Has Forest Co-management in Malawi Benefited the Poor?

Charles B.L. Jumbe and Arild Angelsen

Forests 'grow' on institutions as much as they grow on the soil. The soil provides nutrients for trees to grow and generate different environmental goods and services for use by mankind, while institutions shape the behavior of forest users to ensure sustainable forest utilization and management. After years of stringent government control over forest resources which restricted the flow of benefits to the surrounding communities, many governments worldwide have developed policies to devolve responsibility for forest management to local bodies such as forest user groups. This forest management system is known as joint forest management in India, community forest management in Nepal, forest co-management in Malawi and community-based forest management in the Philippines (Edmunds and Wollenberg 2003; Jumbe and Angelsen 2007). In one way or another, they all involve the transfer of responsibility and authority over forest resources from the state to local bodies which, to various degrees, are guided by the local governance structures. Devolution of forest management is seen as a rural development strategy to enhance the contribution of forests to poverty reduction and to promote village-level economic development and biodiversity conservation (Ribot 1995, 2001; Fisher 1999; Agrawal and Gibson 1999; Agrawal and Ostrom 2001; Kumar 2002; Edmunds and Wollenberg 2003; Adhikari, Falco and Lovett 2004).

When analyzing local or community forest management (CFM), it is useful to distinguish between CFM which originated locally and has existed for some time (traditional CFM), and CFM which is introduced as an integral part of the devolution or decentralization process whereby rights and obligations are transferred from the state to local communities (introduced CFM). Nevertheless, to be successful, CFM policies must be built on traditional institutions while transferring and formally recognizing community rights and obligations through decentralization. Malawi's co-management program falls primarily in the second category, although it is strongly backed by well-established local institutions, particularly for the co-management program in Chimaliro forest reserve, as will be discussed later in this chapter.

A number of studies have been conducted to assess the impact of devolution programs on resource productivity, organizational stability and environmental sustainability. These studies have demonstrated that the success of devolution programs depends, inter alia, on the effectiveness of institutions at the local level and the conduciveness of the policy environment (Meinzen-Dick, Knox and Gregorio 1999). In particular, case studies have generated some evidence that devolution policies have expanded local decision-making authority in forest management and have enhanced the capacity of village-level organizations to halt or slow down natural resource degradation (e.g., Jodha 1995; Baland and Platteau 1996; Agrawal and Yadama 1997; Saxena 1997; Chakraborty 2001). According to Edmunds and Wollenberg (2003), devolution gives the largest number of poor people who live in or near forests a larger voice in decisions about the management and utilization of local forest resources.

In a meta-study of 69 CFM cases by Pagdee, Kim and Daugherty (2006), 58 per cent of the cases studied were considered successful, based on an ecological sustainability criterion (the most typical measure was 'improved forest condition'). The income, livelihoods and distributional criteria were more diverse and therefore more difficult to compare. But in general, the livelihood outcomes were more mixed and less favorable than the conservation outcomes. The study by Behera and Engel (Chapter 7) in this volume finds that despite the concerted efforts by policymakers to empower the poorer and weaker sections of villages through joint forest management in India, the richer and better-educated people in the community influence most decisions.

However, few studies have tried to quantify rigorously the net benefits of devolution programs and their effects on poverty alleviation and equity among different groups of users (Meinzen-Dick, Gregorio and McCarthy 2004). Using household-level data from the Chimaliro and Liwonde forest reserves under the pilot forest co-management program in Malawi, this chapter seeks to address the following questions: Do the poor benefit from participating in the forest co-management program as intended? Are there any biases in the distribution of forest income among different participants and, if so, what are the sources of inequality?

Addressing such questions is important for a variety of reasons. First, evidence from this analysis helps to assess the effectiveness of forest co-management programs as a pro-poor strategy for enhancing the contribution of forests to rural livelihood. Second, with the high priority given to poverty reduction by the government, it is vital to assess whether the poorest and most vulnerable households actually benefit from participating in the program. This analysis therefore helps to identify which people are negatively impacted by the program in order to design suitable policy prescriptions or compensatory mechanisms to mitigate the negative effects from the programs. Lastly, results from this study yield important insights and lessons necessary for designing better interventions in the future.

This chapter applies the propensity score matching and decomposition techniques to measure how participation in the co-management program affects the forest earnings of vulnerable households, especially female-headed and low-income households. Matching techniques are commonly applied in evaluating social and training programs (e.g., Heckman 1997; Heckman and Smith 1999; Dehejia and Wahba 2002; Hirsch and Mehay 2003). Similarly, decomposition techniques are commonly applied in labor market studies to assess the impact of discrimination on the wage rates or earnings of different groups of people defined by gender (Oaxaca 1973; Liu, Zhang and Chong 2004; Jolliffe and Campos 2005), ethnicity (Blinder 1973; Darity, Gullkey and Winfrey 1995; Trejo 1997) or union membership (Andrews et al. 1998; Arbache and Carneiro 1999). This is the first study to combine these econometric techniques to assess the impact of participation in the forest co-management program using household survey data from a developing African country.

In addition, most impact studies of forest devolution programs have not controlled for unobserved heterogeneity and sample selection bias. In this chapter, we use an endogenous switching regression model to adjust the estimates of forest earnings for different groups for sample selection bias.[1] These estimates are subsequently used in the propensity score matching and decomposition analyses. Heckman and Li (2004) show that failure to adjust for unobserved heterogeneity and sample selection effects may lead to incorrect inference as estimates from such analyses may be potentially biased. This is indeed demonstrated in this chapter, as the direction of the effects is often reversed when moving from a simple comparison of averages of forest income between participants and non-participants to the more advanced methods.

FOREST MANAGEMENT IN MALAWI

Malawi has a long history of involving local people in managing forests. Prior to 1891, during the pre-colonial period, informal institutions governing the utilization and management of indigenous forest resources existed as a set of unwritten rules which catered for the needs of the society at that time, mainly to regulate the use of forests for poles, medicines, hunting and fuel wood (Jumbe, Kachule and Mataya 2000). The control over the use of natural resources was vested in the local chiefs, who made decisions regarding the use of different forest products and instituted some controls over the use of forest patches which were preserved as places of worship or as graveyards, while some forest species were protected for their medicinal values.

Forest policies and institutions have evolved from unwritten records to some formal institutions which competed with the informal institutions. During the colonial period (1891–1963), the British colonial administration appropriated large chunks of land in Malawi for large-scale farming (Jumbe, Kachule and Mataya 2000). Most forests were declared protected forest areas by the mid-1920s (Kayambazinthu 2000). The colonial administration further outlawed the cutting or harvesting of indigenous trees on both customary and public land against the ravages of the people who lived on the fringes of these resources (Mayers et al. 2001). However, due to conflicts between the state and the local communities over land, the colonial government established the Communal Forest Scheme, managed by the central government (District Administration). Under the scheme, approximately 2.7 million hectares of forest land were allocated to communities whereby residents decided on their use and management, referred to as the village forest areas (VFAs) (Kayambazinthu 2000). These VFAs were managed by the Village Forest Committees (VFCs), led by village heads. However, the scheme only lasted one decade, when the policy focus of the colonial administration shifted from community forestry to plantation forestry for commercial forest exploitation.

After the country attained independence in 1964, Malawian officials adopted the colonial model of forestry sector management which emphasized forest protection. All forest-related matters on customary land[2] were placed under the responsibility of the local government (District Councils). During this period, the VFCs were mandated to oversee the use, control and management of forests on customary land. In 1985 management responsibility reverted to the central government (Forestry Department). By that time, the authority of village heads to control the VFAs had been usurped by the political influence which dictated the composition and operations of the VFCs. The number of active VFAs dropped from 5,108 in 1963 to 1,182 in 1994 (Kayambazinthu and Locke 2002). The key feature of the government's forestry policy remained that of 'command and control'; most protected areas were heavily guarded and patrolled, and forest products obtained from indigenous forests were confiscated.

Despite the strict controls and significant government investment in forest protection, degradation and deforestation still continued due to forest encroachment and clearing for settlements, opening of new farms, timber extraction and removal of fuel wood (charcoal and firewood) (Malawi Government 2001b). For example, before the 1960s, more than 59 per cent of the total land area of 9.4 million hectares was covered by forests (Jumbe 2006). In the 1970s most forests were cleared to establish large estates for cash crop production, especially tobacco, to boost agricultural exports. As a result, the total forest area had shrunk to 38 per cent by the 1980s (Malawi Government 2001b). Recent estimates indicate that forests now occupy approximately 27 per cent of the total land area (FAO 2005).

As the Malawi government began to formulate the 1996 National Forestry Policy, it took into consideration the continuing forest degradation, the significance of forests to rural livelihood and the 1992 United Nations Earth Summit in Rio de Janeiro. Participants at the Earth Summit had accepted the principle of participatory development as an integral part of the overall rural development strategy. In Malawi, the parliament endorsed the Forestry Act in 1997, that was aimed at better integrating forest utilization and sustainable management. The law removed a number of barriers to people's involvement in the conservation of trees, forests and protected forest areas, and empowered village heads to confiscate forest products illegally obtained from natural woodlands (Sakanda 1996; Malawi Government 1996, 1997). As a framework for implementing the new legislation, the government launched the National Forestry Program (NFP), that specifies forestry sector priorities and strategies to enhance the contribution of forests to rural livelihood, while ensuring sustainable management (Malawi Government 2001a).

THE FOREST CO-MANAGEMENT PROGRAM

In 1996 the World Bank and the British government, through the Department for International Development (DFID), initiated a pilot forest co-management program in Malawi. The program was designed to promote local participation in forest management in exchange for the benefits of long-term sustainable management, such as continued access to fuel wood, poles and non-timber forest products (Kayambazinthu 2000). The Chimaliro and Liwonde forest reserves, located in the North-Central and Southern regions of Malawi, respectively, were selected as pilot research sites. These forest reserves are among the largest in the country, covering approximately 160,000 ha and 274,000 ha, respectively. The woodland in both reserves comprises semi-deciduous and evergreen natural *miombo* woodlands, which are dominated by *Brachystegia, Julbernadia* and *Uapaca* species in the Chimaliro forest reserve; *Uacapa* and *Brachystegia* are the dominant species found in the Liwonde forest reserve (Chanyenga and Kayambazinthu 1999; Makungwa and Kayambazinthu 1999).

These two pilot sites have distinct features. The Chimaliro forest reserve is located in a remote area with underdeveloped forest markets and a relatively more homogeneous society dominated by the Tumbuka tribe. In contrast, the Liwonde forest reserve is closer to the large cities of Blantyre and Zomba. The area is more densely populated and has a more ethnically diverse population. Most households in Liwonde are involved in forest-based businesses such as selling fuel wood, cane baskets and curio products as their main source of livelihood. The average household income in Liwonde is lower than in Chimaliro, where the main source of livelihood is tobacco farming (Jumbe 2006).

Under the program, approximately 210 ha of the Chimaliro forest reserve and 1,172 ha of the Liwonde forest reserve were demarcated into three blocks for joint management between surrounding communities and the government. In Chimaliro, the block sizes are 18 ha, 118 ha and 74 ha, while in Liwonde the sizes are 416 ha, 288 ha and 468 ha. The overall legal framework for the program is guided by a constitution developed and agreed upon by the local communities (Marsland, Henderson and Burn 1999). The rights and obligations of the committees and government, conditions for sharing revenue between government and the community, and the types of forest products which can be legally collected from the forest reserves are clearly detailed in the local constitution. The government's role is mainly to provide guidance, counseling and training to local communities. The program does not provide long-term secure rights to forests and their products, and the forest co-management structures do not have the legal mandate to prosecute violators of forest regulations (Kayambazinthu 2000).

At the heart of the forest co-management program is the implementation of forest management plans, which include boundary marking, firebreak maintenance, controlled early burning, selective harvesting, monitoring of illegal activities such as timber pit-sawing, use of indigenous wood for charcoal production and trafficking in forest products for sale or domestic use. In return, the scheme legitimizes participants' access to and use of the forest reserves to collect various forest products. These include fuel wood, thatch grass, poles, fodder, mushrooms, wild fruits and other non-timber forest products (NTFPs) (Kayambazinthu 2000). These products are important in people's daily livelihood (Campbell and Luckert 2002). In particular, NTFPs such as mushrooms, wild fruits and vegetables help to fill gaps in food supplies during the lean period between November and March, the rainy season when most NTFPs become more abundant (Jumbe 2006).

Within each forest block, a forest management committee with representatives from the designated villages provides leadership in the drafting of the local bylaws and block management plans. The operations of the program differ from block to block and between the two reserves, due to differences in the leadership and the degree of tribal cohesion. Most co-management activities are undertaken during the dry season (July to October), when demand for agricultural labor is relatively low and when forest reserves become more susceptible to wild fires.

Participation in the forest co-management program is voluntary, and members are expected to embrace the principles of forest co-management, abide by the local bylaws and actively participate in the program activities. Members also play a very important policing role by reporting individuals or households who break co-management rules to the local chiefs, government officials or the village forest committees for appropriate disciplinary action. In general, the enforcement of forest regulations hinges on the power and authority of local chiefs and the respect local people have toward their leaders (Jumbe 2006).

This chapter examines whether participation in the program enhances household income. The analysis is based on data from a household survey conducted in 31 villages adjacent to the Chimaliro and Liwonde forest reserves in 2002. Prior to the survey, we conducted focus group discussions and key informant interviews and compiled a list of participating villages and households for sampling purposes. The main survey covered 404 randomly selected households: 205 households from 20 villages in Chimaliro and 199 households from 11 villages in Liwonde.

PROGRAM EVALUATION AND EMPIRICAL STRATEGY

The empirical part of this chapter is based on Jumbe and Angelsen (2006), that gives a detailed theoretical and empirical framework for quantifying the benefits of program participation and how discrimination affects forest earnings for different groups of participants. We hypothesized that participation in the forest co-management program enhances forest-derived income of rural people such that forest earnings of those who participate in the program would have been lower had they not participated. In addition, the model was developed to analyze the net earnings for different groups of participants, classified by gender and poverty class, to assess the sources of unequal distribution of forest earnings.

The model uses different sets of variables to determine factors which influence program participation. These include demographic variables and social capital variables such as past group experience (e.g., farmers' association for tree planting, credit or beekeeping clubs) and tribal cohesion (i.e., whether the respondent belongs to the main ethnic group in the area). The majority of households surrounding the Chimaliro and Liwonde forest reserves belong to the Tumbuka and Yao tribes, respectively. The rest of the variables used are given in Table 6.1 (excluding total monthly income, that is included as background information).

We use the procedure described in Jumbe and Angelsen (2006) to obtain selection-

Table 6.1 Summary Statistics

	Participation status		Gender	
Variables	Yes	No	Male headed	Female headed
Age of household head (years)	44.82*	42.62	46.11	43.28
Education (primary = 1)	0.21	0.16	0.16	0.38
Family size	5.24	4.68	4.68	5.42**
Sex ratio (female to male)	1.27**	1.08	1.12	1.51***
Food insecure months	6.16	6.05	6.17	5.60
Forest business (participate = 1)	0.68	0.68	0.67	0.77*
Own private forest (own = 1)	0.48***	0.36	0.42	0.40
Land per capita (ha/person)	0.34	0.34	0.34	0.34
Ownership of livestock (own = 1)	0.35	0.37	0.36	0.38
Migration status (non-migrant = 1)	0.47	0.56*	0.60	0.51
Duration of residence (years)	29.49	28.68	28.83	32.11
Tribal cohesion (main tribe = 1)	0.61*	0.54	0.57	0.55
Past group experience (yes = 1)	0.36***	0.06	0.19	0.23
Distance to forest market (km)	6.06	7.34***	6.90**	5.70
Distance to forest reserve (km)	0.78	0.87	0.82	0.89
Monthly forest income (MK)	244.58	431.23***	390.06***	218.40
Total monthly income (MK)	2934.97	5174.79***	4680.75***	2620.80
No. of observations	182	222	357	47

bias adjusted estimates of forest income which were subsequently used to assess the impact of participation in the forest co-management program. We use a number of techniques to estimate the impact of program participation. For example, we used the propensity score matching technique proposed by Rosenbaum and Rubin (1983) in which the average forest income of non-participants (selected based on having the same probability of participation) was used as the counterfactual income for participants.[3] We use four matching estimators to estimate the impact of participation in the program: nearest neighbor, radius, kernel and stratification matching. Variables used to estimate the propensity score are listed in Table 6.1 (excluding forest income and total household income).

We employed the decomposition technique as applied in Reimers (1983) to assess whether different groups of participants benefit equally from participating in the program and to identify sources of unequal distribution of benefits. We compared forest incomes between male- and female-headed participants and between high- and low-income households participating in the

Table 6.1 (continued)

Variables	Poverty class: High income	Poverty class: Low income
Age of household head (years)	44.66**	41.00
Education (primary = 1)	0.37***	0.19
Family size	4.20	5.79***
Sex ratio (female to male)	1.19	1.16
Food insecure months	4.55***	6.73
Forest business (participate = 1)	0.72	0.66
Own private forest (own = 1)	0.40	0.42
Land per capita (ha/person)	0.48**	0.28
Ownership of livestock (own = 1)	0.46**	0.320
Migration status (non-migrant = 1)	0.60	0.59
Duration of residence (years)	25.78***	30.59
Tribal cohesion (main tribe = 1)	0.53	0.58
Past group experience (yes = 1)	0.16	0.20
Distance to forest market (km)	6.22	6.98*
Distance to forest reserve (km)	0.99	0.76***
Monthly forest income (MK)	619.72***	237.36
Total monthly income (MK)	7436.70***	2848.30
No. of observations	116	288

Notes:

*Significant at 10 per cent level; **significant at 5 per cent level; ***significant at 1 per cent level.
MK = Malawi Kwacha (US$1.00 = MK76.00 in 2002).

program. Low-income households are those which have daily incomes below the national poverty line of MK19.47 ($0.26)[4] per person per day (National Economic Council 2000), while high-income households are those whose daily income is above this poverty line.

In general, the technique decomposes forest earnings of comparison groups (male versus female, poor versus rich participants) by separating how much of the income gap between the two groups is attributable to the differences in the returns to endowments (coefficients), or inter-group differences in characteristics such as age, experience, education or assets (endowments) (see Jones and Kelly 1984). The first effect is defined as (statistical) discrimination,[5] whereas the second is referred to as the endowment effect.[6] We also applied the decomposition techniques based on the standard OLS regression as applied in Oaxaca (1973) to compare the results with those obtained from the methodology of Reimers (1983).

DESCRIPTIVE STATISTICS

Table 6.1 shows that there are statistically significant differences between participants and non-participants in key variables such as age, education, family composition, group experience and tribal cohesion. There are also significant differences between male- and female-headed households in some variables. For example, female-headed households tend to be less educated and have larger families with more female members than male-headed households. We also note that low-income households have larger families and smaller land size per capita (0.28 ha per person compared with 0.48 ha per person for high-income households). As expected, low-income households are exposed to a longer period of food insecurity (seven months). The average monthly forest incomes per household for low- and high-income households are estimated at MK237 ($3.12) and MK620 ($8.15) respectively, which accounts for 8 per cent of their respective average monthly incomes.

Table 6.2 presents pairwise correlations between program participation, forest income and other variables. Age of household head is negatively correlated with forest income, but positively correlated with participation. This may suggest that as people grow older, they may depend less on forests as their main source of income and be more responsive to forest conservation by participating in the program. This corresponds well with the raw data, where 54 per cent of forest entrepreneurs in the sample are below 40 years of age compared with only 20 per cent among those above 55 years. Thus, the young seem to take advantage of the new forest business opportunities at the expense of conservation. The data show that 46 per cent of oldest households (above 55 years of age) participate in co-management, whereas only 25 per cent of youth (below 40 years of age) participate.

From the last row of Table 6.2, we note that forest income is negatively correlated with participation, especially in Liwonde. This indicates that either participation in the co-management program reduces forest revenue for participants or that high forest income reduces the incentive among households to participate in the program. If the latter is correct, this could have negative implications for the long-term sustainability of the program.

Table 6.3 reports the absolute and relative forest income for different groups. Negative figures in the last column imply less forest revenue for program participants. For example, forest income of participants in Chimaliro and Liwonde drops by 53 per cent and 46 per cent, respectively. Among low-income

Table 6.2 Correlations among Forest Income, Participation and Selected Variables

Variable	Overall		Chimaliro		Liwonde	
	Participation	Income	Participation	Income	Participation	Income
Age of household head	0.07	−0.12*	0.05	−0.12*	0.11	−0.06
Formal education	−0.06	0.02	0.06	0.05	−0.13*	0.14*
Household size	−0.04	−0.03	−0.03	−0.08	−0.05	0.04
Sex ratio	0.11*	0.01	0.19*	0.08	0.13*	−0.01
Food insecurity	0.12*	0.07	0.22*	0.10	−0.01	−0.07
Forest business	−0.00	0.19*	−0.07	0.09	−0.13*	0.09
Woodlot ownership	0.12*	−0.19*	0.24*	0.00	0.05	−0.10
Land holding size	0.01	−0.19*	0.01	−0.02	0.08	−0.10
Livestock ownership	−0.02	−0.07	−0.07	−0.01	0.03	−0.02
Migration status	0.06	−0.09*	0.13*	−0.13*	−0.03	−0.19*
Duration of residence	0.02	−0.06	0.16*	−0.01	0.16*	0.08
Social cohesion	0.07	−0.27*	0.02	0.07	0.16*	−0.14*
Group experience	0.38*	−0.15*	0.65*	−0.08	0.02	−0.11
Distance to forest market	−0.13*	−0.29*	−0.36*	−0.15*	0.12	−0.26*
Firewood price	−0.13*	0.38*	−0.05	0.02	−0.15*	0.11
Distance to forest reserve	−0.04	−0.10*	−0.01	−0.01	−0.16*	−0.06
Forest income	−0.13*	1.00	−0.12*	1.00	−0.19*	1.00
Number of observations		404		205		199

Note: *Significant at 10 per cent level.

Table 6.3 Average Monthly Forest Income Differentials (Malawi Kwacha)

Overall	PP (S.E.)	NP (S.E.)	Difference (t-statistic)	Relative income differential (%)
Full sample	244.58	431.23	−186.65***	−43.28
(PP=182, NP=222)	(42.91)	(37.21)	(2.61)	
Chimaliro	37.45	80.18	−42.73**	−53.29
(PP=89, NP=116)	(1.82)	(22.17	(1.92)	
Liwonde	442.80	815.41	−372.60***	−45.69
(PP=93, NP=106)	(78.82)	(105.59)	(2.83)	
Low-income households				
Full sample	173.62	292.05	−118.43***	−40.55
(PP=133, NP=155)	(23.96)	(47.59)	(53.27)	
Chimaliro	38.90	44.11	−5.21	−11.81
(PP=69, NP=82)	(2.13)	(6.25)	(6.80)	
Liwonde	318.86	570.56	−251.70***	−44.11
(PP=64, NP=73)	(42.99)	(90.54)	(100.23)	
Female-headed households				
Full sample	223.55	210.21	13.34	+6.35
(PP=62, NP=39)	(61.26)	(67.33)	(0.15)	
Chimaliro	35.68	43.11	−7.43	−17.23
(PP=31, NP=20)	(2.53)	(8.59)	(0.83)	
Liwonde	411.42	386.11	25.32	+6.56
(P=31, NP=19)	(113.59)	(127.32)	(0.15)	

Notes:
Asterisks indicate that the means are statistically different between participants and non-participants.
PP = program participants; NP = non-program participants.
**Significant at 5 per cent level; ***significant at 1 per cent level.

households, the program appears to reduce forest revenue of participants by 41 per cent. In Chimaliro, the data show that female participants would 'sacrifice' 17 per cent of their forest revenue, while the program would enhance revenues for female participants in Liwonde by 6 per cent, although the difference is not that significant.

Ironically, the raw data presented above seem to indicate that non-participants benefit more from the forest co-management program than participants. While this may imply that the program is not conducive to enhancing forest income of program participants, it may also highlight the weak enforcement of rules to exclude non-participants from obtaining benefits from the co-managed forests. Nonetheless, using the average income of program participants and non-participants to make inferences about the overall program performance may lead to incorrect inferences, as the estimates often suffer from sample (participation) selection biases, as discussed earlier. This calls for methodologies which correct for potential selection bias.

ESTIMATION RESULTS

Table 6.4 displays the results of both selection-bias adjusted and unadjusted estimates of the average treatment effects on the treated (ATET), which is the measure of the impact of program participation derived from the four matching methods as described in Jumbe and Angelsen (2006). The table shows that selection-bias unadjusted estimates of ATET are consistently negative (except for the female subsample) and not statistically significant across subsamples. This suggests that the program does not increase the income of program participants. This is in line with Table 6.3.

After adjusting for selection bias, most estimates are positive and statistically significant across all subsamples, although the sizes of estimated coefficients and their levels of significance differ across matching methods. As Smith and Todd (2005) point out, results from different matching methods are sensitive to the set of variables used in the propensity scores and the sample used to estimate the program impact. Nonetheless, the selection-bias adjusted results differ sharply from the unadjusted ones. This suggests that there are critical selection biases which should be taken into account when assessing the impact of participation in the forest devolution programs. The rest of the discussion, therefore, focuses on the results from selection-bias adjusted estimates.

Overall Impact of Forest Co-management Program

The estimates from the nearest neighbor and kernel matching methods for the full sample are statistically significant, while those from the radius and stratification matching methods are not, although they are positive (see Table 6.4). Estimates of the net gains to program participants from the nearest neighbor and kernel matching methods are very close (i.e., MK20 ($0.27) and MK18 ($0.24) per month per household, respectively). This represents an increase of 51 per cent

Table 6.4 Matching Estimates of Income Gains from Forest Co-management (Malawi Kwacha)

A: Bias unadjusted ATET	Nearest neighbor Treated mean	Control mean	Average effect	Radius matching Treated mean	Control mean	Average effect
Full sample	138.21	139.23	−1.073	138.21	154.09	−15.88
	[93.46]	[103.10]	(15.17)	[93.46]	[111.12]	(8.92)
Chimaliro	37.45	43.62	−6.17	37.45	40.243	−2.79
	[17.17]	[17.72]	(7.80)	[17.17]	[25.86]	(3.40)
Liwonde	442.80	620.02	−177.22	442.80	734.97	−292.17
	[760.19]	[930.99]	(153.40)	[760.19]	[1053.66]	(157.31)
Females	151.08	139.44	11.64	143.92	113.01	30.91
	[113.07]	[98.40]	(22.85)	[111.69]	[83.87]	(23.42)
Low income	118.60	120.43	−1.84	118.59	129.51	−10.91
	[78.47]	[86.84]	(24.29)	[78.47]	[84.50]	(12.52)

B: Adjusted ATET	Nearest neighbor Treated mean	Control mean	Average effect	Radius matching Treated mean	Control mean	Average effect
Full sample	57.51	37.88	19.63***	57.51	56.52	0.99
	[36.80]	[32.95]	(4.61)	[36.79]	[34.42]	(4.24)
Chimaliro	25.03	12.84	12.19***	25.026	26.19	−0.93
	[11.33]	[10.55]	(2.61)	[11.33]	[11.73]	(5.13)
Liwonde	144.14	312.61	−168.47***	144.14	446.75	−302.61***
	[91.10]	[267.92]	(37.30)	[91.10]	[277.18]	(29.11)
Females	87.03	76.30	10.73	80.84	71.46	18.38***
	[73.90]	[90.73]	[32.36]	[72.26]	[93.98]	(9.38)
Low income	51.77	26.15	25.62***	51.77	37.73	14.04***
	[27.77]	[19.00]	(2.98)	[27.77]	[16.19]	(2.66)

Table 6.4 (continued)

A: Bias unadjusted ATET	Kernel matching Treated mean	Kernel matching Control mean	Kernel matching Average effect	Stratification Treated mean	Stratification Control mean	Stratification Average effect
Full sample	138.21	141.50	−3.291	142.03	140.24	−2.027
	[93.46]	[103.22]	(10.77)	(103.22)	[102.7]	(11.07)
Chimaliro	37.45	42.42	−4.97	61.62	65.10	−3.47
	[17.17]	[19.55]	(6.98)	[180.86]	[26.11]	(6.06)
Liwonde	442.80	552.50	−109.69	641.28	722.82	−81.54
	[760.19]	[897.54]	(118.01)	[964.36]	[956.12]	(104.34)
Females	151.08	140.82	10.25	120.43	108.78	11.65
	[113.07]	(89.09)	(19.94)	[97.20]	[90.74]	(19.98)
Low	118.59	122.62	−4.026	119.76	120.75	−2.16
income	[78.47]	[67.12]	(12.68)	[80.89]	[74.57]	(11.35)

B: Adjusted ATET	Kernel matching Treated mean	Kernel matching Control mean	Kernel matching Average effect	Stratification Treated mean	Stratification Control mean	Stratification Average effect
Full sample	57.51	39.16	18.34***	56.80	60.80	3.29
	[36.79]	[5.88]	(3.75)	(35.22)	[35.23]	(3.37)
Chimaliro	25.03	13.03	11.99***	30.62	31.52	−0.90
	[11.33]	[6.57]	(2.74)	[14.01]	[13.12]	(1.92)
Liwonde	144.14	344.84	−200.71***	339.16	620.91	−281.76***
	[91.10]	[167.97]	(29.27)	[306.79]	[306.79]	(32.27)
Females	87.03	71.34	15.69*	74.42	45.06	29.36***
	[73.90]	[98.12]	(8.33)	(78.58)	[87.53]	(11.73)
Low	51.77	26.76	25.01***	44.39	38.25	13.52***
income	[27.77]	[14.34]	(3.45)	[23.15]	[11.91]	(3.12)

Notes:

ATET: average treatment effect on the treated.

*Significant at the 10 per cent level; ***significant at the 1 per cent level.

Standard deviations shown in brackets and bootstrapped standard errors in parentheses.

and 47 per cent, respectively, of what they would earn had they not participated in the program. These results suggest that the surrounding communities are generally better off by participating in the program.

Similarly, in Chimaliro results from both the nearest neighbor and kernel matching methods show marginal income gains of approximately MK12 ($0.16) per month per household to program participants, an increase of more than 90 per cent of what they would have earned had they not participated in the program. While past studies describe the forest co-management program in Chimaliro as one of 'the most up-to-date' forest devolution programs in Southern Africa from both institutional and ecological perspectives (Kayambazinthu 2000; Shackleton and Campbell 2001), these results indicate that the program has only a minor impact on household income, at least in the short run. However, it must be stressed that most of these households are so poor that even the small cash income and subsistence goods they obtain from forests represent an important component of their livelihood strategies. Moreover, the local chiefs in Chimaliro command deep respect from local villagers and are actively involved in the program (Jumbe 2006). This implies that households are compelled to participate in the program partly for social benefits (e.g., solidarity, social security or self-esteem) and for the inherent fear of social reprisal and exclusion. These are important factors for understanding the relative success of the program in Chimaliro compared with Liwonde.

In contrast, the estimates from all four matching methods in Liwonde are consistently negative and highly significant, suggesting that the forest co-management program does not adequately reward participants by enhancing their income. Results from different matching methods suggest that the forest co-management program reduces forest revenue of participants by between MK168 ($2.22) and MK302 ($3.98) per month per household, a drop in forest revenue of between 54 per cent and 68 per cent of what they would have obtained without participating in the program but illegally obtaining forest products from co-managed forest areas. Thus, households in Liwonde sacrifice their forest income to participate in the program. These findings support other qualitative studies in Africa and Asia which find that sometimes devolution policies can make some groups of forest users worse off (Shackleton et al. 2002; Edmunds and Wollenberg 2003). In fact, the forest co-management program imposes restrictions on participants in terms of the frequency, quantity and type of forest products they can collect from the reserves. These are significant, considering that more than 80 per cent of the households in Liwonde rely on forest-based businesses as their primary source of livelihood (Jumbe and Angelsen 2007).

A methodological reminder is in order here. Our methodology measures the impact of participation in the forest co-management program rather than the general local impact of the program, that would require quantifying all the benefits from sustainable forest management and utilization, such as the preservation of nature, scenery, biodiversity conservation and carbon sequestration. In Liwonde, for example, results suggest that non-participants free ride on the benefits of the program (better forest management). Thus, the correct interpretation of these results is that participation in the program by the households in Liwonde is costly, as it lowers their forest income.

Since the program does not have effective enforcement mechanisms in place to stop free riding and illegal forest use, we can therefore conclude that the socioeconomic and ecological sustainability of the program in Liwonde is at risk, both due to the high costs imposed on participants as well as the high degree of forest exploitation and dependence, where forest income accounts for 23 per cent of their total income (Jumbe and Angelsen 2007).

The results for Liwonde point out the need to address the short-term needs of local people, such as by increasing the share of forest revenue retained by local communities which can be used for village development projects or shared among participants. Currently, 70 per cent of the revenue from sales of forest products from co-managed forests is supposed to be remitted to government, while only 30 per cent is retained by the community (Kayambazinthu 2000). This rule applies to joint bulk sale of forest products from the co-management forest areas, and such sales are not very common. This high 'taxation' serves as a disincentive for people's participation in the program, considering that forest products have substantial commercial values in Liwonde.

Another strategy is to design parallel interventions alongside forest co-management programs to provide forest-dependent households with supplementary sources of income. This may create the incentives among households to participate in the program, to comply with forest regulations and to reduce pressure on the forest reserves.

Does the Program Help Vulnerable Households?

Other analyses were conducted to examine the extent to which the livelihood of vulnerable households, namely female-headed and low-income households, is enhanced by participating in the program. In general, the results from Table 6.4 suggest that the program generates positive income gains to female participants ranging from MK11 ($0.14) to MK29 ($0.39) per month per household, representing an increase in forest income of between 13 per cent and 65 per cent of what they would have earned had they not participated in the program. During the fieldwork, we noted that most fuel wood traders were women who were involved in the day-to-day selling of fuel wood along the main roads. Similarly, empirical results from all the matching methods in Table 6.4 indicate that low-income participants earn more forest income by participating in the program. Income gains to low-income participants are estimated at between MK13 ($0.18) and MK26 ($0.34) per month per household, an increase in forest income of between 35 per cent and 98 per cent of what they would have earned without participating in the program.

Taken together, this analysis suggests that the forest co-management program protects vulnerable households from extreme poverty. We can therefore conclude that the livelihood of both female-headed and low-income households would have declined if they had not participated in the program. In other words, the forest co-management program helps to improve the living standards of vulnerable households which participate in the program, but is not a long-term solution out of poverty. These results are more consistent with the safety-net and gap-filling roles of forests (Byron and Arnold 1999; Angelsen and Wunder 2003).

THE IMPACT OF DISCRIMINATION ON FOREST INCOME

This section discusses the results from the decomposition analysis to assess how the benefits of forest co-management programs are distributed among different groups of participants.

Male–Female Decomposition Results

Table 6.5 presents the results of linear decomposition of forest income for male and female participants. OLS-based decomposition (selection-bias unadjusted) results and their respective standard errors are reported in the first two columns for comparisons, while those based on the switching regression model (selection-bias adjusted estimates from Reimers' [1983] decomposition technique) are displayed in the last two columns. Section A of the table presents predicted values of forest income for male and female participants, while Section B indicates how simultaneous changes in endowments and coefficients affect male–female income disparity.

From Section A, the natural logs of mean forest income for male and female participants are statistically significant from both the selection-bias adjusted and unadjusted decomposition techniques. The difference in average income between male and female participants is highly significant from the bias adjusted, but not from the bias unadjusted estimates (third row). It is, however, interesting to note that the difference between the antilog of average income for male and female participants shows a small positive premium of about MK8 ($0.11) per month per household for male participants. This implies that

Table 6.5 Results of Linear Decomposition of Log of Forest Income

	OLS based (bias unadjusted)		Switching regression based (bias adjusted)	
A: Mean prediction	Mean	Standard error	Mean	Standard error
Male participants	4.582	0.098***	3.925	0.037***
Female participants	4.495	0.126***	3.748	0.053***
Male–female income differential	0.087	0.160	0.177	0.065***
B: Simultaneous change in endowments and coefficients				
Three-fold endowments	−0.160	0.069*	−0.100	0.029***
Coefficients	0.108	0.165	0.179	0.068***
Interaction	0.139	0.081*	0.099	0.033***

Note: *Significant at 10 per cent level; ***significant at 1 per cet level.

income for female participants would increase slightly if they earned like their male counterparts, i.e., without statistical discrimination.

From Section B, endowment coefficients are negative and significant (first row), suggesting that female participants would earn more than their male counterparts if females retained their coefficients, but had the endowments as for males. However, the positive sign for the coefficients in the second row indicates that male participants would still earn more than their female counterparts if female participants retained their endowments, but had similar coefficients to male participants. Similarly, the positive and significant sign for the interaction (last row) indicates that females would still earn less than males even if females had similar coefficients and endowments to their male counterparts.

Table 6.6 presents a summary of male–female income decomposition results. The first column reports the OLS-based decomposition results (selection-bias unadjusted) using average forest income for male participants as a non-discriminatory benchmark. The last column presents bias adjusted decomposition results based on the switching regression estimates of forest income (selection-bias adjusted).

The selection-bias unadjusted results show that 24 per cent of the male–female income differential is attributable to the differences in endowments in

Table 6.6 Summary of Male–Female Income Decomposition

Decomposition summary	OLS based (bias unadjusted)	Switching regression based (bias adjusted)
Predicted income differential (MK/month/household)[a]	8.15	8.22
Proportion of total differential (per cent)		
Total attributable to endowments (variables) (E + C)	60.42	29.91
due to differences in variable means (E)	−2.11	−0.15
due to differences in variable coefficients (C)	62.53	30.05
Unexplained part due to differences in model intercepts (U)	−51.72	−12.71
Unadjusted total differential {(E + C + U) = R}	8.70	17.71
Adjusted total differential[b] {(C + U) = D}	10.81	17.68
Endowments as % of total differential (E/R)	−24.24	−0.83

Notes:

[a]Difference between antilog of earnings of male and female income.

[b]Part of total differential due to discrimination. Positive number indicates advantage to males, negative number indicates advantage to females.

favor of female participants (ninth row, first column). However, results from the last row in the first column indicate that the entire male–female income disparity is due to larger coefficients for male participants or 'discrimination' against the female counterparts, accounting for 124 per cent of the income disparity.

After adjusting for sample selection, the difference in the endowments between male and female participants (fourth row, second column) accounts for only 0.15 per cent of the forest income differential. This minor difference is reflected in the small figure for endowments of just 0.83 per cent (ninth row, second column). From the last row in the second column, results indicate that the main source of income disparity is statistical 'discrimination', that accounts for 100 per cent of the total differential against female participants. Thus, the sizes of the estimated coefficients for variables in the income equation for the male subsample such as age, education and household assets are larger than those for the female subsample. In other words, the difference in forest income between male and female participants reflects how the program functions, and not necessarily that the female participants are more resource poor.

Table 6.7 Results of Linear Decomposition of Log of Forest Income

	OLS based (bias unadjusted)		Switching regression based (bias adjusted)	
A: Mean predictions	Mean	Standard error	Mean	Standard error
High-income participants	4.769	0.177***	3.985	0.051***
Low-income participants	4.473	0.084***	3.721	0.086***
High–low-income differential	0.296	0.196	0.265	0.100***
B: Simultaneous change in endowments and coefficients				
Three-fold endowments	−0.021	0.101	0.155	0.158
Coefficients	0.512	0.376	0.118	0.083*
Interaction	−0.196	0.336	0.023	0.168

Note: *Significant at 10 per cent level; ***significant at 1 per cent level.

High- and Low-Income Decomposition

Table 6.7 presents results from a similar analysis as above to determine the extent of forest income disparity between high- and low-income participants. From Section A, both estimates for the natural log of forest income for high- and low-income participants are highly significant from both the OLS and Reimers (1983) decomposition methods (first and second rows). However, the difference between forest income for the two groups is highly significant from the bias-adjusted decomposition (third row) but not from the unadjusted decomposition. The differences in the antilog of the low- and high-income differentials are MK30 ($0.40) and MK13 ($0.16) per month per household for the bias unadjusted and adjusted decomposition, respectively.

From Section B, endowments, coefficients and the interaction terms from OLS-based decomposition estimates are not statistically significant (first three rows, first column). However, from the bias adjusted decomposition results (second row, second column), only the coefficient is positive and statistically significant. This suggests that low-income households would earn more if they had similar coefficients to the high-income households, i.e., in the absence of 'discrimination'.

Table 6.8 gives a summary of decomposition results, i.e., how much of the differential is attributable to the differences in endowments and statistical 'discrimination' (i.e., differences in the estimated coefficients). Overall, the results suggest that inter-group differences in characteristics (endowments)

Table 6.8 Summary of High–Low Income Decomposition

Decomposition summary	OLS based (bias unadjusted)	Switching regression based (bias adjusted)
High–low-income differential (MK/month/household)[a]	30.20	12.50
Proportion of total differential (per cent)		
Total attributable to endowments (variables) (E + C)	−52.39	−10.83
due to differences in variable means (E)	−21.62	−15.77
due to differences in variable coefficients (C)	−30.77	4.94
Unexplained part due to differences in model intercepts (U)	82.01	−15.62
Unadjusted total differential {(E + C + U) = R}	29.62	−26.45
Adjusted total differential[b] {(C + U) = D}	51.24	−10.68
Endowments as % of total differential (E/R)	−72.99	59.64

Notes:

[a]Difference between antilog of earnings of male and female income.

[b]Part of total differential due to discrimination. Positive number indicates advantage to males; negative number indicates advantage to females.

account for 73 per cent of the total income differential in favor of the low-income participants, while statistical 'discrimination' accounts for 173 per cent of the income differential in favor of the high-income group (last two rows, first column). After adjusting for sample selection bias, 'discrimination' and inter-group differences in endowments between high- and low-income households account for only 40 per cent and 60 per cent of the income disparity, respectively, in favor of high-income participants.

From the decomposition analyses, our empirical results show that statistical 'discrimination' is the source of income disparity between male and female participants, accounting for 100 per cent of the total income differential, while the income disparity between high- and low-income participants is mainly due to the differences in endowments. This is consistent with the descriptive data, where high-income households have better endowments than low-income households in terms of age, education and household assets (land, livestock and private woodlots) which affect forest income. Endowment differences are more structural and difficult to address with the forest co-management program, e.g., a skewed asset distribution. The differences due to 'discrimination', however, can more directly be attributed to the operation of the program.

Thus, these findings highlight problems with the design and/or operation of the program which particularly discriminate against female participants as well as the low-income group. The study did not dig deeply into the nature of this discrimination, but it is likely to reflect the more general norms and structures of the society. And this is not limited to Malawi. These results are in line with the findings of Behera and Engel (Chapter 7): minority groups are de facto kept out of the decision-making processes in India's joint forest management (JFM) programs. As such, they are also less likely to benefit from the program despite the fact that poorer households were more likely to attend JFM meetings.

CONCLUSION

This chapter investigates the impact of participation in the co-management program and the effect of discrimination on household forest income by applying the propensity score matching and decomposition techniques to survey data from the Chimaliro and Liwonde forest reserves in Malawi. After controlling for sample selection bias, there is some evidence from different matching methods that program participation leads to increases in forest income by approximately 50 per cent, using pooled data from both sites.

We find, however, contrasting evidence of the impact of participation between the two sites. While these results indicate that the program enhances forest income of participants at Chimaliro by 90 per cent, the results for Liwonde suggest that participation in the forest co-management program drastically reduces forest revenue of participants by approximately 60 per cent. Due to the very low forest income share in total income of households in Chimaliro, the gain in absolute terms is quite modest, just MK12.00 ($0.16) per month per household. It is, however, worth pointing out that although families earn very small amounts of cash income and subsistence goods from forests, most of these families are so poor that these amounts make a significant contribution to their overall welfare. Again, there are also other benefits in terms of village development projects, environmental benefits from forest productivity through sustainable management, and utilization of forests which have not been captured by this analysis.

The results for Liwonde suggest that participation in the program imposes costly restrictions, in a setting where forest-based businesses (i.e., sale of different forest products) are the main source of livelihood. More generally, these findings are in line with other qualitative studies in other African and Asian countries which suggest that devolution policies can serve as a tool for strengthening the state's control over the management of local resources at a lower cost to the state and can make previous resource users worse off (e.g., Shackleton et al. 2002; Edmunds and Wollenberg 2003).

At the heart of many forest management programs is the fact that previous levels of resource use were unsustainable. Restricting access and limiting resource use are therefore necessary to halt the degradation of – and possibly boost – the resource base. Thus, the jury should take a long-term perspective, and a key hypothesis deriving from this analysis is that forest users in Chimaliro eventually will be rewarded for their better management, while those in Liwonde will suffer from continuing forest degradation. A follow-up study of the same households which participated in the 2002 survey currently (2007) being undertaken will test this prediction.

These results also point to the fact that high forest dependency can make it more difficult for the local communities to achieve compliance with forest regulations, as the opportunity costs of following forest rules and regulations are higher. Thus, the forest co-management program is least successful in Liwonde, where the pressure on forests is higher, and therefore calls for alternative management regimes. This also raises questions about the long-term ecological and socioeconomic sustainability of the program if it cannot cope with higher resource pressure.

Another general lesson of the program concerns the role of social capital and social pressure in enhancing participation and compliance. Chimaliro differs from Liwonde by being more socially and culturally homogeneous. The program is also more integrated into the traditional institutions through the active participation of the chiefs in the program. Thus, non-participation and non-compliance are more socially costly in Chimaliro.

Another lesson concerns the design of the program. The results suggest that the livelihood of women would have worsened without the program. However, decomposition results suggest that female participants derive relatively smaller benefits from the program than their male counterparts due to 'discrimination', that accounts for the male–female income differential. In other words, the program would contribute even more to the livelihoods of female participants if they had similar opportunities to their male counterparts. It is therefore vital for the government and development agencies to design gender-focused devolution programs in order to eliminate 'discrimination' and to boost their income, which would at the same time create better incentives for women's increased participation in the program.

The analysis provides some evidence that the livelihood of low-income households would have worsened without participation in the program. Estimation results suggest that low-income households get between 35 per cent and 98 per cent more forest income compared to what they would have earned had they not participated in the program. However, decomposition results show that high-income participants capture more benefits from the program due to 'discrimination' and differences in endowments, that account for 40 per cent and 60 per cent of the income differential, respectively. These results point to the need to implement complementary interventions alongside forest co-management programs to provide poor households with supplementary sources of income. This may reduce pressure on forests and stimulate greater participation among forest-dependent households.

Lastly, the results of this analysis point to the need for policymakers to address the short-term needs of rural households when designing future co-management programs, for example by increasing the proportion of forest revenue from the forest co-management programs which is retained by the community. Currently the government takes 70 per cent of the cash income from joint sales of forest products from co-managed forests, while only 30 per cent is left to the community. Increasing the share of revenue retained by the community will increase the amount of disposable income which can be invested in village development projects or shared among participants to improve their livelihood, while at the same time increasing the incentives for greater participation in the program and avoiding free riding.

NOTES

We thank Ian Watson, Monica Fisher, David Kaimowitz, D. Andrew Wardell, Ragnar Øygard, Olvar Bergland, Gerald Shively, Steinar Strøm and the editors of this volume for constructive comments on earlier versions of this chapter.

1. For a detailed discussion about selection bias refer to Heckman, Ichimura and Todd (1997) and Heckman and Li (2004).
2. With the exception of land explicitly registered as private land, or registered as 'government land', all the remaining land falling within the jurisdiction of a recognized Traditional Authority granted to a person or group and used exclusively for the benefit of a specific community is referred to as customary land (Malawi Government 2002).
3. For details about the propensity score matching, refer to Heckman, Ichimura and Todd (1997), Smith and Todd (2001, 2005) and Dehejia and Wahba (2002).
4. US$1.00 = MK70.00 in 2002.
5. Discrimination refers to the differences in the magnitude of the coefficients of the estimated equation for the two groups of interest. For example, after running the income equations using the male and female subsamples, 'discrimination' refers to the situation where the estimated coefficients in the income equations for the male subsample for some variables, say 'level of education', are higher than those for the income equation for the female subsample.
6. 'Endowment effects' refers to differences in the averages of household characteristics and other variables which determine income. For example, years of experience in fuel wood selling is an endowment, in that a person with many years of experience as a fuel wood seller may earn more income than the newcomer, due to better communication and bargaining skills.

BIBLIOGRAPHY

Adhikari, Bhim, Salavatore D. Falco and Jon C. Lovett (2004), 'Household Characteristics and Forest Dependency: Evidence from Common Property Forest Management in Nepal', *Ecological Economics*, **48** (2), 245–57.

Agrawal, Arun and Clark C. Gibson (1999), 'Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation', *World Development*, **27** (4), 629–49.

Agrawal, Arun and Elinor Ostrom (2001), 'Collective Action, Property Rights and Decentralization in Resource Use in India and Nepal', *Politics and Society*, **29** (4), 485–514.

Agrawal, Arun and Gautam N. Yadama (1997), 'How do Local Institutions Mediate Market and Population Pressures on Resources? Forest *Panchayats* in Kumaon, India', *Development and Change*, **28** (3), 435–65.

Andrews, Martyn J., Mark B. Stewart, Joanna K. Swaffield and Richard Upward (1998), 'The Estimation of Union Wage Differentials and the Impact of Methodological Choices', *Labour Economics*, **5** (4), 449–74.

Angelsen, Arild and Sven Wunder (2003), 'Exploring the Forestry–Poverty Link: Key Concepts, Issues and Research Implications', Jakarta, Center for International Forestry Research (CIFOR) Occasional Paper No. 40.

Arbache, Jorge S. and Francisco G. Carneiro (1999), 'Unions and Interindustry Wage Differentials', *World Development*, **27** (10), 1875–83.

Baland, Jean-Marie and Jean-Philippe Platteau (1996), *Halting Degradation of Natural Resources: Is There a Role for Local Communities?*, New York: Oxford University Press.

Behera, Bhagirath and Stefanie Engel (2007), 'Participation and Joint Forest Management in Andhra Pradesh, India,' in Natalia Dinello and Victor Popov (eds), *Political Institutions and Development: Failed Expectations and Renewed Hopes*, Camberley, UK: Edward Elgar, pp. 200–227.

Blinder, Alan S. (1973), 'Wage Discrimination: Reduced Form and Structural Estimates', *Journal of Human Resources*, **8** (4), 436–55.

Byron, Neil and Michael Arnold (1999), 'What Futures for the People of the Tropical Forests?', *World Development*, **27** (5), 789–805.

Campbell, Bruce M. and Michael C. Luckert (eds) (2002), *Uncovering the Hidden Harvest: Valuation Methods for Woodland and Forest Resources*, Sterling, VA: Earthscan.

Chakraborty, Rabindra N. (2001), 'Stability and Outcomes of Common Property Institutions in Forestry: Evidence from the Terai Region of Nepal', *Ecological Economics*, **36** (2), 341–53.

Chanyenga, T.F. and D. Kayambazinthu (1999), 'Monitoring and Evaluating Productivity in Miombo Woodlands under Co-management Arrangements: The Case of Liwonde Forest Reserve', in Mzoma R. Ngulube, Lusayo Mwabumba and Paxie Chirwa (eds), *Community-Based Management of Miombo Woodlands: Proceedings of a National Workshop, Sun and Sand Holiday Resort, Mangochi, Malawi, 27–29 September 1999*, Zomba, Malawi: Forestry Research Institute of Malawi.

Darity, William Jr., David Gullkey and William Winfrey (1995), 'Ethnicity, Race, and Earnings', *Economics Letters*, **47** (3–4), 401–8.

Dehejia, Rajeev H. and Sadek Wahba (2002), 'Propensity Score Matching Methods for Non-Experimental Causal Studies', *Review of Economics and Statistics*, **84** (1), 151–61.

Edmunds, David and Eva Wollenberg (eds) (2003), *Local Forest Management: The Impacts of Devolution Policies*, Sterling, VA: Earthscan.

Fisher, Robert J. (1999), 'Devolution and Decentralization of Forest Management in Asia and the Pacific', *Unasylva*, **50** (4), 1–5.

Food and Agriculture Organization (FAO) (2005), *State of the World's Forests, 2005*, Rome: Food and Agriculture Organization of the United Nations.

Heckman, James J. (1997), 'Instrumental Variables: A Study of Implicit Behavioral Assumptions Used in Making Program Evaluations', *Journal of Human Resources*, **32** (3), 441–62.

Heckman, James J. and Xuesong Li (2004), 'Selection Bias, Comparative Advantage and Heterogeneous Returns to Education: Evidence from China in 2000', *Pacific Economic Review*, **9** (3), 155–71.

Heckman, James J. and Jeffrey A. Smith (1999), 'The Pre-programme Income Dip and the Determinants of Participation in a Social Programme: Implications for Simple Programme Evaluation Strategies', *Economic Journal*, **109** (457), 313–48.

Heckman, James J., Hidehiko Ichimura and Petra E. Todd (1997), 'Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme', *Review of Economic Studies*, **64** (4), 605–54.

Hirsch, Barry T. and Stephen L. Mehay (2003), 'Evaluating the Labor Market Performance of Veterans using a Matched Comparison Group Design', *Journal of Human Resources*, **38** (3), 673–700.

Jodha, N.S. (1995), 'Common Property Resources: A Missing Dimension of Development Strategies', Washington, DC, World Bank Discussion Paper No. 169.

Jolliffe, Dean and Nauro F. Campos (2005), 'Does Market Liberalisation Reduce Gender Discrimination? Econometric Evidence from Hungary, 1986–1998', *Labour Economics*, **12** (1), 1–22.

Jones, F.L. and Jonathan Kelly (1984), 'Decomposing Differences between Groups: A Cautionary Note on Measuring Discrimination', *Sociological Methods and Research*, **12** (3), 323–43.

Jumbe, C.B.L. (2006), 'Local Forest Management, Poverty and Energy Use in Malawi', Ph.D. diss., Norwegian University of Life Sciences, Norway.

Jumbe, Charles and Arild Angelsen (2006), 'Do the Poor Benefit from Devolution Policies? Evidence from Forest Co-management in Malawi', *Land Economics*, **82** (4), 562–81.

Jumbe, Charles and Arild Angelsen (2007), 'Forest Dependence and Participation in CPR Management: Empirical Evidence from Forest Co-management in Malawi', *Ecological Economics*, **62** (3–4), 661–72.

Jumbe, Charles B.L., Richard N. Kachule and Charles Mataya (2000), 'Evolution of Forestry Policies in Malawi with Reference to the Miombo Woodlands', *UNISWA Research Journal of Agriculture, Science and Technology*, **4** (1), 69–76.

Kayambazinthu, Dennis (2000), 'Empowering Communities to Manage Natural Resources: Where Does Power Lie? The Case of Malawi', in Sheona Shackleton and Bruce Campbell (eds), *Empowering Communities to Manage Natural Resources: Case Studies from Southern Africa*, Jakarta: Center for International Forestry Research, pp. 53–79.

Kayambazinthu, Dennis and Catherine Locke (2002), 'Malawi Forest Management and

Diverse Livelihoods in Malawi', Norwich, UK, University of East Anglia, Ladder Working Paper No. 24.

Kowero, Godwin, Bruce M. Campbell and Ussif R. Sumaila (2001), *Policies and Governance Structures in Woodlands of Southern Africa*, Jakarta: Center for International Forestry Research.

Kumar, Sanjay (2002), 'Does "Participation" in Common Pool Resource Management Help the Poor? A Social Cost–Benefit Analysis of Joint Forest Management in Jharkhand, India', *World Development*, **30** (5), 763–82.

Liu, Pak-Wai, Junsen Zhang and Shu-Chuen Chong (2004), 'Occupational Segregation and Wage Differentials between Natives and Immigrants: Evidence from Hong Kong', *Journal of Development Economics*, **73** (1), 395–413.

Makungwa, Stephen and Dennis Kayambazinthu (1999), 'Monitoring and Evaluating Productivity in Miombo Woodlands under Co-management Arrangements: The Case of Liwonde Forest Reserve', in Mzoma R. Ngulube, Lusayo Mwabumba and Paxie Chirwa (eds), *Community-Based Management of Miombo Woodlands: Proceedings of a National Workshop, Sun and Sand Holiday Resort, Mangochi, Malawi, 27–29 September 1999*, Zomba, Malawi: Forestry Research Institute of Malawi.

Malawi, Government of (1996), *National Forestry Policy of Malawi*, Lilongwe: Ministry of Natural Resources.

—— (1997), *Forestry Act 1997*, Lilongwe: Ministry of Forestry, Fisheries and Environmental Affairs.

——(2001a), *Malawi's National Forestry Program, Priorities for Improving Forestry and Livelihood*, Lilongwe: NFP Coordination Unit.

——(2001b), *State of the Environment Report, 2001*, Lilongwe: Ministry of Natural Resources and Environmental Affairs.

—— (2002), *Malawi National Land Policy*, Lilongwe: Ministry of Lands, Physical Planning and Surveys.

Marsland, Neil, Simon Henderson and Bob Burn (1999), *On-going Evaluation of FRP Project: Sustainable Management of Miombo Woodland by Local Communities in Malawi*, Reading, UK: University of Reading, Natural Resources Institute.

Mayers, James, John Ngalande, Pippa Bird and Bright Sibale (2001), 'Forestry Tactics: Lessons Learned from Malawi's National Forestry Program', London, International Institute for Environment and Development (IIED) Policy that Works for Forests and People No. 11.

Meinzen-Dick, Ruth, Anna Knox and Monica D. Gregorio (1999), Collective Action, Property Rights and Devolution of Natural Resource Management – Exchange of Knowledge and Implications for Policy; Proceedings of the International Conference, Feldafing, Germany: Deutsche Stiftung für Internationale Entwicklung/ Zentralstelle für Ernährung und Landwirtschaft.

Meinzen-Dick, Ruth, Monica D. Gregorio and Nancy McCarthy (2004), 'Methods for Studying Collective Action in Rural Development', Washington, DC, Systemwide Program on Collective Action and Property Rights (CAPRi) Working Paper No. 33.

National Economic Council (2000), *Profile of Poverty in Malawi, 1998: Poverty Analysis of the Malawi Integrated Household Survey, 1997–98*, Lilongwe: Government of Malawi.

Oaxaca, Ronald (1973), 'Male–Female Wage Differentials in Urban Labor Markets', *International Economic Review*, **14** (3), 693–709.

Pagdee, A., Y. Kim and P.J. Daugherty (2006), 'What Makes Community Forest Management Successful: A Meta-Study From Community Forests Throughout the World', *Society and Natural Resources*, **19**, 33–52.

Reimers, Cordelia W. (1983), 'Labor Market Discrimination against Hispanic and Black Men', *Review of Economics and Statistics*, **65** (4), 570–79.

Ribot, Jesse C. (1995), 'From Exclusion to Participation: Turning Senegal's Forestry Policy Around?', *World Development*, **23** (9),1587–99.

——(2001), 'Integral Local Development: Accommodating Multiple Interests through Entrustment and Accountable Representation', *International Journal of Agriculture, Resources, Governance and Ecology*, **1** (3–4), 327–50.

Rosenbaum, Paul R. and Donald B. Rubin (1983), 'The Central Role of the Propensity Score in Observational Studies for Causal Effects', *Biometrika*, **70** (1), 41–55.

Sakanda, G.P. (1996), 'National Report on the Forestry Policy in Malawi', in Food and Agriculture Organization (ed.), *Forestry Policies of Selected Countries in Africa*, Rome: FAO, pp. 321–41.

Saxena, N.C. (1997), *Saga of Participatory Forest Management in India*, Bogor, Indonesia: Center for International Forestry Research.

Shackleton, Sheona and Bruce Campbell (2001), *Devolution in Natural Resource Management, Institutional Arrangements and Shifts. A Synthesis of Case Studies for Southern Africa*, Bogor, Indonesia: Center for International Forestry Research.

Shackleton, Sheona, Bruce Campbell, Eva Wollenberg and David Edmunds (2002), 'Devolution and Community-Based Natural Resource Management: Creating Space for Local People to Participate and Benefit', *Natural Resource Perspectives*, **76** (March),1–6.

Smith, Jeffrey A. and Petra E. Todd (2001), 'Reconciling Conflicting Evidence on the Performance of the Propensity-Score Matching Methods', *American Economic Review*, **91** (2), 112–18.

—— (2005), 'Does Matching Overcome LaLonde's Critique of Nonexperimental Estimators?', *Journal of Econometrics*, **125** (1–2), 305–53.

Trejo, Stephen J. (1997), 'Why Do Mexican Americans Earn Low Wages?', *Journal of Political Economy*, **105** (6), 1235–68.