

Using Socio-economic Community Sustainability Indicators to Determine How Consumer Patterns Impact the Environment in a Coastal Zone:

City and County of Swansea, Wales



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Aim of Study

To obtain and analyse data derived from individual ecological footprints and carbon footprints from different socioeconomic areas in coastal regions of South Wales, Swansea and Neath/Port Talbot, in order to assess whether socioeconomic status effects the sustainability of lifestyle. This data will then be used to determine trends in lifestyle and consumption that may be linked to ecological and carbon footprint scores. The results will be assessed to critically analyse statements made by Cummins 2004 and Charlier and Bologna in 2003 concerning further deterioration of the coastal environment linked to economic prosperity and the need for measurable indicators that can assess sustainability of sensitive coastal regions.

Literature Review:

As global populations increase with a growing percentage of that population living in coastal areas in which the environment either is already degraded or is in danger due to development related activities (United Nations Environment Programme, 2006), management of these zones need to adopt an integrated approach. Current legislation governing coastal areas state that development must be sustainable for society, the environment and the economy. In order to develop policies concerning coastal development, the services that the zone provides need be quantified in conjunction with measuring the sensitivity and the impact of anthropogenic forces on this environment. In 2009 Coelho et al. stated the importance of understanding population distribution and land conversion in coastal areas to understand the causes of vulnerability in these regions. This supports studies done in 2007 by European Union concluding that sustainable development of coastal zones will only be achieved by understanding the effects of human activities upon coastal ecosystems and understanding the ecological capital of the coast. In 2010, Anilkumar et al. reiterated not only the need to understand coastal zone health and identify variables that indicate this health but the need to develop a set of indicators to quantify ecosystem health from the perspective of all stakeholders. They supported results from Valentin and Spangenberg in 2000 stating that community sustainability indicators, due to their cross-sector nature, are broad based and may be used to determine how coastal resources are allocated used and the impact they have upon the coastal zone. Indicators need to be of a nature that are easy to communicate when developing policy for coastal zones as the process involves participation of experts from a variety of different professional and academic sectors inclusive of the public themselves (Stoeglehner et al., 2008). Studies by Wagemnagel in 2001 showed that as an effective tool for governments, businesses and communities in the creation of sustainable development policy, ecological and carbon footprints calculates how much impact human activities are having on the environment in a way that can be understood internationally. Rees in 2006 supported this and identified as an essential component of the footprint being not only the focus on impact of human activities but also its focus on biocapacity and a way to quantify that in relation to anthropogenic forces. A report published by the University of East Anglia in 2009 critically assessed the efficacy of the ecological footprint in the calculation of impact upon nature of human activities. Critics of the ecological footprint as a policy development tool state that it does not account for sustainable trade (Costanza, 2000) and its inability to predict future growth of consumption as it does not account for technological advances (Fiala, 2008). UEA results found that the footprint was most importantly an important communication tool focusing on

consumption patterns. Studies identifying trends within consumption patterns have found that the higher the income for whomever the footprint is being calculated, the heavier the footprint (Stechbart and Wilson, 2010) and that deprived areas use fewer resources than areas of affluence (Stolkholm Environment Institute, 2008). Different age groups (Haq et al., 2010) and household family composition (Baiocchi et al., 2010) also influence the score of the footprint.

Introduction:

The two greatest factors of coastal degradation are climate change and anthropogenic stressors (Coelo et al., 2009). Already an environmentally sensitive region, the coastal zone globally is put under increasing pressure from anthropogenic forces as a result of economical and technological development and population growth. These stressors endanger the ecosystem services that the coastal zone provides (Creel, 2003). These ecosystem services are of value to humankind yet how much they are valued by society determine the allocation, use and conservation of these services. Inability by governments to put a worth to these services has resulted in overuse and exploitation of coastal ecosystem services leading to market failure. Development of policies and strategies by government agencies can be developed that can protect society from the effects of market failure, such as tax incentives for reduction of emissions. In coastal regions, the negative externality of economic growth previously has been high levels of environmental degradation (Helm, 2009)(Wells, 2000). 75% of the world's cities are coastal with 12 of the world's largest cities located in the coastal zone (Olsen, 2009). Coastal Cities support a vast majority of global infrastructure generating the world's largest amount of waste owing to the consumption of a disproportionate share of global resources (Olsen, 2009).

The development of government policies concerning sustainable development of coastal areas need consider a number of stakeholders, traversing a broad spectrum of sectors; environment, society and economy. In order for environmental government policies to be effective and provide results, government agencies need to be able to quantify how much of nature's resources are being used, how they are being used, and by whom

In Wales, due to geographic location, the coast is of vital importance to the economy providing in direct services: 92,600 jobs, annual income of £6.8 billion, and generating £2.5 billion in Gross Domestic Product (Countryside Council Wales, 2006). There are five cities in Wales, all located on the coast of which Swansea is the second largest and third most populated. A report produced by Stockholm Environmental Institute in 2008 for the Welsh Assembly Government, concluded that Wales had an ecological footprint of 5.25 gha, Swansea calculated 5.15 gha. An ecological/carbon footprint is a life cycle assessment tool that translates the impact of human activities into productive land and sea needed to produce, manufacture, consume and dispose of generated waste. The study showed that housing, food and personal travel accounted for 63% of the ecological footprint. When this is taken into account with data produced by the European Environment Agency in 2006 that said that population density increases in coastal regions and that residential urban sprawl accounts for 45% of the overall land conversion to artificial surfaces, there is a need for a way to identify patterns of consumption in society in order to adopt policies that address the impact that they are having on the environment and society as a whole.

REAP (Resources and Energy Analysis Programme)Petit, developed by SEI is a software tool that enables individuals to calculate how their lifestyle impacts the planet through the use of ecological and carbon footprinting and how it compares to their community and region. Data was gathered using a questionnaire provided through the software that is used to determine lifestyle and consumer habits. The determination of the two socio-economic areas was provided using the Welsh Index of Multiple Deprivation, 2010. This report, produced by the Welsh Assembly Government divides Wales into 1,896 separate geographic areas. Statistics for each area are compiled based on eight categories inclusive of health, income, and education and then given a ranking to ascertain which areas suffer multiple deprivations. Areas that ranked within the top 191 LSOA's in Wales were categorised as deprived and surveyed using the questionnaire produced by SEI regarding patterns of consumption. Areas that ranked between 951 and 1,896 were categorised as affluent and given the same questionnaire. In total 130 households were surveyed with equality between data gathered from both the affluent and deprived areas. The collated data was inputted to REAP Petit which provided not only ecological and carbon footprints for every individual surveyed, but for the community as a whole. The data could also be filtered according to factors such as different levels of income and spending.

Background of study area:

The City and Council of Swansea is located on the south west coast of Wales occupying 378 square miles and 32 miles of coastline. In figure 1, the county of Swansea is demarked in white, whilst the inset picture depicts the location of Swansea in Wales. The population is 231,300 comprising 99,300 households (CCS, 2010). The population is increasing by 1.7% annually with 88% living in 32% of the area. Within the last decade, Swansea has been undergoing redevelopment with high levels of economic investment. In 2009, the Welsh Assembly Government has named Swansea as a Strategic Redevelopment Area, earmarked for further financial investment. Regeneration projects have been largely focused on the zone that fronts the coastline, with the Waterfront project, the Meridian Quay, and Marina redevelopment. Average house prices are lower than the Welsh national average at £117,000 in Swansea yet current residential property is priced at £2.5 million per acre in the SA1 Waterfront Development. 64.9% of working age residents in Swansea are employed with 13% of the area ranking in the top 10% on the Welsh Index of Mass Deprivation (CCS, 2010.) Presently enjoying status as the economic centre of south-west Wales, Swansea due to geographic location at the mouth of the Tawe River has been an operating port since the 1300's when the population was 1,000. From the 17th to the 20th centuries, it was integral in the mining, production, manufacturing, and exporting of coal, copper, limestone, zinc, iron and tin within the region and around the world. Closure of the mines in 1980 saw the end of intensive industry in Swansea and between 1980 and 2008, manufacturing fell almost 50% between 1980 and 2008 (Simmie and Martin, 2009). In 1999, the Welsh Assembly Government was formed and redevelopment of the City and Council of Swansea began. 88% of jobs in Swansea are currently linked to the service sector with the majority employed by government agencies or tourism associated employment (CCS,2010).

Figure 1



Methodology and Results:

The main steps to achieve the aim of the study are detailed following the list of tools used to obtain and analyse collected data.

Welsh Index of Multiple Deprivations, revised 2010

REAP Petit computer software

REAP Petit Questionnaire

10 Households in deprived areas of Swansea Bay, South Wales; ranked from 1-190 in WIMD

Research coastal regions, the ecosystems they provide and their sensitivity to anthropogenic influences.

Research the socio-economic indicators listed in the WIMD to assess whether households are deprived or affluent.

Research the carbon and ecological foot printing tools provided through the REAP Petit software to assess whether lifestyle has an effect on the calculation and measurement of these Life Cycle Assessments.

Research the value of ecosystem services in coastal regions to society and the resulting negative externalities in the allocation and use of natural resources to determine market failure inclusive of policies produced by the government concerning environmental protection as a means to lessening the impact of market failures on society.

Using the questionnaire provided through the REAP Petit software, conduct ten interviews of households living in deprived areas of Swansea Bay, South Wales as listed from 1- 190 in the WIMD.

Input data obtained into the REAP Petit software along with data obtained from thirteen other surveys conducted to achieve an equality of data between affluent and deprived communities as ranked in the WIMD for the Swansea Bay area of South Wales.

Use the REAP Petit software to analyse the data to determine trends in lifestyle effecting the final calculation of individual and community carbon and ecological footprints.

In figures 2 and 3, the cumulative ecological footprints of the deprived and affluent residential areas surveyed are displayed. Comparing these two charts, there is little difference in the community ecological footprint between either affluent or deprived areas. The community ecological footprint of affluent areas is 5.85 global hectares. The community ecological footprint of deprived areas in Swansea Bay is 5.4 global hectares.

Figure 2

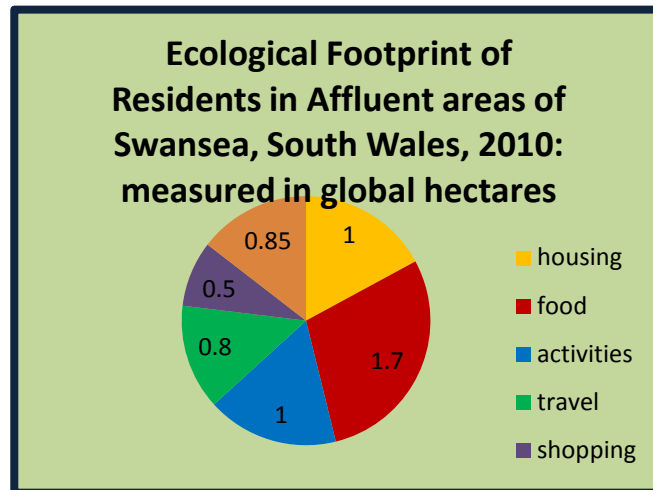
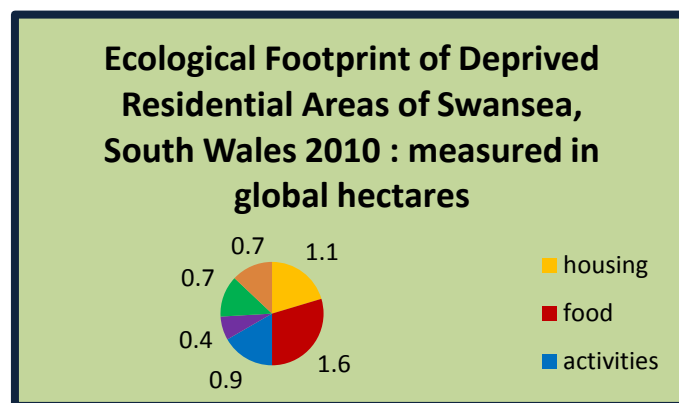


Figure 3



In figures 4 and 5, the community carbon footprint for affluent and deprived areas is displayed. The total carbon footprint for affluent areas is 18.03 CO₂e. The community carbon footprint for deprived areas is 16.89 CO₂e. Here there is a greater difference in scores between the two areas for each sector. It is shown that the greatest difference in individual category scores is that of food with the score for affluent areas being 200% greater than deprived areas. Travel consumption patterns amongst affluent areas accounted for a further 1.5 tonnes of CO₂ into the atmosphere than it did in deprived areas; with a similar amount more being contributed by affluent activities.

Figure 4

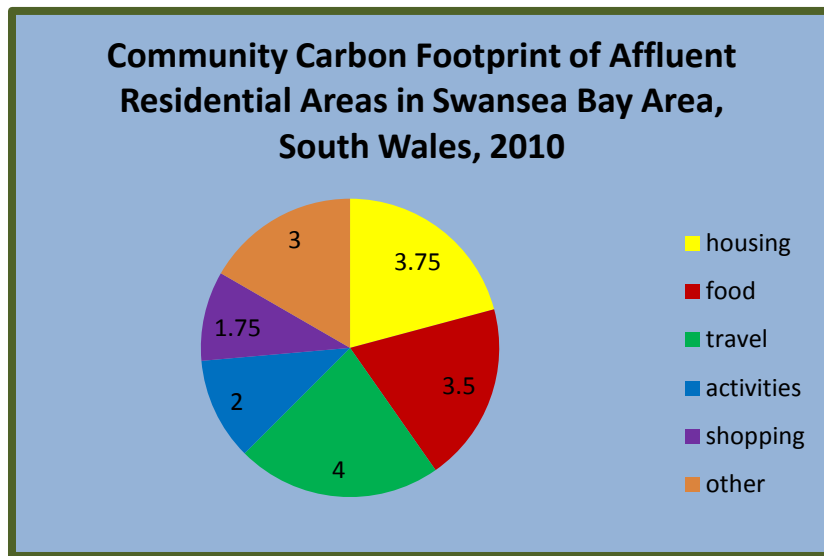


Figure 5

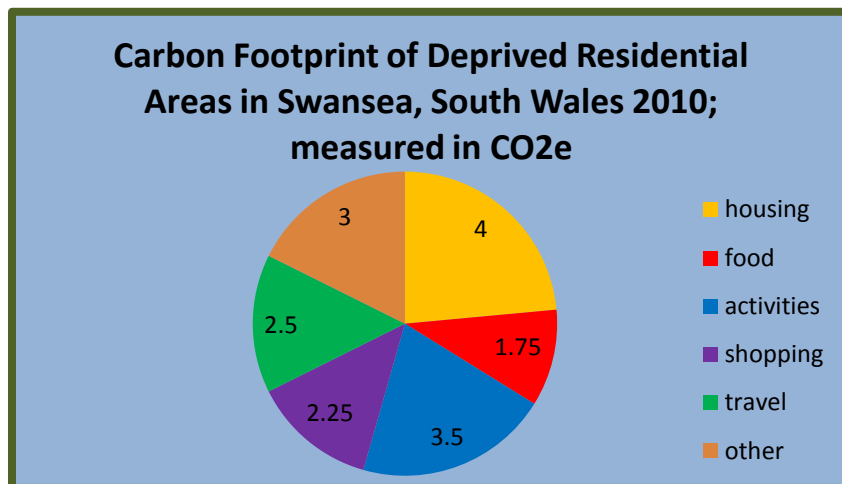
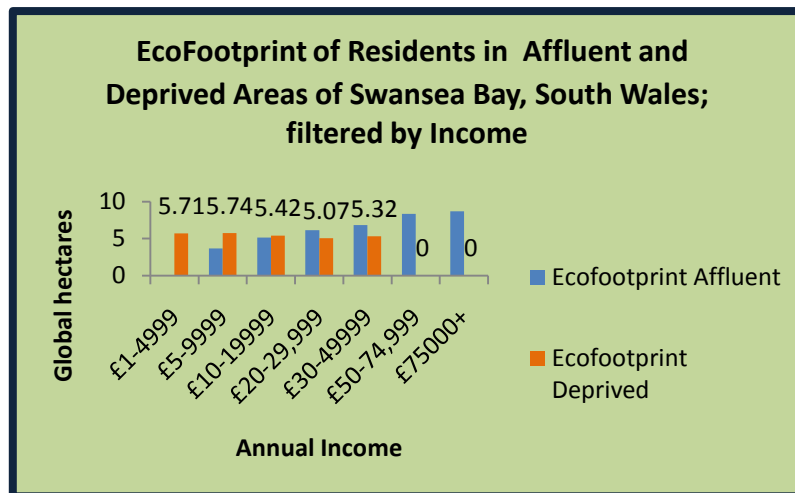


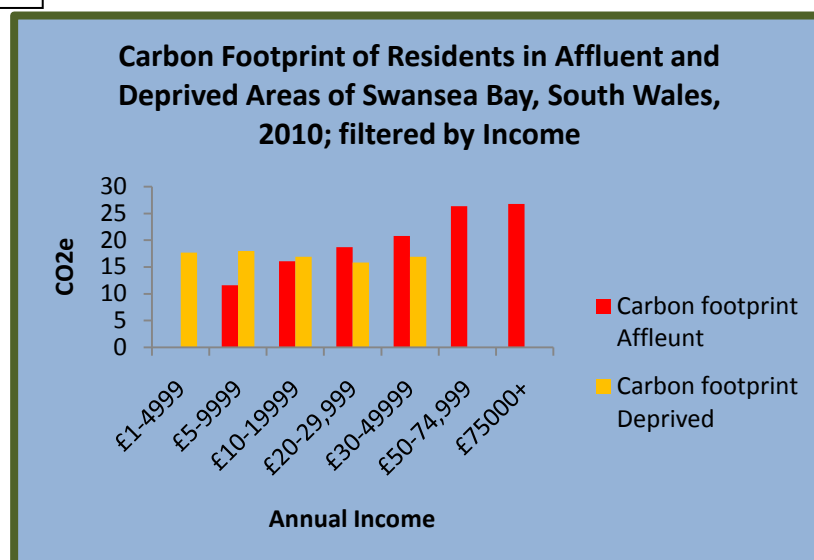
Figure 6 displays the ecological footprints of both community areas surveyed filtered by income. As is shown in the graph, the income threshold for deprived areas is below £50,000. Only residents on very low annual incomes of less than £10,000 have a higher ecological footprint in deprived areas than affluent areas. Annual incomes of £20,000+ show affluent areas to have a higher footprint than comparable incomes in deprived areas.

Figure 6



The graph in figure 7 compares the carbon footprint of affluent and deprived areas. As is shown below, as in figure 6, once income reaches beyond the £20,000 threshold, the carbon footprint of the affluent areas is higher compared with the deprived communities.

Figure 7



In figure 8 and 9, the ecological footprints of the deprived and affluent areas, as filtered by age, are displayed. The trend is that those residents in the 30-49 age groups from both of the communities surveyed have the highest ecological footprint. Whilst in the deprived areas of age 65+ have the lowest ecological footprint of the community, the age group 19-29 had the lowest ecological footprint in affluent areas. The affluent areas score higher calculated ecological footprints for each age group than the comparable ages of the deprived areas, except the 19-29 group of the deprived area. The score for the 50-64 age groups in affluent areas has a score that was 35% higher than the equivalent age group in deprived areas.

Figure 8

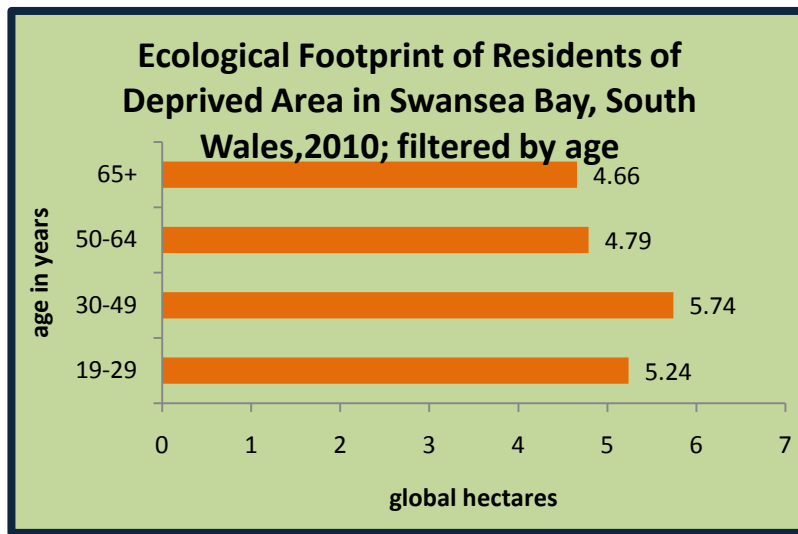
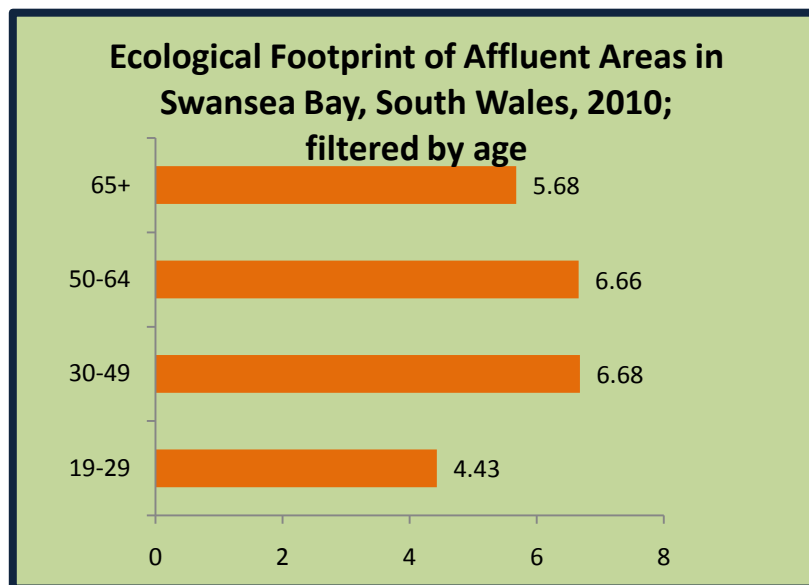


Figure 9



Carbon footprints for both communities, as filtered by age, are displayed in figures 10 and 11. The largest carbon footprint for deprived areas is recorded in the age group 30-49; yet in affluent areas, the highest carbon footprint is recorded for those residents in the 50-64 age group. As in figures 8 and 9, all age groups in the affluent areas recorded higher carbon footprints than the same age groups in the deprived areas, with the exception of the 19-29 age groups.

Figure 10

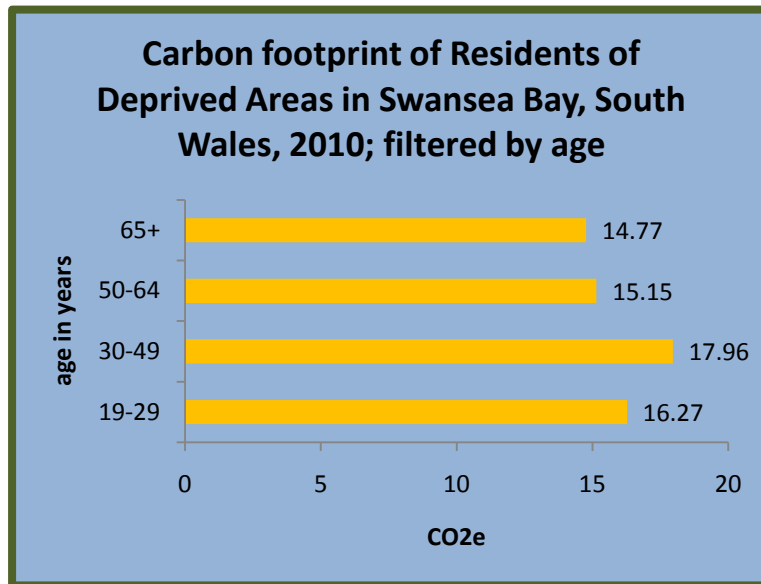


Figure 11

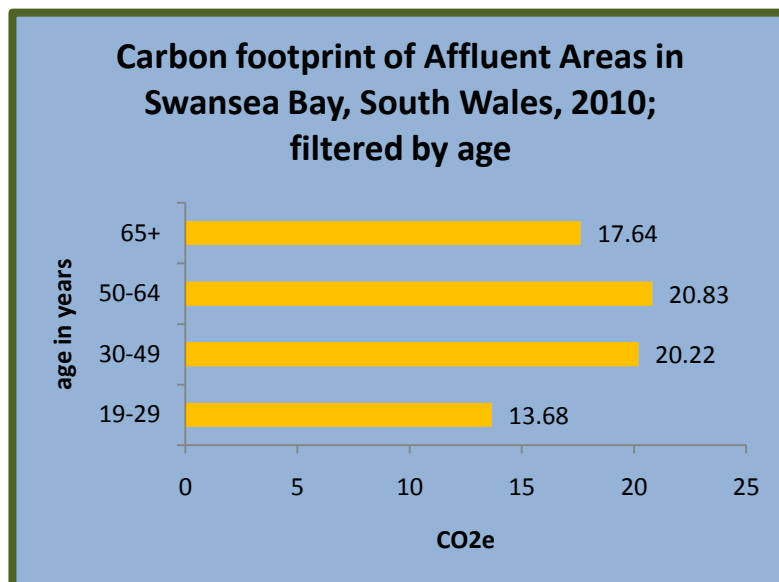
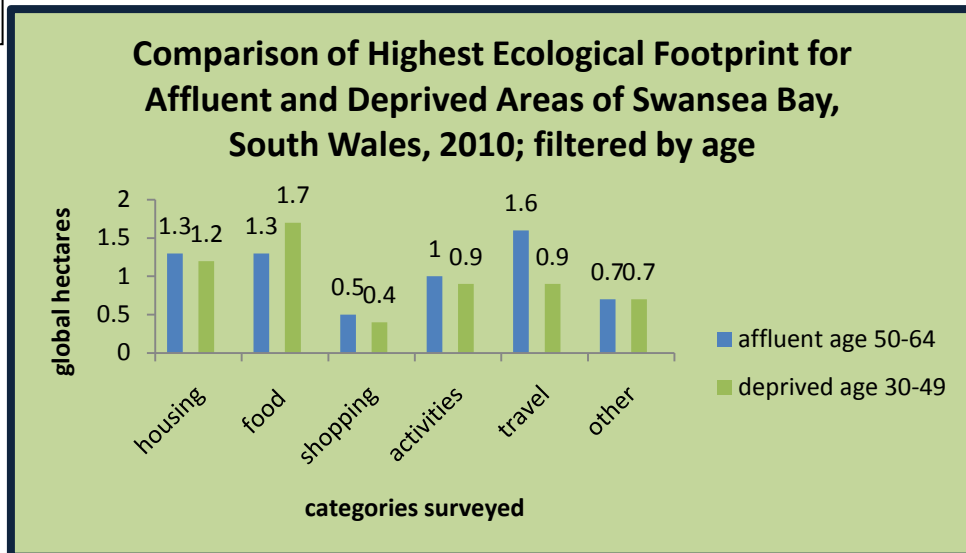


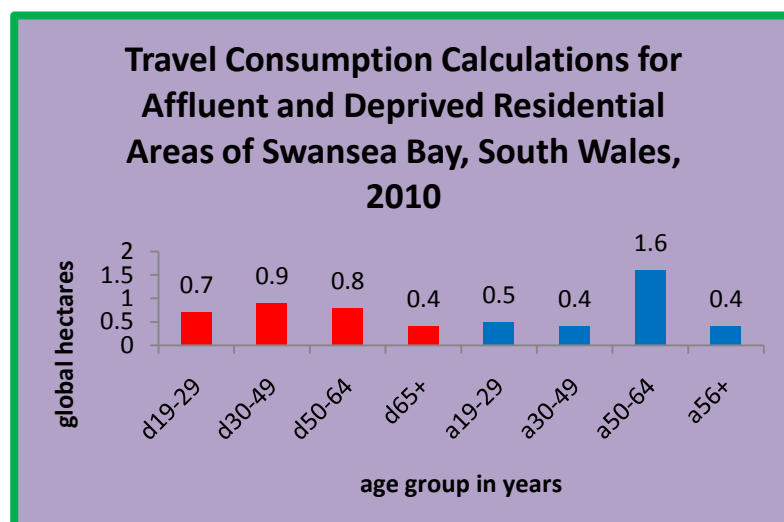
Figure 12, details the individual scores for each category according to the age group that recorded the highest ecological footprint in both the affluent and deprived areas. The age group for the deprived communities with the largest ecological footprint is 30-49, whilst for the affluent it was the 50-64 age group as stated above. It is shown that the deprived age group recorded the largest contributor to the footprint was food at 1.7 global hectares. Travel was the highest contributor for the affluent areas; with food being the only area recording a higher score for the deprived area in comparison to the affluent area's age group.

Figure 12



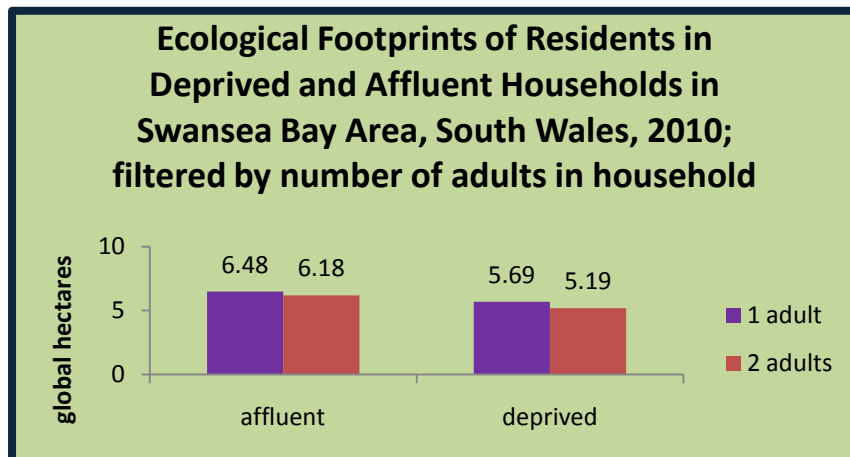
Looking closer at the data, the travel consumption scores for both areas across all areas were tabulated and are displayed in figure 13. The red bars signify deprived areas, blue is the affluent areas. Referring to figure 12, where the 50-64 age group in affluent areas calculated the largest carbon footprint, the data in figure 13 shows that travel may be a large contributor. With a 1.6 global hectares calculated for this group for travel, the score is 175% higher than the nearest score of 0.9 hectares for 30-49 age groups in deprived areas. Referring to figure 11, the 30-49 age group in the deprived areas records the highest carbon footprint for deprived areas, consistent with having the second highest travel consumption score.

Figure 13



In figure 14, the ecological footprints of both affluent and deprived households are compared. The comparison is made for the difference of footprint relating to the number of adults in the household. As is shown the higher footprint is recorded in both areas for those households with one adult. Yet the affluent areas still record the higher ecological footprint whether there are one or two adults in the household. The footprint for two adults living in the household in affluent areas is higher than that recorded for the one adult household in deprived areas.

Figure 14



In figure 15, the same comparison as in figure 14 is displayed, yet concerning the calculated carbon footprint for both communities surveyed. Once again the same trend as in figure 14 is displayed with the two adult household in affluent areas recording a one tonne of CO₂ difference than the one adult household in deprived areas.

Figure 15

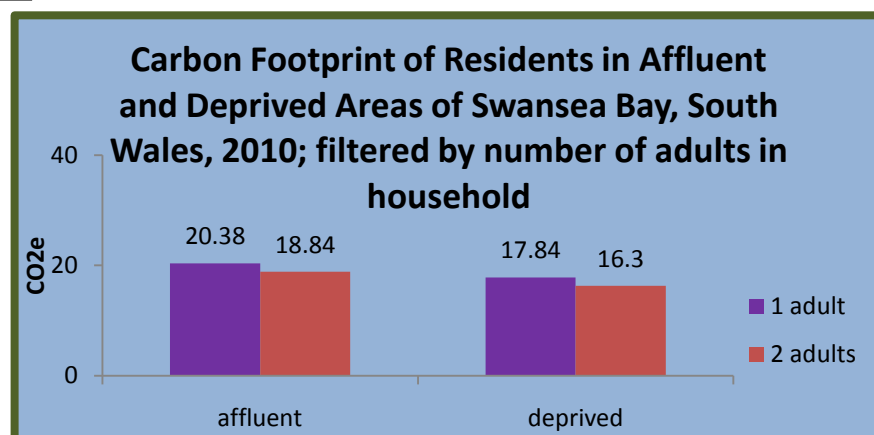


Figure 16 shows a comparison of the difference in range between the lowest and highest individual ecological footprints from both areas. As is displayed, the difference between the two communities in the lowest ecological footprint recorded individually is 1.2 global hectares. Yet the difference between the two areas in the highest ecological footprint is significantly larger; with the highest individual ecological footprint being 400% higher than the deprived result.

Figure 16

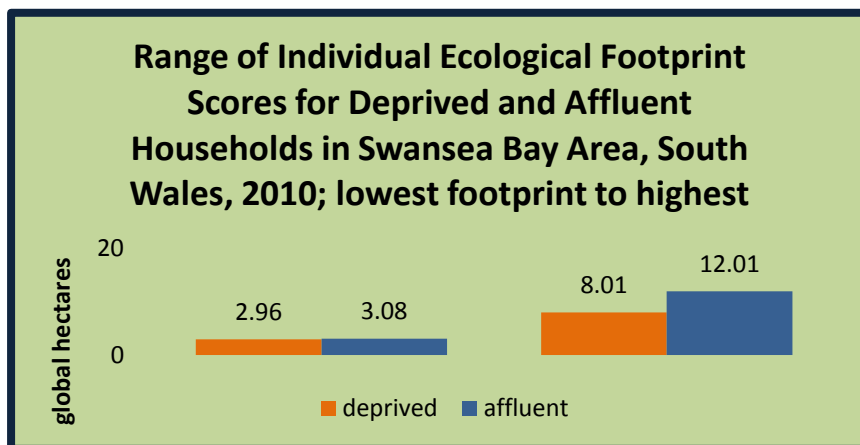
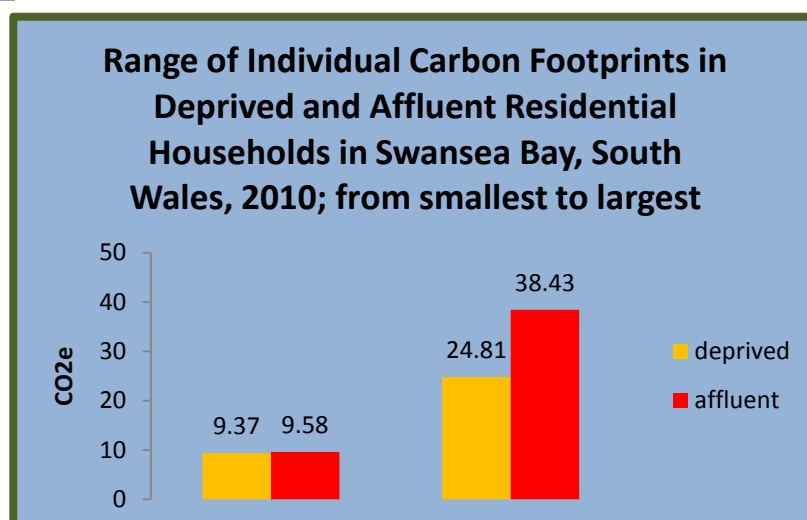


Figure 17 below shows a comparison between the two areas regarding the difference in range between the highest and lowest individual carbon footprints. As in figure 16, there is not much difference between the lowest carbon footprints recorded for individuals in both areas. However, the difference between the two highest recorded individual footprints for each of the areas is 13.62 tonnes of CO₂. This difference is marginally lower than the carbon footprint of the entire age range of 19-29 in affluent areas, 13.68.

Figure 17



Analysis:

The data obtained from the analysis performed by the REAP Petit software shows three clear trends. These trends are all related to the theory that with economic affluence comes a more carbon intensive lifestyle; the higher the household income, the higher the ecological and carbon footprint.

First comparing data displayed in figures 2 and 3, there is little difference in community ecological footprint scores between the affluent and deprived groups. Yet in the community carbon footprints, whilst not a significant difference between the two areas, the percentage of CO₂e for each sector in relation to the total carbon footprint, shown in figures 4 and 5, provide information as to what lifestyle choices are having the greatest impact on the environment. The affluent area records considerably larger scores in the sectors of travel, food and activities. This may infer more carbon intensive choices of food consumption, recreational choices and travelling, i.e. travelling abroad or driving a car with a larger engine. Global studies conducted to ascertain the ecological footprint of countries have consistently shown that those countries with higher per capita income in comparison to those countries of comparable size with lower incomes (Strechbart, M., 2010) have larger carbon footprints.

Further data reveals in figures 6 and 7 how individual ecological and carbon footprints are linked to household income. In figure 6, the ecological footprints for the affluent areas shows a clear trend with the ecological footprint increasing on average 94% as annual income increases. There is little to no trend within deprived areas based on income with the community ecological footprint actually decreasing as annual income increases, with the exception of the highest annual income group. This is an interesting result for it supports the theory that the higher the annual income, the greater the impact the lifestyle of the earner will have on the environment, (Barret et al., 2006). On average, the deprived areas calculated over a 35% decrease as annual income increased.

Using the REAP Petit software, the data was analysed through an age filter and displayed in figures 8 and 9. In both affluent and deprived areas the age group 30-49 had the highest ecological footprint. The carbon footprints in figures 10 and 11, would be expected to establish the same age group as recording the larger score as did in the previous two figures; however this is not the case. The ecological footprint and the carbon footprint highest scores were both allocated to the 30-49 age group. In the affluent area, the age group 50-64 has a larger carbon footprint, indicating a more carbon intensive lifestyle. This data reinforces the findings of SEI by Haq et al in 2010 stating that the age group 50-64, due to increased spending on car and air travel and eating and drinking, has the heaviest carbon footprint of all the age groups in the U.K. Projections put this age group as accounting for 30% of the U.K. population by 2020 (Haq et al., 2010).

Figure 12 is a breakdown of the two groups from the affluent and deprived areas with the highest carbon footprints; it shows what proportion of the total score is divided between each sector. In both areas, the main proportion of the carbon footprint came from housing, travel and food. These findings support the results of a SEI study done for the Welsh Assembly Government in 2008 found that the top three sectors which account for 63% OF THE Welsh Ecological Footprint are housing, travel and food. For the deprived areas, the age with the highest carbon footprint allocated 1.7 CO₂e for food. In the affluent areas, nearly the same amount, 1.6 CO₂e, was accrued for travel. This would

further support the findings of Haq et al in 2010 regarding the 50-64 age group as would the data displayed in figure 13 where the affluent age group 50-64 recorded a travel consumption score 175% greater than any other age group.

It is not only age and income that can influence an ecological or carbon footprint score, how many adults live in the home is a contributor due to the number of resources shared and needed. Referring to figures 14 and 15, the differences in ecological and carbon footprints between one and two adult households is compared for the two areas. In both areas, the larger footprints are with a one adult household. One parent households are the fastest growing sector of housing in the U.K. with a projected growth of 163,000 annually (CCS, 2010). In the survey area of Swansea Bay, the City and County of Swansea in 2009 reported an increase of 76% in lone parent households adding a further 6,088 homes to the amount of future housing needed. The data did show, however that both the ecological and carbon footprint for two adult households in the affluent area ranked higher than the one adult households of the deprived areas. Although this may not be further proof that the higher the income, the heavier the footprint, it may show that merely living within an affluent area despite income can increase the ecological and carbon footprints.

The difference in ecological and carbon footprints within areas of similar socio-economic demographics is displayed in figures 16 and 17 with the range between individual footprints in the community. In the deprived areas the difference between the lowest and highest footprints recorded was 5.05 gha which is a little under the average footprint of a Swansea resident. For carbon foot printing, the difference is 8.93 CO₂e. The difference between the lowest and highest ecological footprint for affluent areas was 15.44 gha. The carbon footprint difference for affluent areas is 29.45 CO₂e.

Recommendations:

The REAP Petit software programme, although inclusive of many lifestyle choices and consumer patterns, there were a few discrepancies found with the program. The total of the ecological or carbon footprint does not take into account resource use and waste generated by children. Neither score altered individually when the filter concerning children was added. The resources used and waste generated for 3 children was equal to having no children. The software did not include information on animals and household pets. Pet owners will testify that pets to consume and do generate waste within a household and should be included in the data. Further studies may wish to focus on evidence from the study that suggests in three different figures that it is not necessarily wealth that increase the footprint but living in affluent areas.

Conclusion:

The identification of consumption patterns within society and quantifying the impact of human activities in relation to the natural world enable policy makers to ensure that policies are implemented where they will be most effective, have the most impact and that future growth and development of society and the economy is achieved sustainably to protect coastal zones from further degradation and conserving ecosystem services for future generations. The results of the study confirmed that increased income does affect the size of the footprint in affluent areas but only in deprived areas when the household income has reached a certain threshold. The data also showed that although age and household family composition did influence the size of the footprint, it is not necessarily individual consumption patterns that may have the largest influence on a

community's ecological or carbon footprint, but the consumption patterns of the community as a whole. Individuals within affluent communities consistently calculated higher footprint scores in comparison to residents of deprived areas on comparable income and of comparable age. In coastal regions therefore, increased economic prosperity may be linked to a larger environmental impact, especially in cities which use a disproportionate amount of resources and generate an unequal amount of waste per capita which exacerbate concerns of sustainable development (Cummins, 2004). The use of the footprint to measure the sustainability of a community, although not completely accurate, is a valuable tool in communicating simply the personal effect that the lifestyles of individuals and communities have upon the environment. Supporting the importance and need for measurable indicators of sustainability to prevent further coastal zone deterioration (Charlier and Bologna, 2003) is the ability to measure the environmental impact of consumer patterns. When this is coupled with the knowledge that said consumers account for the largest proportion of green house gas emissions, community sustainability indicators can assist government agencies in producing strategies and incentives to lessen the impact of human activities on the environment in coastal areas.

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