

ANNEX 5.2 Annual Report 2008-9

RESEARCH PROGRAMME ANNUAL REPORT 2008/09

***** Please Return to the Programme Administrator by 03rd April 2009 *****

This form supplements the NERC OPM questionnaire and should be completed for each Research Programme. The boxes may be resized but the form **MUST NOT** exceed **FOUR sides of A4**, to which may be appended no more than **FIVE** sides of supporting information (single spaced, 12pt). Supporting information should include a summary of each research project's progress, a list of peer-reviewed publications from the projects and a summary of programme activities and publications (if applicable) in 2008/2009.

Name of Research Programme	Joint Environment & Human Health Programme (E&HH)
Programme Administrator / Manager	Dr Pamela Kempton
Science Coordinator (if applicable)	Professor Michael N Moore
Core Team Leader (if applicable)	NA
Date:	12 April 2009

Indicate the percentage of total programme activities in 2008/09 in each of Science themes of the NERC Strategy (please refer to DP Portfolio Mapping Spreadsheet)			
Biodiversity		Natural Hazard	
Climate System		Sustainable Use of Natural Resources	
Earth System		Technologies	
Environment, Pollution and Human Health	100		

1. Scientific Achievements for 2008/09

Selected achievements are presented below and illustrate why the problems being addressed by this programme, can only be addressed by multi- and interdisciplinary groups of scientists working together in cohesive collaborative projects. Many other achievements can be found in the attached summary of Programme Activities & Publications (ANNEX 1).

- 1.1 Evidence obtained that the fluids in the lung can modify the biological reactivity and pathogenesis of airborne nanoparticles causing aggregation of inhaled ultrafine particles thus modifying their biological behaviour and reactivity in the lungs (NE/E009395/1). In combination with lung epithelial cell exposure studies, evidence has been obtained for an adsorption mediated damage mechanism. This may be important for both atmospheric PM and synthetic NP exposure via the lung, and such data will help in predicting hazard and risk associated with synthetic NP exposures.
- 1.2 In lung tissue dosed with real samples of urban air particulates there is a differential in gene and protein response dependent upon the size fraction used. Notably there was significantly more down-regulation of proteins and genes than up-regulation and this increased at smaller particle size (NE/E00833X/1). This is the first time that the gene and protein responses of size fractionated (in the nanoparticle range) real environmental air samples have been tested on human lung tissue.
- 1.3 Demonstration that bacterial endotoxin is associated with airborne particles produced by commercial composting, which have detrimental biological effects on an in vitro cell-based model of the lung (NE/E008534/1). This project underlines the problem of how coatings of biological origin may affect the harmful biological reactivity of micro- and nano-scale particles.
- 1.4 A Report submitted to Defra and HPA on the environmental pathways for exposure to pathogenic viruses and emerging viral problems (e.g., from farm animals and global transport of food products from industrial organic farms in China, Mexico and California). Identification of current knowledge gaps regarding transmission of viruses through the environment and food (NE/E009026/1). This project brought together a wide range of medical and environmental virologists and microbiologists, food and public health scientists, and epidemiologists.
- 1.5 Data analysis is currently underway in the UK on soil and blood samples from a field study in Malawi on the effects of micronutrient depleted soils (e.g., selenium) on maternal health and postnatal development. (NE/E008313/1). This is undoubtedly the most logistically challenging project supported by the E&HH programme, involving soil geochemists, healthcare workers and biomedical scientists working together under very difficult social and cultural conditions in central Africa.
- 1.6 Development of a robust analytical system that can be used for the assessment of the bioaccessibility of arsenic and polycyclic aromatic hydrocarbons (PAHs) in a simulated human gut environment (NE/E008844/1). This has resulted in the development of a patentable test kit. The experimental model of the human digestive tract has provided a novel way of testing the behaviour of harmful toxic environmental contaminants is influenced by the complex interactions between the gut chemistry and microbiology. This project has also demonstrated the detrimental impact of PAHs on the microbial flora from the human gut.
- 1.7 Development of screening tests that can be used for detection of MRSA in the agricultural environment (NE/E008054/1). MRSA is no longer just a problem in the hospital environment. MRSA and other drug-resistant microbes are present in the natural environment with the attendant concerns about the transfer of the genes conferring drug-resistance to other species of bacteria. This project brought together microbial ecologists and clinical microbiologists in order to address the health risks posed by the widespread presence of MRSA in the environment, where it is associated with pig herds, bovine milk and faeces. Dairy products have also been implicated as reservoirs of MRSA in Europe.

- 1.8 Human disease causing bacteria can survive inside nematode worms and are protected from the action of chemical sanitiser treatment (NE/E009085/1). Food-borne diseases are a significant public health problem where pathogens such as *Salmonella* occurring in the soil can interact with other organisms such as free-living helminth worms (nematodes). This project involved the collaborative efforts of epidemiologists, helminthologists, microbiologists and veterinary scientists who have demonstrated that *Salmonella* ingested by the worms can survive and be returned to the environment in a viable and infective state. The inference is that soil nematodes can provide a protective micro-environment for human pathogens with health implications for the persistence of such pathogens in the soil.
- 1.9 A book has been published in October 2008 indicating that there is little or no evidence at present to suggest that there are any quantifiable effects on human health from consuming organic rather than conventional food, and the environment in which food is produced has a far greater impact on the nutritional and contaminant composition of the food than the system in which the food is produced (NE/E008399/1). This project dealt with a complicated set of potentially interacting factors including soil science, pesticide toxicology, biogenic fungal toxins and infectious pathogens, as well as the nutritional composition of the foods in question.
- 1.10 Substantial progress has been achieved towards deriving a summary measure of multiple environmental deprivation at small area level, akin to the measures of multiple socioeconomic deprivation used by health researchers from many disciplinary backgrounds (NE/E0087201). The key achievements have been to i) systematically identify which elements of physical environment should be included in the measure, ii) compile appropriate environmental data for the whole UK, iii) produce several different versions of the measure iv) discover independent associations between the measures and variation in all cause and cause specific mortality, and v) begin to examine the interaction between social and physical environments on health inequalities in the UK.

The capacity building aspect of the Programme has been very successful with many of the investigators forming new links within the Programme and also with other UK and international research groups.

A number of the Projects have already provided Reports and other types of feedback to the User-Community (see ROD and Programme Summary & Publications – ANNEX 1).

Papers have been published or are in press in leading journals including Nature and Environmental Health Perspectives (see Programme Summary & Publications – ANNEX 1).

2. Science activities during 2008/09

Please list major science meetings, workshops, field campaigns, cruises etc

- 2.1 Annual Science Day Conference (U. Birmingham) February 2009. Oral presentations for the Exploratory Studies and Poster presentations for the Workshop, Working Group, Network and Discipline Hopping Projects (see Science Day Proceedings).
- 2.2 Risk Perception Workshop (Swindon) February 2009 (see Science Day Proceedings).
- 2.3 Many Workshops/Mini-Conferences related to the Exploratory Studies, Workshop, Working Group, and Network Projects (see ROD for full details).
- 2.4 International field sampling campaigns have been implemented in the Mekong Delta and Malawi for the Exploratory Study projects led by Dr Few and Prof Atkinson respectively.
- 2.5 UK Field sampling has been carried out in many of the Exploratory Studies (see Programme Summary – ANNEX 1).

3. Knowledge Exchange and User Liaison activities

The Joint Environment & Human Health Programme has succeeded in bringing together many scientists from a broad range of environmental and biomedical backgrounds in order to address critical questions on

health issues that are linked or believed to be linked to the natural environment. This has resulted in knowledge and skill transfers and new collaborations (see Programme Summary & Publications). Many of health issues relate to complex problems such as the environmental biology and geochemistry of soils and how these influence the transport, accessibility and bioavailability of chemical pollutants and infectivity of pathogens. The dispersion of harmful particles in the atmosphere is another area of major concern where the E&HH Programme is breaking new ground on how the chemical and physical properties of such particles influence their environmental behaviour and may govern their toxicity and resultant pathological reactions induced following inhalation. Again this has required the formation of interdisciplinary teams of materials scientists, surface and environmental chemists, geochemists, environmental and human toxicologists, food scientists, veterinary scientists, pathologists, epidemiologists, geographers, social scientists, economists and atmospheric modellers. Working groups and workshops have identified potential health problems concerning the transport and emergence of pathogenic human viruses associated with food and water.

User organisations have been involved in many of these projects either as Co-Is or invitees at workshops and mini-conferences. User organisations have been represented at the Annual Science days Conference held in the University of Birmingham (24-25 February 2009).

4. International Dimensions

Please provide details of International activities in 2008/09.

- 4.1 Workshop/Network and Working Group projects have included many non-UK participants/ collaborators and presentations have been made at various International Conferences (see ROD for details).
- 4.2 Implementation of EU-ERANET programme on Environment and Human Health supported by the UK, Netherlands and France.
- 4.3 Two of the Projects supported by the E&HH Programme are operating overseas: in the Mekong delta (NE/E009042/1) on contamination and seasonal flooding and in Malawi (NE/E008313/1) on the health consequences of micro-nutrient deficiency in agricultural soil.
- 4.4 Many of the Exploratory Studies projects have international collaborators and two projects are carrying out their research in the developing world (Vietnam and Malawi).

5. Data Management

Please provide a brief statement of progress in data management in 2008/09

Since this is primarily a capacity building programme, data management on a large scale is not relevant.

6. Science and Society

Please provide details of any relevant activities (promotion of Programme, media contact, public understanding, science communication etc) undertaken during 2008/09.

- 6.1 The Programme has been actively promoted at various UK and international conferences and meetings as mentioned in section 4, as well as many other less formal meetings and visits to potential future stakeholders (e.g., MetOffice, HPA, Eden Project and Department of Health).
- 6.2 A member of "New Scientist" editorial team is kept apprised of developments in the E&HH Programme.
- 6.3 ESRC has supported four Extension Projects and has awarded 4 Research Fellowships directly linked to the E&HH Programme.
- 6.4 Environmental Health will publish the peer-reviewed Proceedings of the 2009 Science Day Conference.

7. Science Coordination

Please provide information about science coordination activities not detailed above e.g. numbers of visits to PI's, conferences attended, liaison with other programme participants, co-funders, stakeholders and service providers etc.

The Programme Science Coordinator prepared a Discussion Document for meetings between the MRC and NERC to consider the nature and funding of a second phase of the Joint E&HH Programme (see attached ANNEX 2).

The establishment of new active research links between many of the projects funded by the Joint E&HH Programme is helping to build a cohesive community of research scientists with both UK and international linkages. Feedback from the researchers themselves has strongly indicated that the interfacial nature of much of the research has resulted in exciting and challenging projects with a lot of intellectual cross-fertilisation and the spawning of new collaborations involving existing and proposed future projects. To try and identify which has been the most successful matching of disciplines is very difficult, and probably impossible at this stage of the Programme, given the huge range of disciplines involved and the very high quality of the research that has been and is being generated.

This process has been facilitated by 24 PI/Workshop visits during the course of the year, and the 2-day Annual Science Conference and Workshop on Risk Perception. Many of the Projects have regular contact with Stakeholder Organisations as have the Programme Manager and Programme Science Coordinator.

The Science Coordinator has held many other informal meetings with Co-funders/Stakeholders, PIs, CoIs and Postdoctoral Researchers in the E&HH Programme during the course of the year. He has also given 3 presentations on the Joint E&HH Programme at an Interational Conference in Plymouth (Coasts & Public Health), Nanotoxicity mini-symposium in Bristol and an international Workshop on Volcanic Dusts in Cambridge.

8. Problems

Please identify any problems or serious risks (e.g. scientific, technical, financial) that have prevented the achievement of planned targets for 2008/09 or will affect the programme in other ways.

The overall research progress has been excellent with many exciting developments highlighting new avenues for future investigation as indicated above. Fortunately, there have been few problems in the implementation of the programme, which given its complexity is perhaps surprising, but nonetheless serves to underline the dedication, skill, ingenuity and resourcefulness of the many scientists involved. Where problems have arisen, they have largely been limited to logistical and staffing issues. The need to await decisions by University Ethics Committees has also resulted in a few delays; but this is understandable given the multi-institutional nature of many of the Projects.

The delayed start of many of the Exploratory Studies will result in later completion dates and some of these will run into Summer 2010. This will also result in a delay in the preparation of the Final Report.

9. Plans for 2009/10

Please summarise major targets for 2009/10

9.1 Publication of the Proceedings from the Annual Science Conference.

9.2 Circulation of a synthesis of the Workshop on risk perception to Co-funders/Stakeholders.

9.3 Discussions on future links and possible joint programmes with US-EPA, NSF, NOAA, NIH, WHO and EU-Environment & Health Programme

9.4 Completion of the majority of Projects although several will run into 2010/11 because of delayed starts.

If you have any questions regarding the completion of this form, please contact the appropriate Programme Administrator