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**E. D. Ongley[1], A. Zhulidov[2], V. Khlobystov[2] and Y. Konygin[3]**

# Sustainable Surface Water Quality Monitoring in the Russian Federation: A Blueprint for Change in the Lower Don Region

## Abstract

*Surface water quality monitoring and protection in the former USSR and now in the Russian Federation has, historically, had a prominent position in the hierarchy of science, legal framework and institutional arrangements.*

*Regrettably, the difference between intentions and effective programmes has always been large and, since the collapse of the former Soviet Union in 1991, has become a formidable barrier to developing effective solutions to water quality management in the Russian Federation. In recognition of this problem, and as part of the World Bank's Environmental Management Project with the Russian Government, the North Caucasus Sub-Component has had a project focus on the development and demonstration of effective surface water quality monitoring in the Lower Don region. This programme has had three primary objectives -- efficiency, effectiveness and sustainability. Inevitably the outcome has been, to a significant degree, the result of a series of compromises among political, professional, and institutional interests.*

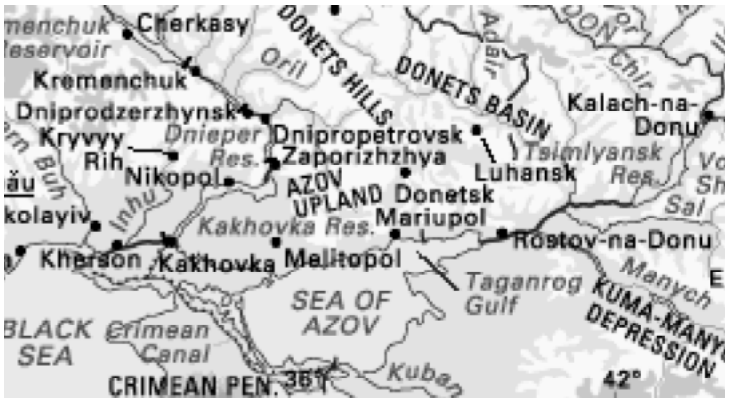
*This paper documents its successes, reasons for its failures, and provides a "blueprint" for future activities in the modernisation of surface water quality monitoring for the Lower Don region and, by analogy, in the Russian Federation. The barriers to progress include lack of a clear policy framework, overlapping and, in some cases, inappropriate institutional arrangements, as well as legal and technical issues. Some of these are in the process of being resolved. The programme, as a whole, provides lessons in steps towards effective national water quality management for other countries with transitional economies and, to some degree, in developing countries.*

[1] Emeritus Scientist, National Water Research Institute, Canada. Corresponding author.
[2] NCB-CPPI, Rostov-on-Don, Russian Federation.
[3] CPPI, Moscow, Russian Federation.

## Introduction

Surface water quality monitoring and protection in the former Soviet Union and the current Russian Federation has, historically, had a prominent position in the hierarchy of science, legal framework, and institutional arrangements. Regrettably, the difference between intentions and effective programmes has always been large and, since the collapse of the Soviet Union in 1991, has become a formidable barrier to developing effective solutions to surface water quality management. In recognition of this problem, and as part of the World Bank's Environmental Management Project (EMP) with the Russian Federation, the North Caucasus Sub-Component has had a project focus on the development and demonstration of effective surface water quality monitoring in the Lower Don region, encompassing the territory from the Tsimlyansk reservoir to the Sea of Azov, including the Russian portion of its tributaries. The project area corresponds mainly with the Rostov oblast with an area of 100.8 thousand km$^2$ and a population of more than 4,385,000 people.

Managed by the CPPI (the institution established by the Russian Government for coordination of international projects) in Moscow and in the North Caucasus Branch (NCB-CPPI) coordination office in Rostov-on-Don, the project began in 1995, under conditions of conflicting departmental interests and no appropriate legal framework in the Russian Federation regarding monitoring responsibilities. The project officially finished in 2001. Success of the EMP has been partial and the intent of this paper is




- To document its principal successes in the field of water quality monitoring,
- Reasons for its failures, and
- To provide a "blueprint" for future activities in the development of water quality monitoring for the Lower Don region and, by analogy, in the Russian Federation.

The fact that success was not complete is not remarkable given the distance the Russian Federation must travel in the water sector in unravelling and simplifying complex and bureaucratic structures, overcoming resistance to new and sometimes quite foreign ideas, developing new and innovative policies, and achieving institutional and economic stability. This experience is not only useful for other regions of the Russian Federation, but also to many other countries with transitional economies that have a similar history of a centralised and an excessively bureaucratic approach to water quality monitoring and management.

## Modernisation - the concept

Full modernisation of water quality monitoring and management programmes in the Russian Federation is a complex task involving significant change in national and local policies, legal structures, institutions, and technical matters. It is much more than a quick technical "fix", which is often the view of donors, recipients, and lending institutions. The modernisation

process has been described by Ongley [1,2,3] and an example is provided by Mexico [4]. Modernisation has three primary objectives:

- Effectiveness: Does the programme meet identified needs of users?
- Efficiency: Does the programme carry out its tasks at the least cost?
- Sustainability: Measures that can be taken to ensure long-term sustainability of the programme.

Relatively few countries have attempted a full modernisation of monitoring. Experience in some western countries is that "rationalisation" of monitoring is mainly driven by economics – less money, therefore fewer stations. Rarely does it trigger a debate over the purpose and mechanics of monitoring in order to achieve greater efficiencies and more useful information at lower cost. In many countries, including many economically developed countries, monitoring remains an activity which fills up databases, but which is rarely used effectively by governments. This is costly and wasteful, and the intent of the EMP developed by the World Bank and the Russian Government was to establish a cost-effective regional surface water quality monitoring system to achieve better information at lower cost.

In 1996, Mexico began a radical change in national water quality monitoring [4]. That experience is still underway. The timeframe is very relevant to the Russian situation insofar as there is an unrealistic expectation that modernisation can be imposed quickly. In the United States, a national task force on monitoring, which had as its main (and modest) objective the improved coordination and rationalisation of monitoring activities among national, state and tribal agencies and stakeholders, took more than three years to complete its recommendations and to implement some modest changes, without any significant change to the actual mechanics of monitoring. The monitoring component of the European Framework Directive (Directive 2000/60/EC of the European Union) took several years to formulate and will take more years to be fully implemented within EU countries. Chile is now beginning such a programme, but is not expected to complete this for several years. For the Russian Federation, as in most countries, the process of modernisation should be seen as a long-term project, which is mainly influenced by

(1) the need for extensive stakeholder consultation, and
(2) the bureaucratic steps needed to implement agreed changes.

## Modernisation – the backdrop

The status of surface water quality monitoring in the Russian Federation and former USSR has been reviewed by Zhulidov et al. [5]. In general, it is concluded that the Russian people have not been well served by national water quality monitoring programmes, either from a public health perspective, for environmental purposes, or for national water management. The following are the essential issues which comprise the backdrop to the modernisation process and which required specific actions to overcome. Some, such as policy ambiguity, have yet to be resolved and remain an important challenge for Russian authorities.

a) ***Policy ambiguity*:** surface water quality monitoring in the Russian Federation was, and remains, tied to an historical policy perspective of the former USSR that data collection by a federal agency over large areas would inevitably lead to environmental understanding and problem identification [6,7]. In fact, the federal surface water quality programme accomplished little of this mission, due to an out-dated understanding of what monitoring can, and cannot, achieve. There is no policy framework then, or now, that requires a data collection programme that serves users' needs for data, or which is linked to specific water management issues. Both in the former USSR and in the Russian Federation, data collection is considered an information activity that was, and remains, mainly unrelated to national water management issues. More generally, Russian policies on monitoring of surface water pollution were, and remain, mainly tied to a specific organisation such as the Russian Federal Service on Hydrometeorology and Environmental Monitoring (Roshydromet -- see below).

   It was only on 23 August 2000 that the Federal Governmental Decree # 622 on "Provisions on State Service of Observation of the Environmental Condition" was approved [8], stating that "for executive bodies of the constituents of the Russian Federation and local self-governing bodies to obtain special information on the environmental situation, territorial observation networks can be formed …". While this decree conveyed legal status to the formation of a monitoring system for the Lower Don and eliminated some of the formal grounds for conflict between the proposed programme and the national monitoring programme of Roshydromet (see below), this decree provided no direction on the modernisation steps required to ensure effectiveness, efficiency and sustainability either regionally or nationally.

b) ***Institutional paralysis and inertia***: Monitoring for surface water quality in the Russian Federation rested, by law, with the organisation now called Roshydromet. While there has been some shift in institutional responsibilities (Federal Governmental Decree # 622 of 2000 [8]), such as the addition of monitoring responsibilities within the Ministry of Natural Resources and by other participating federal and regional executive bodies, national monitoring primarily remains the responsibility of Roshydromet [5]). Roshydromet reports to the Cabinet of the Russian Government and has no accountability to any ministry. This organisation reports vertically upwards, is centrally controlled, controls access to monitoring data (generally, data are not available, even though the law now says it should be available), and suffers from serious paralysis in terms of modern methodologies and approaches to water quality monitoring and management. Roshydromet has not attempted to accommodate the sea changes that are now occurring in the field of monitoring, and suffers generally from institutional inertia, generally poor facilities, underfunding and poor technical leadership.

c) ***Data quality***: Data on surface water chemistry for the Russian Federation produced by Roshydromet (and for the entire USSR prior to 1992) are held in a national databank at the Hydrochemical Institute in Rostov-on-Don. This institute is the national water quality institute for Roshydromet where the data are supposed to be screened for errors prior to data archiving and printing of the national yearbook on water quality. Independent critical analysis of the database for the Lower Don River over the period 1985-1995, carried out by NCB-CPPI [9] with input from other Russian and foreign experts under the "EMP", indicates that a substantial component suffers from serious data quality problems that were never officially identified or corrected. Using analytical as well as inferential criteria (e.g. methodological factors), those authors reported that:

- 25% of data for $BOD_5$ is unreliable
- 30% of data on phosphate and total dissolved-P is unreliable
- 50% of data on all nitrogen species is unreliable
- 70% of data on organochlorine pesticides is unreliable (*plus problem of inadequate detection levels*)

Other researchers have reviewed water quality data elsewhere in the Russian Federation and have come to similar conclusions [10, 11, 12]. Regrettably, the national database has never been "cleaned up" to account for and officially recognise these data quality problems. Additionally, after 1991, the technical infrastructure has, for the most part, declined to such an extent that accurate data are difficult to produce [5].

d) ***Economics***: The deterioration of laboratory infrastructure and inadequate personnel training is a direct result of chronic underfunding during many years.

e) ***Decline of Russian science***: The decline of the proud scientific tradition of the former USSR is a major problem for modernisation. It is often difficult to convince bureaucrats and senior programme managers that Russian water quality science is very out-of-date not only in terms of approaches to water quality monitoring and management, but also in terms of technical applications. The revolution in the past decade in monitoring approaches and technologies is largely unknown to the majority of Russian scientists and bureaucrats. Simply purchasing new apparatus, for example, is not going to solve the existing problems. As we note below, the question of new equipment is one of the last decisions that should be made, not the first -- which is the normal approach by donors and international agencies and the first request of local programme managers. This inward and nostalgic view of Russian science, held by many scientists, technicians and bureaucrats of government agencies, is perhaps one of the most sensitive issues that inhibit modernisation.

## Modernisation - the steps

The process adopted for the modernisation process is outlined in Figure 1. This is a comprehensive approach to modernisation and served as a guideline to this project. All steps were considered, but are not fully implemented at this time. Because this is a lengthy process and highly iterative, Figure 1 serves as a guideline for future steps in the Lower Don region, and also for full modernisation in other areas of the Russian Federation. Table 1 outlines the major issues that are involved in this specific modernisation project and identifies the

strengths, weaknesses, and recommendations for change, of specific modernising steps in this particular project.

1. ***The enabling policy environment*:** Although the Russian policy environment is an inadequate framework for developing a new monitoring regime, it emanates from the Federal government and was not subject to review under this programme. National policy issues such as water quality standards, the role of Roshydromet, national data standards and accreditation, functional linkage of water quality to national water planning and management, etc., need urgent attention. For practical purposes, a number of pragmatic decisions were made regarding policy and institutional rationalisation in the study region.

2. ***Data needs assessment***: Figure 1 outlines the two types of data requirements – long-term descriptive data and more site-specific management-driven data. A needs assessment was carried out by the CPPI Programme Office in consultation with the various major stakeholders. At this stage, the translation of "needs" into an action plan still tends to be strongly biased by historical views of data collection programmes and existing monitoring sites, strategies and objectives, for which the various agencies (Roshydromet, Ministry of Natural Resources of the Russian Federation, Ministry of Public Health of the Russian Federation and its State Sanitary and Epidemiological Service) have responsibilities. This indicates that a major emphasis needs to be laid on education and training in the various local institutions, so that the programme may evolve using concepts that are more modern. Under the current redesigned programme, many of the needs for management-driven data will not be met. This is discussed more fully below.

3. ***Institutional coordination***: In Rostov oblast, as elsewhere in Russia and in many other countries, there is a variety of agencies that have specific responsibilities for water quality. As of Year 2001, the major players with operational mandates in the Rostov oblast are:

    - **Don River Basin Water Management Authority*:*** Responsibility for overall planning and management of the Don River Basin water resources. This is under the ambit of the Ministry of Natural Resources of the Russian Federation.
    - **Department of Natural Resources for the Southern region**: Territorial organisation of the Ministry of Natural Resources of the Russian Federation; in the field of monitoring it is mainly responsible for groundwater, surface and wastewaters monitoring, but increasingly (after elimination of the State Environmental Committee of the Russian Federation) has a national role for monitoring in general.
    - **Rostov Oblast Centre for Hydrometeorology and Environmental Monitoring*:*** branch of North Caucasus interregional territorial department on hydrometeorology and environmental monitoring, which, in turn, is a Roshydromet branch. Independent monitoring agency of the national government with primary responsibility for hydrometric and water quality monitoring under the State Service (Network) of Observation of Environmental Pollution (OGSNK prior to 1992 and GSN from 1992 onward) of the Federal Service of Russia for Hydrometeorology and Environmental Monitoring (Roshydromet) [5].
    - **Committee of Protection of the Environment and Natural Resources at Rostov Oblast Administration**: founded on December 29, 2000 by the Rostov oblast

Administration after dismissal of the State Environmental Committee and passing its responsibilities over to the Ministry of Natural Resources. The Committee ensures that a unified policy on environmental protection is carried out and coordinates the relevant activities of executive bodies on the territory of the Rostov oblast

- **Federal Center of Sanitary and Epidemiological Control in the Rostov Oblast:** branch of the Ministry of Public Health of the Russian Federation – among other things, responsible for drinking water quality and control of sanitary condition of recreational and other areas.

Each of these agencies (apart from the Committee for Protection of the Environment and Natural Resources at the Rostov oblast Administration) has its own monitoring facilities. Some of these (including laboratory facilities) are in such a state of disrepair that they cannot possibly produce reliable information and should be candidates for elimination or replacement. Generally, however, this is not possible for a variety of bureaucratic and institutional reasons. Therefore, the competition for funds is intense and the process of rationalisation is inevitably delicate and highly political.

**FIGURE 1: Framework for surface water quality monitoring in the Lower Don Region**

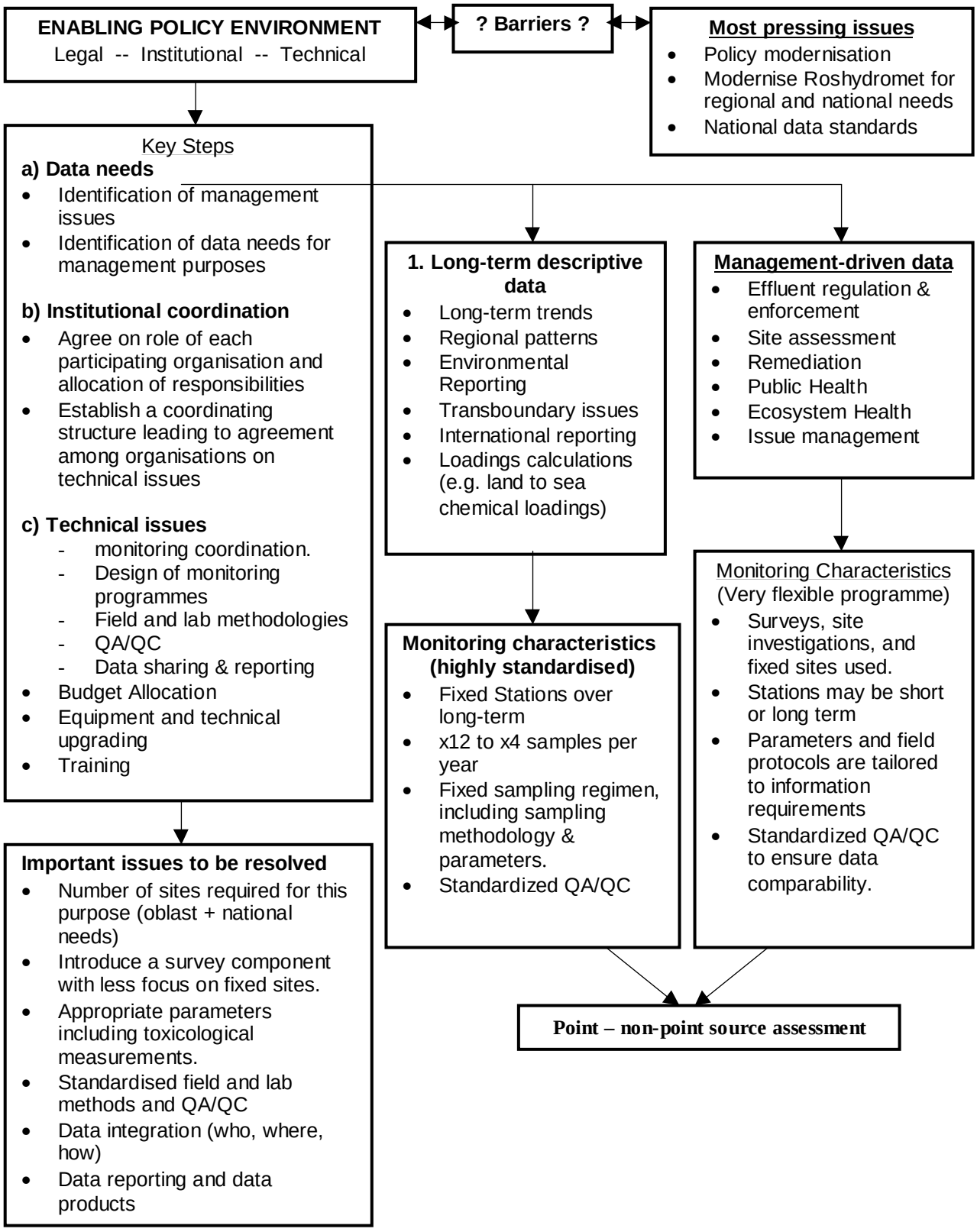


**Table 1. Lower Don Region Monitoring Programme: summary of main problems and solutions.**

| Lower Don Region -- Water Quality Monitoring Programme | | | |
|---|---|---|---|
| **Issues** | **Strong aspects** | **Weak aspects** | **Recommendations** |
| **Policy** | National monitoring policy exists. | Law on federal monitoring is poorly formulated technically and institutionally, with overlap and lack of clarity among various agencies. | Policy, regulations and law require revision to reflect modern approaches to monitoring. |
| | Regulation N 622 of 2000 clarifies and legalises local roles in monitoring. | Not implemented in a useful way. | |
| | Framework exists to establish national QA programme. | No ability to quality assure data at local level. | New, national approach to data standards is required. At local level, quality assurance methods and compliance need to be established. |
| **Technical** | Historically, strong science tradition in Russian Fed. | Current knowledge in many national and local agencies is limited to old concepts. Little cross-fertilisation with independent specialists | Extensive programme of upgrading skills and knowledge of national and local agencies. External agencies and independent specialists should be invited to participate in modernisation issues. |
| | Technical capacity exists outside local and national monitoring agencies. | | |
| | Local agencies accept the need for modernisation to ensure relevancy and cost efficiency. | However, resistance by local agencies reflects a perception that agency's programme will be diminished by process of rationalisation and consolidation. | Foreign expertise is, and will be, required to compensate for lack of domestic capacity and to facilitate change. This must be focused, and strategically planned. Temporary and ad hoc arrangements are wasteful. |
| | | Process of modernisation is only partial. | Full implementation of modernisation is a lengthy process and requires continued education of local agencies, and engagement by knowledgeable professionals. |
| | | Low level of information is available to the public | Methods of data availability need to be developed, including data products, means of access, etc. |
| **Institutional** | Command and control culture allows top-down implementation of modernisation. | Policy framework is not helpful. Little ability or incentive to change priorities or programmes. | More integrated, national level, approach to institutional roles and responsibilities. |
| | Don basin has basin-level organisation as basis for coordination | No control by basin org. over participating agencies' programmes or budgets, therefore little leverage. | Coordinating committee for monitoring requires financial leverage to encourage shifts in priorities. |
| | Local agencies have strong mandates. | | As above: education will also assist in shifting priorities. |
| **Financial** | External funding (World Bank loan) has been essential to achieve change. | This funding source has a limited timeframe. Existing programmes are not sustainable under current internal (domestic) funding allocations. | Continued, limited external funding (national or international) is needed to leverage the continued engagement of local agencies, & to ensure compliance with existing partnership agreements, and to ensure continued progress in modernisation. Need to promote modern lab practices that promote business opportunities. Creative commercial partnerships should be encouraged. Enabling legislation/polices are needed. |
| | Ability to generate revenue exists in some agencies | Modern lab management and business development techniques not well known. Enabling policy framework poorly developed. | |
| **Other** | CPPI, Moscow and NCB-CPPI Programme Office in Rostov has been essential to exercise leadership over the modernisation process. | Russian line agencies are not inclined to take local expertise seriously, no matter how good it may be thereby limiting effectiveness of local leadership. | Combination of local expertise, and strategic insertion of foreign expertise, required to lever change into local agency programmes. This need will continue for some years. |

In this context, and as part of the objective of cost-efficiency and sustainability, a coordinating agreement on "Performing monitoring of water bodies in the Lower Don basin" was arrived at with the Oblast Government and with all the federal agencies responsible for monitoring on the Lower Don territory. Together with one-time capital funding under this project, various parts of the new programme were allocated to specific laboratories with competence in the designated activity. Additionally, a laboratory in the regional Institute of Geology (State Geological Unitary Enterprise - SGUE) of the Ministry of Natural Resources has been equipped with specially procured advanced analytical equipment, including GC-MS, GC, HPLC AAS, a mobile laboratory, reagents and consumables to carry out advanced analyses and to improve the quality of analytical work. Part of the reason for this seemingly strange choice is that the SGUE is considered a neutral player, falls under the authority of an important national agency (Ministry of Natural Resources) and has the potential to become a regional analytical centre. This is not the most optimal solution, especially as this laboratory has had no long-term involvement in surface water quality. Nevertheless, the decision neutralises certain specific problems of institutional intransigence and is sufficiently pragmatic that it has a reasonable chance of success if managed correctly. At this time, this laboratory function is being established and it is too soon to determine if it will meet common requirements or, indeed, will be used creatively for common purpose.

In complex institutional situations such as this, effective coordination is the key to success. The various agencies established an inter-agency coordination committee, which has the power to make technical and administrative decisions. These are, however, non-binding on the various organisations. The committee is managed by the Deputy Head of the Oblast Government, which has the principal responsibility for water quality management in the Oblast. Upon completion of the Project, the committee will be transformed into a body responsible for coordination in the field of monitoring and water management in the Rostov oblast. However, in Russia, where agencies are accustomed to operating in a command and control environment, the absence of a controlling organisation in this arrangement presents challenges for cooperative programmes. The importance of nurturing this arrangement, after the project is completed, cannot be understated.

Another important observation is that, without this World Bank – Russian Federation project to serve as the catalyst and negotiator among the various competing interests, this level of coordination would almost certainly never have happened. There is an important lesson here for other Oblast governments insofar as they, without modern technical capacity, without a mandated coordination role in Russian law or policy, and without the ability to make major capital investments, are poorly positioned to achieve a rationalisation and modernisation of water quality management in their respective oblast.

4. ***Technical issues.*** The several technical issues identified in Figure 1 are discussed in more detail below in regards to current problems and future requirements.

**a. Regional monitoring network design:**

It is well understood that the customary fixed-site monitoring network used in many countries may be suitable for certain long-term descriptive purposes, assuming the network is designed and operated correctly -- a factor which is severely violated in recent Russian history [5]. The existing network, however, is neither efficient nor effective for site-specific or local regulatory purposes. It is, however, the historical approach to monitoring in Russian Federation.

In this Project, network location and sampling design rejected, in principle, the statistical approach that is advocated by some water quality experts. This decision was taken on the basis that:

1. Monitoring stations must be located so that they meet very specific needs for information for surface water quality management at identified locations. The network must be "purpose driven".
2. Sampling regimes that rely on a statistical analysis of data are inherently expensive due to the large numbers of samples required, and are inherently (and seriously) flawed by the assumption that the data set captures the natural variability in time, of the measured parameters. The instantaneous variability in conservative parameters (such as major ions) at a sampling point is in the order of 10-20%; variability in discharge or sediment-dependent parameters (phosphorus, metals, many trace organics – i.e. the things that tend to matter most in water quality management) vary up to, or exceeding, an order of magnitude (see, for example, Horowitz [13]). When one adds cross-sectional variation and short or long temporal variation the variance is even larger and is usually unknown. Therefore, the interpretation of water quality statistics of routine monitoring is inherently uncertain and unreliable and does not justify the costs associated with statistically guided sampling design. There are many other problems with the statistical approach, including "legal" samples used for enforcement orders, where it is necessary to take one or two samples with rigorous QA/QC and using a "chain of custody" approach to managing the sample.

In the Lower Don, the network was developed following an analysis of data needs by all stakeholders in the region in accordance with the 1998 Federal Law "On hydrometeorological services" (No. 113-FZ) [7] and the Governmental Resolution, March 14 1997 # 307 "On performing state monitoring of water bodies" [6]. Therefore, unfortunately, the outcome tends to closely mirror the existing sampling programmes of the several agencies in the oblast, primarily Roshydromet. This is a fixed-site network and is currently unable to deal effectively with many regulatory water quality concerns due to financial and technical reasons. The reason for this outcome is instructive:

- Every agency participating in the project had its own departmental interests and ideas on the structure and objectives of the new regional monitoring network. There was a strong vested interest by these agencies to ensure that their ongoing fixed–site monitoring programmes were incorporated into the new design. In part, this assured the survival of their own mandates and programmes irrespective of whether it is appropriate under the new realities of data needs. No agency had sufficient authority to impose an optimal solution so that the output is, at best, an amalgam of data needs and vested interests.
- The lack, at the time of project implementation, of a legal basis for developing a local monitoring programme led to strong resistance from agencies such as Roshydromet which saw itself as the sole, legally responsible (Law of 1998, No. 113-FZ) [7] agency for surface water quality monitoring. As noted above, the type of programme advocated by

Roshydromet was not only unreliable, but was largely irrelevant to the types of management issues to which this project was directed. This legal conundrum was partially resolved only in 2000 by Government Resolution N622 [8], which created a legal basis for establishing monitoring programmes and, in effect, legalised decisions in the Lower Don region that had already been taken. Nevertheless, the opposition of Roshydromet during the planning stage not only delayed the implementation phase by one to two years, but also led to many decisions that were less than optimal.

- There was no input from external or foreign experts at the time of negotiating the network design, so that the output tended to reflect existing knowledge and understanding. The role of foreign experts in facilitating change is important, especially in the situation where preconceived notions are difficult to break. Local experts are often seen merely as mediators rather than agents of change.
- There was no "education" component mounted before making network decisions, so that agency decision-makers might be more aware of modern approaches to monitoring and, therefore, be able to make a more judicious choice of network.

Nevertheless, certain benefits have accrued from this rationalisation of monitoring. Agencies are much more aware of the need to cooperate, and will work together within the new monitoring framework rather than duplicate each other's work. Work done by each agency tends to reflect their strengths. The numbers of sites has been greatly reduced from the original sets of monitoring programmes. Data sharing will be instituted. At the time of writing, trials for integrated programmes were recently completed and the full programme has yet to be implemented. Lack of sufficient sustainable funding remains an unresolved problem.

As noted in Figure 1, it will be critical to the long-term success of this programme that extensive training be undertaken to upgrade knowledge and skills of local staff and decision-makers so that the monitoring network can be modified over time to take into account more modern approaches. Missing in this programme is a balance between a fixed-site network and a survey or temporary station approach that is more effective in dealing with regulatory issues. The coordinating committee will have to consider, under the current financial realities, how to assign responsibility for operating surveys, and to assign priorities both for site-specific regulatory issues and for the development of protocols for field and laboratory quality control and quality assurance with these issues.

For regulatory purposes, the Mexican example is instructive [4]. A similar programme should be considered in the Lower Don region, where clear distinctions can be made between long-term descriptive monitoring, and specific needs for regulatory information. The latter can be much more efficiently obtained by a temporary network of stations that are tailored to site-specific needs and which may be added, or removed, according to the need for information.

**b. Choice of parameters:**

The parameters that have been selected reflect traditional monitoring programmes of the participating agencies. The focus is mainly on water chemistry but with additional biological measures (phytoplankton, zooplankton, zoobenthos, chlorophyll-a, microbiological and parasitological parameters). In part, this reflects legal requirements in Russia. However, the

entire question of parameters and sampled media needs to be examined, partly in the context of what can be done reliably under the current set of constraints, and partly to replace certain types of monitoring with other and more cost-effective techniques. In particular, it is well known that monitoring for health-related issues, especially control of pesticides, industrial compounds, and heavy metals that comprise most of the US-EPA priority pollutants list, is not effective in water samples. New techniques that focus on sediment-related chemistry, on screening techniques using toxicological screening tools, will be much more effective both for public health and environmental protection. Other techniques such as in-stream biotic assessment should also be considered as a more effective means of long-term assessment of river health. There are new laboratory techniques that provide much more reliable information on toxic stressors in water and effluents, and which can greatly reduce the cost of remediating water or improving effluents when the precise nature of the toxicity is known.

This complex topic reflects major advances in environmental monitoring and assessment over the past decade and which are almost unknown in contemporary Russian monitoring. There is, therefore, a major requirement for enhancing the understanding of programme managers in these various areas and to demonstrate their cost-effectiveness. In many cases, existing staff can be re-trained to perform many of these analyses. For this project, a ten-year timeline should be established in which to introduce a selection of these new types of programmes into the monitoring schema.

In the Russian context, however, it is doubtful if local offices of national agencies will be aggressive in introducing new monitoring technologies. However, the cost-efficiencies of these are so large that, together with the foregone costs associated with poor data that seriously compromise Russian health and economic development, that the Russian government should consider a small, permanent, senior advisory group (including foreign representation) to:

- Draft revised legislation on water quality monitoring to reflect these new technologies
- Review and promote new technologies in national and local monitoring programmes
- Assist all oblast governments in modernising their programmes
- Advise federal agencies on financial measures that provide incentive for the introduction of new monitoring technologies

**c. Quality Assurance and Quality Control (QA/QC):**

Failure of QA/QC is evident throughout the federal surface water quality-monitoring programme of the Russian Federation and in laboratories at the Oblast level. Although all agencies claim to use "standard" methods and laboratories accredited in accordance with Russian Standards, it is obvious that the implementation of QA/QC procedures is not systematic and certainly not enforced. The poor condition of many laboratories makes reliable data almost an impossibility. There is no authority in the region with the mandate to close or consolidate laboratories or to enforce data quality. The existing system of national data standards is not sufficiently developed to ensure the necessary quality guarantees. For example, there are no requirements for regular inspections of laboratories, or standards that lay out a common set of accreditation and compliance practices and penalties for non-compliance.

In the absence of national data quality standards, this project will require, in the near future, agreement on a common set of quality control measures, and an accountable mechanism for quality assurance. At the point of data centralisation for this programme (within the context of information systems and modelling being developed in parallel with the water quality component) there needs to be a set of routines that check incoming data for error and inconsistencies. This should be implemented immediately insofar as this is directly under the prerogative of the Coordination Committee, can be implemented quickly, and will quickly identify poor laboratory performance.

Over the next five years, if not at the national level, then at the oblast level, steps should be taken to develop a regional quality assurance programme that will result in local certification of laboratories. This step could be implemented by the oblast government, insofar as it can exclude any non-certified laboratories from local funding and from participating in local programmes for the oblast government. This approach has been successfully adopted nationally by the Mexican Government and is being implemented by the Government of Nepal. In terms of sustainability of the programme (below) local certification would be a step towards the longer-term goal of certification under other national or international criteria such as ISO 17025 (the laboratory ISO standard). In the economic marketplace, local laboratories can anticipate that their services will be competitive only if they have third-party certification.

QA/QC is not, however, only an analytical issue. It also involves the wider consideration of management practices, use of Good Laboratory Practices, and facilities management. There is no evidence, for example, that local laboratories have, in place, Standard Operating Procedures (SOPs) which are essential for the production of reliable data. Therefore, it is advisable that the Coordinating Board institute a programme of training of laboratory managers in modern techniques of laboratory management.

**d. Databases and reporting**

As part of the Lower Don programme one of the activities has been the development of an integrated information system to assist the various agencies in sharing data and making management decisions. The information system was conceived as housing surface and wastewater quality data as a basis for management but not, at this time, as a tool for public access to information. To date, the database structure using SQL protocols has been

developed together with programmes to convert data from various departmental formats. To date there has been no discussion on mechanisms of data quality assurance including the metadata that are essential for interpreting water quality information.

At the level of the laboratory, decisions must be made on how to internally handle water quality data, including the use of spreadsheet or database structures, and the extent to which participating organisations need simple information systems to explore data relationships and to interrogate data sets for management purposes. The functionality (such as query needs) at the local level is usually different than that required in a central database, therefore the distinction needs to be carefully worked out prior to making final decisions on the functionality of the central system.

Most importantly, consideration needs to be given to reporting requirements, to the types of data products that will be needed, and to public access to data. This ensures that the database will be a dynamic part of water management. Without this, the main activity will inevitably end up being mainly a data repository that is of little value to water quality management.

## Sustainability

The current economic situation is partly to blame for the state of monitoring in Russia in general, and in this oblast in particular. It is not clear at this time if the advances made during the project will be sustainable in the longer term insofar as the fundamental issue is one of future financial support. Nevertheless, the project has taken the essential steps necessary to set the stage for sustainability by focusing on shared resources, elimination of overlap and competition, and a more rationale and cost-effective approach to monitoring. Sustainability, under the circumstances of the Russian Federation, requires a continued presence of technical backstopping to ensure that past gains are not lost, and that momentum is maintained to further increase technical and institutional efficiency.

In the longer term, sustainability can be linked to the ability of existing laboratories to attract non-government funding. Already there is some modest amount of work that is done by some government laboratories for the private sector. The Russian regulatory regime for effluents is well developed in law (some say excessively -- often beyond the ability of local laboratories to accurately measure) and provides a framework for fee-for-service work that can augment the meagre budgets assigned from central agencies. This is particularly important in the context of paying staff a living wage in order to retain skilled personnel in the government sector. Public-private sector partnerships are attractive to European and, especially, North American private sector laboratories when local conditions can ensure a stable business environment. While not considered in this EMP project, the future role of the private sector in operating, or partnering with, local agency laboratories has the potential for off-loading much work now done inside government, and for training and investment in infrastructure by the private sector partner.

In the nearer term, certain measures are important when considering private sector work by existing laboratories. Laboratory managers need to be trained both in technical areas such as Good Laboratory Practices and in management technique. The latter involves a wide range of issues, including costing, pricing, cost avoidance, re-investment, entrepreneurial strategies, etc. The agencies to which these laboratories belong will need to revise their policies on management practices so that local managers are empowered to manage budgets and have the incentives to work effectively and efficiently.

### Role of international experts

In Russia, as in many other countries with transitional economies, the availability of local professionals with the necessary experience in modernisation practices is extremely limited. Most importantly, it was found in this project that, while local professionals were very capable at handling many aspects of the implementation, they lacked the credibility (especially in the eyes of the various agencies) to promote major shifts in programme, administrative arrangements, or in technical modernisation. Consequently, the use of experienced foreign consultants is essential.

For this project, the coordination office in Rostov-on-Don is small, with only one Russian water quality professional. Because this project is part of a much larger national programme, much of the decision-making on project management was centralised in Moscow. For the water quality component in the Lower Don region, over a four-year period, only two foreign professionals were contracted, and one of those for only a week. The other was invited at the beginning and near the end of the project (presumably to reduce costs and in the mistaken belief that there was sufficient expertise inside Russia to implement the plan that was initially proposed). There was no specific strategic framework for the involvement of foreign professionals. This has resulted in delays in implementation, unease by the local office over technical issues that were not within their experience and certain decisions on budget and capital allocations made under pressure from local interests, which, in fact, are not in the long-term interests of local parties and for which a foreign professional would have been able to mount effective arguments for alternative investments.

In retrospect, we believe that the cost-saving efforts to restrict the involvement of foreign professionals were counterproductive and costly. This cost is not only in terms of specific capital and programme decisions, but also can be measured by the accrual of costs and loss of benefits over the longer term by the inability of local staff to mount effective arguments for programme changes that would have been much more cost-effective and would provide more useful information. The role of the foreign professional should be one of guidance and facilitation and, with good local staff as is the case here, needs only be involved on a periodic, but consistent basis to ensure that the strategic direction is maintained. The lesson here is that the lack of consistent access to experienced foreign professionals over the life of the project has resulted in delays, unnecessary costs, and loss of future benefits.

## Conclusions and recommendations

The water quality project in the Lower Don Region, under the general framework of the Russian Federation – World Bank EMP, was established to provide a demonstration of modernisation of water quality monitoring that could be emulated by other local governments. Considerable progress has been made, especially in the identification of management needs for data, and in the development of new coordination mechanisms between existing agencies. However, success has been frustrated by the need to accommodate a large number of vested interests on the part of agencies with specific monitoring mandates and often-rigid views on the practice of monitoring. In part, this results from a confusing policy environment in which the practice of water quality monitoring suffers from overlapping mandates and rigid and out-dated practices. From a technical perspective, this has resulted in a failure to bring a truly modern approach to the practice of monitoring. Nevertheless, progress achieved within the timeframe of this project, from 1995 to 2001 is comparable with progress illustrated in other countries, in which one of the authors has been involved, that have attempted to make significant changes in their monitoring programmes. Progress must be viewed not only within the context of technical implementation but, more importantly, within the timeframe that is required to change the culture of water resources management.

Future developments in the Lower Don region should focus on education of local staff in modern monitoring and laboratory practices with the objective of introducing substantial changes in the programme over the next five to ten years. Because of the absence of well-informed staff within local agencies, technical backstopping and monitoring of project implementation should be part of a follow-up programme. Authorities should consider the potential for private sector involvement in the operation of government laboratories as a means of securing additional investment capital, training, and infrastructure.

At the national level, there is an urgent need to revise existing policies and legislation in the field of water quality. The cost to the Russian government in terms of public health and economic cost, due to unreliable and unrepresentative data, is large. For this reason, it is recommended that there be a standing, permanent advisory committee on environmental monitoring, which is independent of Roshydromet, which includes foreign professionals, and which can advise the government on policy revision, implementation of modern monitoring tools, and oversee implementation of recommendations by national agencies. An appropriate body could be within the Ministry of Natural Resources of the Russian Federation.

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