Natural Capital and Poverty Reduction

A proposal to the AMA BASIS CRSP
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I Abstract

This project examines the role of environmental income in risk management, asset accumulation, and poverty reduction. Activities center on strengthening host-country capacity for policy analysis and deriving policy lessons regarding two topics: (i) the role of natural insurance among the rural poor, including the degree to which environmental income serves as a safety net; and (ii) the potential for poor rural households to use environmental income to accumulate physical and human capital, and move out of poverty. The project will extend and strengthen existing global research partnerships and focus specific attention on building policy-oriented research capacity in Malawi and Uganda through short-term and degree training. The work leverages prior investments in data collection of more than USD 1 million by CIFOR's Poverty and Environment Network (PEN). Country projects will be coordinated by a host-country scientist. Project oversight to ensure policy relevancy will be provided by an external advisory committee. In addition to examining the poverty-environment nexus in areas that are part of the Initiative to End Hunger in Africa, the proposed activities are designed to closely align with USAID pillars and mission strategic objectives related to poverty alleviation, income generation, and environmental protection.

II Project Narrative

Intellectual context

Throughout the developing world, common-pool resources such as forests, pastures, and water resources contribute in important ways to the well-being of rural populations. Field studies show income from resource extraction accounts for 17-45 per cent of total income for rural households in Bolivia, Honduras, India, Malawi, and Zimbabwe (Cavendish 2000; Fisher 2004; Godoy et al. 2002; Reddy and Chakravarty 1999). The importance of resource extraction is amplified in the presence of risk, and such risk is expected to intensify as future climate change precipitates more extreme weather events, especially in marginal agricultural areas (Sivakumar et al. 2005). These observations motivate several questions that we will examine using the CIFOR Poverty Environment Network (PEN) global data set (7,000+ households in 25+ countries) and household panel data from Malawi and Uganda: How important is the safety-net role of local natural resources for households experiencing idiosyncratic and covariate shocks? How does reliance on the commons for shock coping vary by household socioeconomic characteristics, market forces, and geographic factors? Does resource dependence merely represent an "employment of last resort," or can natural capital be leveraged to lift rural households out of poverty? To what degree are opportunities for resource-led poverty alleviation facilitated or constrained by greater degrees of market integration? These are all questions with high policy relevance in the developing world.

There are several reasons why the rural poor turn to local common-pool resources to manage risk or secure livelihoods. First, environmental enterprises tend to be easy to enter. Local natural resources are often held under *de jure* state or communal tenure but are essentially freely available to local populations, either due to government failure to enforce property rights or weakened traditional systems of resource-use regulation (Baland & Platteau 1996; Fortmann &

Bruce 1988; Blaikie & Brookfield 1987). Moreover, many types of natural resource extraction generally require little financial and physical capital either from the perspective of production or marketing (Neumann & Hirsch 2000). A second reason is that natural resources are diverse, providing a range of products and opportunities for income generation; these products are often available at times when other income sources are not, for example, during slack seasons or when crops fail (Byron & Arnold 1999; Pattanayak & Sills 2001). Third, other coping mechanisms may be less accessible: poor households, especially those headed by women, often possess few liquid assets. Finally, poor households face collateral-related constraints to borrowing in credit markets. To invest, the rural poor may turn to local natural resources, converting natural capital to financial, physical, and human capital. The accumulation of asset stocks, in turn, greatly influences the household's ability to move out of poverty, avoid it when misfortunes occur and catch-up to their more-prosperous neighbors over time (Carter & Barrett 2006). Prospects for natural resource-led poverty alleviation hinge largely on the presence of markets for products and conditions prevailing in those markets, which determine the returns to competing activities.

The proposed research will contribute to two bodies of knowledge. First, we will document the ways in which natural capital provides people with both direct and indirect means to deal with income variability and shocks. Second, we will examine household dependence on natural resources and how this reliance varies with levels of income or wealth, gender, and market conditions. A key concern is that resource reliance may ultimately represent a strategy that prevents the poor from participating fruitfully in other activities and escaping their poverty. Resource extraction generally offers relatively low returns to effort. Furthermore, dependence on natural resources can cause environmental degradation, biodiversity loss, and increased poverty (Duraiappah 1998; McPeak and Barrett 2001; Zimmerman and Carter 2003).

Our collaborative research focuses on two related themes:

Research Theme 1. The extent to which local natural resources, by providing informal insurance and a safety net in the face of misfortunes, help to alleviate risk-related hardship among rural households.

Research Theme 2. The potential for poor rural households, especially those headed by women, to use income derived from natural resources to accumulate physical, financial and human capital, and thereby move out of poverty by either "stepping up" (moving into more remunerative extractive or 'value adding' activities) or "stepping out" (shifting some of their effort and resources to other sectors, e.g. agricultural intensification).

Research Theme 1 draws on economic theories and evidence of how households behave in situations characterized by risk, missing markets for credit and insurance. In these settings, households have devised ways to manage risk *ex ante* and cope with idiosyncratic or covariate shocks *ex post*. Examples of such mechanisms include growing low-risk, low-return crops; investing in soil conservation; precautionary saving of grain, livestock, and financial assets; borrowing from informal credit markets; reciprocal gift-giving; accessing informal credit within networks of family, friends, and community; and reallocation of household labor from the family farm to the wage labor market. These strategies are well documented in the literature (Barrett et al. 2006; Besley 1995; Dercon 2005; Fafchamps & Lund 2003; Kochar 1999; Paxson 1992; Rose 2001; Rosenzweig 1988; Rosenzweig & Wolpin 1993; Shively 2001; Udry 1995).

An emergent literature also shows that the commons, particularly forests, provide the rural poor with natural insurance to mitigate risk and a safety net to weather economic misfortunes. For households in the Brazilian Amazon, Pattanayak & Sills (2001) find positive correlations between forest collection trips and both agricultural shortfalls and agricultural risk. In the Peruvian Amazon, Takasaki, Barham & Coomes (2004) show that forest gathering helps households to cope with covariate flood shocks, especially when households are poor in physical assets, but have adult household labor. McSweeney (2004) finds that Honduran households use income from forest product sales to cope with agricultural shortfalls. In a fourth study, Shively (1997) finds that forest pressure in the rural Philippines is inversely correlated with agricultural

capacity. Finally, using seasonal household data for rural Malawi, Fisher & Shively (2005) find that households experiencing an income boost had lower forest extraction compared to otherwise similar households that did not receive such a shock.

We will build on the studies cited above as well as those generally focusing on the forest-livelihood nexus (e.g. Byron & Arnold 1999). Drawing overall conclusions from these literatures is difficult due to wide differences across studies in fieldwork method, variable definitions (e.g., the type of shock experienced), and empirical model. A key contribution of our study is use of the PEN global data set to examine the degree to which local natural resources alleviate risk-related hardship among households at forest margins. This effort constitutes Research Theme 1. The PEN project involves collection in 25+ countries of environmental and socioeconomic data using a consistent survey instrument and implementation approach. These surveys include a very detailed recording on a quarterly basis of all income sources including all uses of forests (see the Appendix). Further, the PEN global data set, because it contains information from more than 200 communities in 25 countries, will allow study of how the role of natural resources in supporting and insuring rural livelihoods varies according to forest type, forest tenure, market access, and other contextual factors. Finally, data from Malawi and Uganda panels will enable a much-needed longitudinal examination of the role of natural insurance. With the exception of Fisher and Shively (2005), earlier work in this area has relied on cross-sectional data.

Research Theme 2 is motivated by household-level studies showing reliance on local natural resources declines as income or wealth rises. For example, Jodha's (1986) study in 21 Indian villages finds that poor households, on average, derive 9 to 26 per cent of their annual income from common-pool resources, while better-off households derive only 1 to 4 per cent. In another study in 12 Himalayan villages, Reddy & Chakravarty (1999) show that poor and rich households respectively obtain 23 per cent and 4 per cent of total income from the commons.

Cavendish (2000) finds in 29 Zimbabwe villages that poor households derive about 40 per cent of their income from natural resources, while the corresponding figure for richer households is 30 per cent. Regression analysis using household data from Malawi suggests the share of income derived from forests is declining in a household's stock of land, education, and livestock (Fisher 2004). Jumbe and Angelsen (2006) also find men and richer households participating in local forest management in Malawi deriving more forest income than women or poorer counterparts. In a meta-study for forest income case studies, Vedeld et al. (2004) finds that, on average, the forest income share of the bottom income quintile is twice that of the top quintile.

Several hypotheses can be forwarded to explain the negative correlation between natural resource dependence and poverty. At the household level, resource reliance is often viewed as both a consequence and a cause of poverty. Income from easy-entry, low-return environmental enterprises acts as an "employment of last resort" (Angelsen & Wunder 2003). And resource reliance represents a strategy that prevents the poor from participating fruitfully in other activities and escaping their poverty. At a more aggregate level, the poor are both agents and victims of environmental degradation; their dependence on natural resources results in environmental degradation, a shrinking resource base, and increased poverty (Duraiappah 1998; Zimmerman & Carter 2003).

A plausible alternative to the downward spiral scenarios is a pattern in which poor rural households convert natural capital into physical and human capital, and use these investments to gradually move out of poverty and reduce their reliance on destructive resource extraction. Our analysis will be among the first to investigate this hypothesis. We will use the PEN global data set and panel data for Malawi and Uganda to measure spatial and temporal variation in environmental income shares to see whether and under what conditions resource dependence is either a poverty trap or a viable strategy for building other forms of capital. We will follow the

structural approach used by Shively and Fisher (2004) and Fisher, Shively & Buccola (2005). We will also examine to what extent opportunities are constrained by market conditions, and under what conditions market improvements improve welfare without further jeopardizing remaining resource stocks.[1] Existing market and marketing survey data, as well as newly collected data will be used to investigate these issues further.[2]

Project findings will be of direct relevance to policy making, not just in Malawi and Uganda, but in other settings as well. We will provide empirically-derived findings on the potential for environmental resources to prevent households from falling deeper into poverty when misfortune strikes, and promote escape from poverty by financing the accumulation of physical and human capital (Wunder 2001; Angelsen & Wunder 2003). We expect our findings to highlight appropriate points of entry for policies aimed at improving rural welfare. In many developing countries, natural resources are increasingly viewed as an important vehicle for poverty alleviation. In Malawi, for example, the National Forestry Program (NFP) states explicitly that forests and trees can and should be used to eradicate poverty (Malawi Government 2001). Similarly, the objective of Uganda's National Forest Plan, which underpins the recent forest sector reform, is to enhance and diversify incomes from forests with an aim of lifting rural households out of poverty (MWLE 2003). But in settings where resource extraction represents a poverty trap, policies that focus on securing natural resource access by the poor and encouraging resource-derived enterprises may perpetuate poverty. A more effective pro-poor (and pro-environment) strategy would assist the movement out of resource dependence into more gainful employment. On the other hand, where natural resources are crucial to weathering income

[1] Market improvement may include an increase in market access or better connectivity leading to improved information about prices in larger markets.

[2] Pam Jaeger, a PEN partner and project cooperator for Uganda collected data from more than 240 producers/traders/transporters/brokers/wholesaler-retailers in a villages and intermediate towns where the PEN household study was conducted. These data can be used to estimate horizontal and vertical profits and market margins across the Uganda sample. We plan to collect similar data for Malawi.

variability and show potential for assisting households in building up their stocks of physical and human capital, resource-based strategies combined with complementary policies may prove useful for improving household welfare. One key policy question is whether, at the household level, the marketing of agricultural products and environment-derived resources are competitive or synergistic. Another question is whether efforts to improve markets for environmental products will exacerbate resource degradation and further impoverish households, or translate into greater agricultural investments. Such questions lie at the center of many policy debates but – owing to data limitations – have not been studied systematically and never rigorously analyzed across a large suite of countries. Marketing studies will be undertaken by the project in both Malawi and Uganda.

Proposed research method

We approach the task of conducting our research in a genuinely collaborative fashion, with significant attention directed at providing training appropriate to different constituencies at different levels. Specifically, our research and training will be arrayed along the following "information gradient:" (a) host-country, short-term training of mid-level university and government ministry staff in the basic use of empirical data and findings to answer questions of policy relevance and develop informed and data-driven policy perspectives and recommendations; (b) extensive use of the PEN global data set to support host-country and international research at the MSc and PhD levels; and (c) intensive analysis of existing and newly constructed panel data by the principal investigators and their graduate students to answer questions of academic and policy importance. We will utilize data from several unique sources:

- The existing PEN global data set, consisting of detailed household- and village-level annual and quarterly data from more than 7,000 households in 25 countries (described further below);
- Existing PEN panel data sets for Uganda and Malawi, including quarterly data on forest

product markets and marketing (about 400 households in each);

• The *Mulanje* survey, a household survey carried out in 1999/2000 in Malawi, which has been extensively studied as a cross-section and will be extended into a panel;

• Data from a sawn wood value chain analysis conducted in Uganda in 2007, which includes data for estimating horizontal and vertical profits and marketing margins for actors engaged in the production and marketing of sawn wood at the forest gate and in intermediate markets throughout western Uganda, and in Kampala (approximately 240 sawn wood commodity specialists);

• Geographic data on rainfall, temperature, distance, and land cover, from the Climate Research Unit (CRU) at the University of East Anglia, UK, FAO's Africover project, and other sources, as appropriate to merging onto georeferenced PEN surveys.

One of our primary objectives is to achieve synergy between the global PEN analysis and more in-depth work in Malawi and Uganda. We will use country studies to generate hypotheses that can be tested with the global data set. In addition, panel data from the two countries will allow detailed analyses of risk coping and poverty dynamics, as conditioned on contextual variables. A comparison of Uganda and Malawi can also be instructive. The countries share a number of features, both being poor and highly dependent on agriculture and natural resources. Both countries also have embarked on decentralization reforms in the forestry sector with variable impacts on the poor (e.g., Jumbe & Angelsen 2006). In Malawi, we will be working in dry deciduous *miombo* woodlands and Afro-montane forests. In Uganda, the research takes place in both Afro-montane and tropical rain forests which comprise the majority of forests in the western part of the country. Uganda has also for the last 15 years enjoyed one of the highest economic growth rates on the continent, as well as one of the highest population growth rates in Africa, making it an excellent crucible in which to examine rapidly expanding market forces.

Our project will extend and strengthen a number of partnerships. The country studies will each be managed by a host-country investigator: Charles Jumbe (University of Malawi) and Dick Sserunkuuma (Makerere University, Uganda). Efforts in each country will be closely coordinated by Shively (Purdue), Fisher (Oregon State) and Angelsen (CIFOR and Norwegian

University of Life Sciences). We will work as a team, with significant scope for cross-fertilization between sites. We have worked together in the past, in various combinations and configurations, but this will be our first opportunity to work together as a 5-person group.

The Poverty-Environment Network (PEN)

The PEN network was launched by CIFOR in September 2004 to coordinate roughly two dozen PhD field studies using standard questionnaires and consistent research methods. PEN represents not only data collection, but also a large and expanding network of more than 50 research partners, coordinated by PI Angelsen. The target populations for PEN data collection are smallholders, landless farmers, and shifting cultivators living in or near forests. The study sites represent different continents, regions, forest types, and socioeconomic environments. Within each PEN country, villages have been selected to be representative of a larger targeted region. Intra-sample variation is maintained along key differentiating gradients (e.g. market access, land tenure, forest abundance). Natural and village-level variations provide means to identify idiosyncratic and covariate risks, as well as variation in the role of the state in regulating forest utilization among different user groups with diverse interests .

PEN data collection consists of three types of quantitative surveys: two village surveys, two annual household surveys (at the beginning and end of the fieldwork period), and four quarterly household income surveys. These surveys are designed and timed such that they cover one full year. Although the PEN study focus is on forest and environmental incomes, in order to assess their relative importance and role, all income sources are recorded carefully to provide a more complete picture of households' livelihood portfolios. As of August 2007, 28 PEN partners have completed or will soon complete fieldwork, while the last 7-10 will start before the end of the year. Both the Uganda and Malawi PEN data collection is being completed in August 2007, and the two are unique among the PEN studies in that they build on previous household surveys,

thereby providing panel data sets. At present, the PEN project has invested significantly in data collection and was recently awarded a US$ one million grant from DfID (UK) for the central coordination of PEN, and a similar amount from Danida (Denmark) for fieldwork and in-depth studies in Cambodia, Ghana and Burkina Faso. The present application, with its focus on in-depth studies and panel-data analysis in Malawi and Uganda and on specific themes within the overall PEN project, is therefore very complementary and synergistic to these two grants.

The proposed project will assume a leading role in the analysis of the PEN data in the thematic areas outlined in this proposal. Thus, the proposed project will have a strong value-added aspect by fully exploiting a unique, rich, and regression-ready global data set.

Mulanje survey

Between June 1999 and August 2000, Co-PI Fisher administered a household survey in three southern Malawi villages selected purposively to represent three forest management types and a spectrum of market access. Data reflect household characteristics, demographics, household assets, tree planting, forest use, labor allocation, agricultural production, and landholding. This survey included some data not available in the PEN data sets, notably expenditures (on health, livestock, food, agricultural inputs, etc.) and labor allocation (to forest, farm, and other wage- and self-employment activities). A follow-up survey will be conducted to construct a panel dataset.

Uganda Sawn wood Value Chain Survey

In 2007 a comprehensive study of the sawn wood value chain was conducted by Pamela Jagger (the researcher undertaking the PEN study in Uganda). The value chain analysis was designed to complement the PEN study; it was undertaken at the forest gate in the 18 villages included in the PEN study, in intermediate towns that fall within the 7 districts included in the PEN study, and in Kampala which is the end market for much of the sawn wood produced throughout western

Uganda. The objective of the study was to understand how substantively and equitably small scale rural sawn wood producers are engaged in the market for one of the highest value forest products in Uganda.

Forest product marketing surveys

The PEN surveys provide information on markets for environmental goods and therefore allow a detailed examination of the existence of markets and household market participation. One component of data collection in this project will be to administer additional market surveys in Malawi and Uganda to augment existing survey data and learn more about how infrequently-studied markets for forest products actually operate. For example, we anticipate studying the value chain associated with the sawn wood, charcoal and forest-based crafts, and how it affects the ability of the rural poor to engage in high value forest product markets.

Proposed Empirical Approach

Proposed methods are outlined in the Research Matrix and discussed below.

Research Theme 1

As part of Research Theme 1, we will investigate two related research questions:

- Research Question 1: How important is environmental harvesting as a safety net in response to idiosyncratic and covariate shocks?
- Research Question 2: How does reliance on natural resources for shock coping vary by season, household characteristics, and broader geographic and socioeconomic factors?

To investigate Research Question 1, we will begin with descriptive analyses of the PEN global, Malawi, and Uganda data sets. The PEN household surveys ask respondents if their household experienced major income shortfalls (e.g., crop failure, morbidity or mortality of household members, loss of important assets) in the previous year and, if yes, how they attempted to cope. Included among the set of coping strategies is an increase in harvesting of forest and other environmental products. For each study area and for each category of coping

mechanism reported, we will construct confidence intervals for proportions of households in the population who reported the particular coping mechanism was the most important one used. We will then compare confidence intervals to gain insights on the importance of environmental harvesting as a safety net when households face misfortunes. Descriptive statistics will also be used to study seasonal patterns of environmental income and to examine whether environmental income has high or low, and positive or negative correlation with other income sources.

Second, using the *Mulanje* survey, we will construct a model of labor allocation that builds on the economic theory of farm households (Singh, Squire & Strauss 1986) and empirical studies of household resource allocation in developing countries (e.g. Abdulai & Delgado 1999; Skoufias 1994). In this model, the representative household is endowed with land and labor and allocates the latter to on-farm work, off-farm work, natural resource extraction, and leisure. The empirical model is a system of three jointly-estimated labor share equations taking the structural form $s_{it}^{j} = \alpha^{j} + \sum_{k=1}^{3} \beta^{jk} \log\left(p_{it}^{k}\right) + \gamma^{j} Z_{it} + u_{it}^{j}$, where subscript *i* corresponds to the household, superscripts *j* and *k* correspond to the activity (on-farm production, off-farm employment, and resource extraction), subscript *t* represents time, p_{it}^{k} is the shadow wage for labor allocated to activity *k*, *Z* is a vector of observed household characteristics (including a binary variable for income shock), and *u* is an error term that can include idiosyncratic and covariate shocks. This model is similar to models of commodity or factor demand based on Deaton and Muellbauer's (1980) Almost Ideal Demand System (AIDS). Successful applications of this approach by team members include Shively & Fisher (2004) and Fisher, Shively & Buccola (2005).

A third empirical approach to studying Research Question 1 will be used in the context of the PEN data sets. We will use reduced-form Probit, Tobit, and count data models where the dependent variable is either the quantity of natural resources extracted or earnings from

environmental product marketing. Explanatory variables include a binary variable indicating whether the household experienced an income shortfall in the previous year, household-level control variables (age, education, number of household residents), gender composition (since in some cases there may be clear gender divisions in forest use), and community/geographic controls (distance to markets or towns, climate, land cover, policy). Additionally, interactions between shock variables and other explanatory variables will be used to examine Research Question 2, how reliance on local natural resources for shock coping varies across different household and community characteristics. Quantile regression represents an alternative method to examine different responses across household groups. Single-year versions of the Tobit, Probit, and count data models will be implemented using the global PEN data set. The household panel data sets for Malawi and Uganda will be used to estimate longitudinal (household fixed-effects) versions of the empirical models. Community/geographic variables will come from the PEN community questionnaire, satellite images, aerial photos, and GIS data sets.

Research Theme 2

Research theme 2 consists of three policy-oriented research questions:

- Research Question 3: Do households use environmental income to accumulate physical and human capital and thereby move out of poverty?

- Research Question 4: Do poor people significantly benefit from high-value environmental products, or are they typically denied access to all but the low-return environmental enterprises?

- Research Question 5: How does better market access and integration shape the use of environmental income as a pathway out of poverty?

To investigate Research Question 3, we will estimate multivariate linear regression models in which the dependent variable is a measure of the household's level of investment in physical or human capital, recorded quarterly in the PEN and *Mulanje* surveys. We will measure investment in physical capital in terms of the value of household's net purchases of livestock and

land. In rural Africa, livestock acquisition remains a key form of wealth accumulation (Dercon 1998). Investment in human capital will be proxied by a household's school-related expenditures per child and spending on preventive health (e.g., purchase of bed nets and coils). Explanatory variables in these models will include binary variables indicating the household experienced an income shock, environmental income, prices, household factors, and community/geographic characteristics. We will include among the set of community variables measures of marketing conditions (e.g., prices of environmental products, distance and travel time to markets) in the area. We will also study interactions between environmental income and market conditions to gain insights regarding Research Question 5. In addition, interaction terms between shock variables and environmental income will indicate the degree to which natural capital helps the poor to preserve stocks of physical and human capital in the face of risk-related hardships. The main empirical challenge is that environmental income is likely endogenously determined with capital accumulation. If appropriate statistical tests suggest endogeneity, we will correct for this statistical problem either by using measures of environmental income for periods that precede capital investment decisions or by using instrumental variables estimation. Use of the latter approach depends on our ability to identify appropriate instruments.

Our analysis of Research Question 4 draws on Fisher (2004) and begins with classification of low-return (LREA) and high-return environmental activities (HREA). The LREA/HREA categorization is important for revealing prospects for natural resource-led poverty alleviation. At best, reliance on LREA helps the poor survive poverty, but is unlikely to reduce poverty. HREA may hold promise for reducing poverty, but this depends on the ability of the poor to enter activities, and the time path of opportunities. As demonstrated in Aryal and Angelsen (2007), income and wealth pattern differs sharply among different categories of environmental products, often making it futile to analyze environmental income as an aggregate.

In addition to simple cross-tabulations of environmental income by total income and wealth categories, two Tobit regression equations will be estimated, one for dependence (measured as earnings share) on LREA, the other for dependence on HREA. Explanatory variables will include controls for household and contextual characteristics. Among the set of household factors, we will include measures of poverty since we would like to know if the poor are able to enter into HREA. One measurement approach we will use is asset poverty as proxied by holdings of various assets including human capital (education, adult labor, health), physical capital (land, livestock, durables, savings, and business assets), and social capital (as measured by trust and village social networks). A second poverty measurement approach will make use of qualitative questions in the PEN questionnaire, in which households were asked how well off they were relative to other households and whether their food production and income were sufficient to cover basic needs. A final note on the empirical model is that contextual factors of primary interest will be those representing environmental product market conditions, the inclusion of which enables study of Research Question 5.

To further explore Research Question 5, we will calculate descriptive statistics for the extent of household market integration in forest product, agricultural, and labor markets. For each sector, cash income as a share of total sector income can indicate the degree of market integration. Also in addressing Research Question 5, an explicit *pathways analysis* will be applied to identify and analyze quantitatively the determinants of different livelihood strategies or pathways. Examples include Pender et al. (2004), using factor and regression analysis on cross-sectional Ugandan data, where both PI Sserunkuuma and project partner Pam Jagger participated, and Ellis and Freeman (2004), using a more descriptive approach to identify critical assets and context factors that enable the poor to get out of poverty.

The PEN global data set, consisting of 25 countries and 7000+ households, offers a rich opportunity for comparative analysis, but also raises methodological challenges. From a statistical viewpoint, a concern is that a simple pooled OLS regression may yield inconsistent estimators, due to underlying structural differences in the data. For example, the impact of market access on forest dependency is probably not the same in Uganda as in Brazil, Bangladesh, or Malawi. The literature on clustered samples suggests a number of potential remedies (Cameron & Trivedi 2005). These include: cluster-specific effects models (analogous to fixed-effects panel data models); work with more homogenous sub-samples; introduce interaction variables; and a hierarchical nested model in which country-specific slope coefficients are identified at a first level, as a function of a small set of case characteristics (e.g., the impact of market distance on forest dependence may depend on factors such as population densities and regional incomes). In the end, the project will draw on both a partitioned (comparison of within-country analyses) and a pooled approach as each approach has its own advantages and drawbacks. We will also draw on the insights from other global comparison projects, such as the LSMS (World Bank) and the World Value Surveys.

Policy relevance and mechanism for evaluation and policy dissemination

Continuous project evaluation and research dissemination will be an integral part of the proposed work. In order to ensure the project is sensitive to the needs of interested stakeholders, our work will be conducted under the auspices of a six-person advisory committee, to include key personnel from USAID and the host countries. The committee will consist of representatives from USAID Global Bureau, the USAID missions, a representative from a government agency charged with responsibility for natural resource management (e.g., Forestry Commissions or Departments), a representative from university scientific staff, and a representative from a non-governmental organization working on poverty alleviation and rural development. The advisory

committee will be engaged via email and will meet with project personnel in person when feasible to review progress, provide recommendations and leadership on program development and research conduct. The advisory committee will also provide oversight regarding the direction project activities should take beyond the funded component of the project. This advisory-committee mechanism is based on a structure used successfully by PI Shively as part of a USAID-funded ALO curriculum development project in Vietnam.

We propose to use a streamlined set of advisory and evaluation methods. At the start of the project, the advisory committee will help project team members refine research topics. At this time, specific attention also will be placed on drafting and enumerating a set of expected outcomes for the research activities. These expected outcomes will serve as the basis for annual and final evaluation of the project. During the project-planning meeting, we expect that the advisory committee will play an important role in helping the team to develop a comprehensive written evaluation instruments to be used for ex-post student evaluation of training materials and instruction modules. Students will be evaluated following existing procedures in their respective universities, but during annual project evaluations the project team will work with the advisory committee to assess research and student progress, review student and faculty evaluation of training modules, and suggest revisions and adaptations in our approach.

Contribution to host country research capacity

Research capacity in both Malawi and Uganda is limited and highly concentrated in a few key institutions. This pattern reflects the general situation in the countries. On a range of economic and social development indicators, Malawi ranks as one of the poorest countries in the world: for many years about 65 per cent of Malawians were unable to secure their food and other basic needs (World Development Report, 2007). Despite many negative factors, Malawi has enjoyed political stability for many years and currently shows signs of economic recovery, including a

maize surplus and an increase in the economic growth rate (Ministry of Economic Planning and Development, 2006).

Uganda similarly faces development challenges, but is enjoying a period of robust economic growth. The FAO regards the country as possessing high potential for effective conservation, sound natural forest management and sustained economic growth (Kanabahita 2001). Although the country continues to draw down its stock of natural capital through fuelwood and charcoal use (MFPED 2004), there is still a solid ecological basis from which sustainable agriculture and forestry might operate. Uganda's Poverty Eradication Action Plan (PEAP) and its Plan for the Modernization of Agriculture (PMA) aim to achieve a GDP growth in agriculture of 7.5 per cent per year. The development of non-timber forest products is viewed as one component of this strategy and has been supported by USAID.

To make meaningful progress toward meeting Malawi's and Uganda's development challenges, it is necessary that we strengthen the skill sets of many individuals operating at different levels. As highlighted above, we aim to do this by focusing attention along an information gradient. Each year of the project, alternating between countries, we will conduct a policy training workshop at the host-country level, focusing on developing the skills of mid-level government, NGO, and university research center staff to use data and research findings in an appropriate way, and especially to adopt recommendations that come out of our research. The workshops will run for at least 2 days with approximately 20 participants. As an example, in Malawi we will organize a training workshop for staff of the *Mulanje Mountain Conservation Trust*, a pilot forest co-management project where USAID Malawi currently supports a project. Potential themes for the training will include appropriate ways to objectively evaluate this pilot project; use our empirically-based research to answer relevant development questions; and refine the design of the co-management project. At a somewhat higher level on the information

gradient, we plan to draw host-country MSc and PhD students into the analysis of the country-level PEN data, as well as fieldwork that can support the current project. Both Makerere and the University of Malawi have recently established graduate programs in development studies and these provide useful platforms for enhancing research and analytical skills of selected students. Students enrolled for degree training at the MSc and PhD levels in each of the host-countries will benefit from participating in an annual short course conducted by the PIs. These annual short courses will cover a menu of applied research topics, ranging from survey design to data analysis and writing. Course content will be determined in collaboration with our host-country partners and our advisory committee.

Finally, through continued maintenance and analysis of the PEN global data sets and the country-level panel data sets, we will seek to engage in innovative research of interest to academic and policy communities. Individual MSc training will take place at Purdue, Oregon State, and the Norwegian University of Life Sciences (UMB). All institutions have well established programs aimed at training students in marketing, agricultural development, and applied economics. In the fall of 2007 UMB began a new MSc program in Development and Natural Resource Economics (DNRE), in collaboration with Makerere University (Uganda) and Bunda College (Malawi), and PI Angelsen will be teaching short courses at Makerere during the spring of 2008. We anticipate co-funding one student from each country in that program, with thesis work closely tied to the project on markets and marketing of environmental products. We will link project research to on-going and new PhD activities. Thabbie Chilongo, who was the fieldwork coordinator for the PEN study in Malawi, is expected to start his PhD studies at UMB in January 2008, with logistic support (not scholarship) from this project. Mr. Chilongo will be responsible for conducting the market survey in Malawi (see footnote 2) and use the PEN data set for his dissertation.

Direct beneficiaries will include host-country students and universities, local government and non-governmental institutions, and development practitioners working in Malawi, Uganda and elsewhere. A fundamental goal is to build the capacity of host-country partners to conduct policy analyses that are relevant, well-reasoned, and timely, so as to benefit smallholder farmers in the region. Key project outputs, performance benchmarks, and dissemination plans are highlighted in relevant sections below.

Contribution to USAID objectives and initiatives

The proposed activities directly address AMA BASIS CRSP research priority 1, namely *Managing Risk and Vulnerability to Enhance Asset Protection and Accumulation*. In addition, the proposal touches on aspects of research priorities 3 and 4. For example, we expect our work to shed light on the issue of local forest management, and its implications for total forest benefits, their distribution, and contribution to rural livelihood enhancement. These issues are of strategic importance to many USAID missions and we expect substantial opportunity to derive lessons that will have broader regional or global applicability.

As articulated by the Congressional Budget Justification, the US has three strategic goals in Malawi: increasing economic prosperity and security; strengthening democracy and human rights; and addressing social and environmental issues. This project explicitly addresses the first and third objectives. This project is also consistent with the recently developed Malawi Growth and Development Strategy to improve forest products marketing and develops standards and value added in the forestry industry (Malawi Government 2006). USAID also has three strategic objectives in Uganda: addressing economic growth, improving human capacity, and promoting effective governance. This project addresses the human capacity and economic growth objectives, the latter of which is concerned with security and sustainable agriculture, environmental degradation, trade and investment. The strategic aim in Uganda is to boost

economic growth, reduce environmental degradation, and enhance food security for vulnerable populations. By addressing root causes of environmental degradation, this work also speaks directly to USAID's biodiversity conservation concerns.

Our proposed work is closely linked to efforts of the IEHA, which works primarily through the African Union's New Partnership for Africa's Development (AU/NEPAD) Comprehensive African Agricultural Development Program (CAADP) (NEPAD 2002). The overall goal of CAADP is to "help African countries reach a higher path of economic growth through agriculturally-led development, which eliminates hunger, reduces poverty and food insecurity, and enables expansion of exports." Our work is consistent with all four pillars of CAADP. In addition, our project is closely aligned with several cross-cutting concerns of the IEHA, namely academic and professional training, and information for agricultural strategy formulation.

Research matrix

Research questions	Theories	Data sources	Methods/indicators	Policy mix
Research Theme I: Natural insurance & safety nets				
Research Question 1: How important is environmental harvesting as a safety net in response to idiosyncratic and covariate shocks? ***Research Question 2:*** How does reliance on natural resources for shock coping vary by season, household characteristics, and broader geographic and socioeconomic factors?	Household production models and livelihoods framework. Economics of rural org. (imperfect markets and transaction costs).	*Global PEN:* household income, environmental harvesting, household and community characteristics, risk exposure and response. *PEN Malawi & Uganda Panel:* Same variables measured over time. *Mulanje survey*: forest use, labor allocation, risk exposure, other household information. *Satellite imagery/GIS data*.	Descriptive statistics for household responses to specific shock events. Seasonal patterns of environmental income, and correlation with other income sources. Regression analysis of labor allocation, natural resource extraction and marketing, and income.	Highlights gaps in knowledge. Informs design of poverty alleviation policies and local/regional and global policy responses.
Research Theme II: Capital accumulation & pathways out of poverty				
Research Question 3: Do households use environmental income to accumulate physical and human capital and move out of poverty? ***Research Question 4:*** Do the poor benefit from high-value environmental products, or are they typically denied access to all but low-return environmental enterprises? ***Research Question 5:*** How does better market access shape use of environmental income as pathway out of poverty?	Household production models and livelihoods framework. Economics of rural org. (imperfect markets and transaction costs). New Institutional Economics.	*Global PEN:* As above, plus data on household wealth. *PEN Malawi & Uganda Panel* as above. *Mulanje survey*: as above plus household expenditures (health, livestock, education, food, etc). <u>*Uganda Sawn wood Value Chain Analysis*: profits and market margins at forest gate; intermediate; and end markets.</u> *Market(ing) survey Malawi & Uganda:* market chains for key environmental products. *Satellite imagery, aerial photos, and GIS data*.	Regression analysis: Dependent variables are measures of physical and human capital accumulation. Regression analysis: Dependent variables are share of earnings from low- or high-return environmental enterprises. Regression analysis to determine horizontal and vertical profits and marketing margins for sawn wood market. Descriptive statistics of household market integration. Descriptive statistics to compare sub-samples with respect to degree of market integration. Qualitative analysis of market survey data.	Inform design of poverty alleviation policies (e.g. PRSP) and local/regional interventions. Assess impacts of investments in infra-structure and marketing reforms. Inform debates on market liberalization and/or globalization.

III Anticipated outputs

Outreach activities

Dissemination activities targeted at policy makers and development practitioners

Our proposed partnerships (with universities, NGOs, USAID, and government ministries) ensure widespread dissemination of our work in the host countries. We will disseminate our work through three main channels. *Internationally*, we will use CIFOR and PEN. PEN has an extensive network of participants and interested individuals and maintains a list server and produces regular newsletters. CIFOR also maintains a range of global communication channels, including POLEX, a fortnightly news service to more than 14,000 subscribers. We will also document our work on the world-wide-web, either through the existing AMA BASIS CRSP website or with a new web presence, as appropriate and necessary. At the *host-country* level, we will work with our advisory committee members to disseminate our work through appropriate local channels. We will especially strive to work with USAID staff, particularly mission staff, to extend our work through the development of a series of short non-technical policy briefs. Each year we will conduct a one-day policy workshop. The venue will alternate between Malawi and Uganda. Participants will include the research team, representatives of the academic community, government officials, NGO stakeholders, and donor representatives.

Anticipated academic output

At the academic level, we will use traditional university media and department seminars to draw attention to our efforts, submitting press releases locally, and through national wire services. We also expect to disseminate details through participation in annual meetings of our professional societies. We will propose organized sessions for the meetings of the American Agricultural Economics Association in 2009 and 2010 and an organized panel for the 4th World Congress of Environmental and Resource Economists to be held in 2009. Our team has a strong track record

of success in such efforts and we anticipate output in several forms, including journal articles, special journal issues, research briefs, and monographs. We also plan to work closely with partners in several other USAID Collaborative Research Support Projects (CRSPs) to explore opportunities for synergies. For example, Shively currently serves as the chair of the Technical Committee for the SANREM CRSP, providing a natural link to that project. Angelsen and Shively have, independently, produced edited volumes containing research output from previous projects (including a CRSP project; see Angelsen & Kaimowitz 2001 and Coxhead & Shively 2005). We have been approached by Routledge to produce an edited volume on Poverty and Forests, and the proposed work would fit naturally with that initiative. We also plan to ask the National Science Foundation to support a major pre-conference meeting in North America, and have sketched out a proposal along those lines for likely submission in 2008.

IV Project benchmarks

We have several overall and cross-cutting project targets. These include:

- A minimum of 30% participation by women in all aspects of the project at the host-country level. This includes short-term training, workshops, and degree training.

- 100% of project-funded MSc degrees at Purdue, OSU, and UMB awarded to host-country students.

- A layered research dissemination plan under which 100% of written research output (such as journal articles and working papers) will be packaged for non-academic audiences in the form of research briefs or research notes, to be disseminated through our partners, organizational networks, advisory committee, and the AMA BASIS CRSP.

Specific numeric and temporal benchmarks are highlighted in the following table.

Project Overall Goals and Process and Outcome Indicators

Overall Goals	Process and Outcome Indicators and Annual Measures
1. Training	
• Increase research capacity in Malawi and Uganda. • Expand the skill set of host-country analysts working in academics, mid-level government, and NGOs. • Increase educational attainment in the host countries.	• 5 funded MSc at Purdue, OSU, and UMB awarded to host-country students. • One half-time researcher in Uganda funded to conduct statistical analysis using the Global PEN data. • Research workshops (every other year) and training sessions (every year) held in host countries, to be taught by PIs. 20 participants. These will be host-country graduate students, academics, and analysts in mid-level government or NGOs. Potential topics include survey design and practice, data analysis, technical writing.
• Increase women's participation in academics and research in Malawi and Uganda. • Increase educational attainment of women in the host countries.	• At least 2 of the 5 MSc degrees funded by the project will be allocated to women from the host countries. • At least 30% of the participants at project-funded workshops and training sessions held in Malawi and Uganda will be women from host-country academic units, government staff, and NGOs.
2.Policy and research integration	
• Conduct research that is relevant to stakeholders in Malawi and Uganda. • Widespread dissemination of research outputs to policy makers, development practitioners, and researchers in the host countries. • Widespread dissemination of research outputs internationally.	• Six-person advisory committee (with representatives from USAID missions, host-country government officials, local NGOs, and host-country academics) formed to monitor progress toward goals. • At least one, short, non-technical policy brief will be prepared and distributed through appropriate outlets in host countries in each year (8 total). • A 1-day policy workshop will be held each year, alternating between hosts.

	• Working papers and policy briefs will be made available on the CIFOR website. • News releases will be generated – one at the start of the project and one near the end with a summary of research findings. Project activities will be advertised locally in the host countries and through national wire services. • At least 6 journal articles will be prepared during the funded part of the project. • One special issue of a journal will be prepared. • One edited volume of research output. • Two organized sessions to be proposed for AAEA (2009 and 2010); one organized symposium to be proposed for the 4th World Congress of Environmental and Resource Economists in 2009.
3. USAID objectives	
• Foster economic prosperity • Address social and environmental issues	• One research brief will use project findings to identify policy interventions that will raise incomes and foster sustainable rural livelihoods • One research brief will use project findings to identify policy interventions that address economic concerns and examine economy-environment tradeoffs.
4. Host-country economic development	
• Foster sustainable rural livelihoods, build assets, reduce poverty, and improve access to markets for environmental-based goods.	• Research and thesis work will focus on the economy-environment nexus, with specific attention on poverty alleviation. Accountability to advisory committee.

V Project timeline

Activities and milestones	2007				2008				2009				2010				2011			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Non-degree training																				
Makerere policy workshop																				
Univ of Malawi policy workshop																				
Makerere short course training																				
Univ of Malawi short course training																				
Degree training																				
Purdue MSc																				
Oregon State MSc																				
UMB/Makerere/Bunda MSc																				
UMB PhD training (pending)																				
Research tools																				
Follow-up survey questionnaires																				
Databases for data entry																				
Concept note on themes I and II																				
Concept note on global analysis																				
Field data collection																				
Main research activities																				
Preparation of U & M panel data sets																				
Analysis of U & M data																				
Global data analysis																				
Special issue of journal																				
Minimum 6 journal articles submitted																				
Policy briefs (2/country, 4 total)																				
Media and popular dissemination																				
Media and popular dissemination																				
Co-edited book																				
Research workshops and conferences																				
AAEA pre-conference workshop																				
International final conference																				
Companion and follow-on funding																				
Apply for NSF workshop funds																				
Apply for follow-on funding																				

VI Budget

The budget is $ 861,710. We request $599,999 from the BASIS CRSP, with funds to be distributed in a 50-50 split between host country partners and the US/Intl partners. We will provide in excess of $250,000 in cost sharing, through matches of faculty time and support for

two graduate students at UMB. Electronic budget pages and narratives are provided in a separate budget document. Letters of institutional commitment appear at the end of the proposal.

VII Short profiles of Researchers

Arild Angelsen (Associate Professor, Norwegian University of Life Sciences - UMB & Senior Associate, Center for International Forestry Research - CIFOR) earned his PhD from the Norwegian School of Economics and Business Administration. He has worked and published extensively on tropical forests and poverty, with a geographical focus on Eastern/Southern Africa (Uganda, Malawi) and Indonesia, where he has lived for a total of 4.5 years. He is coordinator of CIFOR's Poverty Environment Network (PEN), and also coordinator of the Master Program in Development and Resource Economics at UMB.

Monica Fisher (Assistant Professor, Oregon State University) holds a PhD in agricultural economics from Purdue University. She conducts research on rural poverty and natural resource management with a geographic focus on Africa (Malawi, Senegal and Benin). Between June 1999 and August 2000 she worked with local enumerators in rural Malawi to gather data for her dissertation, which explored links between rural poverty and tropical deforestation.

Charles Jumbe (Researcher, University of Malawi) earned his PhD in Economics from the Norwegian University of Life Sciences in Norway in 2006. His dissertation on community forest management, poverty and energy use in Malawi resulted in journal articles in *Land Econ.*, *Energy Economics* and *Ecological Econ.* In early 2006, Jumbe initiated a follow up study of households he surveyed in 2002 using the PEN research format.

Gerald Shively (Professor, Purdue University) completed his PhD at the University of Wisconsin and has conducted and supervised extensive field work and analysis of the farming-forest frontier in Asia and Sub-Saharan Africa. He is the author of more than 50 scholarly articles and books. He currently serves as Co-Editor-in-Chief of the journal *Agricultural Economics* and Associate Editor of the journal *Environment and Development Economics.* He has been a PI for projects in the SANREM and IPM CRSPs, and currently serves as the SANREM CRSP Technical Committee Chair. He is also an Adjunct Professor at the Norwegian University of Life Sciences.

Dick Sserunkuuma (Associate Professor, Makerere University) received his PhD in applied economics from the University of Minnesota. His expertise lies in the areas of Collective Action and Property Rights, Natural Resource Management, and Poverty and Food Security Issues. He has engaged in collaborative research with The Foundation for Advanced Studies on International Development (FASID), the International Food Policy Research Institute (IFPRI), the International Livestock Research Institute (ILRI) and the World Bank (WB). He is currently heading a project on Research on Poverty, Environment and Agricultural Technologies (REPEAT) in Uganda. The overall goal of this project is to identify agricultural technologies and farming systems that will contribute to increased agricultural productivity and reduced poverty in rural Uganda, without degrading the environment.

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Makerere University – General

The Makerere component consists of providing a part time (50%) statistician/econometrician to analyze the PEN global database. In addition, Makerere will administer follow-up surveys and host policy workshops and short-term trainings.

Makerere University – Year One

A. Personnel = $19,584

$3,500 salary for Co-PI Sserunkuma
$3,000 salary for Researcher Jagger
$13,084 salary for Econometrician/Statistical analyst: Ronnie Babigumira

The Econometrician will be responsible for handling the PEN global database, as well as assisting in the analysis of the Ugandan and Malawian data.
The salary for Pam Jagger, a PhD student at Indiana University and a PEN partner currently doing the data collection, will enable her getting involved in the data analysis of this project.

B. Travel = **$3,722**

B1. Travel, International = $3,722

- Sserunkuma will travel to US to meet with project collaborators requiring $3,722. Cost includes round trip airfare of $2,000 (Entebbe, Uganda to W. Lafayette, IN) and $1,722 per diem (seven days at $246 per day).

C. Training = **$13000**

The first component of this budget is $6 000 for training of Mr. Arthur Arinaitwe, who is a field research supervisor of the ongoing PEN data collection. The funds will facilitate travel and a 3 months stay in at Purdue and Indiana universities.

The first project stakeholder workshop will be held in Uganda. This is intended to be a high level policy workshop that will include government officials from the relevant ministries, civic organizations. In addition, collaborators from Malawi, as well as the other co-PIs will attend.

D. Supplies = **$4000**

The project database will be maintained at Makerere University. This cost includes the cost of buying a notebook workstation at $2500 and a desktop workstation at $1500

E. Other Direct Costs = **$4,000**

E1. The PEN data collection is covered by other sources. These costs will include additional data collection from the same households, hiring the field research supervisor to do the data entering, and analysis and preliminary write-up of key results.

Total Direct Costs = **$44,306**
Indirect Costs = **$4,431**

Indirect on Makerere University = 0.10 * $44,306 = $4,431

Total Year One Costs = **$48,737**