International Scholars Journals

African Journal of Environmental Economics and Management ISSN 2375-0707 Vol. 4 (1), pp. 249-254, January, 2016. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Eco-impacts evaluation in the greening approach adopted by the Romanian Public University

Andrew Walker

Dunarea de Jos University, Domneasca, 47, 800008 Galati, Romania. Email: andrew_walker@yahoo.com.

Accepted 04 October, 2015

The present paper compared the results generated from 2 Eco-Indicators (Ecological Footprint and Carbon Footprint) as important markers in future greening strategy evaluation that will be adopted for the first time by a Romanian Eastern Public University (UGAL). The calculated amount of EF value per students is 0.818 gha and per capita is 0.760 gha. The Eco-Indicators values are more reasonable in compare with the recommended amount by the WWF (the average is 1.9 gha per capita) and also with the values which are reported by the other universities. Energy, transportation systems and foods are the most important portions of the total EF value.

Keywords: Eco-indicators, ecological footprint , carbon footprint, higher education.

INTRODUCTION

The real world is moving towards a severe limitation of resources. Energies resource, essential resources for human well-being, which are approaching to their peak point.

Human demand on ecosystem services continues to increase without a correlation with the regenerative and absorptive capacity of the biosphere. The natural capital may increasingly become a limiting factor for the future human demand. Humanity is posed in front of a major nature transformation and to face serious environmental challenges at global and local scales. The ecological attitude and sustainable behaviour has become a necessity in the recent decades (Chambers et al, 2000).

The ecological footprint measure the natural capital demand of human activities (Wackernagel and Rees, 1996) and reveal the sustainability of consumption patterns on individual, local, national and global scales (Arrow et al, 2002). Ecological footprint model assumes that all types of energy, material consumption and waste discharge require productive or absorptive capacity of a finite area. Six types of ecological biologically productive area (arable land, pasture, forest, sea space, built-up land and fossil energy land) are used to calculate the Ecological Footprint and ecological capacity (Wackernagel et al, 2002).

The ecological footprint estimates the ‘‘minimum land necessary to provide the basic energy and material flows required by the economy’’ (Wackernagel and Rees, 1996). The consumption elements are converted into a single index: the land area to sustain the life living among human consummation groups. The area of land or sea available to serve a particular use is called biological capacity (bio-capacity) and represents the biosphere’s ability to meet human demand for material consumption and waste disposal. The degree of non-sustainability is calculated as the difference between actual available and required land. In the original ecological footprints model created by Wackernagel and Rees (1996) and reformulated by Chambers et al. (2000), the land areas included were mainly those directly required by households with self-consummation life style. In the original ecological footprint model, land categories are weighted with equivalence and local yield factors, in order to express appropriated bio-productivity in world-average terms (Wackernagel et al, 2002).

In the original ecological footprint method, only emissions of CO_2 from energy use were considered without the influence of greenhouse gases, land clearing, and enteric fermentation in livestock, industrial processes, waste, coal seams, venting and leakage

Table 1. General Inputs for the UGAL Eco-Indicators Assessment

Element	Value
UGAL total students	18000
Full time students	10000
Part-time students	8000
UGAL total employees	1358
In-campus students	3400
Average total menus served per day	400
Active weeks per academic year	45
Total menus served per academic year	82000
Snack menus served per academic year	4100
Lunch semi-complete menus served per academic year	41000
Lunch complete menus served per academic year	4100
Dinner menus served per academic year	32800

of natural gas. Since the formulation of the ecological footprint, a number of researchers have criticized the method as originally proposed (Arrow, et al 2002; Costanza, 2000).

In nowadays, the EU caterers are concerned about the environmental and sustainability issues, including the provenance and production methods of procured food, waste management, energy and water consumption (Dawe et al, 2004).

Universities are public institutions that move to become more sustainable. New ways to measure progress are being sought such as Carbon Footprint Analysis (CFA) and Ecological Footprint Analysis (EFA). Many universities have adopted broad environmental responsibility and/or sustainability policies (Van Den Bergh and Grazi, 2010).

All the public Universities have a particular social responsibility in encouraging best environmental practice, due to their considerable influence on societal development (Wackernagel, 1991).

A number of campuses have published EFA assessment results (Burgess and Lai, 2006; Conway et al, 2008; Dawe et al, 2004; Flint, 2001; Li et al, 2008; Venetoulis, 2001; Wright, 2002) but only two studies regarding a large public university (Janis, 2007; Klein-Banai et al, 2010). A comprehensive and consistent comparative study of EFA versus CFA results for a Eastern Public University is not available in the scientific literature.

The objective of the present research is to evaluate the actual Eco-impact of UGAL activities by using the EFA and CFA methodology. In the medium term, UGAL intention is to promote a sustainable green policy with the following major objectives:

1. decreasing the material (foods, packages, utilities etc.) and energetic waves as daily activities inputs;
2. improvement of the air quality;
3. improvement of the energetic quality performance and green energy production;
4. improvement of the water management system;
5 . improvement of the green facilities management.

The present research compare the results generated by 2 Eco-Indicators (Ecological Footprint and Carbon Footprint) as important markers in the evaluation of future greening strategy that will be adopted for the first time by a Eastern public University from Romania (UGAL).

MATERIALS AND METHODS

The data involved in the Eco-Indicators assessment were obtained directly from the UGAL campus and general administrative management office. The UGAL campus population in 2010 consisted of 10.000 full-time students, 8000 part-time students and 1358 employed staff. The total UGAL facilities area is in average 11gha and the building area is about 5.4 gha. The EFA methodology was based on Wackernagel and Rees procedure (1996).

In the calculation of specific EF we take into account all the quality-controlled life cycle information including energy, materials, transportation and wastes. In order to calculate EF, the inputs of different kinds are first converted to the corresponding actual area of land/water ecosystems needed to produce the resources or assimilate the emissions. The EFA results were expressed as units of EF in global hectare with world average biological productivity, for the purposes of adding areas together and comparing results across land types.

The CFA is based on the calculation of CF for materials and processes with known quantity of fuel, energy or raw material multiplied by a conversion factor, which is a rate of tons of CO_2e emitted per quantity of the material consumed (DEFRA, 2009). Greenhouse gases emitted through transport and the production of food, energy, utilities (electricity, gas, coal, water) for University activities and services are expressed in terms of the amount of CO_2e emitted, in tonnes units. The methodology is highly compatible with ISO 14042 requirements.

Both methodologies generate the information and data necessary for the Eco-indicators assessment by analyzing and quantifying the flows of all resources (inputs) and produced waste (outputs) on the campus (canteen and student's residence) and in all UGAL facilities. The input data for the Eco-Indicators assessment were presented in Table1, Table 2.1, Table 2.2 and Table 3.

RESULTS AND DISCUSSIONS

The results of EFA include the basic lifecycle data for food consummation, energy demand, food wastes and transportation (Table 4). The results of CFA include the basic lifecycle data for food consummation, energy demand, food wastes and transportation (Table 5).

Table 2 .1. Utilities consummation in UGAL

Utility item	Consummation NO,the units are specified in the utility line
Electricity, MWh	1423
Gas, m3	175313
Water, m3	72808.76
Coal, Gcal	5557.08
Car traffic, km	29588

Table 2 .2. Wastes collected in UGAL

Wastes categories	Total Quantities (kg/year)
Domestic waste	5291.81
Food wastes	419.26
Garden wastes	2439.76
Paper ,packages waste	636.84
Plastic waste	538.52
Glass waste	646.18
TOTAL	9972.37
TOTAL per Employee	7.34

Table 5. UGAL Carbon Footprint Assessment

Component	CF, tCO2Eq
Energy	1358.451
Electricity	1148.361
Gas	143.406
Coal	66.684
Water	0.80
Wastes	3.3
Transport	5177.9
Small traffic (175 g/km)	5177.9
Commodities	43.722
Beef meat	8.951
Pork meat	11.04
Poultry	5.870
Fish	0.039
Vegetables	4.500
Pulses	0,109
Eggs	6.000
Milk	0.272
Cream	0.846
Cheese	0.521
Pasta	0.599
Rice	0.103
Sugar	0.081
Vegetable oils	3.601
Flours	0.317
Cereals	0.873
Total CF, UGAL 2010	6584.173
CF per students	0.365
CF per capita	0.340

Table 3. Commodities Consummation in UGAL canteen

Commodities Item	Consummation, (t/year)
Beef meat	0.626
Pork meat	2.906
Poultry	5.337
Fish	0.089
Vegetables	19.568
Pulses, Flavourings	0.436
Eggs	0.602
Milk	1.362
Cream	0.423
Cheese	0.372
Pasta	0.403
Rice	0.648
Sugar	0.090
Vegetable oils	3.274
Flours	0.357
Cereals	1.468
TOTAL	35.862

Table 4. UGAL Ecological Footprint Assessment

Component	EF, gha
Energy	12301.674
Electricity	1302.045
Gas	5953.629
Coal	5046
Water	380.425
Wastes	3.025
Transport	1479.4
Traffic car	1479.4
Commodities (Foodprint)	559.565
Beef meat	76.24
Pork meat	123.79
Poultry	217.216
Fish	1.424
Vegetables	82.186
Pulses, Flavourings	2.341
Eggs	9.933
Milk	2.64
Cream	8.164
Cheese	5.743
Pasta	10.075
Rice	1.944
Sugar	4.869
Vegetable oils	130.96
Flours	7.854
Cereals	15.854
EF UGAL 2010	14724.089
EF per student	0.818
EF per capita	0.760
Ecological Foodprint per in campus students	0.016
Ecological Foodprint per student which serve the meal in the campus area	1.39

The calculated EF value per students is 0.818 gha and per capita 0.760 gha. The Eco-Indicators values are reasonable in compare with the WWF recommendation (average of 1.9 gha per capita) and the values reported by the other universities (Table 6). Energy, transports and foods are the most important parts of the total EF value.

In the food processing department, vegetables, poultry, beef and vegetable oils have the greatest ratio in the total EF due to the greatest amount in the daily canteen use. In fact, only beef induce the leading impact on the total agro-foods EF and CF, respectively. Vegetables, milk, fruits and cereals have the lower value of EF and the ratio proposed in the optimized Eco-menus must be The increased in order to generate a significant reducing of the total EF. The poultry items present the lowest ecological and emissive impact, in average with 3 times less than beef items. regular use of low-carbon fish (mackerel, herring) could reduce substantially the meal's average carbon footprint.

The food commodities created by an intensive processing such refining (oils, sugar), dry substance concentration (cream, cheese, pasta, cans) or extraction (flour) multiply the EF value of the raw material with the number of concentration /extraction degree. This is a strong reason for avoid the large quantities of industrialized foods, herbs, eggs and red meats and valorise the raw, unprocessed and fresh local/traditional products as input in the canteen production.

In terms of gas emissive effect, the EC per student is calculated at 0.365 tCO2Eq/ year and EC per capita is 0.340 tCO2Eq/ year. The electricity represent 84.5% from total emission generated by all forms of energy used in UGAL facilities and the transportation system cover 78.64% from total CF. Food commodities have a minor impact on the total CF (0.066%) and the undercollected wastes (7.34 kg/year, employees) represent an insignifiant part (0.005%, 3.025 EF units per year). In the food processing department the pork items are environmentally more favourable than chicken and the chicken items are more environmentally favourable than lamb and beef. Beef is found to be around four times more CO2-emissions intense than pork meat. The comparative results of the present research and the prior studies conducted in other campuses and universities are presented in Table 6.

The results are very much similar with the others presented in the previsious works, in terms of EF per capita and ratio of the principal UGAL EF elements (energy 83%, transport 10%, water 2.5%, food 3.8%, wastes 0.02%) from the total EF value.

The proportion of the energy module is overload because of the traditional technologies involved in the general management and the ratio of food is underload because only 11.7% of the total UGAL in-campus students eat in the canteen facilities every day.

CONCLUSIONS

Both EF and CF represent efficient and consistent tools to measure sustainable development by comparing communities' consumption of natural resources and the corresponding bio-capacity.

The principal conclusions of the Eco-Indicators assessment are as followings:

-the energy consummation for food processing is in average 3.967MWh/t, 10% from total energy consumed in UGAL;

-meats commodities are the greatest emissive items involved in the daily menus and the potential environmental damage is estimated at 74.56% from the total foods EF (Foodprint value);

-the primary agricultural products present the lowest EF value; in contrast, a greater industrialisation food degree due to a proportionally increasing of foodprint value (in case of refined foods as oils, sugar or food derivates such as cream butter or cheese);

-as a general rule, the degree of the principal compound from the dry substance concentrated in the industrialisation process represent the factor of multiplying the EF value of the raw food; -the average wastes generated in a day is 0.036t and in average the ratio food/food wastes is 3.59/1;

-the smallest impact on both gas emissive effect (CF) an EF value is generated by the wastes 0,02% from total EF, followed by water 2.5% and food 3.8%.

As a general rule, the choice of raw materials has a considerable impact on greenhouse emissions.

.

Table 6. Comparison of EF for colleges and universities

	University								
	Dunarea de Jos University Galati (UGAL)	**University of Illinois at Chicago**	**University of Newcastle**	**Holme Lacy college, UK**	**Northeastern University, China**	**University of Toronto at Mississauga**	**Colorado College**	**Kwantlen University College**	**Ohio State University Columbus**
Year	2010	2008	1999	2001	2003	2005	2006	2006	2007
EF ,gha	14724.08	97601	3592	296	24787	8744	5603	3039	650,666
Ratio EF to land area	897.81	1005	26	1.23	50	97	154	81	916
EF per capita	0.76	2.66	0.19	0.57	1.06	1.07	2.24	0.33	8.66
Energy,%	83	72.66	47	19	67.97	69.40	87	28.90	23.30
Transport,%	10	12.60	46	23	0.08	16.10	1.40	53	72.24
Materials and Waste,%	0.02	11.83	2	32	5.74	4	na	na	4.46
Paper,%	na	na	na	na	2	na	na	7.20	na
Food,%	3.8	2.60	2	25	21.80	9.20	10	9.60	na
Built-up land,%	na	0.18	2	1%	0.44	1.20	na	1.10	w/transport
Water,%	0.02	0.14%	1	w/built-up land	2	0.20	1	0.16	na

Source: Vintila, 2011: Venetoulis,2001: Flint, 2001: Dawe et al.,2004: Li et al.,2008: Conway et al.,2004: Wright 2002: Burgess and Lai,2006: Janis,2007

Different food ingredients such as low-carbon fish and meats can reduce substantially a meal's average foodprint

RECOMMANDATIONS

The future UGAL Greening strategy include following recommendation based on the present research results:

1.reducing under 50% in the next 5 years the amount of food items with greatest energetically metabolism: meats, especially beef and refined foods as sugar, spices, coffee, oils, butter, cream, cheese.

2. replacing animal origin protein commodities with vegetable protein sources once or twice in a week in the next 5 years;

3. increase with 30% the number of meals served in UGAL canteen in the next 5 years;

4. replacing 50% of the actual imported commodities with local sources of fresh and brute, unprocessed agro-foods in UGAL canteen in the next 5 years;

5. moderate the thermal treatments of food products in order to reduce the energy involved in food processing;

6. selected food equipments with optimal energy consummation related with the productivity and reduce the surface of the foodservice area in order to reduce the utilities consummation;

7. increase the amount of collected wastes and the recycled wastes ratio, especially in case of glass, plastic and paper ;

8. gradually replacing the actual car park used for internal transport with less emissive Eco car model (emission under 120g/km);

9. replacing 5% of the actual conventional fuels with agro-carburant in the next 3 years and with 10% in the future 5 years;

10.increase the amount of renewable energy resources and energy saving equipments;

11.promote a Eco-conscience for all University staff (Eco behaviour courses included in the general curricula), important part of the Eco-citizen attitude in nowadaysworld.

Perspectives

Actual statistics discuss about the resources limitation in the near future in which the Eco-management became a necessity in order to respect the regional biocapacity.

The sustainable green policy is based on the direct relation existing between the quality of the environment and the health status of the students, professors as well as administrative &technical University staff.

“Greening” the Public Universities is a social responsibility which must be imposed by the academic media and involve the development of a more sustainable resources using, transportation systems as well as the reduction of on-campus consumption.

The model for the Eco-indicators assessment of UGAL in 2010 will be proposed as a base of an Eco-strategy constructed in order to reduce the actual EF on the individual, institutional and national scale.

ACKNOWLEDGEMENT

The author would like to thank the UGAL Rector Prof.Minzu Viorel, UGAL General administration Head Ms.Narcisa Condrea,UGAL Canteen Administration Head Mr.Bichescu Cezar and his collaborator Ms.Onofrei Nicoleta.Further,the author would to extend a special thank you to all the collaborators from AgroBio 35 Mr.Jaffre, Conseil Regional de Bretagne Ms. Rouger, Manger Bio35 Mr.Gabillard, Association Solidarite 35 Mr.Venien and Ms.Sinequin, Scarabee BioCoop Mr.Chevalier, FRCIVAM Mr.Marechal, Inter Bio Bretagne Ms.Fassel, Les Quisines du Quotidien Mr.Mariot.

REFERENCES

Arrow K, Bolin B, Costanza R, Dasgupta P, Folke C, Holling CS, Jansson BO, Levin Bagliani M, Ferlaino F, Procopio S (2002). Ecological footprint and input-output methodology: the analysis of the environmental sustainability of the economic sectors of Piedmont Region (Italy) – In: 14th International Conference on Input-Output Techniques, Montréal.

Burgess B, Lai J (2006). Ecological Footprint Analysis and Review.- Kwantlen University College.

Chambers N, Simmons C, Wackernagel M (2000). Sharing Nature’s Interest: Ecological Footprints as an Indicator of Sustainability.- Earthscan Publications Ltd.,London.

Conway TM, Dalton C, Loo J, Benakoun L (2008). Developing ecological footprint scenarios on university campuses. A case study of the University of Toronto at Mississauga.- Int. J. Sustainability High. Ed. 9: 4–20.

Constanza R (2000). The dynamics of the ecological footprint concept.- Ecol. Econ.32:341–345.

Dawe GFM, Vetter A, Martin S (2004). An overview of ecological footprinting and other tools and their application to the development of sustainability process.- Int. J. Sustainability High. Ed. 4, 340–371.

DEFRA (2009). Guidelines to Defra. version 2.0. AEA for DECC and Defra.

Flint K (2001). Institutional ecological footprint analysis: a case study of the University of Newcastle, Australia. Int. J. Sustainability High. Ed. 2:48–62.

Klein-Banai, C, Theis TL, Brecheisen TA, Banai A (2010) A greenhouse gas inventory as a measure of sustainability for an urban public research university.-Environ. Pract. 12: 35–47.

Janis AJ (2007). Quantifying the Ecological Footprint of the Ohio State University. – In: Ph.D Thesis, The Ohio State University, Columbus.

Li GJ, Wang Q, Gu XW, Liu JX., Ding Y, Liang GY (2008). Application of the componential methodology for ecological footprint calculation of a Chinese university campus.- Ecol. Indic. 8: 75–78.

Ree WE (1992) Ecological footprints and appropriated carrying capacity: what urban economics leaves out. -J. Environment and Urbanisation 4 (2): 121–130.

Rees WE, Wackernagal M (1996). Urban ecological footprints andwhycities cannot be sustainable – and why they are a key to sustainability.- Environ. Impact Assess.Rev. 16: 223–248.

Rees WE (2003). Impeding sustainability? The ecological footprint of higher education. – In: Plan. High. Ed. March–May.

Van Den Bergh J, Grazi F (2010): On the Policy Relevance of Ecological Footprints Environ.- Sci. Technol. 44: 4843–4844.

Venetoulis J (2001). Assessing the ecological impact of a university: the ecological footprint for the University of Redlands.- Int. J. Sustainability High. Ed. 2, 180–196.

Wackernagel M (1991).Land Use: Measuring a Community's Appropriated Carrying Capacity as an Indicator for Sustainability and "Using Appropriated Carrying Capacity as an