Customizing methods for assessing economic benefits of hydrometeorological services and modernization programmes: benchmarking and sector-specific assessment

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There is a growing understanding that hydrometeorological data, and weather forecasts in particular, bring economic and social benefits to any country. The use of hydrometeorological information in decision-making makes it possible to minimize economic damages and loss of human lives, as well as to gain additional economic benefits from the forecasts of favourable weather conditions. However, existing methods for assessing the economic benefits of hydrometeorological information and services require reliable econometric and specialized data, considerable resources and expertise. All or many of these ingredients are missing in the developing countries, making it difficult for national hydrometeorological services (NMHS) to demonstrate the economic efficiency of their services and justify the need for adequate public support.

The World Bank was first faced with the need to develop a method for an express assessment of the economic efficiency of NMHS in 2003 while preparing the National Hydrometeorological Modernization Project in Russia. The results of the study, carried out jointly with Roshydromet, were well received by the Russian Government and World Meteorological Organization (WMO). This positive experience has encouraged the bank to launch further studies in cooperation with NMHS.

Over the past 15 years, the NMHS of the transition economies in the Europe and Central Asia (ECA) region suffered greatly from the massive underfunding. This resulted in increased economic losses from hydrometeorological hazards and unfavourable weather conditions, the frequency and scale of which increased in most ECA countries. Modernization of NMHS and improvement of hydrometeorological service (HMS) delivery is one of the key factors in minimizing economic losses from these events and increasing pubic safety. Before allocating resources for such modernizations, the national governments demand that NMHS prove the economic benefits of such a decision.

For most NMHS, this poses a great challenge due to the absence of a generally accepted methodology for assessing the effectiveness of HMS delivery or modernization programmes; lack of basic econometric information needed to assess losses and benefits, and the shortage of expertise in NMHS and weather dependent sectors capable of making this assessment. The process of collection and evaluation of the information is time-consuming and requires substantial funding which is often unavailable.

The World Bank, jointly with a number of NHMS in Europe and Asia (among them Albania, Armenia, Azerbaijan, Belarus,

Photo: Mr P Lurie

In the last five years, 15 cases of waterspouts have occurred 3-5 km from the coast, on two occasions causing the loss of human lives

Main parameters and results of economic efficiency of HMS delivery and proposed modernization programmes (economic parameters are in USD of 2000 constant prices)

	Albania	Azerbaijan	Armenia	Belarus	Georgia	Kazakhsatan	Serbia
Average Annual GDP, $ million	4,229	7,061	2,579	15, 011	3,620	23,991	9,763
Territory, thousand km²	28.8	86.6	29.8	207.6	69.7	2,720	89.0
Population, million.	3.1	7.8	3.0	10.3	4.9	15.1	8.1
NMHS funding, $ million	0.44	1.7	0.47	2.96	0.47	4.21	5.15
Share of agriculture in GDP, %	24	12	30	10	25	7.0	17
Weather dependent sectors in GDP, %	65	51	69	43	62	45	44
Meteorological vulnerability	«relatively high»	«relatively high»	«relatively high»	«relatively high»	«relatively high»	«relatively high»	«average»
State of NHMS and HMS delivery	«poor»	«poor»	«poor»	«poor»	«poor»	«poor»	«satisfactory»
Adjusted share of losses incurred, benchmarking (% of GDP)	1.00	0.5	1.25	0.38	0.99	0.32	0.44
Assessment of economic losses,$ million benchmarking	37.9	35.5	32.2	57.5	35.8	77.9	42.
Assessment of economic losses (direct and indirect), $ million sectoral assessments	32.1	54.5	50.1	72.3-83.1	53.6	-	95
Assessment of preventable losses, $ million, benchmarking	10.5	13.9	7.0	28.8	9.3	39.0	33.5
Assessment of efficiency of the existing HMS delivery (%), benchmarking	432	165	277	206	362	198	219
Annual incremental effect of improvement the status of NHMS and HMS delivery to “adequate” – benchmarking assesment, $ million	2.5	3.8	1.6	8.6	2.2	11.5	5.5
Annual incremental effect of improvement the status of NHMS and HMS delivery to “adequate” – sector-specific assesment, $ million	1.8-3.9	12.3	9.2	7.9-9.1	8.0	-	4.34
Estimated cost of modernization program, $ million	4.0	6.0	5.3	11.5	6.0	14.9	4.4
Investment efficiency, % (across 7 years), benchmarking	630	430	210	530	260	540	880
Investment efficiency, % (across 7 years), sector-specific assessment	320-680	1440	1070	480 –550	1,050	-*	690

Source: authors’ estimates based on official statistics and national hydrometeorological and sectoral experts’ assessment

Georgia, Kazakhstan, Russia and Serbia), has been engaged in developing and piloting new approaches for estimating additional economic benefits from the modernization and development of HMS, as well as for assessing the current economic benefits from existing HMS. These efforts were driven primarily by practical considerations in the process of development modernization initiatives and fostering a better dialogue between HMS and national economic and fiscal authorities. As a result of this cooperation, two simplified methods — benchmarking and sector-specific assessment — have been developed. These two approaches are independent and yet complementary.

Why benchmarking?

Benchmarking offers an express method of obtaining results about damages caused by weather impacts in the absence of essential information, and with financial and time constraints for more detailed studies. The method employs the available official statistics and expert assessment of the weather-dependence of a country's economy, meteorological vulnerability of its territory, and existing NMHS provision.

The benchmarking method has two stages: determining the benchmarks; and correcting them according to country-specific characteristics.

Determining benchmarks

In order to estimate benchmarks, we have used various data and estimates obtained from studies conducted in other countries alongside estimates from experts working for NMHS. For the purposes of this study, the following values for principal benchmarks have been assumed:

1. Average annual level of losses from adverse and dangerous weather conditions as a percentage of GDP — 0.45 per cent. The range of annual losses is assumed to be 0.1-1.0 per cent of GDP. There is no comprehensive database on this important parameter, the estimates available in the literature vary from about 0.1 per cent to over 5 per cent of GDP.
2. Average annual level of prevented losses as a percentage of total losses — 40 per cent (range — 20-60 per cent).

It is also assumed that the country corresponding to these benchmarks would have the following characteristics:

- Weather dependence (aggregate share of weather-dependent sectors in GDP) — 50 per cent
- Share of agriculture in GDP — 15 per cent
- Meteorological vulnerability — 'average'
- Status of HMS provision — 'satisfactory'.

The meteorological vulnerability of the territory was assessed according to specially designed methodology that took account of the observed extreme values of major meteorological components, among them temperatures (minimum and maximum), precipitation and wind, along with characteristics of their statistical distributions.

Correcting benchmarks

At the second stage, the benchmarks are corrected according to country-specific characteristics. The intervals for possible distribution of country-specific estimates and the methods for adjusting benchmarks were devised on the basis of expert assessment and the results of studies conducted in other countries. Finally, the estimates obtained for a specific country are used for calculating the marginal efficiency of the existing HMS and its potential improvement in case of proposed modernization.

One of the constraints of this method is that it allows for assessing the efficiency of HMS only in relation to prevention of direct losses, while indirect losses (including the loss of human lives, profits etc.) are not factored in. As a result, the obtained estimates of economic benefits from NMHS substantially understate their real economic value. Another important constraint comes from the assumption on homogeneity ofa country's territory with regards to its meteorological vulnerability and weather-dependence, which imposes constraints on its use in large and diverse countries. However, the benchmarking method is appropriate for large countries if their territories are broken down into more homogeneous zones.

Methodology on sector-specific assessment

The *methodology on sector-specific assessment* is based on the specially-designed surveys of experts from weather-dependent sectors and aims at obtaining:

1. Information on the level of direct and indirect losses from hazardous weather events and adverse weather conditions in a specific sector
2. Estimates of possible variations in the share of preventable losses and costs of protective measures due to more accurate and timely hydrometeorological information and forecasts as a result of modernization programmes. The data received through these surveys are then used to evaluate the marginal effects from modernization for each weather-dependent sector and the integral effect for the economy as a whole.

One of the advantages of sector-specific assessment is the possibilty of factoring into efficiency estimates some indirect losses from hazardous weather events and adverse weather conditions, in particular those related to lost profits. This method could be particularly useful for the evaluation of NHMS modernization projects, as it allows for estimation of the potential benefits related to improvements in the provision of general and specialized HMS, and takes into account the present and future needs of specific users.

In spite of significant constraints, both methods — the benchmarking and sector-specific assessment — help to generate useful indicative economic estimates of NMHS performance in the surveyed countries. The table presents the baseline parameters for the benchmarking method, the main results of evaluation of economic efficiency of the existing NMHS and efficiency of proposed modernization programmes by both methods — benchmarking and sector-specific assessments — applied in studies carried out in Albania, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Russia, and Serbia.

The state of national NMHS and HMS delivery was rated by national experts of all the countries (except for Serbia) as 'poor'. Meteorological vulnerability for all the countries (except for Serbia) was calculated as 'relatively high'. The estimates of economic losses from hazardous weather events varies between 0.32 per cent of GDP for Kazakhstan and 1.25 per cent of GDP for Armenia.

For the target countries the assessment of the prevented losses was undertaken for the first time and the results should be viewed as tentative. Nonetheless, we believe they indicate a high economic value of the hydrometeorological services and information. The benchmarking estimates of losses were usually lower than the ones evaluated based on sectoral assessments, as the latter attempt to evaluate both direct and indirect losses.

Estimates of relative economic efficiency of the existing NMHS, calculated by comparing the estimates of prevented losses and the cost of NMHS funding, show that the efficiency (or benefit-cost ratio) is rather high, ranging from 165 per cent for Azerbaijan to 568 per cent for Albania. Overall, for each dollar spent for supporting the existing NMHS, the countries usually gain two or more dollars through the avoided economic losses.

Both methods show that an annual incremental benefits of the proposed modernization (improving the status of NMHS and HMS delivery from 'poor' to an 'adequate') will be quite substantial for all the countries concerned. The repayment period of investments in NMHS modernization will be within two to three years. The economic efficiency of the proposed modernization (assumed to be accrued evenly over the seven-year period) ranges from 210 per cent for Armenia to 880 per cent for Serbia assessed by the benchmarking method. Estimates based on sector-specific assessment show even more favourable efficiency ranging from 500 per cent for Belarus and Albania to 1,440 per cent for Azerbaijan. The variability of the results between the two methods is smaller for the countries with better quality of data (Serbia, Belarus). Data in Kazakhstan has proved insufficient to undertake a sectoral assessment.

The results of this study have been discussed at the national workshops in the surveyed countries. The importance of proposed approaches and preliminary results were confirmed by the HMS specialists, sectoral experts and governmental officials. The participants expressed the opinion that the results of economic assessment could be used for justifying adequate financial support of existing NMHS activities as well as for potential NMHS modernization. Some participant countries have already embarked on preparation of large-scale NMHS modernization programmes.

Being fully aware of the deficiencies of the proposed approaches, we believe, nevertheless, that the proposed express method of economic assessment and its preliminary findings can be a useful tool both for the hydrometeorological services in positioning themselves as important public sector, and for the national fiscal/economic authorities seeking rational justification for better targeting its scarce resources.