The Contribution of Non-Physical Resources and Strategic Household Decision-making to Environmental and Policy Risks

Yohannes Mariam and John Galaty and Garth Coffin

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Yohannes Kebede (also known Yohannes Mariam) [1/], John Galaty[2/], Garth Coffin[3/]

[1/] Washington Utilities and Transportation Commission, Olympia, WA, [2/] Professor, McGill University, Department of Anthropology, McGill University, Montreal, Quebec, CA
[3/] Formerly Associate Professor and Associate Dean, Faculty of Agricultural and Environmental Sciences, McGill University

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Abstract

Physical resources such as land, labour and livestock, and nonphysical resources such as indigenous knowledge and institutions of producers in the grain surplus and deficit regions of the Central Highlands of Ethiopia are examined under situation of environmental and policy risks. Frequency distribution and comparative statistical analysis of the grain-surplus regions suggest that in situations where all producers are subjected to a common source of risk (e.g. rainfall): I) institutional resources become less effective, and ii) combination of land, labour, knowledge and other complementary resources form the basis for adjustment mechanisms and sequential or strategic decisions. On the other hand, when essential resources such as land are government owned and household decisions are shared by the state, local institutions or social networks become an effective means to maintain reproduction of the farm and producers through providing access to or sharing of resources.

In the extreme case of environmental degradation (e.g., drought), farmers follow sequential decision-making. This sequence of decision-making begins with minimization of expenditure, selling of resources that are intended to stabilize farm income, selling of resources essential to farming and depletion of household items, and finally evacuation. The ability of such farming system to regenerate, however, greatly depends not only on the availability of physical resources but most importantly by the potential of knowledge and institutions of producers to adjust to environmental changes, and support from governmental or non-governmental sources.

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Introduction

The major cause of environmental or resource degradation is human activity. This activity is greatly influenced by inappropriate government policies and increases in human population. These factors coupled with climatic variability have contributed to severe and sometimes irreversible loss of resources, including humans in less developed countries (LDCs).

Development experts have argued that sustainability of the environment can be insured by targeting strategies to minimize the misuse of resources and ameliorate the effects of inappropriate government policies. Strategies that were implemented in this respect include projects to increase food production because poverty and malnutrition are considered to be factors contributing to resource degradation. Other strategies involve subsidies, grants, preferential loans and bilateral agreements to relax stringent policies (Wilber, 1988; Schultz, 1978, 1980; Hyden, 1986). Nonetheless, projects that were intended to increase food production have resulted in I) unequal distribution of wealth, ii) changes in social organization within a society, iii) eviction of small holders, iv) psychological damages by moving people to different agro-ecological system, and v) disturbed the agro-ecological balance (Chambers, 1983; Hyden, 1986; Richards, 1985). It is only recently that a multidisciplinary approach was adopted in the design, implementation and assessment of development projects (Shaner et al. 1982; Dommen,1988; Richards, 1985; Warren et al. 1989).

Adoption of multidisciplinary approach as a paradigm may be challenged for reasons such as cost-effectiveness, and requirements of an in-depth knowledge regarding the social, economic, cultural and environmental constraints facing the poor in LDCs. Most importantly, however, the present study argues that the definition of resource as utilized by development projects includes only those with physical attributes. Such a definition can be viewed as narrow, and precludes the involvement of non-physical or social scientists in the evolution of practical approaches to the design of environmentally sustainable development.

The study in Ethiopia adopts a more general definition of resource. Misuse of resources, environmental variability and inappropriate government policies are ubiquitous in LDCs. Underlying these conditions, the study examines two issues. Firstly, the study investigates the importance of non-physical resources when I) rainfall and availability of resources are uncertain, and ii) producers are confronted with inappropriate government policies. Secondly, the study examines the manner in which households respond to drought caused by inadequate rainfall, shortages of physical resources and inappropriate government policies.

The Problem

Several studies define resource as an entity that is characterized by its physical attributes (Tietenberg, 1988; Stevenson, 1991). The present study departs from these studies because it relies on the following comprehensive working definition of resource:

> " a source of *supply*, wealth, *information or expertise*, and ability to meet and handle a situation."(Webster's college dictionary, 1991).

According to this definition, resource refer not only to objects with physical but also with non-physical attributes. Examples of such resources that are examined in this study include indigenous knowledge (IK) and institutions.

Knowledge is the entire collection of meaningful-action oriented experience. IK exhibits a sigmoid curve with increases in age, holding other factors such as schooling constant. This knowledge is often referred as "cultural traditions" because it co-evolved with the local environment. While knowledge can be individuated, it also has a social character. Hence, one can argue that IK is a social wealth, especially in organic societies (Weber, 1947; Durkheim, 1947).[1]

Experience is endless, so does is knowledge. As new ways of doing or undoing things emerge, the old way is partly or totally replaced. The dynamics of adjustment in culture, farming, and agro-ecological environment lies within IK. IK is always in dynamic [dis]equilibrium with the environment and influenced by interventions from within and outside.

Food production is possible through "rational" combination of knowledge, physical, institutional and environmental factors. The processes of combining these factors determine the chances of reproduction of the farming unit and producers. While mis-use of physical resources is identified as the major cause of environmental degradation, the importance of knowledge and other non-physical resources to ensure stability of the eco-system is not investigated in detail (Hardin and Baden, 1977; Warren et al. 1988, pp.107; WCED, 1987).

As differences in access to resource endowment reflect standard of living of a nation,

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1 Organic societies are characterized by very close interpersonal relationship among extended family members, and where societal values and benefits take precedence over that of individuals; in mechanical societies, on the other hand, human bondage is very loose and individual values are the driving forces of the system (See Durkheim, 1947).

differential access to knowledge contributes to differences in the processes and consequences of household decision-making. These differences are reflected by the ability of producers to survive under harsh environments and levels of production realized.

Farmers comprise the majority of the population of LDCs. They depend on a system of extended families and institutions to seek for help when there is a need. They are able to maintain autonomy through the dynamics of what Hyden called "exit" option (Hyden, 1986). These options help producers escape efforts of the state to impose policies on the system.

The carrying capacity of the eco-system declines with losses of not only physical but also non-physical resources (e.g. knowledge and institutions). When people are moved to a different location, exposed to different production system, environmental regimes (e.g., rainfall and growing conditions), marketing and consumption techniques, and government intervention, the capacity of knowledge and institutions to enable food production may decline.[2] To attain sustainable development, therefore, investment should give equal emphasis to both physical (e.g. land) and non-physical resources (Berry, 1988).

Several studies have examined the response of producers to new intervention strategies and their consequences under normal agro-ecological situations (Hayami and Ruttan, 1985; Stevens, 1988; Wharton et al. 1969). Once a farming system is hit by environmental crises (e.g., drought), the ability of producers to respond wisely deteriorates.

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[2] When farmers fail to make independent decisions, their knowledge will lose its functional power. This may probably lead to severe cognitive consequences. Such cases are observed in situations where farmers are forced to resettle in different agro-ecological zones or become refugees (Mazur, 1987).

The literature on adjustment mechanisms to resource degradation and patterns of decision-making under situations of environmental and policy risks in Ethiopia is scarce. The objectives of this study are to examine the importance of non-physical resources under situation of environmental and policy risks and provide empirical evidence on strategic decision-making processes that households follow in periods of drought.

Design of the Study and Methods of Analysis

Two studies were carried out in the central Ethiopian highlands. The first study was conducted in 1986/87 in the grain deficit districts of Ankober and Seladengay in northern Shoa, Ethiopia. The second study was carried out in 1990/91 in the grain surplus regions of Ada and Selale, northern and eastern Shoa province, Ethiopia. The study sites belong to the cereal-livestock or mixed farming system zone.

Selale is representative of the high altitude zone (more than 2000 meters above sea level) of the country. Ada represents the country's large middle-altitude cropping zone (1500 to 2000 meters above sea level). The major crops grown in these areas include oat, teff, barley, wheat, chickpeas, horse beans and field peas. The average farm size is 3.1 and 2.6 hectares for Selale and Ada regions respectively (FINNIDA, 1989). Most households in the Selale region belong to the Oromo ethnic group, while that of Ada farmers to the Amhara and Oromo ethnic groups (Gryseels and Anderson, 1983; Belay, 1977). Farmers in the Selale region specialize in livestock production while Ada farmers concentrate in crop production. A sample of 217 and 54 farmers from Selale and Ada regions were systematically selected as a part of larger study (see Kebede, 1993). Frequency and percentage analysis of responses to open-ended questions were performed to examine the importance of non-physical resources.[3]

Seladengay is located at an altitude of more than 2000 meters above sea level while Ankober includes low-lying areas located at about 1800 meters above sea level. The major crops grown include maize, wheat, teff, sorghum, beans, peas, chickpeas and barley. The average farm size in Ankober and Selale regions is 1.03 and 1.25 hectares respectively (see Kebede, 1988). A sample of 80 farmers were randomly selected from drought affected areas of Seladengay and Ankober Districts of Northern Shoa province.

Methods of Analysis

The present study uses multidisciplinary research tools to examine the role of non-physical resources in the design of intervention strategies and analyze strategic decision-making processes in light of environmental and policy risk. These tools include anthropological (participatory, observatory, group discussions and open ended questionnaire), cognitive psychology (problems solving tests or elicitation of causal attribution) and agricultural economics (sequential decision-making). The use of these tools is expected to provide important evidence on the nature of decision-making processes in grain surplus and deficit regions in the presence of environmental and policy risks.

Observatory-participatory, group discussions and open ended questionnaire were used to obtain information on goals of resource allocation strategies and adjustment techniques or

3 To assess and measure indigenous production knowledge, problem solving tests were administered. The tests were intended to examine the kinds of solutions households provide to crop and livestock production problems (see Kebede, 1993).

mechanisms.

It has been pointed out that producers follow sequential decision-making process to the recurrent crises in the Ethiopian highlands (ILCA, 1986). The reaction length could be short or long depending on the amount of wealth or asset holdings and related socioeconomic characteristics of households. This study hypothesizes that decision-making patterns are sequential (see also Feder et al. 1985; W.Mariam, 1984). The sequential decision-making process follows the sell out or eating of the final food stock, seed, different class of livestock and assets before evacuation. Each time an asset is sold it is used to buy grain and its value will influence future decisions. Data regarding cropping patterns under situations of rainfall variability, household characteristic, sequential depletion of assets were gathered.

The statistical model to examine sequential depletion of assets in response to drought could be specified as structural equation which can be ordered in such a way that the first equation include only predetermined variables. The successive equations will include predetermined and endogenous variables as regressors. It is assumed that the residuals of the successive equations are uncorrelated. That is, they have zero mean and unit variance. The model is given as:

$$Y_{jm} = \alpha_0 + \sum_{i=1}^{m} \beta X_{jki} + \sum_{m=1}^{n} \Theta Y_{m-1} + U_j$$

for i= 1…4, and m=1...7

where Y's are endogenous and X's are exogenous or pre-determined variables, α is the intercept term, β and Θ are unknown parameters and U's are error terms. Various formulations of sequential decision-making process were carried out and the following variables were selected.[4]

The exogenous variables include age of head of household, family size, education (years), and asset at times marriage (the value of crop and livestock at market price). The endogenous variables were grain at times of drought (in kilograms), sale of sheep, goat, draft animals (donkey, mule and horse), steer/heifer, cow, an ox and household equipment and assets. Sale or livestock and household assets were measured by their market price.

Empirical Results

Strategic Decision-Making and Environmental Variability in Grain-Surplus Region

Households in the Ethiopian highlands make use of physical resources, indigenous knowledge and institutions to minimize the adverse effects of environmental degradation. The degree with which households minimize these effects differ because knowledge varies by sex, age, ethnic group and degree of contact with the outside world (Warren et al. 1988).

Selale and Ada farmers who are closely affiliated with government institutions receive higher scores in production and marketing knowledge than farmers who are not (Kebede, 1993a). Production knowledge increases with the number of years of farming experience and it is locale-specific. Furthermore, marketing knowledge is relatively high among farmers living closer to big cites (e.g. Ada). These variations in knowledge imply that the ability of households to respond to changes in the physical and socio-economic environment is different (Table 1).

[4] Because of high degree of correlation between variables, backward and forward regressions were employed to identify variables with less correlation (<0.6) and yet important in influencing particular decisions.

Table 1. Responses to Questions Related to Goals of Resource

	Allocation Strategies	
Strategies	Selale	Ada
1. When Rainfall is uncertain		
a. Reduce expense and increase Saving	51	46
b. Sell ruminants/cattle	29	15
c. Reduce consumption	12	12
d. Sell household valuables	8	26
2. Future livestock feed is less, thus		
a. Reduce livestock	37	79
b. Use hay,straw and reduce arable land	55	11
c.Purchase feed	8	10
3. > one crop because of		
a. Pest problems, market Value, Rainfall, family food requriemnt	83	97
c. Others	17	3
4. > 1 livestock class because of		
a. Traction need and milk production	37	58
b. Traction, milk, meat & transport	55	37
c. Others	9	5

Failure to secure subsistence food requirements is manifested by switch from the common to specialized knowledge involving strategic or sequential decision-making. Among farmers of Selale and Ada regions, this pattern starts with reducing expenses, selling livestock, search for off-farm work such as trade and wage labour, reducing consumption and selling of household valuables (Table 1). The last two strategies, however, signify a point-of-no-return (e.g. drought).

Overgrazing of the unmanaged commons has increased with increases in population and villagization.[5] Scarcity of the common grazing lands and excessive use of stubble accelerated depletion of soil fertility. When environmental degradation threatens survival, households receive very little help from social networks or the government. Households, therefore, depend on strategic management of resources to secure subsistence food requirements. This takes the form of planting several crops, raising more than one class of livestock and search for alternative sources of animal feed (Table 1).

Other forms of decision-making or switching from common to private knowledge involve the implementation of adjustment techniques (Jodha and Mascarenhas, 1983). This is accomplished through re-arrangement of resources, management style and making use of social-networks as a last resort. The choice of adjustment mechanisms are influenced by the expectation of rainfall and stock of resources (Table 2). When rainfall is uncertain, i) few plots are planted on low moisture retaining plots (low-land), ii) most crops are planted on high moisture retaining

[5] Villagization refers to government programs that forced farmers living in villages of around 400 hectares in pseudo-cities close to schools or roads. This program was abandoned in 1990-91.

Table 2. Strategic Management or Adjustment Techniques

	ADA		Selale	
	When Expectation of Rain is:			
Adjustment Technique	Certain	Uncertain	Certain	Uncertain
Low lying plots	5	3	3	2
High lying plots	3	6	3	3
Harvested green	3	5	3	2
No. of plots from which weeds are collected	3	6	4	3
Plots from which mature crops are harvested	6	3	4	3
Plots weeded >1	3	5	2	3
Plots planted >1	3	3	3	2

plots (upland), iii) green or immature crops are harvested for livestock feed from large number of plots, iv) weeds are collected from many plots to reduce moisture competition and v) several weeding and re-plantings are performed to secure subsistence (Table 2).

Institution: A Resource and Switch-Board

The extent with which institutions serve their members differ depending on the mode of organization and influence from the outside world (e.g. policies). Farmers of the Ethiopian highlands were organized into private peasant associations, service and producers cooperatives between 1975-1990. Cooperatives were given large subsidies and benefit packages compared to private farmers.[6] Land ownership and marketing knowledge of members of cooperatives was found greater among private individual farmers (Table 3).

Members of cooperatives tend to engage more in distributive type of social networks than in credit or insurance. Despite obtaining large farm size and subsidies to minimize farm income risk, however, land under cooperatives was less protected from erosion and overgrazing compared with land operated by private farmers (Belete, 1989).

Environmental degradation and mis-use of resources results in crop failures. When crops fail, households utilize various alternatives to receive support and design ways of sharing resources (Table 4). In situations where crops fail, the commons (e.g. institutions) become less effective because all households are equally affected and the commons lack the capacity to

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[6] Socialist cooperatives were formed to attain the objective of transforming peasants into a working class. However, advocates of the commons argue that managed commons (e.g. cooperatives) are needed to internalize risks or rents of mis-use of resources and avoid tragedy (Andelson, 1991).

Table 3. Access to Land, Labour and Knowledge

	Peasant Associations		Cooperatives	
	Selale	Ada	Selale	Ada
Parameter	Average values per household			
Land(hectare)	2.9	2	3.1	2.5
Labourfor farming(man days)	168	194	130	149
Production Knowledge[1/]	7.1	7.5	6.2	6.9
Marketing Knowledge	7.2	8.1	7.5	8.4
Labour for social group: Distributive	105	73	167	140
Credit	93	98	68	76
Sample Size	180	50	55	30

Table 4. Adjustment Mechanisms When Households are Exposed to Common Sources of Risk

	Selale		Ada	
	Normal Crop Year	Crop Failure	Normal Crop Year	Crop Failure
Mechanisms	Percentage of farmers			
Sharing resources with:				
Friends	3	2	4	1
Relatives	5	6	3	2
Social networks	18	7	17	6
Own family	74	85	76	91
Assistance from:				
Government	5	15	12	21
Networks	15	5	10	1
Relatives	10	6	6	2
Friends	5	1	3	1
Own family	55	73	71	75
Sample Size	195	140	51	49

provide members with adequate food supply.

Until 1991, Ethiopian government marketing policy required selling output to the government market. Households share or exchange their resources (e.g. knowledge) and make use of social networks to minimize losses in benefits as a result of this policy (Table 5).[7] Most households receive assistance from social networks compared to own family. The relative importance of institutions or social networks is high in a region were social relationship are stronger (e.g. Selale) (Table 5).

Ownership rights to land are the major source of uncertainty in peasant agriculture. Households in Ethiopia have access to land use rights. Similar to any public good, therefore, household care little to the consequences of over-exploitation or losses of fertility as long as they secure subsistence requirements. Similar to the findings reported in Tables 4 and 5, social networks and own resources (family) play significant role in sharing of resources and expectation of assistance when land is state owned than when it is private (Table 6).

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[7] Many producers cooperatives have been dissolved by farmers in 1991. Since 1991, however, the service cooperatives have been reorganized in such a way as to increase benefits to private farmers.

Table 5. Adjustment Mechanisms when Marketing decisions are shared by the government

	Selale		Ada	
	When selling of output is			
Mechanisms	Controlled	Free	Controlled	Free
		Percentage of farmers		
Sharing resources With:				
Friends	5	6	2	1
Relatives	15	12	3	2
Social networks	25	10	15	5
Own family	55	72	77	92
Assistance from:				
Government	1	10	25	14
Networks	60	18	52	10
Relatives	10	5	7	3
Friends	5	2	2	1
Own family	24	65	14	72
Sample size	128	146	51	49

Table 6. Adjustment Mechanisms When Land is Fixed or State Owned

	Selale		Ada	
	When land is owned by the			
Mechanisms	State	Private	State	Private
	Percentage of farmers			
Sharing resources with: Friends	6	5	2	4
Relatives	12	10	8	7
Social networks	35	15	22	10
Own family	47	70	68	79
Own Assistance from: Government	1	9	2	15
Networks	34	15	21	5
Relatives	8	5	3	2
Friends	2	1	2	1
Own Family	55	70	72	77
Sample Size	195	155	45	51

Strategic Decision-Making and Environmental Variability in Grain-Deficit Regions

Producers may be faced with crop failure when farming is rain-fed. In this kind of farming system, production, consumption and other kinds of decisions depend on expectations of the amount and distribution of rainfall. Based on group discussion with the study farmers, responses or expectations were classified into two: certain and uncertain rainfall. While there are other categories of expectations, these two categories of expectations greatly influence decisions of farmers in the study area. Expectation of crop failures lead to adjustments such as saving on current consumption and sale, changing cropping patterns and other strategic decisions.

Strategic decision-making when expectation of rainfall is inadequate can take different kinds of management techniques such as diversification of crop and livestock production, resource augmentations, intercropping, double cropping, and related crop management practices. Crop management practices, especially location of plots, when expectation of rainfall is certain and uncertain are presented in Table 7.

Seladengay is an area with relatively stable rainfall pattern, where as Ankober has variable rainfall and intermittent drought. As a result, the number of plots in the low lying areas when rainfall is uncertain is high for Ankober than for Seladengay (Table, 8). Low lying areas, depending on the soil type, conserve moisture. Seladengay area doesn't not seem to have greater variation in the location of plots. When rainfall is more certain, the number of plots in low or high lying locations in both study sites show no variabilities. Producers change cropping patterns based on expectation of soil moisture. If these management practices fail to provide subsistence

Table 7. Selected Adjustment mechanisms

	Ankober		Seladengay	
Mechanisms	Uncertain	Certain	Uncertain	Certain
Intercropping	4	2	5	4
harvesting While Green	5	2	4	3
Soil and Water Conserv.	6	3	5	5
Planting crop with:Short Growing Season	6	2	5	4
Long Growing Season	1	3	2	5
Sale of Large Ruminants	1	0	1	0
Sale of Small Ruminants	2	1	3	1
Double Cropping	4	1	5	2
Weed More times	5	2	4	3
Sample Size	45	41	35	32

Table 8. Number of plots in the high and low lying area when rainfall is certain and uncertain

	Ankober Region				Seladengay Region			
	No. of High Lying Plots		No. of Low Lying Plots		No. of High Lying Plots		No. of Low Lying Plots	
Crop Type	Uncertain	Certain	Uncertain	Certain	Uncertain	Certain	Uncertain	Certain
Teff	2	3	4	3	2	2	4	4
Barley	2	3	4	4	3	3	3	4
Wheat	2	2	5	3	2	3	5	3
Bean	2	2	3	1	3	2	4	3
Peas	1	1	2	1	2	1	2	2
Chick	1	2	3	2	1	1	1	1
Maize	2	2	4	2	-	-	-	-
Oat	1	1	2	3	1	1	3	3
Average	1.6	2	3.4	2.4	2	1.9	3.1	2.9
Sample	45	41	45	41	35	32	35	32

requirements and followed by drought, households implement strategic or sequential decision-making processes to minimize the effect of crises.

Sequential Decision-Making and Drought

It is hypothesized that the older a farmer is the more asset and grain stock or wealth he/she owns. The larger the family size, the larger the consuming units, and hence the lesser the grain stock available as a security in case of drought. The more educated a farmer is the more likely she/he anticipates the severity of drought and make decisions to save on grain consumption and sale. Similarly, the more asset households posses at the time of marriage, the more likely that they will posses greater asset and grain stock at the time of drought than farmers who are not married or posses few assets when married. The result of this study suggest that the effect of most of the variables conform to the above hypotheses (Table 9).

The decision to sale sheep is expected to be negatively influenced by all variables. The reasons being that sheep are susceptible to water stress and lamb spoils quickly under warm temperature even when preserved using traditional techniques. As a result, the price of sheep at time of drought is extremely low. The choices or decision strategies are either to kill the sheep for home consumption or to sale and purchase food grain. The findings of this study indicate that asset at the time of marriage, family size and grain stock reduce the chances of selling sheep. However, age and education are positively correlated with this decision (Table 9).

The decision to sale goat is negatively influenced by all variables except by the age and education of households. Goats can sale for relatively higher prices because they can

Table 9. Results of Sequential Decision-Making to Drought

		Sequential selling or consuming of						
	Grain at time of Drought	Sheep	Goat	Draft	Steer or Heifer	Cow	Ox	Household Equipments
Intercept	3.308	3.655	-6.496	0.213	0.432	-4.999	-1.519	3.372
	(5.89)**	(6.77)**	(8.46)**	(2.530)*	(6.23)**	(7.961)**	(3.690)**	(6.87)**
Age	0.957	1.24	0.229	0.45	0.048	0.053	0.035	0.041
	(-0.18)	(2.980)*	(2.180)*	(2.056)*	(2.170)*	(3.020)*	(2.250)*	(2.56)**
Family Size	-1.859	-0.638	-0.207	0.008	0.115	0.133	0.007	0.361
	(-4.09)**	-0.48	-1.09	(-0.216)	(3.60)**	(-1.1)	(3.010)*	(2.63)**
Asset at time of marriage	0.09	-0.071	-0.057	-0.002	-0.001	0.034	0.002	0.001
	(-0.36	(-2.23)*	(-2.57)*	(-1.97)**	(-1.01)	(2.140)*	(4.110)**	(-1.42)
Education	1.978	0.662	0.258	0.011	0.013	0.106	0.014	0.208
	(4.51)**	(2.650)*	(-1.46)	(4.753)**	(4.020)**	(3.190)**	(3.080)**	(2.94)**
Grain at beginning of Drought		-1.089	-0.13	0.621	-0.004	0.015	0.001	0.013
		(-4.18)**	(-1.34)	(7.04)**	(2.030)*	(3.040)**	(3.090)**	(-2.01)*
Sale of Sheep			-0.042	-0.021	-0.009	0.009	0.003	0.013
			(-0.18)	(4.06)**	(-0.16)	(2.920)*	(-0.05)	(-1.01)
Sale of Goat				-0.045	-0.084	0.076	0.029	0.04
				(3.21)**	(7.630)**	(2.660)*	(2.310)*	(-2.05)*
Sale of Draft animals					-0.001	0.002	0.028	0.256
					(-2.01)	(2.410)*	(4.56)**	(-0.92
Sale of Steer/heifer						-0.245	-0.624	0.676
						(-5.45)**	(-4.8)**	(3.38)**
Sale of Cow							-0.175	-0.136
							(4.47)**	(-4.17)**
Sale of Ox								-0.7
								(-4.32)**
R2	0.89	0.9	0.84	0.91	0.97	0.89	0.95	0.98

*and**indicatestatisticallysignificantdifferenceat1and5percentlevelrespectively.

withstand water stress. Households may prefer to sale and purchase food grain. If goats sell at a relatively higher price those who are older and educated would be more willing to sell and purchase grain than consuming the meat of goat at home.

The sale of donkey, mule and horse is expected to be positively correlated with all variables because they are mainly used as means of transport (Table 9). Since there are relatively few items to be transported at time of drought, these animals are not needed at home. On the other hand, people who want to evacuate may need these animals. The result suggest positive association of all variables with the sale of draft animals except the sale of sheep and goat. The higher the value of sheep and goat sold or the more the number of days the meat of these animals feed the family, the less the demand for money to purchase food grain. Hence, households may decide to wait a little longer before selling draft animals. The less the price offered to sheep and goat, the more likely that farmers will sale draft animals.

Heifer or steer are important stock to start animal husbandry. In addition, farmers associate cattle with their very existence. Losing cattle is, therefore, considered as losing one's identity. Economically, it is these class of animals that are at the root of the theory of "exchange entitlement" (Sen, 1984). The sale of this class of livestock represent half way in the severity of the drought, and these animals don't with stand water and feed shortages. The sale of heifer and steer is expected to be positively correlated with education, age, and family size, but negatively affected by asset, grain stock and previous sale of animals. Households who are educated, older and support larger family size are more likely to sale these animals rather than letting them die. On the other hand, the more asset and grain stock households posses, the less likely that they will sale heifer and steer. As expected most variables exert statistically significant influence on the decision to sale steer or heifer (Table 10). Previous decisions negatively influence current decisions. That is, the more grain households can buy from previous sale, the less likely they will sale existing cattle or assets.

The sale of a cow and an ox represent critical stage in the life cycle of a farming system undergoing crisis. Among farmers in the Ethiopian highlands, a cow is symbolized as the "mother" of the farming system, of the self, and of children. That is, a cow or an ox serve as a source and means of food production. Therefore, the sale of these animals represent the severity drought and households will be ready to evacuate. The sale of these animals is expected to be influenced positively by all variables except by the preceding decision. Households who are educated, older and support large family size are more likely to anticipate the severity of the drought and willing to sale these animals. The result support this hypothesis (Table 10). The grain purchased from previous sales decisions except the sale of heifers/steer and cow is almost used up. Thus, previous sales encourage the sale of existing animals or stock to replace grain stock or extend the length of time that households can stay in their village.

The decision sale of household equipments and remaining assets represent the final stage of liquidation. Most past decisions will have little impact on current decisions because food grain purchased from the sale of sheep, goat, draft animals, steer and heifer is used-up. Thus, only the sale of cow and ox (recent decisions) are negatively and significantly associated with the decision to liquidate the remaining households assets.

Finally, it was hypothesized that producers decisions, even in a situation of environmental crises, are sequential or recursive. The larger the income or grain purchased from liquidation of assets, the more the number of days that households stay in their village, and the less the need the sale or kill the next animal or household items. This hypothesis is supported in all the regressions.

Conclusions

When producers are subjected to a common source of risk (e.g. rainfall) institutional resources become less effective and combination of physical and non-physical resources form the basis for adjustment mechanisms. When essential resources such as land are government owned and household decisions are shared by the state (e.g. marketing of grain), local institutions become an effective means to maintain reproduction of the farm and producers through providing access to or sharing of resources. Losses of resources are the result of mis-management or the outcome of knowledge-directed actions of decision makers and the infrastructure that permits these actions (i.e. institutions).

The result of empirical analysis of drought adjustment strategies indicate that I) current food stock is negatively and significantly influenced by family size, ii) as drought progress, decisions to sale different classes of livestock are positively influenced by age, family size, education, grain stock and assets, and iii) current sale of livestock is negatively influenced by previous sale. That is, the higher the value of livestock or asset sold, the less willing farmers are to sale the next class of livestock or asset.

Unlike previous studies in peasant economies that relay on the importance of physical resources as key variables contributing to increases in food production, the present study has demonstrated the vital role that indigenous knowledge and institutions play both in resource abundant and scare regions. The ability of humans to act and act wisely is shaped by knowledge and experience they posses. In turn, their actions are given meaning by the institutional framework. Development in its broadest sense and avoidance of environmental or resource degradation can be attained if non-physical resources (knowledge and institutions) are given appropriate consideration in the design and implementation of intervention strategies. Proper analysis and integration of knowledge and institutions of peasants in the planning of development strategies will help minimize misuse of resources, ensures increases in food production and minimizes the danger of environmental crises.

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