local planning issues, because drinking water quality and safety aspects should be integrated into territorial planning and building conditions documents;
- integration of drinking water information necessary for different institutions into drinking water data base; that should lead to better data availability to interested stakeholders (Muceniece, 2011; Ozola, 2011).

The implementation of adaptive management approach into drinking water quality supervision system leads to more operative and flexible decisions and solutions, more effective planning, efficient provision of water resource infrastructure, learning from shortcomings and indicating a need for overall environmental assessments and research, as well as, comprehensive environmental communication. The adaptive water management has an important role for water-based infrastructure systems development, especially in rural municipalities, where the current problems have a complex character and the role of operative and flexible decisions are important (Ozola, 2011).

Adaptive management requires a certain adaptive capacity of principal target groups. For supervision institutions, including Health inspectorate of Latvia, adaptive capacity includes ability to ensure drinking water supervision from water abstraction till consumer, provision of regular controls and complaint reviews, corresponding monitoring programmes. For drinking water suppliers adaptive capacity includes first of all ability to ensure water quality selfcontrol within all water supply steps and strengthening of institutional capacity. Finally, potential for development of water supply technical equipment and corresponding investment attraction, realization of feasibility studies and public information about current water management issues also creates adaptive capacity for water supply enterprises.

A lot depends from municipality capacity and that is a key issue in rural municipalities, where the current problems are related to low institutional capacity, out of date water supply infrastructure. Therefore adaptive capacity building in rural municipalities should develop necessary strategic planning, investment attraction, implementation of new technologies, maintenance of drinking water supply system (Muceniece, 2011; Ozola, 2011).

Main actions

The elaborated proposals for drinking water quality development comprise actions for various target groups: state institutions, municipalities, water supply enterprises, population. There is a need for necessary fundamental improvements in various drinking water quality management issues and proposed actions represent various environmental policy instruments. Part of these actions do not require a principal contributions/ investments, for example for service quality improvement, supervision of tariff treatment and actions. But there are another type of activities, which require a principal contributions/ investments, for example, drinking water quality control and monitoring, technology development (Muceniece, 2011; Ozola, 2011).

Actions for state institutions include:

- more specific definition of strategic aims regarding water management in state level documents (planning instruments);
- elaboration of guidelines for implementation of Water safety plans (planning instruments);
- formation of responsible body (ministry) for coordination of water quality and safety issues in state level ensuring the systemic and integrated vision (institutional instruments);



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- strengthening of survey and research for implementation of new technologies and water quality prevention measures (technological instruments);
- improvement of elaboration of water service tariffs (economic instruments);
- development of environmental awareness raising campaigns about drinking water quality, strengthening of active participation of all stakeholders in drinking water quality development (communication instruments).

Actions for municipalities include:

- strengthening of strategic planning at municipality level (planning instruments);
- capacity development for municipality specialists (institutional instruments);
- survey and assessment of water wells at municipality territory (control instruments);
- development for successful project proposals and investment attraction (finance instruments);
- strengthening of public information about current water management issues (communication instruments).

Actions for water supply enterprises include:

- implementation of Water safety plans (legal instruments);
- strengthening of institutional capacity, incl. consolidation forming larger enterprises (institutional instruments);
- strengthening of water quality selfcontrol (control instruments);
- development of feasibility studies in collaboration with water management experts (research instruments);
- improvement of water supply technical equipment (technological instruments);
- strengthening of public information about current water management issues (communication instruments).

Actions for population include:

- more active participation in decision making in water management area (communication instruments);
- higher environmental awareness, environmental sound behaviour (environmental education instruments);
- maintenance of private water wells and water supply equipments (environmental education instruments).

Conclusions

1. Formation of responsible body (ministry) for coordination of the whole drinking water quality management system at national level should ensure more effective and coherent actions of all involved institutions and could lead to more systemic and integrated vision.
2. The implementation of two new tools: Water safety plans and comprehensive drinking water data base should give a principal contribution to development of drinking water quality management system ensuring a water quality risk assessment, prevention oriented supervision and selfassessment, as well as, comprehensive drinking water related information flow and better data availability to all interested stakeholders.
3. Implementation of both: adaptive and integrative management approaches could provide a better flexibility and operativeness for drinking water quality management system at national level.



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4. Adaptive capacity development issues for all principal target groups form the ability to ensure drinking water comprehensive supervision, regular control, development of institutional capacity and investment attraction.

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