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Prof. Sujatha Ramdorai is an Indian mathematician currently associated with the University of British Columbia, Canada. She is also a professor in the School of Mathematics at the Tata Institute of Fundamental Research, Mumbai. Prof. Sujatha is an internationally reputed algebraic number theorist whose work on Iwasawa Theory is widely respected. She is the first and only Indian to win the prestigious ICTP Ramanujan Prize in 2006 and also a winner of the Shanti Swarup Bhatnagar Award in 2004. She was a member of the National Knowledge Commision from 2007 to 2009. She is at present a member of the Prime Minister's Scientific Advisory Council from 2009 onwards and also a member of the National Innovation Council. Recently on a visit to Tezpur University, we took an interview of her. Her TIFR home page can be found here*, and her UBC home page can be found* here*.*

*The interview was taken by **Pankaj Jyoti Mahanta** and **Manjil P. Saikia**. We are also grateful to Dr. Rupam Barman and Dhrubajyoti Ozah for their help. Below are the replies of Prof. Sujatha to our queries.*

Gonit Sora (GS):How did you become fascinated by mathematics when you were young? Was there anyone in particular who motivated you towards mathematics?

Prof. Sujatha (SR): No one in particular….but learning was deeply appreciated in my family and my grandmother's lifelong interest in learning, being not fully educated herself, influenced me to a large extent. As for my interest in mathematics, I guess I was attracted to abstract thinking and structured formalisms. I did well in math in school and this contributed surely.

GS: What are the skills and requirements needed to become a good mathematician? Please describe a typical day of your work.

SR: An appreciation of abstraction, intellectual discipline and rigour are definitely necessary.

There is also however an element of intuition. A typical day of my work ? It changes…

Earlier when I was focusing more on research, it would be spent reading papers, trying to learn new areas and looking for problems and working on problems. I have had the good fortune of having worked with many collaborators and when it is collaborative work, it is usually intense as we try to complete our work during a fixed time.

Today, I am also involved in teaching, supervision and other policy matters. I therefore read a lot of related articles in science. While teaching, a lot of time goes in towards preparing lectures, assignments, talking to students, etc. I am also lucky now to have had a few good students who are very capable. I usually suggest research problems in areas I think that are central in mathematics and quite an amount of collaborative learning happens.

GS: What do you think is the role of mathematics in our everyday life?

SR: Today mathematics has made inroads in different areas of science, as you will perhaps agree, is pervasive in our everyday lives. But more subtly, a good training in mathematics helps you develop your analytic faculties and to think logically. Pure mathematics by itself, finds unexpected applications in areas ranging from medical imaging to internet security, transport planning, etc to name just a few.

GS: What does your current research deals with? Please explain briefly.

SR: I currently work in an area of algebraic number theory that is called Iwasawa theory.

This is a systematic area today that is used in trying to solve deep open problems in number theory. It has its origins in the work of a great Japanese mathematician, Kenkichi Iwasawa, in the middle of the last century and has grown today to a vast area with many mathematicians working in it. It is difficult to explain it in simple terms but combines tools from algebra, number theory and representations of Galois groups.

GS: Do you ever get to see applications of your discoveries in other fields of study? If so, is there any specific application which is your favourite?

SR: Not yet… Right now, I only see some of the ideas used in our work being applied to other areas within mathematics. This is true even of our work. Some of our results in Iwasawa theory used ideas and tools from other areas of mathematics like non-commutative algebra, K-theory, etc.

GS: You are a major proponent of the Iwasawa theory; can you explain it in brief for our readers?

SR: We all know the field Q of rational numbers. There are finite extensions of this field which has some algebraic invariants attached to it, called the class number. Iwasawa began his ivestigation in understanding how this invariant changes we go to larger and larger finite extensions of Q, eventually reaching an important infinite extension called the cyclotomic extension of Q. These ideas were later found to be fundamental in studying rational points on elliptic curves, and in attacking a central problem in the theory of elliptic curves, called the Birch and Swinnerton-Dyer conjecture. These ideas are also applicable in studying the Galois representations and I work in this broad area. Iwasawa theory provides a philosophical explanation for why something mysterious as the Birch and Swinnerton-Dyer conjecture should hold at all.

GS: As a women mathematician, was there any difficulty in pursuing your work? Is there any kind of social stigma related to women in mathematics in India now?

SR: Not really…I would not say `social stigma' but there is definitely a subtle social difference.

Not just for women mathematicians, but for women working in general. They are expected to `prove' themselves at home and work, whereas such a pressure is not so prevalent towards men. Also, support systems are lacking in our country but I am very pleased to see that institutions and organizations are now trying to tackle this.

GS: You did your Masters Degree course in distance mode. Why did you opt for such a medium? Was it a hindrance in your progress in mathematics?

SR: I got married when I was quite young and my daughter was born soon after. It was unclear where my husband would settle down, we were in Bangalore and there were chances that he might have to move to Bombay. Distance education thus offered a reasonable solution. I don't think it is a hindrance, and today with different forms of technology being available, I would think it is an option to be explored. However,

I want to stress that it cannot replace a good teacher. It can be an excellent supplement, but we stand to lose if we think we can replace teachers with technology. Used judiciously together, it can be a winning combination.

GS: What are the main problems in mathematics education in our country? What is your hope about solving these problems?

SR: For years, we followed an elitist system of choosing the best and caring for the best. I have no problems with this but the best' will always be few and such a system of concentrating on a few at the cost of developing and improving a larger better' base was neglected. It continues to not be the focus, and this is the reason for the big tension and competition. Just as there is a spectrum of abilities in a society, we should concentrate on developing a reasonable spectrum of institutions, where the best are of course supported but where there is also a decent chance for the others to improve. An educational institution should be measured by what it makes of an individual who enters it. For mathematics education I strongly feel that we should support school and college teachers. We hear a lot of stories about teacher absenteeism, lack of work culture etc but no one speaks of the thousands of teachers who are dedicated, and work hard in a system that is designed to make someone feel frustrated! In the NKC document (National Knowledge Commission), we outlined some steps towards improving math and science education in the country. I also feel that there should be a content movement in the country, especially in developing quality content in the vernacular languages. With the explosion of internet connectivity, we are going to be in a situation where content is precious and secure and not for free. This will create a further content divide between the rural and urban settings. We should ensure that this does not happen. At the National Innovation council, under the chairmanship of Sam Pitroda, we are working towards tackling this problem and addressing math education in government rural schools.

GS: You were a part of National Knowledge Commission (NKC) and the Prime Minister's Scientific Advisory Council. What kind of steps would you suggest for the popularization and development of mathematics education in India?

SR: Please see my comments above. I also want to see lots of youngsters like you participating in such a movement. Today the internet and mobile platforms offer limitless possibilities.

You can create portals and coordinate peer-to-peer learning, etc. And all this can be done with little financial backing. What is needed more than money today is commitment, passion and drive. I am optimistic that there are lots of youngsters and teachers who will be happy to participate in such a movement, and that we will see difference in a dozen years or so. We also need to focus on the universities and colleges. This will take a long time but it is an investment of effort and money which should no more be neglected. We also need to bring a variety of new areas of mathematics and devise courses around them. This will help people with a good mathematical training in finding employment that is outside of academia.

GS: Do you believe that India has a convivial atmosphere for the study of mathematics?

SR: What has happened in India-and the world- is that education at all levels have become democratized. So Higher education is not elitist as it used to be. In our country, the problems that it has caused is more acute because of the neglect in the education sector and other systemic malpractices that took root in the last thirty years or so. This has driven away a large number of people who would have liked to be associated with education. We need to change this. I also feel that there are enough elite research institutions now and we should focus on the universities, colleges and school education. We have a broken pipeline when it comes to connecting school education and higher education and research. So the short answer is `No, not wholly'. But we have the capabilities to change this and I hope this will happen. This needs thought and engagement at multiple levels and developing and training a whole new generation of younger leaders in large numbers.

GS: How different are the students from other countries as compared to India?

SR: I think many other Asian countries have realized similar problems and are approaching it systematically. Students from many other countries that I have come across are more independent and enterprising. We have very good students in our country but their exposure is limited and their potential not tapped to the fullest extent. With connectivity and the internet, this is surely bound to change. I already see many youngsters, especially those from smaller cities and villages have a tremendous zeal and energy. We need to have a system that does not disappoint them and provides them equal opportunities.

GS: You were awarded the prestigious Ramanujan Prize, how has it influenced you and our country? You were the first and only Indian to win it; do you see anyone else from India getting honoured in a similar way in the near future?

SR: I was lucky to be awarded the prize. It has of course helped me in many ways and making new contacts. Of course I see lots of others winning this prize from India in the future. But the overall goal and focus of education and research should not be on prizes. One should strive continually to learn, do good work and make things better for the next generation.

GS: What kind of work in Number Theory is going on in India? What are the major contributions by Indians in this field?

SR: There are people working in Analytic Number theory, Algebraic number theory and transcendental Number theory. In addition, there are also people working in arithmetic geometry, a relatively modern and deep area. One of the big results in recent times was the solution of deep conjecture called `Serre's conjecture' by Chandrashekhar Khare, in collaboration with Jean-Pierre Wintenberger from France. There have also been major contributions from all the areas mentioned above.

GS: The recent announcement of celebrating 2012 as National Mathematics Year is indeed a welcome step. How do you think it will impact the present mathematics scenario in the country? What about Assam?

SR: While it is good in creating awareness, such events by themselves are not likely to make a difference, unless there is a plan, strategy and long term vision. You know, this is my first visit to Tezpur; I had visited IIT Guwahati earlier. I cannot tell you how pleased I am to be here, to see this beautiful campus, the country side, the hope and optimism…. The people have such a sense of pride in seeing these universities come up in Assam. We should not fail them, With the people from the northeast, we should try hard to improve the overall education and employment opportunities, as well as the infrastructure. The youngsters from this region have a key role to play in this, and I am very happy to see some of the young faculty from math deparments in IIT G and Tezpur rise up to the occasion.

GS: You are associated with many different activities including editing major international journals and also giving lectures around the world, how do you manage to keep up with your work regularly?

SR: It is difficult but not impossible. Again email and internet have to some extent simplified organizing events and structuring one's work. I have also been lucky with networking with like minded people so that delegating responsibilities and sharing the work makes things easier.

GS: Nowadays mathematics is a vast subject and knowing more than a few fields is next to impossible. Has this in any way hindered the knowledge development of the subject? How can someone wanting to become a professional mathematician select his branch?

SR: I don't think it has hindered the knowledge development… It has expanded; of course there will always be downsides to anything. We cannot devise perfect systems. As for youngsters selecting their branch, they should have an open mind, talk to others in the field and follow their passion and their hearts. I truly believe that if you are a researcher with an open mind and boundless curiosity, you can change areas of work over the years.

GS: In your opinion who are the most innovative mathematicians at the present age? What kind of work do they do?

SR: I don't want to comment on this. There are lots of interesting areas and mathematicians. I am not fully competent to pass judgments on such a vast subject and community!

GS: What mathematical magazines or journals are good for someone in an undergraduate programme in math?

SR: Unfortunately, we have almost none in India. But I think the American Math Monthly is good. The American mathematical society (www.ams.org) has a very rich website with lots of information. Their journals (Notices, Bulletin) are not very expensive. The United Kingdom too has a few good journals for teachers and undergraduates.

GS: There is a problem getting recent issues of journals and books by the students in this part of the country. Is it in any way hindrance to a career as a mathematician?

SR: Well, if internet connectivity improves, this should not be a hindrance. Also, today with more money available in education and the advances in technology, this should not be a serious problem. It is more a question of planning.

GS: What kind of advice would you give to the students of math? What do you think is the most essential quality for someone to become a mathematician?

SR: Work hard, follow your interests and heart and not the mob! Essential qualities: Rigour, Hard work, discipline.

GS: What kind of advice would you like to give to the young researchers from this region?

SR: Be proactive, try to network with others from within India and outside.

GS: In your spare time, what kind of hobbies do you have? Do you read poems, novels etc?

SR: I read poems, especially (translations of) Japanese poems from the 7th century onwards; I prefer non-fiction books, I knit, listen to music, I travel…

GS: If you weren't a mathematician, what else would you want to be?

SR: I would have loved to be a dancer, with an intellectual approach to dancing ….

GS: What is your opinion about Gonit Sora (www.gonitsora.com)? Any advice to improve our website?

SR: I am so pleased with this activity! It looks very good. I hope you team up with others doing similar work. Please get in touch with Professor Vijay Kumar Ambat from Cochin University; he too is interested in math education and has lots of useful information relevant for your website. The country needs youngsters with energy to start on such activities and build meaningful virtual communities. Also, please look up the innovation portal of the National Innovation Council. We need the education portal there to be active and I will ask someone from the innovation council to link up with you.

Gonit Sora thanks Prof. Sujatha for giving some of her valuable time to us.

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