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## Combating indoor air pollution

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A majority of Indians reside in rural areas. In spite of growing urbanization, this state of affairs will continue for at least a few decades. The nation cannot attain the so-called ‘superpower’ status unless special efforts are taken to strengthen the rural economy. The spine of the rural economy is the rural woman, who is increasingly playing the dual role of the home maker as well as the bread winner.

My work contributes to easing the life of rural women to some extent. For as long as I remember, I have always wanted to make a career in science. It was not a surprising ambition. My father is a prolifically talented and successful scientist. Belonging to a family of several generations of social reformers and rationalists, I grew up without the burden of gender discrimination. Even the society at large expected me to do something out of the ordinary. These circumstances have certainly made life easy for me!

I neither enjoyed nor abhorred studies in my school and college days – generally managed to do just enough to stay near the top of the class, year after year. However, the fact that a physical phenomenon can be fully explained with a mathematical ex-

pression particularly fascinated me a lot, and I decided to major in Physics. In my final year of B.Sc. Physics, the curriculum required me to do a research project. At that time my father was Deputy Director of the Centre for Application of Science and Technology for Rural Development (CASTFORD) in Pune. For my project, I worked on optimizing a mixture of sawdust and soil to make compacted fuel for an improved cook stove at CASTFORD. The results of the study were unexpected and interesting, but more importantly, I got fascinated with the scientific challenge of using a wide variety of fuels (from cow dung cakes to logs) with a variety of chemical compositions (different moisture content, ash content, etc.) and physical attributes (different densities, shapes, sizes, etc.) and extracting the same 'quality' of cooking energy day in and day out.

I went on to pursue M.Sc. Physics, in University of Pune. This was the first time I really 'learned' and enjoyed studying. I took 'Energy Studies' as one of my elective subjects in final year of M.Sc., hoping that it would explore the broad canvas of present and possible future science for producing and using various forms of energy. However, the course was primarily focused on describing solar energy technologies. Nevertheless, it gave me another opportunity to do a project in CASTFORD. This time I worked on design optimization of a sawdust fueled stove. And this has now evolved into a commercial product!

By this time I was totally convinced that I wanted to work more in this field. But there did not appear to be any possibility of getting a Ph.D. by working on something as primitive and 'trivial' as providing clean cooking energy to a rural kitchen. Rather than working in a mediocre research group in apparently related areas like solar energy, I chose to work with an internationally reputed research group working in frontier areas of physics. I worked on diamond coatings at the Department of Physics at University of Pune (I 'created' diamonds in my laboratory every day!).

Although I immensely enjoyed the work that I did for my Ph.D., I was back to biomass energy once I had earned my doctorate. My father and his colleagues had by then evolved CASTFORD into Appropriate Rural Technology Institute (ARTI), and wanted

projects for the new organisation. I came up with the idea of converting sugarcane trash into charcoal, and submitted a project proposal to Department of Science and Technology's Young Scientist Scheme. Through this project, we developed an oven and retort type charring kiln and a briquetting process for converting any type of loose biomass into char briquettes. We also developed a highly energy efficient system for using the char briquettes for steam cooking. This cooking device is now quite popular in both rural and urban Maharashtra, and is also attracting people from other parts of India as well as other parts of the world. Towards the end of my Ph.D. work, while netsurfing I stumbled across an e-discussion group on stoves. Through the group discussions, I took the initiative to organize an International Conference on Biomass-based Fuels and Cooking Systems through ARTI. One of the conference delegates, impressed by our technology of converting agricultural waste into charcoal, suggested that we apply for the Ashden Award for Renewable Energy. We did it very tentatively, and ended up winning the award in 2002. Since then, ARTI has moved from strength to strength.

Throughout this period I was awakening to three facts. One, indoor air pollution in the kitchen was a serious and yet the most neglected hardship faced by rural women of the developing world. Two, replacing biomass energy with fossil or other energy sources in rural kitchens was either impractical or not happening fast enough. And three, developing better ways of extracting clean cooking energy from biomass fuels was not enough; concentrated effort was needed to take the innovations from the laboratory to rural kitchens in a sustainable manner. Through support from the Shell Foundation from 2003 to 2005, ARTI built a network of 10 grassroots-level NGOs and through them more than 100 energy enterprises came into existence. Through these enterprises, about 75,000 rural households in Maharashtra purchased clean cooking devices by paying the market price.

Meanwhile my own not-so-inspiring experience of school and undergraduate level teaching and the subsequent enjoyment of learning during post graduate and doctoral research period had generated several ideas about science teaching. After getting Ph.D.,

I grabbed two opportunities for putting the ideas in practice. Firstly, I joined hands with a group bringing out a Marathi bimonthly, 'Shaikshanik Sandarbh' (educational reference) targeted at school level science teachers. Through this periodical we try to motivate and assist teachers to make science learning an enjoyable experience for the students. I also taught for five years Applied Physics in an Engineering college, trying out my ideas in theory as well as laboratory courses.

Today I am engaged in the challenging task of fine tuning and scaling up the concept of rural energy enterprises. Being drawn into addressing the socioeconomic issues related to mitigation of indoor air pollution, has to some extent distanced me from scientific research, but it has not brought it to a complete halt. Interacting with entrepreneurs and rural women has helped in pinpointing several subtle issues requiring scientific solutions – for example, importance of ease of manufacturability and transport in developing designs for cooking devices or importance of understanding the varying energy requirements of cooking tasks in developing new fuels and cooking devices. I believe that although my scientific work over the years may be relatively less in quantity as well as quality than many other professional scientists, it will have a much more direct impact on the life of people. That is what matters the most to me.