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Property Rights, Political Power, and the Management of Ground and Surface Water

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Introduction

Among the more popular contemporary recommendations for improved watershed use and protection is conjunctive use of surface and underground water resources (Burgess and Marnoon 1975; Gleason 1976; Johnson and Peters 1967; Lampe 1987; Mann 1968; Thorson 1978; Trelease 1982; US ACIR 1990). Conjunctive use involves the coordination of surface water supplies and storage with groundwater supplies and storage, for purposes of sustainable watershed use and enhanced watershed protection. Among the several potential benefits that have been promoted by advocates of greater conjunctive use are: improved security of usable water supplies, lessened exposure to extreme events such as droughts and floods, reduced reliance on costly and environmentally disruptive surface water impoundments and distribution systems, and enhanced protection of aquatic life and habitat.

Conjunctive use in a watershed requires a great deal of joint effort among human beings, the prospects for which will be affected strongly, though not exclusively, by institutional arrangements that define organizational forms and jurisdictions and provide incentives and disincentives to individuals (Anderson, 1989; Bittinger, 1964; Grant, 1987; Noel, Gardner, and Moore 1980; Orton 1986; US ACIR 1990). Using a three-state comparison, Arizona, California, and Colorado, we are engaged in a major research project that will advance the theoretical and empirical understanding of the relationships between institutional arrangements governing the allocation, use, and protection of water resources and the development, implementation, and performance of conjunctive use programs. In this paper in particular, we explore the effects of institutionally created heterogeneities among water users on their ability to voluntarily devise conjunctive use arrangements.

How heterogeneities among resource users foster or impede the creation of voluntary agreements for resolving common pool resource dilemmas remains an enduring puzzle.¹ Thus far, scholars who have attended to heterogeneities among users have concluded that, at best, resource users build mutually binding agreements in spite of substantial individual differences, and at worst, such differences prevent users from realizing voluntary cooperation.²

This dreary tone is understandable in light of the obstacles heterogeneities are believed to present. Heterogeneities position users differently in relation to access and use of common pool resources. Some users may even be so advantaged that they are effectively insulated from the effects of CPR dilemmas, at least for a time, and therefore refuse to cooperate in their resolution.³ Even when all resource users recognize that they would be individually and collectively better off by cooperating to resolve shared dilemmas, such cooperation may fail to emerge as users disagree over the distribution of the costs and benefits of achieving more desirable outcomes.⁴

¹ As Ostrom (1994) states: "How individuals who differ substantially from one another agree to sets of rules with major distributional consequences is not yet fully understood." (p.531).

² See Hackett, et al. (1992), and Hackett, et al. (1994) for empirical examples of individuals devising voluntary agreements, in spite of substantial individual differences.

³ See Libecap (1994) for a discussion of numerous such examples.

⁴ In addition to heterogeneities among users, private information inhibits bargaining. As Farrell (1987) states: If people come to bargaining already knowing their [own] private values for a good, then no arrangement exists that will lead them to trade precisely when they should, given that each can choose to walk away (p. 120).

There is, of course, another view of the role heterogeneities play in the emergence of collective action. Olson's (1965) concept of the privileged group suggests that heterogeneities can facilitate cooperation, when members of the privileged group sufficiently value the collective good that they are willing and able to provide it in spite of the actions (or inactions) of the remaining group members. In these instances, Olson predicts that heterogeneous groups are more likely to be successful than homogeneous groups in organizing and acting collectively.

These opposing approaches to heterogeneities, far from being in conflict, instead suggest the need for an explanation capable of incorporating both. Sometimes differences among resource users present substantial obstacles to cooperation, and sometimes such differences provide relief from the otherwise insurmountable costs of collective action. Which circumstances and types of heterogeneities support cooperation, and which support dissension?

The purpose of this paper is to explicitly account for the effects of institutionally created heterogeneities on the abilities and opportunities of resource users to voluntarily engage in and devise governing arrangements for coordinating their use of two common pool resources ~ groundwater and surface water. Property rights and the ability to exercise public authority are two types of institutional arrangements that create heterogeneities among resource users. Some resource users may hold more complete property rights, or superior rights, to those of others, and some resource users may be granted the authority to devise local governing structures that gives them a greater voice in devising access and use rules for natural resources.

Institutionally induced heterogeneities in and of themselves do not inhibit or enhance collective action, rather it is their effect on specific dimensions of the natural resource situation that produce such effects. Diversity in property rights holdings or in the ability to exercise public authority affects the likelihood that resources users will choose to engage in collective action. In the next section we explore and explain two such dimensions that we believe play a critical role in the ability of resource users to engage in collective action — the positions and numbers of actors who must cooperate in order to produce a collective benefit, and the ability of resources users to capture the benefits of their collective endeavors, and to agree upon a fair allocation of such benefits. Next we turn to an exploration of the interactions between the institutional heterogeneities and these two dimensions, deriving a series of testable hypotheses. We conclude with a discussion of how we will empirically test the hypotheses, and what such testing may tell us about the role of heterogeneities in voluntary collective action undertakings.

Two Critical Dimensions of the Collective Action Process

What would motivate an individual to act with others to produce a collective benefit? Among the numerous dimensions of collective action processes that have been studied, two that are of great importance are jointness of production, which refers to the number of actors and their positions, who without their cooperation a collective benefit would not be produced, and the

ability of the cooperating actors to capture sufficient benefits, as against the rest of the world, and as against each other, to make a collective endeavor worthwhile.⁵

Jointness of production may range from low — few actors need cooperate in order to produce the collective benefit, to high — many actors need to cooperate in order to produce the collective benefit. But it is not just the number of actors, it is also the positions that they hold. The participation of certain actors may be critical because of their position of authority in relation to common pool resources, the property rights they possess, or because of the monetary resources or technical expertise at their disposal. The bottom line that connects each actor and that requires that they participate is that they are all affected by one another's use of a common pool resource, or they affect others' uses of the resource, and that without their cooperation, a collective benefit cannot be realized.

Capturing the benefits of collective action provides the motivation to cooperate. While individuals do not have to capture and control all benefits realized as a result of a collective endeavor, they must be able to capture sufficient benefits to offset the costs of acting collectively. Numerous factors affect the ability of groups to capture the benefits they jointly produce, ranging from the physical features of the resource to the institutional setting in which the group acts. For instance, resource users are unlikely to act collectively to maintain or enhance the flow of a resource if they do not control the stock.⁶ Or, if resource users cannot define and enforce property rights over the benefits that they would produce, they are unlikely to undertake collective action.

Resource users may be able to capture sufficient benefits so that they would be better off cooperating, however, they may encounter difficult distributional problems. They may not be able to agree upon a fair allocation of benefits and costs among themselves. The severity of distributional issues is thought to turn on heterogeneities. If resource users are relatively homogeneous, distributional issues are believed to be much less severe, whereas if resource users are heterogeneous distributional issues are believed to be crippling for collective action (Ostrom 1990, Libecap 1994).

Capturing the benefits (and allocating the costs) of collective action involves two considerations. First, can the resource users capture sufficient benefits, as against the rest of the world, to make it worth their while to engage in collective action. Second, can individual resource users capture sufficient benefits, as against the other members of the group, to make it worth their while to engage in collective action.

Differences in jointness and in the ability to capture and consume collective benefits strongly influence individuals' choices to act or refuse to act collectively. However, both of these factors

⁵ See Ostrom (1990); Schlager, Blomquist, Tang (1992); Ostrom, Gardner, Walker (1994) for in-depth discussions of factors that affect the willingness of individuals to engage in collective action to resolve common pool resource dilemmas.

⁶ See Schlager, Blomquist, and Tang (1992) for a discussion of the impacts of physical features of the resource on the likelihood of resource users maintaining and enhancing the flows of irrigation systems, groundwater basins, and coastal fisheries.

must be considered together. Focusing on just one of these dimensions leads to seriously incomplete and deficient analysis.

It is commonly believed that a collective benefit is more likely to be produced in a situation characterized by low jointness, i.e., just one or a very few individuals' cooperation is required, than is one characterized by high jointness. But the likelihood of cooperation in either situation depends on the ability and the position of the cooperators to capture the benefits and distribute the costs of a collective endeavor. Even when jointness is low, cooperation is unlikely to emerge if individuals' positions leave them, unable to capture sufficient benefits from their endeavor to offset their disproportionate share of the costs.

On the other hand, if these same individuals can capture sufficient benefits to make it worth their while to cooperate, then collective action is more likely. While this is a happier situation for the cooperators, it may entail difficult distributional issues from the perspective of the entire group of resource users. Under certain circumstances, a comparatively small subset of users can cooperate to produce substantial benefits for themselves, to the exclusion and perhaps even the detriment of the others.

At the same time, the likelihood of such circumstances arising depends upon the degree of jointness of production. In situations in which jointness of production is high—that is, many resource users must cooperate to provide a collective benefit—the concentration of benefits is likely to be tempered. Even if a subset of users is positioned to capture most of the benefits resulting from a collective good, others whose cooperation is necessary, but who are not so well-positioned, are unlikely to cooperate unless they can be assured of either the forbearance of their better-positioned counterparts or some benefit-sharing arrangement.

Finally, there is the possibility that jointness of production is high, but the many are in a position to ignore or exploit the few. The cooperation of a large number of resource users may be necessary to make collective action viable, but the distribution of benefits and costs may be such that the members of the larger group coordinate their efforts and capture net benefits while imposing net losses on a smaller group who do not cooperate (or at least do not do so rationally).

Thus, jointness of production and the ability to capture the benefits of collective action must be considered together if collective action is to be explained adequately. However, whether jointness of production among resource users is low or high, and whether users can adequately capture the benefits of collective action, both as against the rest of the world and among themselves, depends to a substantial degree on critical institutional arrangements, specifically, property rights, and the ability to exercise public authority. These institutional arrangements, in turn, introduce heterogeneities among resource users that may promote or inhibit collective action.

Property Rights and Public Authority

Property Rights Heterogeneities. Assignments of property rights to the use of a resource can exhibit and establish two broad categories of heterogeneities. Within those conceptual categories, additional distinctions often become terribly important in empirical settings.

Property Rights Bundles of Differing Scope. The scope of a property right is the set of actions or activities it covers or includes. Since users of a common resource may have combinations of rights defining access, withdrawal, etc., we refer also to the scope of property rights *buidles*. Heterogeneities of scope include differences among users in rights of access, rights of use, or extent of possession.

Differences among users in rights of access to a resource range from the extreme of limited-versus-unlimited access to more subtle distinctions among limitations upon users. When users of a common resource enjoy limited rights of access, the limitations usually consist of spatial/temporal qualifications upon their access.

Spatial/temporal qualifications are relatively straightforward to conceive, and whether formal/explicit or informal/understood may be thought of or restated as injunctions against entering a resource or harvesting units except at prescribed places or times. For potential users of groundwater resources in Arizona and Colorado, spatial/temporal qualifications upon access include permit requirements and regulations of the spacing or distance between a proposed new well and already operating wells. Potential users of surface water in Colorado must make good faith efforts over time to demonstrate the capacity to take water, the demand for the water, and that their access to the stream and use of the water will not adversely affect other current users. Only after these conditions are met will a water court judge formally recognize the potential user's rights of access, subject to spatial/temporal qualifications.

Rights of access are often closely tied to rights of withdrawal, that is, what users may/must/may not do in relation to the resource and its valued units themselves. Differences in rights of withdrawal range from the extreme of limited-versus-unlimited uses to more nuanced distinctions in conditions and qualifications. Differences in rights of withdrawal introduce additional institutional heterogeneities. For instance, differences in priority to withdraw units produce heterogeneities, even between two users whose rights of access are subject to identical spatial/temporal conditions (or none at all). Where common-property regimes assign users rights of withdrawal with differing priorities, one user or group of users may by exercising their rights of withdrawal be able to shut others out of the resource altogether, at least temporarily. This difference in rights of withdrawal is a critical feature of water rights in the western United States, where priority of right is based upon seniority of continuous use. Differing priorities constitute an institutional heterogeneity among users of a common resource.⁷

⁷ The priority aspect of western water rights demonstrates the close connection between rights of access and rights of withdrawal. Those who possess lower-priority rights of withdrawal are essentially foreclosed from use, and consequently access, until those who possess higher-priority rights have been able to exercise theirs.

Another example of institutional heterogeneities deriving from differences in rights of withdrawal involve the rules governing groundwater use in California. Owners of lands overlying an aquifer can withdraw for use upon their land any quantity of water they are able to put to a "beneficial use". Since virtually any use of water qualifies under California law as "beneficial" and since the only exception—intentional or knowing waste of water—is almost never found in an official proceeding against a user, overlying landowners in California possess a virtually unlimited right of use.⁸ By contrast, appropriators who withdraw groundwater for use on other lands (either not owned by them or not overlying the aquifer) are limited by the doctrine of correlative rights which allows them to withdraw only an amount of water that is "surplus" to the amount actually used by overlying owners. Another set of rules distinguishes the use rights of public appropriators from those of non-public appropriators, barring the latter group from invading the rights of the former.

Property rights may differ among users with respect to aspects of resource use other than harvesting. For example, in resources where storage and later recapture of valued units is feasible (see Schlager, Blomquist, and Tang, 1994), users may enjoy different rights to the use of the resource's storage capacity. We still are uncovering and cataloguing the instances and extent of these differences among water resource users in Arizona, California, and Colorado, but for now suffice to say a) that the property rights of users of groundwater in those states do not automatically include rights to store water underground for later recapture, but b) some users have been authorized by law or by contractual arrangements with the state to do so. Therefore, an institutional heterogeneity exists in the rights of users to engage in this aspect of resource use.

A third source of heterogeneities in the scope of property rights bundles enjoyed by users of a common resource relates to the extent of possession of property rights. A property-rights system may assign some users what are called "full-ownership" property rights while assigning other users something less than full ownership. Full ownership includes the authority to transfer (by sale, lease, or inheritance) one's right to other parties, in whole or in part, and whether or not the transferee is already a recognized resource user. The water rights systems of Arizona, California, and Colorado make some users' rights of access and withdrawal fully transferable, other users' rights transferable under certain conditions, and still others' rights non-transferable.

Property Rights Bundles of Differing Economic Value. Assignments of property rights may link users to locations or times in ways that create *rights of differing economic value*. Of course, the economic value of a user's property rights will vary for a variety of reasons that have nothing in particular to do with the assignment of the rights themselves—e.g., changes in weather or in the valuation of commodities in external markets. But differences in the economic value of property rights may also be inherent in the rights assignments themselves.

Among users of a resource with mobile flows (e.g., fisheries), for instance, property rights may be assigned in ways that place some users in more advantageous locations and other users in less advantageous locations. Among users of a resource with nonmobile but variable flows (e.g., grazing areas, forests), property rights may be assigned in ways that place users in more

⁸ Overlying landowners can waive this unlimited right, or stipulate to a quantification of their right, and have done so in some basin-wide adjudications of groundwater rights.

productive or less productive locations or provide users with access at more fruitful or less fruitful times.

In a watershed where conjunctive use is being proposed or attempted, users' rights to capture stored underground water supplies may be more or less valuable depending upon their location overlying the aquifer. Users whose wells place them nearer a recharge area, where surface water is being introduced into an aquifer for purposes of storage, are often in a better position to capture the benefits of the conjunctive-use program (or to deny those benefits to others). This circumstance may make those users more likely to contribute to the conjunctive-use effort, but it may also make users farther away from the recharge point less likely to contribute if they lack assurance of receiving net benefits from conjunctive use. In California, such differences of position probably facilitated the development of a conjunctive use program in Orange County but stalled the development of conjunctive use along the Mojave River in California for several years.

Potential Collective-Action Effects of Property Rights Heterogeneities. All other things being equal (for instance, assuming property rights are recognized and can be enforced), institutionally created heterogeneities in property rights can affect the collective-action calculus of resource users in some predictable ways.

1. Property rights heterogeneities can raise or lower the jointness-of-production requirements within a resource. Whether a "privileged group" exists in a particular common-pool resource situation depends not only upon the physical characteristics of the resource and the economic value of the units it produces, but also upon institutional arrangements such as the concentration of property rights among resource users. Similarly, a wide dispersion of rights of access and use may increase the number of users whose cooperation is necessary to resolve a problem.
2. Property rights heterogeneities can raise or lower the likelihood of receiving net benefits from cooperation for some or all users. The cost users will experience from cooperative behavior, and the benefits they will be able to capture therefrom, will depend to some extent on the bundle of rights they possess, the priority their bundle enjoys relative to those of others, and the connection between their rights and the characteristics of the resource itself.
3. Perhaps most importantly, property rights heterogeneities alter the bargaining positions of resource users, affecting both their perceptions of their own situations and their anticipations of the actions of others. This effect can be perceived perhaps most clearly in terms of the "default" positions of users. For instance, users possessing the highest-priority rights or those whose rights are transferable will be able to drive harder bargains because they will either be the last ones hurt by resource degradation or they have the option of "selling out" and exiting the situation. If other users do not possess equivalent rights, their bargaining position is weakened and the likelihood of their exploitation is increased. And if users know each other's relative property-rights positions, bargaining may even be or become impossible.

Based on these reflections, we deduce the following hypotheses regarding the effects of property rights heterogeneities on the likelihood of successful collective action.

Hypothesis PR-1: All other things being equal, in watersheds where differing priorities of rights allow a subset of users to be effectively insulated from resource degradation losses, the jointness-of-production requirements for successful coordination among the remaining users will be greater, their likelihood of capturing net benefits from cooperation will be lower, and therefore the likelihood of successful collective action will be lower, than in watersheds where differing priorities of rights do not allow a subset of users to be effectively insulated.

Hypothesis PR-2: All other things being equal, in watersheds where all users are equally exposed to resource degradation losses, and where some users possess rights of withdrawal that allow them control over substantial amounts of resource units, while other users possess more limited rights of withdrawal, jointness-of-production requirements for successful coordination will be lower, their likelihood of capturing net benefits from cooperation will be greater, and therefore the likelihood of successful collective action will be greater, than in watersheds where rights of withdrawal are more nearly equal across all users.

Hypothesis PR-3: All other things being equal, in watersheds where all users are equally exposed to resource degradation losses, and where some users' rights of access are of substantially greater economic value than the other users, jointness-of-production requirements for successful coordination will be lower, their likelihood of capturing net benefits from cooperation will be greater, and therefore the likelihood of successful collective action will be greater, than in watersheds where rights of access are of more nearly equal value.

Hypothesis PR-4: All other things being equal, in watersheds where a subset of users experience resource losses but are endowed with access and use rights of high enough priority to effectively guarantee their future use of a resource, their ability to capture net benefits from successful coordination is comparatively greater and the likelihood of their cooperation is greater than in watersheds where future access and use rights are less certain.

Hypothesis PR-5: All other things being equal, in watersheds where some users can transfer their access and use rights but others cannot, the jointness-of-production requirements will be greater, the likelihood of capturing net benefits from cooperation will be lower, and therefore the likelihood of successful collective action will be smaller, than in watersheds where the extent of possession of access and use rights is more similar.

Public Authority Heterogeneities. When discussing institutionally created heterogeneities, it is essential to bear in mind the multiple levels of action that human beings display with respect to the design, alteration, and use of institutions (Kiser and Ostrom, 1982). Human beings operate *within* institutional arrangements—i.e., they adopt strategies and make choices in response to incentives, they follow or break rules, they receive rewards or penalties, and so on. Human being may, however, also be able (and in many cases are able) to alter institutional arrangements and create new ones.

This is an essential prelude to our discussion of heterogeneities in the exercise of public authority, because these heterogeneities can exist at multiple levels. The operational rules (rules-in-use) in a common-pool resource situation may confer differing amounts of public authority on users. For example, some users may be authorized or obliged to monitor or sanction the behavior of others while being exempt from such scrutiny themselves. Just as importantly, if not more so, users may differ in their authority to shift to another level of action and alter the positions and patterns of authority regarding resource access and use—in other words, in their authority to rewrite the rules.

What is true of individual users can be true as well of user organizations. Multiple organizations may represent or respond to differing or overlapping groups of users of the same resource—as when a fishery extends across jurisdictional lines, or more than one water users' association represents users on a complex irrigation system, or more than one public authority exists in a watershed. When this is the case, institutional arrangements may confer differing public authority on these organizations with respect to the use of the resource, and (again shifting levels) these organizations may have differing capabilities in redefining their own authority and that of other organizations.

Differing grants of authority, in part, stem from property rights, but this time the rights of management and exclusion. The right of management grants holders of it the authority to regulate resource use patterns. The right of exclusion grants the authority to define access rights and how those rights may be transferred (Schlager and Ostrom, 1992:251). These are collective choice rights. Holders of these rights possess the authority to define who may access resources, and how resources may be used.

It is not uncommon in the western U.S. for resource users to be granted some form of management and exclusion rights. This authority is rarely concentrated in a single organization, rather the state government in conjunction with multiple user organizations concurrently exercise management and exclusion rights. From water conservation districts in Colorado to groundwater replenishment districts in Arizona, resource users possess limited authority to decide how to manage water.

Heterogeneities in rights of management and exclusion arise along several dimensions, however, initially we have chosen to focus on the types of activities that the rights of management and exclusion cover. Gardner, Ostrom, and Walker (1990) argue that in relation to any given common-pool resource (CPR), multiple common-pool resource dilemmas may occur. CPR dilemmas may occur as a result of demand side activities or supply side activities. Demand side dilemmas occur as a result of excessive demand placed on harvesting from the CPR. Examples of demand side dilemmas include production externalities in which users of a shared resource do not take into account the costs that they impose on one another, and thereby overharvest the resource; technological externalities in which users interfere with each others' harvesting activities; and assignment problems in which users race to, and fight over, the most productive spots in a resource.

Supply side dilemmas occur as a result of underinvesting in activities that would ensure that the CPR continues to produce a flow of resources over time. Underinvestment may occur in relation to maintenance, or in relation to a number of other activities that would either prevent the degradation of the CPR, or that would enhance its productivity (Schlager, Blomquist, and Tang 1994).

The Gardner, Ostrom, and Walker (1990) typology of commons dilemmas can be used to evaluate the scope of the authority of an organization. The more dilemmas an organization is authorized to address, the greater the scope of its authority, and perhaps, the greater its power. Thus, if an organization was authorized to address a single demand side dilemma, the scope of its authority would be much narrower than an organization that was authorized to address multiple demand and supply side dilemmas.

Heterogeneities in rights of management and exclusion can affect the likelihood of successful collective action to resolve resource dilemmas. At one extreme, in which the user organization possesses broad rights of management and exclusion, so that it has close to exclusive jurisdiction over a CPR, collective action is highly likely. The organization can capture the benefits generated by collective action, and the organization substantially lowers the costs of collective action for its members. Problems that do arise are likely to center on distributional issues among the resource users.

Moving away from that extreme the likelihood of collective action declines, as the scope of the authority of the user organization is reduced, the jurisdiction of the organization does not match the physical boundaries of the resource, and the membership of the organization excludes critical resource users. Each of these factors either increases the jointness-of-production requirements, or reduces the benefits that may be captured as a result of collective action.

At this point, we offer the following hypotheses concerning the effects of heterogeneities among resource users on their rights of management and exclusion.

Hypothesis PA-1: All other things being equal, in watersheds where a subset of users is able to use public authority to make enforceable rules governing resource access and use for all, the jointness-of-production requirements will be lower and the likelihood of successful collective action will be higher, than in watersheds where subsets of users do not have or cannot access such authority.

Hypothesis PA-2': All other things being equal, in watersheds where a subset of users is able to use public authority to make enforceable rules governing resource access and use for all, the likelihood that the cooperators will be able to capture net benefits from collective action will be greater, and so will the likelihood of successful collective action occurring, than in watersheds where subsets of users do not have or cannot access such authority.

Hypothesis PAS: All other things being equal, in watersheds where a subset of users is able to use public authority to block the creation of rules governing resource access and use, or at least to insulate themselves from the coverage of those rules, the jointness-of-production requirements for

successful collective action among the remaining users are greater and therefore the likelihood of successful collective action is lower, than in watersheds where subsets of users do not have or cannot access such authority.

Hypothesis PA-4: All other things being equal, in watersheds where a subset of users is able to use public authority to block the creation of rules governing resource access and use, or at least to insulate themselves from the coverage of those rules, the ability of cooperators to capture net benefits will be lower and the likelihood of successful collective action will be lower, than in watersheds where subsets of users do not have or cannot access such authority.

Conclusions and Implications

The literature on common-pool resources has long contained observations about the impacts of heterogeneities among users upon the prospects for successful collective action to resolve resource dilemmas. Much of this previous work has concentrated on heterogeneities created by physical characteristics of the resource, by cultural or linguistic differences among resource users, and by differences in the skill levels or technological sophistication of users. This literature has been highly beneficial in increasing the understanding of common-pool resource situations.

We believe that additional sets of heterogeneities arise from institutional arrangements that also shape the resource situation. Like the ones studied previously, these institutional heterogeneities also define and shape the positions of users relative to one another and relative to the resource.

We certainly are not the first to note the significance of these institutional heterogeneities in empirical settings. Many case studies of common-pool resource situations have catalogued differences among users with respect to rights of access and use, and of the authority to alter those rights or insulate them from alterations attempted by others. The intention of our addition has been to attempt to provide a more systematic and inclusive review of some important institutional heterogeneities and of the range of their potential effects on collective action.

We also have observed that previous analyses of the effects of institutional heterogeneities have diverged widely, from the optimistic predictions about the effectiveness of privileged groups or the benefits of full-ownership property rights to the dour warnings of the sad fate that awaits resource users whose economic, legal, and political statuses differ. Accordingly, our effort here has also been to recast the theoretical propositions concerning the linkages between institutional heterogeneities and their effects in a way that might encompass the previous predictions about those linkages.

Our restatement is that the effects of institutionally created heterogeneities depend upon their impacts upon a) jointness-of-production thresholds for achieving successful coordination, and b) the positions of resource users with respect to the benefits and costs of cooperation. As heterogeneities lower jointness-of-production requirements and enhance cooperators' ability to capture net benefits from cooperation, the prospects for successful cooperation increase. As

heterogeneities raise jointness-of-production thresholds and inhibit cooperators' assurance of capturing net benefits, the prospects for successful cooperation dim.

If this restatement stands up to future research, including the research we are conducting in Arizona, California, and Colorado, then more refined and more accurate predictions and explanations of the ability of users to achieve successful resolutions of commons dilemmas should result. In addition to mapping the physical characteristics of a resource, the demographic composition of the users group, and the economic and technological dimensions of their use of the resource, researchers can and should also map the institutional "lay of the land" to identify the relative positions of users with respect to property rights and public authority.

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