



SANDEE 

ECONOMICS & THE ENVIRONMENT

Annual Report
2012

**South Asian Network for Development and Environmental Economics
(SANDEE) © 2012**

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Ziaul Haider – p 16

Annual Report 2012

SANDEE 

South Asian Network for Development and Environmental Economics

Bangladesh • Bhutan • India • Maldives • Nepal • Pakistan • Sri Lanka

Our Mandate

The South Asian Network for Development and Environmental Economics (SANDEE) is a regional network that brings together analysts from different countries in South Asia to address development-environment problems. SANDEE's activities include research support, professional training, and information dissemination.

Our Mission

SANDEE's mission is to strengthen the capacity of individuals and institutions in South Asia to undertake research on the inter-linkages among economic development, poverty, and environmental change, and to disseminate practical information that can be applied to development policies.

Our Core Activities

Research

A competitive research grants programme focuses on the economics of climate change, management of ecosystem services and policies and programmes for greening development.

Training

Teaching workshops by international and regional experts build skills in environment and natural resource economics, policy analyses and research methods.

Underserved Areas Programme

Activities, scholarships and courses strengthen core capacity and improve access to information in smaller countries and less advanced areas.

Dissemination and Dialogue

Publications and workshops facilitate information sharing and networking among individuals and institutions.

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Chair's Message

Madhu Khanna is a professor in the Department of Agricultural and Consumer Economics at the University of Illinois at Urbana-Champaign and a member of the Science Advisory Board of the US Environmental Protection Agency. Dr. Khanna holds editorial positions at several environmental and agricultural economics journals and has published numerous environmental policy analyses. She holds a Ph.D. and M.S. from the University of California at Berkeley.

It is exciting to see SANDEE continue on its upward trajectory in the number of grantees, participants in research and training workshops and publications in peer-reviewed journals. SANDEE researchers are bringing critical regional knowledge to tackle issues of global importance, including the impacts of climate change and methods for adaptation to it, payments for ecosystem services and sustainable development. SANDEE provides unique opportunities for networking with scholars within the region and across the world and its achievements in growing this network over time have been impressive.

I am pleased to see that the number of new grants allocated has been rising over time with increasing participation by researchers from underserved regions. SANDEE has continued to leverage its resources and develop partnerships with other organisations such as INSEE, GIDR and SDPI to reach out to larger audiences all over the South Asian region more effectively.

I look forward to another successful year for SANDEE.

Madhu Khanna
Chair, Management and Advisory Committee
SANDEE

Programme Director's Message



Our focus this last year was on deepening research support in our three thematic areas of climate change economics, ecosystems management, and policies and programs for greening development. While research on climate change economics continues, we are slowly beginning to grow our portfolio related to ecosystems management.

We joined hands with the Natural Capital Project to build skills among our researchers in modeling ecosystem changes and understanding the economic implications of these changes. Given our interest in greening development policies, we launched an interesting set of studies in Bangladesh, Pakistan and Sri Lanka that examines the role of formal and informal regulations in the textile sector. By looking at similar issues in multiple countries, we hope to obtain useful insights into how different conditions and regulatory systems affect environmental compliance.

A highlight of 2012 was SANDEE's increased involvement with Bhutan. Jointly with UNDP and UNEP, we organised a workshop in Paro on economic instruments for environmental change for policy makers from across Asia. While several Bhutanese colleagues have participated in different aspects of SANDEE in the past, last year saw the launch of two research studies – one on assessing demand for better sanitation services in Bhutan and the second on understanding the implications of changes in ecosystem services. We hope to continue to strengthen our engagement with Bhutan.

Priya Shyamsundar oversees SANDEE-supported research and training, and has authored several articles on environment-development issues. She has been a consultant for the World Bank for many years, and served as Senior Program Officer for the John D. and Catherine T. MacArthur Foundation as well as Research Associate at the Institute of Social Studies Trust. She has a Ph.D. in Environmental Economics from Duke University and a Masters in Economics from Delhi University.

The year 2012 brought new opportunities to extend SANDEE's outreach into the policy domain. We were able to take our research findings and understanding to two policy committees – the Expert Group on greening India's national accounts and the scientific and technical advisory committee to the Wealth Accounting and the Valuation of Ecosystem Services program.

SANDEE was also invited to be part of the scientific steering committee for Planet under Pressure. This major conference was the largest gathering of scientists leading up to the United Nations Conference on Sustainable Development and its aim was to bring scientific findings to the discussions at Rio+20. My sincere hope is that SANDEE can continue to engage policy makers and other stakeholders in this form and bridge the gap between knowledge production and use.

As ever



Priya Shyamsundar
Programme Director
SANDEE

SANDEE Secretariat and friends on the banks of the Paro Chhu River in Bhutan at the greening development workshop co-hosted with UN Environment and Development agencies.



The Year Gone By

With 2012 at a close, SANDEE has spent twelve fruitful years fulfilling its mandate to address development-environment problems in South Asia. Our network has strengthened the capacity of institutions and individuals to research and disseminate information that links economic development, poverty and environmental change.



This year SANDEE played a contributory role in two important linked policy initiatives. The Government of India appointed an expert group to develop a framework for greening India's national accounts with SANDEE's Founder Board Member Sir Partha Dasgupta as the Chairperson. Several SANDEE members contributed to this national effort, whose recommendations and report will be released by Prime Minister Manmohan Singh in April 2013. Simultaneously, the World Bank and United Nations Environment Programme jointly created a plan on Wealth Accounting and Valuation of Ecosystem Services (WAVES). SANDEE has a seat on the scientific and technical advisory committee for this crucial attempt to tie national efforts to global efforts. SANDEE sees WAVES and the Government of India's endeavours as an important step to building macro-environmental aggregates in the countries in our mandate, and as an opportunity to engage senior government officials, chief accountants and economists.

In research, SANDEE's 2012 agenda covered the economics of climate change, ecosystems management, and policies and programmes for greener development. SANDEE will maintain this research focus for the next three years as our associates work to tie valuation to policy concerns across South Asia.

2012 in a Nutshell

SANDEE awarded 16 research grants from a total of 117 pre-proposals.

SANDEE published nine working papers and associated policy briefs, and 13 peer-reviewed publications.

SANDEE's nine workshops filled with 232 participants, including university teachers, researchers and professionals.

SANDEE held research and writing programmes in Pakistan and Bangladesh and a policy workshop in Bhutan.

SANDEEites gave 40 presentations at more than 20 conferences and seminars across 13 countries.

SANDEE joined the World Bank and UNEP in an international effort to value ecosystem services.

SANDEEites are assisting the Government of India in the greening of national accounts.

A minimum of 16 universities are using SANDEE material in teaching environment and resource economics in South Asia.

Studies of impact analyses and mitigation instruments dominate SANDEE's research on climate change. SANDEE is making steady progress in growing research on ecosystem services and hopes to launch other studies that relate particularly to the opportunity costs and benefits of conservation. In policy research, fascinating analyses are emerging on why formal or informal regulations work or fail as SANDEE grantees study their respective national textile and garment industries.

Successful research from previous years generated a productive spate of publications. SANDEE researchers published their works in a variety of journals such as *Natural Hazards and Environment and Development Economics*. SANDEE also published several working papers and policy briefs.

There were more than 40 presentations by SANDEE researchers in some 20 conferences or seminars across 13 countries this year. These presentations occurred at SANDEE-sponsored conferences and at international fora. A highlight of 2012 was the key SANDEE involvement in the fifth annual South Asia Economic Summit held in Islamabad in September. South Asia is one of the least integrated regions in the world and this conference is an important attempt at increasing economic integration. SANDEE participated in the plenary panel on the first day and organised a panel on climate change economics in South Asia.

SANDEE's materials and researchers are disseminating into university classrooms. There are indications that teachers in the region are building entire classes around SANDEE working papers and publications. The graduate economics programmes in the Pakistan Institute for Development Economics and TERI University in Delhi are both using the SANDEE book *Environmental Valuation in South Asia* as a part of their curriculum. SANDEE fellows are advancing in their careers at universities or other environments where their training can be brought to bear.

Training is a big component of our annual activities. In 2012, there were more than 230 participants at SANDEE workshops. The three-week annual course in Environmental and Resource Economics continues to be SANDEE's flagship course, strengthening economics teaching in South Asia and helping link research with training.

When planning the teaching and training programmes this year, a significant incentive was the need to bring in more research candidates from underserved areas. SANDEE organised one teaching and research programme in Pakistan and a research and writing workshop in Bangladesh. It co-organised a special policy workshop with UNDP and UNEP in Bhutan. SANDEE is already seeing the results of our efforts to engage and encourage new participants from these countries.

Research

Achieving the goal of long-term environmental sustainability has become a pressing challenge, one that involves increasingly complex issues. SANDEE is committed to prioritising research that aims at measuring and guiding environmental performance, and to spreading awareness about how environmental factors can be integrated into decision-making.

SANDEE awarded 16 grants in 2012 from a total of 117 pre-proposals. Grants are based on a biannual research competition and workshops that help refine and monitor the research.

Our focus areas for the three years beginning with 2012 are Climate Change, Ecosystems Management, and Policies and Programmes for Greener Development.

Climate Change. SANDEE now has ongoing or completed studies in several countries on climate change, that use both primary and secondary data, that examine the impacts of climate-related variables on agriculture. The focus on agriculture is not surprising given that this is the most important sector in the developing world to be affected by climate change. Research related to biofuel, clean stoves, and community-based REDD+ examines the adoption of various instruments to mitigate local pollution and climatic changes.



Ecosystems Management. SANDEE is making steady progress with research on ecosystem services, and currently has a cluster of research grants related to conservation expenditures, and costs and triggers, particularly related to conservation corridors. SANDEE hopes to launch new research that more carefully models ecosystem changes and examines both the opportunity costs and benefits of conservation. The Natural Capital Project at the University of Minnesota and the WWF joined SANDEE in hosting a training programme in ecosystems management. As this area develops, we hope to see more trans-boundary research.

Greener Policies. In the area of greener development policies and programmes, research is emerging on regulations and why they work or fail. SANDEE is monitoring a cluster of studies that centers on the textile industry, a major sector in India, Pakistan, Bangladesh and Sri Lanka. In Bangladesh research focuses on formal regulations and implications for water pollution management within the textile sector. The study in Sri Lanka is on informal pressures and their role in improving environmental compliance in the garment sector. The two studies in Pakistan look at regulations and health costs faced by laborers.

SANDEE received a total of 117 pre-proposals in 2012, up from the 99 pre-proposals in the previous year. From the 76 pre-proposals submitted by grantees through June, eight grants were awarded after the discussions and review at the Research and Training Workshop in June. SANDEE then received another 41 pre-proposals in the fall and winter of 2012 and awarded six grants and two study grants after the Research and Training Workshop in December. The 16 grants of 2012 are reported in Table 1.

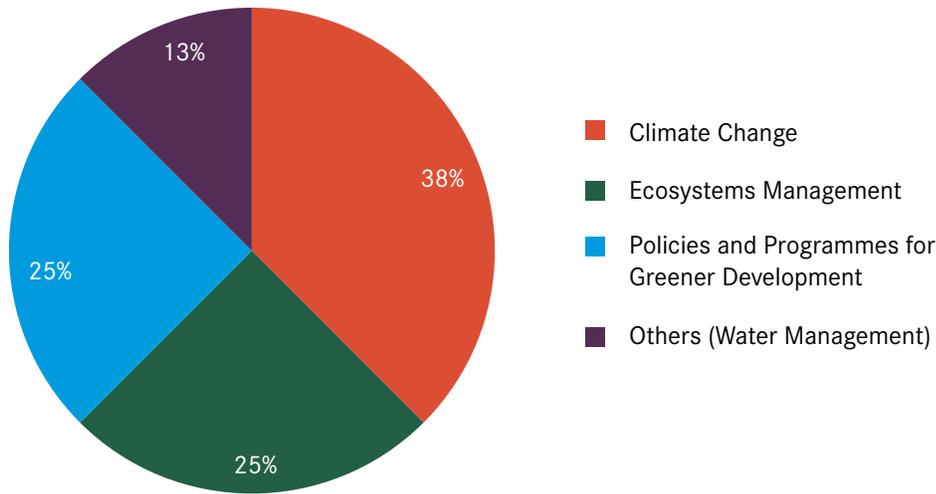


Grant distribution by issues is displayed in Figure 1. Half of all grants in 2012 are in the areas of ecosystems management (25%) and policies and programs for greener development (25%). Another 38% of grants relate to climate change, of which a significant portion is in sustainable agriculture.

Figure 2 shows the distribution of grants across countries. Notably, Sri Lanka leads the number of 2012 grants with 25%. Researchers from Bangladesh, India and Pakistan comprise 19% each of the grant distribution. Bhutan and Nepal have the fewest grants, at 13% and 6% respectively.

SANDEE's Advisors play a pivotal role in helping shape researchers' projects. International Advisors provide feedback online, and in person at biannual Research and Training workshops.

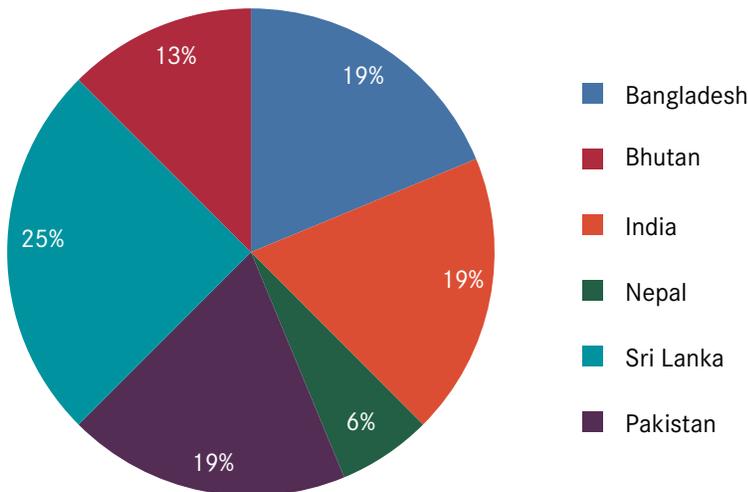
Figure 1: Grant Distribution by Issues (2012)



One of the most rewarding aspects of SANDEE is that it focuses on people and bringing up their skills and capabilities. In a way SANDEE training for the grantee is a customised kind of support. It makes researchers understand their skills gaps and helps them build their technical and research capacities. The opportunity to network with peer researchers and advisors is also very valuable.

*– Asha Gunawardena, Ph.D.
Candidate, School of Agriculture
and Resource Economics,
University of Western Australia,
Perth*

Figure 2: Grant Distribution by Country (2012)



SANDEE Research Grants: Money, Technical Support and Training

SANDEE's grants are based on a biannual research competition and meetings that help monitor and support the research. SANDEE provides monetary and technical support to researchers across South Asia, but also mentors grantees and monitors the progress of their work. A large part of the monitoring takes place during biannual Research and Training (R&T) Workshops. Currently there are 51 open grants.

SANDEE's international Advisors are crucial to the research programme. Drawn from Duke University, University of Queensland, Indian Statistical Institute, Namur University and United International University, they help shape projects and guide researchers along the way. A wide variety of training programmes also enables researchers to hone their skills. The Secretariat facilitates discussions between researchers and their advisors, offers advice on analyses and literature references, and reviews questionnaires and manuscripts.



Table 1: 2012 Research Grants

Climate Change

Aggarwal, A., India	Acquisition of technological capabilities through the clean development mechanism
Akram, W., Pakistan	Adoption of biogas as an alternative energy source in Pakistani Punjab
Borthaku, M., India	Does urban greenery reduce the cost of cooling homes?
Hippu, N., India	Sustainability of electrification projects in India's villages where grid-extension is in-feasible
Edirisinghe, J., Sri Lanka	Distributional impacts of climate change on smallholder agriculture in Sri Lanka
Nadeem, A. M., Pakistan	Targeting and distribution of post-flood aid in Punjab, Pakistan

Ecosystems Management

Belal Uddin, Md., Bangladesh	Non-timber forest products extraction under different forestry institutions in Bangladesh
Katel, O., Bhutan	Mapping and designing payments for ecosystem services in Punkha, Bhutan
Belal Uddin, Md., Bangladesh	An ecological and economic analysis of forest management institutions in Bangladesh
Udaykumara, N., Sri Lanka	Soil conservation benefits of Upper Mahaweli watershed in Sri Lanka

Policies and Programmes for Greener Development

Khondaker, G.M., Bangladesh	Compliance in pollution management: A case study on the textile industry of Bangladesh
Wickramasinghe, K., Sri Lanka	Environmental management practices in post-conflict tourism in Sri Lanka
Bhardwaj, B., Nepal	Why the plastic bag ban decision works in one municipality and does not in another?
Samad, G., Pakistan	Environmental regulations and their compliance in textile processing sector of Pakistan



SANDEE was pleased with increased involvement in Bhutan in 2012. SANDEE co-hosted a workshop in Paro with the Poverty Environment Initiative of the United Nations Development Programme and Environment Programme.

Others (Water Management)

Dendup, N., Bhutan	Valuation of sewage water treatment services in Bhutan
Gunawardena, A, Sri Lanka	Optimal use of policy instruments to control water pollution in Sri Lanka

Beyond Expectations

Abdul Saboor, Chairman of the Department of Economics and Agri Economics, of the University of Arid Agriculture, Rawalpindi and his field enumerators conducted surveys throughout rural Pakistan. The researchers needed to be careful in their interviews with farmers to avoid conflicts among castes or clans. If farmers saw researchers surveying their rivals, they refused to cooperate. Furthermore, none of the farmers obliged researchers unless they first agreed to a meal or to tea. In places outside of Lahore, Qasur, Gujranwala, or Faisalabad, the habits of hospitality sometimes dictate slow progress in the field. So do the inevitable stomach ailments, all in the name of research.

The ABCs of Pollution

Burning agricultural field residue generates black carbon, the second largest contributor to global warming after carbon dioxide. In the Himalayas, black carbon melts glaciers. Throughout Asia, it contributes to the atmospheric brown clouds that, according to the UNEP decrease the amount of sunlight reaching the earth's surface by 10-15% and enhance atmospheric solar heating by as much as 50%. The effects of pollution also decrease agricultural production. In India, harvest reductions attributed to brown cloud pollution are estimated to have grown from 3.94% during the 1966-84 period to 10.6% during the 1985-1998 period

The Burning Question: What to do with Agricultural Residue

There is a brown cloud hovering over South Asia. This atmospheric air pollution is one of the key environmental problems facing the region. SANDEE researchers examine the factors driving the pollution and ways to alleviate it. Farmers who burn agricultural residue contribute significantly to these brown clouds. Will new technology address this problem? What about government incentives? Working papers from Pakistan, India and Bangladesh discuss the issue.

Farmers burn the residue in their fields because the method of disposal is cheap and fast and they can more quickly put a new crop in the ground. From Tanvir Ahmed and Bashir Ahmad's study 'Why Do Farmers Burn Rice Residue? Examining Farmers' Choices in Punjab, Pakistan', we learn that rice residue is burned on 58% of the land in the survey. In contrast, farmers on 25% of the land fully remove rice residue with specialised farming equipment. The remaining rice residue is either partially burned or incorporated into the field.

Of the farmers who remove residue rather than burn it, 63% do so in order to feed their livestock. Farmers who burn residue may not have livestock, may not have access to proper equipment, or cannot afford the specialised equipment necessary to remove the straw. Interestingly, the use of a combine harvester tends to increase the amount of rice residue burned because the harvester leaves a significant amount of rice straw.

84% of farmers surveyed in the Pakistani Punjab were unaware of any alternative technology to burning rice residue.

At PKR 3424 (USD 41) per acre, burning rice residue is by far the cheapest method of preparing the field for the next crop. The next cheapest alternative in the Pakistani Punjab, the incorporation of rice residue into the field, costs a full 20% more than burning it. Full residue removal is the most costly method at 34% more than burning. Incentives are clearly needed to encourage farmers in the right direction.

Ahmed and Ahmad suggest a commercialisation of the rice residue market as one incentive. Educational incentives by the agricultural extension services to promote methods that improve the soil, and to discourage ones that cause environmental damages could also help, especially if combined with monetary incentives for new equipment. The study estimates that encouraging farmers to incorporate residue rather than burn it would cost the government PKR 674-908 (USD 8-11) per acre.

A government incentive programme is crucial also with the Happy Seeder technology currently in use in the Indian Punjab. The Happy Seeder is a machine that helps to sow wheat immediately after the rice harvest, using rice straw as mulch. It does not increase the cost of wheat field preparation and precludes the need for burning rice residue. In 'Causes of Emissions from Agricultural Residue Burning in North-West India: Evaluation of a Technology Policy Response', Ridhima Gupta sees the government's proactive promotion of this newer technology as a solution for the farmers of India.

The Happy Seeder is a tractor-mounted machine that cuts and lifts rice straw, sows wheat into the bare soil, and deposits the straw over the sown area as mulch. Yields of wheat are about the same as with the more conventional methods of farming. The method saves time and reduces the need for weed control measures, but does not win significant economic advantages for individual farmers.

Gupta's study finds that operators of the new technology can save on average about INR 1000-1060 (USD 23) per hectare in field preparation costs compared to plots that are conventionally tilled. Because farmers may not respond to this small advantage and may be slow to adopt an unfamiliar technology, Gupta recommends that the state promote the adoption of the Happy Seeder.

The rice in neighboring Bangladesh is harvested entirely without machinery. In 'Options and Determinants of Rice Residue Management Practices in the South-West Region of Bangladesh', Mohammed Ziaul Haider tackles the burning question of rice residue in the first study of its kind to use farm-level data in Bangladesh.

Haider studied 300 households in 30 villages in southwest Bangladesh that farm the Aman variety of rice whose residue is burnt in the field. The study examined 600 plots over two growing seasons. Like the other countries of South Asia, farmers burn residue because it is cheaper and saves time to do so. If the residue measures over four feet in height,

An annual subsidy of USD 2.1 million, or 4% of available agricultural subsidies, may help prevent residue burning in Bangladesh.

The open burning of crop residue accounts for about 25% of India's black carbon, organic matter and carbon monoxide emissions.



Based on the SANDEE studies on agricultural residue in South Asia, journalist Aisling Irwin is writing a blog on crop residue management. The blog will be launched soon for 'Future Earth', a new 10-year international research initiative focused on environmental change and supporting the transformation towards global sustainability.

70% of farmers burn the residue. Farmers also burn residue if the plots are too far away from the homestead, indicating that transportation costs are a factor.

Bangladeshi farmers who burn their rice residue enjoy 10% less cost per season and 9% more revenue in the successive season. This means that farmers who burn residue enjoy an average net annual advantage of USD 43-45 per acre.

Across South Asia, all farmers would be better off without the atmospheric brown clouds that decrease yields. Yet the SANDEE research shows that individual farmers save money by burning rice residue. It is therefore incumbent on governments to make up this difference to individual farmers, to reduce emissions for all of us. Direct subsidies may not be feasible but technologies can certainly be subsidised.

SANDEE offers South Asian decision-makers the ability to issue policy based on empirical environmental evidence.

These and other SANDEE publications are available at www.sandeeonline.org:

Working Paper, No 66-12 *Causes of Emissions from Agricultural Residue Burning in North-West India: Evaluation of a Technology Policy Response* by Ridhima Gupta

Working Paper, No 71-12 *Options and Determinants of Rice Residue Management Practices in the South-West Region of Bangladesh* by Mohammed Ziaul Haider

Working Paper, No 76-13 *Why Do Farmers Burn Rice Residue? Examining Farmers' Choices in Punjab, Pakistan* by Tanvir Ahmed and Bashir Ahmad



SANDEE Researcher Profiles

When we read **Santadas Ghosh's** excellent papers on the impacts of tourism and the environment on labour migration in the Indian Sunderbans, we would never guess that he balked at the very idea of participating in any SANDEE-related research. He reluctantly agreed to attend a Research and Training Workshop in June 2004 in deference to his doctoral thesis advisor. After that workshop, in his own words, everything changed.

Santadas grew up in Kolkata where his father had immigrated after Partition. Home was a refugee colony near the airport that even today remains his permanent address. As a youth, schooled by the upheaval of his father's relocation, Santadas wanted only a secure job that would enable him to provide a stable home for his family. His success has allowed him to build his family a house.

Santadas attended Kolkata University for his B.Sc. and M.Sc. in Economics. He completed his doctoral thesis at Jadavpur University on Qualitative Input-Output Analysis in 2000, and promptly lost interest in the field. In 2003 he was teaching undergraduate economics in Kolkata when his doctoral thesis advisor hounded him to apply for SANDEE training. That advisor was Professor Joyashree Roy, to whom Santadas remains indebted. "She saw something in me I didn't recognise in myself," he says.

After attending that initial SANDEE workshop in Sri Lanka, Santadas began empirical studies relating tourism in the Sunderbans to changes in the environment, then later focused on climate change adaptation. He has since published papers and presented his findings at conferences hosted by the Asian Development Bank, the International Association for the Study of the Commons, the Centre for Coastal Environmental Conservation and WWF.

His eight years with SANDEE have enabled Santadas to become an exceptional university teacher and SANDEE resource person who trains up-and-coming new researchers. He is an Associate Professor of Economics at Visva-Bharati University Shanti Niketan and coordinates the economics Ph.D. coursework there. The university was founded by poet Rabindranath Tagore as a learning institution without walls. Perhaps it is the Nobel Laureate's influence that leads Santadas to seek out the beauty of remote natural areas when he has free time.

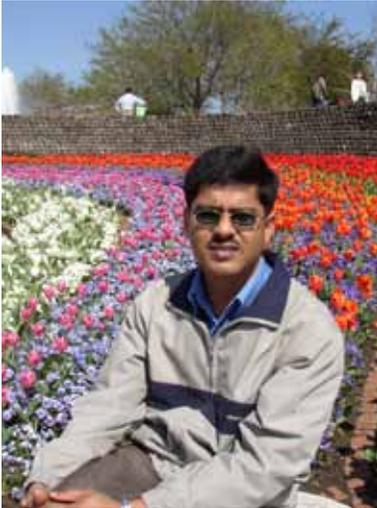
He reflects on the many SANDEE workshops he has attended that have afforded him access to research advisors from around the world. He wishes SANDEE's scope could be extended to all developmental topics of South Asia. Santadas cares deeply about the issues facing the subcontinent, and about encouraging young researchers at SANDEE and his university. SANDEE looks forward to even more achievements by Santadas, and awaits the promising, but reluctant young students he himself will now encourage to earn a spot at the next Research and Training Workshop.



Economics Professor **Santadas Ghosh** coordinates Ph.D coursework at Shanti Niketan University in West Bengal.

*SANDEE is like a great
Banyan tree whose roots
grow into thick trunks that
provide shelter, refresh and
augment the pilgrimage of a
researcher.*

- Santadas Ghosh



Ziaul Haider of Khulna University developed an Environmental Economics course for his graduate students based on SANDEE training and materials.

SANDEE opened my eyes. It has properly guided me to be a researcher. Though I completed my Ph.D before being affiliated with SANDEE, I can firmly say that SANDEE is the platform where I have learned more.

- Ziaul Haider

At home in Khulna, Bangladesh, **Mohammed Ziaul Haider** enjoys perusing the newspaper. In fact, it was there that he first spied a SANDEE call for research proposals. When Professor Enamul Haque later convinced him to apply for a SANDEE research grant, it turned out to be very good news indeed for SANDEE.

Ziaul was born and raised in northern Bangladesh in the village of Baluchar. His parents are both teachers, and they shared their love of education with their children. Ziaul, his brother and his sister are all educators in different cities throughout Bangladesh. And Ziaul often travels even further afield for his profession.

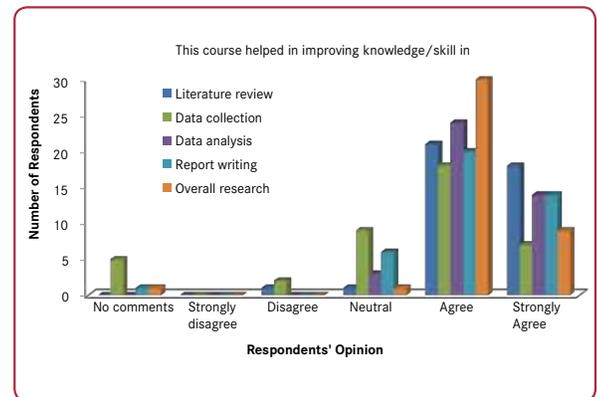
When he left the village, Ziaul moved first to Dhaka and then to Savar for further schooling. He eventually moved as far away as Japan, where he received a Ph.D. in Economics from Tohoku University to add to his M.Sc. in Economics from Jahangirnagar University.

Ziaul has been teaching economics at Khulna University and joined the faculty as a full professor this year. He conducts workshops on research methodology and econometrics for university students and faculty members. Recently, Ziaul designed a graduate-level class on environmental economics based on SANDEE materials. This is very exciting not only for his students, who are receiving an excellent education, but also for SANDEE. Ziaul has given SANDEE a first glimpse of student feedback when its concepts, techniques and tools are integral in the coursework (see graph below).

Ziaul has been an increasingly important member of the SANDEE family. He is now a resource person for SANDEE training programmes, and has already helped coordinate two proposal-writing workshops co-hosted by SANDEE and the Economic Research Group of Bangladesh.

What does this mean for Ziaul? His duties and responsibilities at Khulna University have increased. He has published in a number of journals and presents regularly at conferences on development issues in Bangladesh. He sits on international editorial and advisory boards. In his own words, he is pleased that he can now submit any research proposal without worrying that it will be screened out in the initial round!

Ziaul's wife also holds a Masters in Economics. Much of the focus of their lives is training one particular researcher. She seems to be coming along nicely with her analytical skills and desire to learn. At eight, Ziaul's daughter has inherited the enthusiasm for learning that is her grandparents' legacy and a big part of her father's life. She is not quite ready to submit a grant proposal, but when she does, that will also be great news for SANDEE.



Students' evaluation of Ziaul's Environmental Economics course based on SANDEE materials.

Publications

SANDEE believes in transforming research, that simple gathering of facts, into knowledge mobilisation. Our investigations target solutions to existing problems in South Asia. We hope to bring our research results to large audiences worldwide to exert positive change on poverty and the environment.

SANDEE's first book, *Promise, Trust and Evolution: Managing the Commons of South Asia*, has become a valuable resource on commons management. SANDEE's second book, *Environmental Valuation in South Asia*, examines how economic valuation techniques can be used to assess different environmental problems and brings together multiple case studies on the valuation undertaken by economists and environmental scientists in South Asia. Environmental economic coursework throughout the region now includes one or both of these texts.

SANDEE-supported research continues to generate quality publications. In 2012, thirteen peer-reviewed and popular publications featured articles based on SANDEE research. Notably, some 50% of these were in international journals. SANDEE also published nine working papers and associated policy briefs. Each spring and fall SANDEE's newsletters feature excerpts from the latest research, and list the most recent publications and advances of SANDEE researchers.

Over the last few years SANDEE research has been published in major journals such as the *Proceedings of National Academy of Sciences*, *Environment and Development Economics*, and *Ecological Economics* – proof of the impacts on the international research scene. A full list of working papers and peer-reviewed publications are below. The complete papers and policy briefs are available at www.sandeeonline.org.



In 2012 SANDEE research associates published nine working papers and associated policy briefs, all of which target solutions to existing problems in South Asia, and all of which can be found on the SANDEE website.





SANDEE's research associates, international Advisors and Secretariat join forces to transform research into quality publications in major journals.

Working Papers

Bangladesh

Options and Determinants of Rice Residue Management Practices in the South-West Region of Bangladesh, Ziaul Haider, WP 71-12

India

Causes of Emissions from Agricultural Residue Burning in North-West India: Evaluation of a Technology Policy Response, Ridhima Gupta, WP 66-11

Inclusive National Accounts: Introduction, Partha Dasgupta, WP 67-12

Is the Deposit Refund System for Lead Batteries in Delhi and the National Capital Region Effective?, Yamini Gupta, WP 68-12

Analyzing Institutions in Resource and Development Econometrics: Recognizing Institutions, Exploring Levels and Querying Causes, Vikram Dayal, WP 70-12

Awareness as an Adaptation Strategy for Reducing Mortality from Heat Waves: Evidence from a Disaster Risk Management Program in India, Saudamini Das and Stephen C. Smith, WP 72-12

Farm Productivity Loss due to Flood-Induced Sand Deposition: A Study in Dhemaji, Kalyan Das, WP 73-12

Nepal

Measuring the Health Benefits from Reducing Air Pollution in Kathmandu Valley, Naveen Adhikari, WP 69-12

Valuing the Damage Caused by Invasive Plant Species in a Low-Income Community in Nepal, Rajesh Kumar Rai WP 74-12

Peer-reviewed and other Publications

Adhikari, N. (2012). Air pollution and human health in Kathmandu Valley. *Public Health Perspective Online Newsletter*, 2 (5).

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- Rafiq M. (2010). The value of reduced risk of injury and deaths in Pakistan using actual and perceived risk estimates. *Pakistan Development Review* 49 (4).
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- Udagama M, Jyasinge-Mudalige U., & Anjali G. (2009). Managers' environmental altruism and firms' compliance to national environmental management strategies: Evidence from the food processing sector in Sri Lanka. *Journal of Food and Agriculture*, 2 (2).

Professional Progress by SANDEE Researchers in 2012

Bishnu Prasad Sharma received a Ph.D. from Tribhuvan University. His dissertation, funded by SANDEE, was entitled 'Contributions of Leasehold Forests in Household Income and Poverty Alleviation in Nepal'.

Herath Bandara, a SANDEE graduate, completed his Ph.D. from Davis College of Agriculture, Natural Resources & Design, West Virginia University, USA.

Indira Devi from the Department of Environment and Climate Change got a grant from Kerala to set up a Centre for Excellence in Environmental Economics at Kerala Agricultural University.

Indrila Guha from Vidya Sagar College for Women in Kolkata got a grant from the Indian University Grant Commission for a project that explores economic adaptation in the Indian Sunderbans.

Joyashree Roy and Indrila Guha won a research grant for a two-year Asia Pacific Network project on changing coastal ecosystems. SANDEE is a knowledge partner.

Kanupriya Gupta has joined Asian Development Bank in Programs and Development Effectiveness.

Mohammad Rafiq of the University of Peshawar received grants for two studies from the HEC National Research program for Universities on tourism, employment and environmental health in Pakistan.

Mohammed Ziaul Haider became a Professor at Khulna University, Bangladesh.

Muhammad Irfan received his Ph.D. from Federal Urdu University of Arts, Science and Technology in Islamabad. His SANDEE-funded dissertation concerns the impact of disamenity in Rawalpindi.

Nayanatara Nayak from the Centre for Multi-Disciplinary Development Research in Karnataka won a large grant and will partner with other SANDEEites to examine alternatives to tobacco.

Santadas Ghosh became the coordinator of Ph.D. coursework at Visva-Bharati University in Shanti Niketan, West Bengal.

SANDEE graduates have been elected in various capacities in the INSEE Board for 2012-14: Amita Shah is President; Pranab Mukhopadhyay is Secretary; Purnamita Dasgupta is Treasurer, and Seema Purushothaman is a co-opted member.

SANDEEites E. Somanathan, Priya Shyamsundar, and HariPriya Gundimeda continue to serve on the Indian Ministry of Planning and Implementation's Expert Group on greening India's national accounts.

Saravana Kumar is Principal Investigator for an Indian Government grant from the Ministry of Agriculture on examining the costs, estimates and methodology of production systems.

Vinish Kathuria was awarded the 2010 Mahalanobis Memorial Medal, a national award given by the Indian Econometric Society.

Dissemination

The information sharing and networking via SANDEE's publications and regional workshops are at the very core of SANDEE's mission. Inter-linkages among researchers encourage unique progress on analysis and understanding of the connections among economic development, poverty and environmental change across South Asia.

In 2012, SANDEE researchers gave 40 presentations at more than 20 conferences and seminars across 13 countries. SANDEE sponsored some of these conference activities, but not all. SANDEEites have a budget within their grant for dissemination, which happens routinely through seminars. The increasing number of presentations that are happening outside of SANDEE-supported channels (see Table 2) is very interesting and exciting for our researchers. Equally exciting are SANDEE's invitations to organise events at various international fora.

5th South Asia Economic Summit (SAES), Making Growth Inclusive and Sustainable in South Asia, 11-13 September 2012, Islamabad, Pakistan

A highlight from 2012 was a plenary presentation (on day one) and a panel presentation on climate change at the 5th South Asia Economic Summit. South Asia is one of the least integrated regions in the world and SAES is an important attempt at increasing integration. SANDEE was pleased to have been invited to engage in this effort.

In 2012, SANDEE researchers gave 40 presentations at more than 20 conferences and seminars across 13 countries.



SANDEE researchers and their contribution to capacity building in their respective countries will soon have marked impacts on the environmental policies of South Asian countries.

- M.N. Murty, Professor Emeritus, Institute of Economic Growth, Delhi

Planet under Pressure, 26-29 March 2012, London, United Kingdom

This major international conference brings together academics, policymakers, private sector leaders, development organisations and others to focus on issues of global stewardship and sustainability. This great networking opportunity brought SANDEEites to the table as experts on the environmental economics issues of South Asia. It allowed SANDEEites to understand the scientific underpinnings of much of the work that they do.



Mani Nepal, Priya Shyamsundar, Anuradha Kafle, Joyashree Roy and Prasenjit Sarkhel represented SANDEE at Planet under Pressure.

Table 2: A Selection of Conference and Seminar Presentations (2012)

	Conference Name	Country	Date	Presenter
1	SDPI's Fourteenth Sustainable Development Conference	Pakistan	13-15 Dec 2011	Naeem Akram
2	Conference on Statistical Sciences	Pakistan	19-22 Dec 2011	Waqar Akram
3	Australian Agricultural and Resource Economics Society 56th Annual Conference	Australia	10 Feb 2012	Rajesh Rai
4	Planet under Pressure	United Kingdom	26-29 Mar 2012	Priya Shyamsundar Mani Nepal Joyashree Roy Prasenjit Sarkhel
5	12th Congress of the International Society for Ecological Economics	Brazil	16-19 June 2012	Udith Jayasinghe-Mudalige Saudamini Das
6	16th International Consortium on Applied Bio-economy Research Conference	Italy	24-27 June 2012	Khuda Baksh
7	Conference of European Association of Environmental and Resource Economists (EAERE)	Czech Republic	27-30 June 2012	Saudamini Das Kanupriya Gupta
8	Seminar: Department of Urban and Regional Planning BUET	Bangladesh	1 July 2012	Afsana Haque
9	Conference on Climate Change URB Students Association	Bangladesh	8 July 2012	Afsana Haque
10	Conference of Agricultural Economists	Brazil	18-24 Aug 2012	Krishna Pant
11	5th South Asia Economic Summit	Pakistan	11-13 Sept 2012	Heman Lohano Prakash Karn Saudamini Das Joyashree Roy Iftikhar Husnain Priya Shyamsundar
12	3rd URBIO 2012 Conference	India	8-12 Oct 2012	Ridhima Gupta Krishna Pant Prajna Mishra
13	Climate Change Adaptation Workshop	Thailand	24-26 Oct 2012	Saudamini Das

SANDEE believes that the networking and sharing of information among its researchers is crucial to their successful research, publication and dissemination.



The Benefits of SANDEE's Training Flow to the Next Generation

We not only monitor the professional progress of SANDEE associates, we also track the various teaching programmes that launched as a result of SANDEE training, or that use SANDEE working papers, books and materials. This is a partial tally of those programmes for 2012.

Bangladesh

- Khulna University: Master of Science in Economics
- Sylhet University: Master of Science in Forestry, Research Methods
- United International University, Dhaka: Bachelor of Science and Master of Science in Economics
- Bangladesh Agriculture University, Mymensingh: Bachelor of Science in Agricultural Economics

India

- Central University of Hyderabad: Master of Arts in Economics
- Goa University: Master of Arts in Economics
- Ravenshaw University, Orissa: Master of Arts in Economics
- TERI University, New Delhi: Master of Arts in Economics
- University of Calcutta: Master of Science in Economics
- Visva-Bharati University, Shanti Niketan: Master of Philosophy and Doctor of Philosophy in Research Methods, Master of Arts in Economics

Pakistan

- Institute of Management Sciences, Lahore: Bachelor of Science and Master of Science in Economics
- International Islamic University, Islamabad: Master of Science and Master of Philosophy
- Pakistan Institute of Development Economics, Islamabad: Master of Philosophy in Economics

Nepal

- Pokhara University: Curriculum Committee
- Institute of Agriculture and Animal Science, Rampur College, Chitwan: Master of Science in Agriculture
- Tribhuvan University: Master of Science in Environmental Science
- Tribhuvan University, Patan Multiple Campus: Master of Arts in Economics



Training

Good policy analysis begins with skilled research. Training researchers has become one of the most important annual components of the SANDEE agenda. SANDEE hosts biannual Research and Training Workshops where attendees refine proposals, streamline work and benefit from the advice and instruction of experienced professors.

In addition to the SANDEE associates we train in our biannual workshops, we also trained some 168 professionals and decision-makers last year at our winter school in research methods, summer school in environment and research economics, and research and writing workshops. SANDEE provides training in specific practical areas, such as research methods and proposal development, as well as in environmental topic areas. Our annual three-week summer school course in environmental economics in Bangkok continues to be our flagship course to strengthen teaching, research and curriculum development.

Our workshops and training sessions increase the number of South Asian professionals who can use economic tools to analyse environmental problems. Participants with honed research skills can then teach their colleagues, amend university curriculum, apply for more funding, train their own students, sit on policy committees and more.

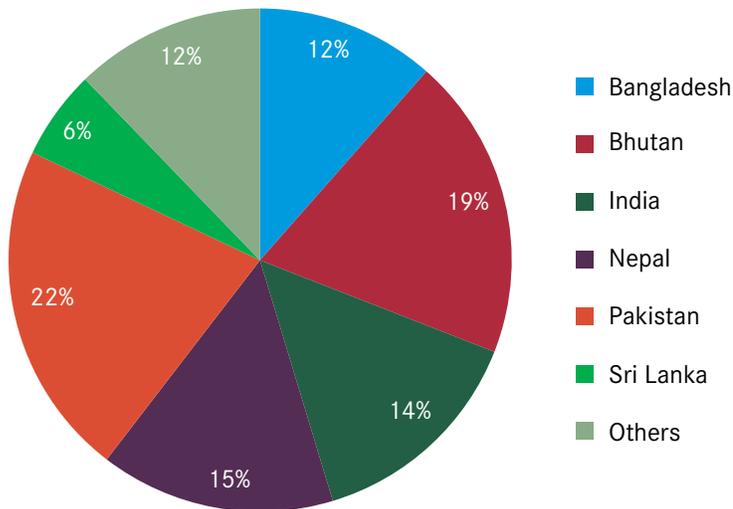
In 2012, SANDEE offered a total of nine training courses, including three in underserved areas. As Figure 3 indicates, workshop attendees from Pakistan comprised the largest group of trainees in 2012. Both Bhutan and Nepal also had a healthy percentage of trainees this year, at 19% and 15%



Professor Jeffrey Vincent of Duke University gave a presentation on “Watershed Services of Tropical Forests: Econometric Evidence from Malaysia” at the Summer School in Environment and Resource Economics in Thailand.



Research associates who attend the annual three-week flagship course in the summer gain a semester of learning about natural resource management, environmental economics, sustainable development and climate change.

Figure 3: Training Distribution by Country (2012)

respectively. The Indian Society for Ecological Economics (INSEE) co-hosts an annual course for research scholars on ecology and economics in Ahmedabad. This course draws at least 30 researchers, so India is routinely well represented in the number of researchers trained. Some 14% of the 2012 trainees were from India, followed closely by 12% from Bangladesh.

Winter School in Econometrics for Environmental Economics: Theory and Application

8-18 January 2012, Dhulikhel, Nepal

SANDEE organised a two-week training course meant for current SANDEE researchers who need to learn applied econometrics in order to complete their research projects. The workshop provided researchers with the basic skills necessary to analyse data. Participants were provided hands-on training in econometric software such as STATA.



At the InVEST workshop in Nepal, researchers learned to model ecosystems and integrate results with economic analyses.

Summer School in Environment and Resource Economics 7-23 May 2012, Bangkok, Thailand

This annual three-week programme on Natural Resource and Environmental Economics is the equivalent of a semester of learning about natural resource management, environmental economics, sustainable development, and climate change. Participants delve into theoretical issues and economic tools for analysing environmental and resource problems in developing countries.

Ecology and Economics for Research Scholars Workshop 29 November - 2 December 2012, Ahmedabad, India

Together with INSEE and GIDR, SANDEE organised a workshop on ecology and economics for Ph.D. scholars. Recognising the critical importance of continued support and guidance for younger researchers and for inter-disciplinary work, workshop leaders sought to strengthen insights into the various aspects of ecology, natural resources and development.

Modeling Ecosystem Services – InVEST, Natural Capital Project 9-11 December 2012, Kathmandu, Nepal

The Natural Capital Project has developed a family of tools called InVEST to map and value the goods and services from nature that are essential for sustaining and fulfilling human life. The objective of this training was to enable the group of researchers to understand better how ecosystems can be modeled and how these results can be integrated with economic analyses.

SANDEE has world-class training materials and expertise in the field of environmental and resource economics. The set of courses that SANDEE offers is both broader and deeper at the undergraduate and masters level than probably any single university in the world.

– Professor Dale Whittington, University of North Carolina, USA and Manchester Business School, UK



Professor Steve Polasky of the University of Minnesota gave a presentation on “Natural Capital and its Role in Economic Development” at the Research and Training Workshop in Kathmandu in December 2012.

Biannual Research and Training

18-22 June, 2012
Colombo, Sri Lanka

12-15 December, 2012
Kathmandu, Nepal

SANDEE holds these ‘R&T’ workshops twice each year for current SANDEE research associates. With the help of their advisors, researchers refine proposals, discuss their progress and present their final work. The Kathmandu meeting dovetailed nicely with the InVEST workshop. Researchers were able to benefit from a plenary presentation by Steve Polasky from the University of Minnesota on Natural Capital.

The Underserved Areas Programme

An important part of SANDEE's mandate is its support to smaller countries and less advanced areas in South Asia. SANDEE's teaching and training programmes in 2012 were significantly influenced by the need to bring in more research candidates from these underserved areas. To that end, SANDEE held workshops in Bangladesh, Bhutan and Pakistan attended by 77 participants.

The workshops SANDEE organised in Bangladesh and Pakistan were research and writing workshops designed to build research skills and impart proposal-writing techniques. The event in Bhutan was a special international training session co-hosted by the Poverty Environment Initiative that spanned not only South Asia but East Asia as well. SANDEE is already seeing the results of our efforts in underserved areas, and has checked the decline in grants from these countries.

Economic Instruments for Greening Development, Poverty Environment Initiative, 12-13 August 2012, Paro, Bhutan

Along with the Poverty Environment Initiative (PEI) of UNDP and UNEP, SANDEE co-organised a workshop on economic instruments for greening development. The two-day workshop brought together regional policy makers, planners and academicians from Pakistan, India, Nepal, Bangladesh, Laos, Thailand, Burma, Indonesia and the Philippines. The activity created a platform



The Economic Instruments for Greening Development conference in Bhutan was a two-day workshop that drew economists from all over South and East Asia to share their countries' experiences in addressing environmental challenges.



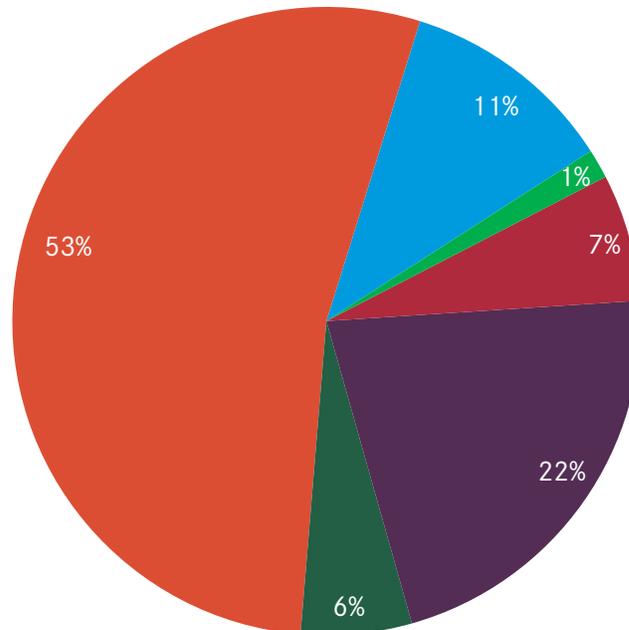
to discuss and share the various countries' economic development and environment problems. Individual representatives relayed how their country is addressing environmental challenges.

Research and Writing Workshops 14–17 September 2012, Islamabad, Pakistan 6–9 October 2012, Dhaka, Bangladesh

SANDEE jointly organised the workshop in Islamabad with the Sustainable Development Policy Institute and in Dhaka with the Economic Research Group. The Research and Writing workshops are designed for research associates primarily to build capacity in environmental and natural resource economics, and to assist in improving proposal-writing techniques.

Financial Information

Expenditures 2012: USD 998,133



■ Direct Secretariat Expenses

■ Research Support

■ Institutional Support

■ Training Support

■ Policy Advocacy and Dissemination

■ Management Committee, Business Plan and Evaluation

Sponsors and Partners

SANDEE was established in late 1999 with initial support from the Swedish International Development and Cooperation Agency (SIDA), Sweden, guidance from the Beijer International Institute of Ecological Economics at the Royal Swedish Academy of Sciences, as well as institutional and individual goodwill and support from many people within and outside South Asia.

The International Centre for Integrated Mountain Development (ICIMOD) currently hosts the offices of the Secretariat of SANDEE and has done so since August 1, 2009.

SANDEE was supported in 2012 by the International Development Research Centre (IDRC), Canada; the Norwegian Agency for Development Cooperation (NORAD), Norway; the Swedish International Development Cooperation Agency (SIDA), Sweden; and the World Bank. SANDEE looks forward to many more productive years working in collaboration with our sponsors.



Institutional and Faculty Partners

SANDEE does not undertake its activities on its own. The network has the support of an even wider network of institutions and teaching faculty. We are grateful for the cooperation and support of our institutional and faculty partners.

Institutional Partners

- Economic Research Group, Bangladesh
- Gujarat Institute for Development Research, India
- ICIMOD, Nepal
- INSEE, India
- Natural Capital Project, USA
- Sustainable Development Policy Institute, Pakistan
- UNDP, Bhutan
- UNDP-UNEP Regional Program, Thailand
- WWF, USA

Faculty Partners

International Faculty

- Cambridge University
- Duke University
- Queensland University
- University of Minnesota
- University of Namur

Regional Faculty

- ATREE, India
- ERG, Bangladesh
- IBA, Pakistan
- Indian Statistical Institute, India
- Jadavpur University, India
- Kolkata University, India
- PIDE, Pakistan
- SDPI, Pakistan



Governance

Management and Advisory Committee

A Management and Advisory Committee of scholars and policy makers governs SANDEE.

Annamaria Oltorp/Renée Ankarfjärd

Head/Research Advisor, Asia Region, SIDA, Sweden

Bhim Adhikari

Programme Leader, Environmental Economics, Senior Programme Specialist, IDRC, Canada

David Molden

Director General, ICIMOD, Nepal

Eli Koefoed Sletten

Advisor, NORAD, Norway

Herath Gunatilake

Principal Energy Economist, Asian Development Bank,
the Philippines

Madhu Khanna

Professor, University of Illinois, USA

Priya Shyamsundar

Programme Director, SANDEE

Syeda Rizwana Hasan

Chief Executive, Bangladesh Environmental
Lawyers Association, Bangladesh



Research Advisors

A global group of Research Advisors support and mentor the researchers in the SANDEE network.

A.K. Enamul Haque

Professor, United International University, Bangladesh

Céline Nauges

The University of Queensland, Brisbane, Australia

E. Somanathan, Professor, Indian Statistical Institute, India

Jean-Marie Baland

Professor, Facultés Universitaires, Notre-Dame de la Paix, Belgium

Jeffrey Vincent

Professor, Duke University, USA

Subhrendu Pattanayak, Associate Professor, Duke University, USA

Secretariat

Daily operations are managed from Kathmandu, Nepal, where the International Centre for Integrated Mountain Development (ICIMOD) has housed SANDEE since August 1, 2009.

Anuradha Kafle

Senior Training and Research Coordinator

Malvika Joshi

Accountant

Mani Nepal

Senior Environmental Economist

Neesha Pradhan

Administrative Programme Associate

Priya Shyamsundar

Programme Director

Pranab Mukhopadhyay

Goa University, Technical Support

A Farewell to Friends and Mentors



We owe much to the leadership of Dr. Yoginder K. Alagh. Dr. Alagh steps down after several years as a member of SANDEE's Management and Advisory Committee. His guidance, particularly when he was the Chairperson, is much appreciated.

We bid farewell to Dr. William Chameides, who served on the SANDEE Management and Advisory Committee. He is Dean of the Nicholas School of the Environment at Duke University in North Carolina and a member of the National Academy of Sciences. Thank you for your support Dr. Chameides.



The Year Ahead

Research

- Research and Training Workshop
19–23 June 2013, Thailand
- Research and Training Workshop
10–14 December 2013, Nepal

Training

- Winter School in Research Methods
14–24 January 2013, Nepal
- Summer School in Environment and Resource Economics
29 April–19 May 2013, Thailand
- Policy Analyses for Environmental Economists
20–22 May 2013, Thailand

Capacity Building in Underserved Areas

- Research and Writing Workshop
March 2013, Pakistan
- Research and Writing Workshop
August 2013, Bhutan

Dissemination and Policy Support

- Working Papers, Newsletters and Policy Briefs
(ongoing)
- Conference/Policy Dissemination
- Scientific Advisory Committee (IGBP)
Technical Committee REDD+ (GoN)
- Curriculum Advisory Services
(TERI and Pokhara University)

SANDEE looks forward to a successful and productive 2013.



Key Environmental Indicators for South Asia

	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Population (millions)	148.7	0.726	1,224.6	0.316	30.0	173.6	20.9
GNI per capita, Atlas method (\$)	700	1,870	1,270	5,750	490	1,050	2,240
GDP (\$ billions)	100.4	1.5	1,727.1	1.9	15.7	176.9	49.6
Agriculture							
Land area (1,000 sq. km)	130	38	2,973	0.3	143	771	63
Agricultural land (% of land area)	70	13	61	27	30	34	42
Forests and Biodiversity							
Forest area (% of land area)	11.1	84.6	23.0	3.3	25.4	2.2	29.7
Annual deforestation (% change, 1990-2005)	0.2	-0.3	-0.3	0.0	1.4	2.0	1.2
Nationally Protected Area (% of land area)	1.8	28.3	5.0		17.0	10.1	21.5
Energy, Emissions and pollution							
Electricity generated using fossil fuel (% of total)	95.9		83.8		0.4	67.5	60.3
Electric power consumption per capita (kWh)	252		571		91	449	408
CO ₂ emissions per capita (metric tons)	0.3	1.0	1.5	3.0	0.1	1.0	0.6
Water and Sanitation							
Access to improved water sources (% of total population)	81	96	92	98	89	92	91
Access to sanitation in rural areas (% of rural population)	55	29	23	97	27	34	93
Internal freshwater resources per capita (cubic meters)	714	109,295	1,197	96	6,734	1,236	2,555
Total freshwater withdrawal (% of internal resources)	2.9	0.4	39.8	15.7	4.7	79.5	24.5
Under-5 mortality rate (per 1,000 live births)	48	56	63	15	50	87	17
National accounting aggregates							
Gross national savings (% GNI)	35.2	...	34	12.0	33.9	21.0	25.1
Consumption of fixed capital (% GNI)	7.5	10.4	9.3	11.8	7.8	8.5	10.1
Education expenditure (% GNI)	1.8	3.2	3.1	5.0	4.2	1.6	1.7
Energy depletion (% GNI)	1.8	0.0	2.5	0.0	0.0	2.1	0.0
Mineral depletion (% GNI)	0.0	0.0	1.3	0.0	0.0	0.1	0.0
Net forest depletion (% GNI)	0.4	3.6	0.5	0.0	2.5	0.7	0.3
CO ₂ damage (% GNI)	0.4	0.4	0.9	0.4	0.2	0.7	0.2
Adjusted net savings (% GNI)	26.2	...	21.8	5.4	27.6	9.4	15.9

Source: Little Green Data Book, 2012. World Bank.

