J L Sehgal: the Pedologist I met

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Prologue

I deeply appreciate the honour the Indian Society of Soil Survey and Land Use Planning (ISSLUP) has done me for delivering the J.L Sehgal memorial lecture. Hearty Congratulations to the Society for conducting the National Seminar. Welcome to all the participants.

I met Dr. J L Sehgal in the year 1986 after he took the office of the Director, NBSS&LUP, ICAR. In fact, he wanted to meet me and I didn't know the reasons. I had to wait for about 4 hours to meet him in person. I'll talk about this meeting later.

You may be aware that Pedology is the grammar of soil science (Bhattacharyya 2014). It is understanding soil for its basics which influence utilities of soils for agricultural and non-agricultural activities. Pedology studies soils as pedons. It involves special skills and techniques. A few of these are taught in our courses. And the most important aspect of Pedology *that is* soil survey and mapping are not regularly taught in the UG and PG programmes in most of the state agricultural universities (SAUs) and the deemed universities (DUs). Dr Sehgal as a pedologist and a university teacher was aware about this. I have divided my talk into three parts. These are Pre-Sehgal era, Sehgal regime and Post Sehgal regime. I will be brief most except Sehgal regime.

A. Pre Sehgal era (Pre 1986)

Previously (since 1976) rapid reconnaissance (RR) survey was the practice. Later it became progressive reconnaissance (PR) survey. In fact, I was associated with PR since 1984 when I joined this institute. In those days, for PR, 1:50000 scale survey used to be conducted. It used to progress at a snail's pace. There were requirements of reporting a fixed number of soil series to the ICAR. Things were little slow. And the institute was still following the legacy of earlier work culture during this era (Bhattacharyya 2021a, b).

B. Sehgal regime (1986 to 1996)

Dr Sehgal understood the situation prevailing before 1986 after meeting the scientists in this institute. He realized that most of them do not know the art of soil survey, soil classification following the US soil taxonomy, cartography, and mapping the soils in time-bound manner as professionals. He understood the need of training his own scientists,

informing them about the latest in US soil taxonomy and linking it to mapping (scale of mapping). He realized using the remotely sensed data for developing the first layer of base maps quickly for field work.

B1. J. L. Sehgal and soil taxonomy

Dr. Sehgal had a strong foundation of soil genesis linked with US soil taxonomy. His Belgium training helped him in this regard. And I guess it helped him to convert it into practicality so far as natural resource mapping is concerned. I understand many people engaged in soil mapping realize the difference between mapping and soil mapping (Bhattacharyya 2021a). Dr. Sehgal knew it. And he was extremely knowledgeable about scale of mapping *vis-a-vis* category of soil taxonomy. And that's how (and maybe that's why) he never tried to use other soil classification systems into his National project since US soil taxonomy was officially accepted.

Dr Sehgal had a god knowledge about Alfisols (Sehgal and Stoops, 1972). Personally speaking, I am not a great fan of US taxonomy. However when people talk about Alfisols I find myself in a stable landscape where rate of infiltration surpasses that of surface run off. Dr. Sehgal knew about the provenance of clay illuviation. Identifying illuvial (Bt) horizons in field and confirming it through microscopic studies was also his well-acquired skill.

So you may appreciate that when Dr. Sehgal was busy in soil mapping and correcting boundaries of different polygons, his field and laboratory experiences were his strength. Dr. Sehgal was not well connected with Indian Vertisols. However, he picked up working knowledge of these black soils from various experts stationed in Nagpur.

B2. J. L. Sehgal: Soil mapping.

Sehgal took the charge of this institute with the mandate of developing soil map of India. For those who are not aware of the backgrounds of soil mapping project, I may mention here that ICAR was supposed to prepare soil map of India through NBSSLUP. The institute requisitioned for nearly 100 S1 scientists in ARS (agricultural research service) Cadre at that point of time. Those who joined ARS may remember that in those days ASRB (agricultural scientist recruitment board) used to show similar quantum of vacancies in soil science discipline. I am a 1982 ARS batch when there were 91 vacancies of S1 scientists in soil science. And, as a matter of fact, all these posts were meant for NBSSLUP. These S1s were supposed to lead soil survey parties. I was one of them to contribute to this huge National Project of Dr. Sehgal.

Interestingly, when Dr. Sehgal jumped into this project he realized that only NBSSLUP cannot complete this job. India is a large country. Moreover, time, manpower and funding were

extremely important. Dr. Sehgal realized that cooperation of all the state governments is extremely important to complete the job in time. And that's how he started meeting the chief of all the states and UTs. He also met the Directors of Agriculture and other senior officers in the line departments. All the regional centres of NBSSLUP were made responsible for linking with the state departments.

It was a huge job. Mindboggling. It required training of state soil survey officers. NBSSLUP and its centres' role was important. Dr Sehgal was aware of the necessity of soil survey related literatures for *how and why soil survey documents* as pamphlets, research articles, books and bulletins.

Project of this magnitude required funds. Dr. Sehgal was engaged in resource generation. Providing technical backstops with the publications to convince state and central (ICAR) administration; regular liaisons with the chief secretaries either directly or through ICAR were his agenda. Dr Sehgal was everywhere. He was a single man army.

B4. J. L. Sehgal: in the field for soil survey

Dr. Sehgal was extremely particular about field work. And never compromised with soil survey and its ignorance. He modernised the proforma for filling up the profile card and its contents. I had a few occasions to work with him in the field. He was extremely dedicated and sincere during profile examination. I learnt a few of his techniques in the field. Dr. Sehgal was very particular about base map finalization in the field itself and not in office using remote sensing data. He was in favour of using Remote Sensing data for developing base maps. But he was more particular about the usefulness of topo sheets and details shown there in topo maps to fine-tune the maps.

B5. J. L. Sehgal: the teacher of pedology and the Capacity Builder

Dr. Sehgal brought UNDP assisted Land Resource management Under Graduate programs with Dr. PDKV, Akola, Maharashtra. And the courses were specially evolved to fill the gaps of soil science courses in almost all the universities. The purpose was to prepare a host of land resource managers necessary for communicating NBSSLUP success stories to others. We now find that his initiatives are relevant in the current scenario of achieving land degradation neutrality. This is necessary for quantifying pedodiversity and linking it to biodiversity. This could have armed the planners of our country to have a battery of experts to quantify soil endemism, soil rarity, and soil uniqueness and finally to plan appropriate land use options. This land resource management (LRM) course is now discontinued!

As a capacity builder Dr. Sehgal sent almost all the scientists in the NBSSLUP to both Europe and the USA. It was difficult to send scientists abroad to learn more about land use,

planning for land use options, soil grouping, land evaluation, geomorphology and a few other soil/land survey related subjects. I personally feel that this was a rare feat achieved by any Directors in any ICAR and other research organizations. Dr. Sehgal had that kind of vision to see the utility of imparting foreign training to his own colleagues. He had a strong wish that these people after receiving advanced training in up countries shall contribute hugely for soil resource mapping and research. He was a rare Director of NBSSLUP, I know, to act as a capacity builder to that magnitude.

B6. Sehgal and agro ecology

Agro ecology was earlier conceptualized in NBSSLUP. Sehgal elaborated it and gave it a shape and brought it to the National level. I learnt that he made several copies of the map and text and distributed to the representatives of government of India through ICAR. The purpose was to communicate that NBSSLUP generated AESR (agro-ecological sub-regions) map is more scientific unlike Planning Commission's ACZ (agro-climatic zones) which was based on physiography and climate (Sehgal et al, 1992).

Dr. Sehgal knew very well that the soil map needs to be used ultimately for crop planning and planning for other agricultural aspects. He talked about utility of soil maps and thought about AER [*agro-ecological regions: climate, LGP, landform and soils: for resource planning at national level; soil great groups (1:7 scale*)], AESR [*agro-ecological sub-regions: for resource planning at regional level; soil subgroups (1:1 million)*], AEZ (*agro-ecological zones; for resource planning at state level soil family*) AEU (*agro-ecological units; for resource planning at district and watershed levels; soil series and phases; 1: 50000 to 5000 scale*) as a wheel for technology transfer at different levels of management. He prepared the draft manuscript for AESR bulletin which was finalized later (Sehgal, 1992, 1996).

Dr. Sehgal was aware about the difference in mapping and soil mapping. He could understand the utility of US soil taxonomy and its categories and its link with scale of mapping. This was the reason why he could sharpen the concepts of AER (soil subgroup), AESRs (soil families), AEZ, and AEU concepts (Bhattacharjee et al, 1982; Sehgal et al, 1987, 1992) using soil information collected at that scale of mapping.

This is worthwhile to mention here that AESR map, Dr. Sehgal prepared, was not very meaty so far as soil information is concerned due to lack of information at that point of time. Much later we brought soil information, climate and many other soil related parameters through pedo transfer functions into it. In fact we revisited AESR concepts to revise total AESRs in the Indo-Gangetic Plains (IGP) (from 12 to 29) and black soil region (BSR) (from 18 to 54). The

remaining areas were kept as such (34 nos.). As a result of this effort the number of AESRs in India may be revised as 117 now (Mandal et al., 2014; Bhattacharyya 2021 a, b).

B7. Sehgal and soil and land degradation

Dr. Sehgal pioneered soil/land degradation assessment following GLASSOD technique and later the modified version. He wanted to bring all the information of states/UTs as a separate chapter in soil resource mapping report. Soil conservation assessing soil erosion following appropriate models was his important agenda. Fortunately I contributed little in Dr. Sehgal's dream project. This helped me later to sharpen the soil conservation/erosion vis-à-vis crop productivity model (Bhattacharyya 2021a).

B8. Sehgal and International collaboration

I joined NBSSLUP in 1984. Dr Sehgal took the office in 1986. Besides NBSSLUP link with ICRISAT Patancheru, I don't think this institute had any other foreign collaborations. It was Dr Sehgal who brought NBSSLUP in the international map. The experts who visited and helped to build rapport with this institute are who's who of soil and land information authorities. We had Dr Sys, Prof. Rene Tavernier, Dr Peter Bullock Dr Mermut, Hari Eshwaran and many others. He also organized International seminars and workshops. His Belgium education and the contacts with International experts helped him and he made full use of his acquaintances to bring NBSSLUP to a greater height.

I remember after Dr. Travernier finished his invited lecture Dr. Sehgal introduced a few of us with him. We had a long discussion with the Dr. Travernier. Remember delegates, it's not easy to talk to one of the founders of US soil taxonomy. You need a lot of preparations and courage to ask questions and the gaps of taxonomy so far as tropical soils are concerned. It was only for Dr Sehgal we got that opportunity.

Dr Mermut (from Canada) visited our laboratory in Nagpur. Dr. Sehgal was accompanying him. I wanted to talk separately with him to clarify a few points on Vertisols. Dr Sehgal granted. I remember my long discussion with Dr Mermut in SRS division. Although I didn't accept some of his concepts about Indian Vertisols but I expressed my gratitude to Dr Sehgal for that. The fact of the matter is he was regular about the latest happenings of soil taxonomy. And as soon he realized that these young people are conversant with the latest, he saw to it that they can discuss with senior experts with international fame.

B9. My concept of Interdisciplinary research and J L Sehgal

If you remember that I saved the discussion transpired between me and Dr. Sehgal in 1986. I promised to explain it. In fact I wrote about it as a part a Souvenir article for our

Interdisciplinary Society for Advancement of Agricultural Technology (ISASaT) Society's inaugural meeting at Dapoli, Maharashtra.

It was a peak summer in Nagpur, Maharashtra. I was summoned by my Director of NBSSLUP through the Head of Regional Centre where I was working. It was 1986. I just reached the headquarters at Nagpur from my strenuous 3 months' long soil survey tour from the Western Ghats. It was my third official survey tour and I was bubbling with enthusiasm to share my field experiences with senior colleagues. My earlier such efforts to share field experiences drew a flak! And naturally when I got a letter from the Director of my Institute, I was elated.

For a S1 scientist it was not that easy at that point of time to meet a Director. I learnt that my Director was a pedologist with specialization in mineralogy, soil survey, mapping and soil taxonomy. I reached his office at 11 am and was ushered in his office at 1.45 noon. It was lunch time. I was extremely hungry and was also angry due to this delay. However, I presented myself in front of him and found him busy with many papers. After preliminary exchange of pleasantries, Dr Sehgal enquired about the area of survey I conducted. Immediately both my anger and hunger disappeared. I started discussing about my experiences about the area I surveyed, soils I studied, samples collected and things like that. There were success stories and lapses in the field. He caught the lapses and started asking me about the difficulties in the field. Dear delegates, at that point time I did not have any idea about the intention of Dr. Sehgal. I had a knowledge about many colleagues in the Institute who were working in laboratories and other places. Most of them were reluctant to go to the field for regular soil survey. Much later I learnt that many of my colleagues informed Dr. Sehgal about the drudgery of field work since soil survey was a troublesome profession which keeps people away from their families for nearly 6 months in a year. Lack of sanitations, accommodations, food, and bad roads in the remote village were real problems.

I did not know about these things that my Director had a first impression of strong repulsion of scientists about field work. So naturally when he asked about problems, I said that soil survey is difficult. Other than village environment with limited urban facilities, soil survey is truly difficult from a professional point of view. He did not expect it from me and wanted an explanation in greater detail. I said, sir, when I was standing in front of the Western Ghats in Pune district, Maharashtra on top of a plateau /butte/mesa, I found myself extremely insignificant in front of this vast nature. I was doubtful about my ability to map this landscape painted with different types of soils! When I found stones, cobbles, rocks and failed to identify them, I missed the company of a geologist! I saw many plants and trees in the Western Ghats

which are not at all related to agriculture and are not a part of curriculum of agriculture I studied. I also realized my basic botany knowledge is too meagre in the field. I did also feel the absence of a geomorphologist, an agronomist and many other experts including remote sensing! Dr Sehgal was spell-bound and said, do you really mean it? I replied, sir, as a soil scientist with my limited knowledge I find myself extremely helpless to comprehend the vastness of Nature. This is a genuine problem since soil survey involves contribution of many experts from other branches of science. It is an interdisciplinary research; could be multi-disciplinary and at a certain point of time trans-disciplinary. Dr. Sehgal listened carefully and promised that other experts will be provided from the next tour. It did not happen; but that is a different story altogether. The fact of the matter is that was my first meeting with a pedologist to express that soil survey is not the job of soil scientists alone. It helped me at the later part of my career.

C. Post Sehgal era (after 1996)

Dr Sehgal could not complete a few of his many dream projects. These are related to completing SRM reports, completing a (summary), b (executive summary), and c (database) series reports of each state. He wanted a complete database of Bench mark soils identified during the SRM. We completed a few although. Till 2014 total number of series was more than300.

To quantify pedodiversity of Indian soils I have reached at the last phase of my research. It is in this connection I may mention a few points. For the USA, dear colleagues, ~10000 uncorrelated soil series were reported. For India ~1800 soil families were reported. Judging by the relation between the number of soil family and soil series, roughly 3500-5000 soil series may exist in India. This job may seek priority to finalise quantification of pedo-diversity linked with biodiversity and land degradation neutrality (LDN) (Bhattacharyya 2021a, b).

Soil mineralogy map(s) of India was one of Dr. Sehgal's pet project. I tried with a few states and published it (Bhattacharyya 2021a, b). There is scope for improvement of the mineralogy map of India. This also requires attention. Completing the printing of Soil Map of India happened after 1996: I was one of the many contributors. The map is a National Asset and contains many answers to the questions the next generations might put. Such gigantic work led by Dr. Sehgal demands respect and retrospection to reschedule future soil research and education (Bhattacharyya 2022a).

Soil survey units in many parts of the world are in disarray. In India also, many state soil survey units are not performing well. Besides, with the advent of new technologies soil survey and mapping activities are reorganized and reoriented. New techniques are good and welcome.

But it should not be utilized blindly. These are only tools and should not be imbibed at the cost of truthfulness and national interest.

Our team of scientists in the entire NBSS&LUP initiated several projects to address National and International issues post 1996. Dr. Sehgal would have been extremely happy to see our achievements which include land degradation neutrality (LDN), climate change and global warming, predictive modeling, establishing Pedology- Edaphology link and many contemporary issues detailed in the citations. We are following the path of Dr Sehgal in right spirit.

We are asking questions to develop Soil information system (SIS) into Soil information technology (SIT) which might lead us to develop Soil Google, Crop Google, and Rural Google. It can be made available as priced information and may be self-sustaining to meet institute research expenses. To develop and store it how much space should we require in our hard wares? Shall we save it in cloud? Which organisation will do it? Indian Council of Agricultural Research (ICAR), National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), state agricultural universities (SAUs)? Who will be the experts? Can it go in the framework of NBSS&LUP policy as Vision 2075? Shall we do it? Now? Should our information be all digital? Only digital? Without soil data? We might ask us that without soil information, soil map will look like a *person without soul*. No short cut. The departed soul of Dr. Sehgal will be happy if we put our feet on the ground and not in space. Dr. Sehgal wanted information to reach the farmers. Scaling up our SIS or SIT through Information & Communication Technology (ICT) using students are part of what we have been addressing now (Bhattacharyya et al 2022a,b ; Bhattacharyya 2022a,b). Dr. Sehgal was close to students due to his long association with the SAUs. We are now linking issues of New Agricultural Education Policy (NAEP) with future of soil research using Information and Communication Technology (ICT) (Bhattacharyya 2022a, b) following the footsteps of Dr J.L. Sehgal.

Epilogue

My association with Dr. Sehgal taught me very many things. It helped me in fixing and revising *do's and don'ts* in my future career. Through this invited lecture, I tried to mention the complete pedologist I met in the form Dr. J L Sehgal. There could be many other important achievements of this great scientist. I wish others will pen those issues in future.

Dear professionals, following focused attention, your principles, and ethics to serve science may not always put you in comfortable situations. Dr Sehgal faced it. To achieve the institute mandates, on many occasions, dear professionals, you will be misjudged, your name will be misspelled, mispronounced; you may be ridiculed, and neglected. At a certain point of

time, dear delegates, you will be incomprehensible to your near and dear ones, you may be deprived of your just.

This is the real award of a true and dedicated professional. And after pursuing your work to do good for all, you may find yourself alone. And in one such evening, looking at the setting sun in pensive mood, you find yourself completely lonely.

Dear delegates, please do not worry. At such a point of time in your career you may take the advice of Rabindranath Tagore, the great poet and philosopher and saint. And just follow what he said. *"When no one responds to your call, go your own way alone……..."*

God bless you all, all the time.

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About Dr. J. L. Sehgal

The lecture was instituted in 2007 in the memory of late J.L. Sehgal, the pedologist par excellence and the founder Vice-President of the Society. He was born in Jalandhar on 7th September 1937. Dr. Sehgal had more than 37 years of experience in Soil Science with special reference to Pedology. For his contribution to soil survey in Iraq, he was honoured by the President, Govt. of Iraq during 1978-79.

As the Director of National Bureau of Soil Survey & Land Use Planning, Nagpur (January 1986 to January 1996), his major contributions were publication of Soil Resource Map of all the states of India on 1:500,000/1:50,000 scale, Agro-ecological zoning and assessing Land Degradation Status. Among many honours he received, his election as Vice-president, Commission-V at the World Soil Science Congress held at Acapulco, Mexico is worth a special mention. He breathed his last on 11th April 2006 in Ludhiana, Punjab.

About the Speaker

Tapas Bhattacharyya, Ph.D. is a Principal Scientist & Head of the Division (Former) (ICAR, India), Visiting Scientist (formerly), ICRISAT Development Center, ICRISAT, Patancheru, Telangana, India and Vice-Chancellor (former) of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth (DBSKKV), Dapoli, Maharashtra, India (www.dbskk.org). He has been carrying out basic and fundamental research in terms of soils and their utility for now and posterity. He has worked for various national and international projects with special reference to soil carbon sequestration and soil carbon modelling to address the issues of global warming and climate change related to soil resource survey, mapping and planning. Dr. Bhattacharyya had worked closely with Dr J L Sehgal in soil resource mapping and tribal welfare project funded by the World Bank. Dr Bhattacharyya is now busy in academics and writing. He stays in Nagpur, Maharashtra.