

# An unusual journey towards Complex Systems

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Life is driven by struggle. Struggle is multi-facet and may lead to sometimes unimaginable destination which we never thought of it. Because future is generally unpredictable which has predictable and unpredictable forces on its own way. Hence, fortune is painted with these events along the journey of life and we are the books on which God has beautifully and perfectly written on it.

My journey of life was unusual and a complete struggle. I was born at a small village, now small town, Mayang Imphal Konchak. I was fourth child of my parents late R.K. Tombisana Singh and late R. K. Leibi Devi. I have two elder sisters, one elder brother and one younger sister. My eldest sister could not able to study due to my parent's financial condition and married early when I was a child. My elder brother, R. K. Sanajaoba Singh, did BSc as well as a diploma in Radio mechanics. My elder sister, late R. K. Premo Devi, struggled to study and could able to complete BA. My younger sister, R. K. Landhoni Devi, did till class XII.

I originated from a quite poor family. My struggle of life can be broadly divided into three parts, childhood (after become conscious who I am), life with my mother and life without my mother. My childhood was quite ordinary, full of excitement to play the whole day with my friends in my locality. Even though I had hardly two times food at home everyday I was quite happy in going to our Government LP (lower primary) school headed by our head Master Oja Nimaichand who dedicated his whole life in educating us all not only bookish knowledge but

also moral, ethics to be done at school as well as at home with family members. Our LP school was single room school which had three clusters of benches and desks which served for class I-II: (in our language we call it Ahanba, Anishuba and Mangasuba). Our teachers including head Master had their sitting chairs with the students. The roof of the school was covered with very strong steel Tata zinc which was quite old having large number of holes with different sizes. Our school have muddy walls which have big holes through which we generally play hide and seek during half-time of the school. Rainy season was the worse condition of our school because of the water flooded inside the school. We use to bring our plates from home to remove the water inside the school. If it is heavy rainfall, we generally have holidays. I, as a child, enjoyed those days and did not much care of hungry. Whenever I am declared top the class our Oja Nimaichand use to give me one exercise book with lined pages and I was so happy with the exercise book, kept it on the bed near my pillow, use to look at it by touching the pages and did not write anything on the pages except for very important things like class routine etc. When I was upgraded to class III, I have to change my school from LP school to another higher one till class V. During that time, I started sensing the meaning of hungry, the meaning of poor, and started sensing the everyday struggle of my parents for livelihood. Then slowly I started sitting with my parents and other family members and started participating in everyday struggle and discussion. I became emotionally sensed why my mother use to see our plates having little rice/bread before she ate and said in most of the dinners I had “Today I am not so hungry” and distributed her part to all we five brothers and sisters, and she slept drinking water with smiles of hidden sorrow showing she is not hungry at all. Initially, we were happy that we had more food and ate. In some other days, we ate our parts before she returned from bazar. However, she might have the same idea that we slept with half-empty stomach and left her part without eating much and slept with drinking water most of the time. Later, generally I use to hold her hand and one day we all said that we will not eat until she eats. She was really surprised emotional to hear that. She held all of us tightly (luckily I was the first one she held tightly to her) and probably she was unable to control herself and cried. Thus we learned from her that whatever little amount we have we should share equally and we did throughout our life.

When I shifted to Mayang Imphal higher secondary school (Now Ch. Tomchou higher secondary school) to study class VI-X, I was drastically transformed as a family boy. My mother was vegetable businesswoman who use to buy vegetables from the neighbouring villages (mainly from Wabagai) via bus and sold them at Mayang Imphal Bazar and the profit she used to earn was our everyday livelihood. Everyday, I use to go to Mayang Imphal bazar in the morning to receive my mother’s vegetables from the bus, carried all with my mother to the place where my mother use to sell them and then I use to go to the school. In the evening, I use to go to my mother to collect rice/Atta with vegetables for that night’s dinner and next morning’s food. This was my daily routine and my mother was everything to me. My mother use to say that she does not have anything to give to me but education. That was the starting point of my keen towards education. I tried every single work I can do to help my mother. Not only me but also my brothers and sisters did all possible works we can do. Every time examination results are out for each class, the bunch of blank papers, few exercise books, pens, pencils along with golden words of encouragement from our principal for topping the class grew my intimate friendship with variety of books. I still remember my mother’s glowing face when I narrate her the news of securing seventh position in all Manipur class VIII competition and our principal declared holiday of our school that day. For my mother, I became quite religious and kept fasting for every Thursday.

I did my class XI-XII from Johnstone higher secondary school and got the idea of research from my teachers in the school as well as from the Manipuri magazine “*Vigyan gi Waa*” and I became very fond of research even though I did not have the clear meaning of research. During those days, I use to buy books on Physics and Mathematics in MIR publication (Russian publication in English version) which are very cheap (generally one/two rupees maximum ten rupees in those times) and become addicted in trying to understand which are written in those difficult books. In those days getting admission to pursue MBBS was considered very popular but somehow I decided to choose academic research even though my local people, who are rich, promised me to fund money for the entire MBBS course. During my BSc (Physics) days at DM college of Science, my research interest grew quite strong and tried my best to clear the basic Physics (Mathematical Physics, Classical, Quantum, Thermodynamics, Electrodynamics etc) by myself as I could not afford for tuitions.

One biggest tragic in my life was when I lost my mother at the end of my BSc 2<sup>nd</sup> year. When I get conscious of loosing my mother, it seems like everything in my life has gone. I lost hope. My life became meaningless. Everything I thought to do became despair. I felt simply nothing was left. I stopped fasting every Thursday. I cried many times complaining to God for taking away my mother from me. I thought of taking away my own life at that time. At last, I decided to take care of my family for the rest of my life. Time was great heal and somehow start addicting in books. After completion of my BSc (Physics) with the encouragement of my family members, friends and well-wishers, I decided to follow the path which I decided to do and wanted to go outside Manipur for MSc but it was not possible as I did not have money for that. So I dropped one year to collect money by doing tuitions of my local students as well as my brother and elder sister also collected money by repairing radios and televisions and weaving clothes. Then I came to Delhi to pursue MSc at Jamia Millia Islamia and I had golden and helping friends during those days helping me in all aspects. I learned my friends are my extended family. During those two years I still remember how my brother (Sanajaoba) and sister (Premo) struggle to send money for my education in Delhi through letters exchanged between my brother and me. In those letters posted we did not hide anything and wrote straight from our hearts. Every people in our locality told me that in the wee hours of midnight the only sound they heard was my sister’s (Premo) weaving sound. In those MSc days, I got to learn Physics from excellent Professors. I managed books from our library. In those days, we four friends shared a room. After every month’s contribution for rent fee and food, only little money was left which was quite difficult to manage each month. So I generally avoid any occasions, festivals, movies etc but my friends knew it and always supportive. My close friends at that time use to joke me that they were still surprised and could not believe how patient I was to complete MSc with my family condition. Finally, I secured gold medal in MSc (Physics).

My first area of research interest was Quantum measurement theory, Bell’s inequality etc during my MSc time. I started collecting xerox copies of the papers published in this area from my university library from the little amount of money I had for every month. After completion of MSc, I pursued Ph.D. in Theoretical Condensed Matter Physics at Jawaharlal Nehru University which was the turning point of my career. My Ph.D. supervisor, late Prof. Deepak Kumar was one of the best researcher and educator at that time. My around four and half years with him was my clear foundation of Physics and Mathematics for my future research work. After submission of my Ph.D., before Ph.D. defense, I got postdoctoral fellowship from Prof. Michael Schrieber, Chemnitz University of Technology, Germany. When I received the offer letter, I was very happy but I did not have the expenses of my journey. At that time, I was staying with my longtime friend, Shri Moirangthem Shubhakanta Singh, to whom I explained about my problem. At that time, he was working in SSPL as a JRF and the Director was very

close to him. He discussed it with the Director of SSPL, H.P. Vyas. Next day we went together and when I explained about the financial problem, he immediately encouraged me to go there and he help me without thinking twice. I was quite lucky. Then I went to Germany and worked under Prof. Michael Schreiber along the area I did during my Ph.D. and got great exposure in computational Physics.

After coming back from Germany, I worked under Prof. R. Ramaswamy in the area of Systems Biology which is completely different area of research and opened up a door to get job and understanding complex dynamics of biological systems and their collective behaviour. At that time, I was quite worried of getting job but because of the new area of research area i.e. Systems Biology which I shifted was quite emerging area of research having good job opportunity. I was a little selfish to shift in this area as I have to get job to take care of my family. Then, I got job as Assistant Professor at Centre for Interdisciplinary Research in Basic Sciences, Jamia Millia Islamia in the year 2007 and worked till 2013. I came back at School of Computational and Integrative Sciences, Jawaharlal Nehru University in 2013 and working here since then. I am now Professor of Physics at this mentioned school.

Another blow on my life was the simultaneous lost my father and sister Premo. The blow was so strong and last many years which I could not able to come out. That was the same situation happened to me again as was happened when I lost mother. I thought of even taking my own life for the second time. But time is a great heal. It took time long time but could able to came out of the mental trauma.

Switching and search for area of research interest could be possible if one has strong foundation in the subject area, keen interest, and hard working. It was not difficult for me to change in the area of complex systems as I had keen interest in this area and inclined to the Physics and Mathematics as my foundation towards this research area of complex systems. This area of complex systems is quite promising and vibrant area of research which aims to study emergent properties of systems consisting of large number of interacting components, their organization, pattern formation, system's dynamics at far from equilibrium and many other characters and aspects of the systems. This area covers science, social sciences, economics etc.

After I had worked in the area of complex systems, I went to University of Sydney for one month to extend and notion of this field. There complex systems techniques were used in different areas specially in agriculture and drug designing and they were quite successful. Then, I went to the University of California, Santa Barbara for one year to work under Prof. Linda Petzold who was close collaborator of Prof DT Gillespie. There I worked on the application of stochastic dynamics in the area of ecology. It was quite interesting to work there and could able to explore various computational techniques in this area.

My early life's heroes were Einstein and Feynman. Einstein's theory of relativity and Feynman's teaching style were source of my inspiration at that time. Still I am big fan of Feynman's path integral formalism and his way of looking at natural phenomena and interpretation. He introduced me Dirac through his writings of research papers and his famous principle of least action. One fine day, I was so lucky to get Dirac's book "Principles of Quantum mechanics" at Sunday second hand books market at Darya Ganj, Delhi at only Rs 5. I thought how stupid that person was who has given away that book to the Sunday market's second book seller. But I was fortunate to have that book because of that person's stupidity because at that time the book was out of print and could not get anywhere. Later years I was greatly influenced by JS Bell, Kolmogorov, Feller, Kac and Nash and their quantum,

probability, and game theories. I am currently working along this direction. Now, I strongly believe the idea of theory of everything by late Prof. Stephen Hawking and hope to work along this direction some day.

I am now working on the Mathematical Physics and computational foundation of complex systems to understand their complex dynamics, emergent properties, emergent patterns, their organization, beautiful order structures coming out of disorder, nonlinear dynamics, the roles of fluctuations, stochastic thermodynamics bounds, quantum thermodynamics etc.

My journey of life was not so easy, smooth, and straightforward but full of unimaginable struggles of life. But if one is determined, dedicated, hardworking and believes in God, one can overcome these difficulties. I strongly believe in God. Whatever I am today, is because of my family, friends, well-wishers of my life and by the grace of God.