How Should the Commons be Governed? Household Preferences for CPR Management Regimes in Tigray, northern Ethiopia

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Abstract

The paper is based on fieldwork conducted in Tigray Region, northern Ethiopia, which investigated the relationship between sustainable livelihoods and the sustainable management of common property resources. The overall research investigated in depth the variety of internal and external factors influencing the likelihood that community-based management can ensure both sustainability of natural resource utilisation and sustainable livelihoods.

In contrast to many CPR studies, the research analysed management regimes governing a wide variety of natural resources: in the Tigray context different natural resource management regimes can be found within the same landscape. The variations between different property rights arrangements were investigated, with the aim of identifying external and internal determinants of these arrangements. In this respect, the research followed the more recent developments in CPR analyses of identifying determinants of co-operation/collective action in CPR management. This more recent development in CPR studies tends to focus on the conditions under which individuals will co-operate, either through specific incentives/sanctions, or through the existence or construction of social capital to facilitate co-operation. Such studies are however often limited in the extent to which they model actual processes involved in determining co-operation or non-co-operation in natural resource management. It is important to elicit the actual perspectives and preferences of households involved in CPR utilisation as a basis for understanding the sustainability of the CPR regime.

The analysis reported in this paper therefore involved multivariate analysis of households' preferences for particular management and tenure arrangements governing different natural resources, as a contribution to understanding the complexity of factors which determine both the nature of specific natural resource management regimes, and the sustainability of the resources themselves. The multivariate analysis was based on the technique of logistic regression, and was applied to six different CPRs, where households expressed preferences for management regimes and tenure systems governing each of the six CPRs. Results of the analysis are reported in the paper. One key general finding is that, although there has been considerable construction of social capital in Tigray in recent years, clear differences in preferences for management regimes and tenure systems could still be observed. These differences in preferences – which are related for example to differences in degrees of dependence on CPRs, in awareness of the extent of CPR degradation, and in broader commitments to co-operation – need to be taken into account in analysing the relationship between households' goal of attaining sustainable livelihoods, and the community-wide goal of sustaining natural resources.

1. Introduction

The issue of whether common property resources (CPRs) are managed sustainably is inextricably linked with the issue of whether households which use such CPRs can sustain their livelihoods as a result. Any comprehensive assessment of the effectiveness of community-based management of CPRs needs to focus on these two dimensions of sustainability: the sustainability of the natural resource itself, and the sustainability of the livelihoods of those households using the resource. The assertion that community management of CPRs *can* ensure both sustainable natural resource management and sustainable livelihoods is, however, somewhat trivial, given the large body of empirical evidence of successful community-based natural resource management. What is of greater interest is to identify those internal and external factors that influence the likelihood of sustainability: just as the existence of a common resource does not automatically guarantee its over-use (contrary to Hardin 1968), so also the presence of a local institution governing a common resource does not automatically guarantee sustainable use (Ostrom 1990).

The tradition of CPR analysis developed by Ostrom and others focussed in detail on the institutional features of successful CPRs, and attempted to identify "design principles" or other factors determining whether CPR management would be successful or not. Agrawal (2001), in analysing three comprehensive analyses in this tradition (Ostrom 1990, Wade 1988, Baland and Platteau 1996), notes that a careful reading of their analyses renders a total of 36 important conditions which the authors identify as being relevant to successful CPR management. Agrawal notes the difficult analytical problems involved in any analysis of the sustainability of the commons going beyond the purely descriptive, given (a) the large number of apparently important "success factors", (b) the likelihood that some determining factors are correlated, and (c) the likelihood that there will be interaction effects between many of these variables.

Recent analyses which have moved CPR research beyond the "purely descriptive" have focussed on the importance of collective action and social capital. The presence of social capital is hypothesised to be an important determinant of whether collective action and/or co-operation in CPR management will take place. A relatively small number of studies (for example Meinzen-Dick, Raju and Gulati 2000, Bardhan 2000) have undertaken quantitative analyses including explanatory variables which are designed to capture the social capital effect. Such variables tend to measure the extent of organisation in a "community", and therefore the sampling unit is generally the village or a natural resource-based unit, for example an irrigation system. Meinzen-Dick et al (op. cit.), for example, in analysing factors determining farmer participation in managing irrigation systems in India, use the number of temples and co-operatives at village level as indicators of social capital. Social capital is treated in such studies as an explanatory variable explaining the existence and/or extent of co-operation in CPR management: a high degree of co-operation/participation is taken to indicate that sustainable community-based management of the CPR exists or at least is more likely to exist.

Similar analyses focus on the determinants of collective action, where the existence of collective action again appears to denote co-operation in CPR management and/or community-based mobilisation to overcome externalities which exist due, for

example, to landscape-level interactions within a watershed. Recent detailed analyses of factors determining sustainable land management in Tigray Region, Ethiopia, for example, base their analyses of the determinants of collective action on village-level variables (Gebremedhin, Pender and Tesfay 2002 a, b). White and Runge (1994), and Gaspart, Jabbar, Melard and Platteau (1998) conduct analyses of the determinants of participation/non-participation in watershed management-related activities using data for households within particular watersheds. Whereas the Tigray village-level studies naturally draw attention to determinants of collective action which vary across villages (for example population density, distance from markets), the latter two studies focus on household-level characteristics. However, they arrive at different findings in terms of the extent to which the self interest of individual households contributes to their involvement in collective action or not. Whereas Gaspart, Jabbar, Melard and Platteau find that *"participation rates are largely influenced by the personal benefits which different farmers can expect to draw from the creation of the drainage infrastructure"* (Gaspart et al, pp. 179-180), White and Runge find that a principle of reciprocity operates in the Haitian watersheds studied such that both beneficiaries and non-beneficiaries of checkdam construction participated in the collective labour input required.

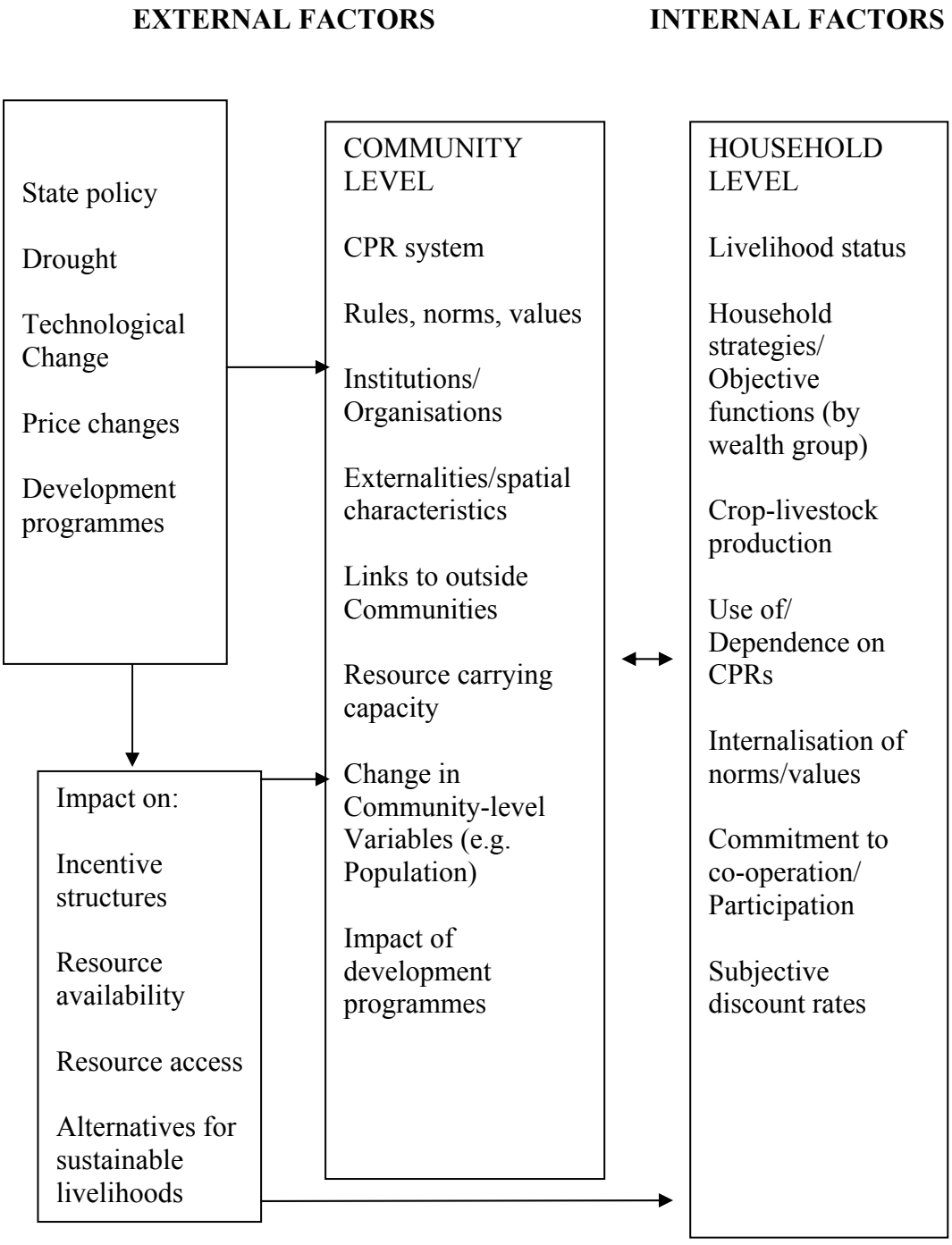
There is a divergence of perspectives in these studies on the extent to which the focus is on individual incentives to co-operate, or the extent to which social capital exists or can be constructed to facilitate or "enforce" co-operation. At one extreme is the view that each individual weighs up her potential benefit from co-operating in each potential situation and then chooses whether to do so or not. Much of the game theory literature (e.g. as extensively reviewed in Baland and Platteau 1996) follows this perspective and focuses on identifying the circumstances under which individuals can be induced to co-operate. At the other extreme is the view that once an institutional structure is established, then members of the institution will co-operate and the CPR management problem is solved. Attention in the latter studies may be on the precise rules and sanctions by which members' compliance is achieved. Both of these perspectives are limited in the extent to which they model actual processes involved in determining co-operation or non-co-operation in natural resource management: the former is implicitly based on a view of human behaviour emphasising the primacy of self-interested calculus, even in the short term, while the latter makes contrasting assumptions which subsume individual perspectives under an assumed common good.

It is therefore important to conduct analyses of the conditions under which people will co-operate to manage a natural resource sustainably, recognising that a range of internal and external factors will influence the decisions of different households. This paper presents the methodology and results of such an analysis, conducted in the Tigray Region of northern Ethiopia.

2. Conceptual Framework

The research on which this paper is based focussed on an in-depth exploration of the variety of internal and external factors influencing the likelihood of achieving the joint objectives of sustainable natural resource management and sustainable livelihoods, in four distinct areas of Tigray Region, northern Ethiopia. The conceptual framework developed for the analysis is shown in Figure 1.

Figure 1. Factors determining NRM and livelihood sustainability



Whereas the focus of many CPR studies is on the institutional structure of the management regime and its effectiveness in securing co-operation, the conceptual framework in Figure 1 indicates a much wider set of factors which need to be taken into account. In the specific context of Tigray, some of the critical factors include the following:

(i) renewable natural resources are often managed as CPRs, but in the context of household-based economic systems. Analysis of the management and utilisation of such natural resources needs to be placed in the context of the contribution of those resources to the overall household economy;

(ii) the sustainability of natural resource management depends on both internal and external factors: internal factors include the rules of access and organisational forms developed to monitor and enforce such rules, while external forces include (in the case of Tigray) the effects of State policy on land tenure, the impact of drought, and the potential influence of development interventions. The specific nature and levels of these internal and external influencing factors also have to be identified through the data collection process;

(iii) differentiation within specific resource-using communities can affect the sustainable utilisation of resources. Some theoretical debates on the poverty-environment relationship suggest that poor people may be pushed into degrading their environment to survive in the short term (WCED 1987, Pinstrup-Anderson and Pandya-Lorch 1994); contrary views suggest that poor people, because they are more dependent on natural resources, may in fact be more inclined to protect natural resources to survive in the longer term (Broad 1994, Duraiappah 1996). It is therefore important to consider (a) the extent of differentiation within communities, (b) the degree of dependence of different categories of households on natural resources, and (c) the evidence in relation to the nature and direction of the poverty-environment relationship;

(iv) some categories of farmers may be less likely to make land-conserving investments, either because they are "investment-poor" (Vosti and Reardon 1997), or because they are tenure-insecure. These hypotheses need to be examined in terms of farmers' investment behaviour or stated intentions;

(v) even if some categories of people are more inclined to degrade the environment than to conserve it, are there countervailing mechanisms, developed either at the level of the community or the State, which attempt to ameliorate these tendencies? Furthermore, are there some communities, or State actions, which appear to be more effective than others in developing sustainable management systems? Is social capital at the community level an explanatory factor in this respect? Are upstream-downstream externalities a further factor? Community-level data, focussing on the natural resource management systems at different points in the landscape, and on the propensity for collective action, are required to address this issue;

(vi) are there changes in the balance between resource availability and use, for example due to exogenous decline in the size of the resource due to drought or other influences, or due to increased pressure of the resource resulting from population pressure or changes in access regulations?

Where historical data are lacking, analysis of these issues depends on cross-community analysis and on eliciting households' views on resource trends and causal factors;

(vii) Relatedly, are there (a) changing perspectives on how natural resources should be managed, and/or (b) differing perspectives according to households' socio-economic/wealth status? These issues can best be addressed by eliciting households' opinions on their preferred resource management options.

Adding to the complexity of the analysis in the Tigray context is the fact that a wide variety of natural resource management regimes exist even within the same landscape. From a methodological perspective, it is desirable to capture these variations between property rights arrangements, and to attempt to identify external and internal determinants of the arrangements. This is seldom done in the common property literature, where the emphasis has tended to be on detailed analysis of individual common property resource regimes from an institutionalist perspective, usually with the aim of identifying "success factors" in the management system. Other analyses (e.g. Stevenson 1991) compare the same resource operated under different property arrangements from the perspective of their relative productivity, but such analyses do not consider the situation where a single household may simultaneously use a variety of natural resources which are governed by different property rights arrangements.

3. The Study Area

Tigray Region is in northern Ethiopia, with a total land area of about 80,000 sq. km., about 65% of which is cultivated, and a population of about 3.5 million, of which 85-90% is rural. From an agro-ecological perspective it is characterised by sparse and irregular rainfall, and is highly drought-prone. The topography of the area varies from about 1500 metres a.m.s.l. in the north-east to about 3000 meters a.m.s.l. in the south-west. Except for pastoralist areas in the southern lowlands, and large-scale commercial farms in the western lowlands near the border with Sudan, most of Tigray is characterised by a mixed crop-livestock farm economy, mostly rainfed. Crop production in these areas is determined by specific climatic conditions, in particular the distribution of rainfall and temperature variations. In the warmer and wetter lower altitudes in the west and south-west, maize, sorghum and other sub-tropical crops are grown. Teff (an indigenous grain), wheat and barley are the major cereal crops at all altitudes, with barley replacing teff at higher altitudes. Yields generally vary between 1-2 tonnes per ha, but are frequently reduced in some areas due to drought.

During the middle decades of the 20th century Tigray experienced a trend of growing impoverishment and degradation of the natural resource base. At the same time, the Region became politically marginalised. From the mid-1970s onwards, the Tigray Peoples Liberation Front (TPLF) was engaged in a military struggle with the central Government of the Derg regime, largely with the aim of reasserting Regional autonomy and self-respect within the Ethiopian State. Ultimately this resulted in the overthrow of the Derg Government and its replacement by a TPLF-led Government in 1991. A major reason for the success of the TPLF was its ability to address the issues of greatest concern to the increasingly impoverished peasantry: in this way the TPLF

helped to create social capital which, after the civil war, was harnessed for the purposes of addressing land degradation and broader development objectives.

However, the institutional structures for management of natural resources in Tigray are not wholly the outcome of this social capital construction. "Traditional" institutions exist for the management of single natural resources, such as grazing lands, irrigation systems, and forest areas. The significance of the social capital created by the TPLF (which took the form of organisations known as *baitos*, or peoples councils) is that these structures have been used to achieve collective mobilisation of rural households to address landscape-level institutional failures which were contributing to land degradation.

Why were such landscape-level failures occurring? Major reasons for degradation could be traced to the impact of external shocks, rather than to endogenous factors such as population growth or "lack of education". In the case of Ethiopia in general, and Tigray in particular, the two primary external shocks were the influence of recurring droughts, which exacerbated livelihood insecurity, and the effects of socio-political changes and discontinuities in policy, particularly the impact of land reforms and other State legislation which reduced the rights of rural households over tenure of trees, or at least made such tenure rights uncertain. The effect of such policy changes was to convert the property rights regimes governing trees from private or CPR rights to de facto open access: households were then effectively induced to over-exploit these resources as a consequence of the perverse effects of State policy.

Therefore these specific shocks set in motion spirals of unsustainable behaviour, which could only be arrested and reversed, in a sustainable manner, through the building of institutions and social capital in the manner facilitated by the TPLF. The institutions[1] built in Tigray during the struggle against the Derg Government provided the structure through which landscape-level externalities – particularly land degradation at catchment and sub-catchment level – could be addressed, and the trust established between the peasants and the TPLF helped to establish a set of values and norms which promoted and galvanised collective action. The latter manifested itself in mass-based soil and water conservation efforts, including a considerable amount of voluntary collective labour, and in the setting aside of heavily degraded areas for revegetation.

4. Methodological Issues

A number of key points were noted above which need to be taken into account in the analysis of how CPRs are managed in Tigray:

(I) the wide range of internal and external factors influencing sustainable management of CPRs and the sustainability of livelihoods

(II) the considerable variation in natural resource management regimes, even within the same landscape

[1] The primary institution is the baito, but in addition at village level there are three mass associations: Farmers Associations, Womens Associations, and Youth Associations.

(III) the recent history of impoverishment and environmental degradation
(IV) the unique creation of social capital, arising out of the struggle against the Derg Government.

Taking into account the variety of natural resource management regimes, four study sites were selected for in-depth quantitative and qualitative analysis. Table 1 shows the study sites and the key natural resources found in each.

Table 1. Study Areas and Key Resources

Location	Kushets (villages)	Resources
Birki	Birki Adengar	Irrigation Common grazing Hillslopes
Addis Zemen	Gunguna Maeguma	Watershed Individual grazing Irrigation Hillslopes Soil & water conservation
Era	Enguleita Adi-Tsakla Errere	Forest Common grazing Hillslopes Micro-dam
Derge-Agen	Aragure Endamichael	Forest Common grazing Hillslopes

In each area differences in natural resource management regimes can be found. In Birki (as in all of Ethiopia), land is owned by the State but use rights of individual farmers are similar to private leasehold; however, the community has post-harvest grazing rights on such land; irrigation water is managed through collective action; *hizati*[2] grazing areas are common property and actively managed by the community, and hillslopes are also common property but less actively managed. In Addis Zemen grazing land has been divided up between individual households and is not collectively managed, but hillslopes are common property, and there is a traditional irrigation system operated through collective action. In Era and Derge-Agen, crop land is again governed by household-level use rights, but grazing land is common, forest areas were regarded as common property until State management was imposed on the area, but bee keeping, for example, is an individual income-generating activity conducted within the forest. In all of the areas where there are hillside enclosures, few people are clear as to who can actually lay claim to the benefit stream which can potentially accrue from the enclosures.

Within each area, there are landscape-level effects, and the study areas were selected to capture such effects: in Birki and Addis Zemen, both of which include irrigation systems, upstream and downstream villages were included to explore any differences

[2] *Hizati* are small, village-level common grazing areas used particularly for grazing of oxen.

in economic conditions, in involvement in CPR management, and/or in perceptions about how natural resources should be managed. Similarly, in Era and Derge-Agen, villages at different distances from the Dessa'e Forest were selected, since traditionally villages closer to the forest had stronger claims over forest resources and stronger management rights – until in the early 1990s the State gazetted the area as State forest, resulting in the disempowering of those communities and undermining of their management system.

Given the possible landscape-level effects, the existence of CPR management regimes and social capital at village level, and the within-village economic differentiation between households, data had to be collected at all these levels. Households were stratified according to wealth category. Wealth classification is essential given the hypotheses relating to the link between poverty and environmental degradation, and similar hypotheses relating wealth characteristics to the propensity to invest in land-conserving investments, and/or to participate in collective action. In the mixed crop-livestock economy of the Northern Highlands of Ethiopia, including Tigray, it is well recognised that oxen ownership is a critical determinant of a household's food security: households with oxen are better able to cultivate their land or to rent-in land for cultivation. More recently, there is a growing problem of landlessness in some areas, including parts of Tigray: this is partly a result of the TPLF land proclamation following its 1991 land reform, with the aim of providing tenure security, that there would be no further land redistributions. Given a constitutional ban on land sales, the result has been that younger households have had no opportunity to gain access to land other than through inheritance or renting.

Given these factors, households were classified into three categories:

(a) landless households
(b) households with land but no oxen
(c) households with land and at least one oxen.

This classification is based on a simple dichotomous land/no land distinction, and then a further distinction by oxen ownership. This reflects the high degree of equality in land ownership which was one outcome of the successive land reforms of the Derg and TPLF Governments during the 1975-1991 period.

Many issues concerning the use and management of natural resources, differentiating by wealth category, by village, and by landscape unit, can be (and were) examined using descriptive statistics in the broader analysis, using household-level data. The key analysis focused on in this paper is the testing of hypotheses in relation to households' preferences for specific access rules and tenure systems governing six different natural resources: grazing land, post-harvest cropland, forest areas, area enclosures, water resources, and hillslopes. The requirement to conduct such analyses reflects two empirical observations: first, as previously mentioned, the diversity of natural resources and natural resource management regimes found in the study area; and second, the responses from households which indicated considerable divergence in households' preferences for specific access rules and tenure systems governing natural resources, despite the successful creation of social capital by the TPLF. Therefore this analysis went beyond many CPR studies in attempting to disaggregate "community" attitudes towards management of natural resources and, in doing so, addresses the issue of the extent to which households are prepared to subsume

individual preferences for the "common good" –or the extent to which such potential conflicts can be managed at community level. There is clear relevance for policy makers in such analysis: whereas it was widely assumed that the active TPLF-led construction of social capital, supported by successive equalising land redistributions, had succeeded in minimising intra-community differentiation and had fostered an egalitarian and far-sighted commitment to community-based sustainable development, the empirical evidence in specific communities suggests a more complex and less homogeneous situation, which policy makers need to be attuned to.

5. Analytical Approach

The analysis aims to identify factors determining households' preferences in relation to rules of access and tenure systems governing key common resources: specifically the analysis seeks to identify factors determining the extent to which households are satisfied or dissatisfied with existing access rules and tenure arrangements. Initially, households in each area were asked to explain trends in availability of, and access to, different natural resources over the previous ten-year period. Where the availability of a natural resource had declined significantly over that period, it could be expected that households might want to see a tightening of access rules, for example. Table 2 gives an example of responses on preferences in access rules, for the Era study area.

Table 2: Era: Household preferences over rules of access to different natural resources

Resource	Number of households			
	Keep unchanged	More restrictive	Less restrictive	Indifferent/Don't know
Grazing land	46	15	10	22
Post-harvest cropland	63	11	4	19
Forest area	35	15	24	16
Area enclosure	42	22	13	21
Water sources	79	3	2	16
Unenclosed hillslopes	85	1	9	4
Wild fruits	24	3	2	4

Although the modal response for all natural resources is to keep access rules unchanged, disaggregation of the responses by wealth group reveals a divergence in preferences. For grazing land, for example, the largest group of households indifferent to the rules or without an opinion are those with land but no oxen. In relation to the forest area - where recent State control, including a total ban on using the forest as a source of fuelwood, had weakened the "traditional" management system - although the modal response is to maintain the current access rules, a majority of responding households want the rules of access to be changed. In particular, households with land but no oxen want access rules to be less rather than more restrictive, whereas households with land and oxen are almost equally divided on the issue. The latter are

more able to use animal dung for fuelwood and therefore less dependent on using the forest for this purpose.

The analysis was extended to identify those factors influencing households' preferences to either retain existing rules and tenure systems governing common resources, or to change them. This involves multivariate regression analysis using the technique of logistic regression. This approach can be used when the dependent variables are binary categorical variables, taking values of 0 or 1 (Kleinbaum 1994). In this case the dependent variables represent change or no change in access rules, and change or no change in tenure system, for each of the six common resources. As is apparent from Table 2 these binary variables are derived from a broader set of initial responses.[3]

A large number of explanatory variables are used in the logistic regression analysis (see Appendix 1). Following Ervin and Ervin (1982) and Gebremedhin and Swinton (2001) these variables were sub-divided into a number of categories: socio-demographic, physical, economic, and institutional. In addition village effects are included by entering village as an adjustment variable in the analysis. Socio-demographic variables are essentially measures of a household's productive capacity, primarily household labour and land owned or rented-in. Physical factors in this analysis are limited to the existence of irrigated plots: other characteristics, for example land quality and elevation, are reasonably uniform and therefore do not have explanatory power. A large number of economic variables are included in the analysis, relating to agriculture and food security, ownership of animals and other natural resources, investments in conservation measures and conservation-oriented farm practices, measures of income, and use of natural resources and trends in availability and access to them. Finally, institutional factors are included primarily to address the influence on households' preferences of tenure security and collective action/social capital.

The analysis was conducted on the pooled data for all sample households from the four study areas, 303 households in total. Logistic regression analyses were conducted to determine the predictor variables influencing the likelihood that households will prefer a change in the access rules or tenure system governing each of the six common resources (12 analyses in total). However, in the case of post-harvest cropland and water resources, differences in preferences relate to access issues rather than tenure, so that analyses of tenure preferences for these resources was dropped, leaving a total of ten analyses.

The odds ratios (OR) calculated in the logistic regression analysis measure the strength of the association between predictor variables and the dependent variable. In general, an OR>1 implies an increased likelihood of preference for change (in access rules/tenure system), while an OR<1 implies a decreased likelihood of preference for change. One of the limitations of the analysis is that the option of "change" in access rules could be either for "more restrictive" or "less restrictive", therefore interpretation of the results is not always straightforward.

[3] "Change" is a combination of more restrictive and less restrictive, "no change" is a combination of keep unchanged and indifferent/don't know.

6. Results

The following discussion and tables provide results of some of the regression analyses. Only predictor variables which are significant in the final models (at the 5% level) are included in the results. Table 3 presents results of the logistic regression model of access rules for grazing land.

Table 3. Logistic Regression Model of Access Rules for Grazing Land

Dependent Variable: Households preferring change in access rules to grazing land

Predictor Variables (significant at 5% level)	OR	95% interval for OR	p-value
Male adult labour > 15 years	2.56	1.461 – 4.487	0.001
Number of equines	2.138	1.148 – 3.980	0.017
Number of TLUs	0.750	0.605 – 0.930	0.009
Number of oxen-pair days used in cultivation	0.949	0.917 – 0.981	0.002
Grain consumption per adult equivalent:			
0 – 100 kg.	1.00		
100 - 200 kg.	1.669	0.751 – 3.710	NS
200 – 300 kg.	3.294	1.081 – 10.041	0.036
> 300 kg.	32.640		NS

Number of cases = 236.
Nagelkerke R^2 = 0.229, Hosmer-Lemeshow χ^2 = 12.547, p = 0.128.
Percent correctly predicted = 71.1%.

This model suggests that households with more labour power at their disposal have a higher likelihood of preferring a change in access rules (OR=2.56). The empirical data showed a positive correlation between household size and wealth (measured by land and oxen ownership): therefore it is probable that such households, since they already have relatively superior access to *hizati* (common) grazing land than other households, prefer a tightening of access rules. The odds ratios of the variables number of TLUs (OR=0.75) and number of oxen-pair days in cultivation (OR=0.949) both reinforce this finding, suggesting that households which make more use of oxen in cultivation prefer to maintain the status quo with respect to access rules for grazing land.

Households with foodgrain consumption per adult equivalent between 200-300 kg. per annum have a higher likelihood of preferring a change in access rules, compared to the reference category (households with 0-100 kg consumption per annum). The reference group reflects households with very low levels of consumption who are less likely to have either access to the *hizati* land or the possibility of such access due to their own lack of productive capital. Households in the higher consumption category may either prefer a change in the direction of making access more restrictive (if they have oxen) or less restrictive (if they currently lack oxen but want to gain access to the *hizati*).

In general the model suggests that households with more productive assets –especially labour power and oxen – are more likely to want to either preserve the status quo or to tighten access restrictions. However, these conclusions cannot be drawn definitively because of the nature of the dependent variable, where "change" could refer either to more or less restrictive rules.

Table 4 shows results of the logistic regression analysis of access rules for forest resources, and Table 5 shows results of the analysis of the tenure system for forest resources. The Dessa'e forest is the last remaining sizeable forest area in the Eastern Zone of Tigray Region, with an area of about 120,000 hectares, and was previously under community management, and in general successfully guarded against attempts at over-exploitation by outsiders. During the 1990s, the State took over the management and, according to local informants, this resulted in a weakening of community controls and significant increase in deforestation – the converse of what the State had intended. It could therefore be expected that communities might want prevailing access rules and/or the tenure system to be changed.

Table 4. Logistic Regression Model of Access Rules for Forest Resources

Dependent Variable: Households preferring change in access rules for forest resources

Predictor Variables (significant at 5% level)	OR	95% interval for OR	p-value
Household perceptions of trends in forest size:			
Households perceiving no change	1.00		0.000
Households perceiving increase	0.140	0.032 – 0.609	0.009
Households perceiving decrease	0.954	0.276 – 3.293	NS
Household perceptions of trends in hillslope size:			
Households perceiving no change/increase	1.00		0.004
Households perceiving small decrease	0.170	0.060 – 0.478	0.001
Households perceiving large decrease	0.536		NS

Number of cases = 236.
Nagelkerke R^2 = 0.527, Hosmer-Lemeshow χ^2 = 7.080, p = 0.528.
Percent correctly predicted = 80.2%.

Table 5. Logistic Regression Model of Tenure System for Forest Resources

Dependent Variable: Households preferring change in tenure system for forest resources

Predictor Variables (significant at 5% level)	OR	95% interval for OR	p-value
Number of oxen	2.234	1.436 – 3.476	0.000
Households who invested in soil bunds	0.206	0.086 – 0.492	0.000

Number of cases = 236.
Nagelkerke R^2 = 0.357, Hosmer-Lemeshow χ^2 = 4.887, p = 0.674.
Percent correctly predicted = 72.9%.

Households who perceive that there has been an increase in forest size in the last 10 years have a lower likelihood of preferring a change in access rules compared to the reference category, households who perceive no change in forest size (OR=0.140). It is somewhat surprising that there was no significant association with households who perceive a decrease in forest size. Although discussions on the condition of Dessa'e forest clearly identified lack of access for fuelwood as an issue, there has also been a considerable focus across Tigray on re-afforestation through the area enclosure programme and tree plantation as part of soil and water conservation activities: the analysis suggests that households who perceive that re-afforestation is having a positive impact on forested area are less concerned to change the current access rules compared to households who perceive no change in forest area.

Similarly, with respect to the variable relating to household perceptions of trends in hillslope size: households who perceive that hillslopes have declined are focussing on the availability of hillslopes particularly for grazing land, which has been affected by re-afforestation and area enclosures. In this respect the decrease in hillslope availability and increase in size of forest area are two sides of the same coin.

The results in Table 5 do indicate the concern of some households with regard to the current tenure system: households with more oxen have a higher likelihood of preferring a change in the tenure system (OR=2.234). The Dessa'e situation is clearly germane to this relationship, since large numbers of oxen are grazed in the forest and the continued uncertainty over tenure is contributing to deforestation and deterioration of grazing quality. It is likely that the preferred change in tenure system is back towards a form of community-based management.

Households who invested in soil bunds have a lower likelihood of preferring a change in tenure system governing forests, compared to the reference category of households who do not make such investments (OR=0.206). Since investments in soil bunds are particularly low in the Dessa'e area, this variable is probably a further reflection of the influence of the Dessa'e situation over preferences for change in the tenure system.

Table 6 shows results of the logistic regression analysis of access rules for water resources.

Table 6. Logistic Regression Model of Access Rules for Water Resources

Dependent Variable: Households preferring change in access rules over water resources

Predictor Variables (significant at 5% level)	OR	95% interval for OR	p-value
Households who invested in irrigation channels	4.717	1.278 – 17.414	0.020
Households who see no disadvantages in collective labour	0.419	0.187 – 0.938	0.034

Number of cases = 303.
Nagelkerke R^2 = 0.283, Hosmer-Lemeshow χ^2 = 3.735, p = 0.810.
Percent correctly predicted = 87.8%.

Households who have invested in irrigation channels have a higher likelihood of wanting a change in access rules compared to households who have not made such investments (OR=4.717). This is not surprising: those households who have invested their own labour in irrigation channels are clearly more concerned about access to irrigation water than households who have not made such investments. The change in access rules could however be in opposing directions: upstream users might be more likely to prefer a tightening of access rules to improve their own already relatively good situation, whereas downstream users might prefer a change in access rules that enabled them to obtain similar rights to upstream households.[4]

Households who see no disadvantage in collective labour have a lower likelihood of wanting a change in access rules compared to households who do see some disadvantages (OR=0.419). This probably reflects the fact that households who see no disadvantage in collective labour are likely to be in a better position to supply such labour, since they are already better-off households, including those households with access to the irrigation system and who are content with the current CPR system. Furthermore, such households are motivated to ensure continued provision of the irrigation system through collective labour, since they will thereby benefit directly from it. This logic has been found in other CPR studies, for example Gaspart et al (op. cit).

Table 7 shows the results of the logistic regression analysis of access rules for hillslopes. Hillslopes are critical resources in the study area, primarily used for open grazing. Tenure arrangements over hillslopes have been somewhat unclear at least since the Haile Selassie period, and at times this has created an open access vacuum during which deforestation accelerated. Since the TPLF takeover of power in Tigray in 1991 "management" of hillslopes has been devolved to some extent; at the same time the emphasis on area enclosure to allow regeneration has meant significant parts of some hillslopes have been shut off and cannot be used for grazing. Although there is recognition and quite broad acceptance of the need to allow for regeneration, there is also concern that grazing land for livestock is being reduced.

Table 7. Logistic Regression Model of Access Rules for Hillslopes

Dependent Variable: Households' preferences over access rules for hillslopes

Predictor Variables (significant at 5% level)	OR	95% interval for OR	p-value
Land owned (hectares)	2.213	1.212 – 4.039	0.010
Number of voluntary days' collective labour per adult family member	0.683	0.484 – 0.964	0.030

Number of cases = 303.
Nagelkerke R^2 = 0.164, Hosmer-Lemeshow χ^2 = 6.011, p = 0.646.
Percent correctly predicted = 80.8%.

[4] The relevance of this statement is that local court rulings have confirmed the primacy of the right of upstream communities to water during periods of scarcity, although "traditional" management structures exist which attempt to share irrigation water equitably.

The model indicates that households have a higher likelihood of preferring a change in access rules as land size increases (OR=2.213). It is possible that larger landowners have a stronger view that access to hillslopes should be restricted to prevent further degradation. Empirical data from the household surveys and from group discussions indicates that some households are clearly aware of on-going degradation and express the view that hillslopes have to be protected "for future generations". The model suggests that these sentiments tend to be associated more with larger landowners, implying that the preference for change in access rules is in the direction of tighter controls on use. This would also be consistent with the evidence that larger landholders are in a better position to forego some of the benefits derived from hillslopes since they have readier access to substitutes: for example they can meet a higher share of feed requirements from the *hizati* and from crop residues, and can supply a greater proportion of their fuel needs from animal dung.

Households who provide more days of voluntary collective labour per adult family member have a lower likelihood of preferring a change in access rules (OR=0.683). The reason for this association is however not clear.

Table 8 shows results of the logistic regression analysis of the tenure system for area enclosures. Area enclosures are essentially hillslopes which have been closed to permit revegetation, therefore it is more accurate to regard these areas as a land use type over which a specific form of access rule operates, i.e. total exclusion at the current time. Similarly, although there is community involvement in designation, implementation and monitoring of area enclosures, there is an ambiguity over the tenure arrangements in the sense that it is not clear who will eventually gain the benefits from the current regeneration.

Although there is evidence of support for the policy of area enclosures, given the extent of land degradation, nonetheless there are also issues of concern to households. Area enclosure was used as a conservation approach during the Derg regime but was largely rejected by the peasantry as a top-down, coercive measure. The TPLF adopted a similar approach but has achieved greater acceptance and legitimacy due to the construction of social capital already referred to, and also due to the more participatory approach used in designating enclosed areas. Some dissatisfaction remains however: many households complain they have no access to grasses growing in the area enclosures, which could be used on a cut-and-carry basis. Area enclosure also by definition reduces the land available for open grazing. Furthermore, in some areas certain individuals have been able to benefit from area enclosures, for example if they fulfil a guarding function, or through illegal cutting, and this creates some resentment. Finally, there is total uncertainty, and no clearly stated Government policy, on who will benefit in the longer term from the growth of trees in the enclosed areas.

Table 8. Logistic Regression Model of Tenure System for Area Enclosures

Dependent Variable: Households preferring change in the tenure system for area enclosures

Predictor Variables (significant at 5% level)	OR	95% interval for OR	p-value
Households with natural resource-based primary income source	2.576	1.136 – 5.840	0.023
Household perceptions of trends in hillslope size:			
Households perceiving no change/increase	1.00		0.007
Households perceiving small decrease	4.857	1.632 – 14.457	0.005
Households perceiving large decrease	1.072		NS
Households' attitudes to on-farm investment after last land reform:			
Households whose attitude was not affected by land reform	1.00		0.000
Households more likely to invest because of land reform	0.159	0.062 – 0.404	0.000
Households less likely to invest because of land reform	0.710		NS

Number of cases = 303.
Nagelkerke $R^2 = 0.543$, Hosmer-Lemeshow $\chi^2 = 3.302$, $p = 0.914$.
Percent correctly predicted = 80.4%

Households whose main income source is derived from natural resource-based activities (crops, livestock products etc.) have a higher likelihood of preferring a change in the tenure system governing area enclosures (OR=2.576). This is to be expected: these are households who are more directly concerned with land allocation decisions since such decisions affect their livelihoods to a greater extent than, for example, households whose main source of income is wage labour (including Food for Works). These households are likely to want greater access to area enclosures and, ultimately, a clear share in the long-term benefits from the enclosures. They also probably want clarity as to the tenure situation regarding these potential products.

Households who perceive a small decrease in the availability of hillslopes have a higher likelihood of preferring a change in the tenure system, compared to households who perceive either no change or an increase (OR=4.857). There is no significant association with households who perceive a large decrease. Since the decrease in the availability of hillslopes is in fact primarily a result of the expansion of area enclosures, it is not surprising that those people who are more aware of this land use change – or those households more affected by it – are more likely to want a change in the tenure system, either towards cessation of further enclosures, or towards a change in the tenure rights prevailing over the product of area enclosures in the longer term.

Households who are more likely to invest following the last land reform have a lower likelihood of preferring a change in the tenure system, compared to the reference category of households for whom the last land reform had no influence on their investment intentions (OR=0.159). Households more likely to invest may primarily

represent better-off households who may be in a stronger economic position to overcome the problems posed to their immediate livelihood by the loss of hillslope land to area enclosures, and may give relatively more importance to the longer-term sustainability gains resulting from the area enclosures. Conversely, households in weaker economic positions will be more concerned to gain immediate benefits from the enclosures through changes in the tenure arrangements governing them.

7. Discussion

A summary of results of the logistic regression analysis for the six natural resources is shown in Appendix 2. On the basis of all the analyses, a number of general conclusions can be drawn for the study area:

(I) There is some evidence from the analyses that households with more productive assets - notably land, draught power and household labour – are more interested either in maintaining existing rules and tenure arrangements, or are interested in making access rules in particular more restrictive. In other words, they are interested in maintaining or increasing the benefits which they derive from their existing use of the resources. These conclusions are suggested from the analyses of access rules for grazing land and for hillslopes. The empirical data for the study area also shows that such households make more use of the common resources which serve as inputs into the crop-livestock system, and it is therefore not surprising that these households want to protect their position. This finding tends to support the conclusion - which goes against the findings of many CPR case studies (e.g. Jodha 1987, Beck and Nesmith 2001) - that in Tigray better-off households tend to make more use of common resources than poorer households, at least in the study areas.

(II) However, there is also some evidence that better-off households are more aware of the need to protect common resources and to adopt a sustainability perspective. This can be deduced from the findings in relation to tenure systems for grazing land and forest areas, and access rules for hillslopes. This finding supports the hypothesis that better-off households may have lower subjective discount rates than poorer households (as noted in other studies, e.g. Holden , Shiferaw and Wik 1998). It is also the case that such households are in a better position to forego the short-term income gains that might result from increased exploitation of these common resources.

(III) There is some related evidence from the analyses that households which are more inclined to undertake collective labour are less likely to want a change in the current access or tenure arrangements. The analyses with respect to access rules for water resources and hillslopes, and of tenure systems for grazing land and hillslopes, provide some support for this conclusion. There could be a number of explanations for this finding however: with respect to water resources, there appears to be a positive relationship between collective labour provision and appropriation of irrigation benefits; therefore those who construct the irrigation channels are generally in favour of the current access rules which work to their benefit. With respect to other resources the link between collective labour and maintenance of current access and tenure arrangements may be more indirect, and may be more a reflection of the

general commitment of such households to co-operation and collective action to uphold current arrangements, in a way that provides assurance and makes a general contribution to sustainable CPR management.

(IV) The analyses also provide evidence to suggest that households which are more aware of trends in the availability of specific resources are more concerned about how they should be managed (as summarised by access rules and tenure systems). This finding is supported by the analyses with respect to access rules to post-harvest cropland, and tenure systems for grazing land, hillslopes and area enclosures. Not surprisingly, this finding suggests that awareness of a decline in availability of a resource can act as an incentive to protect it, which in some respects is a replication of Scherr's adaptation of Boserup's (1965) hypothesis on the relationship between population growth and agricultural intensification (Scherr 1999). In other words, as a resource declines in availability, access rules are tightened up to restrict use (this was clearly observed in the irrigation system in the study area of Birki, for example). This response is however subject to "communities" having control over these resources: the trends in Dessa'e forest indicate that, although households are generally well aware of the declining availability, and experience loss of access, since they no longer have control over management they are powerless to reverse this decline.

(V) There is however also evidence from the analyses that some households might have a different view from what might be expected on the basis of observed trends: for example the analysis of preferences for access rules for forest areas did not produce the expected results reflecting declining access in Dessa'e, but instead emphasised the increase in forested area (mostly eucalyptus) which has taken place in some areas due to area enclosure and re-afforestation. Objectively there is a qualitatively different situation between the loss of livelihoods occurring currently in Dessa'e due to (mostly State-induced) deforestation, and the possible long-term benefits to the environment and to livelihoods from the re-afforestation efforts. It is possible that this finding in part reflects the general enthusiasm of most of the study area population for the wide-ranging development effort which has been initiated through the TPLF; to an extent that some continued negative trends are downplayed. This conclusion has to be speculative however.

8. Conclusions

The above findings need to be regarded as indicative rather than definitive, but they add to the overall analysis of CPR management in the study area which, in the larger research on which this paper is based, also includes qualitative analysis and analysis of descriptive statistics. Combining the results of the various analytical instruments used in the study, perhaps the key finding of relevance for other CPR studies is that household-level socio-economic characteristics, perceptions and opinions have a clear influence on what institutional arrangements people prefer to be established to provide the framework for their utilisation of key natural resources. In other words, people's preferences cannot be assumed to be uniform, even in an environment where there has been an impressive degree of construction of social capital to facilitate co-operation in natural resource management.

The significance of this point cannot be overstated. It implies that even where social capital clearly and strongly exists, this does not mean that potential problems of lack of assurance, free riding or defection cannot arise which, if allowed to grow to a significant extent, can result in the collapse of carefully-constructed systems of co-operation. It is essential that community leaders, development workers and policy makers are constantly aware of the inherent tensions that exist within a "community" involved in shared use of natural resources, which arise from the fact that at basic economic levels different households have different interests. The real success of a CPR management system, or of other promoters of collective action, lies in their being able to reconcile and overcome these potentially different interests for the benefit of a socially-defined "common good". In Tigray, communities themselves are generally aware of the need to promote a form of conditional equity, and have developed redistributive and compensatory mechanisms which serve to mitigate differences in access to resources: for example asset-poor households who are putting pressure for redistribution of common grazing land, are lent an oxen-pair to plough rented land, and attempts are made to share irrigation water equitably during droughts – but within limits.

In Tigray there is therefore quite a strong underlying ethos which promotes a degree of equity –although not equality – in access to resources. Furthermore, given the specific conditions of high levels of poverty, and the risk of continued environmental degradation, the community-based mechanisms which address inequities in access do so with the aim of breaking the potentially damaging link between poverty and environmental degradation: essentially such mechanisms, underpinned by local organisations (social capital), have the effect of (approximately) equalising discount rates across the community. Therefore even where households do have different interests and preferences ex ante, and will still express these preferences when asked, it is possible to achieve co-operation in practice through the mediation of social capital and specific mechanisms, monetary or non-monetary. In this respect, studies which elicit subjective discount rates (e.g. Holden et al, op. cit), and use those to draw conclusions about how natural resources will be managed, may be missing what actually happens in terms of how people actually manage resources, if social capital (or other instruments) exist to encourage a convergence of subjective rates towards a social optimum. Nonetheless the fact that particular households may have high subjective discount rates is important, since it indicates there remains the possibility of defection from co-operative arrangements.

There is a clear lesson for policy here. Specific actions and more general policies (e.g. on land and tree tenure) need to be designed so as to ameliorate the tendency of some households towards short-term, non-sustainable actions. The construction of social capital is one measure, although in the Tigray case it grew endogenously from very specific circumstances. Other measures include targeted Government actions including subsidies/safety-net payments (in cash or kind) to poorer households,[5] development interventions to augment natural resources (e.g. grazing land enrichment, water harvesting, agro-forestry), and broader development interventions aimed at supporting the creation of alternative non-natural resource-based, livelihood opportunities.

[5] In this respect Food-for-Works programmes appear to have played a positive role in Tigray, notwithstanding their potential negative effects on local production.

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Appendix 1.

Table A1. Explanatory Variables Used in Logistic Regression Analysis

Explanatory Variable	Unit of measurement
1. Socio-demographic factors	
(i) Land owned [LANDOWN]	Ha.
(ii) Land rented-in [LRI96KR]	Ha.
(iii) Male-headed/female-headed hh [GENDER2]	F=0, M=1
(iv) Household size [FAMSIZE]	No.
(v) Male adult labour>15 years [MADULT15]	No.
2. Physical factors	
(i) Irrigated plots [IRRPLOTR]	N=0, Y=1
3. Economic factors	
(i) Total cereal production [FSTGRPRO]	Kg.
(ii) Total cereal production/ha [GRPROHA]	Kg/ha
(iii) Total cereal production/adult eq. [GRPROCON]	Kg/adult eq.
(iv) Fertiliser purchases/ha [FERTCOHA]	Birr/ha
(v) Oxen use [OXDAYS]	Pair-days
(vi) No. of oxen [OXENNO]	No.
(vii) No. of other cattle [CATTLENO]	No.
(viii) No. of small ruminants [SHOATNO]	No.
(ix) No. of pack animals [DONNO]	No.
(x) No of Tropical Livestock Units [TLUNO]	No.
(xi) No. of trees [TREENO]	No.
(xii) No. of beehives [BEENO]	No.
(xiii) Investment in stone bunds [STBINVR]	N=0, Y=1
(xiv) Investment in soil bunds [SOBINVR]	N=0, Y=1
(xv) Investment in farm ponds [FAPOINVR]	N=0, Y=1
(xvi) Investment in on-farm drains [ONFDINVR]	N=0, Y=1
(xvii) Investment in irrigation channels [IRCHINVR]	N=0, Y=1
(xviii) Investment in tree plantation [TRPLINVR]	N=0, Y=1
(xix) Practice inter-cropping [ICPRACR]	N=0, Y=1
(xx) Practice manuring [MANPRACR]	N=0, Y=1
(xxi) Practice contour ploughing [COPPRACR]	N=0, Y=1
(xxii) Primary income source from crop/natural-resource-based activities [PRIMINC]	N=O, Y=1
(xxiii) Secondary income source from crop/natural-resource-based activities [SECINC]	N=O, Y=1
(xxiv) Total per cap. Income 1/adult eq. [INCADEQ1]	Birr
(xxv) Total per cap. Income 2/adult eq. [INCADEQ2]	Birr
(xxvi) Use of grazing resources [GRAZENRR]	N=0, Y=1
(xxvii) Use of post-harvest cropland [PHNRR]	N=0, Y=1
(xxviii) Use of forest resources [FORESNRR]	N=O, Y=1
(xxix) Use of area enclosures [AREANRR]	N=0, Y=1
(xxx) Use of water resources [WATERNRR]	N=0, Y=1
(xxxi) Use of hillslopes [HILLNRR]	N=0, Y=1
(xxxii) Use of wild fruits [FRUNRR]	N=0, Y=1
(xxxiii) Perceived trend in size of grazing land [GLSIZER]	1= no change, 2=small decrease,

	3=large decrease
(xxxiv) Perceived trend in size of post-harvest cropland [PHSIZER]	1= no change, 2=small decrease, 3= large decrease
(xxxv) Perceived trend in size of forest area [FORSIZER]	1=no change, 2=increase, 3=decrease
(xxxvi) Perceived trend in size of area enclosures [ARENSIZR]	1=no change, 2=increase, 3=decrease
(xxxvii) Perceived trend in size of water resources [WATSIZER]	1=no change, 2=small decrease, 3=large decrease
(xxxviii) Perceived trend in size of hillslopes [HILSIZER]	1=no change, 2=small decrease, 3=large decrease
(xxxix) Perceived trend in size of wild fruits area [FRUSIZER]	1=increase/no change, 2=decrease
(xxxx) Perceived trend in access to grazing land [GLACCESR]	1=no change, 2=small decrease, 3=large decrease
(xxxxi) Perceived trend in access to post-harvest cropland [PHACCESR]	1=no change, 2=small decrease, 3=large decrease
(xxxxii) Perceived trend in access to forests [FORACCER]	1=no change, 2=small decrease, 3=large decrease
(xxxxiii) Perceived trend in access to area enclosures [AREACCR]	1=no change, 2=small decrease, 3=large decrease
(xxxxiv) Perceived trend in access to water resources [WATACCER]	1=no change, 2=small decrease, 3=large decrease
(xxxxv) Perceived trend in access to hillslopes [HILACCER]	1=no change, 2=small decrease, 3=large decrease
(xxxxvi) Perceived trend in access to wild fruits [FRUACCER]	1=increase/no change, 2=decrease
4. Institutional factors	
(i) Impact of last land reform on investment decisions [LAREFIMR]	1=no impact, 2=more likely, 3=less likely
(ii) Days of unpaid labour on collective activities per adult [VOLDAYAD]	Days/adult
(iii) Total days of labour on collective activities per adult [CADAYAD]	Days/adult
(iv) Advantages/disadvantages of collective labour [ADVDISAD]	Disadvantages=0, No disadvantages=1

Appendix 2.

Table A2. Summary of Results of Logistic Regression Analysis

Resource	Main Findings	Comments
Grazing land	• Households with more productive assets prefer existing/tighter access rules • Households who are aware of degradation of hillslopes prefer existing tenure arrangements • Households more committed to collective action prefer existing tenure arrangements	Households with more productive assets (especially labour power and oxen) benefit from existing arrangements and want them to be maintained; such households may be more committed to collective action needed to maintain common grazing arrangements.
Post-harvest cropland	• Households perceiving decline in available post-harvest cropland resources prefer existing access rules • Economically weaker households prefer existing access rules	Existing access rules provide "free" access for 2 months: any change would restrict such access. Economically weaker households, and those perceiving reduced availability, want to preserve this access option.
Forest resources	• Households perceiving increased afforestation prefer existing access rules • Households with more oxen prefer a change in tenure system	Households more aware of re-afforestation prefer to maintain current access restrictions. Households with more oxen, particularly in Dessa'e, are losing livelihoods due to current State-controlled tenure arrangements, and are more likely to want restoration of community management.
Water resources	• Households who invested in irrigation channels prefer change in access rules • Households supporting collective labour prefer existing access rules	Households investing in irrigation channels are more concerned about the nature of access rules than other households. Households who are motivated to ensure provision of the irrigation system through collective labour prefer the existing access rules since they benefit from them.
Hillslopes	• Households with larger land size prefer change in access rules • Households practicing conservation-oriented farming prefer the existing tenure system	Larger landowners are aware that hillslopes should be protected for "future generations": such households are better placed to obtain alternative feed sources for their livestock.

	• Households perceiving a decrease in hillslopes prefer the existing tenure system	Households perceiving a decline in hillslopes appear to be concerned about the effect of setting aside too much of the hillslope area for area enclosures.
Area enclosures	• Households with more small livestock prefer a change in access rules • Households using area enclosures prefer existing access rules • Households with natural resource-based income prefer change in tenure system • Households perceiving decline in hillslopes prefer change in tenure system • Households likely to invest post-land reform prefer the existing tenure system	Households needing access to open hillslopes prefer a change in the restrictive access rules governing area enclosures, and households more dependent on natural resources as a source of income want a change in the tenure system which would give them more benefits.