Conditions for effective management of a river basin in the European Union

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Introduction

The uncontrolled, irrational use of the water ecosystem, either as a production and consumption factor or as a discharge receiver, results in the constant degradation of its quality and in the increase of the deficit in water balance, with negative impacts on economic development and social welfare.

After 25 years of European water legislation, related to the protection of drinking water, bathing waters, fish/shellfish waters and groundwater, a new European Water Framework Directive (WFD, 2000/60/E.C., O.J. L327/22.12.2000) was adopted in October 2000, which incorporates and updates all previous objectives. It includes 26 Articles and 11 Annexes and establishes the framework for community action, in order to reach a "good" ecological status by 2015 in all inland (rivers and lakes), estuarine and coastal waters, as well as in the associated underground waters.

River basin management

A river basin – also known as catchment basin or watershed – is the area of land from which all water flows towards the sea. This area is used as the planning-management unit in the case under consideration.

The WFD requires member states to establish river basin management plans for the protection, improvement and sustainable use of water resources.

An economic analysis of water uses (Article 5 and Annex III) is needed to support the design and the implementation of these plans. As stated in the WFD, the economic analysis in the field of water policy should contain enough information in order to:

- make the relevant calculations for the application of the full cost recovery principle, taking into account long-term forecasts of supply and demand for water in the river basin district; and,
- make judgments about the most cost-effective combination of management measures.

In order to carry out this economic analysis, it is necessary to have the participation of all interested parties. A guidance document relevant to the WFD (E.C., 2002a) cites: *"This participation is defined as allowing people to influence the outcome of plans and working processes. It is a means of improving decision making, to create awareness of environmental issues and to help increase acceptance and commitment towards intended plans. This participation can avoid potential conflicts, problems and costs in the long term."* Thus, the adoption of co-management principles could be considered as a prerequisite for their effective involvement.

Co-management is defined as the cooperative and participatory process of regulatory decision making among representatives of user-groups, government agencies and research institutions. The institutional design is included in the conditions for the success or failure of co-management regimes. Furthermore, a flexible management system is required where all the actors are in an entrepreneurial and creative role (JENTOFT et al., 1998).

Co-management should be seen as a continuously evolving process where a set of alternative management strategies, which are appropriate in certain situations and conditions, are examined (NIELSEN and VEDSMAND, 1999). An overview of effective participatory processes is provided by De Jong et al. (1997).

For the organization of a co-management framework in the water sector, firstly the cooperation between natural and social scientists is required, in order to identify, with the contribution of the stakeholders' knowledge, the relationships between the water ecosystem and the socio-economic activities in the study area.

Consecutively, the dissemination of scientific knowledge in a way that could be understood by the users (through meetings, workshops, discussions) and the exchange of opinions with other groups of stakeholders for the design and implementation of the policy measures are important steps for the improvement of the water quality in cost-effective ways, which is the aim of the WFD (see the second component of the economic analysis mentioned earlier).

According to Karl (2000), *"Projects that were socio-culturally compatible and based on an adequate understanding and analysis of the social conditions had average rates of economic return that were more than twice as high as those for socially incompatible and poorly analyzed projects."* Moreover, education-information programs, which will improve the users' positive involvement in these water policy processes, are required.

The evaluated proposed management measures, resulting from this cooperation of all the parties concerned, are presented by the scientists to the public decision maker. The presentation of these results and of the analysis of the data and the procedures used with a structure, which will facilitate the finding of information and argumentation, will contribute to their adoption.

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Hereunder, a description is given of the relationships between scientists, users and policy makers which are needed in order to accomplish the objectives of the economic analysis, in the framework of a successful integrated river basin management.

Relationships between natural and social scientists

The studies in the water sector, undertaken by natural and social scientists, concern the relationships between the water ecosystem and socio-economic activities, under the so-called DPSIR (*Drivers-Pressures-State-Impacts-Response*) framework (E.E.A., 1999; UN, 1999).

Within this framework a systemic analysis is carried out among the *drivers* by anthropogenic activities and their *pressures* on the water ecosystem, which result in the degradation of the water quality *state* with negative *impacts* on social welfare. A policy *response* is needed and alternative policy options could be evaluated with the support of an economic analysis.

An analytical presentation of the components of the economic analysis included in the text of the WFD, mentioned previously, could help the identification of the continuous exchange of opinions required between the different disciplines of scientists.

Concerning the first component of the economic analysis (*"the identification of full cost recovery of water services"*), knowledge of the social, environmental and economic effects of the recovery is needed (WFD, Article 9). With the use of the Cost-Benefit Analysis (CBA) or the Multicriteria Analysis (MCA), this knowledge could be drawn through the evaluation of the proposed measures related to pricing structures of water services and uses. More specifically:

- Cost-Benefit Analysis (CBA) calculates the net present value of a policy option in order to find the options which improve the social welfare (social benefit > social cost). CBA provides useful information for the users' willingness to pay and the incentives requirements, for the distribution of the costs and benefits between social groups, for the economic efficiency of a project, and for the use and non-use monetary value of an environmental asset, etc. (TIETENBERG, 1996; BOARDMAN et al., 2001; E.C., 2001b; FLORIO and VIGNETTI, 2003).
- Multi-Criteria Analysis (MCA) is also a decision support tool, considering the impacts which cannot be measured easily in monetary units, and it allows for the simultaneous consideration of multiple, often conflicting, objectives. In MCA there is a ranking of alternative scenarios, including environmental and socio-economic values with different weight and points of view, in order to select the most feasible preferable option (NIJKAMP, et al., 1990; HERMANIDES and NIJKAMP, 1997).

It is by CBA or MCA that the social and ethical dimensions of water pricing are studied. For instance, the impact of full cost recovery of water supplies on farmers with low-income is examined for irrigation purposes. Moreover, the possible negative environmental impacts are also considered. As an example of the environmental problems of a new water tariff, one could mention the case of the Greater Athens area (Greece) in 1993 when it was decided that the Water Company (EYDAP) change the water price with increasing rates of consumption (escalated water charge), in order to reduce the consumption of household water. As a result, this policy had a significant decrease in the domestic water supply but it had also negative impacts from the uncontrolled drilling of wells. From this example the need arose for cooperation with the public sector, in order to organize administrative control (new personnel or training courses, etc.), before the design and adoption of new tariffs in water supply. With this control there will also be increased efficiency of the existing irrigation networks (e.g. in most regions of Greece there is only 50 percent efficiency of the irrigation networks, ZANOU and ANAGNOSTOU, 2001).

Moreover, in the framework of the CBA or MCA, a study should be included concerning the level of financial support to actors, mainly for the sector which uses the greatest quantity of water supply. For example, in cases where agriculture is the main human activity (e.g. in Greece the irrigation of farms covers about 75 percent of the total water supply), financial support could be given before the imposition of new water tariffs, for:

- the adoption of new irrigation methods;
- the recycling of water and the re-use of wastes; and,
- the non-cultivation of water intensive crops that would be harmful to the environmental balance.

Beyond financial support, land reclamation works (mini dams, channels for the run-off of stagnant waters, flood controls, etc) should be examined.

Furthermore, before the application of water pricing practices, the information-consultation or/and education of end-users should be organized (e.g. training courses and technical assistance for the new irrigation methods, the new crops, etc). The information gained would also minimize the political cost, which in many cases is the reason for the non-application of cost recovery.

The cost and the benefit of the above-mentioned actions are included in the procedure of the CBA or MCA. These methods are also appropriate for waterfront management (fishery, aquaculture, tourism, coastal and marine constructions, marine transportation) where conflicting uses and various ranges of socio-economic requirements should be arranged, with environmental principles.

Concerning the second component of the WFD economic analysis, i.e. *"the identification of the most cost effective combination of management measures achieving the environmental objectives of the Directive,"* the Cost-Effectiveness Analysis (CEA) (E.C., 2002b; ZANOU et al., 2003) is used for the evaluation of the proposed measures.

With CEA a ranking of measures according to their cost and environmental effectiveness is undertaken to achieve a specific environmental objective ("x" reduction of pollutants) in a water body level.

For the cost-effectiveness evaluation of the measures, there is an interdependency between the environmental and the socio-economic study. For instance, let us suppose that, in the study of a water body, environmental scientists identify a eutrophication problem caused by agricultural run-off ("the main source of nitrogen pollutants is the run-off from agricultural land," E.C., 2002c). In this case, a 50 percent nitrogen (N) abatement of agricultural run-off is necessary in order to achieve the improvement of the water quality.

A team of social scientists studies the land use, and the socio-economic profile of the area affected by this water body, and they pay particular attention to the analysis of agricultural activities as well as the collection of information related to the legislation, administrative framework and existing development plans. These quantitative and qualitative indicators will be used for the identification of alternative management measures in the agricultural sector, considering that the target is "the nitrogen (N) abatement".

The achievement of "50 percent" reduction of N signifies the need for the application of more measures and also a different combination of measures, in comparison with another target where a smaller decrease of N (e.g. 20 or 30 percent) was required.

Nevertheless, the marginal cost of the measures examined, calculated by the social scientists, could change the environmental target of the 50 percent N decrease proposed by the natural scientists. In other words, let us suppose that for a 50 percent reduction the cost of the required management measures is US$35 million and for a 45 percent N reduction the cost is US$25 million, i.e. a 5 percent increase in N (nitrogen) reduction

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would cost US$10 million. The social scientists would then present these costs to the natural scientists who would reconsider whether the achievement of the proposed target (50 percent decrease of N) is essential for the environmental balance in the study area, or if there is a possibility to decrease this percentage, due to budget limits.

In this framework of the cooperation and exchange of opinions between the natural and social scientists, the involvement of users is required.

Relationships between scientists and users

Article 14 of the WFD states the need for public participation including users of water. As mentioned in the relevant guidance document of the E.C. (E.C., 2002a), the existing forms of public participation have an increasing level of involvement. These forms are:

- supply of information;
- consultation; and,
- active involvement.

According to the WFD the first two are ensured and the latter should be encouraged. Moreover, consultation implies supply of information and active involvement implies consultation.

The choice of participation level depends on the political and historical context of users' involvement, available resources, etc. Some case studies state that there was information or consultation of users, but no analysis of the action taken. An indicative context of the action, included in the three above-mentioned forms of participation, is the following (E.C., 2002a):

- Access to background information: e.g. creation of an information center in a river basin, responsible for information management and dissemination.
- Consultation: reports, scenarios or plans presented on which interested parties are asked to comment. There are two types of consultation: the written consultation and the oral consultation. The oral consultation is more active and users have the possibility to discuss with the competent authorities (interviews, workshops or conferences).

A good proposal is the combination of these two types of consultation, i.e. active involvement which means that users actively participate in the planning process by discussing issues and contributing to their solution.

Overall, higher levels of participation are "shared decision making" and "self-determination." Shared decision making implies that interested parties not only participate actively in the planning process but also become partly responsible for the outcome, e.g. water-use sectors could be represented in the river basin organizations. Self-determination implies that (parts of) water management are handed over to the interested parties, for example by establishing water users' associations.

Beyond the choice of participation level and the determination of the action needed for its application, it is also very important to know the factors influencing the users' participation. According to this document (E.C., 2002a) these factors are:

- the context factors (culture, resources, history of previous attempts, etc.);
- the process factors (co-ownership of the process design, creation of opportunities for learning, encouragement to respect other people's views, flexible and "open" processes, continuous evaluation); and,
- the content factors (evaluating diversity of knowledge, decisions based on all the available evidence, explicitness in conditions of uncertainty, reporting).

In another study related to the water policy (WILSON, 1997), where questionnaires are given to farmers in ESAs in the U.K., the author has classified all the factors that may influence the farmers into two central categories (scheme factors and farmer factors) and he also cites that "in many studies the relationship between attitudes and behavior is complex".

Wicker (1969) points out that there is often a significant difference between the attitude and action of users.

Morris and Potter (1995) lay out the complexity of factors influencing a farmer's decision making about participation or non-participation in a agro-environmental scheme. The authors have used questionnaires in order to explain the participation of farmers in agro-environmental schemes in the U.K. and make a point of the need to study the relationship between "willingness to adopt" and "ability to adopt" (i.e. the economic status of the farmer and the economic barriers to apply a new practice).

Therefore, considering that the determinative factor for the application and the effectiveness of water policy measures are the end-users, priority is given to identifying the appropriate process-techniques in each case study, in order to know the profile of users for an effective exchange of knowledge and experience.

Different program-models have been established for their successful participation in watershed management (COLLENTINE et al., 2002).

Jentoft et al. (1998) cite *"when users obtain more management responsibility in functional terms, they are likely to behave more responsibly in moral terms. An important consequence may be greater compliance with agreed-upon regulations."*

Particular attention in their consultation/education is also needed as this is one of the strongest variables determining their behavior. The vital role for the application of the appropriate education programs is recognized by the European Commission and other international organizations as well, as is demonstrated in the results of case-studies in the water policy sector. Most of these case-studies, which examine the end-users' profile, focus on farmers.

For example, in the Pyrovetsi and Daoutopoulos study (1997), data were collected from Greek farmers interviewed on the demographic variables of farm operators, on irrigation practices, on their attitudes towards the environment and wetland resources, on their opinion on the Common Agricultural Policy reform as well as their knowledge on the impact of agriculture on the local environment. The results of this paper revealed the need to provide farmers with information and education regarding environmental issues.

In Morris and Potter (1995), it is cited that the application of a new measure depends on the willingness of farmers to participate. This willingness can be encouraged through the use of advice and training and by exploiting the demonstration potential of those who have already implemented successful farming.

As mentioned by Gilman (2002), users will be more likely to accept changes in their traditional activities if they understand and support their roles through direct participation in planning and management decision making.

This issue is also noted in Curry (1997), where the farmers have adopted a new practice because they had a more direct role in the formulation of environmental policies through consultation before the policy was introduced or in other cases through a wide-ranging series of discussions. This "policy networking" had helped in the understanding of the new policy, the reasons for it, and the acceptance to implement it.

As Borrini-Feyerabend (2000) argues, in the framework of the co-management of natural resources, social communication has remarkable effects including one-to-one dialogue and group meetings, for example with brainstorming, which is a gathering technique based on a freewheeling offer of non-leading ideas. This technique can elicit multiple ideas on a given issue or problem.

Kristensen et al. (2001) give the results of questionnaires filled in by farmers in two study areas in Jutland (Denmark). An anal-

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ysis of the existing links is presented between a number of human factors (such as age, employment level, duration of farm ownership and farmer's landscape activities) and the relationship between farm location and farm characteristics. The authors suggest that agro-environmental programs have a higher chance of success if they are adapted to local conditions both in terms of the biophysical and the socio-economic environment.

From these indicative examples we may mention that the involvement of the end-users in the planning process, with a "common understanding," is a prerequisite for successful water management on a sustainable basis.

Moreover, scientists should organize workshops and meetings with other groups of stakeholders[1] (local authorities and other interested political representatives, NGOs, the public) for the dissemination of research data and exchange of opinions, during all the steps of planning and implementation processes.

In a report of the E.C. (E.C., 2001a) is cited "*It is generally thought that increased stakeholder participation in the early phases of the preparation of policy measures not only reduces the risks of ill-conceived legislation but also improves implementation significantly.*"

As Van Asselt and Rijkens-Klomp (2002) state according to the relevant interesting literature cited in their study, *"the engagement of non-scientific knowledge, values and preferences through social discourse will improve the quality of research by giving access to practical knowledge and experience and to a wider range of perspectives and options".*

Relationships between scientists and public policy decision makers

River basin management measures aim at mitigating the existing water pollution, preventing the creation of new polluting activities and minimizing the conflicts of land uses. For the realization of these purposes, the following policy options could be examined:

- New legal and administrative framework on a level of country or case-study. It is noted that before the adoption of a new legislation, in cases where the existing legislation has not been implemented, examination of the reasons for this non-application is required (i.e. non-application due to very strict or too flexible legislation or due to lack of financial resources, or because of an ineffective administrative structure or due to residents' reactions, etc). Furthermore, there is need for the identification of the responsibilities and actions of the authorities involved and the efforts for their coordination.
- Construction of infrastructures (land reclamation works, wastewater treatment plants, etc.) with particular attention paid to their operation, taking into account existing examples of treatment plants, dams, etc., which have not been used due to lack of funds for their operation and maintenance.
- Use of market based mechanisms (instrumental economy such as subsidies, charges, etc, and/or environmental agreements) for the application of new management practices (new mode of cultivation, changes in land use, use of new environmental friendly technologies, water recycling, etc.).
- Horizontal measures of support:
  - The need for new research activities, taking into account that with new research results the future uncertainty will be decreased and the preventive management mechanisms could be increased.
  - Efforts for better insight into the behavior and attitudes of the users which could be achieved through appropriately designed workshops, training courses, and technical assistance, in order to stimulate the active/positive participation of all the stakeholders.

The optimum combination of the above-mentioned policy options could be defined according to the environmental objective for each river basin studied; the consideration of the socio-economic impacts of these options, the competitive advantages of the region, its development planning and the budget constraints.

Furthermore, the evaluation of the efficiency and effectiveness of measures already adopted through monitoring programs is needed for the design of a new policy.

According to an E.C. report (E.C., 2001a), an evaluated project should give responses for the: *"(i) Efficiency: Are the immediate outputs proportionate to costs and resources used? (ii) Effectiveness: Have the stated objectives been achieved? (iii) Relevance: Does the intervention meet the needs or solve the problems for which it was launched? and (iv) Sustainability: Will the benefits last over time?"*

However, specific evaluation questions according to the context of the evaluated measure(s) should also be formulated. The identification of these questions is the most important step in the design of an evaluation project.

In this report is also cited: *"It is very difficult to evaluate the results or impact of a programme or policy if its objectives are vague, if no indicators for success were defined, or if no data on resources used and outputs delivered are available".*

For the economic evaluation of the policy measures, as mentioned above, the Cost-Benefit Analysis (CBA), the Cost-Effectiveness Analysis (CEA) or the Multicriteria Analysis (MCA) etc. should be used. The evaluated results will provide the public decision maker with the required information for the water policy design.

Sometimes, the CEA is confused with the CBA. The basic difference between these two decision-supporting tools is that in the CEA the economic cost of a management measure is compared by its effectiveness in physical units (e.g. tons of nitrogen (N) abatement per year), allowing a relevant rating of the measures examined, while the CBA evaluates measures in absolute terms by expressing all the effects in monetary terms. The problem with the CBA is to reliably monetarize the ecological consequences of emission reduction policies (SCHLEINIGER, 1999; McALLISTER, 1995).

As a practical example, for a better understanding of the different results of the CBA and CEA submitted to the policy maker, we may consider the evaluation of the management measure as "restoration of a wetland." The use of this example is based on its importance for the WFD implementation.[2]

The selection of CBA or CEA depends mainly on the target required. More specifically:

- The CEA is used if the target is the calculation of the environmental effectiveness of the wetland's restoration (e.g. there is a decrease of the water pollution by wetland "x", which has a retention capacity of 0.5 of the nitrogen (N) load).

For the estimation of the cost for the actions, in order to achieve this restoration, the following have to be estimated:

- the cost for the studies as well as for the workshops, meetings, etc. with stakeholders, in order to identify in detail the exact steps that have to be taken for the application of the measure,
- the cost for the construction-operation-maintenance of the necessary infrastructures,
- the "opportunity cost" of land,
- the cost of information or required education of the stakeholders,
- the cost of application/control by public authorities; and,
- the monitoring cost (sampling stations for the calculation of the environmental effectiveness) (ZANOU, 2003).

The addition of these cost components will give the total cost of this measure, which will be compared with the cost of other measures examined.

Thus, with the CEA the direct target is to find low-costing mea-

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sures for the decrease of water pollution and the indirect target is the improvement of "human welfare," through the expected water quality improvement. Furthermore, it is useful to note that without the calculation of the environmental benefit of a measure it is not possible to identify the total socio-economic benefit, which is calculated with the CBA method (ZANOU, 2003).

• With the use of the CBA, a monetary evaluation is made of the measures needed for the increase of wetland functions and services, in order to increase social welfare. This welfare includes:

- economic benefits;
- social benefits; and,
- biodiversity protection.

More specifically:

- **Economic benefits** provided by the environmental improvement and the required change in the land uses. That is to say, there will be an increase of revenues of existing or of new activities by actions for:

• the decrease of soil erosion;
• the protection against floods;
• the run-off of stagnant waters;
• the inhibition of wetland use as a disposal site for debris of illegal constructions and sand extractions; and,
• the determination of low-intensive activity zones with also the development of new activities (e.g. organic farming, winter crops, aquaculture units, recreational opportunities, etc.).

A new land use planning is needed in order to decrease the polluting activities and the conflicting uses, as well as to create new revenues from the increased land value and the created new economic activities in the wetland area and around it (e.g. tourist shops, shops with fishing equipment, restaurants, etc). This category of economic benefits also includes the saving costs from wetlands services (ecological flood protection and wastewater-effluent-sink) in comparison with the cost needed for the construction and operation of the relevant engineering infrastructures, which in some cases are not in accordance with the environmental balance.

- **Social benefits** for today and also for future generations, from recreational opportunities such as fishing, bird-watching, strolling on footpaths, and generally enjoying the landscape. Furthermore, benefits from educational possibilities and new scientific research results are also provided.

- **Conservation and increase of biodiversity.** Considering that losses of biodiversity affect the functioning of ecosystems and the support of the human life system, the protection of natural habitats has been widely recognized as a priority. In this framework, wetland functions and services promote the conservation of biodiversity and the sustainable use of its components.

For a calculation of the cost of the action needed for the achievement of the above-mentioned benefits from wetland services, the following cost components, included in a CBA, will be added in the existing cost equation used in the CEA:

• the cost of the investment in the new forms of tourism (e.g. stations for bird-watching, footpaths, etc.);
• the administrative costs (public authorities services); and,
• other costs according to the designs of the wetland use in which the shadow prices for the social benefits are also included.

All this information, resulting from the application of the CEA or CBA or from other evaluated methods, is provided to the decision maker who will promote the policy outcomes.

In other words, from this information the policy maker will find responses for:

• the anthropogenic pressures and their impact on the water ecosystem;
• the need for the adoption of the proposed management measures;
• their cost and effectiveness; and,
• their socio-economic effects.

The optimal use of this enormous quantity of information depends on the structure of its presentation.

The team of scientists should support the work of the decision maker with precise information on the comprehensive organization so that it is easily found and understood.

Conclusion

River basin plans are needed in order to promote social, economic and environmental benefits from water uses and services on a sustainable horizon.

For the design and effective implementation of these plans, a co-management framework should be identified, based on:

• The continuous cooperation among the scientists of different disciplines: The study of the economic analysis included in the E.U. Water Framework Directive identifies the plan of their relationships, the socio-economic and environmental data required and the methods used for the evaluation of the proposed management measures. These methods are the Cost-Effectiveness Analysis (CEA), which is used for the evaluation of the water pollution control options, and the Cost-Benefit Analysis (CBA) or the Multicriteria Analysis (MCA), which are mostly applied in the policies of water pricing and waterfront management.

• The participation of users: Their successful involvement depends on the choice of participation level, the analysis of the factors influencing their participation and, in general, on the identification of the process-techniques required for each case-study. Particular attention to their consultation-education is also needed, as this is one of the strongest variables determining their behavior.

• The exchange of opinions with all the other stakeholders (the local authorities and the other interested political representatives, the NGOs and the public) during all the steps of planning and implementation processes.

• The presentation of all this information to the policy maker with a structure, which facilitates the understanding and finding of data.

Van Asselt and Rijkens-Klomp (2002) state that "it is of crucial importance that principles, considerations, arguments, participatory process design and lessons learned are documented in a structured and transparent way to encourage collective learning." This framework of "common understanding" could contribute to the implementation of the European Water Framework Directive with the improvement of water quality and social welfare.

Notes

1. The term stakeholders includes all organizations and individuals who have management responsibilities or have the power to influence decision-making process or could have a role in the implementation of decisions or will be affected by the resulting management activities (E.C.1999). The most fundamental division between stakeholders is between those who affect (determine) a decision or action, and those affected by this decision or action (GRIMBLE and WELLARD, 1997; KARL, 2000).
2. E.C. (2003) "*Wetland creation and enhancement can in appropriate circumstances offer sustainable, cost-effective and socially acceptable mechanisms for helping to achieve environmental objectives of the WFD*". See also: ZANOU et al. (2003).

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