

# Announcement Opportunity

## Quantifying and Understanding the Earth System (QUEST)

### The Global Potential of Sustainable Forestry and Bioenergy to Mitigate Climate Change

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QUEST invites applications for a research project to quantify the worldwide potential of different plant-based options to mitigate climate change, accounting as far as possible for their environmental, biodiversity, economic and social consequences. The options to be considered will include **avoided deforestation**, the use of degraded or otherwise available land (i.e. land not in economic production or of important conservation or heritage value) for **carbon sequestration**, and the use of available land for **biomass energy production** substituting for fossil fuels (including changes in land carbon, direct emissions and full life-cycle potential of different bioenergy options).

The Kyoto Protocol includes mechanisms for achieving emissions reduction through carbon sequestration in forests, and projects to offset fossil fuel carbon emissions through biomass energy production. Current climate policy negotiations under the UNFCCC (United Nations Framework Convention on Climate Change) aim both to strengthen and to widen these mechanisms. There is particular interest in accounting for the carbon value of avoided deforestation. However there is a general lack of quantitative scientific information about the potential importance, effectiveness and consequences of different biosphere management options that might contribute to international climate policy goals, including not only the direct impact on emissions and removals but, also life-cycle emission and the impact on biodiversity and other ecosystem services. There is a desire to pursue options that are economically, socially and environmentally acceptable considering the needs of other international agreements such as the CBD (Convention on Biological Diversity) and the Millennium Development Goals. QUEST therefore proposes to commission a **comparative and quantitative global study of sustainable options for climate mitigation through biosphere management**, with a primary aim to provide information needed by decision makers involved in international climate policy negotiations.

#### 1. The Research Project must consider the following activities:

- **Avoided deforestation.** Excluded from the first commitment period of the Kyoto Protocol negotiations due to complexities in accounting for issues such as leakage (whereby deforestation takes place elsewhere), avoided deforestation was put back on the international climate policy agenda in Montreal in 2005. How and whether avoided deforestation will be included in future climate policy is now a topic of intense negotiation. The project should provide quantitative information necessary for decision makers to assess its potential significance both in terms of carbon and other benefits.
- **Using available land for carbon sequestration.** Sequestration options to be considered include leaving available land to naturally regrow vegetation, and managing the land more actively to sequester carbon e.g. by planting forests or deep-

rooting grasses.

- **Using available land, and residues, for bioenergy.** Plant-based energy production allows land to be used indefinitely to substitute for fossil fuels. Plant residues from agriculture and forestry are also potentially available for energy production. Modern biomass usage for electricity and transport fuels is gaining share in the energy market. but assessments of the global potential for bioenergy production up to now, have not explicitly considered the potential for carbon mitigation of the full life-cycle from biomass production to end-use of energy.

The project should exploit recent advances in life-cycle analysis to carry out a comprehensive study of the potential benefits of bioenergy options that are reconcilable with environmental standards and socio-economic constraints.

Consideration must be given to the technical development of bioenergy crop production and conversion technologies, near-term changes in land and energy costs, and potential financial incentives and subsidies.

The project should examine alternative energy crops, both agricultural (e.g. sugar cane, rape seed, miscanthus) and forestry (e.g. short-rotation coppice, jatropha, eucalypts) and assess the most appropriate, taking into account requirements for water and nutrient subsidies, climate variability and changes in CO<sub>2</sub> and climate expected in the next 10 to 20 years. It should consider different conversion technologies and end products (liquid fuels, heat and electricity) and should present comparative options where several alternatives have different benefits.

### **The Project must:**

- consider activities that can be realistically implemented within the next 10 to 20 years, a timescale relevant to the negotiations. While this will avoid drawing on scenarios of future changes in population, world economics etc., that become more uncertain into the future, it should include bounding assumptions regarding improvements in plant production and bioenergy conversion technologies, changes in production costs as bioenergy markets develop, and economic impacts of changing subsidies, carbon taxes and fuel prices that are possible in the near-term.
- assess the carbon and environmental impacts (including biodiversity) in the near- (20 to 30 yr), medium- (50 yr), and long-term (100 yr).
- provide information on changing ecosystem goods and services (e.g. food vs fuel) and other social consequences (e.g. job opportunities).
- provide information on the cost effectiveness of different options per ton carbon abated (with and without ancillary benefits).
- provide information on a national basis as far as practicable, with regional and global aggregations.

The analysis should take account of information (which will be supplied through other QUEST activities) about likely changes in CO<sub>2</sub> and climate, which could affect the

distribution of natural forests and the potential suitability and yields of different biomass crops during the next 10-20 years. (There is little difference between the various climate scenarios on this time frame, for which we are already committed to a certain degree of change). The project should not attempt to model different scenarios of climate change on a longer time frame. However, it should assess the vulnerability of forest sinks and offset schemes to changes in climate based on published studies, by taking advantage of other work carried out by QUEST's Theme III, and by liaising with the QUEST Core Team.

## **2. Land availability assessment**

Land availability and the competition between different land uses is one of the most controversial issues regarding biosphere mitigation potential. Large areas of land are often considered potentially available for mitigation or conservation projects.

In completion of the land availability assessment, the Research Project should

- **exclude** land that is protected for conservation or heritage value or that is already in economic use (e.g. agriculture, forestry).
- include land set-aside from agricultural production due to surplus production or imports. Increased efficiency in agricultural and/or forest production in the near term (including agroforestry) potentially further increases the stock of available land and should be taken into account.
- include degraded land.
- include other land types sometimes controversially considered potentially available such as low-productivity grasslands or shrublands, secondary forest areas, and even primary forest and wetlands.
- evaluate the ecosystem services provided by different land types under consideration.
- evaluate changes in above- and below-ground carbon, biodiversity, soil condition, provision of subsistence goods (e.g. woodfuel, indigenous medicines, grazing) and other ecosystem services that result from the changing land use.

## **3. Deliverables**

- Best estimates (with uncertainty) of land cover and carbon in extant forests on a global gridded basis, using existing data (e.g. the Millennium Assessment land cover maps, FAO) and ecosystem modelling approaches if necessary. An assessment of biodiversity and other ecosystem services supplied by these ecosystems that capitalizes on other work sponsored by QUEST's Theme III;
- Assessment of the potential for global CO<sub>2</sub> emissions reductions by avoided deforestation, consistent with the above, and the economic, social and environmental implications thereof;
- Assessment of different classes of land available (section 2) for mitigation projects, taking account of the potential for increasing land availability through intensification

of forestry and agriculture over the next 10 to 20 years, using land use maps, FAO data and country specific data as far as possible;

- Assessment of the potential for carbon sequestration projects on "available" land to reduce atmospheric CO<sub>2</sub> concentrations and enhance biodiversity using existing data and ecosystem modelling approaches. This should include natural regrowth of vegetation and plantation forestry, and should assess the costs and risks (e.g. permanence), changes in biodiversity, soil condition and ecosystem services;
- Assessment of the technical potential for net global carbon offset resulting from a range of biomass energy production scenarios (different crop types, conversion pathways, and energy carriers) on "available" land, and from residues using available data (e.g. yield tables, conversion factors, emissions factors). The assessment should consider suitable crop types for land available and climate, and requirements for energy, water and nutrients including greenhouse gas emissions associated with energy and fertiliser use. It should assess change in net carbon storage on the land, changes in biodiversity and other environmental impacts.;
- Assessment of the potential impacts of changing fossil fuel prices, agricultural and energy subsidies, carbon taxes and the international trade in biofuels on the economics and carbon balance of bioenergy production in a modern biomass fuels market, leading to an assessment of the economic and market potential of different biomass energy production scenarios to offset carbon;
- A comparative assessment of the above options with each other in terms of potential for carbon offset, environmental and social impacts, changes in ecosystem services and cost effectiveness of different options per ton carbon abated (with and without ancillary benefits). This information should be presented in a way that will enable a more quantitative analysis of which land conversion options are sustainable, which are unsustainable or undesirable, what trade-offs will be entailed in making certain choices, and what might be a desirable balance between different options, goods and services. It should be compared with other published studies and information available to decision makers;
- Communication of results and relevant experiences to key stakeholders including the IPCC, UNFCCC COP/MOP, CBD COP/SBSTTA, UK government (DEFRA, DfID), the Environment Agency, the European Commission, and NGOs and the private sector.

#### **4. Management**

##### The Project

- will be managed by the prime contractor in close consultation with the QUEST Core Team including regular meetings between the project and QUEST Core Team representatives, and monthly updates to enable integration across QUEST.
- should make full use of tools, methods, data and ongoing research by other QUEST projects and activities (the Core Team will facilitate this).
- should consult with stakeholders (particularly policy makers involved in the UNFCCC negotiations and other international environmental agreements, UK government,

NGOs) throughout the development and duration of the project to ensure the results are relevant, useful and disseminated in a way that will inform the policy debate.

- should take full advantage of synergies with other projects and research programs, particularly in the UK and EU, synthesising available information as far as possible.