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Changing Access to Forest Resources in Tanzania

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Changing Access to Forest Resources in Tanzania

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Abstract

This paper provides an empirical exploration of the dependence of villagers on non-timber forest products in the Morogoro region in Tanzania, the decision rules that villagers use concerning where and how much they collect, how their collection changes with degradation, and the implications of introducing more restrictive access rules of participatory forest management. Villagers' responses to increased degradation vary by forest product: fuelwood collection tends to be displaced to other forests in response to degradation, fewer forest fruits and vegetables are collected, and collection times increase considerably for weaving and building materials.

Key Words: forest degradation, non-timber forest products, Tanzania, participatory forest management

JEL Classification: Q23, Q57

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Elizabeth J.Z. Robinson and George C. Kajembe*

Introduction

People in economically poor countries often depend on extracting resources from nearby forests for their livelihoods, whether for consumption or fuelwood, or as a source of income. In Tanzania, similar to many other countries, access to forest resources is changing, in part due to forest degradation and, more recently, due to the introduction of participatory forest management (PFM)—which changes the extent to which villagers are permitted to collect non-timber forest products (NTFPs) from village and government reserve forests. Forest degradation has influenced where villagers collect specific NTFPs, how long they spend both searching and collecting, the total amount that they consume, and their dependence on markets. These changes affect both villagers' livelihoods and other forests, where NTFP collection is "displaced" to.

In this paper, we argue that it is essential to understand spatial aspects of resource extraction in order to predict the impact on villager livelihoods, degradation, or new approaches to protecting forests (such as PFM) and mitigate any negative impacts. We identify and calculate two distinct time costs—the time spent getting to a particular forest resource and the time spent collecting that resource. Using a smaller but more detailed data set, we demonstrate how villagers have changed the way that they interact with the local forests as a result of degradation, the different "decision rules" that villagers employ concerning where and for how long they extract during any particular trip, and how this varies by resource. We use these findings, plus villagers' recall of how patterns of extraction have changed over the past five years due to increasing scarcity. In section 1, we discuss the literature on NTFP extraction, including the

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impact of PFM on local livelihoods and other forest areas. Section 2 details our methodological approach. Section 3 provides a brief historical perspective on changes in forest access in Tanzania. It also documents in detail current spatial patterns of resource extraction by villagers living in and around Tanzania's Eastern Arc Mountains, where the forests have gradually but pervasively degraded; many of these forests are critical for ecosystem provisioning. In section 4, we conclude by considering the implications of our findings for the introduction of PFM in Tanzania's government reserve forests, particularly how extraction patterns are likely to change and how these changes will affect villagers' livelihoods and other forest resources.

Our research, therefore, addresses a number of specific questions. First, what are the key forest resources collected by villagers who live around the Eastern Arc Mountains in Tanzania? Second, what are the decision rules that villagers employ when determining how much of a specific resource to collect in a particular trip? Third, how have villagers' patterns of forest resource collection changed in response to increasing degradation of the nearby forests? And finally, what can these observations teach us about expected changes in resource collection as a result of participatory forest management that imposes more stringent forest access restrictions?

1. Literature

A growing body of literature addresses specific aspects of NTFP extraction. Examples of papers that focus on the quantity of resources extracted, the contribution to livelihoods, and how dependence on common land resources varies with household wealth include de Beer and McDermott 1989; Fearnside 1989; Poulsen 1990; Jodha 1986 and 1992; Ganesan 1993; Gunatilake et al. 1993; Reddy and Chakravarty 1999; Bahuguna 2000; Cavendish 2000; Adhikari 2003; and Mahapatra et al. 2005. These analyses are useful in terms of showing the importance of NTFPs to local livelihoods, particularly the rural poor. However, they are non-spatial in nature, typically use cross-sectional data, and place little emphasis on where the resources are collected and the time and distance costs involved.

Over time, as access to NTFPs changes due to degradation, as rules of access and the extent to which they are enforced change, or as the population itself changes, so will villagers' patterns of extraction change—including the time (and therefore the cost) of extraction and the quantities extracted. Recently in the literature, more attention has been paid to the impact of participatory forest management on villagers' access to resources, and forest and park departments are under increasing pressure to address the impact of their policies, particularly exclusionary policies, on resource dependent villagers in and around the forests (White and Martin 2002; Wells 2003).

Much of this literature focuses on community-based forest management in South Asia and on fuelwood in particular. Sarin (1995) and Agarwal (2001) demonstrated how some villagers in India and Nepal, when excluded from participating in village community forest sites, may travel to different forests and incur substantial additional time costs, risk being caught and fined, switch to different fuels, or cut down on the total amount of fuelwood (or its substitutes) that they use. Narain et al. (2005) used cross-sectional data to demonstrate how the relationship between dependence and household wealth changes with variations in the stock of natural resources; and Adhikari et al. (2007) looked at how farmers' livelihoods have been affected by community forestry in terms of forest product extraction and livestock numbers. Sekhar and Jørgensen (2003, 1) noted that in South Asia, the success of "social forestry" has "been limited in terms of reaching the poorest segments of the population—some of whom have actually lost access to common pool resources as a result of social forestry intervention."

There is much less information available on the impact of changing forest access in sub-Saharan Africa, in part because initiatives, such as participatory forest management, are more recent and thus less established than in South Asia. Gosalamang et al. (2004) considered the impact of changes to the legal status of a forest reserve in Uganda and its impact on household livelihoods, but had little quantitative data. Lokina and Robinson (2008) explored how PFM in Tanzania has had an impact on the PFM forests themselves, nearby forests, and people's livelihoods, relying on villagers' perceptions of changes due to a lack of baseline data.

The success of JFM initiatives from an ecological perspective is typically judged on the impact on resources within the specific JFM forest. However, as Lewis (2002) recognized, the level of environmental services provided by forests as a whole can be negatively affected by the displacement of extraction from a particular protected area to less protected forests. Yet, although the consequences for nearby forests have in part been recognized in the literature, there has been little empirical analysis (Faith et al. 1996; Köhlin and Parks 2001; Sekhar and Jørgensen 2003; Pattanayak et al. 2004).

Theoretical models of the impact of degradation and exclusion on nearby villagers and nearby forest resources can be found in Robinson et al. (2002, 2005). Robinson et al. (2002) predicted how changes in resource density due, for example, to degradation affect how far villagers go into a forest to collect NTFPs and how intensively they harvest, assuming that they have some fixed requirement for a particular resource. Robinson et al. (2005) developed a framework for considering how exclusion from a particular area of forest affects both villagers and forest resources. Two effects are identified, a "displacement" effect, in which the villager extracts more intensively elsewhere, thereby displacing the problems of degradation to other

forest areas; and a "replacement effect," in which villagers purchase more of the resource from the market (or sell less to the market), thereby possibly increasing pressure on a more distant forest which supplies the market. Villagers may also reduce the total amount that they extract or sell. That is, villagers may displace, replace, or reduce their NTFP extraction in response to access changes. A fourth possibility, not addressed in either paper but evident in practice, is that villagers start to cultivate the resources on their own or other village land. The establishment of village woodlots is one such example.

The literature almost completely ignores the decision rules that villagers actually follow, concerning which part of the forest they collect from and how much they collect in one trip. In part this is because most of the papers are not explicitly spatial. There are exceptions. Robinson et al. (2002) took into account the distance that people go into the forest and the time spent collecting. But, this paper assumed that villagers have a fixed consumption requirement for NTFPs that can be fulfilled through NTFPs collected from the forest or purchased from a nearby market. Albers (1998) explicitly included distance, but this paper assumes that villagers make a marginal decision over how far they will go into the forest to collect NTFPs. The assumptions made in these papers are not backed up with quantitative empirical evidence.

2. Methods

We undertook our fieldwork in villages located near the Nguru South Mountains in Tanzania, one of the largest and richest intact rainforest areas of the Eastern Arc and a biodiversity "hotspot," rich in species of restricted distribution and of high hydrological and biodiversity value (Mwihomeke 2000). The extraction of NTFPs has been identified as one of the key threats to the biological viability of the nearby government reserve forests. Many of these forests, because of their important contribution to biodiversity and ecosystem provisioning, have been designated "protection" rather than "production" forests, implying that no forest resources can be collected legally. Yet, NTFP collection in this region is also recognized to be an important livelihood activity (Monela and Solberg 1998). In our fieldwork, we chose villages for their varying proximity to the reserve forest where degradation has been considerable and where future access changes are likely to have a large impact on local villagers because of their current, considerable dependence on forest resources in, and extracted (illegally) from, the government reserve forest. The villages have been involved in ongoing discussions about the introduction of JFM, which implies that limited (if any) extraction activities would be allowed in the government forests, particularly in the early years while the forest regenerates.

Our 170-household survey, undertaken in six villages at varying distances from the protection forest, provides detailed data on the quantities of NTFPs that villagers collect, the distance they travel to find the resources, and the time spent collecting once they identify an area of resource, in addition to relevant socio-economic data about the individual households. In addition, we selected two villages, where we undertook village-level participatory mapping with focus groups of 10–15 villagers, including village elders, members of the village committee, and a balance of men and women, to understand better their collection decision rules for different forest resources. We also undertook detailed semi-structured interviews with 24 households to determine how the villagers, as a group, perceived access to forest resources had changed over the past decades as a result of changes in rules, enforcement, and degradation.

To increase the likelihood of gaining the villagers' trust and thereby obtain truthful answers, we worked with a PEMA (Participatory Environmental Management Program), a local non-governmental organization, which has been working in the villages we surveyed for a number of years; and with research assistants from the local university. We relied on the villagers' recall to determine changes, rather than asking them to record what they collected over time. Naturally, relying on recall can be problematic, as villagers may not accurately remember details about their extraction activities. However, asking villagers to record and specify illegal activities over a period of time is unlikely to result in truthful responses. Indeed, even though there is currently almost no enforcement of the no-extraction regulations in the government reserve forest, collecting from this forest is *de jure* illegal, and villagers typically were not comfortable discussing explicitly from which forested area they collect NTFPs.

3. Findings

The findings in this section bring together our analysis of the data we collected using three different approaches: village-level focus group discussions, semi-structured interviews, and individual household interviews.

3.1 Historical Perspective

Focus group discussions at the village level revealed that villagers felt that access to forest resources in Tanzania had changed considerably by the end of the colonial period. Access restrictions in government forests that had been strongly enforced during this period remained in effect on paper, but sufficient funds were no longer available to protect these forests, and so they became *de facto* open access. In some areas, villagers could obtain all the resources that they needed from the surrounding village forest without going into these reserve forests. As a result,

the villagers and the government forests initially were relatively unaffected by the changes, despite less enforcement. However, over time, increasing population growth and unsustainable use of the village forest led to significant degradation close to the villages and increasing reliance on the more distant and, at that point, relatively pristine government reserve forests. As more people migrated to the area in the 1970s, villagers had to go further to find materials to build their homes and resources to supplement their consumption and income. The village focus groups also perceived an increased dependence on the forest during the 1990s because, as they said, they had fewer non-forest income-generating opportunities. The increased pressure on all forested areas around the villages has resulted in significant degradation of many of the village and government forests.

Following the 1998 National Forest Policy and the Forest Act of 2002, PFM is being introduced to manage Tanzania's forests, allowing—under specific conditions—local communities to benefit legally from nearby forests, but at the same time re-imposing more restrictive extraction rules in forests that are particularly important for ecosystem provisioning and biodiversity protection (MNRT 1998, 2002a, 2002b; Kajembe and Nzunda 2002). Two broad approaches to PFM are being introduced. Under community-based forest management (CBFM), villagers can declare and gazette forest areas on village land as "Village Land Forest Reserves." The villagers take full management responsibility, setting and enforcing rules and regulations over the forest management and use, including the collection of NTFPs. The second approach, joint forest management (JFM), applies to the management of national or local authority forest reserves, where villagers enter into management agreements with the district council or forest division. Under JFM, villagers may be given rights to collect forest resources, such as timber and firewood, within forests designated for production, but not those designated as protection reserves—such as those around the study site where JFM is being introduced (Ramadhani, as reported in Mertz 2005; Lovett 2003; FBD 2006).

3.2 Key Non-Timber Forest Products Collected by Villagers

As is commonly found in surveys of forest product extraction, the villagers that we interviewed collect a broad range of NTFPs from the nearby forests. However, a relatively small number of resources are particularly important to most of the villagers, namely fuelwood for cooking; timber, poles, and ropes for house construction; and vegetables, fruits, and mushrooms to supplement households' diets. It is these products that are the focus of this paper. Other resources are collected by a smaller number of villagers, such as charcoal (although not strictly an NTFP, charcoal is produced from forest resources and so we include it in the survey), honey,

and medicinal plants.[1] The key forest resources mentioned by the focus groups as important for local livelihoods are listed in Table 1. From Table 2, we can see that firewood is collected by almost all households, and that forest vegetables and fruits are collected once or more per week by almost two-thirds of those surveyed.

Table 1. Key Forest Resources Discussed by Villagers

Resource	Who typically collects resource	Comments	Frequency of collection
Firewood	Women (men may be involved)	Primarily for home consumption; village and government reserve forest contribute to household needs, but collection times have increased.	Essential for most households; relatively constant household demand over the year; typically collected once or twice per week
Vegetables and fruits	Women (children help)	Consumed and sold in village or local markets; collected from village and government reserve forest.	Not considered essential; collected regularly by some households
Mushrooms	Women	Mainly gathered for home consumption, sometimes sold. Collected from village and government reserve forest.	Seasonal, does not store well
Weaving materials	Men and women	Typically collected for occasional home use or sale; increasingly hard to find. Now only available from deep inside the government reserve forest.	For home consumption, collected once or twice per year; for sale, typically collected once per month
Poles, ropes, and timber	Men	Used for home construction, furniture, and occasional sale, but much more difficult to find now, especially ropes. Collected mainly from the government reserve forest.	Occasional, as needed, for home construction and raw material for small businesses, such as furniture making
Charcoal	Men	Produced for sale in nearby market; highly destructive practice occurs in government reserve forest.	Income-generating activity; regular production in the forest by a small sub-group of villagers
“Udaha” (black pepper)	Men	Indigenous plant that is difficult to find now, only deep inside the government reserve forest.	Rarely collected because of its scarcity; used in home cooking

[1] This paper deals with NTFPs and not with particularly destructive forest activities, such as logging and the increasingly common cultivation of cardamom under the forest canopy.

Resource	Who typically collects resource	Comments	Frequency of collection
Honey	Men	Typically sold in the local market or informally in the village, and is a tradi-tional product for some villages. Collected from govern-ment reserve forest.	Income-generating activity for some households who collect on a regular basis
Medicine	Men and women	Traditionally collected by specialist healers; increasingly scarce in all forests.	Collected as needed
Bushmeat	Men	Used to be collected, but no longer available at any feasible distance from the village.	No longer collected because unavailable

Source: Authors' village-level focus group discussions, 2006

Table 2. Percentage of Households That Collected Each Resource

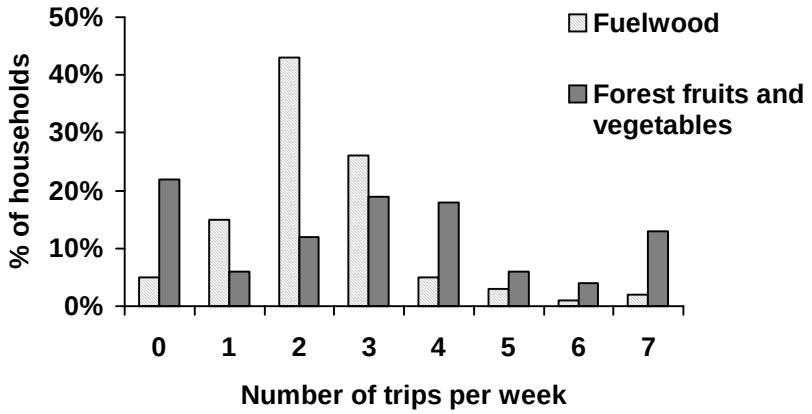
Resources obtained from the forest	% of households which *collected* resource in the past week or month		% of households which *purchased* resource in the past week
	Week	***Month***	
Firewood	95%	96%	10%
Vegetables and fruits	62%	68%	14%
Mushrooms	2%	16%	2%
Weaving materials	3%	5%	4%
Building materials	15%	22%	1%
Charcoal	1%	2%	13%
"Udaha" (black pepper)	1%	4%	0%
Honey	1%	4%	2%
Medicine	11%	16%	2%
Bushmeat	0%	0%	0%

Source: Authors' household survey, 2006.

Figure 1 provides more detail on the number of trips made per week for these key resources. Forest medicinal plants are collected on a weekly basis by the 10 percent of households who specialize in this resource, and occasionally by other households. Building materials are collected regularly by about one-sixth of households. Other forest resources are collected less frequently or seasonally, as with mushrooms. Few households that we interviewed

purchase forest products. This is not surprising because all of the villages in our sample are located relatively close to the forest and are relatively distant from labor and product markets. Forest resources most likely to be purchased are charcoal (albeit a processed forest product), which is only produced by a very small proportion of specialized households; fuelwood, often to supplement collected fuelwood; and fruits and vegetables. Charcoal is purchased from the roadside or the market, whereas forest fruits and vegetables are typically bought from individual households who have collected a surplus. Those who purchase fuelwood tend to have their own businesses, such as a shop where both the men and women of the household work or which uses fuelwood as an input.

Figure 1. Number of Trips per Week Made by Households to Collect Fuelwood and Forest Fruits and Vegetables

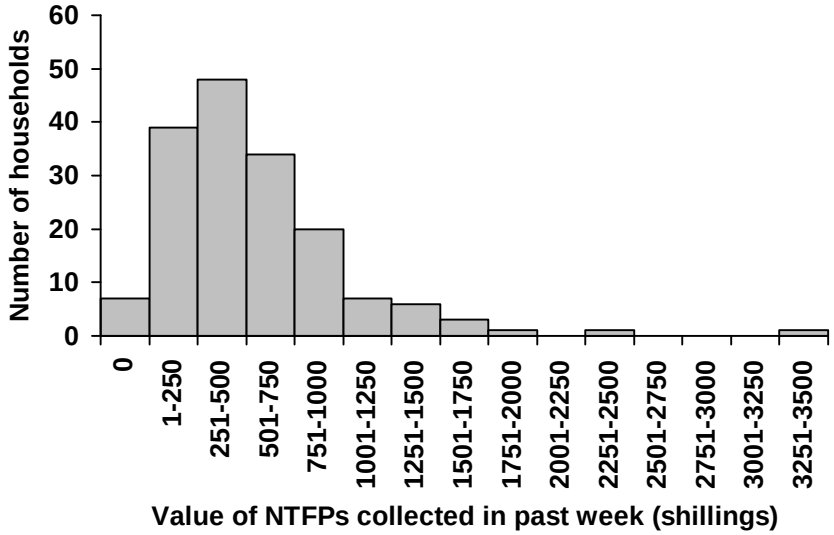


Source: Authors' household survey, 2006.

We found the average value of NTFPs collected by villagers in the week before our interviews to be TZS 580 (Tanzanian shillings), equivalent to TZS 30,200 per year or just under US$ 30.[2] (See Figure 2 for the distribution of the value of NTFPs collected in the week before our survey.)

[2] Rate of exchange in 2006.

Figure 2. Total Value of NTFPs Collected per Household in the Week before the Interview (in 2006 Tanzanian shillings)



Source: Authors' household survey, 2006.

Although this may seem a small number in absolute terms, gross domestic product per capita in Tanzania was only US$ 335 (UN Statistics Division) and, in the households that we surveyed, annual wealth (proxied by households' estimates of non-farm income plus the value of agricultural output) was an average of TZS 235,000, or a little over $200.[3] That is, NTFP value accounted for an average of 12 percent of household annual wealth in our surveyed villages. When we considered the importance of NTFPs for each household as a function of the total value of each household's overall wealth, we found that those with intermediate levels of wealth had the greatest dependence on forest resources in absolute terms, with the better off and the poorer having less dependence (Figure 3a). But, as a percentage of wealth, NTFPs are most important for the poorest households (Figure 3b).

[3] Ibid.

Contribution of NTFPs to Livelihoods as a Function of Annual Wealth

Figure 3a.

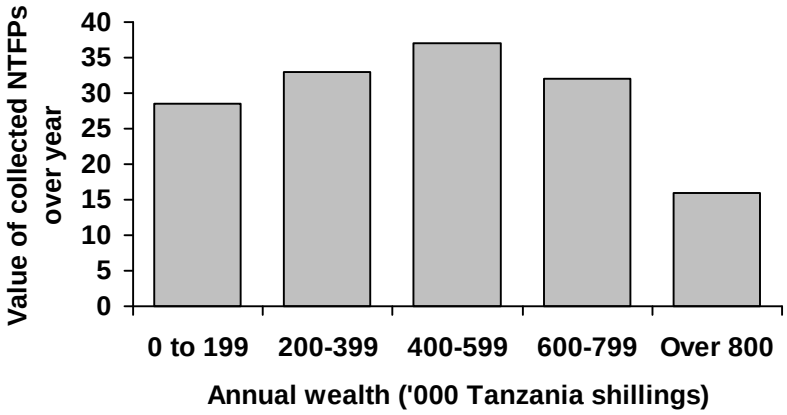
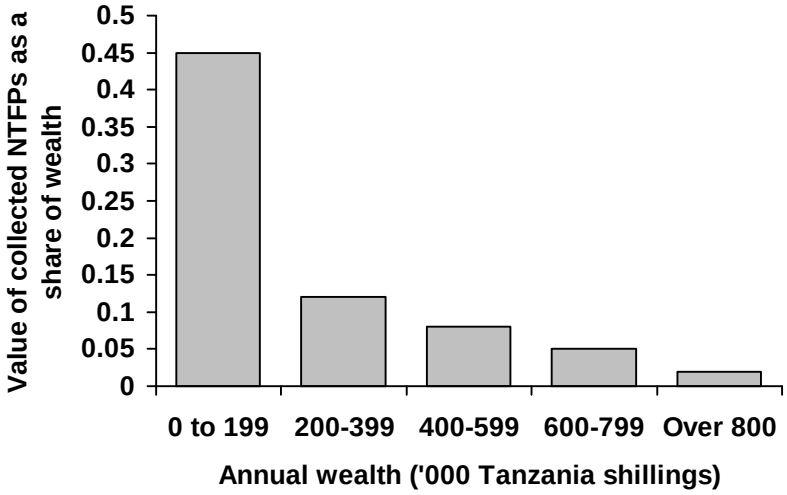


Figure 3b.



Source: Authors' household survey, 2006.

3.3 Decision Rules and Changes in Extraction as a Response to Changing Access

Villagers have responded to changes in availability of nearby forest resources in different ways, depending on the particular resource, its importance for their livelihoods, access to cash, and presence of local markets that trade in the resource or a close substitute. Over the long term, the response has been a change in volume, in the specific resources collected, and in where they

are collected, as certain resources are no longer accessible and as villagers identify new market opportunities. For example, wild animals (bushmeat) are no longer hunted for food in the surveyed villages because they are no longer found near enough to the village for hunting them to be worthwhile. “Udaha,” an indigenous black pepper, is increasingly scarce and hard to reach from many villages, so it is now rarely collected. Rope material and poles, although available, are increasingly difficult to find; villagers continue to search for them, going further and further distances to find rope materials because these resources are essential to house building. Weaving materials and charcoal have increased in importance since the 1980s as key income generating activities as a result of new markets being identified. But, we found that weaving materials are now only available quite far from the villages and hence are only collected by a small number of households.

Our fieldwork identified two distinct time costs that villagers take into account when collecting forest resources: the travel time to a particular area of forest and the harvest time, both of which are influenced by the resource density throughout the forest. The average travel and harvest times for different resources are shown in Table 3. To collect these data, we asked respondents to think about the last time that they collected a particular resource. We asked them how long it took them to walk to where the resource was and how long it took to collect it.

Table 3. Travel and Collecting Times for Different NTFPs

	Time taken to reach (minutes)		Time taken to collect (minutes)		N
	Mean	***Standard deviation***	***Mean***	***Standard deviation***	
Fuelwood	33	30	33	25	165
Forest vegetables	30	28	26	17	141
Forest fruits	47	33	27	20	12
Mushrooms	47	29	25	17	53
Weaving materials	101	92	143	194	8
Building materials	44	34	86	67	62
Forest medicine	44	43	51	59	30
“Udaha” (black pepper)	25	17	14	4	8

Source: Authors’ household survey, 2006

Taking into account these two distinct time costs and villagers' decision rules over how much to collect before returning home, rather than simply considering the overall time spent collecting NTFPs, is important when villagers' responses to access changes are considered explicitly. With increasing scarcity of NTFPs near a village, due to degradation, villagers can choose whether to search more intensively closer to home, where the resource is already degraded, which increases the harvest time; to search more extensively further from home, thereby increasing the travel time; to reduce the amount they collect; or to plant their own.[4] The weight of the resource being collected, in part, determines whether extraction occurs closer to home, despite the increased degradation and greater search time (particularly heavy resources, such as fuelwood and timber) or whether villagers venture further where the resource is less degraded. In this case, the search time is lower, but the travel time is greater (seen especially with lighter resources, such as weaving materials). Villagers are likely to simply cut down on what they might consider non essentials (forest fruits, vegetables, and mushrooms).

Villagers' decisions about collecting fuelwood are relatively simple: villagers collect a head load (as much as they can carry), then return home, and collect again once they have used up their supply. The data show that villagers still have relatively good access to fuelwood by both the time it takes to reach an area with fuelwood (on average, thirty minutes each way), and the time it takes to collect the fuelwood (an additional thirty minutes). Given that on average villagers collect fuelwood twice per week, the total time collecting fuelwood is about three hours per week.

In more detailed interviews, we explored typical responses of villagers to the increasing scarcity of fuelwood. Although purchasable substitutes are available, such as kerosene and charcoal, low levels of cash and income-generating activities in general, the prevalence of women collecting fuelwood, and fuelwood's continued—if more scarce—availability have resulted in very few households switching to the market for even some of their requirements. Notable exceptions within our sample were the best-off villagers, including store owners with income-earning activities that take up much of their time. Villagers told us that they have not noticeably reduced the amount of fuelwood that they collect and use, suggesting a highly

[4] Villagers may also have the option of growing their own replacements for the forest products that they collect. We did not see much of this where we did our fieldwork. But, other research suggests that "replacement" of forest resources does occur; it is most often tree planting to provide fuelwood, fruits, and building materials, such as timber, poles, and timber.

inelastic demand, little substitution, and sufficient availability within the forests.[5] That is, for fuelwood, the displacement effect into other areas is large, the replacement effect low, and there is little reduction in extraction or use. Some women reported that if they have to go farther into the forest, they cannot carry as large a bundle because of the increased distance they must carry the heavy weight. So, the increasing scarcity of fuelwood results in more trips with smaller loads, but they still collect about the same amount in total. Both travel time and search time increase in response to increasing scarcity.

By contrast, the households we interviewed in detail perceived no particular requirement for vegetables, fruits, and mushrooms, which are often identified while the villagers are collecting fuelwood. The typical quantity of forest fruits, vegetables, and mushrooms collected is a small bucket's worth—much less than the household can carry in one trip—reflecting that villagers' collection decisions are driven primarily by how much they can consume, the perishability of these products, and the thin and informal markets. Villagers might sell a surplus to another villager, but they rarely take these products to the formal market. They also told us that they tend to identify locations of fruits, vegetables, and mushrooms when they are collecting fuelwood, so not surprisingly the time needed to reach them is similar to the time to reach fuelwood. Villagers appear to have a relatively elastic demand for these forest resources and increasing scarcity results in a relatively small displacement effect and little replacement. Although the impact of reduced access is likely to be less severe on the forest, the impact on villagers' health and nutrition status is likely to be significant, as cash-poor households do not often substitute forest fruits and vegetables from the market.

The distance and time to reach particular forest resources impose a natural limit on how much the villagers extract at any one time and possibly over all (Albers 1998; Robinson et al. 2008). Consider the example of weaving materials, which are the most distant resources collected and are mainly sold, although some is used to make mats for the home. Unsustainable extraction near the village means that villagers walk ever greater distances into the forest; the materials are found high in the hills of the reserve forest, requiring a steep walk that often takes many hours. On average, villagers took over 100 minutes (> 1.5 hours) to reach the resource and, once there, they spent on average almost 150 minutes (~ 2.5 hours) collecting. The quantity that

[5] By contrast, Sarin (1995) found that when the volume of fuelwood used decreased, villagers switched to alternatives.

villagers collect is constrained by the distance (and therefore time) and effort required to reach the resource.

Previously, when weaving materials could be found closer to the village, villagers collected as much as they could carry, made relatively frequent trips, and sold more to the market. Now, the decision rule for many villagers is to collect as much as possible in one day, taking into account the considerable travel time. The greater travel time reduces the harvest time, and thus harvested amount, so villagers go home with less than they previously could carry. The travel time to collect weaving materials has increased dramatically over the past 5 to 10 years and the harvest time has been reduced, suggesting an overall time constraint—the number of daylight hours. Villagers have reduced the amount that they collect, both per trip and overall, and may well have reached a natural maximum distance they can go to find the resource. The women in particular noted that, because it was such tiring work, they preferred to collect only once or twice per month at the most. Villagers appear to have "mined" the resource systematically and possibly irreversibly, starting close to home and gradually displacing their extraction deeper into the forest.

Although building materials, such as poles, are also increasingly scarce, and although villagers are going deeper into the forest to find them, villagers typically choose to search more intensively closer to home, rather than go further into the forest where poles may be more easily found, but are more difficult to get back to the village because of their weight. This is reflected in the 45 minutes to reach building materials, and the nearly 90 minutes of collection time. Compared to 5 to 10 years ago, villagers told us that they are much less likely to sell poles, given how much harder it is to find them than in the past. Now they typically collect poles only when required to build or repair their own homes. The displacement effect has therefore resulted in more degradation closer to the village, but less degradation farther away, compared to the reduced amount of weaving materials collected and marketed.

4. Concluding Comments and Implications for the Introduction of Participatory Forest Management

This paper has analyzed the time villagers spend collecting key NTFPs and how degradation has changed their collection behavior. Degradation has changed the relative time spent collecting and the quantities collected of different forest products. The recent introduction of participatory forest management, both JFM and CBFM, represents a new access restriction for villagers and is likely to result in more changes to where villagers can collect NTFPs.

One of the chief objectives of PFM is to improve both the condition of forests, in terms of ecosystem services (including biodiversity protection), and the livelihoods of local villagers. Yet, as the literature from South Asia demonstrates, villagers may well be negatively affected. Kumar (2002) found that the poor living near JFM forests in Jharkand, India, have been net losers over a 40-year time horizon. Where we undertook our fieldwork in Tanzania, one likely consequence of the introduction of JFM was that access to the government protection reserve forests would be prohibited (although in practice, this prohibition may not be fully enforced). And even in CBFM forests, moratoria over all extraction for at least five years are being introduced while resources regenerate. Although alternative income-generating activities for villagers are supposed to be introduced in parallel (and indeed, in some villages where degradation is extreme, NGOs have encouraged woodlot planting), it is highly likely that, at least initially, PFM will have a negative impact on villagers' livelihoods, particularly those currently most dependent on the forest, as well as on less-protected forests where villagers displace their resource collection (Robinson et al. 2005).

For resources that have a highly inelastic demand and few substitutes, the displacement effect is likely to be large. For example, fuelwood will almost certainly continue to be extracted in similar volumes, either more intensively elsewhere or illegally within particular areas of the JFM forest. It is possible that villagers' current, relatively extensive extraction of fuelwood throughout the village and government reserve forests could, in fact, be less ecologically harmful than if these activities were forced into a smaller area without sufficient regulation. This could lead to what might be considered "excessive" degradation of forest areas outside the protection reserve and have a negative effect on both villagers and forest resources (Lewis 2002; Robinson et al. 2005). Therefore, it is particularly important that significant efforts be made to introduce tree planting and technologies that use fuelwood more efficiently, ideally before PFM is introduced.

The displacement effect for resources, such as forest vegetables and fruits (for which demand is more elastic), is likely to be smaller, and therefore the impact on other forested areas will be smaller. Less-poor villagers with available cash will be able to supplement from the market, purchasing fruits and vegetables either collected from more distant forests or farm-produced. (The former implies a displacement effect into more distant forests by those who supply the market.) Poorer villagers are likely to reduce their overall consumption, which has little negative environmental impact, but possibly a significant impact on their health and nutritional status. The cultivation of NTFP substitutes and the gradual domestication of NTFP species by local people, although not addressed in this paper, is another important approach that

is already occurring, although this is a long-term strategy (Kessy 1998; Munyanziza and Wiersum 1999). Because the source of weaving materials is now so deep inside the government reserve forests, PFM, if enforced effectively, is likely to stop their collection altogether. Building materials are already scarce and it is likely that—because they are essential for local home building and costly to purchase from the market—villagers will continue to collect them, either illegally from the PFM forest or from other areas.

Our findings suggest that indiscriminate prohibition of resource extraction from government forests, following the introduction of PFM, may not be the best approach. Rather, discriminate regulation that permits limited collection of fuelwood and forest fruits, vegetables, and mushrooms may have a small ecological cost in the particular PFM forest, but offer significant gains in terms of protecting other forests from excessive degradation, providing essential micro-nutrients for poor households, and avoiding the very negative impact of blanket access restrictions on poorer villagers. Yet, policies that permit specific resources to be collected are tricky to implement. Villagers must be free to enter what would otherwise be designated a protected exclusion area of the forest, and so can only be penalized if in possession of an illegal resource, rather than simply being in the wrong place (Robinson 2008). And, given that villagers often identify other resources while collecting, the temptation may be to collect any valuable resources that are found in a particular area, and perhaps hide what is extracted illegally. Almost certainly, the extraction of specific resources must be limited, whether through the use of buffer zones, allowances for seasonal extraction, simple quantity, or home-use only restrictions. In general, the more differentiated the resource management policy is, the greater the enforcement and monitoring costs, but the greater the potential benefits for both forests and livelihoods.

Finally, this paper has used villagers' historical experiences about the impact of degradation to explore the possible impact and implications of exclusion from JFM forests on patterns of NTFP extraction and, hence, villager welfare and forest resources. More research on the actual impact of JFM is needed. The welfare and ecological changes due to JFM can only be determined if base-line data are collected—*before* JFM is introduced—that detail not only the value of collected resources to local villagers but also where these resources are collected from and the time costs involved. These data can then be compared with extraction activities *after* JFM is introduced. By understanding the differential displacement, replacement, and welfare effects on villagers and resources, institutions designed to protect the forests are more likely to be effective and less likely to harm the nearby communities.

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