Journal of Environmental Economics and Management 61 (2011) 95–106

Contents lists available at ScienceDirect

Journal of Environmental Economics and Management

journal homepage: www.elsevier.com/locate/jeem

Shifting cultivation, forest fallow, and externalities in ecosystem services: Evidence from the Eastern Amazon

Heather Klemick*

National Center for Environmental Economics, US Environmental Protection Agency, 1200 Pennsylvania Avenue, NW (1809T), Washington, DC 20460, USA

ARTICLE INFO

Article history:
Received 2 June 2008
Available online 19 August 2010

Keywords:
Forest
Farms
Fallow
Ecosystem services
Land use
Spatial econometrics
Externalities
Brazil

ABSTRACT

This study examines the value of fallow ecosystem services in shifting cultivation, including hydrological externalities that may affect other farms. Using farm-level survey data from the Brazilian Amazon, I estimate a production function to assess the value of forest fallow and test whether it provides local externalities to agricultural production. Soil quality controls, instrumental variables, and spatial econometric approaches help address endogeneity issues. I use GIS data on external forest cover at the farm level and model the hydrological externality as an upstream-to-downstream process. The estimated parameters indicate that fallow contributes significantly to productivity both on farm and downstream. In addition, most farms allocate sufficient land to fallow, accounting for both the value of hydrological spillovers and the opportunity cost of land left out of cultivation. These results suggest that farming communities may have some self-interest in preserving forest cover locally—a finding that may bolster policy efforts aimed at conserving tropical forests for their global public goods.

Published by Elsevier Inc.

1. Introduction

With tropical deforestation a major contributor to greenhouse gas emissions and biodiversity loss, the land-use decisions of small-scale farmers at the forest margins have important implications for the global environment. Proposals such as Payments for Ecosystem Services [1] and Reduced Emissions from Deforestation and Forest Degradation, or REDD [2], focus on compensating local communities to preserve virgin forests and their associated ecosystem services.

Under a shifting cultivation or slash-and-burn farming system, long fallow periods can allow secondary forest to regenerate, providing similar levels of carbon sequestration and other ecological functions as virgin forests [3]. Farmers' incentives for maintaining forest fallow depend on the market and non-market services it provides to them. Farmers who maintain large amounts of forest fallow as an agricultural input do so not because of the global climate benefits, but because fallow improves agricultural productivity at low cost. Where land is abundant and other inputs are scarce, long fallow periods can be a cost-effective way to restore land for future use, providing on-site benefits such as soil regeneration, erosion prevention, weed control, and harvestable products. Fallow may also provide local off-site services, such as hydrological regulation that moderates the flow of water in the soil.

Understanding how farmers in key eco-regions value and manage forests in agricultural systems can help in predicting future trends in tropical deforestation and designing policies to protect global public goods provided by forests. Improved information about the magnitude of secondary forests' contribution to agricultural productivity will be increasingly important as population and economic pressures spur many of the estimated 300 million [4] shifting cultivators

* Fax: +1 202 566 2338.
E-mail address: klemick.heather@epamail.epa.gov

0095-0696/$ - see front matter Published by Elsevier Inc.
doi:10.1016/j.jeem.2010.07.003

world-wide to shorten fallow periods, adopt new technologies, and intensify cultivation. But economic studies accurately estimating the value of forest ecosystem services are sparse. Valuing the net benefits of forest cover to local populations could help justify conservation efforts with global importance [5]. The Millennium Ecosystem Assessment [6] has identified lack of information about the value of non-market ecosystem services—particularly regulating services such as hydrological functions—as a major knowledge gap hampering informed decision-making on ecosystem management.

This paper takes up this challenge by estimating the value of fallow ecosystem services in shifting cultivation in one region of the Brazilian Amazon. The analysis uses cross-sectional farm survey data from the Bragantina region of the Eastern Amazon to assess the value of forest fallow to farmers and test whether it provides economically significant local externalities that may justify forest conservation from a local perspective. I estimate a production function to determine the contributions of on-farm and off-farm forest fallow to agricultural income. Soil quality controls, instrumental variables, and spatial econometric approaches help address issues of endogeneity and variation in unobservable factors over space. I use geographic information on the location of farms to obtain data on external forest fallow and to model the hydrological externality as an upstream-to-downstream process.

A related contribution of this study is the separation of on-farm soil quality benefits and local hydrological spillovers, which is made possible by private land tenure in the study region. In many contexts world-wide, fallow is a common property resource prone to overexploitation in the absence of community controls [7–9]. The few previous studies estimating the value of fallow in agricultural production have focused on open access systems, making it more difficult to disentangle on-farm and off-site effects.

Estimation of these separate effects also allows me to investigate whether farmers manage fallow efficiently to maximize agricultural income, accounting for the opportunity costs of leaving land out of production. I test empirically whether farmers in the study region manage fallow efficiently from either a household or a community-level perspective. If fallow ecosystem services are limited to improving on-site productivity, then a private land ownership regime could foster improved outcomes compared with common property management. However, if local externalities are economically significant, then inefficiencies could arise even under private land tenure. Correcting these inefficiencies could boost downstream farm income while providing incidental carbon sequestration. Thus, whether fallow biomass provides externalities is an empirical question with important implications for tropical forest policy.

2. Fallow as a production input in shifting cultivation

Fallow refers to land that is idled as part of a shifting cultivation system after being planted with annual or short-term perennial crops, accumulating nutrient-rich biomass that can serve as fertilizer when the land is brought back to cultivation. Some authors distinguish among different categories of fallow based on age and biomass density, with forest fallow representing more mature regrowth than grass fallow or bush fallow [10]. In some areas of the humid tropics, tree cover rapidly regenerates on fallow land, leading to considerable secondary forest cover if fallow periods are sufficiently long. Fallowing restores plots for future cultivation by drawing soil nutrients and water to the surface, raising soil pH, minimizing surface erosion, and suppressing weeds [10–15]. In addition to these ecosystem services, forest fallow also serves as a source of harvestable forest products such as firewood.

Agroecological studies also suggest that forest fallow provides beneficial spillovers that can enhance agricultural productivity on nearby farms, particularly through the hydrological cycle. Tree cover lessens peak flows and surface runoff due to increased infiltration and evapotranspiration of soil water [16,17]. Recent studies examining the impact of afforestation in Latin American tropical grassland ecosystems found that tree cover caused statistically significant reductions in soil water flow, which became more pronounced with the age of the forest stand [18,19]. Reduced baseflow can be detrimental in dry regions but advantageous in wet areas by lessening floods, waterlogging, and leaching, which may benefit agricultural activities downstream. Larger changes in baseflow typically occur in areas with flatter slopes and less-rocky soils because water is less likely to escape the soil [18]. Improved infiltration may also lead to higher dry season baseflow in some cases [17]. Forest stands can enhance nearby farms' productivity through crop pollination [20,21] and tree seed availability [25].

Few studies have estimated the value of fallow biomass and forest cover in agricultural production, and none have separately estimated the value of on- and off-farm services in the same agroecosystem. López [7,8] showed that village-level fallow biomass (capturing both on-farm soil quality and external hydrological benefits) contributed significantly to agricultural profitability in Ghana and Côte d'Ivoire. Goldstein and Udry [9] also showed the importance of fallow for on-farm soil quality restoration in Ghana but did not address off-site benefits. Research in Ruteng National Park, Indonesia, found that sub-watershed-level off-farm forest cover provided beneficial hydrological services (in this case, drought mitigation) to small-scale agricultural production [22,23]. This study adds to the literature by isolating the value of fallow externalities from on-farm services at the household level in the Brazilian Amazon, an eco-region with global importance due to its vast biodiversity and carbon stocks.

3. Study region and data

The Bragantina region offers a compelling case study as a region with over a century of agricultural settlement, where shifting cultivation persists as the principal means of livelihood. Despite integration into regional markets through

Download English Version:

https://daneshyari.com/en/article/959269

Download Persian Version:

https://daneshyari.com/article/959269

Daneshyari.com