CARBON FOOTPRINT OF AN ORGANIZATION: A CASE STUDY, FACULTY OF AGRICULTURE, UNIVERSITY OF RUHUNA

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Abstract

In order to identify the organizational impact on global warming, an analysis was carried out using planned CO_2 inventory with setting organizational and operational boundary under three scopes, according to GHG protocol. Carbon Footprint was calculated by using emission factors, obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Most relevant and appropriate emission factors for Sri Lankan conditions were selected by using assumptions to increase the transparency of the study. Results show that total CFP of the Faculty is 418.5 t CO_2-e/yr. Average CFP per person in the Faculty is 0.571 tCO_2- e/yr. Transportation accounts for highest percentage, 37%, followed by electricity consumption having 27%, handling of farm animals with 22% and waste disposal is 11% of the total CFP. Other sources and activities show small portion of the total, such as stationary combustion sources accounts 2%, water consumption from outside water plants having 1% and rice cultivated area with 0.04%. It is concluded that calculated CFP is low compared to the estimates available worldwide. Net CFP of Faculty may be less than calculated value, as Faculty has further contributed to reduce and offset its CFP through adapting to the eco friendly activities and available natural forest cover with in the Faculty.

Keywords: Carbon footprint, Emission factors, CO_2 inventory, Renewable energy. Carbon offset

1. INTRODUCTION

Global warming is the name given by scientists for the gradual increase in temperature of the Earth's surface that has worsened since the industrial revolution. Over the past two decades the effect has become more marked. Considerable evidence exists that most of this warming B human have altered the chemical composition of the atmosphere through a buildup of greenhouse gases (GHG) such as primarily carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

If no actions to be taken against it, the world have to face many problems such as rising global temperatures will cause sea level to rise and alter local climate conditions, affecting forests, crop yields, and water supplies. It may also affect human health, animals, and many types of ecosystems. Deserts may expand and some of our countryside may be permanently altered. Therefore it is needed to identify how the human personally or organizationally react on global warming. Calculating Carbon footprint (CFP) is the valuable first step towards making quantifiable emission reduction. CFP measures the total set of GHG emissions caused directly and indirectly by a person, an organization, an event or a product in a given time probably a year, is measured in tones of CO_2 equivalent (CO_2-e).

A CFP Analysis is one of the most effective and important steps, an organization can take into account for lowering its CFP. Faculty of Agriculture at University of Ruhuna is an organization which releases some GHGs from different activities such as electricity usage, water usage, employee and student commuting, and other business travel. Not only that but also there are some cattle population and paddy fields which may release some GHGs in to the atmosphere. Therefore it is very important to calculate the CFP of Faculty of Agriculture. Besides quantifying organizatio
organization with a comprehensive GHG inventory, allowing it to identify and target

reductions from its major emissions sources. As well this analysis will participate in global CFP reporting and public disclosure initiatives and determine the business case for carbon neutrality or other internal emission reduction targets

OBJECTIVES OF THE STUDY

- To assess Carbon footprint of Faculty of Agriculture
- To find available methods and suggestions to reduce and offset Carbon footprint in the Faculty

2. METHODOLOGY

2.1 PLANNING OF CO_2 INVENTORY

To plan a CO_2 Faculty, a list of CO_2 emission sources of offices and their quantities were considered. F marked according to the GHG B marked by considering all operations which generate emissions.

The buildings of Faculty of Agriculture are located in more than one location, and CO_2 emissions generated at each location was recorded. According to that, emissions sources and activities of Dean office, six department buildings, hostels, bachelor quarters, canteen, library, security offices, farm house and computer unit were included for CO_2 inventory of Faculty of Agriculture. As well as the Faculty as a whole owns all its operations, its organizational boundary are the same, whichever approach is used. Therefore, the attention was not paid for the equity share approach and control approach.

To determine the Faculty

GHG Protocol, were used as shown in Table 1. All emissions sources and activities within the chosen boundaries were included according to data availability to fulfill principle of completeness. However, some emission sources and activities, such as waste water, paper and other organic waste disposal, air travel and HFC emission from air conditioners were excluded due to data unavailability.

Table 1: Emission sources of Faculty under the three scopes

Scope	Activities
Scope one Direct emissions	Combustion of LPG in furnaces for generating of heat within the faculty Combustion of diesel for Generating electricity in generators within the faculty. Business travel in vehicles that are owned by the Faculty such as cars, three wheelers, tractors Employee commuting in faculty owned vehicles, such as cars CH_4 emissions from farm animals CH_4 emissions from waste disposal
Scope two Indirect emission	Generation of purchased electricity
Scope three Indirect emissions	Business travel in outside vehicles such as rental cars, van employee cars, trains Combustion of fuel (LPG) in furnaces not owned by Faculty. (canteen, hostels) Employee commuting in vehicles not owned by the Faculty such as cars, train, buses, and bikes

	Usage of pipe born water

GHG boundary includes CO_2, CH_4 and NO_2 emissions arising from fuel combustion and CH_4 emissions from waste disposal to landfill, farm animals and paddy field in the Faculty.

2.2 DATA COLLECTION

Two kinds of data were identified as activity data and emission factors (EF) for each emission source. EFs were developed from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories using most relevant and appropriate values for Sri Lankan conditions with appropriate assumptions to increase the validity of the study. Activity data were collected from different types of primary and secondary sources as given in Table 2.

Table 2: Parameters and Sources for activity Data in the Faculty

Aspects	Parameters of activity data	Source
	Annual Electricity consumption (kWh)	Electricity bills
	Operating time of electric equipment (hr)	personal communication
Premises-Electricity	Energy efficiency of (watts)	label of equipments
Premises- LPG	Annual LPG consumption (kg)	invoices
Premises-Generator	Annual Fuel consumption (l)	running chart
	Annual Fuel consumption (l)	running chart
	Distance traveled (km)	running chart
	Average fuel efficiency of Vehicles	personal communication
Transportation	Type of vehicle	running chart
	Distance traveled annually (km)	questionnaire
	Average fuel efficiency of Vehicles	questionnaire
	Type of vehicle	questionnaire
	No of days per week traveled	questionnaire
	No of weeks per year worked in the Faculty	questionnaire
	Type of fuel	questionnaire
commuting	Average No. of persons	questionnaire
Waste disposal	Annual Food waste generation (kg/person)	personal communication
	No of animals	farm data sheet
Farm animals	Age of animals	personal communication
Rice cultivation	Area of land cultivated (ha)	farm data sheet
Water usage	Water consumption annually (m3)	Water bills

2.3 *CALCULATING CFP*

CFP was calculated using common equation (1). EFs were developed using assumptions according to IPCC Guidelines for National Greenhouse Gas Inventories, 2006. Then EFs were converted into CO_2-e per unit of activity data, as the common unit of CFP, using equation (2).

$$CFP = \text{activity data} \times \text{emissions factor} \quad (1)$$

$$EF_{CO2\text{-}e} = (W_{CO2} \times GWP_{CO2}) + (W_{CH4} \times GWP_{CH4}) + (W_{NO2} \times GWP_{NO2}) \quad (2)$$

Where,

$EF_{CO2\text{-}e}$ = Emission factor in g CO_2-e/unit of activity data
W_{GHG} = Amount of GHG emission/unit of activity data
GWP_{GHG} = Global Warming Potential of the relevant GHG

Types of activity data depended on the data availability.

2.3.1 CALCULATING CFP FOR FUEL COMBUSTION FOR STATIONARY AND MOBILE SOURCES

The EFs were assumed based on full oxidation of the fuel. In stationary combustion, there were no any variation of emission of GHGs, due to combustion technology, operating conditions, control technology, quality of maintenance, and age of the equipment used to burn the fuel and country-specific data. For example carbon contents of the fuels used carbon oxidation factors, fuel quality and the state of technological development were considered as no variation. As well EFs were assumed as common one for both stationary and mobile combustion sources. Therefore in mobile combustion, there was no any variation of emission of GHGs due to vehicle type, age, emissions control technology, and operating conditions for example of urban or rural road type, climate, or other environmental factors.

The amount of fuel, used for transportation by Faculty owned vehicles, heating by LPG, and power generation by diesel, was considered as activity data for calculating fuel based CFP. As the amount of fuel, used for employees traveling by the outside vehicles, and employees and students commuting, were not known, calculating of CFP was done based on the distance that vehicles traveled and fuel efficiency of the vehicles. As the fuel efficiency of different types of outside vehicles was not available in running charts, fuel efficiency of cars and buses, was assumed as 10km/l and 3km/l respectively based on informal discussion, considering average number of persons in a bus was 55. For private transportation, the fuel efficiency of vehicle was known by the owned person.

2.3.2 CALCULATING CFP FOR ELECTRICITY USAGE

The baseline EF of thermal power generation in Sri Lankan grid was 0.78 kg CO_2/kWh according to the calculation made by the Ministry of Science and Technology in 2009. Sustainable Energy Authority in Sri Lanka showed that the thermal power generation was 56% of the total electricity power generation in 2009. Therefore the average emission was assumed as 56% of the CO_2 emission from one unit of generated electricity. Among emissions of different types of GHGs in electricity generation, only emission of CO_2 was considered. Therefore it was not needed to convert to CO_2-e/unit.

The activity data needed to calculate the CFP generated by electricity usage of the Faculty were obtained from the monthly electricity bills of the Faculty. As the electricity meters were not available in each building separately, the energy efficiency of elements and the period they were used, were applied to calculate CFP in building wise manner. It was assumed that those elements were operated in efficiency as given in labels and there were no any variations due to various weight or speeds of the elements.

2.3.3 CFP OF WATER USAGE

The Faculty uses pipe borne water from a water plant outside and water from owned wells. To calculate CFP per unit of water, it was assumed that GHG emission occurred only with water pumping. Therefore electricity units which were used only to pumping, was considered to calculate CFP for water usage from outside water plant. Activity data for water usage was obtained from monthly water bills. CFP of water usage from Faculty own wells were not calculated again as it was included to CFP of electricity usage in the Faculty.

2.3.4 CFP OF FARM ANIMALS

The most relevant and appropriate values for Sri Lankan conditions were selected considering animal breeds, type of feed, level of management and body weights. The cattle and buffalo herd comprise of animals with different age groups and different body weights. Therefore, to avoid variations, all these animals were brought to a standard unit, which is accepted universally (Initial National Communication, 2000)B B

Then LU of mature cow, mature bull, buffalo, and calves/ heifers was considered as 1, 1.25, 1 and 0.6 respectively. All of cattle and buffaloes are considered as dairy animals as there is no beef cattle operation or feed lot system in this Faculty. Almost all the ruminant livestock are managed under a free grazing/browsing system mainly depending on natural roughages. Concentrate feed is used in very insignificant amounts compared to the total dry matter intake. Since all ruminant livestock are managed under a free grazing system, excreta (both urine and dung) are naturally disposed on the field. No stockpiling or accumulation appeared. Similarly, goats were not specified individually, they are taken together as similar LU values. All ruminant livestock species are fed similar diets mainly roughages. CH_4 production is therefore similar. The ruminant livestock population in the Faculty is found within the same temperature range. The EF for enteric fermentation and manure management systems are scanty.

2.3.5 CFP OF WASTE

CO_2 and CH_4 both of which are GHGs released from solid waste disposal sites. But the CO_2 emissions were assumed to be exactly offset by carbon sequestration, however, they were not counted as net GHG emissions to the atmosphere. CH_4 emissions from landfills, on the other hand, do contribute to the atmospheric buildup of GHGs. As well, there was built an assumption that all potential CH_4 is released in the year by the waste is disposed of, was used to estimate CFP of waste disposal in the Faculty. The default method will give a reasonable annual estimate of actual emissions if the amount and composition of deposited waste have been constant or slowly varying over a period of several decades.

There were many types of waste included in municipal solid waste. From those, CH_4 was emitted by organic waste such as food waste, garden (yard) and park waste, paper and cardboard, and wood. However only food waste was considered as dispose in the site due to considerable portion was represented from total solid waste and data availability. As well all of those food wastes were disposed at relevant sites. Type of site was assumed as unmanaged and shallow site which all solid waste disposal site (SWDS) not meeting the criteria of managed SWDS and which have depths of less than 5 meters. IPCC Guidelines provide a default value of 0.77 for Fraction degradable organic carbon dissimilated, based on a review of recent literature. Fraction by volume of CH_4 in landfill gas is usually assumed to be 0.5. There was no any recovery method for CH_4. Therefore recovered CH_4 was assumed to be zero. The amount of CH_4 from SWDS was not reflected, that was oxidized in the soil or other material covering the waste due to type of site was an unmanaged site. According to that assumption for the default oxidation factor in the IPCC Guidelines is zero. The calculated EF was 770 g CO_2-e/ kg of food wastes/yr.

2.3.6 CFP OF RICE CULTIVATED AREA

Tier 1 applies to countries in which either CH_4 emissions from rice cultivation are not a key category or country specific EF does not exist. There were some paddy fields which were cultivated rice in every season of the year in the Faculty. Many assumptions were taken to calculate EF for rice cultivated area. Rice was assumed as the only crop cultivated under submerged conditions. As well Yala and Maha were taken together in every year. Even though Maha season extends to the following year, it was included in the current year for calculations. Default CH_4 baseline EF assuming no flooding for less than 180 days prior to rice cultivation, and continuously flooded during rice cultivation without organic amendments was 1.3 kg CH_4 ha^{-1} d^{-1}. Default CH_4 emission scaling factors for water regimes during the cultivation period relative to continuously flooded fields was consider as 0.78 by assuming the Faculty rice cultivation as intermittently flooded which fields have at least one aeration period of more than 3 days during the cropping season and fields have a single aeration during the cropping season at any growth stage .Default CH_4 emission scaling factors for water regimes before the cultivation period was considered as 1.22. Scaling factor (SFo) should vary for both type and amount of organic amendment applied was not taken due to only chemical fertilizers were used. Therefore SF_o was assumed as one. Scaling factor for soil type, rice cultivar were not considered due to data unavailability.

3. RESULS AND DISCUSSION

Developed EF for different types of sources and activities are given in Table 3.

Table 3: Developed EF for fuels

Activities and sources	Emission factor
Motor Gasoline	2243.5 g CO_2-e/l
Other Kerosene	2615.4 g CO_2-e/l
Gas/Diesel Oil	2738.5 g CO_2-e/l
LPG	2987.8 gCO_2-e/kg
Electricity consumption	436.8 g CO_2-e/kWh
Mature cow	2075 kg CO_2-e /yr/head
Mature bull	1437.5 kg CO_2-e /yr/head
Buffalo	1450 kg CO_2-e /yr/head
Calves/ Heifers (buffalo)	870 kg CO_2-e /yr/head
Calves/ Heifers (cow)	1245 kg CO_2-e /yr/head
Goat	130.5 kg CO_2-e /yr/head
Water consumption	187.12 g CO_2-e /m^3
Rice cultivated area	5566.75 kg CO_2 -e /yr/ha
Food waste	770 g CO_2 -e/ kg /yr

3.1 CALCULATION OF CFP OF FACULTY OF AGRICULTURE

The total CFP of the Faculty of Agriculture is 418.5 t CO_2-e per year. That calculated value was based on the data on the year 2009. The average CFP per person of Faculty of Agriculture is 0.571 t CO_2-e per year. It has not been higher than 0.61 t CO_2/yr which was the average CO_2 emission of the Sri Lankan person in 2007. Based on the table 4, indirect GHGs emission, under the scope three is 152.9 t CO_2-e/yr. It has represented the highest portion of the total CFP of the Faculty. Other indirect emission under scope two is 114 t CO_2-e/yr. Under scope one, CFP of all direct emissions of the Faculty, is 151.61 t CO_2-e/yr. GHGs emission by farm animals and waste disposal have contributed considerably to direct emissions under scope one. Majority of the GHGs were emitted indirectly by employee and student commuting and electricity consumption.

Table 4: Calculated CFP of Faculty of Agriculture under Three Scopes

Scope	Activity	CFP (t CO_2-e/yr)	Subtotal (t CO_2-e/yr)
	Transportation(own)	7.26	
	Farm animals	89.45	
	Rice cultivated area	4.5	
	Waste disposal	47.62	
	Kerosene usage	0.04	
	LPG usage	0.73	
Scope 1 (direct)	Backup generator	2.01	151.61
Scope 2 (indirect)	Electricity	114.00	114.00
	Commuting	133.18	
	Transportation(not own)	11.16	
	LPG usage	6.13	
Scope 3(Indirect)	water usage	2.50	152.97
Total			418.5

Total CFP of Faculty of Agriculture can be divided into sub categories based on its activities and sources as shown in Fig 1. Transportation is the main factor that has mostly affected CFP. It accounts 37% of the total. CFP from the electricity consumption represents the second largest portion of the total (27%), while farm animals show 21% of the total. GHG emission from the rice cultivated area accounts lowest percentage, 1%, followed by water usage having 0.6% and stationary combustion sources, 2.15%. CFP from the waste disposal is 11%. The highest portion of CFP in the stationary combustion shows 76%, with consumption of LPG while, consumption of diesel for generating electricity has represented 22%.

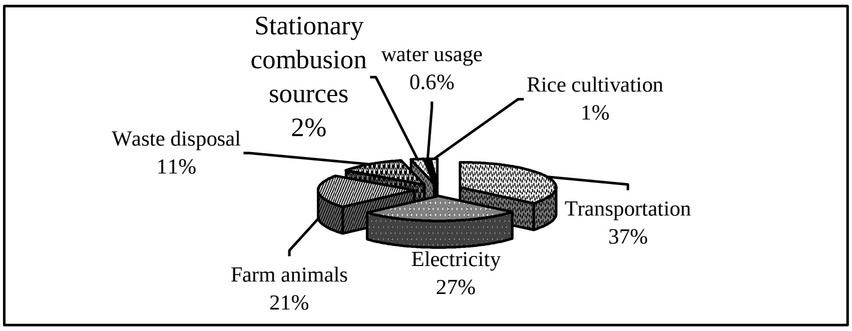

Figure 1: Percentages of CFP of Faculty of Agriculture in Activity Wise

3.1.1 CFP OF TRANSPORTATION

Mobile sources contribute to transport people and goods. CFP of mobile sources is major factor that caused to emit the GHGs in the Faculty. It was said that, transportation is also the largest end-use source of CO_2, which is the most prevalent greenhouse gas (Nurul, 2009). As well, according to the sectorial consumption of petroleum product in Sri Lanka, transportation sector was represented the highest portion which was 48.97% of the total in 2007 and the CO_2 Emissions from transportation sector was 32.5% of the total Energy consumption from fossil fuels (Energy balance, 2007). Faculty also represents the highest portion of the total GHG emission by transportation, Therefore, It is in according with those indicated by Nurul.

CFP was calculated under three categories in mobile sources in the Faculty. Employee and student commuting account for highest percentage, 88%, followed by transportation by outside vehicles having 7% and transportation by Faculty own vehicles 5% of the CFP of mobile sources as shown in Fig. 2.

CFP of the employee and student commuting has been main factor, affected to the total CFP of the Faculty. Commuting by buses account for the highest percentage, which was 78%. Commuting from bikes, cars and three wheelers shows 9%, 4%, and 1% of the total mean of the commuting as shown in Fig. 3. Eight percent of people use carbon zero activities such as walking and riding bicycles. Those people live in Mapalana and Kamburupitiya area where the commuting distance is less than 2 km.

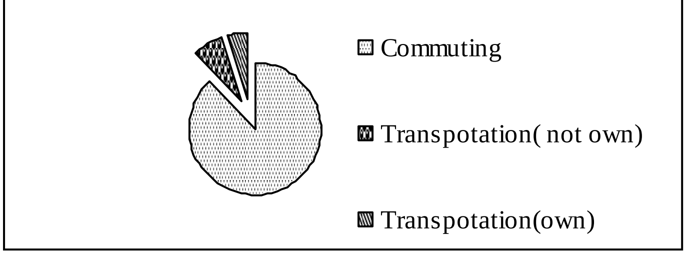

Figure 2: Percentages of CFP of different category in mobile sources

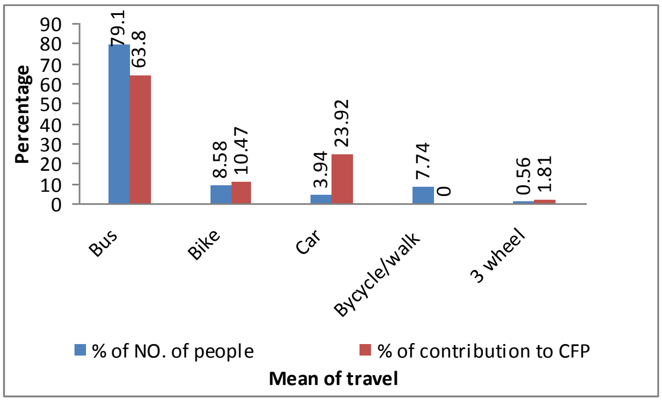

Figure 3: Percentages of No. of people and % of contribution to CFP in different types of mean of travel

According to the calculation of the NCPC in Sri Lanka, CFP of diesel and gasoline passenger cars accounts 113 Million t CO_2/yr while CFP of buses account 10 Million t CO_2/yr. However CFP of the employee and student commuting from buses account the highest, 64% of the total CFP of commuting in Faculty of Agriculture. Main reason is the number of people traveled from the busses is higher than private cars considerably. Although 4% of the people have been traveled by their private cars, they contributed 24% of the total CFP as shown in Fig 3. Therefore, private cars have contributed to CFP considerably higher than other means of transportation.

According to the two sample t test there is a significance difference in different types of means of transportation in gCO_2-e/km as shown in Fig 4. (<0.05). Comparing with other sources, Cars emit significantly high amount in CO_2-e/km. It was said that traveling by car will emit 127 g CO_2-e per km (National Express, 2008). But the present findings show, it was 168 g CO_2-e/km. This variation may occur due to different factors such as changing of fuel efficiency with time, quality of the roads, and efficiency of the engine. It was found that, CFP of diesel and gasoline passenger cars accounts 113 Million t CO2/yr while CFP of buses account 10 Million t CO_2/yr in Sri Lanka (NCPC, 2009). As there is a significant difference between travel from cars and buses, (T = 17.97, P<0.05), traveling by buses are most suitable mean of transportation to reduce the CFP due to less Carbon emission to the environment. If a person goes by bus instead of his private car, 151.5 g CO_2-e can be reduced per km.

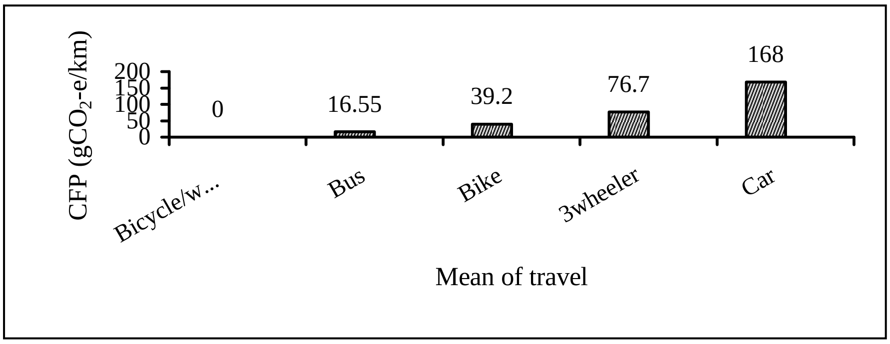

Figure 4: CFP of different types of mean of transportations in gCO_2-e/km

3.1.2 CFP OF PURCHASEED ELECTRICITY

CFP of purchased electricity is 114 t CO_2-e/yr which is the highest in academic activities. It included all academic departments, computer unit and examination hall in the Faculty. The main reason for the highest CFP of academic activities was the computer usage of students in the computer unit. Other highest CFP was represented by the tissue culture laboratory in the Crop Science Department. The Activities of the tissue culture laboratory required large amount of lights, air conditioners and other high Wattage electric elements to maintain its environment properly.

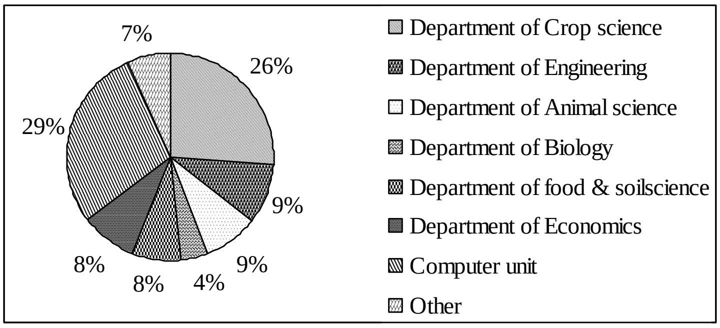

Figure 5: CFP of the academic activities for purchased electricity

3.1.5. Carbon footprint of farm animals

CFP of the handling of the farm animals was the third largest factor of the total CFP of the Faculty.

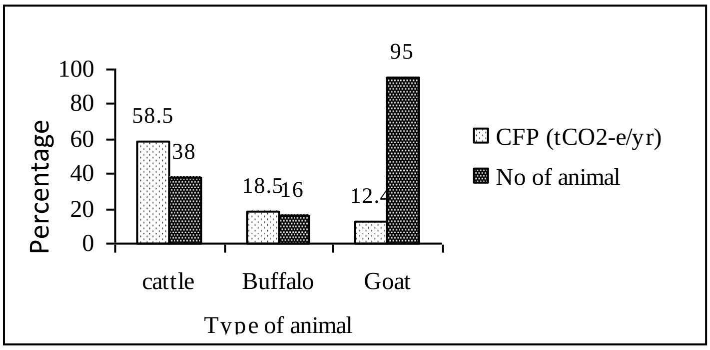

Figure 6 : CFP of different type of animals in t CO_2-e/yr

Cattle population accounts for the highest CFP, 58.5 t CO_2-e/yr, followed by buffalo population having 18.5 t CO_2-e/yr, and goat population is 12.4 t CO_2-e/yr as shown in Fig. 6. Although number of goats is higher than other types of animals, CFP of them is less due to less GHG emission from their enteric fermentation and manure management.

3.2 AVAILABLE METHODS USED TO REDUCE AND OFFSET CFP IN THE FACULTY.

3.2.1. PUBLIC AWARENESS

The most suitable way to reduce CFP is adapting of zero cost activities. People may be aware of those activities through posters. There are some posters used to make people aware such as turn light off when offices and meeting rooms are empty, ensure electric equipment is off when not in use, and dispose the waste separately in the Faculty.

3.2.2 PROVIDING ACCOMMODATION

Accommodation is provided for the undergraduate students, research assistants and post-graduate students in the hostels of the Faculty. Quarters also provided to academic and non academic staff members. Therefore all of the student and most of the staff members commute by walking. CFP of employees and students commuting reduce as they use the zero carbon activities. But providing accommodation has contributed to increase CFP of the Faculty like increase of use electricity, LPG consumptions and waste disposal.

3.2.3. USING RENEWABLE ENERGY

Recently constructed Science and Technology Park at the entrance of the Faculty is now one of an important centre in the Faculty that shows the ancient and modern technologies available for Agriculture in Sri Lanka. It demonstrates the solar energy water pump, micro hydro power and wind energy water pumping mechanisms. Therefore adaptation of renewable energy is an important aspect to reduce CFP of the Faculty.

3.2.4. PRODUCING BIOGAS

There are different types of biogas units including demonstration models which can be used for the energy generation for different types of wastes. Specially, bio gas produced from the cow dung and straw, used to stationary combustion sources in farm house and canteen for cooking purpose. Assuming, dung for biogas sustainable 100%, it is said that, CFP of burning biogas is 3.577 g CO_{2}-e for getting 1MJ of energy while CFP of burning LPG is 74.633 g CO_{2}-e/MJ, (Smith, 1999). Therefore using biogas is helped to reduce CFP of stationary combustion sources than LPG.

Using a manure storage cover and burning the captured biogas reduce farm emission of CH4 by 30% with a 22% reduction in the global warming potential of the total farm emission of greenhouse gases (Chianese et al, 2008). Therefore producing biogas contributes to reduce Faculty.

3.2.5 USING BIO FUELS FOR TRANSPORTATION

Bio diesel can be used in any diesel powered vehicle, it is biodegradable and non-toxic. Bio diesel is a helps to reduce CFP as it only releases CO_2 that the plants absorbed whilst growing; therefore there is no negative impact on the carbon cycle.

Bio diesel which is used in Faculty owned two wheel tractors, has produced from the plant oil extracted from the Jatropha oil, palm oil and used scraped coconut with transesterification process within the Faculty. It was found that, the emission of CO from engine exhaust is 45% less than mineral diesel. Therefore it contributes to reduce present and future total CFP in the Faculty. Some researches are being conducted to produce bio fuels from Algae in the Faculty also.

3.2.6 RAIN WATER HARVESTING

The model of a home garden established near the Department of Agricultural Engineering is rainwater harvesting mechanism. This is a low cost option that simply involves the collection of rainwater from surfaces on which rain falls. Generally, water will be collected from the roofs of buildings and stored in rainwater tanks. That tank reduces the CFP of water usage from outside water plant. The establishment cost is only the cost spent for that.

3.2.7 WASTE MANAGEMENT

Students and all staff members are encouraged for segregating waste at the point of origin in the Faculty. Three containers have been established at every building to dispose the waste separately. It helps to prevent of mixing of recyclable waste with biodegradable waste. There

are some composting bins in the Faculty. As well there is no any GHGs emission for
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contribute to increase CFP through fuel combustion. Therefore, Faculty attempts to reduce CFP by waste management.

3.2.8. FARMING ORGANICALLY.

Organic food generally has a lower CFP, compared to food items grown in the same area with agro chemical fertilizer.
fertilizers and pesticides. Vermy wash and compost are used as organic fertilizer for farming different types of crops in the Faculty own farm while some research are on going to find the new type of organic fertilizers such as fermented fruit juice, Lactic acid bacteria serum and Bokashi compost for future usage. Therefore, Faculty makes effort to reduce CFP by farming organically.\

3.2.9 NATURAL FOREST COVER

Land extent of the Faculty is around 60 ha. Buildings and other installations are established within the 2-3 ha. Remaining area is covered by natural forest and other cultivated crops. It was said that agro forestry trees, planted in tropical climates, which sequester atmospheric CO_2 at an average of 22 kg CO_2 per tree per year (http://www.plant-trees.org.). Amount of CO_2 emitted from the Faculty activities is 277 t CO_2 per year of the total CFP. According to those values, around 12590 trees should be there in the Faculty to compensate CO_2. If there are 220 trees/ha, Faculty can compensate the annual CO_2 emission in every year. Therefore, total annual CFP may be rather less than the calculated value.

4. CONCLUSIONS

Total CFP of the Faculty is 418.5 t CO_2-e for the base year 2009. Transportation is the main factor that most affected to CFP. It accounts 37% of the total. CFP of the electricity consumption of farm animals, waste disposal, stationary combustion sources, rice cultivated area, and water usage are 27%, 21%, 11% , 2.15%, 1% and 0.6% respectively. Indirect GHG emissions show the highest value, than direct emissions. CFP of commuting per an employee or a student varies due to usage of various means of transportation. Employees, who commute by their own cars, show higher CFP of transportation than the people who, commuting by other means of transportation. Usage of computers and lights emitted higher amount of GHGs than other electric elements in the Faculty. LPG consumption is higher than other types of fuel, used for stationary combustion sources in the faculty. CFP of water usage by pipe born water is low compared to CFP of water usage of inside wells. Cattle population shows the highest CFP among other farm animals.

Although CFP of the Faculty is low, it is necessary to take responsible steps to reduce the CFP as much as possible and then offset the remaining unavoidable emissions. Net CFP of Faculty may be less than the calculated value as Faculty has further contributed to reduce and offset its CFP through adapting to the eco friendly activities and available natural forest cover with in the Faculty.

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