PhD Proposal Plan (refined)

- The PhD plan is jointly prepared by the student and the supervisor at UG.
- The PhD plan will be used for setting up a matchmaking process aiming at identifying a relevant co-supervisor at a Danish University
- The PhD plan up max. 5 pages is to be sent to Susanne Amsinck, sla@dmu.dk no later than March 5, 2012.

1. Name of the PhD student

Ernest Agyemang

2. Project working title

Climate change, sustainable land use and management and transportation in Ghana

3. Abstract

Recent rapid urbanization, especially in cities of developing countries and the resultant growth of trip distance and motorized travel result in greenhouse gas emissions. This Project contends that while sustainable land use management curbs urban sprawl and the need for long-distance travel and car use, there is virtually no government policy framework in Ghana, as in most developing countries, to address land use, transport and their impact on climate.

The urban system dynamics and interdependence theoretical framework will be employed to unravel the synergies among land use, transport and climate change for policy recommendations.

With the use of the triangulation research technique, primary data will be generated and will be augmented by secondary sources to answer the research questions in this Project.

4. Project background (including state-of-the-art)

The UN (2007) estimates that nearly 70% of human population, especially those in cities of developing countries, will be urban dwellers by 2050. Vehicle population in these cities is also expected to rise from 25% in 1995 to 48% in 2050 (UN, 2001). This is because as cities sprawl, there is a dramatic growth of trip distance and motorized travel (Khisty, 1993; Kenworthy, 1995; Gakenheimer, 1999; Zhao, 2010). While the transport sector is a crucial vector for urban insertion (Wane, 2001), it generates greenhouse gas emissions which affect the climate adversely. Climate change literature suggests that road transport related air pollution was 23% of total air pollution, close behind industrial pollution (Huang, 2009; Zhao, 2010). Emissions are expected to increase 57% worldwide by 2030 and more than 80% by 2050 (UN-Habitat, 2009). The transport sector in developing countries is said to contribute 3.4 % per annum of CO_2 emissions (IEA, 2006). Thus, "effective Climate Action is incomplete without addressing the overall system performance of the Transport Sector" (Bellagio Declarations, 2009).

However, studies in Western cities have shown that the degree of mixed land use and sustainable management have a significant impact on travel patterns (Newman & Kenworthy, 1989; Cervero, 1996; Frank & Pivo, 1994,; Hickman & Banister, 2007; Grazi, et. al, 2008; cited in Zhao, 2010). Thus, sustainable land use management, designed to curb urban sprawl on the urban fringe, holds the panacea for long-distance travel and car use to cut down emissions in developing countries.

5. Hypothesis/aim of project

This Project hypothesises that sustainable land use practices affect car use and levels of emissions. The overarching objective of this Project is to ascertain the feasibility of climate change mitigation and adaptation mechanisms in view of current land use management practises and transportation patterns in Ghana.

Specifically, this Project will:

1. examine geo-spatial patterns in land use management;
2. map travel patterns in terms of
   a. trip generation;
   b. trip distribution;
   c. modal split and
   d. traffic assignment
3. examine the extent to which current land use and travel patterns affect GHG emissions;
4. identify sustainable alternative transport means that will reduce levels of GHG emissions.

6. Project description

According to Oteng-Ababio & Agyemang (2012), there is an obvious lack of co-ordinated land-use planning and enforcement of appropriate regulations in Accra, as in most cities in the developing countries. Land use patterns in these cities are such that high value socio-economic functions or activities are located at the hub, necessitating growth of trip distance and motorized travel, especially from the peri-urban areas. Quarshie (2007) estimates that about one million passenger trips are made daily in and out of Accra's CBD using mini vans and taxis which have low carrying capacity and are usually rarely maintained. The current public transport accounts for about 70% of emissions such as carbon monoxide, particulate matter 10, sulphur dioxide, nitrogen dioxide and manganese, some in high concentrations, at various locations in Accra (GoG, 2008, Nerquaye-Tetteh 2009; Armah et al, 2010).

As a way forward, the government of Ghana has outlined various policy statements on fuel efficiency, conservation and pollution control measures that shall be promoted to address climate change (GoG, 2008). While the policy emphasises fuel efficiency, the use of alternative fuels, and fuel efficiency technologies, the role of effective land use management in promoting sustainable transportation so as to reduce emissions is overlooked, possibly due to paucity of research on the land use/transport/climate change linkages. This comes against the backdrop of studies that have confirmed that the degree of mixed land use and sustainable management have a significant impact on travel patterns and emission levels (Zhao, 2010).

In the light of this policy gap, one wonders: can Ghana have an efficient land use and management systems that will reduce trip distance and motorized travel? To what extent will changes in land use practises affect transportation patterns? Are there alternative means of transport that could reduce level of emissions and their impact on the climate?

In order to answer the above research questions, this Project will use the urban system dynamics and interdependence theoretical framework. These theories simply posit that all things have connections with many other things and the significance of any one depends on its relationships with others (Oteng-Ababio& Agyemang, 2012). Chisholm (1967) opines that a unit of study should not be considered as a single thing but a system of interrelated objects or ideas such that a change in a sub-sector causes a change in the total system (Young 1964; Warneryd, 2004). The import of the systems theory to this Project is the interdependent relationship among urbanization, land use management, transport. The interactions among these sub-systems, whether positive or negative, will produce a feedback on emission levels and the impact on climate.

The major strength of this theory is that it will help identify 'the multi-loop, multi-state, non-linear feedback system that reacts to the decision makers' actions in ways both anticipated and

unanticipated' (Forrester 1969; Armah et al, 2010: 257). Again, the theory has been employed extensively in traffic congestion studies (Springael, 2002; Wegener 2003; Armah et al, 2010); informal transport in Accra (Oteng-Ababio& Agyemang, 2012); housing provision in Kumasi (Asiedu, 1991) and development of essential environmental facilities (Asiedu, 2001). The major limitation with the use of this theory, perhaps, is the attempt to adapt the theory in a context which is radically dissimilar to the original context within which it was first formulated and applied.

7. Methodologies

The *triangulation approach* will be used to gather evidence from multiple sources, broaden the research work and strengthen its validity (Baker, 1990). Qualitative and quantitative data will be generated in Accra, Ghana's most urbanised area. Research instruments include:
Questionnaire and *interviews* (to address Research Objective 2); *In-depth interviews* with key informants at the Environmental Protection Agency (EPA); city authorities; ministry of transport (to address Research Objectives 3 and 4). Functional landuse and land cover as well as digitized road networks will be generated with GPS/GIS tools.
Secondary data sources include: The *2010 Housing and population census*; Air quality monitoring data from EPA; 3. Relevant library and online literature.

Geo-spatial analyses to be performed include: 1.Cluster analysis of land use patterns and generation of air quality surface and its relationship with trip volume with ARCMAP GIS software. Qualitative data will be transcribed and presented as quotes to complement the quantitative analyses.

8. Work plan

Year 1	Year 2	Year 3
Initial meeting with Principal Supervisor & Revision of Research Proposal Starts Course work	Research Design/ Methodology	Processing of Field Data/ Data analyses
Seminar 1 (Presentation of Research Proposal to the relevant Department)	Seminar 2 (Presentation of Research Instruments to the relevant Department)	Seminar 3 (Presentation of Preliminary findings to the relevant Department)
Literature Review & Designing of Conceptual Framework Ends Course work	Revision of Methodology based on inputs received from Seminar 2	Final Thesis Write-up starts
	Preparations towards Fieldwork in Ghana	Final editing & Processing of thesis
	Actual Fieldwork in Ghana	Submission of Final Thesis for examination

9. References

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10. Proposed PhD courses

Course title	Institution	Suggested ECTS-points

11. Time schedule (courses, stays in Denmark/abroad/at other national institutions, publishing of results).

12. Scientific competences that the student will get from the project

My initial academic interest is in transportation systems analyses. The addition of sustainable landuse management systems and climate change will equip me with multi-disciplinarity skills that will impact positively on my teaching, researching and dissemination of research knowledge to stakeholders.

13. Date and signatures

	Date	Name	Signature
Principal supervisor		Prof. Alex Boakye Asiedu (PhD)	
Project supervisor			