Available Online at http://www.journalajst.com

ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 5, Issue 5, pp. 285-291, May, 2014

RESEARCH ARTICLE

AWARENESS CAMPAIGN AND MITIGATION STRATEGIES ON CLIMATE CHANGE: A UNIVERSITY OF NORTHERN PHILIPPINES INITIATIVE

[1]Manuel Bajet, Jr., [1]Joussie B. Bermio, [1]Crizzle B. Paz and [*2]Junel Bryan Bajet

[1]University of Northern Philippines, Tamag, Vigan City, Ilocos Sur, Philippines
[2]St. Louis University, Baguio City, Philippines

ARTICLE INFO

Article History:
Received 07th February, 2014
Received in revised form
07th March, 2014
Accepted 14th April, 2014
Published online 20th May, 2014

Key words:
Campaign,
Aware,
Mitigate climate change

ABSTRACT

This study focused on the initiatives of the University of Northern Philippines (UNP) on awareness campaign and development of research-based technologies as mitigating strategies to climate change. Awareness on climate change was conducted to several communities to increase awareness especially the refrigerant and air conditioning sector in Region I and in Northern Luzon. The campaign was done through seminars, for a and IEC distribution on developed technologies as a means of information dissemination. The development of Refrigerant Recovery and Recycling Machine played an important role in minimizing the ozone depleting substances to vent into the air and primary destroy the ozone layer. Through the UNP Extension Program, the utilization of technologies contributed to the improvement of farmers productivity while at the same time mitigating climate change as the community became aware of environmental problems. Further, the organic agriculture is one way of mitigating climate change. To influence farmers to go into organic farming, machines for organic fertilizer production were developed and has been adopted by several communities in Ilocos Sur. The shift of farmers from conventional to organic farming assured food security as well as reduction of the emission of greenhouse gas from agricultural sector that caused damaged to the ozone layer.

INTRODUCTION

Ozone depletion describes two distinct but related phenomena observe since the late 1970s. A steady decline of about 4 percent per decade in the total volume of ozone in Earth's Stratosphere (the ozone layer), and a much larger springtime decrease in stratospheric ozone over earth's polar regions. The latter phenomenon is referred to as the ozone hole. In Addition to these well known stratospheric phenomena, there are also springtime polartropospheric ozone depletion events. The details of polar ozone hole formation differ from that of mid-latitude thinning, but the most important process in both is catalytic destruction if ozone by atomic halogens. The main source of these halogens atoms in the stratosphere is photo dissociation of manmade halocarbon refrigerants (CFCs Freon halons). These compounds are transported into the stratosphere after being emitted at the surface. Both types of ozone depletion were observed in increase as emissions of halo-carbons increased. CFCs and other contributory substances are referred to as ozone depleting substances (ODS). Since the ozone layer prevents most harmful UVB wavelengths (280-315nm) of ultraviolet light (UV light) from passing through the Earth's atmosphere , observed and projected decreases in ozone have generated worldwide concern leading to adoption of the Montreal Protocol that bans the production of CFC's halons and other ozone-depleting chemicals such as carbon tetrachloride and trichloroethane. It is suspected that a variety of biological consequences such as increases in skin cancer, cataracts. Damage to plants and reduction of plankton populations in the ocean's photic ozone may result from the increased UV exposure due to ozone depletion.

Refrigeration industry is one of a large user of electricity energy that continuously contribute to the global warming because of the energy waste such as the use of conductors, insulators and heat emitted by refrigerating units. Thus, refrigeration sector plays a vital role in the implementation of Montreal Protocol to phase out ozone depleting substance (ODS). The success in the compliance in the implementation of the local policies greatly dependent to this sector. It is to ensure low leaks of refrigerant and lowest energy consumption to hasten the impact on the environments of ODS and global warming as well as the indirect effect of carbon dioxide emissions caused by energy consumption. Chlorofluorocarbons (CFCs) is identified as ODs which are used for refrigerator equipment. However, CFCs have the potential to destroy ozone in the atmosphere if there is an absence of refrigerant recovery and recycling that often lead to the emission of a significant proportion of the refrigerant directly into the atmosphere. In developing countries, CFCs has been phased out beginning since 1996 and are given a grace period from July 1999 for the first control measures the

Corresponding author: Junel Bryan Bajet
St. Louis University, Baguio City, Philippines

freeze in the production and consumption, the total phase-out of CFCs in 2010. In the Philippines, DENR Administrative Order No. 08-Series 2004 is a Chemical Control Order aligned with the policy of the State. It is purpose is to regulate, control, restrict or prohibit the import, export, use, manufacture, distribution, processing, storage, possession and sale of Ozone Depleting Substances to abate or minimize their risks and hazards to the stratospheric ozone, public health, and the environment. Thus, the phasing-out of CFS in the refrigeration sector could be best achieve if there is integrated effort the refrigeration sector and other agencies including the academe who have a big role in doing public awareness campaigns and trainings especially to owners and services technicians of refrigeration shops. The University of the Philippines (UNP) is a state university who's mandate is not just to provide quality education but also a partner in countryside development through its sustainable programs focused on economic development, health, technology adoption and environment among others as the priority programs. UNP had took its part in responding to the current global problem-the climate change in the refrigeration sector in the locality and in the Region in general. It was done through the development of a prototype refrigerant recycling and recovery machine which was utilized through its extension program in the awareness campaign on Ozone Depleting Substances in accordance with the International and Local protocols as well as its effect on global warming.

Moreover, agricultural sector in the community was also assisted by teaching them organic farming using the prototyped machines of the university for organic fertilizer production. Organic farming is a sustainable agricultural practices which can provide synergistic benefits that include mitigating climate change. In the 2002 report of the United Nations Food and Agriculture Organization (FAO), organic agriculture enables ecosystems to better adjust to the effects of climate change and has major potential for reducing agricultural greenhouse gas emissions. Further, it has been found out in FAO report that, "Organic agriculture performs better than conventional agriculture on a per hectare scale, both with respect to direct energy consumption such as fuel and oil and indirect consumption of synthetic fertilizers and pesticides", with high efficiency of energy use(www.i-sis.org.uk/mitigatingClimateChange.php*)*.

In the United States, agriculture contributes 7.4 percent of the national greenhouse gas emissions. Livestock enteric fermentation and manure management account for 21 percent and 8 percent respectively of the national methane emissions. Agricultural soil practices, accounts for 78 percent of the nitrous oxide emitted. In the UK, agriculture is estimated to contribute directly 7.4 percent to the nations greenhouse gas emissions, with fertilizer manufacture contributing a further one percent, and is comprised entirely of methane at 37.5 percent of the national total and nitrous oxide emissions are dominated by synthetic fertilizer application and leaching of fertilizer nitrogen and applied animal manures to ground and surface water. A study in New Zealand had suggested that methane output of sheep on the changed diet could be 50 percent lower. The UK study did not achieve this level of reduction, but found nevertheless that "significant quantities" of methane could be prevented from getting into the atmosphere. Growing clover and birds foot trefoil could help naturally fix nitrogen in organic soil as well as reduce livestock methane. Soil are in important sink for atmosphere CO2, but this sink has been increasingly depleted by conventional agricultural land use and especially by turning tropical forests into agricultural land. (the Stern Review on the Economic of Climate Change Commissioned by the UK Treasury 2007. Sustainable agriculture helps to counteract climate change by restoring soil organic matter content as well as reducing soil erosion and improving soil physical structure. Organic soils also have better water. Holding capacity which explains why organic production much more resistant to climate extremes such as droughts and floods (Organic Agriculture Enters mainstreams, organic yields on Pas with Conventional and Ahead during Drought years, Sis), and water conservation and management through agriculture will be an increasingly important part of mitigating climate change. The evidence for increased carbon sequestration in organic soils seems clear. Organic matter is restored through the addition of manures, compost, mulches and cover crops. Thus, this paper documented the effort of the University in the awareness and mitigation campaign on climate change.

Objectives

University of Northern Philippines community extension service generally aims for countryside development in a way that is economically viable, ecologically sustainable and responsive to the current needs of the local communities. Specifically, to evaluate the UNP initiatives on its awareness campaign on climate change through:

1. Increasing awareness on climate change cutting across different sectors in the community.
2. Using research-based developed machines utilized in mitigating climate Change and towards sustainable development.

MATERIALS AND METHODS

An evaluation type of research had been utilized to determine the merit on the initiatives of the University of Northern Philippines on its awareness and mitigation strategies on climate change. Activities were done by developing a research-based technologies. One is the Refrigerant Recovery and Recycling Machine which is utilize in the awareness campaign on Ozone Depleting Substances (ODS) and the global warming. The project is in collaboration with the Department of Science and Technology and the refrigeration sector in Region I. Other prototype machines developed were for the production of organic pesticides and fertilizers. The machines were utilized to influence farmers to adopt a sustainable way of warming which is organic farming.

RESULTS AND DISCUSSION

Mitigating Strategies on Climate Change

Development of fabricated machines

The function of the Mechanized Refrigerant Recovery and Recycling Machine is mitigating climate change in preventing the emission of the ODS into the atmosphere. This machine has also the ability to recycle, restore virgin refrigerant making it substance reusable in the same or to another units

and this reduces the use of ODS. On the other hand, the contaminated refrigerant substance will be keep until the chemical component will cease or subside making the substance not hazardous to human and to the environment. This process makes the machine significant in protecting everybody's health, in our environment and mitigates global warming. The Mechanized Refrigerant Recovery and Recycling Machine was utilized on the awareness campaign related to ozone depleting substances and climate change. The design of this machine was also distributed to refrigeration and air conditioning shop owners and service technicians to influence them by using design since easily be followed and fabricated using locally available materials. In this way, handling of ODS can be properly manage that will not cause additional damage to them being in direct contact on the chemicals as well as to the environment in general. The machine could be used for several purposes; for vacuuming cooling units like refrigerators and air conditioners. In the recovery of refrigerant from malfunctioning cooling units to the refrigerant tank. In the recovery and recycling of refrigerant from cooling units to another unit such that those ODS will be properly disposed such that it will not go to the atmosphere and cause additional damage the ozone layer, and in the cleaning of its own piping system (self-vacuuming). This operation is very important to avoid contamination of the refrigerant or Freon from the atmosphere.

Figure 1. Mechanized Refrigerant Recovery & Recycling Machine

Waste management through organic fertilizer production using UNP fabricated machine

To influence farmers to go into organic farming which is was more energy efficient, machines for organic fertilizer production were developed and tested by the University. The machines were utilized and adopted by several communities in Ilocos Sur. In this way, farmers started to adopt the technology and that emission of greenhouse gas is minimized because globally, agriculture is estimated to contribute directly eleven percent to total greenhouse gas emissions that contributes to the depletion of the ozone layer (2005 figures from Intergovernmental Panel on Climate Change). Also, in sustainable agriculture it tries to balance the effect of climate change by restoring soil organic matter content as well as reducing soil erosion and improving soil physical structure. Organic soils also have better water-holding capacity, which explains why organic production is much more resistant to climate extremes such as droughts and floods and water conservation and management through agriculture will be an increasingly important part of mitigating climate change (*www.i-sis.org.uk/mitigatingClimateChange.php)*.

Figure 2. Field demonstration on organic fertilizer production

Agricultural facilities developed by the UNP for mitigating Climate Change through Organic Fertilizer Production for Sustainable Agriculture

Dual powered foliage chopper is a machine operated by foot through a pedal or by an electric motor (Rabena and Bajet, 2007). This machine promoted organic farming in 2008 through the use of botano-pesticides and biofertilizers, composed of kakawate (*Gliricidasepium*), neem leaves, lagundi, "males' mabukay" horse radish, farm waste, animal wastes and environmental wastes. It could serve other purposes like chopping Sargassum seaweeds used as supplement feeds for chicken and for pulverizing bio-fertilizer for easer mixing.

Figure 3. Dual Powered Foliage Chopper

Multiple foliage chopper prototype was fabricated due to the persistent request of the local governments of Burgos, Sta. Maria and Sto. Domigo and the Provincial Agricultural Office of Ilocos Sur through the expressed need of corn growers in these municipalities (Bajet and Esguerra, 2010). Similar to the dual powered foliage chopper, this machine also addresses environmental and agricultural concerns in support to R. A. 100681. It hastens the decomposition of biodegradable garbage, like twigs, branches, fruit peelings and other forms. It is powered by 7.5 hp diesel engine. It could chop whether fresh or dried materials in an average speed of 100 kilograms

in ten (10) minutes. Bio fertilizer pulverize machine was conceptualized to address the problem of mixing organic fertilizer constituents (Bajetet.al., 2010) It facilitates the mass production for faster packaging and distribution. It was made of rows or metals, like sheets, pipes and bars, hard steel, shafting, blocks, bolts and nuts. The housing frame is 80 cm wide, 120 cm high and 140 cm long. There are two compartments, the clipper hopper and the pulverizer, together extending 60 cm long. It has a detachable rotor powered by a 3-hp gasoline-fed engine and with attached blades inclined 25^{o} and a paddle with three blades. At the lower left side is the chute which is directly connected to the movable screen. The screen has two layers. The wire mesh screens and separates the unchipped materials from the finely pulverized ones. At the chute a sack is installed for automatic packing of the graded organic fertilizer. The unchipped portions will be refeeded to the machine for finer particles. It can process an average of 64 sacks of bio-fertilizers in an hour with 3 laborers, while if done manually with the same number of workers, only 3 sacks are processed per hour in poorer quality.

Figure 4. Multiple Foliage Chopper

Figure 5. Bio Fertilizer Pulverizer

Rice hull carbonizer is a recycled gadget made out of perforated old liquefied petroleum gas container and old galvanized iron pipe (Gascon and Bajet, 2010). Carbonization is partial combustion of biomass. As the process starts by igniting combustible materials inside the tank, which is the ignition chamber, it would then be covered with the rice hull to make the mound. Draft force that pulls the smoke through the chimney would continually draw air to carbonize the rice husk. When the rice hull surrounding the chamber turns black, then they should be swept away to give way for another volume of rice hull to be carbonized, which will be mixed with chicken dung and animal wastes, and form an important part of the organic fertilizer. Carbonized rice hull is best for nurseries as a soil media for mass production of planting materials such as ornamental plants.

Figure 6. Rice HullCarbonizer

Awareness Campaign

Refrigeration sector

Awareness campaign on the effect of ozone depleting substances, global warming, climate change, health and environment were done by developing and production of IEC materials, radio program and lectures conducted during trainings, seminar and for a Participants during the awareness campaign includes the students, professionals, service technicians and owners from the refrigeration sector.

Figure 7. Field demonstration on refrigerant, recovery and recycling machine

Lectures during the awareness campaign related to climate change includes discovery of the Antarctic "Ozone hole in 1985". Scientific evidence confirmed that ozone damage are caused by man-made compounds specially the chlorofluorocarbon a miracle compounds in a chemical industry and was identified as the leading cause of the ozone depleting. Also, legal policies related to refrigeration sector such as the Department of Environment and Natural

Table 1. Properties of some selected substitute to replace CFCs (CFC-12, R502)

Substance	ODP (R11=1)	GWP (CO2=1)	Oil	Flammable	Boiling Temp.	Application	Temp. Glide
CFC-12	1	8,100	Mineral	No	-30	Domestic refrigeration, centrifugal chiller, industrial refrigeration	No
HFC-134a	0	0	Synthetic	No	-26.1	Domestic refrigeration, centrifugal chiller, industrial refrigeration	No
R290/600a	0	0	Mineral	Yes	-30	Domestic refrigeration	8K
R 401A	0.037	1,100	Synthetic	No	-33	Industrial refrigeration	<4K
R409A	0.048	1,400	Synthetic	No	-34	Industrial refrigeration	<6K
R502	0.23	5, 500	Mineral	No	-45.6	Commercial refrigeration	No
R404a	0	3,700	Synthetic	No	-47	Commercial refrigeration	<0.5
R507	0	3,800	Synthetic	No	-47	Commercial refrigeration	No

Table 2. Participants attended awareness campaign on climate change using the Mechanized Refrigerant Recovery and Recycling Machine

Particulars	f	rf
D.O.S.T.) Lecture and demonstration attended of different) DTI accredited refrigeration shops/ technician/ professionals, students, etc. DOST - Northern Luzon cluster	300	62.89
DOST- Region 1 -owners/ service technicians refrigeration sector	76	15.93
(D.O.S.T.) lecture and demonstration attended of different) DTI accredited refrigeration shops/ technician	42	8.80
Students in 1 year special course 2008-2009	7	1.47
Students in BSIT-IV 200-2009	2	0.42
Students in one year special course RAC 2009-2010	12	2.52
Students BSIT-IV 2009-2010	7	1.47
RAC 2010-2011	9	1.89
BSIT-IV 2010-2011	5	1.05
RAC 2011-2012	7	1.47
BSIT-IV 2011-2012	10	2.09
Total	477	100

Table 3. Adopters of the different machines for organic fertilizer production and participants on the series of trainings conducted related to organic farming

Type of the Machine	Community Adopted	f	rf
Dual Powered Foliage Chopper	The machine is utilized by communities of Pantaydaya, and Rugsuanan, Vigan, Sto. Domingo, Lidlida, and Bantay, Ilocos Sur and Ayusan FITS Center, in Vigan City.	138	14
Multiple Foliage Chopper	Utilization of this machine was adopted by Quimarayan, Sto. Domingo and Burgos communities in Ilocos Sur.	48	15
Bio Fertilizer Pulverizer	Communities adopted utilized this technology were Quimarayan, Sto. Domingo and Santa, Ilocos Sur.	26	8
Rice Hull Carbonizer	Vigan, Quimarayan, Sto. Domingo, Santa and San Mariano, Bantay, Ilocos Sur and Ayusan FITS Center in Vigan	113	35
TOTAL		325	100

Resources Administrative Order No. 08 serves of 2004, that re-used Chemical Control Order for ODS in the pursuant to the provisions of Executive Order no. 192, serves of 1987 Republic Act No. 6969 and Resolution No. 28 dated march 10, 1993 of the Senate of the Republic of the Philippines notifying the Copeuhageu amendments, and to strengthen the legal infrastructure to support the implementation of the Philippine National CFC –"chlorofluorocarbon phase out. Participants were also informed by citing provisions of the DENR-Administrative Order No.08 series 2004 specifically on sections 4 to 10 which identify penalties in violation of this chemical controlled order particularly on: a) back conversion, b) Installation of CFC-using systems, c) sale and used of small disposable containers with CFCs d) importation or manufacturing, e) used of CFCs in mobile air-conditions starting 2012 in all motor vehicles, f) used of CFC-11 as blowing agent for foam manufacturing, g) international release/verifying of ODS when servicing equipment and f) industry with ODS shall be penalized under DAO 2004-08 section 12 that any person, natural or juridical, who violates the chemical controlled orders shall be penalized in accordance with the scheduled of fines and other related sanctions, and cancellation of certificates of the service shops and of the technicians. It is a must that all refrigerant with composition of Chlorofluorocarbons are to be recovered using Refrigerant Recovery and Recycling Machine. It is also use to recover refrigerant from refrigerator or air conditioning system, to decommissioned and the recovered refrigerant is pumped into a cylinder for storage. Also, the machine cleans the recovered refrigerant to a given standard, the recycle refrigerant is pumped into a refillable cylinder, and or to recharge the recycled refrigerant back into the serviced refrigeration system instead of emitting to the atmosphere that destroyed the Ozone Layer. From the above analysis, it should be stressed that CFC recycling only plays a marginal role in reducing the use of virgin CFC. The most promising prospect for reducing the application of CFC-12, R22 and R502 is the retrofitting technology of refrigeration equipment under operation and the decomposition of the recovered CFCs. Refrigerants that are considered to be appropriate substitute

especially in the domestic sector, the commercial and industrial refrigeration sector are available. Natural refrigerants are important because they reduce the depletion of the Ozone Layer and reduce the impact of the Greenhouse effects. The mixture of R290/600a applied to retrofit domestic appliances is most promising because the originally used minerals oil is compatible with the new refrigerant. The refrigerant R290/600a as retrofitting substitute allows the operation of the old refrigerator without any modification. The mixture of R290/600a has the advantage that the less than half of the original quantity of CFC-12 is required due to its much lower density, which reduces the risk of accidents with the flammable substitute. A drawback results from the temperature glide, which avoids that some application of refrigerators (two evaporators in serial connection) cannot be retrofitted this way. Further, the machine is domestically inspired and demand driven technology developed since the main objective of the machine during the prototyping period was presented to the 78th DTI- accredited refrigeration shops all over in Region I to professionalize the recovery and recycling of refrigerants, the DOST who funded the prototyping of the machine requested the researchers through the University of Northern Philippines for a face to face sharing of knowledge and conducted demonstration of the prototyped machine DTI-accredited refrigerators shops owners, service technician and other TESDA trainees.

Figure 8. MRRM on Recovery Process

Also, students and the instructors have an involvement through social mobilization thru face to face communication and emerging the students into a shared experience that helped them enhance their knowledge and skills in the manipulation of the machine. It includes manipulation of the four distinct functions of the machine namely: vacuuming refrigeration and air conditioning unit, recovery of refrigerant from malfunctioning cooling units to the refrigerant tank, in the recovery and recycling of refrigerant from malfunctioning units to the another unit and in the cleaning of its own piping system (self vacuuming) of the machine.

Farmers sector on organic fertilizer production

Awareness to farmers was anchored on the practice of organic farming as one way of mitigating climate change. Information were provided to farmers where in through sustainable agriculture, it helps counteract climate change by restoring soil organic matter content as well as reducing soil erosion and improving soil physical structure. Organic soils

Figure 9. During a lecture forum on Awareness Campaign

Figure 10. Field demonstration on organic farming machine

also have better water-holding capacity making organic production much more resistant to climate extremes such as droughts and floods. Farmers were encouraged to gradually shift to organic farming because modern agriculture has been found out contributing to global warming. It is because the use of synthetic fertilizers and chemicals agriculture becomes a source of green house gasses such as nitrous oxide and methane and the use of fossil fuel contributes to the loss of soil carbon and it continue to loss when conventional way of farming continue. Also, part of the awareness campaign was the financial benefits that the farmers could possibly earn by shifting their production process in an organic way by reducing the cost of production such as the use of synthetic fertilizers and chemicals. Thus, farmers from different communities as shown in Table 2 were trained to make botano pesticide/insecticide, organic fertilizer and carbonized rice hull. For the farmers to easily understood the technology, field demonstrations were done to different partner communities. Farmers cultivating rice, corn, grape growers were benefited from the said trainings and field demonstration. IEC materials were also developed and distributed added form of information to farmers.

Conclusion

The developed research-based and a demand driven technologies by the University of Northern Philippines played an effective tool in the awareness campaign on climate change to its service communities. Technologies developed had been an instrument for the refrigerant and farmer sectors in understanding the global warming and at the same time served as a mitigating strategy for climate change. The increase of awareness on climate changed among different sectors is evident by the adoption of the technologies

developed by the University. On the other hand, the radio program and other information drives such as IEC distribution and participation to forum widens the number of individual that had been reached out by the University for the community to be aware on climate change and to responded in mitigating climate change.

Recommendations

Continued collaboration with other government agencies in the campaign for the phasing out of ozone depleting substances (ODS). A follow-up study on the utilization of ODS in the refrigerant sectors since there had been already a policy to phase-out the said chemicals. Also the compliance on the Chemical Control Order in the Philippines. A follow-up on the community adopters to documents other benefits they had derived from the technology developed.

REFERENCES

Bajet Manuel et al 2011. Community Adoption of Organic Machine, Asian Journal Vol.5

Benedick, Richard Elliot 1991. Ozone Diplomacy: New directions in safeguarding the planet.

Cambridge: Harvard University Press. ISBN 0-674-65001-8. (Ambassador Benedick was the Chief U.S. Negotiator at the meeting that resulted in the Montreal Protocol.)

David L. Downie 2012. "The Vienna Convention, Montreal Protocol and Global Policy to Protect Stratospheric Ozone", in P. Wexler et al. (eds.) Chemicals, Environment, Health: A Global Management Perspective. Oxford: Taylor & Francis.

Dotto, Lydia and Harold Schiff 1978.The Ozone War. New York: Double Day.

Downie, David 1993. "Comparative Public Policy of Ozone Layer Protection." Political Science (NZ) 45 (2): (December): 186-197.

Downie, David 1999. "The Power to Destroy: Understanding Stratospheric Ozone Politics as a Common Pool Resource Problem", in J.Barkin and G.Shambaugh (eds.) Anarchy and the Environment. Albany: State University of New York Press.

Downie, David 2013. "Stratopheric Ozone Depletion. "The Routledge Handbook of Global Environmental Politics. New York: Routledge.

Hasek, Pam, David Downie, and J.W. Brown 2013. Global Environmental Politics, 6th Edition, Boulder: West view Press.

Litfin Karen 1994. Ozone discourses: Science and politics in global environmental cooperation. New York: Columbia University Press. ISBN 0-231-08137-5

Morissette P.M. 1989. "The evolution of policy responses to stratospheric ozone depletion "Natural Resources Journal 29: 193-820.

Parson. Edward 2003. Protecting the Ozone Layer: Science and Strategy. Oxford: Oxford University Press.

www.i-sis.org.uk/mitigatingClimateChange.php Mitigating Climate Change through Organic Agriculture and Localized Food Systems

****