

**South Asian Regional Experiment to Characterize and
Evaluate Physiological Response of Rice Varieties to CO₂
Enrichment for Use in Crop Production, Modelling, Policy
Making and Management Technology Assessment
(APN 2000-08)**

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APN Funding

US \$74,700

List of participating countries

Bangladesh, India, Nepal, Pakistan, Sri Lanka

Introduction/Background

There is agreement among the scientific community that the CO₂ concentration in the atmosphere has increased from 280 ppm in pre-industrial time to about 380 ppm in 1999 primarily as a result of human activities. The current rate of CO₂ increase is 1.5 ppm per year and it is estimated that by the middle of the 21st century the level of CO₂ in the atmosphere will be double the pre-industrial level. There is a significant impact on crop productivity from CO₂ enrichment as well as from associated climate change. In order to study the future impact of CO₂ on crop varieties open top chamber techniques and mid FACE techniques have been utilised in South Asia.

This proposal is a continuation of an earlier APN funded FACE activity (99008) which is geared towards capacity building and generation of awareness among scientists and policy makers in South Asia for CO₂ enriched rice research. The grant made available under the earlier project has been used to spread know-how, through a training workshop in September-October 1999 and a post experimental workshop with policy makers in February 2000 on use of open top chambers and mid-FACE for growing rice under an elevated CO₂ environment. A hardware kit needed for installing an open top chamber was also distributed to each participating country, i.e. Bangladesh, Nepal, Pakistan, and Sri Lanka.

The objectives of APN 2000-08 include:

- 1) To set up and operate for the first time an Open Top Chamber network in South Asia for studying crops under elevated CO₂ conditions.
- 2) To operate the mid-FACE facility at the Indian Institute of Agriculture (IARI), in New Delhi, India.
- 3) Identification of some rice varieties from each participating country responsive to CO₂.
- 4) Firming up of protocol for later use of this regional rice research network for characterization and evaluation of physiological response data of rice varieties from different locations in the five participating countries for use in various crop

modelling exercises and policy decisions for modifying rice crop production strategies and management technologies.

- 5) Joint workshop of scientists, crop modellers and policy makers, 2 - 4 March 2000, to evolve using the experiment, CO₂ responsive rice variety selection and crop production management strategies to be tried out regionally in subsequent years.

Outline of activities conducted

Scientists from the Indian Agriculture Research Institute facilitated in developing a network of CO₂ dissemination and storage system for South Asian Research Scientists.

Also:

- Three OTCs have been installed in Bangladesh - summer rice studied under elevated CO₂ conditions;
- Two OTCs have been installed in Nepal - summer rice studied under elevated CO₂ conditions;
- Three OTCs installed in Pakistan - two wheat varieties are currently under study, with intent to carry on with summer rice studies;
- Two OTCs installed in Sri Lanka - winter rice is under study at present;
- Three OTCs installed in India - summer rice studied; and
- Mid-FACE facility made operational at IARI, New Delhi for studying winter crop.

For setting-up Open Top Chambers the following amounts (US \$) were spent:

Country	Amount	No. of OTCs
Bangladesh	5,000	Three
India	5,000	Three OTCs and one Mid-FACE
Nepal	5,000	Two
Pakistan	5,000	Three
Sri Lanka	5,000	Two

Note that it costs US \$5,000 to set up one OTC. Funding for setting-up additional OTCs came from external sources.

Outcomes/Products

- 1) Data regarding the physiological parameters such as photosynthesis, respiration, growth, yield, protein profile etc. of the plants under CO₂ enrichment for two years has been generated from all the participating countries in this project. Data is presently being processed.
- 2) The results of this project appear in the SASCOM web site at: <http://www.npl-cgc.ernet.in> as well as on the GCTE web site

The following is a list of some of the publications from this phase of the project (2000-2001):

- D.C. Uprety and V. Mahalaxmi, 2000. Effect of elevated CO₂ and nitrogen nutrition on some physiological characters in brassica juncea. J. Crop Sci and Agron. (Germany). 184 (4), 271-276;
- D.C Uprety, S.C. Garg, M.K. Tiwari, and A.P. Mitra, 2000. Crop Responses to Elevated CO₂: Technology and Research (Indian Studies). Global Environ. Res. (Japan). 3(2), 155-167;
- D.C. Uprety, N. Dwivedi, R. Mohan, and G. Paswan, 2001. Effect of elevated CO₂ on leaf structures of brassica juncea under water stress. Biologia Plantarum. Vol. 44, (1), 149-152;
- D.C. Uprety, Kumari Sunita, Dwivedi Neeta, Mohan Rajat, 2000. Effect of elevated CO₂ on growth and yield of rice variety. Pusa 834. Ind. J. Plant Physiology, 5, 1 (N. S), 105-107;
- D.C. Uprety, 2000. Contributed to a note on “IARI as main centre for CO₂ enrichment research on crops in South Asia”, IARI, 16, 2, 1-2; and
- D.C. Uprety, 2000. Contributory author of International Geosphere Biosphere Program (IGBP) – SASCOM Synthesis Report, Chapter 5, “Implications of Regional and Global Changes for Agriculture”.

Future directions/Follow-up work

- 1) Physiological response data of rice varieties derived from this project at different locations in the five participating countries are to be incorporated into various crop modelling exercises and policy decisions for modifying rice crop production strategies and management technologies.
- 2) Mid-FACE to be expanded to have 3 rings at IARI.
- 3) Micro-analysis of plant processes using mid-FACE.
- 4) Development of transfer function of crop data from OTC to mid-FACE.
- 5) Sri Lanka has secured funding for continuation of this project for three more years.

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