

Surface water withdrawal permit programmes for humid regions

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Abstract In the humid regions of the eastern United States, rainfalls and streamflows have usually been sufficient to supply nearly all human needs. In those states a set of common-law precedents known as the riparian doctrine has evolved. This doctrine is rather imprecise compared to the appropriative doctrine of the western states. In recent years, problems of concentrated use have become more common and severe in humid regions, leading to calls for water regulations. There are a number of options for such regulations; this paper provides a comparison of alternatives in the context of six programme objectives and a number of agency decisions. The first programme objective is the ease of implementation, its administration and enforcement. The second is maintaining equity, or the perception thereof, among water users. The third is to maintain minimum streamflows. The fourth is robustness, or insensitivity to errors in the data. The fifth is economic efficiency. The final objective is political and legal feasibility. The first agency decisions are what the permit should entitle its holder to do and under what circumstances. It is customary to think of a permit as entitling its holder to withdraw a certain volumetric flow rate (e.g. litres per minute) of water, but an operational definition must be more complete. One choice is the basic structure of the system, the options for which are: (a) no regulations, (b) prioritized permits like those used in the western USA, and (c) fractional permits, in which users' allowable withdrawals increase and decrease with streamflow. Another agency decision is on what basis permits should be distributed initially. In the past in appropriative states, allocations to users were based on user claims or the agency's judgement about the amount of water each user "needed". The potential for equity challenges to this approach is obvious. Instead, the size allocations could be roughly proportional to some measure of past use rate or current size of operation (e.g. hectares irrigated or population served). Provisions could be incorporated to avoid rewarding those who had used water wastefully in the past or to dissuade users from profligate use for the sole purpose of receiving a higher allocation. Another decision is whether or not permits should be transferable and, if so, under what circumstances or restrictions. The most frequently cited argument in favour of allowing users to transfer permits is economic efficiency. Transfers are usually considered equitable by users and provide an incentive for improving the efficiency of water use. The chief drawback of transfers is that, through an unfavourable set of transfers, local streamflow standards could be violated. Concentrated withdrawals might render it more difficult to maintain instream flow needs near withdrawal points and could lead to third-party impairment.

Programmeación de permisos para la utilización de aguas superficiales en regiones húmedas

Resumen En las regiones húmedas del este de los Estados Unidos, las precipitaciones y las corrientes superficiales han bastado tradicionalmente para satisfacer prácticamente la totalidad de las necesidades hídricas

humanas. En dichos estados ha evolucionado lo que se conoce como doctrina "riparia", que no es más que una serie de precedentes de ley común. Esta doctrina es bastante imprecisa comparada con la doctrina de asignaciones propia de los estados del oeste. Recientemente, los problemas derivados de la concentración en el uso del agua vienen siendo más comunes y agravados en las regiones húmedas. Este artículo compara las diferentes alternativas en los contextos de seis diferentes objetivos de programación y cierto número de decisiones por parte del organismo. El primer objetivo del programa es la facilidad de implementación del programa en su fase inicial, de su administración en el día a día, así como de asegurar su cumplimiento. El segundo es mantener la equidad, o la percepción de la misma entre los usuarios del agua. El tercero es el mantener unos caudales mínimos en ríos y torrentes. El cuarto es la robustez o insensibilidad a errores en los datos. El quinto es la eficacia económica. El último objetivo es la viabilidad política y legal. Las primeras decisiones del organismo se refieren a qué es lo que el permiso autoriza a su poseedor y bajo qué circunstancias. Es habitual pensar en el permiso como una autorización para su poseedor para extraer un cierto caudal (por ejemplo, litros por minuto) de agua, pero una definición operativa debe ser más completa. Una elección tal es la estructura básica del sistema, cuyas opciones son: (a) ninguna reglamentación, (b) permisos priorizados como los utilizados en el oeste del USA, y (c) permisos fraccionarios, en los que las extracciones permitidas aumentan o disminuyen dependiendo de las corrientes. Otra decisión del organismo es en base a qué se deberían distribuir los permisos inicialmente. En el pasado, en estados de asignación, las asignaciones se basaban en las peticiones de los usuarios o en el criterio de la organización sobre la cantidad de agua que cada usuario "necesitaba". El potencial para cuestionar la equidad de tal planteamiento es obvio. En su lugar, las asignaciones de cantidad podrían ser de alguna manera proporcionales al ritmo de utilización en el pasado o al volumen actual de utilización (por ejemplo, hectáreas regadas o población abastecida). Puede ser necesario incorporar alguna estipulación para evitar favorecer con tal planteamiento a aquellos usuarios que han estado malgastando el agua en el pasado, o para disuadir usuarios de un uso despilfarrador con el único objetivo de recibir mayores asignaciones. Otra decisión es si los permisos deberían ser transferibles y, en tal caso, bajo qué circunstancias o restricciones, etc. El argumento más frecuentemente citado en favor de permitir a los usuarios el transferir permisos es la eficacia económica. Las transferencias son generalmente consideradas por los usuarios como equitativas, y proporcionan un incentivo para mejorar la eficacia en el uso del agua. La principal desventaja de las transferencias es que, debido a transferencias poco propicias, se podrían violar las reglamentaciones de las corrientes locales. Extracciones concentradas podrían hacer más difícil el mantener las necesidades de caudales de toma cerca de los puntos de extracción, y podría perjudicar a terceros.

INTRODUCTION

In the humid regions of the eastern United States, rainfalls and streamflows have usually been sufficient to supply nearly all human needs. In those states a set of common-law precedents known as the riparian doctrine has evolved to govern water use. This doctrine is rather imprecise compared to the appropriative doctrine of the western states and many riparian states lack a strong, comprehensive, set of water

use regulations. In recent years, however, problems of concentrated use have become more common and severe in humid regions. Aquifer levels and aquatic stream habitats have been threatened by concentrated withdrawals as cities have expanded, and highly consumptive irrigation has increased in use. While discussion of comprehensive management programmes has occurred (e.g. Mack & Peralta, 1987).

It is assumed here that a water management agency or ministry (referred to as the ministry) has been charged with developing and administering a water withdrawal permit programme. Each user receives a permit allowing a rate of withdrawal that depends, generally, on ambient conditions. A set of target minimum streamflows is assumed already set. The difference between this minimum and the streamflow at any point is the total allowable withdrawal, or TAW.

The ministry is assumed to pursue six objectives. The first is to maximize the ease on its part in setting up the programme initially (implementation), operating it routinely (administration), and ensuring compliance with it (enforcement). The second objective is maintaining equity among water users. Equity is very much in the eye of the beholder, and the decision about what is equitable or inequitable is arbitrary to some extent. The third objective is that the programme is originally devised, *viz* to maintain streamflows. The fourth objective is that the social benefit of the programme be robust, or insensitive, to errors in the data upon which its design and operation depend. The fifth objective is to maximize economic efficiency, i.e. the economic benefit per unit of water used. The final objective is political and legal feasibility.

DEFINITION BASIS

The ministry must first decide what the permit should entitle its holder to do under what circumstances. It is customary to think of it as entitling its holder to withdraw a certain volumetric flow rate (e.g. litres per minute) of water, but an operational definition must be more complete and must say where water may be withdrawn and what happens when there is not enough water to supply all permits. Other ministry decisions are how permits should be distributed initially, how many should be distributed, whether or not they should be transferable and, if so, under what circumstances or restrictions, etc. Some options are:

Prioritized permit basis Under the prioritized basis a set of priorities is established whereby a user is allowed a certain fixed rate of water withdrawal as long as the TAW is enough to satisfy him or her and all other users with a higher priority. When it is not, users forego withdrawals according to their priorities. This basis is used under the appropriative doctrine in the western USA.

Fractional permit basis Under the fractional basis of definition, each user is allotted a constant percentage of the TAW. Thus, as the TAW fluctuates, so does the amount of water allotted to each user; no user is ever entirely deprived of water. Under this type of permit, no permit has priority over another. The fractional permit

basis is often regarded as advantageous for humid regions because of the lack of historical data by which to establish priorities among users. There may, however, be some perceived equity and administrative disadvantages to this basis. First, there is no easy way to issue free permits to newcomers, although they may buy their way in and may be accommodated through staggered limited-duration permits. By contrast, the prioritized permit basis may be structured to accommodate newcomers by assigning them lowest priority. The second disadvantage is that it is more difficult to account for the geometric complexity of real river systems under this type of permit definition basis. Ways of addressing this problem also exist, however (Eheart & Lyon, 1983).

ALLOCATION BASIS

The ministry must decide the basis for distributing the permits among the users, i.e. deciding the rate of allowable withdrawal or the fraction of the TAW the user is allowed to withdraw. Such allocations could be roughly proportional to some measure of past use rate. Provisions could be incorporated to avoid rewarding those who had used water wastefully in the past, and certainly to dissuade users from profligate use in the present for the sole purpose of receiving a higher allocation in the future. This poses the problem of estimating past withdrawal rates that may have been unmeasured. Alternatively, the size of a fractional permit might be set proportional to a measure of the size of an operation such as the length of riparian streamfront, the area of riparian land, or the population served by a municipal water supplier.

PERMIT TRANSFERS

Transfers of water rights or permits may be allowed within limited lengths of stream. The most frequently cited argument in favour of allowing users to buy and sell (transfer) permits is one of economic efficiency (see e.g. Anderson, 1983a,b; Eheart & Lyon, 1983). Transfers also provide an incentive to develop and adopt ways of using water more efficiently through recycling and waste reduction (Anderson, 1983b). Transfers have received endorsements from many policy analysts (Johnson *et al.*, 1981; Stavins, 1989). The additional administrative costs of transfers are expected to be modest; the ministry must maintain a registry of permits and transfer restrictions must be decided upon and administered. No cost data need be collected, however, and no cost optimization need be done (at least, not by the ministry). The ministry may *opt* to set up a brokering operation, but transfers are generally voluntary and need not be brokered by anyone. The chief drawback of transfers is that, through an unfavourable set of transfers, concentrated withdrawals might occur, rendering it more difficult to maintain instream flow needs near such points of concentration. Additionally, under these circumstances, the neighbours of a permit buyer may be impaired and the neighbours of the seller may receive a windfall

benefit (Eheart & Lyon, 1983). This problem may be addressed by limiting the trading to users who have approximately the same effect on the streamflow. Alternatively, permits may be otherwise altered as they are transferred so as not to impact minimum flows or third parties. A third approach is to require compensation to third parties. Transfer restrictions may undermine efficiency gains and may not be effective in protecting third parties anyway. Third party compensation has been endorsed by some researchers (e.g. Coase, 1960). Others (e.g. Baumol & Oates, 1988) note potential problems of strategic behaviour if third parties are given final authority on whether a transfer is allowed. Another potential drawback of transfers is that, because of the usually small number of participants, one or more parties may be able to manipulate the permits market to their advantage.

SUMMARY

In choosing a system of rules for administering water withdrawals, the ministry faces a bewildering array of decisions and trade-offs. In regions where water using economic activities are well established, it is unlikely that anything but a system of sharing will be politically acceptable. Permit transfers are a feature that will probably find favour among users and the ministry will be under some pressure to undertake the administrative cost to implement them. Key to the operation of any such programme is the existence of an adequate system of streamgauges and streamflow record keeping.

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