# PRIVATE EXCHANGE AND SOCIAL CAPITAL: MULTIPLE FUNCTIONS OF COMMON PROPERTY REGIMES IN HAITI[1]

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## Introduction and Objectives

A great challenge facing common property regime (CPR) enthusiasts today is understanding the role of CPRs in society.. Meeting this challenge entails understanding why individuals choose to create CPRs and the conditions in which CPRs are established and maintained. Research in this domain often assesses individual motivations for participation strictly in terms of their potential to gain from the output of the action (e.g. the managed forest, irrigation system or well). Increasingly, practitioners and researchers realize that individuals often contribute to collective actions for reasons other than those that are narrowly rational, and other than those associated with the output. These "other" reasons can include minimizing risk; fulfilling social obligations, banking favors; enhancing personal prestige, or other ideological/personal/cultural reasons (cf. Swallow 1996). Evidence indicates that these "other" functions can sometimes be as important as, or possibly more than, narrow incentives to capture gains from action, in explaining the performance of collective actions (such as CPRs).

In addition to performing multiple functions at the individual, or private, level, CPRs also perform multiple functions at the social, public level. Of course, a primary social-level function is to address a particular collective issue, but as at the individual-level, there are probably a host of "other" social-level functions. These functions are less well studied and understood, but perhaps no less important. For example, Albert Hirschman (1984) found that the collective action groups he studied in Latin America

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were mutations and extensions of pre-existing groups. He also found that the individual and collective experience of developing skills, trust and norms within each group formed the basis for new and more complex organizations, formed to address new and more complex social, economic and political issues. In this manner, an important social function of each group was to facilitate the formation of another. He termed this transformative process "the conservation and mutation of social energy".

More recently, politicians, development practitioners, and noted academics alike have shown new and great interest in the role of collective actions and other forms of social capital in government performance and economic development.[3] For example, Robert Putnam (1992) argues that government performance in Italy (and by inference, democratic governments in general) can largely be explained by the presence and strength of social capital. That is, strong civil societies lead to responsive and efficient governments. Mr. Putnam (1995) further claims that social capital "can improve education, diminish poverty, inhibit crime, boost economic performance, foster better government and even reduce mortality." Francis Fukuyama (1995) claims that differences between countries in industrial structure, and by inference, economic development, can best be explained by social capital. Mr. Fukuyama (1995) further predicts that "The character of civil society and its intermediate associations, rooted in as it is in nonrational factors like culture, religion, tradition, and other premodern sources, will be key to the success of modern societies in a global economy." The underlying thesis of both Mr. Putnam's and Fukuyama's claims is that social history matters. In essence, areas with a greater history of trust-based civic networks, have greater chances to have responsive governments and economic development.

If the claims by Mssrs. Putnam and Fukuyama, and the many other promoters of "civil society" as a powerful driver of political and economic development are true, even if partially, then CPRs, and other forms of collective action, perform a valuable role in societies, not only by the particular issues they address, or economic gains they generate, but by their subtle and generalized contribution to the construction of other and future forms of social capital. The relevant policy question is whether the benefits of these "other" functions of collective action - calculated in addition to the value of the objective output of action - is sufficiently significant to merit particular government support for civil society. The weight and import of these claims, and implications for policy, calls for increased scrutiny of the multiple functions of collective actions.

This paper has two objectives: (1) to identify the multiple functions performed by a particular case of collective action in Haiti - at both the private and social levels[4]; and (2) to assess the implications of these findings for research and policy in Haiti. The paper will first review the research and analyses, discuss findings and conclusions, and then assess the implications.

[3] The term social capital refers to "features of social organization, such as networks, norms and trust, that facilitates coordination and cooperation for mutual benefits (Putnam 1993).

[4] Differentiating between private and social functions is of course very problematic. The difference is made here to facilitate analysis and the organization of the discussion.

## Research and Analyses

### The Case

The research case entails collective action to control transboundary erosion in 22, small, multi-owner watersheds in Maissade, Haiti. The collective action consisted of voluntary labor contributions to build checkdams in ravines that crossed private land holdings. Checkdams were the technical innovation that controlled the erosion externality by withholding water and soil. These checkdams were demanded by landholders because they reduced land degradation and enabled farmers to plant high valued crops in the trapped sediment. Cooperative management was the institutional innovation that allowed these gains to be realized. Research focused on understanding why individuals chose either to participate (or not to participate) in the activity, and why new cooperative groups formed in some watersheds and not in others. See Annex 1 for a more detailed description of research results and White and Runge (1995) for a comprehensive description of the site, conceptual model, research methods and implications for collective action theory.

### Predictors of Individual Participation

Research found that the strongest predictors of participation - for participants who held land in the watersheds - were: (1) membership in pre-existing producer associations (*groupman*); (2) prior adoption of soil conservation techniques on their own private parcel; and then (3) likelihood of checkdam construction on participant's land. Notice that the variable indicating economic incentive to directly benefit from the collective action event was significant, but the weakest of the three significant variables. Additional research indicated that the strongest predictors of participation - for participants who did *not* hold land in the watersheds - were: (1) membership in pre-existing producer associations; and (2) membership in reciprocating labor-exchange groups. It is also worthy of note that focus-group interviews revealed a moral dimension to the individual's participation calculus. Individuals were generally expected to participate, that is, the community felt that individuals *should* participate in the action as it was yielding public benefits. These same focus group interviews found that many peasants enjoyed the experience of working together on the watershed protection interventions.

Because of the obvious importance of membership in producer associations and labor-exchange groups, we next sought to better understand the relationship between these fundamental social units. The strongest predictors of membership in producer associations were: (1) membership in labor-exchange groups; and (2) affiliation with Protestant religions. Membership in labor-exchange groups and, to a lesser extent, affiliation with Protestant religions is apparently an important precursor to membership in other forms of collective action. Apparently, participation in these fundamental groups provides the necessary experience of sharing information, building trust, constructing rules, monitoring relations and sanctioning necessary for higher order structures. This

experience, and the assurance of solidarity and reciprocity, allow members to share risk, leverage resources, extend pay-back periods, and make leading contributions to collective actions, even when they know that these ventures might not be rewarded. Numerous tests found that no variables predicted membership in labor exchange groups. We also found that membership in producer groups was the strongest predictor of soil conservation adoption. This indicates that such forms of social capital also facilitate the acquisition of knowledge, diminish the risk of innovative behavior, and thus decrease the cost of adopting new technologies.

### Predictors of Emergence of Collective Action

The level of collective action ranged from high in some watersheds to low in others. Research was conducted to identify the variables associated with collective action. Strong action was significantly predicted by: (1) the proportion of watershed parcels that were in the mid-stream position (indicating the aggregate potential for economic gain); (2) the proportion of watershed landholders who had adopted soil conservation techniques; (3) the proportion of landholders who were members of labor exchange groups; and (4) the proportion of landholders who were members of producer groups. Note that at this aggregate level of analysis, the potential for economic gain from the collective action was the most important predictor. In essence, groups formed to manage watersheds only where there was sufficient economic logic. High levels of knowledge concerning the benefits of the techniques themselves, and high levels of social capital - in the form of producer associations and labor-exchange groups, were apparently necessary conditions for successful emergence.

## Discussion and Conclusions: Multiple Functions of Watershed Management Regimes

### Individual Level

The watershed management regimes served as "bundles of opportunities", performing different functions for different individuals. These functions can be usefully separated into two artificial categories, those functions associated with the *output*, and those associated with the *process* of action. Clearly, at the individual level, process-related functions were a more important motivation for participation than output-related functions. That being said, as illustrated by the social-level analysis, groups did not form unless there was sufficient economic logic at the aggregate-level to form.

The management regime appeared to perform at least three output-related functions: (1) provided direct economic gains to those who benefited from establishment of checkdams on their land; (2) decreased land degradation on-site, providing farmers with more assured expectations over production; and (3) minimized risk of land degradation downstream, providing downstream farmers more assured expectations over production.

The function of reducing the uncertainty, and enabling more secure expectations over production, appeared especially important. Weather, and its varied impacts, is a constant source of uncertainty in Haiti. Rainfall is frequently torrential and because soil conservation is uncommon, overland flow can ruin a planted field overnight. In constructing the regimes farmers sought to coordinate the behavior of upstream farmers to reduce their own insecurity. More secure expectations would, in turn, enable better investment decisions and more efficient production.

The regime appeared to perform at least three process-related functions: (1) provided a mechanism to invest effort (and good will) in reciprocal relations; (2) enabled religious, or morally motivated individuals an opportunity to express their beliefs regarding how land should be managed, and how social organization should contribute to land management; and (3) provided an opportunity for conviviality. We do not know precisely how much participation was motivated by expectations of reciprocity; social, cultural or religious norms; or conviviality. The fact that participants were disproportionately Protestant indicates that the regime functioned as a domain where they could express their particular beliefs concerning land management and social action. Field work indicated that the regimes emerged on the basis of moral claims that the existing situation of land degradation was "wrong" and that land users could and should do something about it. That is, moral claims drove the process of collective action. This "fulfillment of moral/religious claims" function of regimes is apparently integral to the emergence and survival of collective actions.

Because of the importance of labor-exchange membership, it appeared that participants, at least to some degree, were "banking favors", or "building debts", and therefore reducing uncertainty over ability to muster labor the future. It was also apparent that these debts were fungible, and that a labor contribution to build a checkdam on an individual's land might be repaid in other types of favor at a later date. These "tit-for-tat" reciprocal relationships functioned, at least in part, because they were both fungible and redeemable over longer periods of time.

The function of providing an opportunity to bank favors cannot be underestimated in rural Haiti where poverty is extreme and social services almost nonexistent. One's survival, or the survival of a loved one, can hinge on the extent, and rapidity, to which neighbors respond to cries for assistance. There are two important dimensions to the reciprocal assistance: timeliness, and quantity. For example, the call for labor is routine and comes annually with the agricultural season. Because of the high labor demands of preparing fields, the unpredictable rainfall, and the poor water retention capacity of the soil, when peasants call for labor, the response must be rapid and substantial. This implies that in order to produce, peasants must not only strategically bank favors with a large number of individuals and respect their own debt commitments, but also regularly investigate the opportunity for new favors and regularly monitor all relationships to keep tabs on favor and debt balances.

**Social Level**

As in the individual-level analysis, functions performed by the regime at the social-level can be separated into two broad categories; those functions associated with the *output*, and those associated with the *process* of action. Output-related functions include: (1) increased agricultural production and economic wealth in the watersheds; and (2) decreased land degradation and risk of crop damage due to storm events. The wealth generated by the action, and the more secure environment for production enhanced, even if slightly, social welfare. Because of the strong cultural pressures for redistribution in rural Haiti, the wealth generated by the action was undoubtedly redistributed, and its effects multiplied.

Process-related functions include: (1) a stimulated labor market, with more opportunities for building debts and favors and monitoring commitments; (2) reinforced social, cultural and religions norms; and (3) a reinforced social safety net. The relationship between the watershed management regimes and the labor market illustrated both the critical importance of secure access to labor, and the role of the labor exchange institution in rural society in general. Labor exchange groups reduce the cost of labor, by reducing transactions costs of acquisition and reducing costs of supervision, and thereby reduce the costs of labor-intensive land improvements. Labor exchange groups are apparently a font of higher-order social capital in rural Haiti, forming the proving ground for trust, organizational skills and leadership. In this manner the individuals who choose to acquire labor via exchange arrangements also contribute to the construction of social capital. In this case, social capital is a positive externality of private exchange.

In addition to the watershed management regime-specific functions cited above, it is probable that the regimes themselves in some, and perhaps only a small, way will contribute to forming new, and more ambitious social, economic and/or political actions. In the case of producer organizations (far more numerous than watershed groups in Maissade), their contribution to more ambitious organizations are proving true. Currently (10 years after producer groups were encouraged to form) new associations of producer groups are providing local farmers unprecedented access to credit, low-cost agricultural inputs and opportunities to store grains. Producer organizations have influenced the political process as well. The majority of municipal officials elected in Maissade in the 1995 election were leaders of peasant groups and civic activists who campaigned on their proven ability to manage rural development. For example, the new mayor of Maissade was an extension agent who provided technical assistance to peasant groups and the watershed management regimes before his election. This trend was repeated across Haiti in the municipal and parliamentary races of 1995 bringing to Haiti a new generation of political leaders (Maguire 1996).

## Implications

### Haiti

Labor exchange groups and producer organizations, and other fundamental, reciprocity-based social units, contribute to a basic foundation for economic and democratic development. These units are often embryonic, weak and small, but they are some of Haiti's only traditions in democratic governance. Forces that (directly or indirectly) weaken such institutions eventually affect the potential for voluntary supply of public goods and local governance capacity. There will sometimes be tradeoffs associated with individual income gains and particular forms of rural social capital. For example, increases in farmer disposable income - all other variables held constant - would tend to discourage labor exchange as wealthier farmers prefer to hire labor. On the other hand, if rural labor rates increase - as is currently taking place via the new minimum daily wage and the numerous make-work programs in rural areas - and disposable income remains limited, then labor exchange may remain an important feature of rural society. Because of the special importance, and vulnerability, of labor exchange and producer organizations, policy makers should carefully consider the effects of all programs and policies on social capital, and carefully weigh all tradeoffs before embarking on particular courses of action.

### General

As illustrated by this case from Haiti, collective action arrangements are completely emeshed within existing social, economic, cultural/religious and political systems where interdependent individuals have multiple relations with multiple social actors at multiple layers for multiple reasons. For this reason, assessments limited to the narrow incentives for action can grossly underestimate both the potential for groups to organize and the full role of collective action in society. Attempting to understand the motivations and functions of action is daunting, especially for outsiders. Nonetheless, researchers, practitioners and policy makers should consider paying greater attention to the "other" functions of collective actions. Additional rigorous analyses will be needed to more fully understand the role of collective action in society, and enable more appropriate policy interventions.

Research along the following lines of inquiry would be especially fruitful: (1) the moral/religious dimension of collective action; (2) the role of collective actions to reduce uncertainty; (3) the role of reciprocity-based institutions on the generation and adoption of innovations; and (4) the specific socioeconomic functions of collective action and the particular linkages between collective action and economic and political development. Progress on this last issue will be especially difficult but will yield especially important contributions to social science and public policy.

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## Annex 1
## Results and Analysis

**(Taken verbatim from:**
**T. White and C. Runge, 1995. The Emergence and Evolution of Collective Action: Lessons From Watershed Management in Haiti.**
***World Development*, 23:10:1683-1698)**

### Factors Associated With Individual Choice to Cooperate

In order to better understand the motivations for cooperation we tested a series of Logit regressions to identify the variables associated with cooperation.[i] The first Logit model was constructed to determine the variables associated with individual landholder choice to either cooperate (or defect).[ii] Other models were developed to better understand motivations.

**Predicting Watershed Landholder Cooperation.** "Membership in *groupman*", "prior adoption of contour soil conservation techniques" and "number of checkdams acquired" were the variables most strongly and significantly correlated with landholder choice to cooperate.[iii] Positive responses in these attributes are positive predictors cooperation. The other variables: "age", "religious preference", "*voodoo* practice", "wealth status", "parcel position", "labor acquisition type", and "land tenure type", were not significantly correlated with cooperation.

Motivations associated with membership in *groupman* and practical knowledge of the benefits of soil conservation thus overrode other motivations. When considering these results it is important to keep in mind that only those individuals with land in the watersheds were included in this model, and that 36 percent of the effort was contributed by individuals who were non-watershed participants.

**Predicting Non-watershed Cooperation.** The phenomenon of non- watershed participation was one of the more curious aspects of the activity for analysts, implying a richer sociological interdependency than defined by the watershed itself. Who were these people and why did they come into the watershed to help their neighbors? The best fitting Logit model indicated that their participation was positively correlated with *groupman* membership and membership in reciprocating labor exchange groups, and negatively correlated with age.[iv] Some 90 percent of the non-watershed individuals were *groupman* members.

**Predicting Membership in Labor Exchange and *Groupman*.** Because "*groupman* membership", and "membership in labor exchange groups" were strongly associated with the choice to cooperate for both watershed landholders and for non-watershed participants, we tried to identify variables that predicted individual choices to engage in *groupman* and labor exchanges. The strongest Logit model found that *groupman* membership was best predicted by prior membership in labor exchange groups and individual affiliation with Protestant religions.[v] *Groupman* membership was not significantly associated with age or any indicator of wealth.

Labor exchange membership thus appeared to be a facilitating condition for joining *groupman*. We also found that labor exchange membership was the strongest predictor of

individual choice to independently adopt soil conservation structures on one's own land. The finding that *groupman* members are disproportionately Protestant correlates with several earlier findings. Cooperators in collective action were disproportionally Protestant and did not regularly engage in *voodoo*. Perhaps Protestant willingness to contribute labor to a common cause was due to "missionary zeal" or a sense of obligation.

Membership in labor exchanges is apparently a key variable underlying higher forms of risk-taking (e.g. technique adoption) and cooperative behavior. What are the determinants of membership in labor exchange? Of nine models tested, none provided a good fit. No variables were significant. This is intriguing. Previous tests suggested that labor exchange members could tend to be poorer and might tend to exchange labor because they lacked capital to purchase labor. However, they were not poorer at significant levels. Previous tests also suggested that labor exchanges might be associated with Protestantism and youth. They were not. Understanding the determinants of participation in this fundamental social organization is an area meriting further investigation.

**Factors Associated With Emergence and Evolution of Collective Action**

The level of watershed treatment ranged from high in some of the 22 watersheds to low in others. Why this difference? What explains why groups emerged and survived in some watersheds and not in others? This question was addressed with two sets of analyses: (1) identifying and ranking the variables significantly associated with different levels of cooperation; and (2) identifying the variables significantly associated with group choice to continue action over the four year test period. From these analyses models were constructed that could predict the emergence and survival of collective watershed management groups.

To conduct the analysis, the 22 watersheds were divided into three categories of treatment (complete, partial and scant) representing three levels of cooperative activity. Completely treated watersheds averaged 37 checkdams, partially treated averaged 25 and scantily treated averaged 8.[vi] A series of Poisson models was tested to identify explanatory variables. A parallel series of least squares linear regressions was tested to check the findings of the Poisson models. In all of the cases discussed below, the least squares regressions verified the findings of the Poisson models.

**Predicting the Emergence of Collective Action.** A preliminary series of statistical tests identified the variables that were statistically different across the different categories of collective action. The likelihood of collective action emerging in watersheds significantly increased with: (1) the proportion of watershed parcels that were in the mid-stream position; (2) the proportion of watershed landholders who had adopted soil conservation techniques; (3) the proportion of landholders who were members of labor exchange groups; (4) the proportion of landholders who were members of *groupman*; (5) the percentage of landholders who directly benefited from the collective action (with checkdams constructed on their land); and (6) the mean number of landholders who participated per work event. The first four of these six variables can be used to predict collective action *ex ante* (i.e., before the action has emerged), while the latter two are correlates of action *ex post* (i.e., once the action had occurred).

The following variables were not statistically significant: (1) mean ages of both landholders and non-watershed participants; (2) mean levels of landholder wealth (as indicated by quantity of pigs, cows, land parcels and total land hectarage owned); (3) proportion of formal religious preference (Catholic or Protestant); (4) mean watershed size; (5) mean number of years of project activity; (6) mean number of landholders; (7) distribution of land tenure types; and (8) mean parcel size.

Poisson models were fitted to identify which of the significant variables were the best predictors *ex ante* of cooperation, and which of the variables were the most strongly associated with action *ex post*. The best fitting predictive model included the "proportion of landholders who had adopted soil conservation techniques" variable only.[vii] The other three variables (proportion of lands in mid-stream position, proportion of landholders who were labor exchange members, and proportion of landholders who were *groupman* members) were not statistically significant.

The model that best identified the strongest correlates of action (*ex post*) included the "proportion of landholders who benefited" variable only.[viii] This finding strongly suggests that the most important correlate of collective action is a high ratio of benefits per capita.

Interestingly, aggregate levels of potential to gain (indicated by the number of parcels in the midstream position), and aggregate levels of landholder participation appeared to be relatively unimportant for the emergence of collective action. Such action was most strongly correlated with the ratio of gain for all landholders, the ratio of individuals who had practical knowledge of that potential gain, and the ratio of individuals who were members of social groups that facilitated its capture. It is also notable that the ratio of gain for <u>all</u> landholders was significant, not the ratio of gain for <u>each</u> participating landholder. This suggests so-called "enlightened" and forward-looking behavior, and confronts predictions that a "limited good" mentality constrains rural development in Haiti.

Because indicators of the ratio of benefits per all potential beneficiaries proved the strongest correlate of collective action, another model was formulated to identify the variables that best predicted this outcome. Of nine variables tested, the most important, single variable predicting the ratio of gain to all landholders was the "number of non-watershed participants per hectare of watershed". This finding is quite striking and suggests that -- holding all other variables constant -- the level of <u>external</u> assistance (from non-watershed participants) was the single strongest correlate of the rate of action. But this does not necessarily suggest causation. Perhaps non-watershed participants were drawn into watersheds where there was a high amount of action. Apparently, not only did external assistance contribute to the gain of cooperating landholders, but also (and especially) to the gain of the non-cooperating landholders.

**Predicting Continued Action.** Another series of tests was prepared to identify the variables associated with group decision to continue collective action to treat the same watershed work was initiated four years previously. Two sets of models were prepared, one including variables that would permit the *ex ante* prediction of group choice to continue and the other the *ex post* situation faced by the group.

The model that best predicted continued action *ex ante* included only the "proportion of landholders who had adopted techniques" variable.[ix] The "proportion of landholders who exchanged labor" and the "proportion of landholders who were

*groupman* members" variables were the next most important followed by the "proportion of parcels in the midstream position". The two variables indicating watershed size were the least important. This last finding again suggests the weakness of physical scale variables in predicting collective action. It also corroborates previous findings and indicates that prior practical knowledge of a potential gain is the best predictor of participation in a collective action that produces similar gains.

The model that best explained continued action *ex post* included only the "proportion of landholders who had adopted soil conservation" variable. This was the same model found with the *ex ante* variables only. Interestingly, the "proportion of landholders who benefited", "proportion of landholders who were *groupman* members" and the "proportion of landholders who engaged in exchange labor" were not significant. Neither was the "number of non-watershed participants" variable significant. Apparently the attributes required for the emergence of action are not necessarily the same ones required to sustain it. In this case, it appears that the practical knowledge of potential gain was the only variable that was both necessary and sufficient for the emergence and continuation of collective action in the long-run.

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[i] Logit regressions were used because they permit the use of both continuous and categorical data, and because they predict the probability of a binary response (in our case, predicting either cooperation or defection). The following variables were tested to determine correlation with individual choice to cooperate or defect: (1) Potential to directly benefit financially from the output of the collective action: the installation of checkdams. This variable is indicated by landholding position in the watershed (sideslope, upstream, midstream, downstream) and length of ravine on individual's landholding; (2) Number of checkdams constructed on individual's landholding (indicating the individual's actual realization of direct gain from the collective activity; (3) Land tenure of the agricultural parcel held in the watershed (rented, owned, share-cropped, or undivided inheritance); (5) Individual's official religious affiliation (Catholic or Protestant); (6) Whether or not the individual regularly participated in *voodoo* ceremonies; (8) Individual's wealth. This variable is indicated by total number and aggregate size of lands held, and the number of cows and pigs owned; (7) Whether or not individual is a member of a *groupman*; (8) The manner in which the individual acquires labor for major agricultural tasks (individually (*pou kont yo*), in pairs (*boukante maten*), via labor exchange groups (*asosye*), hires day labor (*bay djob*)); (9) Whether or not individual had previously adopted soil conservation techniques on their own land; and (10) Age of the individual.

[ii] The backward elimination method was used to choose between candidate models. Variables were dropped from the equation if they did not contribute significantly to explaining the deviance (i.e. if the p-value of the difference in model deviance was > .05). Models were chosen on the basis of lowest AIC (Akaike Information Criterion) for models with significant variables. Parallel linear regression models were prepared in order to test the findings of the Poisson technique. In order to run the linear regressions, all categorical variables were transformed into representative parametric statistics, and a new continuous variable was devised to represent the level of treatment. All sociological parameters were put on a per hectare (rather than proportional) basis. All of the new variables were highly correlated with the original, (proportional) variables. Candidate models were screened with the Durbin-Watson test for autocorrelation and the Wilk-Shapiro test to assure that the standardized residuals were normally distributed. Standardized residuals were also plotted against the dependent variable to assure that the assumption of randomness was not violated. In all cases the linear regressions verified the chosen Logit and Poisson models.

[iii] Of 13 models tested to predict landholder choice to either cooperate or defect, the final model chosen was: y (log odds of cooperation) = -1.66 + 1.85 (*groupman* membership) + .66 (technique

adoption) + 1.09 (number of checkdams acquired). Thus, for example, for an individual who is a *groupman* member, and a technique adopter, yet did not benefit with the placement of checkdams on his/her land, the odds of choosing to cooperate in the collective action are as follows: y (log odds of cooperation) = -1.66 + 1.85(1) + .11(0) = .84. Log odds (i.e., logits) are converted to probabilities with the following formula: probability = $e^{logit}/1 + e^{logit}$. Using this equation, our logit of .84 converts to a probability of .7. The coefficients of the final model can be used to indicate the odds of an individual choosing to cooperate or defect: (1) *Groupman* membership alone increased the odds of choosing to cooperate by 6.4 times; (2) Prior technique adoption alone increased the odds of cooperation by 1.9 times; (3) The odds of cooperation increased by 1.1 times for each checkdam constructed on peasant land; and (4) Positive *groupman* membership and technique adoption together increased the odds of peasant participation by 12.3 times.

[iv] Of the 12 models tested, the final model chosen was: y (log odds of non-watershed cooperation) = -.05 (age) + 1.39 (whether or not individual was a member of a *groupman*) + .59 (whether of not individual was a member of a labor exchange group). For example, for a non-watershed individual who is 30 years of age, a *groupman* member and a member of a labor exchange group, the odds of choosing to participate are as follows: y (log odds of participation) = -.05(30) + 1.39(1) + .59 (1) = .34. This logit of .34 converts to a probability of .59. The coefficients of the logit regression indicated that: (1) *groupman* membership alone increased the odds of participation by 4.0 times; (2) membership in labor exchange groups alone increased the odds of participation by 1.8 times; (3) the odds of participation decreased by 1.1 times for each year of age; and (4) *groupman* membership and labor exchange together increased the odds of non-watershed participation by 7.2 times.

[v] Of 12 models tested to predict *groupman* membership, the final model chosen was: y (log odds of *groupman* membership) = 2.36 (whether or not the individual was a member of a labor exchange group) + 1.02 (whether the individual was Protestant or Catholic). For example, for individuals who are member of labor exchange and refer to themselves as Protestant, the odds of being a member of a *groupman* are: y (log odds) = 2.36(1) + 1.02(1) = 3.38. A logit of 3.38 converts to a probability of .55. The coefficients indicated the odds of an individual being a *groupman* member: (1) Labor exchange membership alone increased the odds of membership by 10.6 times; and (2) Protestant affiliation alone increased the odds of membership by 2.8 times.

[vi] The "completely" treated category includes watersheds in which checkdams were constructed in the principal ravine from the uppermost to the most downstream parcel. The "partial" category includes watersheds in which 11 or more checkdams were constructed but treatment was not achieved from up- to downstream. The "scant" category includes watersheds in which 10 or fewer checkdams were constructed. Statistical analysis affirmed that the level of action between these different categories was statistically significant. The mean number of checkdams per hectare was statistically different in each of the categories ($p <= .075$), as was the number of checkdams per linear meter of the principal ravine ($p <= .062$).

[vii] The final model chosen was: ln (level of treatment: 1-3) = 1.21 (proportion of landholders who have adopted contour soil conservation techniques on their own land). For example, if 70 percent of landholders had previously adopted soil conservation, the predicted level of treatment would be: ln (level of treatment) = .847. The inverse of the natural log of .847 equals 2.3.

[viii] Of seven models tested to identify *ex post* correlates of action, the final model chosen was: ln (level of treatment: 1-3) = 1.4753 (proportion of landholders who benefited with the construction of checkdams on their land). For example if 70 percent of all watershed landholders received checkdams from the collective action, then the correlated level of treatment would be: ln (level of treatment) = 1.03. The inverse natural log of 1.03 equals 2.8.

[ix] Of eleven *ex ante* predictive models tested, the final model chosen was: y (log odds of continued action) = -2.24 + 4.20 (proportion of landholders who had previously adopted soil conservation). Thus, for example, if 50 percent of the landholders in a watershed were adopters, the probability that its group would choose to continue action would be: y (log odds of continued action): -2.24 + 4.20 (.5) = -.14. A logit of -.14 converts to a probability of .47. This model predicts that the probability of sustained action closely follows the proportion of landholders who have practical knowledge with the intended output of the collective action.