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**INTERNATIONAL PROGRAMME FOR RESEARCH ON THE
INTERACTIONS BETWEEN POPULATION, DEVELOPMENT AND
THE ENVIRONMENT (PRIPODE)**

APPLICATION FORM

**Application deadline: 11 April 2003
(electronic file)**

Dossier n°

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To complete the application form, follow the instructions given in the instruction note

Title of the project

**POPULATION, DEVELOPMENT AND ENVIRONMENT IN
METROPOLITAN ACCRA: A TWO-PHASE STUDY**

Name of the person in
charge

Professor John K. Anarfi

Applicant Centre

Institute for Statistical, Social and Economic
Research (ISSER), University of Ghana, Legon,
Accra.

Country

Ghana

I - PROJECT SUMMARY

<p>1. <i>Project Title:</i></p> <p>POPULATION, DEVELOPMENT AND ENVIRONMENT IN METROPOLITAN ACCRA: A TWO-PHASE STUDY</p>
<p>2. <i>Name of person in charge:</i> Professor John K. Anarfi</p>
<p>3. <i>Address of the person in charge:</i></p> <p><i>Postal address:</i> Deputy Director ISSER, POB LG 74, University of Ghana, Legon, Accra, Ghana</p> <p><i>E-mail address:</i> jkanarfi@yahoo.com</p> <p><i>Telephone:</i> +233 21 501182 <i>Fax:</i> +233 21 500937</p>
<p>4. <i>Centres or teams involved in the project:</i></p> <p>ISSER Dept. of Geography & Resource Development, University of Ghana Faculty of Law, University of Ghana Accra Metropolitan Assembly, Public Health Department Harvard School of Public Health, Boston MA, USA San Diego State University, California, USA.</p>
<p>5. <i>Number of researchers involved in the project:</i> 12 plus</p>
<p>6. <i>Disciplines concerned by the project:</i> Public Health, Medicine, Sociology, Geography, Law, Environmental Sciences</p>
<p>7. <i>Area(s) of research:</i> Community health assessment. Urban poor communities. Promoting development.</p>
<p>8. <i>Key words describing the project (between 2 and 4 per heading):</i> Population: Urban population growth, urban poor, slum-dwellers Development: Income generation, local management of environmental conditions, gender inequalities. Environment: Water, sanitation, living arrangements, spatial distributions. <i>Geographical field:</i> Accra, Ghana <i>Methods of analysis:</i> Geographic and statistical analysis of health, environmental and poverty data <i>Sources of data:</i> Census of 2000, routine cause of death records, out-patient morbidity data, Accra Women's Health Survey, Demographic and Health Surveys (1998 and 2003), WHS, LRC reports on community actions.</p>

9. Summary of the project (no more than one page):

POPULATION, DEVELOPMENT AND ENVIRONMENT IN METROPOLITAN ACCRA: A TWO-PHASE STUDY

Summary

The proposed research is designed to test the hypothesis that health levels in urban places are importantly influenced by the local neighbourhood environment, including the nature of the built environment (buildings and infrastructure), the socio-economic environment (including average levels of income and education as well as the availability and judicious use of resources), and the location of a neighbourhood within the broader urban environment (including its proximity to health clinics and hospitals). This is also tied to the kind of institutional arrangements that regulate resource allocation from the centre to the local level. The Accra Metropolitan Area (AMA), Accra, Ghana has been selected for this study.

The lead institution is the Institute of Statistical, Social and Economic Research with researchers from other Departments and Schools of the University of Ghana (Dept. of Geography & Resource Development, School of Public Health, Medical School, Faculty of Law) working with health officials from the Accra Metropolitan Assembly. Collaboration is planned with colleagues from San Diego State University for the satellite interpretation and spatial statistics and with the Harvard School of Public Health for the epidemiology and demography.

The first phase of the project involves the collation of existing census, survey and health data for the city and organizing these data in a common geographical database. The primary unit of analysis will be the 2000 census enumeration areas of which there are 1700 in the city. The census data allow the calculation of a measure of early childhood mortality (children ever-borne/surviving) as well as providing detailed information about living conditions at the household level (water, sanitation, bathing and cooking, house type and tenure, for example). The routine death registration data for 1999, 2000 and 2001 will be captured in a new database with the usual addresses, age, sex and cause of death of the decedents. Morbidity data will be added from out-patient records from the city's public hospitals and clinics. The environmental conditions in each EA will then be assessed from ground enquiries and from a digitised satellite image available for 2002.

The project will then link new data from the 1998 DHS survey, the 2003 proposed DHS, the WHO World Health Survey (WHS - fieldwork February – May 2003) and the Accra Women's Health Survey (AWHS - fieldwork March – July 2003), each of which contains geocodes for the sample clusters (DHS) or for the individual households interviewed (WHS and AWHS). Objectively assessed and subjectively reported measures of adult health will thus be available for a representative sample of 3200 women aged 18 and over from the AWHS. Only self-assessed health status is available in the WHS but this covers adult men and women. These data will then be linked and a spatial statistical analysis conducted to assess measures of association between environment, living standards and health.

In a second phase, the project will examine in detail these connections at a local level in a poor neighbourhood, Nima-Maamobi, where the Legal Resources Centre has been active in health promotion at the community level for over 5 years. The LRC, staffed by lawyers from the Faculty of Law, other lawyers and environmental scientists, has formed solid working relations with women's groups, the gender action committees and local political, religious and traditional leaders to promote health through improved water and sanitation and the payment of exemptions from user fees for health services. Working with the local community, the project will produce a subjective assessment of environmental risks and compare this with assessments based on the statistical evidence. The result will be a plan of action developed by the AMA Health Department in conjunction with the community leaders for scaling up of the project to cover other poor neighbourhoods of the city. For this reason, the Medical Officer for Public Health for the AMA is part of this project from the outset. Other support is being sought for objective assessment of water and air quality at a later stage. The baseline analysis in Phase 1 will also form the starting point for the assessment of planned interventions.

II – DESCRIPTION OF THE PROJECT (no more than 5 pages)

1. Problem statement

The proposed research is designed to test the hypothesis that health levels in urban places are importantly influenced by the local neighbourhood environment, including the nature of the built environment (buildings and infrastructure), the socio-economic environment (including average levels of income and education as well as the availability and judicious use of resources), and the location of a neighbourhood within the broader urban environment (including its proximity to health clinics and hospitals). This is also tied to the kind of institutional arrangements that regulate resource allocation from the central resource pool to the local levels. We propose to attempt an assessment of the relative importance of each of these sets of factors contributes to health outcomes in metropolitan Accra and in a more detailed household-level study in a poor slum neighbourhood. We hope to model the interaction among the variables that predict health levels to determine what changes must be introduced into a neighbourhood to bring its overall level of health up to a minimally acceptable standard. The aim will be to improve health and to raise economic productivity without compromising the urban environmental integrity that protects health – a key element of sustainable development. We assume a closed-loop relationship among residents' economic productivity, environmental integrity, and residents' health states rather than a discrete independent triangular relationship of the three variables. In previous studies, the difficulty has been linking these different components. By using some newer geocoded data in conjunction with digitised satellite imagery, we think we can make more progress towards integrating population, development and environment factors in a more rigorous fashion, revealing the nature of the inter-dependency between the variables.

2. National and international importance of the problem

In sub-Saharan African countries, with the fastest national rates of population growth in the world, we are finding even faster growth rates in urban places. According to data from the United Nations Population Division (2002),¹ the urban populations of this region grew at a rate of 5.8% per year between 1990 and 2000, doubling the urban population every 12 years. Sub-Saharan Africa is still viewed as a predominantly rural region but with such growth rates, very soon the majority of the region's people will live in urban places, many of them mega cities like Lagos, Ibadan and Kinshasa. Surprisingly, the study of health and environment links in urban places is still not well developed in Africa.^{2 3}

This growth is not evenly spread within the urban areas, however, in some instances concentrated in slum areas within the older city limits, in other cases distributed around the expanding periphery. In both cases, however, the rates of local population growth far outstrip the capacity of city or local governments to keep pace in the provision of education, housing, water, sanitation and other social services. In addition, with few economic opportunities in poor urban neighbourhoods, the separation of workplace and residence is leading to major traffic problems, wasted national resources and environmental pollution.

International pressures under the rubric of structural adjustment, have exacerbated the situation for the urban poor where responsibilities for the provision of education and health facilities have been devolved to local levels of governments (metro and sub-metro district assemblies in Accra) with slender budgets and weak technical capacities to respond. In addition, many services, especially health services, are now offered on a "cash and carry" basis with some statutory allowances for fee exemptions by the poor.⁴ These allowances are in practice often unpaid.⁵ The net effect is that urban poverty is deepening, both in older slums and in newly settled areas with rapid population growth resulting in large urban health disparities in the city. Thus, it is in cities and not in the rural areas where we can observe the starkest contrast in health, environmental conditions and living standards where luxurious villas are found cheek by jowl with shantytowns and slum conditions.⁶

3. Relevance for policies on sustainable development

With poor water and sanitation, the urban environment is degrading quickly as people make what adaptations they can to these new challenges. In Accra and Sao Paulo, the subject of recent analyses, it is estimated that the ultimate result of poor sanitation leaves a situation in which poor children in slum and poorer neighbourhoods

¹ United Nations. 2002. *World Urbanization Prospects: The 2001 Revisions*. New York: United Nations Population Division.

² Atkinson, S, J Songsore and E Werna (eds) (1996) *Urban health research in developing countries: implications for policy*. Wallingford: CAB International.

³ Hardoy, JE, D Mitlin, D Satterthwaite (2001) *Environmental Problems in an Urbanizing World: Finding Solutions in Africa, Asia and Latin America*. Earthscan Publications, Ltd

⁴ Guidelines on use of government budgetary support for exempted patients. Ministry of Health letter, 15 August 1997.

⁵ Legal Resources Centre (2001) Health Project Report. Nima.

⁶ Ghana Statistical Service (2000) Ghana Living Standards Survey. Report of the Fourth Round. Accra.

are nearly three times as likely to have diarrhoea, cholera, and other enteric diseases, as are children of wealthy families with better sanitation services.^{7 8} Further, when electricity is unavailable, households resort to charcoal for cooking with all the attendant risks of using this fuel in crowded quarters. These risks include not only the risk of fire, but also the more pervasively long-term risk of poor health from the effects of the locally created air pollution as consequence of local concentrations of toxic oxides of heavy metals in crowded household environments. In Accra in 2000, 58% of households cooked with charcoal, most in the open (see Table 1 below). Without electricity too, the monthly costs of lighting for the poor, whether candles, oil lamps or domestic generators, are several times that of mains electricity.⁹ Disposal of solid waste is haphazard, polluting waterways and public roads, leading to invasion of rodents and other vermin. Altogether, the combination of rapid population growth and resource-poor, dense urban environments provides a new challenge for the understanding and then the resolution of the problems faced by urban Africans.

Sustainable development in Africa, as elsewhere in the world, requires that future population growth be absorbed by cities because only in or near cities are increasing numbers of people likely to find the kind of employment opportunities that will permit them to rise above and stay above the poverty level.¹⁰ At the same time, sustainable development requires a healthy population, because only a healthy population can improve levels of economic productivity necessary to lift an economy out of widespread poverty. The conjunction of these two propositions means that sustainable development in the context of continued population growth demands an urban environment that promotes improved levels of health services as well as of health equity among its residents. Because of the very limited resources available to most nations of sub-Saharan Africa, urban health promotion in the future will demand ever more efficient, parsimonious use of scarce resources. It is thus important to identify the minimum threshold requirements of adequate levels of health in the urban environment, so that resources can be devoted to bringing every neighbourhood up to at least that level.

4. Scientific objectives

a. Previous work

The plight of poor households in Accra has been the subject of some important previous work. An analysis of existing health data and a household survey by Songsore and Goldstein¹¹ revealed the stark contrasts between the better off neighbourhoods and the slum areas of the city. This work began the description of the urban ecology of the city. Some new historical work has revealed the distinctiveness of the city's structure – owing more to the continuing urban tradition of the Ga (Greater Accra) than to any imposition of a new layout in colonial times as was the case with other major cities in East Africa.¹² More recently, there have been many studies of urban planning and ways to improve the provision of basic services to the poorer areas of the city. Meanwhile, population growth has continued unhindered with Greater Accra growing by nearly 4% per year between the 1984 and the 2000 censuses.

At the local level, the Legal Resources Centre, an NGO based in Nima, has had an active health project and a project focusing on community action towards a human right to health for several years.^{13 14} This work and the confidence it has built in the community provide a solid platform for community involvement in the research. More details on the LRC are available on the website - <http://www.lrc-ghana.org>.

b. The Study Area

The area chosen for this study is the administrative unit known as the Accra Metropolitan Area. Responsibility for the health, welfare and governance of this population rests with the Accra Metropolitan Assembly (AMA). The metropolitan area comprises 1.66 million people and 365,550 households according to the March 2000 census. Anticipating possible interventions after the study has been completed, the planning team decided that it

⁷ Stephens, I Timaeus, M Akerman et al (1994) *Collaborative studies in Accra, Ghana and Sao Paolo, Brazil and analysis of urban data of four Demographic and Health Surveys*. London School of Hygiene and Tropical Medicine.

⁸ Songsore, J and G McGranahan (1998) The political economy of household environmental management: gender, environment and epidemiology in the Greater Accra Metropolitan area. *World Development* 26(3): 395-412.

⁹ The Volta River Authority estimates that the monthly costs of lighting, compared to light bulbs and mains electricity, are 3.55 times higher with oil lamps, 6.98 times higher with candles and 7.76 times higher with a separate generator.

¹⁰ UNICEF and Ministry of Health (2002) *Situation analysis of children and women in Ghana 2000*. Accra.

¹¹ Songsore J and G Goldstein (1995) Health and environment analysis for decision-making: field study in Accra, Ghana. *World Health Statistics Quarterly* 48(2): 108-117.

¹² Parker, John (2000) *Making the town: Ga state and society in early colonial Accra*. Oxford: James Currey.

¹³ Legal Resources Centre (2002) *Community action towards a human right to health*. Unpublished report.

¹⁴ Legal Resources Centre (2003) *Health project, Nima, Accra*. Unpublished report.

would be advantageous to work within one administrative district, the Accra Metropolitan Area governed by the Accra Metropolitan Assembly, rather than the larger 3-district area known as Greater Accra.

There is considerable socio-economic and cultural diversity within this area as work by Songsoore and others (op.cit) have demonstrated. The census data for metropolitan Accra show that the mean household size ranges from 3.9 to 5.1 persons. Even a cursory inspection of the housing figures reveals major contrasts between the high-income areas such as Airport Residential and East Legon, the crowded informal settlements of Nima or Maamobi, and the older inner core areas of James Town and Ussher Town. There is clearly enough diversity in the metropolitan Accra population for us to draw out some differentials in health status and associated environmental exposure and risk factors.

c. New research opportunities

There are new opportunities to take the understanding of population, health, development and environmental factors further forward, testing the basic hypothesis set forth previously about the relationships between and among economic productivity, local environmental (e.g., aspects of urban ecology) integrity and human health. We have new data, new analytic methods and new intervention opportunities.

5. New data

- a) First, we have at our disposal new data that describe the living conditions of the Accra population. The census of 2000 asked a whole series of questions on the living conditions of each household. An example of the data for Greater Accra is presented below. It also asked questions on the socio-economic conditions (employment status and income levels) of residents which should provide a conclusive picture of the existing intra-urban income differentials. This then gives us a good basis for modelling the interactions between economic productivity and the health status of residents as well as the intervening environmental controls.

Table 1a. Housing conditions in Greater Accra, 2000 census.

Rooms occupied	%	Drinking water	%	Lighting	%
1.00	42.18	Pipe outside	44.98	Electricity	76.42
2.00	29.49	Pipe inside	35.92	Kerosene	21.81
3.00	8.83	Tanker	7.30	None	1.12
4.00	6.80	Well	5.36	Other	0.38
5.00	5.05	Dugout	1.85	Gas	0.19
6.00	2.84	River	1.58	Solar	0.07
9+	2.07	Spring	1.44		
7.00	1.61	Borehole	1.06		
8.00	1.13	Other	0.50		
TOTAL	100.00		100.00		100.00

Table 1b. Housing conditions in Greater Accra, 2000 census.

Cooking space	%	Cooking fuel	%	Bathing	%
Open	30.52	Charcoal	57.27	Own b/room	27.97
Excl. use	25.64	Gas	21.79	Open cub shared	27.02
Veranda	21.57	Wood	8.75	Shared b/room	25.75
None	8.49	None	4.78	Open cub exc.	5.67
Shared	4.80	Kerosene	4.25	Open cub shared	5.36
Bedroom etc	2.97	Electricity	2.22	Public b/house	4.52
Roof, no walls	2.96	Other	0.76	Other house	2.26
Enc. no roof	2.39	Coconut	0.17	River	0.63
Other	0.66			Other house	0.44
				Lake	0.39
	100.00		100.00		100.00

These data can be disaggregated down to the enumeration district level. In metropolitan Accra, there are over 1700 of these units. The boundaries of all the EAs are known but only 200 sample EAs have been mapped using the GIS for the Accra Women's Health Survey.

In addition to the data on housing standards and facilities, the census also included questions on children ever-borne and surviving to all women of reproductive age. These data provide the basis for estimating childhood mortality levels and trends for very small areas of the urban population.

- b) Secondly, we have access to the 1998 DHS data that include a significant numbers of clusters that fall in Accra. There is a new DHS scheduled to be in the field in mid-2003 and this survey, as for the 1998 data, will also include GIS references for the centre of each cluster.
- c) Third, a major new interview and examination survey of women's health, a sample of 3200 women aged 18 and over living in the Accra Metropolitan Area, is being conducted between April and July 2003. This study will provide new self-report health data, data from a clinical examination and laboratory work as well as data on the household's facilities matched to the census of 2000.¹⁵
- d) Fourth, WHO is supporting a version of the World Health Survey in Ghana and approximately 40% of the interviews (3000 men and 3000 women aged 15 and over) will fall in Accra. This survey includes self-reported health data as well as information on the source and costs of health with information on the users' satisfaction with the services provided. These data are geo-referenced. See the WHO WHS website <http://www.who.int/whs>.
- e) A preliminary review of the routinely collected vital statistics and out-patient data for the Accra Metropolitan area suggests that such data are quite plentiful and can be obtained for small areas of the city. These data include birth and death records with cause of death and other details including accurate address data, as well as out-patient data on morbidity from health and other government facilities. Some data from major private clinics will be examined and we have plans to geo-reference the health facilities in the detailed study of Nima-Maamobi.
- f) Finally, we propose to obtain and analyse a high-resolution multi-spectral Digital Globe satellite image at 2-8 m resolution of the Accra metropolitan area that was acquired on 12 April 2002 on a cloudless day.

6. New analytic methods and satellite imagery

The project will bring the new technology of the spectral analysis of satellite imagery to assess health and environment risk. This technology has been applied in recent demographic work in Egypt and Jordan.^{16 17} The analysis involves creating a set of quantitative landscape metrics from the classification of the spectral properties of the imagery that describe the type of land cover and the geometric arrangement of land cover within a given area on the ground (in this case the enumeration areas (EA) of Greater Accra). These data provide an assessment of the built and natural environment within each EA, and they will be combined in a geographic information system (GIS) with layers of data from the census, surveys and vital statistics as described above. Using methods of spatial analysis and multi-level analysis we will then be able statistically to evaluate and model the interaction between the built and natural environment, the socio-demographic characteristics of the population, and the health of the population.

7. New intervention opportunities

The Legal Resources Centre (LRC) is a non-governmental, not-for-profit human rights organisation formed in 1997 by a group of Ghanaian lawyers and law students. It was incorporated as a company limited by guarantee under the laws of Ghana in February 1998. The underlying philosophy of the LRC is that democracy can only thrive in an environment in which the majority of the people a) know and understand their basic human rights; b) have quick and effective access to justice and entitlements; and c) understand and play their role in the functioning of the constitutional democratic structures. Based on this the LRC is engaged in a number of activities including public/civic human rights education; legal aid and alternative dispute resolution (ADR); grassroots participatory democracy activities; parliamentary advocacy; and an international human rights and lawyering internship programme. In a meeting with the Deputy Minister of Health on 28 January 2003, the communities of Nima and Maamobi presented three ways to increase the efficiency and effectiveness of current efforts, each involving the development of a partnership between government at several levels and the local communities. These included exemptions from user fees and identification of the most needy; review of the package of health services exempted; and the need for joint action to improve water and sanitation, recognising the major capital costs in building community water and sewerage systems.

¹⁵ Anarfi, J, R Darko and AG Hill (2003) Proposal for a Comprehensive Study of Women's Health in Accra. University of Ghana School of Public Health, University of Ghana Medical School, Institute of African Studies, Institute for Social Science and Economic Research, Harvard School of Public Health, Harvard Medical School.

¹⁶ Rashed, T, JR Weeks, MS Gadalla and Allan G. Hill. 2001. Revealing the anatomy of cities through spectral mixture analysis if multi-spectral satellite imagery: a case study of the Greater Cairo region, Egypt. *Geocarto International* 16(4): 5-13.

¹⁷ Weeks, J, M Saad Gadalla, T Rashed, J Stanforth and Allan G. Hill. 2000. Spatial variability in fertility in Menoufia, Egypt assessed through the application of remote sensing and GIS technologies. *Environment and Planning A*: 40.

A new partnership has been developed by LRC with the Accra Metropolitan Area Health Department to explore novel ways of improving the living environment of poor neighbourhoods. To act on behalf of the poor of Accra, either on the ground or in the courts, requires the culmination of the kind of evidence we propose to generate in this project

8. Methodology

The work plan can be summarized as follows:

Phase 1:

- Digitise the boundaries of the Enumeration Areas and produce an ArcGIS shape file to which all other data will be linked. 200 EAs already captured so feasibility and costs known.
- Link the census data by EAs to the EA shape files.
- Link all other survey data (WHS, AWHS, DHS) to the EAs in which the sampled households were located.
- Link all vital statistics and administrative data to the EA or sets of EAs in which events occurred.
- Geocode health facilities in Accra and measure distance from the centre of each EA to the closest health facility of each type.
- Purchase DigitalGlobe multispectral satellite image of Accra, classify image into land cover classes using multiple end member spectral mixture analysis, and create variables representing land use and landscape metrics as measures of the built and natural environment.
- Develop indices of threshold health levels by EA.
- Test OLS, logistic regression models in which threshold health level of EA is modelled by variables describing the social and built environment as derived from census, survey, vital statistics, administrative, and remotely sensed imagery sources.

The basic model to be tested with data on health derived from census and/or vital statistics is as follows:

Health levels in EA ~ fn (housing characteristics of EA, socio-demographic characteristics of EA, environmental characteristics of EA, health facilities per person within distance (d) of centre of EA).

Multi-level regression models (OLS and logistic as appropriate to the dependent variable) will be employed with data from the various surveys, in which the variability from respondent to respondent in health levels will be partitioned between the influence of individual characteristics as derived from the survey, and the environmental factors of the neighbourhood in which they live as derived from the census and remotely sensed data. The basic model to be tested is as follows:

Health of individual in EA ~ fn [individual socio-demographic characteristics, characteristics of neighbourhood environment (including census variables, satellite image variables, and proximity and use of health facilities)].

Link results of regression models to policy initiatives that could be undertaken at the local level.

Phase 2:

- Develop local perceptions of environmental risk with communities in Nima-Maamobi, record these by type and reasons for the severity ratings. Focus groups with sub-groups of the population.
- Map these areas and compare them with the objectively assessed risks from satellite, survey data and work on the ground, based on the statistical models as described above
- Show how income-generating projects that are environmentally sound (the LRC work on composting and garbage separation by Nima youth) can be extended and broadened.
- Establish a baseline and prepare for intervention projects directed by the LRC, the AMA Health Department and communities in Nima-Maamobi.

Use and dissemination of results

The results will be immediately useful to the community, the AMA and health planners in the central Ministry of Health. There will be regular progress reports and meetings with all stakeholders. USAID is preparing a seven-year strategy for investment in poor urban areas and so there is a real prospect of some major interventions in future for which these baseline data will be invaluable. In addition, DFID(UK) wishes to pursue further the rights-based approach to improving environment and environment health.

III - THE TEAM

1. Person in charge

Name: ANARFI **First name:** John K.

Sex: Male **Date of birth:** 27 April 1949.....

Nationality: Ghanaian

Current position: Deputy Director, Institute of Statistical, Social, and Economic Research (ISSER), Professor of Sociology.....
.....

2. The Centre

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Acronym: ISSER

Postal address: POB LG 74, University of Ghana, Legon, Accra, Ghana.

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Give the complete name and position of the person representing the organisation:

Name: Professor Ernest Aryeetey

Position:Director, Institute for Statistical, Social, and Economic Research

3. Table of the members of the team

Name	First name	Parent organisation	%
ANARFI	John K	ISSER	30%
BOTCHIE	George	ISSER	30%
COLEMAN	Niie Ayite	Accra Metropolitan Assembly	10%
ATUGUBA	Raymond	Faculty of Law, University of Ghana	10%
AGYEI-MENSAH	Samuel	Dept. of Geography & Resource Development, U of Ghana	10%
FOBIL	Julius Najah	School of Public Health, University of Ghana	30%
SONGSOORE	Jacob	Dept. of Geography and Earth Sciences, U of Ghana	5%
HILL	Allan G.	School of Public Health, Harvard University	10%
WEEKS	John	Dept. of Geography, San Diego State University	10%
ANO		Field workers and research assistants to be identified	Full time

4. Individual forms

Researchers taking part in the project for more than 30% of their working time must each fill out an individual form. See attachments at end.

INDIVIDUAL FORM (one for each member of the research team)

Name: ANARFI

First name: John Kwasi

Sex: Male

Date of birth: 27:04:49

Nationality: Ghanaian

Organisation: INSTITUTE OF STATISTICAL SOCIAL AND ECONOMIC RESEARCH (ISSER)

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Current position: Deputy Director, Institute of Statistical, Social and Economic Research University of Ghana , Legon

Main degrees (title, University, year):

Jan. - Dec. Post-Doctoral Fellow, ANU, Canberra.
1993.

May 1986- Ph. D. in Population Studies, United Nations Regional Institute

Nov. 1989 for Population Studies, University of Ghana, Legon.

Thesis: International Migration of Ghanaian women to Abidjan, Cote d'Ivoire - A demographic and socio-economic study.

Jan. 1980 - M. A. in Population Studies, United Nations Regional Institute for Population Studies, University of Ghana, Legon.

July 1981 Thesis: International Labour migration in West Africa: A case study of the Ghanaian migrants in Lagos, Nigeria.

October 1979 Graduate Diploma in Population Studies, United Nations Regional

Institute for Population Studies, University of Ghana, Legon.

July 1976 B.A. (Hons) Geography, Education, Economics, University of Cape Coast, Cape Coast.

Discipline(s) specialised in:

- i. Migration Studies
- ii. Women in Migration
- iii. Sexuality and AIDS
- iv. Adolescent Reproductive Health
- v. Street children

Five main publications during the last five years relating to PRIPODE:

- 2000a [With Clara Korkor Fayorsey] “Male protagonists in the `Commercialisation` of aspects of the Female Life-Cycle in Ghana”. Pp 144-162 in Bledsoe, C. et al. (Eds) Fertility and the Male Life-Cycle in the Era of Fertility decline. Clarendon Press, Oxford.
- 2000b [With McCombie, S and Hornik, R]. “Effects of a Mass Media Campaign to Prevent AIDS Among Young People in Ghana”. In Robert Hornik (ed.) Public Health Communication: Evidence for Behaviour Change, Lawrence Erlbaum Associates.
- 2000c [With K. Awusabo-Asare and E. N. Appiah]. “Female emigration, AIDS and their socio-demographic impact: a case study of a Ghanaian rural community”. Pp. 99-114 in J. C. Caldwell et. al. (eds.). Toward the Containment of the AIDS Epidemic: Social and Behavioural Research, Health Transition Centre. Australian National University, Canberra.
- 2001a [With Judy E. Mill] “HIV Risk Environment for Ghanaian Women: Challenges to Prevention”. Social Science and Medicine, 0:1-13.
- 2001b “Migration and Livelihoods in the era of AIDS: A West African focus with Emphasis on Ghana”. Pp. 17-23 in *Research review*, New series, Vol. 17, No. 1. Institute of African Studies, University of Ghana, Legon.
- (Forthcoming) [With Susan McCombie] The Influence of sex of Interviewer on Results of an AIDS Survey in Ghana.

INDIVIDUAL FORM (one for each member of the research team)

Name: BOTCHIE First name: GEORGE
Sex: Male Date of birth: 21:03:44
Nationality: Ghanaian

Organisation: INSTITUTE OF STATISTICAL SOCIAL AND ECONOMIC RESEARCH (ISSER)

Complete address: I.S.S.E.R P.O BOX 74, UNIVERSITY OF GHANA , LEGON
City: ACCRA **Country:** GHANA

Telephone: 233-21-501182 **Fax:** 233-21-512504/500937

E-mail address:

Current position: DEVELOPMENT PLANNING RESEARCH

Main degrees (title, University, year):

B.A (HONS) UNIVERSITY OF GHANA	1970
PHD UNIVERSITY OF GHANA	1974
POST DOCTORAL DIPLOMA, MIT CAMBRIDGE	1979

Discipline(s) specialised in: DEVELOPMENT PLANNING

Professional experience, notably in research:

Undertake a number of research projects including studies on urban solid waste management; Rural District Planning, Technology and small medium scale Enterprise Development, Population, Poverty and Environment and Utilities development in Ghana

Five main publications during the last five years relating to PRIPODE:

George Botchie : 1. Rural District planning in Ghana, Environmental planning Issues No.21 IIED 2000
2. Technology and small-medium Enterprise Development in Ghana: The case of the GRATIS project, ATPS 2001
3. Urban, solid waste management in Tema fast growing industrial and port city in Ghana, African Urban Quarterly vol.9 Nos. 3 and 4
4. Population, Poverty and environment in Ghana in state of Ghanaian Population report, 2001
5. Policy implications for trend Data for infrastructure and utilities in Ghana, Ghana statistical service, 2003

INDIVIDUAL FORM (one for each member of the research team)

Name: COLEMAN **First name:** NII AYITE

Sex: MALE..... **Date of birth:** 04/21/60.....

Nationality: GHANAIAN

Organisation: ACCRA METROPOLITAN ASSEMBLY.....

Complete address: P. O. BOX MB 568, ACCRA, GHANA.....

City: ACCRA..... **Country:** GHANA.....

Telephone: 233 21 768835..... **Fax:**

E-mail address niicoleman@yahoo.com

Current position: DIRECTOR, PUBLIC HEALTH DEPARTMENT

Main degrees (title, University, year):

MB ChB; KNUST; 1985

MPH; HARVARD UNIVERSITY; 1991

Discipline(s) specialised in: PUBLIC HEALTH.....

Professional experience, notably in research:

DISTRICT MEDICAL OFFICER OF HEALTH

REGIONAL DIRECTOR OF HEALTH SERVICES

DIRECTOR OF POLICY, PLANNING, MONITORING AND EVALUATION

LECTURER, SCHOOL OF PUBLIC HEALTH

CONSULTANT, BOSTON DEPARTMENT OF PUBLIC HEALTH

PRACTICING PHYSICIAN

DIRECTOR, DEPARTMENT OF PUBLIC HEALTH

INDIVIDUAL FORM (one for each member of the research team)

Name: ATUGUBA.....**First name:** RAYMOND

Sex: MALE.....**Date of birth:** 1ST APRIL 1974.....

Nationality: GHANAIAN

Organisation: FACULTY OF LAW. UNIVERSITY OF GHANA; AND LEGAL RESOURCES CENTRE, MAMOBI, ACCRA.

Complete address: P. O. BOX LG 70, LEGON.....

City: ACCRA.....**Country:** GHANA.....

Telephone: 233-21-502255/7 EXT. 2119 **Fax:** 233-21-502385.....

E-mail address: ATUGUBAATUGUBA@YAHOO.COM

Current position: Assistant LECTURER, UNIVERSITY OF GHANA
ASSOCIATE EXECUTIVE DIRECTOR, LEGAL RESOURCES CENTRE.

Main degrees (title, University, year):

LLB, UNIVERSITY OF GHANA, 1997

BL, GHANA SCHOOL OF LAW, 1999

LLM, HARVARD LAW SCHOOL, 2000.....

SJD, HARVARD LAW SCHOOL, EXPECTED JUNE 2004.....

Discipline(s) specialised in:

HUMAN RIGHTS LAW; DEVELOPMENT STUDIES

Professional experience, notably in research:

1. Directly responsible at the LRC for the production of “The Right to Development Report: Ghana Country Study”, commissioned by the United Nations Expert on the Right to Development and the François-Xavier Bagnoud Center for Health and Human Rights at the Harvard School of Public Health.
2. Assisted to conduct comparative studies of modern legislation in the area of family, inheritance, marriage and fertility rights. (UNFPA sponsored project).
3. Worked as a member of a team of five legal consultants for the German Technical Cooperation (GTZ) on a research project to determine child maintenance practices in Ghana and make recommendations for reform.
4. Currently working on a social science research project on the law and practice in relation to Moslem marriages in Ghana and a draft law for the regulation of Moslem marriages- United States Embassy and USAID funded project.
5. Currently managing a 150 student research team to do micro-level research on access to healthcare in urban Ghana.

Five main publications during the last five years relating to PRIPODE:

1. Authored together with Julius N. Fobil, “Traditional African Cities: Spaces, Parables and Myths” in Proceedings of a Conference on African Urban Spaces: History and Culture. Held at the University of Texas at Austin, 28th -30th March, 2003.
2. Authored, “Women’s Survival in Ghana; What Has Law Got To Do With It?” in Oppong & Oppong (eds) Sex, Work and Survival: Gendered Struggles and Coping Strategies in Ghana at the close of the Twentieth Century. (Forthcoming).
3. Authored together with Aryeetey and Kunbuor, The Right to Development Report: Ghana Country Study. (United Nations/FXB Center, Harvard School of Public Health, 2003) (Forthcoming).
4. “Colonialism, Institutionalism and Democratic Social Change through Law-Making in post-colonial settings.”

Paper presented on my behalf at the African Studies Annual conference in Washington DC, USA on the 6th December, 2002-11-21.

5. “Challenges Faced by Moslem Marriages in Ghana’s Plural Legal System: Strategies for Improvements.”
Paper Presented at a Seminar organised by the Family Law Focal Area of the German Development Cooperation (GTZ) at the La Beach Hotel on the 23rd May 2002.

INDIVIDUAL FORM (one for each member of the research team)

Name: AGYEI MENSAH..... **First name:** Samuel

Sex: Male..... **Date of birth:** 28 March 1961

Nationality: Ghanaian

Organisation: Department of Geography, University of Ghana

Complete address: Department of Geography, University of Ghana, POB LG 59, Legon, Accra, Ghana

City: Accra..... **Country:** Ghana.....

Tel : 233 21 500394

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E-mail address: AgyeiMens@yahoo.com

Current position: Senior Lecturer, Department of Geography, University of Ghana

Main degrees (title, University, year):

main degree PhD

Title : Fertility Change in a time and space perspective: lessons from three Ghanaian settlements, Norwegian University of Science and Technology, Trondheim, Norway 1997

Discipline(s) specialised in: Discipline, Geography

Specialised in medical Geography

Professional experience, notably in research:

1. Child survival in fishing and a farming community in Ghana

2. Patterns of fertility change in an urban elite, urban poor and rural community in Ghana

3. Geographical patterns of HIV/AIDS in Ghana

4. Spatial patterns of mental health in Accra

Five main publications during the last five years relating to PRIPODE:

1. Agyei-Mensah and A. Aase (1998). Patterns of Fertility Change in Ghana: A Time and Space Perspective. *Geografiska Annaler*, 80B pp 203-213.

2. Agyei-Mensah, S. (1999). Risk factors for infant mortality in a fishing and a farming community in Ghana. *Bulletin of the Ghana Geographical Association*

3. Agyei-Mensah, S. (2001). Twelve years of HIV/AIDS in Ghana: Puzzles of interpretation. *Canadian Journal of African Studies*, vol 35, no 3 pp 441-472.

4. Agyei-Mensah, S. (2002). Fertility Decline in West Africa. *The Journal of African Policy Studies*, vol 8 no 2 &3 pp 63-86

5. Agyei-Mensah, S, A Aase and K. Awusabo-Asare (2003) Social setting, birth timing and subsequent fertility in the Ghanaian south. In Samuel

Agyei-Mensah and J.B. Casterline (eds.) *Reproduction and Social Context in Sub-Saharan Africa*. Greenwood Press, Westport Connecticut. USA

INDIVIDUAL FORM (one for each member of the research team)

Name: FOBIL.....First name: JULIUS

Sex: MALE.....Date of birth: 11/10/1973

Nationality: GHANAIAN

Organisation: UNIVERSITY OF GHANA

Complete address: GHANA SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF GHANA, P. O. BOX LG 13, ACCRA.

City: LEGON, ACCRA.....**Country:** GHANA.....

E-mail address: JFOBIL@UG.EDU.GH OR JN_FOBIL@HOTMAIL.COM

Current position: RESEARCH FELLOW

Main degrees (title, University, year):

M.PHIL, UNIVERSITY OF GHANA. 2001

B.SC (HONS), UNIVERSITY OF GHANA, 1997.....

Discipline(s) specialised in: ENVIRONMENTAL SCIENCE (M.PHIL)

BIOLOGICAL SCIENCES [B.SC (HONS)]

Professional experience, notably in research:

- ❖ **Sanitation and Development specialist** (March 2001-present); Legal Resources Centre (LRC) (<http://www.lrc-ghana.org>) A local NGO involved in advocacy, free legal aid, dispute conflict resolution and development activities in deprived and poor urban communities in Ghana.

Responsibilities: Design, implementation and management of development projects on environmental sanitation, health reform and access to health, as well as on solid waste management in poor urban communities.

- ❖ **Environmental Engineer** (November 2000-February 2001):-Southern DataStream Inc. LaBelle, Florida (USA). Actively participated in the Okeechobee/Everglades watershed restoration project in south Florida.

Duties/Responsibilities: Biosolid application to soils and monitoring of progress in storm water as well as its capacity to arrest pasture nutrients from run-off water. Delivered project outputs and deliverables to trade journals and loading of the findings onto the worldwide web as well.

- ❖ **Teaching / Research Assistant** (July 1997–October 2000) – Department of Zoology & Volta Basin Research Project (VBRP), University of Ghana.

Duties / Responsibilities: Holding tutorials, laboratory demonstratorship, marking of scripts and lab work, collection of field research data, health intervention studies, epidemiological surveys and health education, including the use of appropriate computer software and programs to process the data. Local community livelihoods and environmental restoration in the Lower Volta River Basin.

Five main publications during the last five years relating to PRIPODE:

- ❖ Carboo, D.; Clement, C and Fobil, J. N. (2000) Waste Stream Analysis in the Accra Metropolis. Proceedings from the 10th Faculty of Science colloquium, University of Ghana.
- ❖ Carboo, D. and Fobil, J. N. (2000) Physico-chemical analysis of MSW in the Accra metropolis. (*In press*) A paper presented at the Ecological Laboratory Seminar, University of Ghana (West African Journal of Applied Ecology, 2000).
- ❖ Fobil, J. N. (2000) Environmental Remediation of the Impact of Akosombo and Kpong Hydropower Dams in Ghana. Horizon Solutions Site (<http://www.solutions-site.org>).
- ❖ Coping with Plastic Waste Problems in Large Cities in Sub-Saharan Africa, The Case of the Plastic Waste Recycling Scheme in Pokuase near Accra in Ghana. Proceedings of the 17th

International Conference on Solid Waste Technology and Management, October 21–24, 2001, Philadelphia, PA U.S.A.).

- ❖ Municipal Wastes Collection and Urban Environmental Management in Accra, Ghana: Proceedings of the International Symposium on Environmental Pollution Control and Waste Management, Tunis, Tunisia. January 7-11, 2002, p. 193-206.
- ❖ Fobil, J. N. (2002) Shea Butter Production in Ghana (Submitted to the HORIZON solutions site, <http://www.solutions-site.org>)
- ❖ Fobil, J. N.; Carboo, D. and Clement, C. (2002) Defining Options for Integrated Municipal Waste Management in Large Cities of Low-income Economies-The Case of the Accra Metropolis in Ghana. *Journal of Solid Waste Technology and Management*, Vol. 28, No. 2, pp 106-117, Chester. USA.
- ❖ Fobil, J. N. & Ahuble, D. (2002) Comparative Assessment of Hydro- and Thermal-Power Exploitation in Ghana: Akosombo Hydro vs. Aboadze Thermal Generations. Proceedings of the World Renewable Energy Conference, June 29 to July 5, 2002, Cologne, Germany. Elsevier Science Ltd. Oxford.
- ❖ Fobil, J. N. and Carboo, D. (2002) Evaluation of Municipal Solid Waste (MSW) for Utilization in Energy Production in Developing Countries. Proceedings of the World Renewable Energy Conference, June 29 to July 5, 2002, Cologne, Germany. Elsevier Science Ltd. Oxford.

INDIVIDUAL FORM (one for each member of the research team)

Name: Hill..... First name: Allan G.....

Sex: Male **Date of birth:** 16 Sept. 1944

Nationality: Irish

Organisation: Harvard School of Public Health & Ghana School of Public Health

Complete address:

Dept. of Population and International Health,
Harvard School of Public Health,
665, Huntington Avenue,

City: Boston MA 02115..... **Country:** USA

Telephone: +1 617/495-3007 **Fax:** +1 617 495-5418.....

E-mail address: ahill@hsph.harvard.edu

Current position:

Andelot Professor of Demography, Harvard School of Public Health and Visiting Professor (2002-2003), Ghana School of Public Health.

Main degrees (title, University, year):

Dates	Discipline	Degree	Institution
1973-75	Demography	Diploma	Princeton University
1966-69	Demography - social sciences	Ph.D.	University College, Durham
1963-66	Geography with Middle East Studies	BA (Hons) First Class	University College, Durham

Discipline(s) specialised in: Geography, Demography and International Health.

Professional experience, notably in research: (last 10 years only)

Principal Investigator, Accra Women's Health Study, Ghana School of Public Health (2002-3)
Portfolio manager, AIDS Prevention Initiative in Nigeria, Harvard School of Public Health with Gates Foundation support. Topic – Prevention of Mother to Child Transmission (2001-4)

ARCH: Portfolio manager for the Nigeria project: a research competition for Nigerian researchers. Applied Research on Child Research project, Center for International Health, Boston University. (2000-2004).

Liaison with the Ghana School of Public Health: PI for the McConnell Clark grant for institutional development and community health research. Harvard School of Public Health. (1999-2001).

Male and female fertility in The Gambia: PI - The Rockefeller Foundation. (1998-2000).

ARCH: Portfolio manager for a series of West African studies to eliminate poliomyelitis in Mali, The Gambia, Benin and Ghana. Applied Research on Child Research project, Harvard Institute for International Development. (1996-9)

Director and PI: Birth interval dynamics in the MRC Main Study Area, The Gambia (1991-96).

Director, Centre for Population Studies, London School of Hygiene and Tropical Medicine. Centre grant of £1.4 million from the UK Overseas Development Administration for research and training in overseas population and health research. (1988-91).

Five main publications during the last five years relating to PRIPODE:

John R. Weeks, Arthur Getis, Xiaoling Yang, M. Saad Gadalla and Allan G. Hill. 2003. Spatial Patterns as Predictors of Fertility Change in Rural Egypt. Forthcoming in Demography 2003.

- Amy A. Ratcliffe, David P. Harrington, Allan G. Hill, Gijs Walraven. 2002. Differences in Reporting of Pregnancies and Births by Men and Women in Rural Gambia. *Demography* 3:
- Rashed, T, JR Weeks, MS Gadalla and Allan G. Hill. 2001. Revealing the anatomy of cities through spectral mixture analysis if multi-spectral satellite imagery: a case study of the Greater Cairo region, Egypt. *Geocarto International* 16(4): 5-13.
- Weeks, J, M Saad Gadalla, T Rashed, J Stanforth and Allan G. Hill. 2000. Spatial variability in fertility in Menoufia, Egypt assessed through the application of remote-sensing and GIS technologies. *Environment and Planning A*: 40.
- Allan G Hill, WB MacLeod, D Joof, P Gomez, AA Ratcliffe, and G Walraven. 2000. Decline of mortality in children in rural Gambia: the influence of village-level Primary Health care. *Tropical Medicine and International Health* 5(2): 107-18.

INDIVIDUAL FORM (one for each member of the research team)

Name: WEEKS.....**First name:** John

Sex: Male.....**Date of birth:** 1 June 1944.....

Nationality: USA.....

Organisation: International Population Center, San Diego State University.....

Complete address: International Population Center, Department of Geography, San Diego State University, 5500 Campanile Drive.....

City: San Diego, CA 92182-4493**Country:** USA.....

Telephone: +1-619-594-8040**Fax:** +1-619-594-4938.....

E-mail address: john.weeks@sdsu.edu

Current position: Director and Professor of Geography.....

Main degrees (title, University, year):

Ph.D. (Demography), University of California, Berkeley, 1972

M.A. (Demography), University of California, Berkeley, 1969.....

A.B. (Sociology), University of California, Berkeley, 1966

Discipline(s) specialised in: Demography

Professional experience, notably in research:

Director, International Population Center, SDSU, 1984 - present.....

Professor of Geography, SDSU, 1992 – present.....

Clinical Professor of Family and Preventive Medicine, UCSD, 1998 - present.....

Assistant Professor to Professor of Sociology, SDSU, 1974 - 1992

Assistant Professor of Sociology and Anthropology, Michigan State University, 1971-1974.....

Principal Investigator, "Arab Fertility Transition Project," funded by the U.S. National Science Foundation, 2001-2004

Five main publications during the last five years relating to PRIPODE:

1. **John R. Weeks**, "The Role of Spatial Analysis in Demographic Research," in Michael F. Goodchild and Donald G. Janelle (eds.), *Spatially Integrated Social Science: Examples in Best Practice* (New York: Oxford University Press), 2003 (in press).

2. **John R. Weeks**, "Using Remote Sensing and Geographic Information Systems to Identify the Underlying Properties of Urban Environments," in Tony Champion and Graeme Hugo, eds., *New Forms of Urbanization: Conceptualizing and Measuring Human Settlement in the Twenty-first Century* (London: Ashgate Publishing Limited), 2003 (in press).....

3. Christopher Peak and **John R. Weeks**, "Does Community Context Influence Reproductive Outcomes of Mexican Origin Women in San Diego, California?," *The Journal of Immigrant Health*, 4(3):125-136, 2002.

4. Tarek Rashed, **John R. Weeks**, M. Saad Gadalla, and Allan G. Hill, "Revealing the Anatomy of Cities through Spectral Mixture Analysis of Multispectral Imagery: A Case Study of the Greater Cairo Region, Egypt," *Geocarto International*, 16(4):5-16, 2001.....

5. **John R. Weeks**, M. Saad Gadalla, Tarek Rashed, James Stanforth, and Allan G. Hill, "Spatial Variability in Fertility in Menoufia, Egypt, Assessed Through the Application of Remote Sensing and GIS Technologies," *Environment and Planning A*, (32):695-714, 2000.

5. Presentation of the team (no more than 2 pages)

Indicate the origin of the team, the institutions the researchers are affiliated to, the means available to the team, the comparative advantages of the team, the specific objectives of the team in terms of training, and of the dissemination and transfer of results, the organisations the team is working with and its needs in terms of expertise and consulting for it to be able carry out the project.

The team consists of specialists with established research interests in the links between health, development and the environment. All, with the exception of Hill and Weeks, are based at the University of Ghana or in the Health Department of the Accra Metropolitan Assembly (Coleman).

Dr. John ANARFI has an established international reputation as a social demographer with current interest summarized briefly on the individual form. As Deputy Director of ISSER, he is in a strong position to direct the diverse activities undertaken by this project. A sample of his accomplishments are outlined on the attached sheet.

Dr. George BOTCHIE, also based at ISSER, has undertaken many environmental studies as his personal form shows. He has agreed to serve as the day-to-day co-coordinator of the project.

Dr. Nii Ayite COLEMAN is Medical Officer of Health for Metropolitan Accra and a Visiting Lecturer at the Ghana School of Public Health. His responsibilities include all non-medical aspects of public health (a separate department deals with epidemics, outbreaks and other medical emergencies). This includes responsibility for water, sanitation, cemeteries, hygiene in markets and restaurants, rubbish removal and all aspects of environmental sanitation and health.

Mr. Raymond ATUGUBA LLB, a lecturer in the Law Faculty, provides the link to the local communities of Nima and Maamobi where some intervention work has been undertaken with the assistance of the Legal Resources Centre. He has used legal means, including court appearances and collection of evidence and affidavits, to pursue environmental issues adversely affecting the local communities' health. More recently, the legal work has focused on pressuring the government to release funds so that the fees charged in the public health facilities can be exempted for paupers.

Dr. Sam AGYEI-MENSAH is a geographer with established interests in areas such as child survival in a fishing and a farming community in Ghana; patterns of fertility change in an urban elite, the urban poor and rural community in Ghana; the geographical patterns of HIV/AIDS in Ghana; and spatial patterns of mental health in Accra. He brings a strong knowledge of geographical mapping and spatial pattern analysis to the team.

Mr. Julius Najah FOBIL is a Research Fellow at the Ghana School of Public Health with degrees in Biology and a research degree in environmental sciences. He is the sanitation and Development specialist (March 2001-present) with Legal Resources Centre (LRC) (<http://www.lrc-ghana.org>), a local NGO involved in advocacy, free legal aid, dispute conflict resolution and development activities in deprived and poor urban communities in Ghana.

Dr. Jacob SONGSORE has agreed to act as an advisor to the project since he has had previous experience of similar work that he directed in the early 1990s. He maintains a strong interest in gender-based poverty and local interactions between sanitation and welfare.

Dr. Allan G. HILL has been working in West Africa for over 20 years and is currently a Visiting Professor at the Ghana School of Public Health. He is the co-PI of the Accra

Women's Health Survey (with Dr. Anarfi and Dr. Darko), a large health interview and examination study in 200 sample EAs of metropolitan Accra. He has previous experience with environmental impact assessment and the measurement of health outcomes in field situations.

Dr. John WEEKS directs the International Population Center at he San Diego State University. He has specialized in the spatial interpretation of satellite and census data and has worked on patterns of fertility change in the Middle East. The Centre has extensive experience with the management of the large census and digitised files for such analysis and a strong grasp of the spatial statistics needed for complex analysis of the kind proposed here.

IV - WORK SCHEDULE

a) Research work carried out before the mid-term evaluation (from June 2003 to May 2004)

Phase 1:

- Digitise the boundaries of the Enumeration Areas and produce ArcGIS shape files to which all other data will be linked. Field visits with additional support from Lands and Surveys. A digitised version of the 4 1:50,000 sheets for Greater Accra has already been obtained.
- Link the census data to the EA shape files through the Locality, EA and GIS codes.
- Link all other survey data (WHS, AWHS, DHS) to the EAs in which the sampled households were located.
- Capture death records for AMA from the Registry of Births and Deaths.
- Capture a sample of the out-patient data for the AMA.
- Link all vital statistics and administrative data to the EA or sets of EAs in which events occurred to be able to calculate rates;
- Geocode health facilities in Accra and measure distance from the centre of each EA to the closest health facility of each type.
- Purchase DigitalGlobe multi-spectral satellite image of Accra, classify image into land cover classes using multiple end member spectral mixture analysis, and create variables representing land use and landscape metrics as measures of the built environment.
- Test OLS and logistic regression models in which threshold health level of EA is modelled by variables describing the social and built environment as derived from census, survey, vital statistics, administrative, and remotely sensed imagery sources.

b) Drafting of the mid-term report (for May 2004)

Seminar at ISSER

c) Research work carried out after the mid-term evaluation (from June 2004 to May 2005)

Phase 2:

- Develop indices of threshold health levels by EA.
- Link results of regression models to policy initiatives that could be undertaken at the local level.
- Develop local perceptions of environmental risk with communities in Nima-Maamobi.
- Document and map these local priorities and compare them with the objectively assessed risks from satellite, survey data and work on the ground.
- Establish a baseline and prepare for intervention projects directed by the LRC, the AMA Health Department and communities in Nima-Maamobi.

d) Drafting of the pre-report (for May 2005)

Accra, ISSER

e) Meeting of Centres (May 2005)

f) Final drafting of the provisional report (for June 2005)

g) Revision of the report after evaluation by the scientific Committee (June-July 2005)