An effective solution to mitigate greenhouse gases environmental sciences essay

Although Vietnam's greenhouse-gas emissions are relatively low, emissions would triple by 2030 without significant emissions-mitigation solutions being taken. In addition, if the country did not adapt to climate change, farmers' living conditions would be negatively impacted (Vietnamnet, 2012). In this context, Vietnam plans to decrease greenhouse gas emissions 20% by 2020 (from 2005 levels). However, farmers need more income which means that more emissions from agricultural sector would be created. So, how to mitigate greenhouse gases in agricultural sector that benefit rural farmers? The answer is carbon credits. Greenhouses gas emissions in agriculture can be reduced by such measures as changing the diet of livestock, collecting and recycling agricultural waste for biogas, and implementing water-efficient rice farming. By 'trading' carbon stored or emissions reduced, a carbon market provides a means to turn this useful activity into a profitable one (New agriculturalist, 2012).

Introduction

The issue of mitigating Green House Gas (GHG) emissions and trading carbon credits is quite new and an emerging field for the agricultural sector in Vietnam. However, 80% of Vietnamese households engaging in farming and agricultural waste endanger the environment because of fresh animal dung being discharged into open gutters and community waterways. This poses an urgency to reduce the GHG emissions in Vietnam. One of the biggest incentives on the horizon appears to be the sale of potential carbon credits (Dave, 2004). Many practices within the agricultural industry allow the opportunity for GHG emissions to be captured and measured (thebioenergysite, 2013).

1. An introduction to carbon credits

A carbon credit or a carbon offset is an instrument that represents a tonne of CO2 (carbon dioxide) or CO2e (carbon dioxide equivalent gases) removed or reduced from the atmosphere from an emission reduction project (climate friendly, 2013). In other words, a carbon credit is given for the reduction of every metric ton of carbon dioxide prevented from being emitted into the atmosphere from climate change mitigation projects. For example, hydropower projects replacing coal-fuelled plants, or that sequester carbon through afforestation. Industrialized countries pay the project. Credits are awarded to developing countries that, through these projects, have reduced their greenhouse gases below their emission quota. Developed countries buy these credits to help meet their emission target (Climateavenue, 2013). Industrialized country(Annex I) to meet quotaAfforestation projectin developing countryFigure 1: Emission trading and carbon credits. Source: Climateavenue, 2013

2. Why should carbon emissions be reduced in agricultural sector?

Greenhouse gases such as carbon dioxide and nitrous oxide are often believed to be associated with heavy industries and other activities that are powered by fossil fuels. However, agriculture has been shown to produce and release green- house gases such as carbon dioxide, methane, and nitrous oxide, which induce climate change (IRRI, 2013). Farmers in the lowland areas prefer to keep their rice fields continuously flooded because this has several benefits. For instance, it effectively suppresses the growth of weeds, thus eliminating the need for herbicides. It also promotes the rapid

decomposition of organic matter, which increases soil fertility without using chemical fertilizers. However, under flooded conditions, the decomposition of organic materials such as decaying rice roots, leaves, and straw or organic fertilizer consequently leads to the production of methane, a gas that is 25 times more effective in trapping heat in the atmosphere than carbon dioxide (IRRI, 2013). Figure 2. Share of agricultural to total emissionsSource: IPCC, 2007; based on global emissions from 2004. Vietnam remains a country relying heavily on agriculture. In 2010, approximately 63 per cent of the working population was in agriculture, it is projected that the share will be decreased to 59 per cent by 2020. Because of this high percentage of the population in Vietnam active in the agricultural sector, there is significant mitigation potential through improved agricultural practices (Vietnamnet, 2013). Figure 3: GHGs emission from Agriculture sector in Vietnam. Source: Nguyen, 2008. Despite the agricultural sector is a major contributor to Vietnam’s economy, it is a main contributor to environmental degradation in two important ways. First, it is the largest emitter of national greenhouse gas emissions, especially methane generated from livestock waste and wet rice cultivation. Vietnam ranks the second largest rice exporter in the world, providing around 16% of the world’s milled rice exports, and producing approximately 31% of the country’s overall GHG emissions as a result of rice cultivation (Ahuja, 2012). Second, the discharge of untreated livestock waste is contaminating the environment with high levels of pathogens, endangering the health of people and animals. In addition, over 40% of arable land is now degraded because of the heavy use of inorganic fertilizers and other unsustainable agricultural practices. To meet the demand for safe food and a healthy environment it is necessary for Vietnam to progressively

adopt the use of climate smart agriculture practices (NDF, 2013). Table 1: National GHG Inventories in Agriculture in Vietnam. Source: Nguyen, 2008. As Vietnam relies heavily on agriculture and with many of the poorest people living in rural areas, linking poor farmers to voluntary carbon markets could provide significant economic benefits from activities that reduce greenhouse-gas emissions. A a major greenhouse gas emitted in rice farming is methane. However, most of Vietnamese farmers do not have expertise on how to cut emissions during farming procedures. In addition, many of them lack sufficient knowledge about land reparation, water management, seed preparation, harvesting and fertiliser application. Therefore, improved farming practices, especially in rice cultivation could reduce greenhouse-gas emissions and genarate economic benefits for Vietnamese farmers (Ahuja, 2012).

3. How to mitigate greenhouse gases in agricultural sector that benefit rural farmers?

Climate change mitigation is known as activities to reduce emissions into the atmosphere, primarily carbon dioxide, methane and nitrous oxide (CAI, 2011). As can be seen from table 1, greenhouse gases are mainly emitted from rice cultivation and enteric fermentation and manure management. Consequently, emissions can be significantly reduced through the adoption of climate-friendly agronomic practices such as low carbon farming and bioenergy. Then carbon stored or emissions reduced traded brings millions of dollars to rural farmers (New agriculturalist, 2012).

3. 1. Low carbon farming practices

Low carbon farming practices and techniques can help to reduce GHG emissions and energy use on farm and improve resource efficiency. They not only have a positive environmental effect but will make farms generally more efficient leading to positive cost benefits as well (soilassociation, 2013). Key mitigation strategies including alternative wetting and drying (AWD) and direct seeding of rice could considerably reduce methane emissions. For instance, AWD could reduce emissions by 63 million metric tons CO2e with potential gains for farmers of US$627 million annually (new agriculturalist, 2013).

3. 1. 1. What does low carbon farming involve?

Low carbon farming involves the adoption of practices and techniques which lead to a reduction in greenhouse gas emissions and improved energy efficiency. In the agricultural sector, methane and nitrous oxide make up the majority of the total GHG emissions, contributing 54% and 38% respectively. However, these gases are released as a result of natural biological processes which mean they cannot be eliminated altogether. The cycles involved can be affected by farming practices and controlled and reduced to a certain extent (Soilassociation, 2013). Low carbon farming aims to primarily control and regulate methane and nitrous oxide through soil, livestock and manure management practices while concentrating on reducing fossil fuel and fertiliser use and maximising carbon sequestration to reduce carbon dioxide emissions (Soilassociation, 2013).

3. 1. 2. What are the benefits of low carbon farming practices?

Low carbon rice cultivation practices bring about development, environmental and climate co-benefits. Firstly, changes in rice cultivation practices help to reduce the costs of input materials and labor, and to improve crop yield thereby boosting farm profitability. Secondly, improved rice cultivation practices including changes in seeding practices such as drill seeding, water, fertilizer and residue management offer farmers the opportunity to capitalize on the carbon market because they shift to agricultural methods that are more sustainable, involve lower input costs and result in emission reduction and sequestration by sinks (Fairclimate, 2013). In addition, improved rice cultivation practices supports sustainable farming by encouraging farmers to adopt practices that minimize the use of synthetic fertilizers while, at the same time, improving soil carbon content. This is done through reduced tillage, anaerobic composting, using organic fertilizers, mulching, intercropping, multi-cropping, and a horde of techniques specially designed for particular regions, populations and climatic zones (Fairclimate, 2013). Changes in paddy-rice cultivation practices can benefit the environment because of the reduction in methane and nitrous oxide gases. Methane and nitrous oxide are potent greenhouse gases: they respectively trap heat an estimated 23 and 310 times more effectively than CO2 when considered over a 100 year timeframe. Over a 20-year timeframe, however, methane has an even stronger warming impact, estimated as 70 times that of CO2 (its lower 100-year warming impact is due to its relative short lifetime in the atmosphere) (Ahuja, 2012). Reduction of GHG emissions from changing rice cultivation practices will produce additional development

benefits derived from the sale of " carbon credits." These credits are a valuable commodity that can generate additional income for participating farmers and stimulate local economies. Carbon credits can be quantified and verified, then used to offset GHG emissions elsewhere. Initial buyers of carbon credits will likely companies or governments from Vietnam or from western countries who are interested in promoting low-carbon agriculture that benefits farmers (Ahuja, 2012).

3. 2. Biogas energy

3. 2. 1. What is biogas energy?

Biogas is commonly known as a gas which has been produced by the biological breakdown of organic matter without oxygen. The methane, hydrogen and carbon monoxide gases can be " combusted or oxidized" with oxygen thus the resultant energy release allows biogas to be used as a fuel (biofuelsassociation, 2013). In Vietnam, biogas is mainly produced from animal manure. This practice allows farmers to generate their own electricity and reduce the water contamination, odour pollution, and global warming emissions caused by animal waste (NRDC, 2013).

3. 2. 2. What is Biogas made from?

Biogas is a biofuel generated through the process of anaerobic digestion or the fermentation of biodegradable materials such as biomass, manure, sewage, municipal waste, rubbish dumps, septic tanks, green waste and energy crops. This type of biogas mainly consists of methane and carbon dioxide (Bioassociation, 2013). A typical type of biogas is 'landfill gas' (LFG) which is produced by wet organic waste decomposing under anaerobic

conditions in a landfill. The waste is covered and then compressed by the weight of the new material that is deposited on top. This material keeps the oxygen from escaping and helps the anaerobic microbes to thrive. The gas slowly builds up and is released into the atmosphere if the landfill site has not been engineered to " capture" the gas (Bioassociation, 2013). Figure 4: Biogas production. Source: Bioresource Technology, 2004

3. 2. 3. Benefits of Biogas Energy to the environment and the farmers

a. To the environment

With 25, 000 biogas plants completed by the end of 2006 in Vietnam, the estimated reduction of GHG in this country amounts to 75, 000 tons of CO2 per year. Together this equals the green house gas emission of over 500, 000 tourists flying from Amsterdam to Bangkok (Hedon, 2007). With huge greenhouse gas emissions being cut, biogas energy benefits the environment in three ways. Firstly, the air quality is improved significantly because of the reduction in the smell of manure, turning its volatile organic compounds (VOCs) into odorless methane and carbon dioxide. Hydrogen sulfide, the source of the " rotten egg" odor, is captured in the biogas and destroyed during combustion. Cleaner water is the second important benefit. Biogas plants reduce environmental load on surface waters as a result of averted discharge of untreated manure (Biogas Vietnam, 2013). Biodigesters reduce bacteria levels in animal waste, which means that any runoff to surface waters will be less harmful. Digesters also reduce biochemical oxygen demand (BOD), a measure of the ability of organic wastes to remove oxygen from water. Aquatic species depend on dissolved oxygen in water for

survival, so farms that reduce BOD help protect aquatic ecosystems. Thirdly, bio energy reduces the GHGs emissions by switching a high GHG emissions practice to a lower GHG emission practice. It substitutes synthetic fertilizer with the organic residue from the digestion process – bioslurry. It improves the sanitary conditions on the farms through connection of latrines to sewers or biogas digester and regular collection and treatment of animal manure from stables (Biogas Vietnam, 2013).

b. Economic benefits to the farmers

Biogas plants generate more income from animal raising. Thanks to a biodigester, the environment is protected, a household can raise more animals and generate more income. For some households, animal husbandry will bring in 60-75% of their total income (Bioassociation, 2013). In addition, Biogas plants helps farmers to save fuel. Biogas replaces firewood and coal for the entire family’s needs for cooking and electricity for lighting produced by a generator using biogas. This represents a direct yearly saving of $80 to $200 for those previously buying all their fuel (Bioassociation, 2013). Biogas helps to create a sustainable agricultural practice. Fertilisers generated by the bio-digestion process have high nutrient value, and are safe to use on fruit trees, fishpond, rice paddies and vegetable gardens and are preferable to chemical fertilizers (Bioassociation, 2013). However, the significant benefit that could encourage farmers to apply biogas practice is carbon credits. Since methane is the most " potent" GHG emission, farmers get paid from the amount of CH4 that they could reduce by carbon offset trading companies (NRDC, 2013). The Clean Development Mechanism (CDM), one of the agreements of the Kyoto Protocol, opens the opportunity to capitalize on

green house gas emission reduction. In a carbon market, developing countries can sell their quantity of green house gas emission reduction (Certified Emission Reductions) to carbon offset companies and generate revenues. Carbon offset companies have been on the rise because of the growing demand from companies and individuals desiring to reduce their environmental impact by " offsetting" the emissions they produce in their everyday activities. These companies sell " carbon credits" to interested parties, and use the proceeds to pay others to reduce their global warming pollution companies (NRDC, 2013). This mechanism will generate funds for the biogas programmes to reduce the farmer’s investment costs (Teune, 2007).

4. Conclusion and recommendations

Trading carbon credits seems to be an effective tool to encourage farmers to engage in agricultural practices that can mitigate GHG emissions and benefit themselves. However, to capture those elusive dollars associated with carbon credits, a few things need to do. Firstly, the agricultural industry should take a leading role in helping farmers to gain a sound understanding of the causes and impacts of climate change given the predicted economic impacts in the years to come because it is reported that millions of farmers are not familiar with several concepts relating to climate change. In addition, in order for farmers to buy into the idea of conservation farming, the benefits which are not only for the present generation, but for generations to come should be well articulated. Additionally, the agricultural industry should take full advantage of positive support from the government

and nongovernmental organizations enhance and expand the application these environmentally friendly practices.