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Effects of postsocialist reforms on land cover and land use in South-Eastern Albania

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Abstract

This paper examines effects of postsocialist reforms on land cover and land use through a case study from South-eastern Albania. The paper uses satellite data to measure changes in land cover between 1988 and 2003, draws on a village survey to assess changes in local land-use practices, and examines shifts in the determinants of land cover through seemingly unrelated regressions at the village level. The results show a high incidence of cropland abandonment especially in lower-lying areas closer to markets. Socio-economic factors have emerged as new determinants of spatial variation, suggesting a growing influence of market principles on land use.

Keywords: Land-cover change; Land-use change; Postsocialist reforms; Seemingly unrelated regression (SUR); Migration; Albania

Introduction

Rural areas in the postsocialist countries of Central and Eastern Europe have experienced radical economic and political reforms over the past decade and a half (Swinnen, 1997; Swinnen, Buckwell & Mathijs, 1997). Land reform, liberalization of domestic markets, and integration into international markets have fundamentally altered the socio-economic conditions of land use. Evidence furthermore suggests that land use and land cover have drastically changed in Central and Eastern Europe after the demise of

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socialism (Lerman, 2001; Swinnen et al., 1997). Yet, studies taking an in-depth look at the spatial patterns, processes and consequences of postsocialist land-use and land-cover changes remain absent (for a notable exception, see Nikodemus, Bell, Grine, & Liepins, 2005).

Albania has experienced one of the most radical cases of postsocialist reform. It was the only country in postsocialist Europe outside the former Soviet Union that switched from state to private ownership (Lerman, 2001). Up to 1990, the socialist state owned all land, controlled the flow of produce and inputs through a procurement system, and isolated the country from the West and East (Sjöberg, 1991). This situation changed drastically in the South-eastern European country after 1990. The Albanian state distributed all agricultural land to the rural population in 1991 (Swinnen, 1997). Albania is the only country in Central and Eastern Europe that followed such a pure land distribution strategy.[1] It also liberalized domestic markets for agricultural produce and inputs and opened Albania's international borders to movements of goods, capital, and people (Cungu & Swinnen, 1999).

This paper analyzes the effects of postsocialist reform on land cover and land use in South-eastern Albania. The analysis targets three main research questions: First, how did land cover change in the study area between 1988 and 2003? Second, what were the changes in rural livelihoods during the postsocialist period? And, third, what are the determinants of the changes over time and how are they linked to changing rural livelihoods? The first question is addressed using satellite data to measure changes in land cover between 1988 and 2003. The second draws on a village survey to assess changes in rural livelihood strategies intertwined with land use. The assessment of shifts in the determinants of land cover between 1996 and 2003 relies on econometric modelling. Two models are estimated for land cover as a function of variables that are hypothesized to influence the spatial arrangement of land cover. The independent variables are derived from geographic information systems (GIS) and the village survey. Taken together, the analysis provides unique insights into the effects of postsocialist reforms on land cover and land use.

Changing rural livelihoods in Central and Eastern Europe

Rural livelihoods in Central and Eastern Europe have undergone significant changes since 1990. Numerous people across the region have become land owners as a result of postsocialist land reforms (Swinnen, 1997). Many of them have received tiny plots dispersed across their villages, leading to high degrees of land fragmentation (Sabates-Wheeler, 2002; van Dijk, 2003). Land fragmentation has also been associated with the dissolution of the socialist cooperatives and their successor organizations (Lerman, 2001). This fragmentation of land ownership and farm structures is particularly pronounced in Albania (Cungu & Swinnen, 1999).

A second, connected change has been a widespread move away from cereal production destined for sale (Swinnen et al., 1997). In reaction to the liberalization of markets promoted by their governments, more commercially minded farmers have instead expanded livestock husbandry to supply meat to growing domestic and international

[1] Hungary and Romania chose a mixed strategy of restitution to former owners and distribution to former farm workers (Lerman, 2001).

demands. In contrast, many small producers have withdrawn from agricultural produce and input markets, turning towards subsistence production (Lerman, 2004). Both trends are visible in Albania (Ministry of Agriculture and Food, 2002). Livestock production indices have almost doubled between 1989 and 2004 (Food and Agriculture Organization, 2005). At the same time, many Albanian producers work their land with the most rudimentary implements and consume most of their produce at home (World Bank, 2003).

A third, and perhaps most drastic change, has been associated with unprecedented migratory movements. Particularly in South-eastern Europe, many people have migrated over the past decade in reaction to changing employment and income opportunities (King, 2005). The incidence of migration has been highest in Albania, where census data show that one in five of the 1989 population have left the country until 2001 (INSTAT, 2004). In addition to this international population shifts, eight percent migrated internally between 1989 and 2001, mainly to the economic centres around Tirana and Durres (INSTAT, 2004).

Central and Eastern Europe, therefore, has experienced drastic changes in rural livelihood strategies since 1990. These changes have been especially pronounced in Albania. The drastic nature of the changes suggests the question if these have caused similarly far-reaching changes in land cover and land use. That this may be the case is suggested by comparative findings from the Vidzeme Uplands in Latvia, where more than half of agricultural land has been abandoned after 1990 (Nikodemus et al., 2005).

Data and methodology

Study area

The study area includes the four districts Elbasan, Gramsh, Librazhd, and Pogradec in South-eastern Albania, covering a total of 3800 km^2 (Fig. 1). The area was chosen to represent a transect of economic and ecological diversity, containing a range of agroecological zones with flat, drier lowlands in the West and East, and more humid hilly uplands in the North, South, and central part of the study area. In particular, the flat areas are intensively used for agricultural production.

Elbasan is the third largest city in Albania with approximately 100,000 inhabitants and high growth rates. Pogradec in the East of the study area is another major market centre attracting a large number of migrants from the surrounding rural areas. Pogradec is situated at Europe's oldest lake, Lake Ohrid, and is one of the major tourist attractions in Albania.

Poorer areas are found in the less accessible mountainous regions, particularly in Gramsh and Librazhd districts. The poverty headcounts in 2001 were highest in Librazhd (37 percent below the national poverty line), followed by Gramsh (35 percent), Pogradec (31 percent) and Elbasan where 29 percent were below the national poverty line of 405 US dollars per year (World Bank, 2003).

Land-cover data

The land-cover data are derived from the analysis of time series of Landsat and Aster satellite images for the years 1988 (Landsat Thematic Mapper, TM), 1996 (TM), and 2003

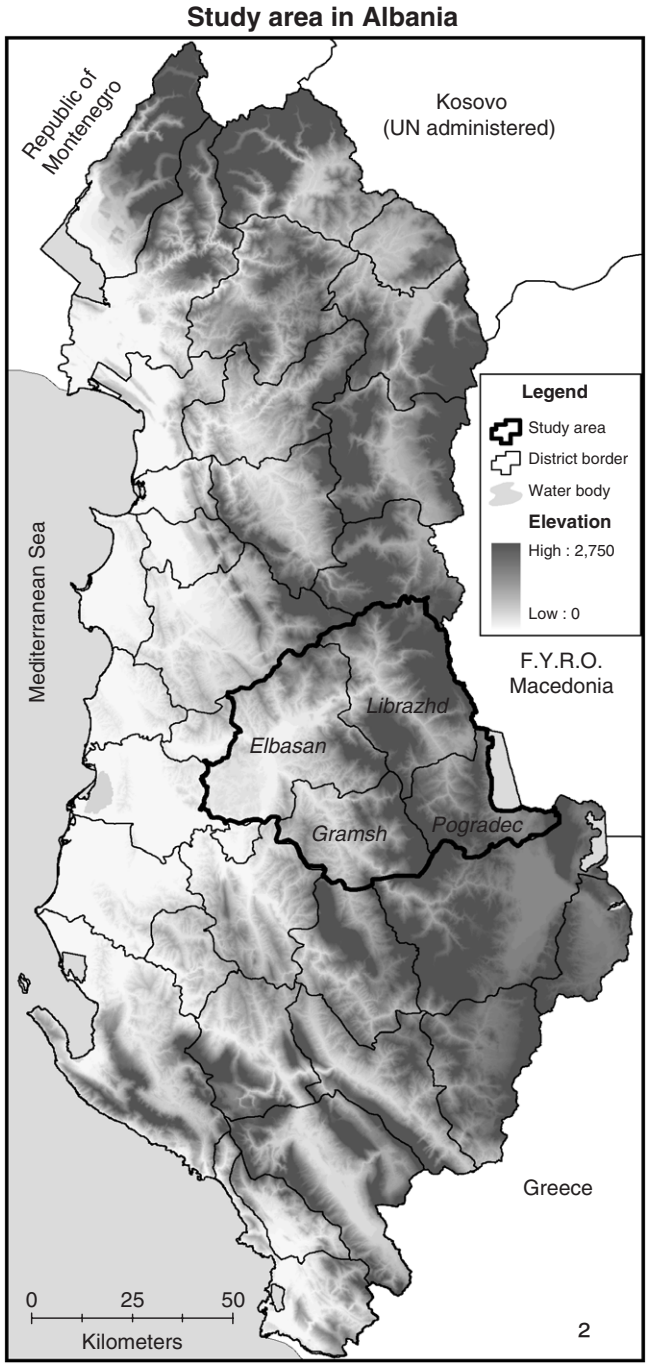

Fig. 1. Study area in Albania. *Source*: authors.

(TM and Aster).[2] The year 1988 shows the collective agricultural system before the demise of socialism. The year 1996 is chosen as an intermediate point to distinguish the immediate effects of postsocialist reform from more medium-term effects. Image interpretation results in one land-cover map for each of the respective years. Overlays of three land-cover maps produce two land-cover change maps that indicate both the quantity as well as the location of changes.

The analysis concentrates on three land-cover categories (subsequent labelling in italic):

1. *Forest* contains coniferous, deciduous, and mixed forest classes with more than 10 percent crown cover.
2. *Shrub and grassland* comprise shrub, grass and bare areas; areas covered by Mediterranean Maccia and coppice; as well as open vegetation with sparse trees and shrubs.
3. *Cropland* includes intensive agriculture, temporary cropland and permanent cultivations like fruits and olives.

Urban and built-up areas as well as water bodies are excluded from the analysis. The three categories above allow to proxy two major changes in the land-cover categories:

(a) *Changes in forest cover*: Deforestation (a change from forest to a non-forest category) and forest regeneration (a change from non-forest category to forest).
(b) *Cropland abandonment*: A change from cropland to a non-cropland category.

GIS data

Important geophysical variables available in sufficient spatial detail for Albania include rainfall, elevation, and slope. Rainfall data stem from rainfall stations that are interpolated to create continuous rainfall maps. The mean rainfall inside a village area is used as a covariate in the empirical model. Ten-meter contour lines from topographic maps are employed to derive a digital elevation model (DEM). Elevation values at the location of the village centre are extracted from this DEM to capture the topographic location and remoteness of a village. The second derivative of the digital elevation data, i.e. the change in slope, is calculated from the DEM to proxy the terrain roughness. Large values indicate rapidly changing elevation values and roughness approaches zero in flat areas.

A road layer was digitized from the topographic maps. For the analysis in this paper, only the major national roads were used. These already existed under socialism and are therefore assumed to be exogenous to the representation of land cover that is observed from the time series of satellite data employed in this paper.

The transportation costs to derive the strata were calculated using cost distance modelling in a GIS and approximate the economic costs to transport goods from each village to the closest district capital that represent the major market centres. The transportation costs integrate variables expected to influence the friction of terrain. It takes

[2]Visual on-screen interpretation on a scale not smaller than 1:40,000 is used to derive the land-cover information from these medium-resolution satellite images. Six spectral bands of the Landsat TM images are employed for the image interpretation that all have a ground resolution of 30 m. All three bands in the visible and near-infrared spectral range with 15 m ground resolution were used from the Aster image (Lillesand, Kiefer & Chipman, 2004).

into account the land cover, the density and quality of the entire road network, and terrain slopes. The cost surface further serves to decompose the changes in land cover and socioeconomic determinants by market access in the descriptive analysis of the sections on land-cover changes and socioeconomic developments.

Village survey

Farmers make decisions on land management and land use based on objectives and constraints of the households and their individual members. At the village level, the aggregate behaviour of all land users acting within the village boundaries is observed. Land-use patterns and processes at the village level thus replicate the aggregated behaviour of households within a village, which in turn consists of the behaviour of the individual household members (Müller & Munroe, 2005). The motivation for the choice of the village level in this study is the possibility to obtain a representative sample for the entire study area covering four districts.

The village survey was carried out in 100 rural villages during autumn 2004. All villages in the research area were stratified into two equally sized groups according to the estimated transportation costs from each village to the nearest city. Using proportional random sampling, 50 villages were randomly selected from both subgroups, proportional to their representation in the entire population.

Interviews were conducted with groups of villagers, including the village mayor, a number of elderly villagers and females as well as other key informants using structured questionnaires. The survey used recall techniques that focused on the years 1991, 1996, and 2004. The year 1991 was used as a starting point of interest, as the year when socialism collapsed and the land reform was implemented. The year 1996 was chosen as an intermediate point in time, as the political upheavals of 1997 marked the beginning of a second, more turbulent phase of postsocialist transformation in Albania. The three years were selected to help distinguish two periods in rural transformation, for which different land-use dynamics were hypothesized. Moreover, the selected years provided points of reference that villagers easily remembered.[3]

The village survey covered important socioeconomic changes hypothesized to influence land use and land-use change in the study area as well as the influencing factors on the variations in livelihood strategies. In the empirical model indicators are included representing the demographic developments such as natural population change, immigration and emigration behaviour; variables pertaining to the income sources within a village; market access and infrastructural changes; land-use patterns, agricultural production indicators, and input intensities; as well as land reform proxies. At the end, two villages were dropped from the sample due to missing data, giving a total of 98 observations.

Data integration strategy

Villages are the unit of analysis, implying an aggregation of individual to household behaviour, and of households to the village level. The typical rural settlement patterns in

[3]Official statistical data on village level does not exist. Therefore, we have no means to verify the quality of the recall data. However, the confidence of the interviewees in their answers and cross-checks with non-interviewees are reassuring that the answers get sufficiently close to reality for the purposes of this paper.

the study area are nucleated villages surrounded by their cropland and pastures. Therefore, the functional village boundaries or village influence spheres are assumed to be the unit of decision making in the empirical set-up. As digital village boundaries are not available, the boundaries were proxied using a data set that derives estimated village boundaries from the extent of the cadastral areas that cover all the agricultural land distributed during the land reform. The remaining areas outside the residential and agricultural land were approximated by local technicians using expert knowledge, topographic base maps and remote sensing information. The land-cover data and the spatially explicit GIS data are aggregated for the sampled villages by calculating the area shares for each land-cover category, and by taking the average amount of rainfall and the average terrain roughness within the village boundaries.

Econometric set-up

Seemingly unrelated regressions (SUR) are used to explore the village-level relationships between exogenous and predetermined covariates and the shares of the three land-cover categories as the left-hand side (LHS) variables. SUR uses generalized least squares (GLS) estimations for a set of equations that are "seemingly" related through their disturbances only, by allowing the error terms to be correlated across equations. If significant correlations between the error terms of the equations are present SUR produce more efficient estimates than ordinary least squares (OLS) regressions (Greene, 1997; StataCorp, 2005). SUR may also increase the efficiency of the estimations, if the explanatory variables differ across equations (Greene, 1997; StataCorp, 2005). Cross-equation correlations are tested and reported using the Breusch-Pagan χ^2 statistic.

The estimation of reduced-form models is employed to represent potentially endogenous relationships among the variables. Predetermined variables are taken from the preceding period or point in time and, therefore, assumed not to be influenced by present-day land cover and are treated as exogenous. This procedure generates asymptotically consistent estimators (Greene, 1997).

The percentages of the three land-cover categories within a village are regressed on a set of (a) geophysical indicators capturing the natural suitability of a location for a certain land use such as the elevation of the village nucleus, proxies for the terrain roughness, and average rainfall within the village boundary; (b) on several variables mirroring largely socioeconomic village-level characteristics like the village surface area, population density, migration movements, agricultural intensity and input use, and land-use strategies; and (c) on exogenous policy and investment decisions.[4] Here, market accessibility, reflecting an investment decision imposed by the government, is proxied by the Euclidean distance to the nearest national road. Market access also captures most of the variation in farmgate input and output prices that are largely related to transportation costs. A major outcome of the land reform is included with a variable depicting the average number of distributed

[4]Some variables hypothesized to influence the representation of land cover and land use had to be dropped from the econometric analysis. Credit use per village is excluded as a covariate as a very low share of farmers used credit for agricultural production, with very little variation across the whole research area. The number of cattle and the firewood consumption per village are dropped from the estimations as the two are highly collinear with the number of households.

plots per household in 1991.[5] In addition, unobserved district-level heterogeneities across the study area are captured by three dummy variables as fixed effects for the four districts.

One model is estimated for the determinants of land cover in 2003 (subsequently labelled *model 2003*) and one for 1996 (*model 1996*). In both models only exogenous and predetermined covariates are used in order to reduce potential endogeneity bias. To assess the changing influences across the two points in time the same covariates appear in both models. In this way, it is possible to compare variations in the determinants of land cover over time.[6]

Results

Land-cover changes

Land-cover changes over the last 15 years for the three categories are depicted in Fig. 2. Forest recovered by 3% in the first period and declined by almost 3% between 1996 and 2003. Forest cover in the second period mostly degraded to shrub land and a total removal of forest cover resulted in bare land and grassland. Fig. 2 also manifests an abandonment of cropland from 940 to 680 km^2 between 1988 and 2003, a decrease from 26% to 19%. Four fifths of the abandonment occurred in the first period. In contrast, shrub and grassland expanded from 33% to 40% over both periods.

The spatial configurations of cropland abandonment and of deforestation are depicted in Fig. 3 with changes from 1988 to 1996 on the left and changes from 1996 to 2003 on the right. Large spatial clusters of both types of land-cover changes are evident in the two periods. For example, large tracts of forest disappeared in the first period in Elbasan district while in the second period Gramsh had the highest decrease in forest cover (dark grey). High rates of cropland abandonment were evident in the second period in all four districts (light grey). There were hotspots of abandonment along the national road network and in the Southern part of Pogradec, an area that experienced especially high emigration rates.

Looking at the spatial distribution of land cover by elevation terciles reveals the dominance of cropland at low and of forest at high elevations, as one might expect (Fig. 4). Land-cover changes were most dynamic in the low and medium elevation categories and relatively static in the highest elevation tercile. Forest expanded by 5% from 1988 to 1996 in the lowest elevation group, largely on abandoned agricultural areas. Forest cover then dropped below 1988 levels in the subsequent period. Cropland decreased by 8% in the first elevation tercile and by 10% in the second. The abandonment of cropland, therefore, was much more significant at low and medium than at high elevations.

[5]The number of distributed plots per household within a village depended on the household size and on the available quantity and quality of agricultural land per village in 1991. There was very little variation in per capita land holdings within a village due to the equity considerations adhered to in the land distribution process.

[6]All variables are transformed to normality based on the assessment of skewness and kurtosis as well as the inspection of normal-quantile plots (StataCorp, 2005). Multicollinearity among the independent variables is assessed using variance inflation factors (VIF). All variables with a VIF above five are removed from the estimations. The mean of all VIFs are close to two for all regressions, suggesting no significant evidence of multicollinearity. The goodness-of-fit statistic reported is the R^2 measure as the percentage of variance explained. Additional statistics are omitted due to brevity, but can be obtained from the author upon request.

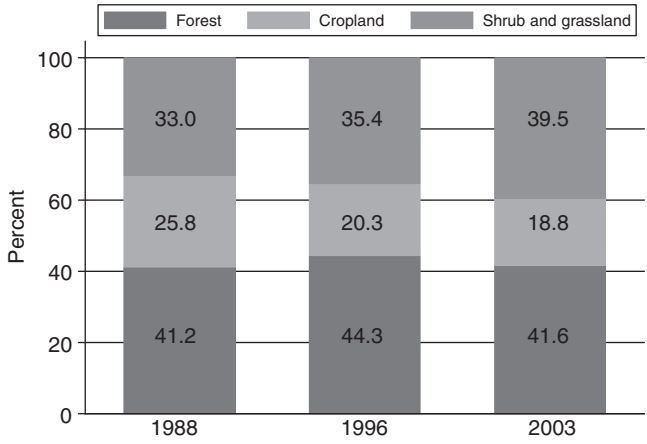

Fig. 2. Aggregated land-cover changes. *Source*: calculated from results of satellite image interpretation by Daniel Müller and Ylli Hoxha.

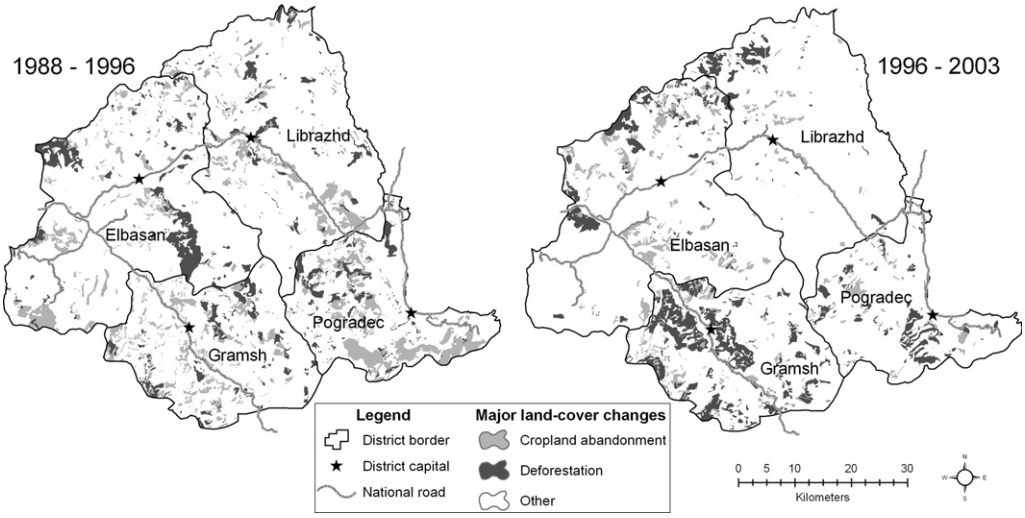

Fig. 3. Spatial configuration of cropland abandonment and deforestation. *Source*: Calculated from results of satellite image interpretation by Daniel Müller and Ylli Hoxha.

Socioeconomic developments

Fig. 5 visualizes the changes in the number of households per village resulting from migration movements. Villages across the whole area reportedly lost on average 10% of households to migration movements between 1991 and 1996, and another 13% between 1996 and 2004. In villages further away from market centres the net emigration rates (emigration minus immigration expressed as a percentage change of the total number of households) were higher in both periods. Combined, one in three households have emigrated from the more remote villages.

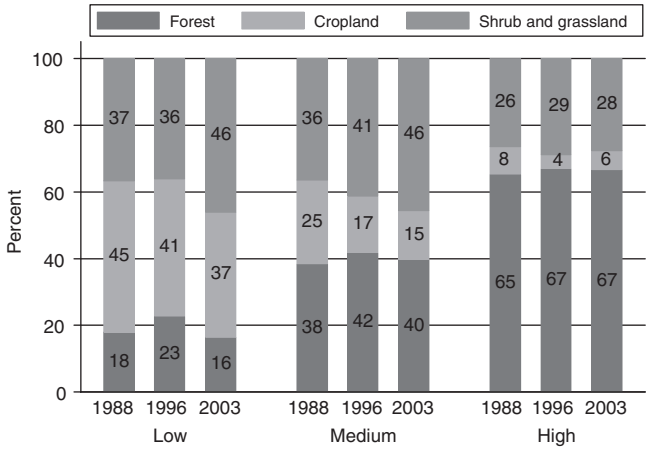

Fig. 4. Land-cover changes by elevation terciles. *Source*: Calculated from results of satellite image interpretation by Daniel Müller and Ylli Hoxha.

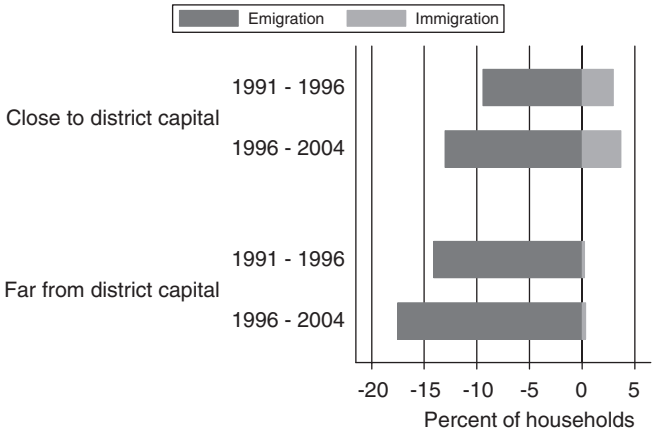

Fig. 5. Migration patterns by market access. *Source*: Albania village survey 2004.

In the majority of the villages, income generation shifted away from agriculture to off-farm employment and, more importantly, to migration and the associated transfer of remittances. Particularly in remote areas, agricultural production was oriented towards home consumption by 2004, as the main cash income source were money transfers of family members who emigrated to Tirana or abroad (Fig. 6). Almost 60% of the rural families still residing in the villages were reported to live of remittances as a major source of their cash income in 2004. Non-agricultural activities followed as the second most important source of cash income. Most of this broad shift from agriculture to migration and off-farm activities already took place before 1996.

The large migratory movements did not lead to the consolidation of agricultural holdings and an increase in the average farm size. In the opposite, the large change in village population had relatively little effect on farm sizes (Fig. 7). The number of farms

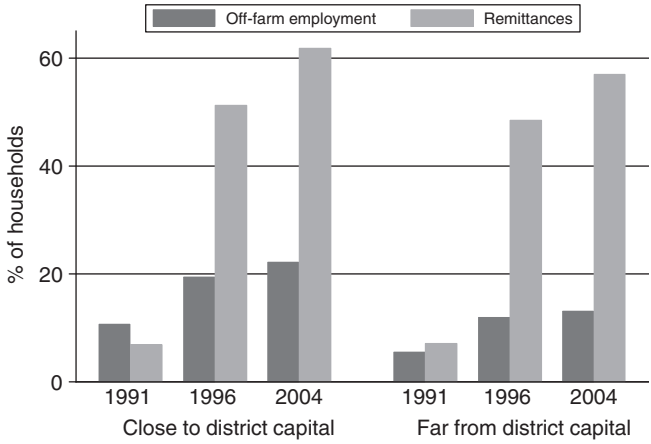

Fig. 6. Major cash income sources. *Source*: Albania village survey 2004.

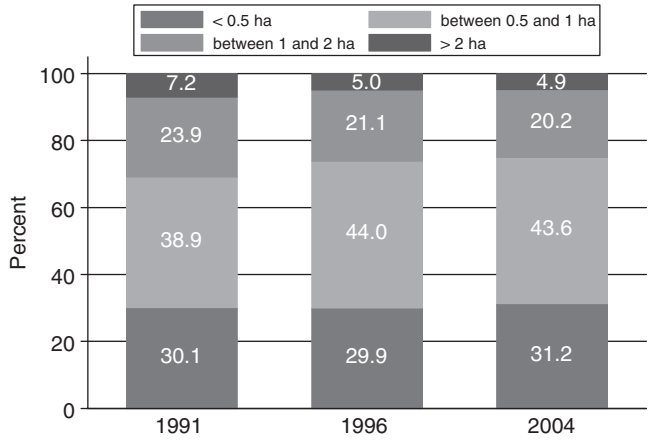

Fig. 7. Farm sizes. *Source*: Albania village survey 2004.

smaller than 1 hectare even increased by six percentage points, largely between 1991 and 1996. The average cropland cultivated by a household decreased in the first 5 years after reform (Table 1).

The agricultural production structure shifted away from crop cultivation towards livestock production in many villages, mirrored by an increase in goats (Table 1). The decline in crop cultivation was associated with the deterioration of irrigation infrastructure, decreasing mechanization levels, and the reported abandonment of marginal plots (Table 1).

Determinants of postsocialist land cover

Descriptive statistics of the dependent and independent variables are depicted in Table 1 and estimation results in Table 2 for the models of both periods. As indicated by the

Table 1
Descriptive village-level statistics for survey sample

Variable	Mean	Std. Dev.	Source
Forest (%), 2003	33.49	28.31	RS
Forest (%), 1996	35.02	27.65	RS
Cropland (%), 2003	22.17	24.99	RS
Cropland (%), 1996	24.26	25.66	RS
Shrub and grassland (%), 2003	39.04	26.05	RS
Shrub and grassland (%), 1996	36.37	25.31	RS
Village area (km^2)	9.85	6.93	GIS
Elevation of village location (m)	569.33	305.10	GIS
Average terrain roughness	6.30	1.59	GIS
Average rainfall (mm)	1310.76	310.90	GIS
Households (number), 1996	161.41	148.09	Survey
Households (number), 1991	159.29	128.52	Survey
Cropland per household (ha), 1996	0.89	0.51	Survey
Cropland per household (ha), 1991	0.95	0.56	Survey
Net emigration (% of hh), 1996-2004	14.42	19.25	Survey
Net emigration (% of hh), 1991-1996	10.65	13.88	Survey
Most income from remittances (% of hh), 1996	49.79	23.69	Survey
Most income from remittances (% of hh), 1991	7.17	15.06	Survey
Tractors (number), 1996	1.16	1.76	Survey
Tractors (number), 1991	1.52	2.08	Survey
Irrigated area (ha), 1996	58.41	94.11	Survey
Irrigated area (ha), 1991	81.18	105.99	Survey
Goats (heads), 1996	285.82	403.19	Survey
Goats (heads), 1991	216.54	299.37	Survey
Travel time to commune centre (min)	51.17	48.56	Survey
Travel time to asphalt road (min)	67.09	59.87	Survey
Distributed plots per household (number)	4.37	1.33	Survey
District: Gramsh	0.21	0.41	Survey
District: Librazhd	0.27	0.44	Survey
District: Pogradec	0.12	0.33	Survey

Notes: The mean land cover shares for each year do not add up to 100 percent as built-up areas and water bodies are excluded from the calculations. The number of observations is 98 for all variables. Std. Dev. = standard deviation, Min. = minimum, Max. = maximum, RS = remote sensing, GIS = geographic information systems, survey = village survey, hh = households.
Source: Own calculation from satellite image interpretation and Albania village survey 2004.

standard deviations in Table 1, there was a large variation in the land-change drivers across the sample villages.

Econometric results suggest that a higher share of forest is associated with larger villages that are located at higher altitudes and have more undulating terrain in both periods. These results point to a higher share of forest land in more marginal and remote villages and further indicate that the occurrence of forest cover is mainly determined by the geophysical conditions. The other indicators are largely insignificant, suggesting that forest cover shows little statistical association with the socioeconomic characteristics and the policy and investment indicators used.

A high share of shrub and grassland is more likely in villages with a rough terrain in both periods. Some socio-economic variables show interesting differences between the

Table 2
The results of the seemingly unrelated regressions

	Model 1996			Model 2003		
	Forest	Shrub & grassland	Cropland	Forest	Shrub & grassland	Cropland
Village area (km^2) (log)	1.446***	−0.589	0.013	1.579***	−1.339***	0.547
Elevation of village location (meters)	0.001*	0	0	0.002***	0	0
Average terrain roughness	0.239**	0.262***	−0.078	0.191**	0.241***	−0.338***
Average rainfall (mm)	0.001	0	−0.002***	0.001	0.001	−0.002***
Cropland per household (ha), 1996/1991 (log)[a]	−0.103	0.174	−0.128	0.133	0.016	−0.021
Households (number), 1996/1991 (log)[a]	0.052	−0.03	0.334*	0.133	0.173	0.237
Net emigration (% of hh), 1996-2004/1991-1996[a]	0.009	0.004	−0.001	0.01	0.013*	−0.01
Goats (heads), 1996/1991[a]	−0.05	0.127		0.037	0.077	
Most income from remittances (% hh), 1996/1991[a]		0	0.017***		0.002	−0.002
Tractors (number), 1996/1991 (log)[a]			−0.245			1.378
Irrigated area (ha), 1996/1991 (log)[a]			0.017			−0.063
Travel time to commune centre (minutes) (log)	0.058	0.084	0.078	−0.061	0.171	0.248*
Travel time to asphalt road (minutes) (log)	0.156	−0.145	−0.167	0.314	−0.471***	−0.159
Distributed plots per household (number)		0.119	−0.001		0.154**	−0.01
District: Gramsh	0.056	0.005	−0.563	−0.267	0.081	1.115***
District: Librazhd	−0.005	1.016***	−2.242***	−0.035	0.873***	−1.369***
District: Pogradec	0.64	0.255	−1.754***	1.218*	0.129	−1.129**
Constant	−5.409***	2.041	5.194**	−7.100***	3.456**	1.345
Number of observations	98	98	98	98	98	98
R^2	0.49	0.26	0.59	0.59	0.32	0.64

Source: Own calculations; corresponding standard errors, *z*-statistics, and *p*-values are suppressed due to brevity, but can be obtained from the authors upon request.
*$p<0.10$, ** $p<0.05$, *** $p<0.01$.
[a]The state in 1996 as a predetermined variable for model 2003 and the state in 1991 as a predetermined variable for the model 1996.

models 1996 and 2003. A higher number of distributed agricultural plots per family positively influences the amount of shrub and grassland in the model 2003 but not in the model 1996. Shrub and grassland is more likely closer to tarred roads in the second period only, mirroring the higher share of that category in areas close to the national roads in 2003. Shrub and grass are less likely in villages with large areas in the second period, displaying a highly significant association not found for the first period.

A higher share of cropland is more likely to be found in villages with more households in the model 1996 and with less rainfall in both models. Just as found for shrub and grassland

above, three other variables indicate interesting differences between the two periods. Cropland is statistically unrelated to market access in the model 1996 but significantly related in the model 2003 at the 10 percent significance level. The importance of cash remittances for the village economy positively influences the share of cropland in the model 1996 at the one percent significance level, but is unrelated to the area allocated to crop production in the model 2003. Terrain roughness is not associated with the variation in cropland among villages in the first period but shows a highly significant association in the second.

The strongly significant district dummies point to substantial remaining differences between the four districts, not captured by the variables included in the models. Particularly, cropland is more likely to be observed in Gramsh, and less likely to be found in Librazhd and Pogradec than in the (omitted) reference district of Elbasan. Shrub and grassland is more likely in Librazhd than in Elbasan in both periods.

Breusch-Pagan tests confirm that the correlations of the residuals are significantly different from zero and, consequently, the SUR approach is a more efficient estimation technique than three separate OLS models and yields consistently lower standard errors than OLS.[7] The R^2 in Table 2 show relatively high explanatory power for the categories forest and cropland in both models with 49 to 64 percent of the variation explained. However, the econometric estimations with the relatively small sample size ($N = 98$) can not explain a large part of the category 'bush and grassland'. This is partly due to the heterogeneity of this land-cover category, which aggregates the fairly diverse land-cover and land-use types of grass, bush, and bare land. In addition, the challenge of identifying pasture land from remote sensing images and the lack of spatial data on livestock densities obstructs a more in-depth analysis of changes in grazing intensity and pasture use.

Discussion

Land cover shows a very dynamic behaviour in the research area between 1988 and 2003. The predominant changes in land cover, i.e., forest regeneration, deforestation, and cropland abandonment, lead to a substantial reorganization of the landscape. Land change is highly heterogeneous across the four districts and across villages. A large share of the heterogeneity, particularly in shrub and grassland cover, cannot be explained by the variables hypothesized to influence land use.

Changes in forest cover

Forest cover increases in the first period and decreases in the second (Fig. 2). The change in trends appears to be connected with changes in the broader dynamics of rural transformation in postsocialist Albania. Between 1988 and 1996, forests expand onto land previously used by agricultural cooperatives during socialism but abandoned after reform. In the second period, forest regeneration is off-set by an increase in logging, most of which is illegal. Timber and wood extraction expand rapidly in the wake of the political upheavals of 1997, as the Albanian state is no longer able to keep illegal loggers out of

[7]The corresponding χ^2 statistic is 19.46 for the model 1996 (probability = 0.0002) and 18.71 (probability = 0.0007) for the model 2003. The correlation matrix of residuals is suppressed due to brevity and can be obtained from the author upon request.

state forests.[8] This is also the reason why the decline in forest between 1996 and 2003 is mainly concentrated in low altitude areas (Fig. 4). These areas are more accessible to loggers and closer to populated centers that exert a high demand for firewood.

The forest-cover data presented in this paper may not reveal the full extent of deforestation for two reasons. First, the spatial resolution of the satellite images can not give a clear indication about the quality of forests, because changes in the canopy cover detected in the land-cover interpretation may be unrelated to changes in the actual biomass on the ground. According to villager's perceptions, forest has degraded rapidly in some areas due to selective extraction without visibly altering the spectral reflectance of the canopy cover. As a result, forests may have experienced a larger extent of degradation than suggested by the relatively small forest-cover changes observed from the satellite images employed. Second, the village survey reveals a continuous extraction of firewood for subsistence purposes (mainly heating and cooking). Reliable information on firewood trade is not available, however. This shortcoming is likely to hide the forest-reducing influence of an active trade in firewood.

Cropland abandonment

Cropland abandonment is widespread across Central and Eastern Europe after 1990 (Brouwer, Baldock & La Chapelle, 2001). Similarly, the rate of cropland abandonment in the study area is considerable (Fig. 2). Yet it is significantly lower than, e.g., in the Latvian Vidzeme Uplands, where the new land owners terminated cultivation on more than half of cropland after 1990 (Nikodemus et al., 2005). The difference may be due to differences in the nature of land reform between Albania and Latvia. In contrast to Albania, the Latvian state restituted agricultural land to the historical owners and their heirs. As a result, much of the land in Latvia has been restituted to people living in cities and abroad, who have been unable to farm the land themselves or make use of it otherwise. The comparatively low rate of abandonment in Albania, therefore, may be due to the Albanian government's decision to distribute agricultural land to the rural population and not restitute it as in the rest of Central and Eastern Europe.

Nevertheless, the abandonment of cropland reflects underlying socioeconomic developments. Agriculture has become a much less important economic activity than migration and off-farm activities. Many rural people have migrated (Fig. 5), making migration the most important source of income next to off-farm activities (Fig. 6). The socioeconomic changes in the study area thus mirror larger trends observed in postsocialist countries, particularly in South-eastern Europe (cf. King, 2005).

The move out of agriculture is reinforced by a shift from crop cultivation to livestock husbandry. The numbers of goats have increased, while cropland is being abandoned (Table 1). Remittances are no longer invested in cultivation, losing their statistically significant influence on cropland (Table 2). Cropland becomes less likely where steep terrains reduce the profitability of production (Table 2). These changes suggest that the decreasing profitability of agriculture, in general, and crop cultivation, in particular, is increasingly reflected in farmers' land-use decisions and also in land-cover patterns.

[8]This interpretation is informed by three in-depth village studies on the social dynamics producing land-use change conducted by Johannes Stahl, which were carried out in conjunction with this research (personal communication).

The spatial distribution of cropland abandonment offers further evidence for an increasing influence of market principles on land-use and land-cover changes. Much of the abandoned cropland is located in lower-lying areas (Fig. 4). In these areas, alternative income sources are more readily available, motivating rural people to leave agriculture behind. Similarly, market access does not have a statistically significant influence on cropland in 1996 but does so in 2003 (Table 2). Road access, land fragmentation, and net emigration matter for the likelihood of shrub and grassland in 2003 but not in 1996 (Table 2). These results suggest that market principles, such as the availability of alternative income sources and factors affecting the profitability of agricultural production, increasingly influence and differentiate rural people's land-use decisions. The effects of postsocialist reforms are becoming visible in Albania's landscape.

Environmental implications

The environmental consequences of cropland abandonment are largely unknown. Nevertheless, research from other parts of Europe suggests that land abandonment can lower soil fertility, decrease biodiversity levels, degrade water ecosystems, and lead to a loss of cultural landscapes (MacDonald, Crabtree, Wiesinger, Dax, Stamou, Fleury et al., 2000). An initial increase in landscape heterogeneity may be followed by later homogenisation due to the decease of the aging population (Nikodemus et al., 2005). Such a homogenisation affects both the biological and scenic diversity of the land. Effects on biodiversity are of global significance as the research area is located within the Mediterranean Basin, which is recognized as a global biodiversity hotspot in terms of endemic flora and fauna species (Myers, Mittermeier, Mittermeier, da Fonseca & Kent, 2000). On the other hand, land abandonment may also lead to increases in biomass, e.g., through an expansion of woodland and a regeneration of forest land, with positive effects on global carbon cycles and local hydrological cycles (Kozak, 2003; Poyatos, Latron & Llorens, 2003).

Conclusion

The discussion illustrates that land cover and land use in Albania exhibit significant changes in the wake of postsocialist reform. Land cover displays a significant move away from cropping in a period of merely 15 years. Local livelihood and land-use strategies demonstrate similarly pronounced trends away from cropping and toward migration and off-farm activities between 1991 and 2004. Changes in the determinants of land cover indicate the growing influence of market principles on land-use practices in the wake of reform, mirrored by a shift to alternative income sources and by the increasing importance of terrain suitability for agricultural production.

It would be interesting to compare the results from Albania to those from other countries in Central Eastern Europe, such as the findings reported in Nikodemus et al. (2005). Changes in land cover and land use may follow a particular trajectory in Albania, as the country may be considered a special case of postsocialist transformation. Yet there is a lacuna of studies on land cover and land use throughout the region, as research in land-change science has concentrated on the tropics. This is unfortunate because postsocialist Europe is not only one of the regions experiencing the most dramatic changes in land cover and land use, but also offers a special opportunity for research to study the social determinants of those changes.

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