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IMPACT OF LAND TENURE AND OTHER SOCIOECONOMIC FACTORS ON MOUNTAIN TERRACE MAINTENANCE IN YEMEN

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ABSTRACT

This paper describes the land property rights and tenure systems in the western escarpments of the Yemeni Highlands, and analyses the impact of land tenure arrangements and other socioeconomic factors on terrace maintenance.

Owner-cultivated land is dominant in the terraced area, but more than one-third of the land is sharecropped. Terraces cultivated by landowners have a lower number of broken walls per hectare than those cultivated by tenants under sharecropping arrangements. This is more significant on sharecropped public (state and *waqf*) than private lands the reason being the lack of clearly defined responsibilities between tenants and landowners for maintenance and cost sharing. These responsibilities are defined in the customary rules of land use, but uneven power distribution, which favors landlords, results in lack of clear rules and enforcement mechanisms.

The study recommends government action in strengthening existing local institutions in documenting sharecropping contracts, improving and targeting agricultural credit services, instituting better price policies, and improving technologies for farmers. These measures will likely increase land users' expected returns to investment, particularly for food crops, and increase landowners' willingness to invest in terrace maintenance.

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1. BACKGROUND

The Republic of Yemen has limited arable land, which is estimated at 1.66 million ha. In 1996, 64 percent of the total area was cultivated. About 25 percent of this land is in the form of man-made terraces in the highlands. For centuries, Yemeni farmers have developed indigenous techniques of water-spreading and water-harvesting and construction of mountain terraces. These and other community-based practices have enabled the long-term sustainability of agriculture in Yemen over many centuries. However, socio-economic changes including rapid urbanization, improved infrastructure, increased role of markets, and increased off-farm employment opportunities have increased the earnings in non-farm sectors, and hence led to a massive rural-urban migration and to an increase in agricultural labor wages. Moreover, food aid, subsidized food supplies, and higher non-farm income reduced dependence on the land for food and income. These factors have changed the traditional values which were the basis for community cohesion and management of community land resources.

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Soil erosion due to land abandonment and lack of regular maintenance has caused degradation of terraces in the highlands, and valuable agricultural land is lost every year. The degradation of terraced lands in the mountains has serious consequences on the production systems downstream. Lack of maintenance of individual terraces could result in the knocking over of other terraces down the slope, increased run-off damaging *wadi* banks, and flash floods affecting the spate irrigation systems on lowlands.

There are four types of agricultural land ownership in Yemen; namely, private land (*milk khas*), state land (*aradi al dawla*), religious endowment land (*aradi waqf*), and communal land.

Private land is the most predominant form of land ownership in the highlands. Given the inaccuracy of land registration and cadastral maps, exact data are not available. It is estimated that 81 percent of the land in the northern provinces is private land (Varisco 1985), with nearly half of this land owned by two hundred “important” families (Noaman, 1989). For agricultural land, a registration system does not exist in Yemen. The Survey and Land Registration Authority (SLRA) in Sana'a deals only with urban land registration.

Privately owned land includes alienation rights and unrestricted user rights. Rental agreements are allowed and can be paid in cash or kind (a share of the cultivated crop). State land includes land that was confiscated by the *imam* prior to the 1962 revolution from big landholders and tribes as settlement on disputes, and land that was confiscated from the *imam's* family after the revolution. It is estimated that state land occupies two to three percent of the arable land in the northern provinces (Varisco 1985).

The Authority of State Land, under the Ministry of Finance, is responsible for the state land, which is rented to tenant farmers with similar arrangements to tenancies on other land. Because the Authority has no reliable records of the land, state land continues to be lost by grabbing.

Religious endowment land, known as *waqf* land, is land donated by people for the enhancement of religious institutions such as mosques and schools. This cannot be transferred by sale, gift or inheritance, and the close relatives of the person who donated the land have priority in renting *waqf* land for sharecropping. The total *waqf* land is estimated at 10 to 15 percent of the agricultural land in Yemen (Noaman 1989). The Ministry of Religious Endowment and Spiritual Guidance holds the endowment land. In strict terms, the state has no right to *waqf* land: it is simply a trustee. Although the Ministry does not have central records of *waqf* land in the country, its offices in the provinces have some records of the lands (*Ayan*). *Waqf* land is cultivated by tenant farmers under sharecropping arrangements with the state, and the Ministry collects rents based on crop shares. Similar to state land, *waqf* land is not registered with the SLRA. As a result, *waqf* land is also grabbed by big landholders without compensation to the previous holders. The legal process to settle such disputes is often lengthy. During the course of this study in August 1997, the Council of Ministers, in response to the increasing losses of *waqf* land, formed a committee to investigate the matter and to collect the land records from all provinces in the country. This is not the first attempt carried out by the Government to collect the records, but previous attempts had only limited success (Noaman 1989). Communal land comprises the vast mountain slopes

which are not utilized for crops and not used as catchment areas for terraces. This land is used for grazing, and provides wood for construction and fuel. It appears that these areas are open access resources and all the communities in the surrounding areas have the right to use them. As this study investigates the impact of land tenure systems on terrace degradation in the cropped highlands of Yemen, communal land is not covered in this study.

The main objectives of this study are to describe the land property rights and tenure arrangements over land and determine the effects of these and other socioeconomic changes on terrace maintenance in the western escarpments of Yemen. The hypothesis is that the prevailing sharecropping tenure arrangements in the area are not conducive to long-term investment in land improvements, resulting in terraces on sharecropped land being more degraded than those on owner-cultivated land.

2. STUDY AREA AND METHODOLOGY

STUDY AREA

The study area lies within the two districts of Sharis and Kohlan in Hajja province, which is located in the western escarpments of Yemen. The total agricultural area in Hajja province is estimated at about 124,600 hectares, of which 36 percent or 46,000 hectares are predominantly cultivated terraces and *wadi* banks. Rangelands comprise about 63 percent of the province or 78,000 hectares. The study covers an area of about 53 km² and comprises five sub-districts (*uzlah*), one located in Sharis district and the other four within the district of Kohlan-Affar. The area is characterized by very

steep slopes, which descend from mountain tops at 2,600 m above sea level to *wadi* bottoms at 900 m. Agriculture is mainly rainfed, with annual average rainfall of 300-500 mm falling in two seasons: spring (March-April) and summer (August-September). The main crops include sorghum, wheat, barley, lentils, dry peas, faba beans, maize, coffee and *qat*. The total population was estimated at around 36,000 inhabitants in 1994 (Ministry of Agriculture and Irrigation, 1994). Agriculture is the principal economic activity in the area, and it engages 80 percent of the population. However, because agriculture is unable to support the expanding population, there is increasing out-migration from the region.

METHODOLOGY AND DATA

Data collection for this study was done through informal and formal interviews. General information about the area including land ownership, customary tenure systems and crop shares were collected through informal interviews with farmers, key figures in local communities, local administration officials in key departments on land and agriculture, and other authorities such as judges. It was gathered through group discussions and individual interviews using open-ended questions.

Two formal surveys were conducted, one in the spring of 1997 and the other in the summer of 1998. A sample of 56 farmers was interviewed on market day (Monday) at Kohlan district market in the spring of 1997. Conducting successive interviews at the market was considered a good way of getting cross-sectional data from a sample of farmers from different areas. Farmers at the market were selected at random. The

market is located in the study area where all categories of farmers come, and there was equal chance of selecting any category.

In the second survey a sample of 100 farmers was randomly selected from four clusters of villages in the study area¹ (about 25 farmers from each cluster). The clusters consist of four to five villages on different slopes. The villages in each cluster were selected based on the size of the cultivated area. A list of the farmers in each of the selected villages was made, and farmers were selected randomly from the list. A pre-tested questionnaire was used to collect data on holding size, land fragmentation, land property rights, tenure arrangements, crops, and sharecropping arrangements. Data on degraded and broken terraces, farmers' perceptions on constraints of terrace maintenance, and sources of finance for terrace repair were collected. Farmers were also interviewed in their fields and in villages along a transect from a mountaintop down to a *wadi* bottom. The condition of terraces, which was measured by the number of broken terraces per hectare, was compared for holdings of different tenure arrangements.

Sharecropping information was also collected from other areas in highland provinces through *ad hoc* farmer interviews to compare with the study area, but the detailed survey was carried out only in Kohlan and Sharis districts in Hajja province.

¹ Eighty-four questionnaires were completed and used in the analysis.

3. LAND PROPERTY RIGHTS

LAND OWNERSHIP, HOLDING SIZE AND LAND FRAGMENTATION

All four types of land ownership (private property, state property, endowment land and communal land) exist in the study area. Communal land was not covered in the survey; only cultivated land was considered. Among cultivated holdings, private land is the predominant form of tenure, accounting for about 75 percent of the total area of the sample, while *waqf* land was estimated at 20-23 percent and state land at 2-5 percent (Table 1). Farmers prefer sharecropping on *waqf* land because they feel more secure compared to sharecropping on state and private land, and some farmers regard it as private property. However, a common understanding is that the heirs of the donor have prior rights for sharecropping on *waqf* land. Thus, *waqf* land usually remains within the close family members of the donor.

Table 1 Major types of land property rights and their importance in Yemen and Hajja province

Type of land property	Sample farmers in Hajja ^a	Yemen ^b
	<i>Percent</i>	<i>Percent</i>
Private	75	85
Endowment (Waqf)	20-23	10-15
State	2-5	3-5

Source: ^a Estimates provided by local people, field survey 1997; ^b Noaman (1989) and Varisco (1985).

The average holding size in the study area is 1.3 ha. There is, however, a clear concentration of holdings as shown in Table 2. About 55 percent of the sample farmers

interviewed have holding sizes of less than one hectare, comprising only 25 percent of the area, whereas 15 percent of the farmers have about 41 percent of the area with a holding size of two to five hectares. Smaller holdings are more frequent in the *wadi* banks where irrigated crops are cultivated, while larger holdings are more common in the upper and middle altitude slopes where rainfed farming is practiced. Land concentration in Yemen has been documented in other studies and in some areas a few landlords own large tracts of the agricultural land (Noaman 1989). Similarly, there are a few important families and prominent individuals who own large tracts in the study area.

Table 2 Land holding size and distribution of the sample farmers in Hajja province, 1998

Holding Size	Percent area	Percent farmers
Less than .5 ha	6	24
0.5 -1 ha	19	31
1-2 ha	34	30
2-5 ha	41	15

Source: Field survey 1998.

Land fragmentation occurs in predominantly agrarian economies where a major section of the population is involved in agriculture. It can affect the scale of agricultural production and reduce farmers' ability to invest in land improvement. This is because it is a lot less efficient (in terms of supervision, input application time and transportation) to manage several small parcels scattered along a mountain slope than if they were consolidated.

However, fragmentation may be a logical response of small farmers to environmental risk. Compared to large-scale farmers, small landholders have relatively

fewer resources to invest, and their relative poverty results in lower capacity to absorb risks. Furthermore, small farmers often do not have access to credit due either to infrastructural or bureaucratic obstacles, weakening their ability to invest and insure themselves against risk. They may also discount the future more heavily than wealthier individuals due to their relative poverty, such that they are less inclined to invest for the long term. Their reduced capacity to withstand risk may lead farmers to choose to fragment their plots in order to take advantage of land and microclimatic variation.

In the farm survey conducted in summer 1998, sampled farmers cultivated holdings in an average of five locations, locally known as *wattan*, representing micro-agroecological areas. Over 55 percent of the sample farmers cultivated holdings in three to five separate locations. Some seven percent of the farmers had holdings in eight to nine locations (Table 3). In the spring 1997 survey, eleven farmers were specifically asked about the number of parcels and the time spent walking to those parcels. The average holdings of 1.8 ha owned by these farmers consisted of 45 terraces (*abr*), which were fragmented into four parcels each with an area of approximately half a hectare. Each of these parcels is located within a different micro-agroecological zone, or *wattan*, and farmers spend an average of 65 minutes in walking to reach each location. This small sample may not represent all the farmers, but it indicates the efforts that some small farmers spend cultivating fragmented parcels in these mountain areas.

Table3 Land segmentation of the sample farmers in Hajja Province, 1998

Different locations (<i>watans</i>) that farmers cultivated		Tenure types that farmers hold	
<i>Watans</i>	<i>Percent farmers</i>	<i>Number of tenure types</i>	<i>Percent farmers</i>
1-2	14	1	28
3-5	56	2	39
6-7	23	3	23
8-9	7	4	11

Source: Field survey 1998.

In the study area, application of inheritance law mainly results in land fragmentation. According to Islamic inheritance law, the number of heirs can vary depending on different situations. For example, if the deceased person had no sons, other relatives will inherit, and since these may be numerous, land fragmentation increases. According to a local judge, inheritance also results in many disputes over land property rights. Land fragmentation occurs with sharecropped land as well because sharecropping tenancy is inheritable. As a result, tenants cultivate increasingly smaller fields. Attempts to consolidate land by exchange of parcels among farmers, locally known as *monaqala*, have been made, but are not commonly practiced, possibly due to the variations in land quality.

Although the distribution of land into separate parcels located within different micro-agroecological zones reduces the risk due to weather fluctuations, all farmers interviewed indicated that they would prefer to have their plots consolidated. However, the absence of effective land markets for sales and the social value of land may have prevented land consolidation. In some cases, families keep their land under collective management as one unit to avoid the negative effects of land fragmentation.

TENANCY ARRANGEMENTS

There are two main tenancy arrangements common in Yemen: fixed rent and sharecropping. Fixed rent is more common in the irrigated systems, while sharecropping is found both in irrigated and rainfed areas.

Although owner-cultivation is the predominant type of land tenure system in Yemen (82%)², sizeable areas of land are operated under sharecropping arrangements. The data from the Ministry of Agriculture and Irrigation in Table 4 show average holding size and proportion of sharecropped land in five provinces in Yemen. The sharecropped area in the highland provinces ranges from an estimated five percent in Hajja province

Table 4 The total area and area cultivated by sharecropping in the highland provinces of Yemen

	Total area	Proportion in Yemen	Average holding size	Sharecropped land	
				All Province	Terraced area
	<i>ha</i>	<i>Percent</i>	<i>ha</i>	<i>Percent</i>	<i>Percent</i>
Hajja	124,594	7.5	1.5	5	19
Mahwit	29,169	1.8	0.8	33	32
Sana'a	380,726	22.9	2.6	9	26
Thamar	138,220	8.3	1.5	31	37
Ibb	101,521	6.0	0.7	26	26
Taiz	123,432	7.4	0.9	14	17
Average				18	35

Source: Agricultural Statistics Year Book 1985 and 1996, Ministry of Agriculture and Irrigation, Sana'a.

² Estimated from unpublished report: Agricultural Sector Study, Yemen, Annex 12. Land Tenure. The World Bank 1995.

to nine percent in Sana'a province and 33 percent in Mahwit. In Hajja province, there is a higher percent of sharecropped land in the terraced area of the province (19 percent) than in the province as a whole.

Generally, in Yemen, fixed-rent arrangements mostly occur in state and *waqf* land and in low land and irrigated areas. However, since fixed-rent arrangements were not reported in the survey, they are not discussed in this paper.

In the study area, 66-70 percent of the area cultivated by sample farmers was owner-cultivated, while 21-23 percent of the land was sharecropped private land, 10 percent was sharecropped endowment (*waqf*) land and only one percent was sharecropped state land (Table 5). The low reporting of state land in the samples may be the result of farmers' unwillingness to report these lands. As mentioned earlier, grabbing state and endowment lands in Yemen is a frequent problem due to lack of proper land registration and cadastral maps. The total sharecropped land occupies 31-34 percent of the area and about 70 percent of the farmers cultivate land under some sort of sharecropping arrangement. This demonstrates the significance of sharecropping, and hence, understanding its impact on land improvement, particularly terrace maintenance, is important.

Table 5 Distribution of the cultivated area by land tenure system in Hajja province, 1997/98.

Type of land tenure	Area cultivated by sample farmers (1997 survey, n=56)		Area cultivated by sample farmers (1998 survey, n=84)		Farmers (1998 survey)
	<i>ha</i>	<i>Percent</i>	<i>ha</i>	<i>Percent</i>	<i>Percent</i>
1. Owner cultivated	119	69	63	66	85
2. Sharecropped private land	36	21	22	23	57
3. Sharecropped Waqf land	17	10	9.4	10	45
4. Sharecropped state land	n.i	n.i	1.1	1	11
5. All sharecropped land	53	31	33	34	70

Source: Survey data. n.i = no information was given. The 1997 survey included owners of relatively large land; while the 1998 survey includes the cultivators only. Thus, large land owners who usually rent out their land to tenants were not included in the sample.

SHARES OF HARVESTED CROPS

Sharecropping is an old system in Yemen and it has been adapted to many different situations. It varies according to region, crop, type of land, availability of irrigation water, sharing arrangements on cost of production, and availability of other economic opportunities for landless farmers. Sharecropping arrangements are conditioned on the agreement on sharing the cost of terrace maintenance. Tenants' shares of production and cost of terracing in different provinces is shown in Table 6. The higher the tenants' share of the crops, the higher their share of terrace maintenance costs.

The most common sharecropping arrangements in the study area are one-half to one-half, two-thirds to one-third and three-fourths to one-fourth of the harvested crop for the tenant and landowner, respectively. These shares are based on the prevailing customary rules in each community. Hence, all farmers in a community or in a sub-

Table 6 Tenant's share of production and costs of major terrace maintenance

District/Province	Production share	Terrace repair cost share
	<i>Percent</i>	<i>Percent</i>
Kohlán/Hajja	50	50
Bni Awan/Hajja	67	100
Mahwit	67	50
Jahala/Sana'a	50	50
Raymah/Sana'a	67	100
Humir/Thammar	50	67
Otoma/Thammar	75	100
Habali/Ibb	50	50
Suhool/Ibb	67	100
Saber/Taiz	67	50

Source: Field survey 1997

district apply the same ratio of shares. Under rainfed conditions, tenants receive two-thirds of the production of lentil, wheat, barley, and fenugreek, and half of the sorghum (with fodder) and millet. In the flooded (spate irrigation) areas, tenants get one-third of the production of all field crops and coffee. However, in the *wadi*, where irrigation water is available, tenants receive one-third, while landowners and pump owners divide the remaining two-thirds.

Production estimates are mainly based on mutual trust (reported by 44 percent of the respondents), but often on private land a trusted person, the *amin*, or the owner either takes direct measurements (by volume) at harvest with the tenant (29 percent) or makes estimates by a field survey (19 percent). The remaining eight percent of respondents reported using a combination of these methods. On *waqf* land, the Ministry of Endowments and Spiritual Guidance sends experienced staff to make estimates of production by field survey. However, suspicion of production estimates leads some

landlords to either demand higher shares or avoid the payment of their shares of terrace repairs. Disagreement over the production estimation still remains a potential source of dispute with landowners.

4. SOCIOECONOMIC FACTORS AFFECTING INVESTMENT IN IMPROVING TERRACED LAND

SOCIOECONOMIC CHANGES

Land property rights and tenure systems form part of the larger social, economic, political and legal systems of any society. The socio-economic and political developments of Yemen during this century (particularly the northern part of the country) can be divided into three main periods. These are the pre-*imam* era (before 1919), the era of *imam* Yahya (until the revolution of 1962), and after the revolution. The pre-*imam* era was a time when the tribal system was dominant. Land ownership was mainly divided along tribal and family lines, farming communities were relatively isolated and were not easily accessible, and production was mainly destined for subsistence use, although local markets were exchange places. Generally, there were no income-earning opportunities outside agriculture and communities were largely self-sufficient in basic food supply.

Community cohesion was necessary for survival. Customary land tenure systems were based on the tribal law, known as *urf*, which was the basis for all common rules used to resolve disputes over ownership by local elders, who had knowledge of the land and property boundaries. Communities cooperated in building and maintaining the mountain terraces. There were strong reciprocal relationships between individuals and

families in a community. It is believed that the tribal land tenure system was based on ideals of equity, in which every tribal member had to have land to cultivate (Carapico and Tutwiler 1981). In each community there was a *Sayid or Faqih* (now called *amin al-shari'*), usually a man of religious significance (*imam* of the mosque) who performed many religious functions, including inheritance and issuance of land inheritance certificates, known as *fasl*, which still is the basic document of land ownership held by descendants. The *Faqih* also prepared the land title documents known as *basira*.

In the second period, 1919-1962, the political system was marked by the effort of the *imam* to establish his authority over these tribal communities. In order to achieve absolute power and authority, the *imam* nominated local representatives, known as Sheikhs, who enforced the *imam's* decrees and their interests with local militia supported by the *imam's* army (Carapico and Tutwiler 1981). The political and economic system under the *imam* heavily relied on land taxation. The Sheikhs, their favored individuals and families acquired large tracts of land. The system favored big landlords and the Sheikhs, who laid claim on all uncultivated land, sometimes required their tenants' labor without payment.

Although, more terraces were possibly built and cultivated during this era, because of the *imam* and his Sheikhs' desire to capture the maximum possible agricultural surplus, the customary (tribal-based) land tenure systems were weakened by state intervention. The *amin al-wajibat* or *ma'mun* was introduced with the responsibility

to collect Zakat taxes³ for the *imam* and verify that tenants on the *imam*'s land paid their dues. The *amin*⁴ also issued land titles (*basira*).

After the revolution of 1962, the *imam*'s land was converted into state farms and state land cultivated under sharecropping. The *amin al-wajibat* became the government official responsible for collecting Zakat, keeping records of land transactions and issuing land titles. There was no land reform and big landlords kept their land. However, they could not enforce their own interests as before, at least not through government sanctions.

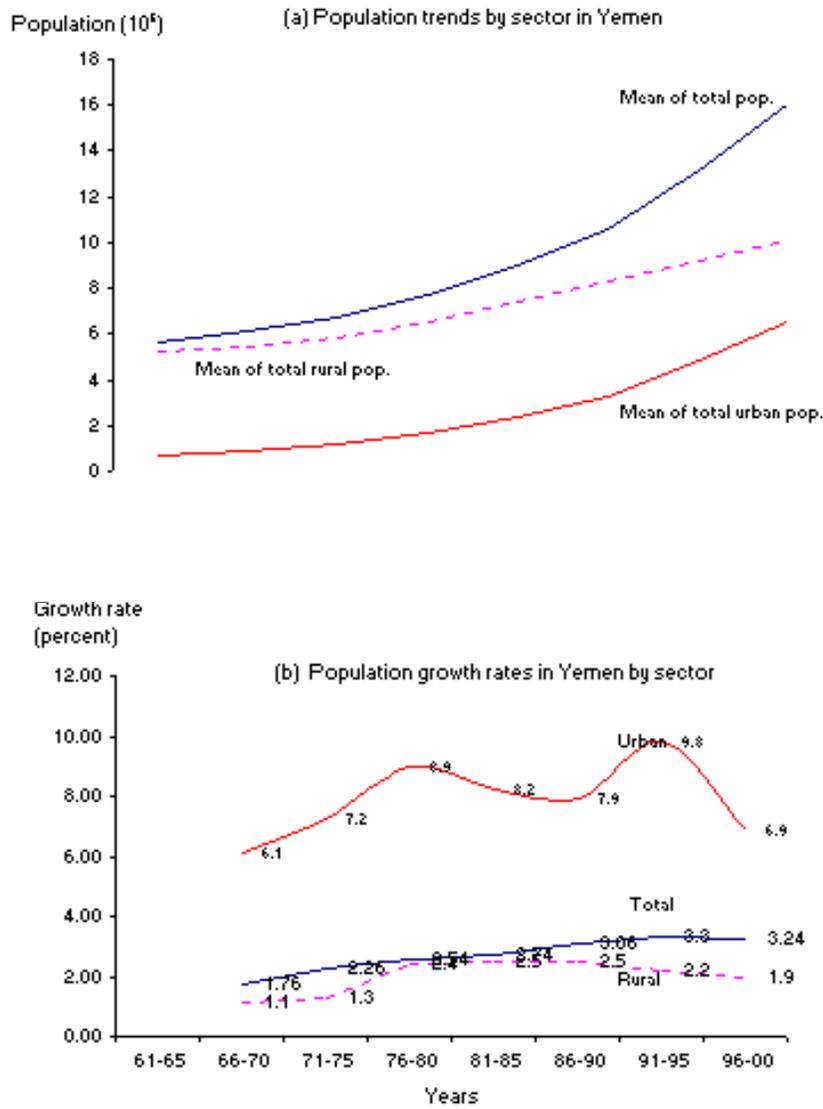
The most important development was the rapid expansion of commerce and trade in the rural communities. The second most important factor that affected land use during this era was the migration of labor from agriculture to other sectors in the local economy and abroad. Figure 1 shows the population of Yemen and growth rates by sector since the 1960s. The annual population growth rate has steadily increased from 1.8 percent in the 1960s to 3.3 percent in the 1990s. The urban population grew at an annual rate of 6.1 percent in the 1960s at a rate of about 10 percent in the early 1990s, while the rural population grew at a rate below the annual national average, ranging from 1.8 percent to 3.3 percent per year from the 1960s through the 1990s.

This massive rural-urban migration has affected land improvement in two ways. First, the supply of labor for dryland agriculture has declined, which has led to increased

³ Zakat is an annual payment provided as an act of worship and is proportional of one's wealth.

⁴ In some villages, the two positions (*amin al-wajibat* and *amin al-shari'*) are held by the same person; in other villages, the positions are held separately. Currently the two responsibilities fall under two different ministries, Finance and Justice, respectively.

Figure 1 Population trend and growth rates in Yemen for 1960s to 1990s



agricultural labor wages and raised the cost of land improvement. Secondly, as urban centers have grown and gained more importance, government policies favor food policies that have taxed agriculture and reduced farm income, making land improvement less profitable. The positive effects of migrants' remittances flowing back to the rural areas have been offset by these negative effects.

The labor migration reached its peak in the 1970s economic boom of the Gulf States, when it is estimated that about 40 percent of the male labor force migrated. Dependency on land for food and income has declined, while wages in other sectors have increased more rapidly than farm wages. During the interviews, farmers reported that in the 1950s and 1960s, their communities were self-sufficient in staple food grains, particularly sorghum, millet, and barley. Some communities were self-sufficient in wheat, but today they rely on imported wheat and wheat flour from the market for 60 percent of their staple food. The subsidy on wheat and flour was reduced during the course of this study in June 1998. Many farmers considered subsidized wheat, which also depressed the farm prices of other grains, most importantly sorghum, as the reason why many people left the land. As a result of emigration and neglect, many terraces have been severely degraded and are no longer cultivable.

These changes affected people's attitude and the way in which they managed the land. In the past, it was 'shameful' for a tribesman to sell or leave his land uncultivated (Puin 1984). Today, however, people leave their land for better employment elsewhere, which results in the abandonment of terraces in the mountains. Migrant labor has brought a great deal of wealth to the country, but since returns to investment have been higher in non-agricultural sectors, the rural sector has lost in relative terms. Investment in agriculture has occurred only in irrigated areas where it is still possible to generate positive returns.

This process of social, economic and political transformation of Yemeni rural society has led to a decline in the resources devoted to terrace construction and maintenance, and has led to their increasing abandonment and degradation. The

customary land tenure system has apparently evolved within this broader social, economic and political development in the country. Although it is difficult to definitively pinpoint the aspects of the customary tenure systems that have weakened, certainly the tribal law (*urf*) has been generally undermined by urbanization and labor migration as well as by government institutions that provide alternative legal frameworks and protection mechanisms.

One example of customary law that has largely disappeared is the pre-Islamic tribal concept of protection (*hijrah*), which grants protection under tribal law to specific groups of people (for example those who are weak and do not have tribal ties for protection) and places such as markets, mosques, the house of *faqih*, etc (Puin 1984). Another example of the weakening of the customary land tenure systems is the gap between customary rules and what is actually practiced, particularly with respect to the cost-sharing of terrace maintenance between tenants and landlords. A breakdown in the enforcement of customary rules has reduced the maintenance of terraces and sometimes leads to their abandonment.

RECIPROCITY AND COLLECTIVE ACTION (*JAYSH AND AWN*)

Mountain terraces in Yemen were constructed over many centuries and maintained by community cooperation. *Jaysh* and *awn* are two practices of community labor resource pooling used in the study area and in other parts of Yemen.

Jaysh is a form of reciprocal labor exchange that takes place when a farmer or a household needs assistance for major terrace repairs, or other urgent situations such as diverting floods or repairing a damaged house. The concerned farmer informs each

household in the community of the need for collective action (*jaysh*) to repair damaged terraces, and provides food for the participants in the *jaysh*. An announcement is made the following morning by drumbeats, and men, normally an adult male from each household, are called to join this community action. Historically, participation in *jaysh* was considered voluntary, although not doing so was regarded as shameful.

Awn is assistance that is offered by one farmer to another farmer on less urgent activities such as harvesting crops or repairing minor damage to terraces. However, *awn* is considered a debt, and reciprocity is expected.

These practices have largely disappeared due to migration, urbanization, and change of peoples' attitude arising from increased off-farm opportunities, increased cost of labor and declining reliance on land for food.

In spite of the decline in cooperative action in modern times, village crop rotation systems were found in the study area. In these systems, the whole community adopts the same rotation on fields in the same area, *watten*. Farmers believe that this practice will sustain the productivity of the soil and reduce the damage from pests, birds and other animals.

LONG-TERM INVESTMENT AND LAND TENURE

Flexibility of Customary Tenure Systems

Customary land tenure systems in Yemen recognize that, in certain situations, investment in land improvements constitutes an assurance to tenants for the returns to their investment. For example, special tenancy arrangements apply if rangeland or uncultivated land is reclaimed and transformed to farmland. In the study area, tenants

may be entitled to a larger share (75%) of the harvest, or they may keep the whole harvest for a period of four to six years to cover the cost of land reclamation. The landowner will collect his share only after this period elapses. It was also found that tenants who shift from cultivating cereals to *qat* and bear all investment costs can keep the whole production for 3–4 years,⁵ after which the landowner receives one-third of the annual harvest. Furthermore, the tenant establishes quasi-ownership rights to one-third of the value of the land in exchange for his investment. In this case, if a landlord wishes to terminate a contract, the tenant will have to receive a payment equivalent to one-third of the actual market value of improved land. This clearly provides tenants with incentives for investment. If, on the other hand, the owner provides the investment capital, the crop shares will be 50:50 and the tenant does not establish property rights on the land.

In other areas, for example in Sahool (Ibb province), tenants may claim ownership on one quarter of the reclaimed land if the landowner decides to terminate the tenancy arrangement. In Hayma district (Sana'a province), tenants could claim half the land that they cultivated with coffee or *qat* if the landowner suddenly decides to terminate the tenancy arrangement, and in Raymah district (also in Sana'a province) the tenant's share is 75 percent of the production of coffee, while it is 50:50 for annual food crops.

This tendency for the customary tenure system to reward tenants for their long-term investment in land improvement, particularly when it comes to reclamation of degraded terraces, is more common where high value crops like *qat* and coffee are

⁵ *Qats* start production after four years, so there is no payment to the landlord for 7-8 years.

cultivated and in more favorable environments along *wadi* banks where irrigation by spring water is available. This is so because the potential profit and returns to investment are less risky than the investment in rainfed and more marginal areas where basic food crops are grown. Most terraces on lands where investments are profitable are well maintained unless the property rights are in dispute. *Qat*, coffee and fruits are the main crops cultivated under sharing arrangements in these areas. However, in marginal areas where there are inherently low and uncertain returns to investment, the customary tenure system provides limited opportunity for tenants to be compensated for their investments in land improvements.

Twenty-nine holdings of rainfed land were reported in the survey to have undergone reclamation during the last five years. Sixteen of these were reclaimed by land owners, while the remaining 13 were reclaimed by tenants: seven in sharecropped private land, five in *waqf* land and one in state land. A higher proportion of owner-cultivated holdings (23 percent) than sharecropped holdings (14 percent) were reclaimed. The reclaimed lands make up only about five percent of the cultivated area and 17 percent of all holdings. For the last five years, most of the reclaimed rainfed land has been planted with food crops under sharecropping arrangements. Food crop cultivation on this land outweighs that of coffee or *qat* by a ratio of 6:1 on owner-cultivated holdings and 3:1 on sharecropped holdings. The food crops grown are primarily sorghum and millet, which are mainly consumed at home. Although from a limited sample, this is an interesting finding because one may assume that the low and variable returns from food crops under rainfed conditions would not have justified the investment in land reclamation and construction of terraces.

For sharecropped land in the 350-400mm rainfall zone, negative and zero gross margins were estimated for rainfed sorghum and millet crops, respectively (FAO 1997). However, this calculation may have not fully accounted for the value of stalks and leaves of thinned sorghum that are used as feed, dry stalks and residues that are grazed out, and roots that are used as fuel.

Rainfed food crops are still preferred by the majority of farmers. About 82 percent of 120 holdings, which constitutes 73 percent of the area of the sampled farmers, were sown with food crops. Sixteen percent were divided between food crops and either *qat*, coffee or fruit trees, while the remaining two percent were not cultivated. More economic research on land improvement in the mountainous areas of Yemen is needed to explain why more investment is not allocated to higher value non-staple crops. Investigations should include the impact of price, credit and infrastructure investment policies on crop choice, and returns to private investment in land improvement, particularly terrace maintenance.

Sources of Finance for Land Improvement

Although the customary land tenure systems in Yemen clearly reward investment in land reclamation and tree planting, the same does not automatically apply to the reconstruction and maintenance of broken terraces on cultivated land—at least in the study area. The cost of building terraces was estimated at 160,000-170,000 Yemeni Riyals per ha (USD 1200-1700/ha) in 1998. The costs of terrace repairs depend on the extent of damage and the nature of the site. Repairs to severely damaged terraces could cost up to one-third of the initial investment. The costs mainly include hired labor,

material (walling stones) and transportation of these materials. This investment is typically too high for small farmers without access to external financial resources, particularly when crops such as *qat* do not produce returns until four years after planting.

The sources of finance for land improvements (terrace repair and terraced land reclamation) for the last five years are given in Table 7. Self-financing was the most common source of finance, being the source for 66 percent of the farmers who undertook land reclamation and 64 percent of those who engaged in terrace repair. Loans from the local community were the second most important source of finance; 13 percent for land reclamation and 27 percent for terrace repairs. Loans from the landlord and reciprocal labor exchange were the least important sources, though both were more important in land reclamation than in terrace repair. This may be because there are established reciprocal labor pooling norms that apply to land reclamation, which involves building many terraces, unlike terrace repairs which do not exact labor obligations from others. Loans from formal credit sources were virtually non-existent, indicating the apparent absence of these services in the study area.

Table 7 Farmers' described sources of finance for terrace repairs for the last five years in Hajja province, survey 1998

Source of finance	Land reclamation (n=32)	Terrace repair (n= 89)
	<i>Percent of farmers</i>	
Own sources including off-farm support	66	64
Local community, friends and relatives	13	27
Loan from landlord	9	7
Formal credit institutions	3	-
Reciprocal arrangements of labor exchange (<i>jaysh</i>)	9	2

Source: Survey 1998

The fact that farmers are investing in land reclamation and development in these marginal areas suggests that there is likely unmet demand for formal agricultural credit institutions to improve services in these areas. The Cooperative Agricultural and Credit Bank (CACB), which is the only formal agricultural financial institution in Yemen, provides credit to less than one percent of the farm families.

Farmers' perceptions of the constraints to terrace repair is presented in Table 8. Lack of financial resources is perceived by most farmers as the most important constraint, followed by lack of landowner support (19 percent) and lack of family labor (16 percent). Low returns to investment were not perceived as a major constraint by most of the farmers in the sample.

Table 8 Farmers perceptions of the constraints to terrace repair

Constraints	Farmers perceptions of constraints to terrace repair (n=84)
	<i>Percent farmers</i>
Lack of financial resources	55
Lack of landowner's support	19
Lack of family labor	16
Dispute over land	6
Low returns to investment	4

Source: Survey 1998.

5. TERRACE MAINTENANCE AND LAND TENURE

TENURE SECURITY

Place, Roth, and Hazell (1994) have identified four elements of tenure insecurity:

1) inadequate duration in rights; 2) inadequate number of absolute rights; 3) lack of

assurance of existing rights; and 4) high cost of enforcing rights. In the study area, tenure insecurity can be attributed to the last three elements.

Three types of tenancy contracts for sharecropping are identified in the study area: namely, open, long-term, and short-term agreements. Tenants and landowners sign written contracts, *waraqat eyjar*, on open and long term tenancy arrangements. The contract is prepared by a trusted individual in the communities (*amin*). The period of tenancy agreement is not mentioned in the contract for open tenure, although the arrangement is intended to last for years, whereas the period of tenancy is stated in the contract for long-term tenure arrangements. Tenancy agreements with a duration of 20, 30, and 50 years are found in the study area. Both open and long-term contracts are inheritable. Short-term tenancy arrangements are least common. They last only for one season or one year, and a written contract is not required. These contracts are mainly limited to rainfed areas. The open and long-term arrangements are prevalent in the study area (86 percent of tenants), while short-term contracts are held by only 14 percent of the sample.

Many of the farmers interviewed indicated that tenure security, in the sense of having a sufficiently long-time horizon to reap the benefits from their investments, was not a major problem. The sharecropping arrangements for almost three-quarters of the tenancies (73 percent) were retained for more than 10 years, about 16 percent of the sharecropping tenancies were held between five and 10 years, while only 11 percent have been held for less than five years (Table 9). Furthermore, all the sampled farmers saw no problem in continuing to hold these rights. Hence, tenure insecurity, in terms of duration in rights, does not seem to exist, but tenure insecurity is attributed to the other three elements.

Table 9 Distribution of duration of tenure holdings for different parcels of land in Hajja province, 1998

	Sharecropped private land (n=47) ^a	Sharecropped waqf land (n=38)	Sharecropped state land (n=8)	All (N=83)
<i>Years cultivated</i>		<i>Percent farmers</i>		
More than 10 years	72	71	87	73
Between 5-10 years	17	18	-	16
Less than 5 years	11	11	13	11

^a The sample was 84 farmers, but only the valid observations for the duration of cultivation on each tenure type are reported.

Source: survey 1998.

Tenancy contracts generally state that the tenure agreement is based on the customary rules and regulations, but do not actually specify what these rules are. A typical contract states the names of the landowner and the tenant, location of the farm and boundaries with other farms, and sometimes the shares of the two parties. It also states that the tenant has the responsibility for keeping the land in a cultivable condition (*eqamet elmal*). The crops to be cultivated on the land are not specified in the contract, nor are cost-sharing arrangements for terrace maintenance. The reasons why these contracts do not contain such stipulations may stem from landowners' unwillingness to accept such inclusions. The result is that tenants lack the ability to enforce their customary rights over the landlords' contribution to terrace maintenance.

Another reason for the increase in tenure insecurity is the weakening of customary law enforcement capabilities. Traditionally, land tenure arrangements were bound by an oral agreement based on trust and community norms, which provided security for the tenant and a guarantee of payment for the landowner. Evicting tenants from the land was

not an honorable thing to do. For example, it is commonly held that as long as a tenant cultivates the land and pays the owners' share, there is no reason to terminate the contract. However, increasing land scarcity due to high population growth (3.5 percent per year) and the resulting increase in the number of rural households and demand for food, renders the traditional methods of keeping track of land holdings as well as enforcement of customary law ineffective. As a result, most of the disputes currently end up in court. In addition, court rulings are made more difficult by the lack of land registration and cadastral maps.

There is also evidence that landowners, considered to have more power than tenants, are exploiting the situation to their advantage. Tenants are more dependent on land for household income compared to landowners. In order not to lose their tenurial rights, they may have forgone some of the rights that the customary land tenure system granted them. Our study indicates that it is a commonly held view that landowners' rights override tenants' rights: 51 percent of surveyed farmers stated that landowners always win any land dispute simply because, as they put it, "it is their property". This implies that tenant farmers have, or at least perceive that they have, weaker access to legal services than landlords or that power imbalances produce skewed legal outcomes that favor landowners. This lack of assurance of customary rights is likely to diminish tenants' incentives to invest in land improvements, such as terrace maintenance.

In summary, although there is tenure security in terms of the duration of customary rights for tenants, the extent of these rights is subject to negotiation. The lack of specific contracts and/or effective enforcement mechanisms of customary rules create

tenure insecurity. Tenants tend to surrender some of their tenurial rights in the event of dispute due to their relatively weaker position and the high cost of enforcement. This reduces the incentives to invest in terrace maintenance.

Formalization of land registration is evolving slowly. At the local level, title deeds (*basira*) are the only documents that prove individual land ownership. Title deeds, which are locally prepared, usually at the sub-district level, record cadastral information, including farm boundaries. This document is accepted in court litigations. As a result of increasing land scarcity, false title deeds are increasingly produced, leading to more conflicts over land ownership and farm boundaries. This results in title deeds being a less reliable proof of land ownership.

In order to address the problem of land registration, the Ministry of Local Administration asked the *amin* to keep records of all land transactions at the sub-district level, such as land sales and tenancy arrangements. Since 1990, the government has strongly recommended that title deeds be endorsed by the court to assure that they are valid. The government recommends the use of written contracts on land tenure agreements to reduce disputes. Hence, the local administration authorities at sub-district levels (*Uzla*) are required to endorse and keep records of tenancy contracts and other land transactions. However, at present the institutional capacity at the local and provincial levels is not sufficiently strong to effectively document all contractual arrangements and to enforce tenurial rights.

CUSTOMARY RULES OF TERRACE MAINTENANCE

The responsibility for terrace maintenance between tenants and landowners is based on customary rules. According to one rule, the tenant bears the full cost of “minor” damages that are considered part of necessary farm husbandry and shares equally with the landlord the cost of “major” damages caused by heavy storms or floods. Another common rule is that tenants repair broken terraces and recover their costs by retaining the whole harvest for two to five years. According to farmers interviewed in this study, however, these common rules are not followed.

One reason may be that the rules are not stated in written tenure contracts, which could provide tenants with greater assurance and clearly indicate landowners’ obligations. Instead, the contract states that the tenant should keep the land in a cultivable condition. This is based on a widely held view that it is the responsibility of the tenant to return the land “in good condition” (*eqamet elmal*). Furthermore, the definition of minor and major damages may be contested.

Farmers in Hajja and Mahwit provinces and western districts of Sana'a province have developed the term *mathber* to describe when a portion of the terrace wall falls and the soil behind the wall is washed away. Partial fall of terrace walls without soil erosion is not considered a *mathber*. Farmers indicated that damages on terrace walls that require no more than two to three workdays of labor and are within the range of “minor” damages should be fully paid for by tenants.

DEVIATIONS FROM THE COMMON RULES

Although the prevailing view is that the responsibility for terrace maintenance is determined according to customary rules, there is a lack of clarity in the responsibility for terrace maintenance. Unlike the customary rules governing sharecropping and land reclamation investment, those governing terrace repair are less clear and their application is contested. The customary rule that farmers repair damaged terraces and the landlord's portion of the cost be deducted from the production share based on mutual agreement is a way to avoid delays in terrace repairs. However, this practice has diminished mainly because of landlords' unwillingness to pay their share of the cost. Landlords' reluctance to support terrace repairs is attributed to low expected returns to investment, as a result of low yields, weather variations, and steadily increasing cost of labor.

The fact that tenants have to repair all "minor" damages and keep the land in a cultivable condition places landlords in a strong position. Although tenants could, in principle, withhold the landowner's share if the latter's share of terrace maintenance is not paid, they may be in a weaker position to do so, given their greater reliance on the land for family livelihood. Tenants perceive that proper enforcement of the 50:50 rule would increase the incentives to invest in land improvements, particularly terrace maintenance.

In the survey conducted in 1998, about 36 percent of all tenant farmers stated that landowners rarely or never pay their share of terrace repairs, 33 percent stated that landowners sometimes pay part or the full share of the cost, but only 31 percent stated that landowners pay their full share of the cost at all times. In the spring 1997 survey, only 46 percent of tenants who cultivated *waqf* land, mentioned that they were allowed to

subtract the shares of major terrace maintenance costs from the harvest shares.

Meanwhile, a similar percentage indicated that they have to bear the whole cost of both minor and major damages. Nearly seven percent of tenants indicated that the *waqf* authority refused to share the costs. But, four percent of the tenants did not try to ask the *waqf* authority, nor were tenants either asked to repair damages that occurred more than five years ago. Where landlords avoid and sometimes refuse to share with tenants the costs of major damages, the tenants in turn see no reason to carry out the repairs without assurance that they will receive the returns from their investment. As a result, some terraces continue to deteriorate due to lack of proper maintenance.

Those tenants who reported that landlords do not fully pay their share of the terrace-repair costs were asked what they would do in the event that landowners did not contribute. Fifty-nine percent stated that they would either leave the land, do nothing, or carry out the repairs alone. Twenty-two percent said they would take the matter to the authority, and 19 percent said they would deduct the costs from the landlord's share of the harvest. However, deductions from landlords' crop shares at harvest without consent could result in a major dispute.

The reasons given by the farmers behind landowners' reluctance to share terrace repair costs is given in Table 10. The main reasons are lack of resources and low land productivity (43 percent), the owner does not perceive adequate returns to investment (22 percent), the owner is not giving priority to the land (13 percent), and the owner does not want to have his crop share deducted for terrace repair because of his perception that the tenant's benefits from the land are greater (11 percent). Furthermore, the unreliability of

production estimates leads some landlords to delay or refuse to pay their share for terrace maintenance. The logic, from the landlord' point of view, appears to be that tenants would have no choice but to repair the terraces alone.

These responses should be interpreted with caution because tenants may want to avoid giving any negative information about their landowners. All in all, tenant farmers perceive that the customary rules on terrace maintenance are not followed because of landowners' increasing reluctance to contribute. Low expected returns and increasing costs of terrace repair due to high labor costs are likely to add to their unwillingness to contribute. However, lack of clarity on the responsibility for terrace repair and lack of effective enforcement mechanisms reinforce this behavior.

Table 10 Farmers' explanations for landowners' unwillingness to share terrace repair costs (sample = 82 farmers)

Reason	Percent
Lack of resources and low land productivity	43
Owner does not perceive adequate returns to his investment	21
Owner is not giving priority to the land	13
Owner does not want to get his crop share deducted for terrace repair because of his perception that the tenants benefit more from the land	11
Owner does not need the land	4
Owner is not getting his proper share	4
Owner gave the land in good condition and it is tenant's responsibility to take care of it and return in good condition	2
Due to dispute in inheritance	2

Source: Survey 1998. Most respondents (70%) cultivate own plots as well as sharecropping plots, with an average of 3 tenure types per respondent, hence, it was difficult to separate farmers' perception by tenure type.

INCIDENCE OF BROKEN TERRACES

Table 11 shows the average number of broken terrace walls on farms of different land tenure systems for two samples from the farmers in the study area. In the 1998 survey, a higher number of broken terraces per hectare were recorded for sharecropped private (23), *waqf* (34) and state (60) lands than for owner-cultivated lands (21). The results of a t-test for mean differences are given in Table 12. The mean difference in broken terraces between owner-cultivated and sharecropped private land was not significant, but the difference between owner-cultivated and sharecropped public land (*waqf* and state combined) was significant. The higher number of un-repaired terraces in the sharecropped land can be explained by the increasing tenure insecurity arising from the lack of clear rules and responsibilities on terrace maintenance, the increase in contestation of current rules, and the lack of efficient enforcement mechanisms for ensuring landlords pay their share of the costs.

Table 11 Average number of broken terrace walls on farms of different land tenure systems

Type of land tenure	Average farm size Ha		Broken walls (<i>Mathaber</i>) per holding		<i>Mthaber</i> per 10 terraces	<i>Mathaber</i> per ha	
	1997	1998	1997	1998	1998	1997	1998
Owner-cultivated land	1.35	0.90	16	19.5 (15)	7 (5)	12	21
Sharecropped private land	0.43	0.45	8	10.2 (8)	10 (7)	19	23
Sharecropped Waqf land	0.3	0.25	8	8.6 (7)	18 (22)	25	34
Sharecropped state land	n.i	0.12	5	7.2 (8)	18 (8)	n.i	60
All sharecropped land	n.i	.55		12.7(13)	18 (18)		29

Source : Field surveys in 1997 (n=56) and 1998 (n=84). n.i = no information. The 1997 sample included relatively larger landowners. The number in parenthesis is standard deviation.

Table 12 T-test values for mean differences for the number of broken terrace walls (*mathabir*) reported by farmers on lands with different tenure arrangements

	SC-private land			SC-public land		
	<i>t-value</i>	<i>degrees of freedom</i>	<i>Sig.(2-tailed)</i>	<i>t-value</i>	<i>degrees of freedom</i>	<i>Sig.(2-tailed)</i>
Owner cultivated land	-0.2	82	ns	-3.52	70	0.001
Sharecropped private land	–	–	–	-2.52	44	0.015

Source: Survey 1998.

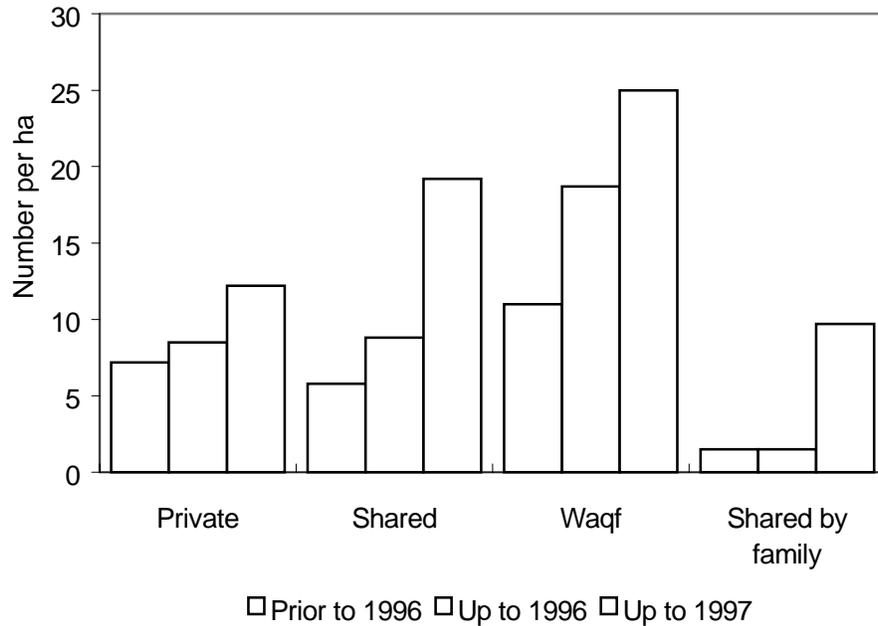
During group discussions, farmers ranked state land as the most degraded land followed by the *waqf* land, while private land was considered to be in a relatively better condition. Although the small size of public land in the sample makes the comparison difficult, the main explanation for the higher number of degraded terraces on public land (state and *waqf* combined) is the lack of clear agreement between tenants and the state on maintaining the terraces. The *waqf* office told the researchers that they have started reducing their contributions to terrace maintenance because of declining revenue.

The data collected during the survey are farmers' responses, which provided only respondents' perceived assessment of terrace degradation. Objective assessments of the extent of terrace degradation, which requires standardized indicators of degradation, will be necessary in future studies.⁶

The cumulative average numbers of broken terrace walls per hectare that occurred until 1997 for different land tenure systems are shown in Figure 2. The figure shows that broken terraces are increasing over time in all types of land tenure systems, but relatively

⁶ Such methods proved too costly for this study to undertake.

Figure 2 Cumulative broken terrace walls in fields of different land tenure arrangements for sample farmers in Hajja Province, 1997



more so on sharecropped land than on owner-cultivated land. The relatively higher number of broken terrace walls detected in 1997 compared to that which occurred in 1996 is partly the result of the 1997 survey being taken prior to crop harvesting. Terrace repairs are usually postponed until the crops are harvested when tenants will be able to receive the landowner's share of repair costs as a portion of the harvested crop. The increasing number of broken walls recorded up to 1996 indicates the slow repair responses to terrace damage. Tenant farmers consider many of the un-repaired broken terraces that occurred in the past as major damages which are the responsibility of landlords. In the case of owner-cultivated land, damaged terraces are considered expensive to repair and lack of financial resources was identified as the main limiting factor.

6. CONCLUSIONS

Our study has investigated the effects of land tenure and other socioeconomic factors on terrace maintenance in the Hajja province, in the western escarpments of the Yemeni highlands. The investment in land improvement, particularly terrace maintenance in the dry highlands of Yemen has declined for the last 30 years. The number of abandoned, degraded and unrepaired terraces found in the study area clearly indicates this trend. Although the number of degraded terraces per hectare is increasing over time in all land tenure systems, the number of broken terraces in sharecropped public (state and *waqf*) land is significantly higher than that in owner-cultivated land. This can be attributed to the slow response by the state and the *waqf* authorities to undertake terrace repairs. The incidence of degraded terraces on private sharecropped land is not significantly higher than that on owner-cultivated land.

Although tenure security is not a problem in terms of length in the duration of tenure, tenants' weak position vis-à-vis landlords create other forms of tenure insecurity. The study indicates that lack of clear agreements and different interpretations of customary rules governing terrace repairs and cost-sharing arrangements between tenants and landlords, and lack of enforcement mechanisms have created insecurity in terms of the number of absolute rights, assurance of existing rights and the cost of enforcing rights. The uneven power distribution, which favors landlords, has reinforced the lack of clear rules and made enforcement difficult. All of these factors have affected the investment incentives for terrace maintenance.

Apart from tenure security, investment in terrace improvement depends on the cost of borrowing, expected returns to investment and the livelihood dependence on the land. Certainly, farmers in the study area still invest in terrace maintenance and in building new terraces in order to secure their livelihoods. However, because of the insecurity that tenants feel, the variability of returns due to weather fluctuations, the high labor cost of terrace maintenance due to massive out-migration, and the limited access to credit, investment in terrace maintenance in the study area is lower than it would have been without these constraints.

Our study also found that incentives from high value tree crops like coffee and *qat* have led tenants and landlords to reach mutual agreements on sharing the costs and benefits of long-term investment in land improvement. Such arrangements, however, do not apply to the land cultivated with annual food crops where returns are lower and less certain.

The continuous degradation of terraces in the Yemen highlands has serious environmental and economic implications. Terrace degradation not only results in net arable land loss in the highlands, but it also affects downstream slopes, produces erosion on wadi banks, and contributes to flash floods in the spate irrigation systems, all of which could cause irreversible damage to Yemen's natural resource base and endanger the country's long-term food production capacity.

The results of this study lead to the following recommendations:

- Government action in strengthening existing local institutions in documenting sharecropping contracts, which will facilitate the enforcement of rights stipulated by customary tenure rules

- Improved and targeted agricultural credit services and better price policies that will increase farm income and counterbalance the negative effects of food subsidies and rising terrace repair costs brought on by increased wages and male out-migration,
- Research to develop improved production technologies and more profitable land use options to increase private investment in land improvement, particularly terrace maintenance in the dry mountain areas of Yemen.

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