

Romance of Innovation

Human interest story of R&D in rural setting



Anil K Rajvanshi

About the book

This digital book presents a brief history of renewable energy work carried out since 1981 at [Nimbkar Agricultural Research Institute \(NARI\)](#).

Too often the record of research and development (R&D) is written up as articles in journals and books. The human-interest story of the way the research was done, interactions with the stakeholders and the pushes and pulls in doing it are left out of the record.

This book is an attempt to record these details. It also shows how R&D can be done in a small rural institute and should provide inspiration to other NGOs who want to do a similar type of work.

The aim of the book is to inspire youngsters to enter the field of rural innovations and to provide challenging ideas for research and development to those who already are converts.

Dr. Rajvanshi has written in an engaging style about the romance of doing research in rural setting and has shown that with meager resources and few members of staff, very meaningful and satisfying R&D work can be done.

It is often said that good R&D requires lot of equipment, money and manpower. Work on renewable energy at NARI has shown that it is possible to do good work in little money and resources", said Dr. Rajvanshi.

There are six chapters in the book, out of which five describe the hardware development work carried out in household energy (cooking and lighting); gasification; electric cycle rickshaws and water-related problems among others. The last chapter deals with the philosophical issues and hence gives a roadmap for the future development of rural India.

The book is a very interesting read as it emphasizes the human-interest aspect of problem solving for rural India. The future research areas described at the end of each chapter will certainly be very useful for persons who are planning to develop a career in research and development for rural areas.

The book is available free of cost and is available on NARI website <http://www.nariphaltan.org/roi.pdf> (with links to chapters) and www.nariphaltan.org/roibook.pdf (full book). This book has been written in the hope that it may inspire bright engineers to be engaged in rural R&D and thus making the book available free may help in this effort. A short video on [renewable energy work is available here](#).

The [book was released](#) by very well-known Indian scientist Dr. R.A. Mashelkar and Dr. Rajat Moona, DG of C-DAC in Pune on 20th October.

A [nice story on the book came in Daily Mail](#). 2 February 2015. In addition, an excellent review of the book was [published in Current Science, 25 December 2016](#).

About the author



[Dr. Anil K. Rajvanshi](#) has more than 30 years of experience in renewable energy R&D and rural development. He did his B.Tech and M.Tech in Mechanical Engineering from Indian Institute of Technology (IIT) Kanpur in 1972 and 1974 respectively. He received his Ph.D. in Mech. Engg. from University of Florida, Gainesville, USA in 1979 under solar energy pioneer Dr. Eric Farber. He was on the faculty of University of Florida (Dept. of Mechanical Engineering) for 2 years before returning to India in 1981 to run his own rural NGO - [Nimbkar Agricultural Research Institute \(NARI\)](#) in Phaltan, Maharashtra.

NARI has done pioneering work in agriculture, renewable energy and sustainable development areas specially those affecting rural population. Dr. Rajvanshi has devoted the last 33 years at NARI to apply sophisticated science and technology to solve the problems faced by the rural people in the areas of energy, water, pollution and income generation, broadly based on renewable energy in environmentally sound ways.

Dr. Rajvanshi has written extensively on his work on rural self-sufficiency and has attracted the attention of the print and visual media worldwide. He has more than 160 publications; [four books and chapters in various books](#); and 7 patents to his credit. He has been inducted into several prominent committees of the government of India at the national and state level. He is the principal author of the Govt. of India national policy on Energy Self Sufficient Talukas.

For his work, Dr. Rajvanshi has received a number of prestigious national and international awards, such as [Jannalal Bajaj Award](#), induction to the [U.S. based Solar Hall of Fame](#), Austria based **Energy Globe Award**, Federation of Indian Chambers of Commerce and Industries ([FICCI Annual Award](#)), Sweden based [Globe Award](#), [Distinguished Alumnus Award from University of Florida](#) (he is the first Indian to receive this award), among others. He has been a featured speaker at many prominent institutes, conferences and forums, both in India and U.S. and lectures regularly on the issues of sustainability and rural development.

Besides his engineering work, he is also involved in studies of human consciousness and the interaction of spirituality and technology. His [writings](#) on these issues have appeared regularly in Times of India in Speaking Tree column. He also writes a [blog in Times of India](#) and [Huffington Post](#).

He is an author of a book entitled, ["Nature of Human Thought"](#), which tries to bring about a synthesis of ancient Indian Yogic thought and modern cosmology and brain research. The book contains many essays on spirituality and technology and reflects his belief that sustainability and spirituality go hand in hand. He has also penned his memoirs of his US student days in a book entitled ["1970s America - An Indian Student's Journey"](#). Recently he has written [his autobiography in e-book format](#).

Romance of Innovation

(A human interest story of R&D in rural setting)

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Phaltan, Maharashtra, India.

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Preface

I present in this book the romance of innovation in a rural setting. It is basically a short history of the renewable energy work at Nimbkar Agricultural Research Institute (NARI), Phaltan. This is also a human interest story of doing research and some meaningful work in the area of rural development.

I have written an account of what we were able to accomplish at NARI in renewable energy research and to show how much more needs to be done in the area of providing basic amenities to the rural population. I hope it inspires and helps others who are so inclined and it is my fervent hope that some bright research-minded reader will take up this challenge.

I came back to Phaltan from U.S.A. in 1981 after getting a Ph.D. and spending a few years teaching renewable energy at University of Florida. In late 1981 when I returned, very few Indians with an IIT degree came back. Even the ones who did come back went to big cities like Bombay, Delhi, Bangalore, etc. I went straight to rural Maharashtra which was as alien to me as any foreign country since I hardly knew the local language or the milieu.

Why I came back to rural Maharashtra is a long story and [I have written about it in another book](#) entitled “1970s America – an Indian student’s journey”. This book is a sequel to it. Nevertheless it would suffice to say that I came back because of my arrogance and the naive belief that I would help change India. India did not change but it changed me since staying in rural India made me aware of the problems and challenges of the rural population, and which technologies and strategies to develop to help them. This book is an account of that experiment.

I was always inspired by Mahatma Gandhi’s rural development work. Though I had read quite a number of books on him during my IIT Kanpur days but it was in University of Florida (UF) that I read extensively on him. UF library had excellent material on Gandhi including D.G. Tendulkar’s 8 volume biography.

Gandhi's work on rural development made a tremendous impact on me and inspired me to do something for rural areas but through technology. I was also quite sure that the poverty and the primitive conditions in rural areas deeply influences a sensitive mind and too often well meaning people, even with technology background, who want to work for rural upliftment have been sucked in by the misery they see and end up doing social work only.

I was therefore very clear that the greatest social worker Mahatma Gandhi could not make much dent in improving the life of rural people through his social experiments so who was I to think that I will make a difference. Thus I felt that with my training as an engineer I should try to utilize my knowledge for developing technologies for rural areas and hence my effort in that direction.

I was also inspired by Gandhi ji's experiments in living simply and sustainably and have tried to follow his example though not to the extent he did. My small experiments in that direction are given in Chapter 6.

However, coming to and working in the small rural town of Phaltan in 1981 was not easy. There were lots of struggles initially and very soon after my return the ground realities hit me and all my romantic notions and arrogance vanished. If I had an iota of intelligence I might not have taken this step of coming to rural India.

Yet, once I took it there was no looking back. I would like to share how one can do meaningful and satisfying R&D work even in a small rural town with hardly any facilities. This is what I call the 'romance of innovation' since the work was done for the very selfish reason of doing something meaningful with my life. And it is my hope that the book will inspire some youngsters to follow this dying vocation of doing R&D in engineering for rural areas.

Doing R&D in any setting is a challenging task but more so in rural setting and especially when there was no model to emulate since NARI was the first rural NGO in India in early 1980s to initiate work in renewable energy R&D. This book is therefore an account of that unique experiment.

For the first two years after we returned from the U.S. my wife Nandini and I lived in a small rented house in the slums of Phaltan. We moved into our present house, designed by me, in early 1984. Both of us used to cycle to the Institute every day – a distance of about 3 km one way. In 1984 my brother, an orthopedic surgeon who was moving to Saudi Arabia, took pity on me and gave me his old scooter which he had purchased in 1975. That was our first motorized vehicle.

In those days one had to go to Pune – a town 100 km away – to buy even small things. Now with its milk, sugarcane and horticulture economy, Phaltan has grown to be a mid-size town with supermarkets and easy availability of other services.

Telecommunication facilities were almost non-existent in those times and it was a nightmare to make a long-distance phone call to any place. One had to book a call in the early morning and if one was lucky the call would materialize by the evening. So quite a few times I would hop on the bus and go to my friend's office in Pune to make phone calls. The bus journey in those times took about four hours one way. Today the situation is better with the availability of broadband internet connections and telephone facilities to call anywhere in the world. The roads are much improved, which has almost halved the travel time from Phaltan to Pune.

When I came to Phaltan there was a flat piece of land where I was supposed to start building my energy lab. The Institute at that time had a small building and farm land with almost no other infrastructure. I got an old fan fitted in my office, and that was the only fan in the whole Institute. Besides one rarely had electricity so the fan was mostly non-functional!

In the early days of setting up my lab, it was very difficult to get engineers and scientists. It took me nearly four years to get the lab to become functional and hire decent staff. Even now there is a tremendous problem in getting good staff. The situation has become worse because we cannot compete with the very high pay packets being offered by the industry and the government.

I now realize that one of the biggest drawbacks in setting up a research Institute in a rural area is getting good people to come and work in it. The rural infrastructure

precludes any long-term commitment by people to work in such institutes. This has been the main reason why NARI has remained small. Still, even with the small staff, meager budget and limited infrastructure we have been able to do reasonably good work with lots of firsts to our name.

I have always believed that good research can be done by thinking deeply about the problems and one can extract a huge amount of information from simple and clever experiments. In fact sometimes too much money and equipment are a hindrance to good research. We have shown this in our lab where we have been able to accomplish the entire R&D work in renewable energy **from 1981 till the present in a total budget of Rs. 2 crores (Rs. 20 million) only!**

Our work at NARI has mostly focused on **developing devices, hardware and policies for rural development with special emphasis on the use of [high technology for a holistic and sustainable India](#)**. Some of these technologies and ideas have been picked up nationally and internationally, and that has been an exhilarating experience.

For example, our work on Taluka Energy self-sufficiency became a national policy (Chapter 3). Similarly our pioneering work on [ethanol from sweet sorghum](#) is now established nationally and internationally. So is our work on biomass gasifiers, safflower, multifuel lanterns, ethanol stoves, electric cycle rickshaws and vehicles for the handicapped, etc. All these pioneering efforts have inspired people all over the world. For our efforts in rural development we have also received quite a number of [prestigious national and international awards](#).

India is a young society with 54% of its population below 25 years of age. The aspirations of this young generation, majority of whose members live in rural India, are not being fulfilled. With increasing exposure to mass media they aspire to a better quality of life, which I think can be made possible with development and application of technology especially for them.

It is a matter of shame for all of us that 67 years after independence we still have 60% of our rural population living in primitive conditions. They lack electricity, clean

cooking fuel, potable water and toilets in their homes. Somehow modern technology has not touched their lives.

To find solutions to these problems offers the greatest challenge for any engineer or technologist and I feel that most of the Indians, wherever they are in the world, should help in trying to solve these problems with the help of advanced tools of science and technology. After all what we are and wherever we may be is because of the early life that we spent in this country of our birth and we should give back something to it. The real challenges are in India and if we can improve the lives of our rural population then we would have solved the problems of 1/5th of mankind!

Presently our greatest problem is that most of the engineers and technologists from our best schools opt for non-engineering careers where the pay packets are higher. India spends a huge amount of money on their education and yet they do not use their technical education for India's benefit. Unless and until this problem is rectified India will always remain backward in technology and hardware.

The reasons for this state of affairs could be many - one of which could be [our faulty schooling system](#) which somehow neither encourages young students to tinker nor inspires them about the romance of science. Another reason could be that our [top engineering schools do not challenge our bright students](#) in technology areas. I hope the work described in this book will challenge some of these bright students to take up technology related work for rural development.

In my innumerable interactions with young students all over the country I have always got the impression that they want to do something meaningful in their lives. Yet, they are neither shown the opportunity nor the path because of the paucity of good and motivated teachers. I am sure if given a chance and provided motivation our engineering students can do wonderful work to help the country.

During my interaction with these young students I have often been asked how I have continued doing this type of work despite all odds. I think the [answer is 'junoon' or passion](#). Without a single-point focus and passion for doing something meaningful

one cannot continue on this path. That is the romance of innovation. Also if the focus is only on money then it is not the path to be taken.

Junoon not only provides the energy to do something but also takes the mind away from external pressures. One can then do things one likes and not what others want you to. I have never been afraid to tackle any problem and challenge. This is what my Ph.D. has taught me. It is a training of the mind and given enough time and patience one should be able to attack any problem. Readers will see how we have managed to work on myriad problems facing rural India.

Another way in which *junoon* is sustained is by developing hardware. **The motto in our lab has been ‘just do it’!** Even when the theoretical challenges have been daunting we have solved them by developing devices first, experimenting upon them, and then developing appropriate theories. In this we have followed the old school of thought where experiments often showed us the theoretical underpinnings of the design.

Most of the problems we have worked on have come from our surrounding area. I feel that all the problems exist right in front of us. If each one of us can provide solutions to them then we could rapidly develop India. There should be a concentrated effort to expose students in our schools and colleges to the local problems and their possible solutions rather than giving them esoteric problems which unfortunately have no connection to the local conditions.

Sometimes we faced social problems. For example our bathrooms in the Institute were filthy and since we were quite far from town nobody came to clean them. So when I proposed that all of us will clean them there was a revolt by the staff. Even when I [took the lead in cleaning them](#) they did not budge. Thus not only do we need to train the scientists and engineers in R&D but also in the ethics of work. This training nevertheless needs to be imparted during school and college days.

The romance of innovation is like *Yoga*. The goal is clear and attainable and by pursuing it one forgets about all other problems, odds and obstacles. For rural development it is essential that single-minded focus on doing meaningful work

becomes the paramount purpose in life. How we can teach this to young students is the biggest challenge and [I try to engage the students on this subject](#) at any opportunity I get.

There have been many times when our research has not progressed as planned because of so many uncertainties in the rural set up. I have utilized that time to think deeply about [spirituality and the problems of rural India and have written about these issues](#). I have also tried to utilize the knowledge of science and technology in the realm of spirituality and hence have tried to blend [spirituality with technology](#). I think this is a novel and innovative theme. Writing on these issues has been very enjoyable and therapeutic, giving me new vigor and motivation to overcome challenges and hardships. It has also made us well known world over, and one of the tangible benefits has been a [good number of interns](#) who have come to help us from across the globe.

I believe that thinking deeply and writing about higher issues is also a part of the romance of innovation since it could be in any field, whether technology or spirituality. However the ability to think and work on these higher objectives is achieved only when one simplifies one's life. Once the basic needs are met most of the energy can be focused on doing something that is enjoyable. Living in rural areas helps in simplifying one's life and becoming spiritual.

With hardly any avenues to spend money and availability of very few amenities, one starts living a simple life, which is the first step towards spirituality. Initially one may not like it but with time one starts to enjoy the benefits of a simplified life. I recommend such a life for anybody who believes in sustainability because when everyone becomes sustainable in their personal life, the world will automatically become sustainable. I feel one can live a simple, high thinking and emotionally satisfying life with much less energy, and in our small way we have shown that it is possible (Chapter 6).

This does not mean that we should live a primitive life. In fact the extremely sophisticated technologies that provide modern tools of communication and power are an important part of reducing energy consumption, thereby promoting

sustainable living. What is needed is to curb our consumptive lifestyle, which promotes greed for resources, and spirituality helps in doing that. I believe the mantra of India's development should be ['Spirituality with High Technology'](#).

I feel very lucky to have come to rural India so that I could develop simplicity in my daily life and now I feel that it is my duty and responsibility to spread the message. This I have been doing through my work, speeches and writings, and this book is another small step in that direction.

I have always believed that the purpose of human beings is to first become happy and self contented and then give something back to the society. [Giving back to society gives a purpose in life and brings joy and happiness.](#) I feel our work in rural development is a small contribution to society. Towards that goal we have made available [most of our publications and work on the net.](#)

Organization of the Book

I have decided to publish this as an e-book and make it freely available. These are e-book times with a proliferation of book readers like Kindles, iPads, etc. Young people, at whom this book is primarily directed, are computer savvy and more comfortable reading e-books than physical ones. Also, e-books lend themselves to the use of links as references and these have been extensively used in this book. I am sure some of the research minded readers will find them useful.

All the chapters in the book are standalone and can be read in any order. Since there was quite an overlap in the technology development at NARI, rather than arrange the chapters chronologically, I have decided to place them according to areas of development.

Since this book is primarily meant for younger readers, I have included at the end of each chapter unsolved problems and future research areas on renewable energy for rural applications; these are in addition to those appearing at appropriate places in the chapters. I hope these will provide a challenge to idealistic young engineers and technologists.

Besides the hardware oriented work that we have done at NARI, I have also thought deeply about the problems and possible solutions of rural India. I have written about them and published them in various newspapers and magazines. I feel they may provide readers food for thought and have thus included their genesis and rationale in chapter 6, titled 'Roadmap for Rural India'.

Finally, it is my fervent hope that this book conveys the romance of innovation, and if somebody is inspired by our work it will give us great joy and satisfaction.

Anil K Rajvanshi

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