World Development 101 (2018) 133–141

Contents lists available at ScienceDirect

World Development

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

Does Collective Action Sequester Carbon? Evidence from the Nepal Community Forestry Program

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ARTICLE INFO

Article history:
Accepted 29 July 2017
Available online 27 September 2017

Key words:
South Asia
Nepal
collective action
community forestry
carbon sequestration

SUMMARY

This paper uses 620 forest plot measurements taken from a nationally representative sample of 130 Nepal community forests combined with information on forest collective action to estimate the effects of collective action on carbon per hectare and three additional measures of forest quality. We use three measures of forest user group collective action, including membership in the Nepal Community Forestry Programme (CFP). Collective action shows large, positive, and statistically significant carbon effects vis-à-vis communities exhibiting no evidence of forest collective action, which do not necessarily correspond with results for other measures of forest quality. We find that depending on the collective action definition and physiographic region, forests controlled by communities exhibiting no evidence of forest collective action may have as little as 34% of the carbon of forests governed under collective action. We do not, however, find evidence that CFP forests, our narrowest measure of collective action, store more carbon than forests outside the CFP. Our results therefore suggest that it is the collective action behavior and not the official CFP label that offers the largest gains. Carbon benefits from collective action are therefore not found to be conditional on CFP participation.

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1. Importance of the issues and introduction

Lower income countries emit little of the carbon pollution that causes climate change. They are, however, responsible for the majority of net deforestation and forest degradation, which are also important sources of carbon emissions. Net deforestation and forest degradation account for between 12% and 20% of annual greenhouse gas (GHG) emissions, which is more than all transport combined (IPCC, 2007; Saatchi *et al.*, 2011), and net carbon emissions from tropical land use change are estimated to be 2.4 ± 0.4 Gt per year (Pan *et al.*, 2011). Total carbon stored in forests is 638 gigatons (UNFCCC, 2011) to 861 gigatons (Pan *et al.*, 2011), with over half above ground.

The United Nations Framework Convention on Climate Change (UNFCCC) Initiative on Reducing Emissions from Deforestation and Degradation (REDD+) is a program by which UNFCCC Annex 1 countries provide support to non-Annex 1 countries, such as Nepal, in exchange for measurable additional carbon sequestration. An important question is how to incorporate the approximately 25% of developing country forests that are managed by communities (World Bank, 2009) into REDD+. These community forests may contain significant carbon that could be protected under REDD+ and the collective action (CA) they are engaging in may even now be sequestering carbon.

Such carbon sequestration is costly, because community forests in low-income developing countries provide products that are essential to the daily lives of billions of people, including fuelwood, forest fruits and vegetables, building materials, and animal fodder (Cooke, Köhlin, & Hyde, 2008). More effective CA is believed to lead to better management of these ecosystem services (Yadav, Dev, Springate-Baginski, & Soussan, 2003), but it may also yield more carbon sequestration, because reduced pressures allow forests to regenerate.

https://doi.org/10.1016/j.worlddev.2017.07.030
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The Nepal Community Forestry Program (CFP) is one of the most important examples of forest CA in a low-income country and the most important forest devolution program in Nepal. It has almost 19,000 registered forest user groups representing over 35% of the population and as of 2015 in hill districts over 78% of households were community forest user group (CFUG) members.[1] For example, in the hill district of Salyan (population approximately 250,000) in 2014 there were 558 CFUGs[2] The existence of the CFP therefore makes Nepal an ideal setting for testing the hypothesis that forest CA sequesters carbon.

Building on preliminary analysis in Bluffstone *et al.* (2015), we test whether being part of the CFP has an effect on carbon. We utilize a nationally representative random sample of CFP communities and forests. The CFP subsample (i.e., the treatment) is then matched with an equal number of observationally equivalent forests and communities that are not part of the program. Because CFP status is defined at the forest level and likely non-random, we select non-CFP forests (i.e., NCFs) and associated communities to be observationally equivalent to community forests (CFs).

A total of 620 forest sample plots in 130 forests are analyzed using random effects panel data and OLS regressions with errors clustered at the forest level. We also aggregate our plot-level data to the forest level and test our hypothesis using nearest neighbor propensity score matching. We find that many forests that are not part of the CFP exhibit CA that is similar to CFs. We therefore expand our definition of CA to include two additional CA measures and examine whether forest CA in those forests and communities lead to more carbon per hectare. More carbon is not necessarily consistent with and can indeed be inversely related to other possible measures of forest stand health, such as greater tree density per hectare, additional canopy cover, and regeneration (Coomes, Hodaway, Kobe, Lines, & Allen, 2012; Enquist, West, & Brown, 2009; Stephenson *et al.*, 2014). We therefore separately evaluate the effects of the CFP and two broader CA definitions on these potential quality measures.

In Section 2 we provide very brief discussions of the Nepal community forestry experience and literature at the intersection of carbon sequestration and CA. Section 3 presents our methods and data. Section 4 overviews results followed by conclusions, policy implications and areas for research.

2. Key literature on carbon sequestration and collective action

Forests play a critical role in climate change, because they are a source of greenhouse gas emissions and offer sequestration opportunities (Chaturvedi, Tiwari, & Ravindranath, 2008). Carbon sequestration in forests may also be particularly cost-effective climate investments (Kindermann *et al.*, 2008; Stern, 2007; Strassburg, Turner, Fisher, Schaeffer, & Lovett, 2009). These combined observations provide important justifications for REDD+.

An estimated 15.5% of global forest area is under the formal control of communities, providing key subsistence products and community control has increased over time (RRI, 2014). Using worldwide forest data and CA elements, Chhatre and Agrawal (2009) demonstrate there are both tradeoffs and synergies between carbon sequestration and community livelihoods. They suggest detailed studies to better understand the implications when forests are controlled by communities. In this vein, Beyene, Bluffstone, and Mekonnen (2016) evaluate the effect of local community forestry collective action on carbon sequestration in Ethiopia, but find minor effects. Yadav *et al.* (2003), Gautam, Webb, Shivakoti, and Zoebisch (2003) and others claim that CFs in Nepal can help reduce forest degradation, which could imply less carbon emissions that should be credited under REDD+. Karky and Skutsch (2010) estimates that the opportunity cost of such carbon sequestration may be less than $1.00 per ton.

Nepal introduced the CFP in the late 1980s, because centralized forest management appeared to be leading to serious deforestation and forest degradation (Carter & Gronow, 2005; Guthman, 1997; Hobley, 1996; Springate-Baginski & Blaikie, 2007). The introduction of the National Forestry Plan in 1976, Decentralization Act of 1982 and Master Plan for the Forestry Sector of 1989 were key policy steps leading to the present day CFP. The Master Plan was followed by the Forest Act of 1993, which provided a clear legal basis for CFs, enabling the government to "hand over" national forests to CFUGs. The handover rules were detailed in 1995 forest regulations and operational guidelines, which were revised in 2009 and in 2014. CFUGs are recognized as self-governing, autonomous, perpetual and corporate institutions that can acquire, possess, transfer, or otherwise manage property (HMGN/MoLJ, 1993: Article 43). They can sell and distribute forest products according to an operational plan approved by the government District Forest Officer (DFO).

The distinction between CF and NCF forests is a legal one and well-defined. Becoming a CF requires that communities document claims, organize into user groups, elect officers, commit to participatory governance and prepare operational plans, which must be approved by DFOs every 5 years. DFOs provide technical support and issue permits for timber harvests. The main driver of CF status is therefore local CA, with the state playing enabling and oversight roles.

The CFP includes about 19,000 CFUGs and over 2.4 million households managing 1.8 million hectares (DoF, 2017). Three-quarters of CFs are in the hills, 16% in the high mountains and only 9% are in the lowland *Terai* (MOFSC, 2013). Nepal's REDD+ activities are largely focused on the CFP (Oli & Shrestha, 2009) and it is therefore especially important to understand the linkages between CFs, CA, and carbon sequestration.

A variety of indicators are used to assess forest health and vitality, including tree and seedling density, crown cover and primary productivity measured as biomass and/or carbon stock, with higher levels indicating higher quality.[3] The relationships between these forest parameters have been extensively investigated and the main conclusion of this literature is that depending on individual tree and forest stand circumstances, these measures may not always be positively correlated. For example, higher carbon stocks may be associated with higher or lower levels of canopy cover, tree density, and seedling regeneration (Coomes *et al.*, 2012; Enquist *et al.*, 2009; Stephenson *et al.*, 2014; West, Enquist, & Brown, 2009). In assessing the effects of an outside force such as CFP participation on forests, these forest quality measures cannot be presumed to give similar results and are most appropriately evaluated independently.

Assessing biomass in forests over time is critical for calculating carbon increments and a range of remote sensing and ground-based methodologies are available to estimate baselines. One widely used and important metric is the Normalized Difference Vegetation Index (NDVI), which is a measure of vegetative cover based on remotely sensed data. The NDVI is directly related to

[1] National information available from the Ministry of Forest and Soil Conservation (MoFSC) Department of Forestry (DoF) Community Forestry Division website http://dof.gov.np/dof_community_forest_division/community_forestry_dof. Hill district information based on author calculations and data from the Community Forests Database (August 2015) available at http://dof.gov.np/image/data/Community_Forestry/Summary.pdf and the 2013 Nepal Statistical Yearbook (most recent available), which is available at http://cbs.gov.np/publications/statisticalyearbook_2013. All accessed August 16, 2016.

[2] See http://www.dfosalyan.gov.np/eng/images/pdf/database/database_of_cfugs.pdf for details.

[3] Carbon constitutes approximately 50% of forest biomass (Gibbs, Brown, Niles, & Foley, 2007) and this is also the IPCC (2006) default value.

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