EXPLORING THE POTENTIALS OF PAYMENT FOR ENVIRONMENTAL SERVICES IN THE CONTROL OF AGRICULTURAL LAND DEGRADATION IN NIGERIA

Abdullahi, Ahmed Chinade
Environmental Management Technology Programme
School of Environmental Technology
Abubakar Tafawa Balewa University Bauchi
P.M.B 0248 Bauchi
Bauchi State, Nigeria

Abstract
Agriculture accounts for 25% of land use globally and since 1950, about two billion hectares of agricultural land is being degraded due to a number of natural and anthropogenic causes. Concerns about agricultural land degradation (ALD) have hitherto largely being focused on its effects on agricultural productivity while the effects on environmental quality have not received commensurate attention. Agricultural lands generate a number of vital ecosystem services and when degraded they create disservices with the attendant negative consequences on the environment and human well-being. Over the years, effective methods of controlling agricultural land degradation have been established. These include a number of best management practices, land improvement technologies and numerous other indigenous methods. Despite adequate knowledge of methods of controlling agricultural land degradation, the problem still persists largely because farmers are unable to implement them. Their constraints range from poverty, lack of investment, land tenure, among others. This paper explores the possibilities of using the payment for environmental services (PES) approach in combating ALD in Nigeria by suggesting some necessary steps before such a scheme could be entrenched in the country. The paper concludes that carefully designed PES schemes hold much promise in combating ALD in Nigeria. It is also suggested that Nigeria could finance its PES through ecological fund, fuel tax, grants from multilateral donors and budgetary provisions.

Keywords: Agricultural land degradation, payment for environmental services, ecosystem services, environmental quality and best management practices.

Introduction

Developing countries like Nigeria are facing the uphill task of meeting the millennium development goals (MDGs) before the year 2015. It is becoming increasingly clear that the first goal of halving the percentage of people in extreme poverty and the seventh goal of achieving environmental sustainability are unlikely to be met unless a sustainable solution for tackling environmental problems such as agricultural land degradation are found. With more than 70% of its 140 million population depending on subsistence agriculture,

Nigeria will only guarantee food security and economic well being if its land resources, the base of agriculture, are protected from degradation or the quality of already degraded lands restored. Over the years, the problem of agricultural land degradation (ALD) is increasingly taking a worrying dimension due to a number of reasons.

Despite numerous attempts in tackling it, at various levels, the problem still persists even though most of the solutions are known. Lack of incentives to induce farmers to adopt good practices, failure to take a farmer perspective approach and the top down nature of interventions are believed to be some of the reasons why addressing the problem has been difficult.

Various approaches are being advocated in achieving sustainable development in the agricultural sector. One of such approaches requires a market that will recognize the value in environmental services (ES) generated by agricultural lands and a buyer is identified who can buy such services from the farmer who ensures that such services are generated or preserved. Experiences in many countries such as the United States, Costa Rica (Chomitz et al, 1998) and Nicaragua (Pagiola et al, 2007) have revealed the relevance of this approach in ensuring forest and biodiversity conservation through inducement of resource users to generate or protect vital ecosystem services through an approach called 'Payment for Environmental Services' (PES).

This paper explores the possibilities of using the PES approach in inducing farmers to adopt land improving technologies (LIT), adopt best management practices (bmps) or stop degrading activities. This is because a degraded land prevents agricultural systems from benefiting from or generating vital environmental services.

Land degradation on agricultural lands

Land degradation refers to changes in the quality of soil, water and other characteristics that reduce the ability of land to produce goods and services that are valued by humans (Wiebe, 2003). A degraded land is believed to be structurally unstable, has eroded topsoil, depleted or washed nutrients, less plant cover and in some cases it is saturated with salts. This degradation could be either temporary or permanent. Land degradation is a serious environmental problem experienced in many parts of the world especially Sub-saharan Africa. About 2 billion hectares of cropland, pastures and forests worldwide have been degraded since 1950 (Scherr and Yadav, 2006) while the annual loss of land degradation is estimated at 5-10 million hectares. The impact of this to agricultural production is tremendous.

The effects of land degradation on the environment and on rural economies are enormous as most farmers find it necessary to exploit the land resources for their livelihood. Most farmers in developing countries in particular have poor access, financial wherewithal and incentives to afford land improvement technologies (LITs) or fertilizers. They are also unable to adopt best management practices (BMPs) to control or prevent land degradation due to the same reasons. This poses a serious threat to environmental quality, food production and livelihood in such areas.

2.1 Causes and effects of agricultural land degradation:

Land degradation can be caused both by biophysical (natural) and socio-economic (anthropogenic) causes. Biophysical causes can be sub-divided into physical,

chemical and biological causes. The physical causes include compaction, crusting, water imbalance, runoff etc; the chemical causes include acidification, nutrients depletion, leaching, salinization/alkanization among others (Mbagwu, 2003). The biological causes include decline in soil organic carbon, decrease in biomass carbon, decrease in soil biodiversity etc. All these occur mainly as a result of agricultural activities. The anthropogenic (human induced) land degradation, which is of greater concern, occur due to land tenure, poverty, increased pressure on land due to population increase, poor financial and market returns, lack of capital to afford appropriate land improving/protection technologies, power and social status among others (Stocking and Niamh, 2000).

The effects of land degradation vary in form and nature, time and space (Wiebe, 2003). Basically, the effects are on productivity and impacts on the environment (Stocking and Niamh, 2000). Loss of topsoil, organic matter and water holding capacity may affect productivity of the soil in a particular location whereas eroded soil deposited elsewhere may affect that location's ability to provide clean water, irrigation, flood control and other environmental services (Wiebe, 2003). Some effects of land degradation are felt in the future. Some of these effects include loss of soil productivity due to cumulative changes in soil quality, changes in carbon flow between the atmosphere and the soil may have an effect on the climate in the long run (Lal, 1998a; Pagiola, 1999b in Wiebe, 2003). If land degradation persists, it will eventually reduce crop yields in the short run. This may in turn lead to food scarcity over wide areas in the long run.

Apart from biophysical effects and the associated negative impact on productivity and crop yields, land degradation also has broader consequences on incomes and economic growth. In Southeast Asia, economic loss due to land degradation is estimated at 1-7%, and in Zimbabwe 9% (Scherr and Yadav, 2006). The poor people are generally the most vulnerable due to their overdependence on agriculture and also because they have few livelihood options. Due to poor land tenure systems, poverty and other factors they are also unable to invest in land improving technologies and or adopt BMPs.

2.2 Strategies and options for agricultural land degradation control:

Despite the numerous causes of agricultural land degradation and the consequences, there are several strategies; best management practices (BMPs) and policy options being advanced in tackling it. In agricultural lands, some BMPs being used include: agroforestry, conservation farming (such as minimum tillage and no till farming), nutrient replenishment, sedentary livestock and terracing, fish scale pits (Shi and Chevin, 2004), re-building of top soil through amendments (Scherr and Yadav, 2006), watershed management and water harvesting and conservation strategies. Others include sand dune rehabilitation, afforestation and reforestation, restoration of degraded lands, forest and rangeland management, community woodlots, fertility replenishment (Westanys and Woodley, 1998), pitcher irrigation (Abdullahi, 1996), dryland range rehabilitation among others. Community based initiatives such as farmers' cooperatives to establish woodlots, favourable property rights could also prove useful in land degradation control.

Promotion of land improving investments, improvement of economic conditions of resource users (through the development of market infrastructure, correction of distorted price incentives, encouraging income diversification) and guaranteeing ownership and access to land resources are believed to be more effective and sustainable options for land degradation

control (Giger, 1999). Giving incentives to farmers to improve their degraded lands also have another advantage of alleviating poverty and may constitute a veritable means of maintaining income streams before the benefits of land improvement begin to yield dividends in form of improved land quality and subsequently higher crop yields.

However, some suggestions were advanced on how and when to use direct incentives as strategy of inducing land improvement initiatives. According to Giger (1999), direct incentives should not be aimed at implementing pre-conceived conservation measures rather the objective should be to increase the options available to resource users. Incentives should be the result of clear-cut agreement between independent parties on services and results expected and not to be made to serve as 'incentives' for any preconceived measures in the conventional approach (Giger, 1999). Based on this, therefore, incentives should not be seen as 'financial help' but financial instruments solely provided to pay for ecological services rendered.

Despite the shortcomings of direct incentives as useful natural resource management tools, they are still considered useful means of investing in land improvement. The Environmental Quality Incentives Programme (EQIP) in the United States is a clear example where the strategy is used in natural resources management. There are a lot of examples where investment in NR has improved environmental quality. De Clerck et al (2006) reported that in Costa Rica payment for ecosystem services has been used in determining the monetary value of carbon sequestration and water purification (WRI, et al 2005). Land owners are paid US$50 /ha/yr to maintain forest cover on their property. Pagiola et al (2007) and Borner et al (2007) report how PES has proved useful in encouraging farmers to restore degraded pastures and protect forests in Nicaragua and Brazil respectively. Investment in land degradation control is also useful considering the fact that farmers are less likely to voluntarily control offsite costs (or costs that may manifest in the future) simply because there is no incentive for them to do that.

Based on the above, it is possible that investment in NR will be a viable option for controlling agricultural land degradation in Nigeria.

2.3 Payment for Environmental Services

As mentioned earlier, Payment for Ecosystem Services (PES) could be adapted and used as a sustainable strategy for agricultural land degradation control in Nigeria. This is because agricultural lands also generate environmental services and when they are degraded vital ES are lost. This section will review the theoretical concept of the PES approach with a view to understanding how it can be used for combating agricultural land degradation in Nigeria. According to Wunder (2005), '*PES is a voluntary transaction where a well defined Environmental Service (or a land use likely to secure that service) is being 'bought' by a (minimum of one) environmental service (ES) provider if and only if the ES provider secures ES provision (conditionality)'.* The services in question must be measurable against established baselines (additionality). PES schemes could be generally categorized into four: Carbon sequestration and storage, biodiversity protection, watershed protection and landscape beauty (Landell-Mills and Porras, 2002). In some instances, these services could be bundled and paid for by the same buyer. All these could be designed as area-based, product-based,

public, private or use restricting schemes (Wunder, 2005). PES emerged out of the recognition that the environment renders vital services that generally go unnoticed. The Millenium Assessment Report (MA, 2005) identified these services as: Provisioning services (e.g Food and Water), Regulating services (e.g regulation of soil and water loss/quality, population dynamics of pests, pollinators, pathogens and wildlife, diseases control, carbon sequestration etc), Cultural Services (e.g recreation and spiritual activities) and Supportive services (e.g maintenance of soil fertility, nutrient cycling etc). These services are considered public goods with positive externalities, undervalued, unrecognized and therefore fail to attract any market that would ensure their protection or continuous generation (Landell-Mills and Porras, 2002, Swinton, et al 2007). It is therefore envisaged that by paying resource users to adopt practices that will ensure ES generation, the environment will be protected in the process. In addition, the ES providers (sellers) can diversify their livelihood thereby reducing the incidence of rural poverty.

The challenge has been how to identify where the resource buyers can perpetually source the finances to continue to pay for ES? This is even more problematic in developing countries like Nigeria where the markets are undeveloped. This challenge is partly overcome in Costa Rica where the market is created by legislation and the ES valued by political decision (Chomitz et al 1998). In the United States, PES-like schemes covered in the U.S Farm Bill such as Environmental Quality Incentives Programme (EQIP), Conservation Reserve Program (CRP), Conservation Innovation Grant Programme (CIG) are all financed by the Federal Government through the United States Department of Agriculture (USDA) (Krome et al, 2009)

PES may also be difficult to implement because of high transaction costs, lack of property rights, and absence of regulatory and institutional frameworks in most developing countries. PES has been criticised for raising equity concerns for favoring the rich over the poor and land holders over the landless. Despite these criticisms however, interest is growing on the PES approach globally (Wunder, 2006)

2.4 The link between agricultural land degradation and environmental (ecosystem) services

Agricultural lands constitute the largest managed ecosystems on earth accounting for 25% of total land use (Zhang, et al 2007; Swinton, et al 2007). Agriculture provides critical ecosystem services (ES) and it in turn benefits from many ES from the environment. Ecosystem services defined by Daily (1997) as *'the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life'* are broadly categorized by the Millennium Ecosystem Assessment report as provisioning, regulating, supporting and cultural services (M.A, 2005). The best known ES generated by Agriculture is provisioning services in the form of food, fuel and fiber. However, it in turn relies upon regulating services (pollination services, flood control, water purification, habitat for beneficial insects etc) and supporting services (nutrient cycling, soil formation, water provision, etc). Unmanaged (or degraded) agricultural systems also cause significant disservices to the ecosystem such as habitat loss, nutrient runoff, pesticide poisoning of non-target species etc (Zhang et al 2007:254).

Agricultural land degradation is directly responsible for eroding vital ES in agricultural lands. The consequences of which may manifest onsite or offsite farmers' fields. PES may offer a real possibility in combating these impacts (especially) the off-site ones since farmers

may not have incentives in controlling them.

4.0 The Potentials of PES in Controlling Agricultural Land degradation

Despite the numerous challenges that may make PES implementation (in Nigeria in general and in agricultural land degradation in particular) difficult, there are still enormous potentials for using this approach. The justification for using PES in agricultural land degradation control lies on the fact that:

Agriculture has been documented by several authors to accounts for about 25% of the total land use in the world. Thus, protecting such lands from degradation may need the environment to guarantee the continuous generation of its goods and services to humanity.

It is of note that agricultural land degradation (natural and anthropogenic) is one of the environmental problems worthy of concern in Nigeria.

Therefore, if greater percentage of arable land could be brought under a sort of uniform management, then the percentage of agricultural land degradation would drastically fall (better if farmers have additional means of income in the process). This requires an innovative approach such as PES that has the potentials of inducing adoption of BMPs or avoidance of bad practices and at the same time providing alternative income stream to farmers.

This paper is aimed at highlighting the relevance and potentials of the PES approach in tackling agricultural land degradation by encouraging farmers to invest in Land Improving technologies (LIT), adopt best management practices (BMPs) or stop degrading practices.

5.0 A Possible Way of Using PES to Combat Agricultural Land Degradation

This section suggests possible steps to be followed in using the PES approach to combat agricultural land degradation. In order to investigate whether farmers can adopt conservation measures on their lands using the 'PES' approach, it is necessary to first of all investigate the incidence of land degradation, identify why it has taken place (using a farmer perspective approach), select a technology or BMP that worked in that particular context (also based on farmer perspective), appraise whether the LIT/BMP is economically feasible. It is only when these are confirmed that it would be worthwhile to use 'PES' in generating the needed 'incentives' capable of inducing adoption of the technology or BMP.

Determination of incidence of Land Degradation (LD) on farmers' fields

It is essential to establish the incidence of LD before investigating whether the 'PES' approach can be used to combat it. This is difficult to do because LD takes place at various spatial and temporal scales and its causes are both natural and anthropogenic. Based on the foregoing, field level indicators cannot be relied upon, completely, to explain landscape level land degradation and vice versa. Similarly, a combination of both biophysical and socio-economic measures must be used to fully establish the incidence of LD. A useful approach in this circumstance is the adoption of 'farmer-perspective approach' as highlighted by

Stocking and Niamh (2000). The approach entails the selection of field-level (mostly visual), productivity and seasonal indicators. The specific measures will ultimately be determined by field and farmer peculiarities. However, the following indicators might be useful (adapted from Stocking and Niamh, 2000): Indicators of soil loss (such as rills, gullies, pedestals, armour layer, buildup against barriers, deposits of soil on gentle slope, plant/tree root exposure, rock exposure, tree mound, sediment in drains, soil texture and colour etc); indicators of productivity constraints (crop yield, crop growth characteristics, nutrient deficiencies and toxicities etc)

4.1.2. Identification of causes of agricultural land degradation (LD)

After confirming that LD is indeed actually taking place, the next stage is to seek answer to the question why is LD taking place. The process of LD is generally a biophysical one but to a large extent the causes are socio-economic (anthropogenic) in nature. Some of these factors include: poverty, land tenure, increased pressure on land (due to increasing population), labour availability, lack of economic incentives, appropriateness of technology, economic and financial returns, off-site versus on-site costs, power and social status etc (Stocking and Niamh, 2000). These factors are not mutually exclusive but their occurrence depends on contextual peculiarities. It is useful to adopt a farmer-perspective approach in ascertaining why L.D is taking place so as to understand why people carry out degrading activities or to identify the conditions that can make them conserve their lands.

These factors can be assessed using the Sustainable Rural Livelihood approach (SRL). SRL has been developed by DFID for analysis of rural livelihoods. The approach seeks to identify the different assets and capitals farmers rely upon for their livelihood. These assets and capitals have far reaching implication on farmers' behavior and how they relate with their land. Any changes (increase or decrease) of assets and capital available to the farmer would have different effect on L.D. The effect would depend on the resilience and sensitivity of both the farmer and the land. This is because most farmers rely heavily on the natural capital and any effect on it would profoundly affect their circumstances. The SRL approach may facilitate the identification of the root causes of L.D and the best (sustainable) way(s) of combating it. It may also allow for comparisons between circumstances of different land users and how that affects L.D.

The SRL analysis is presented in a framework called Sustainable Livelihood Framework (SLF). The framework provides a useful means of organizing the various pieces of information gathered about the farmer's circumstances which, in a way, control the biophysical processes of L.D (Stocking and Niamh, 2000:23).

In generating the data for the SLF, Participatory Rural Appraisal techniques could be used (PRA). Participatory Rural Appraisal is *'a family of approaches and methods to enable rural people to share, enhance and analyse their knowledge of life and conditions to plan and act'(Chambers, 1994).*

Specifically, the PRA tools may be used in:

1. Identifying whether L.D is an issue in a given area
2. assessing how it affects land users
3. identifying locally adaptable solutions (land improving technologies and best management practices whose

adoption would be induced through 'PES')

There are several tools and techniques of PRA but the choice depends on the kind of information needed and the purpose of investigation. Some of these include: sketched maps, transect walks, calendars, historical profiles, timelines, wealth ranking, system diagrams, stakeholder analysis, problem trees, decision trees etc (Stocking and Niamh, 2000:25-26). The PRA generates the information for analysis through Semi-structured interviews, interviews with selected people and focus group discussions.

Based on the foregoing, it is envisaged that the SRL and PRA approaches may be useful in establishing why land degradation takes place in a particular area. This will now pave the way for finding sustainable and appropriate technologies and BMPs for combating it through the PES approach.

4.1.3. Identification of suitable LIT/BMP capable of combating agricultural land degradation?

Having ascertained the reasons why LD is taking place, the next step would focus on identification of appropriate Land Improving Technologies (LIT) and/or Best Management Practices (BMPs) to adopt in combating it. Perhaps, the best way of beginning the search for solutions for land degradation is to start from identifying the current strategies farmers use to tackle their problems locally. Just like the way LD is caused by several factors; strategies for combating it are as numerous. In addition, each of the five major types of LD (Water erosion, Wind erosion, Chemical degradation, Physical degradation and Biological degradation) requires a different LIT/BMP in controlling it. PRA tools such as transect walks, sketched maps, focus group discussions and interviews may be relevant in identifying local technologies and BMPs and measuring their effectiveness in controlling LD. The information can be complemented with interviews with extension agents and relevant agencies responsible for agricultural development such as Agricultural Development Agencies (ADPs).

The LIT/BMP considered effective in controlling each of the five types of LD would be selected and used in driving the PES scheme.

Investment appraisal

After identifying an acceptable and effective LIT/BMPs a possible next step is to appraise the investment needed to guarantee adoption by farmers. This appraisal will reveal the 'with and without technology/bmp' situations (Stocking and Niamh, 2000). What benefits would the farmer gain from controlling land degradation? What is the cost of investing in the LIT or adopting the BMP vis a vis alternative actions or no action? Some benefits and costs are realizable in the long run and some have offsite impacts. This appraisal can make this determination possible. The ideal tool to be used in these circumstances therefore is cost-benefit analysis (CBA). It is envisaged that the result of the CBA can reveal whether the investment is feasible or not economically.

Determination of feasibility of using the 'PES approach' to induce farmers to invest in LIT/BMPs

After ascertaining the actual cost and benefit of investing in LIT/BMP, the opportunity cost and the economic feasibility, efforts would then focus on determining whether PES can be relied upon to generate the needed resources for the investment or provide the incentives for adoption of a BMP. This is the key issue

and it seeks to determine whether the 'PES' approach can actually be used to motivate farmers to adopt LIT/BMP in combating any of the five types of LD. To carry out this feasibility, answers to the following questions must be found?

What would be the farmers' willingness to accept (WTA) to forego a degrading activity or adopt a conserving technology or BMP?

The contingent valuation method (Mitchell and Carson, 1989; Freeman, 2003; Ready et al 1997; Bateman et al 2002 etc) could be used in establishing this. The method creates a scenario in which respondents are asked to directly state their maximum WTP or minimum WTA for a specified change in an environmental amenity (Barr, 2008). The scenario will depict a realistic and viable feature of the amenity's value. The response obtained is generally considered to be a true reflection of the value of the environmental service. For this purpose, information from farmers would be elicited on how much they would be willing to accept to stop degrading activity or invest in LIT or adopt a BMP in order to control any of the identified five types of LD. This information can be obtained through surveys and interviews with individual farmers and farmers' groups. Barr (2008) reported how a hypothetical PES scenario can be used for marine protection in La Paz, Baja California Sur, Mexico. Results of median willingness to pay by tourists and willingness to accept by fishermen (to abandon fishing) revealed that farmers need more than what tourism can offer to abandon fishing. However, PES for marine protection can be used where fishermen's opportunity costs are low and can complement existing markets (Barr, 2008). It is also necessary to include a viable payment vehicle and institutional framework in constructing the scenario (Arin and Kramer, 2002; Arrow et al, 2003 in Bass 2008). It is expected that, the determination of farmers' WTA would reveal the level of payment or incentive necessary to induce/motivate farmers to stop a degrading activity or adopt a conserving one.

What type of payment would the farmers want?

The type of payment can affect the scheme's sustainability and determine farmers' participation in the programme. According to Wunder (2005) cash payment are only ideal where the farmers' opportunity cost is in the form of cash income. Cash payments may encourage extravagant spending on alcohol or luxury items which may cause social disharmony. However, some have argued that cash payment may be more effective in alleviating poverty (Hanlon, 2004). In some situations farmers may prefer non-cash payments. As in the case of this research, non-cash payment of material (s) to be used in controlling LD may be more relevant in achieving results. Consequently, a survey will reveal the payment mode acceptable to the farmers.

Who is going to pay and how can the buyer generate resources to pay the farmer?

This is a critical question whose answer will determine whether the PES scheme can actually be used in controlling LD. Generally, PES schemes are designed as market instruments where the market can pay for the environmental services generated or conserved (Kroeger and Casey, 2007). However, in this circumstances, the market approach may be difficult since the market is undeveloped in Nigeria and some of the effects of LD are offsite the farmers fields. Other reasons include lack of property rights, absence of regulatory mechanisms and a possible high transaction cost which all may affect the private market for PES (Kroeger and Casey, 2007). For these reasons, public payment options may have to be explored. In Costa Rica, PES schemes are financed by a fuel tax, environmental service certificates and grants by multilateral agencies such as the

World Bank and Global Environmental Facility (GEF) (Chomitz et al 1998). In the United States the USDA finances PES-like schemes enshrined in the Farm Bill (Krome, et al, 2009). In Nigeria, it may be possible to fund the PES scheme through the ecological fund, agricultural subsidy and grants. The potentials of all these options could be explored in depth through eliciting government's willingness to pay (WTP) farmers to invest in LIT or adopt BMPs in order to control land degradation by survey targeted at relevant policy making officials.

5.0 Conclusion

Environmental Services (ES) include provision, regulating, supporting and cultural services. However, agricultural problems such as land degradation prevent agricultural systems from generating or benefiting from these ES. Degraded lands are implicated in some cases for creating disservices with negative consequences to the environment and human well-being. A major environmental problem in Nigeria is agricultural land degradation where its effects are exacerbated by endemic poverty because majority of the people are subsistence farmers, who must use the land resources to 'eke out' a living. Unsustainable farming practices, climatic vagaries and policy inconsistencies are the principal reasons that may be attributed as responsible for the problem. This situation continues to pose monumental challenge to achievement of the millennium development goals and related national development policies.

Considering the failure of past attempts to tackle the problem, this paper explores the possibilities of using PES to combat agricultural land degradation in Nigeria and suggests how such a scheme could be used. The money paid to the farmers under this scheme is expected to induce them to invest in land improving technologies, adopt best management practices or stop degrading activities which may lead to improvement of the quality of their lands. The improved family income from the scheme may also reduce rural poverty.

In order to use PES for this purpose, a number of methods are suggested. The incidence of land degradation can be established using simple field-level indicators, the causes of land degradation and the type of LIT and BMPs to promote under the scheme can be determined using sustainable livelihood and participatory rural appraisal techniques. Cost-benefit analysis would determine whether the investment would be worthwhile, economically. Finally contingent valuation method would be used to determine sellers' (farmers) willingness to accept to adopt LIT/BMP or stop degrading practices and buyers' (government or multilateral agencies) willingness to pay to drive the scheme.

PES holds much promise in combating ALD in Nigeria if carefully designed following the steps outlined above. The scheme could be financed through the ecological funds, introduction of fuel tax, outright budgetary provisions and leveraging funds from multilateral and bilateral donors.

References

Abdullahi, A.C (1996) Investigating Pitcher Irrigation with Vegetables on Sandy Loam soil of North-Eastern Nigeria. An unpublished BSc project submitted to Department of Soil Science, University of Maiduguri, Nigeria

Agrawal, A and Redford, K (2006) Poverty, development and biodiversity conservation: shooting in the

dark? Bronx, NY: Wildlife Conservation Society. WCS working paper no.26

Barbier, B. (1998) Induced innovation and land degradation: Results from bio-economic model of a village in West Africa. *Agricultural Economics*, 19:15-25

Barr, R. (2008) Investigating the Potential for Marine Resource Protection through Environmental Service Market: A case study from La Paz. UKNEE Seminar. London.

Bateman, I. & et al (2002) Economic valuation with stated preference techniques: A Manual, Edward Elgar, Cheltenham.

Bontkes, T.S (2001) Agricultural Prices and Land Degradation in Koutiala, Mali: A Regional Simulation Model on Farmers' Decision Rules. Economic Policy and Sustainable Land Use, Physica-Verlag, New York

Borner, J., Mendoza, A., Vosti, S. (2007) Ecosystem Services, agriculture and rural poverty in the Eastern Brazilian Amazon; Interrelationships and policy prescriptions. Ecological Economics 64. 356-373

Brockington, D and Schmidt-Soltau, K (2005) The social and environmental impacts of wilderness and development. Oryx 38:140-42

Casey, F., Schimtz, A., Swinton, S., Zilberman, D. (1999) Flexible Incentives for the adoption of Environmental Technologies in Agriculture. Kluwer Academic Publishers, Boston

Chomitz, K., Brenes, E., Constantino, L (1998) Financing Environmental services: The Costa Rican Experience and its Implication. World Bank. Washington D.C

Daily, G. (1997) Nature's services Island Press, Washington, D.C

Dale, V., and Polasky, S., (2007) Measures of the effects of agricultural practices on ecosystem services. Ecological economics 64. 286-296

DeClerck, F., Ingram, J.C., Rumbaitis del Rio, C.M (2006) The role of ecological theory and practice in poverty alleviation and environmental conservation. Frontiers in Ecology Environ. 4 (10): 533-540 (www.frontiersinecology.org Accessed 12th February 2007)

Freeman, M.(2003) The Measurement of Environmental and Resource values: Theory and methods: Resources for the Future., Washington D.C

Giger, M. (1999) Avoiding the shortcut: Moving beyond the use of direct incentives. Development and Environment Reports No.17. Centre for Development and Environment, Institute of Geography, University of Berne Switzerland.

Hanlon, J (2004) Is it possible to just give money to the poor? *Development and Change* **35**(2): 375-383

Heerink, N., Kuyvenhoven, A. van Wijk, M.S, (2001) Economic Policy Reforms and Sustainable Land Use in Developing Countries: Issues and Approaches. Economic Policy and Sustainable Land Use. Physica-Verlag, New York

Junge, B. *et al* (2006) Monitoring land use intensification and linkage to soil erosion in Nigeria and Benin. Conference on International Agricultural Research for Development. University of Bonn, October 11-13, 2006

Kroeger, T., Casey, F. (2007) An Assessment of market-based approaches to providing ecosystem services on

agricultural lands. Ecological economics 64 pp 321-332

Krome, M., Maurer, T., Weid, K. (2009) Building Sustainable Places: Federal Programmes for sustainable agriculture, forestry, entrepreneurship, conservation and community development. USDA Publication

Kruseman, G. (2001) Assessing the Effects of Policy Measures on Household Welfare and Agro-Ecological Sustainability: An overview of Farm Household Modelling Approaches. Economic Policy and Sustainable Land Use, Physica-Verlag, New York

Kruseman, G., Bade, J., (1998) Agrarian policies for sustainable land use: bio-economic modeling to assess the effectiveness of policy instruments. Agricultural System, 58:465-481

Kruseman, G van Keulen, H (2001) Soil Degradation and Agricultural production: Economic and Biopysical Approaches. Economic Policy and Sustainable Land Use, Physica-verlag, New York

Kruseman, G., Ruben, R., Hengsdijk, H., van Ittersum, M. (1995) Farm household modeling for estimating the effectiveness of price instruments in land use policy. Netherlands Journal of Agricultural Science, 43:111-123

Lal, R. (2001) Soil Degradation by Erosion. Land Degradation.Develop.12:519-539

Mbagwu, J.S.C (2003) Aggregate Stability and Soil Degradation in the Tropics. University of Nigeria Nsukka

McNeely, J.A. (2006) A new approach to Incentives under the Convention on Biological Diversity. Eighth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP8), Brazil, 20-31 March 2006. IUCN Information Paper

Mitchell, R.C., Carson, R.T (1989) Using surveys to value Public Goods: The Contingent Valuation Method. Resources for the Future, Washington D.C

Millenium Ecosystem Assessment (2005) Ecosystems and human well-being: Synthesis. Washington, DC: World Resources Institute

Pagiola, S., Arcenas, A., Platais, G. (2005) Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date. *World Development* **33:** (2): 237-253

Pagiola, S., Ramirez, E., Gobbi, J.,de Haan, C., Ibrahim, M., Murgueitio, E., Ruiz,J.,(2007) Paying for the environmental services of silvopastoral practices in Nicaragua. Ecological Economics 64, 374-385.

Rigby, D.; Howlett, D; Woodhouse, Phil. (2000) A review of Indicators of Agricultural and Rural Livelihood Sustainability. DFID WP Project No. R7076CA

Ready, R., Berger, M.C., Blomquist, G.C (1997) Measuring amenity benefits from farmland: hedonic pricing vs Contingent valuation. Growth and Change 28 (4), 438-458

Sara, J.S., Yadav, S (2006) Land degradation the developing World: Issues and policy option for the year 2020. Chapter 21

Shi M. and Chen, K (2004) Land degradation, government subsidy, and smallholder's conservation decision: the case of loess plateau in china. Journal of Zhejiang University SCIENCE 5 (12):1533-1542

Shiferaw, B., Holden, S. (1999) Soil erosion and small holders' conservation decision in the highlands of

Ethiopia. World Development, 27: 739-752

Swinton, S.M., Lupi, F., Robertson, G.P., Hamilton, S.T. (2007) Ecosystem services and agriculture: Cultivating agricultural ecosystems for diverse benefits. Ecological economics 64 pp 245-252

Westaneys C, Woodley, E (1998): Afforestation and Social Forestry in Northern Nigeria: a success

Economics Research Service, and Soil Conservation Service, Temple, TX

World Bank (2006): http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRCAAEXT/NIGERIA/EXT/0,,menuPK:368902~pagePK:1411159~piPK:141110~thesitePK:368896,00.html EXTN

WRI (2006) Paying for Environmental Performance: Using Reverse Auctions to Allocate Funding for Conservation: WRI Policy Note No 3

WRI , UNDP, UNEP, (2005) World resources 2005 : the wealth of the poor-managing ecosystems to fight poverty. Washington, DC: World Resources Institute

Wunder, S (2005) Payments for environmental services: some nuts and bolts. CIFOR occasional paper No.42 Center for story in desertification /land degradation control. UNEP Save the dryland project

Wiebe, K (2003) Linking Land Quality, Agricultural Productivity and Food Security. USDA /Economic Research Service. AER -823

Williams, J.R., Jones, C.A., Dyke, P.T. (1987) EPIC, the Erosion Productivity Impact Calculator, US Department of Agriculture, Agricultural Research Service, International Forestry Research, Jakarta, Indonesia.

Wunder, S (2006) Are direct payments for Environmental Services spelling doom for sustainable Forest Management in the tropics? *Ecology and Society* 11(2):23

Zhang, W., Ricketts, T.H., Kremen, C., Carney, K., Swinton, S.M. (2007) Ecosystem services and dis-services to agriculture. Ecological Economics 64 pp 253-260