METHODOLOGICAL MOORINGS IN AGRICULTURAL GEOGRAPHY*

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Esteemed Delegates

I stand before you in all humility to unfold the layers of remembrances of a scholar, a personal friend, a fellow teacher, and a practitioner in the field of Agricultural Geography. The tragedy of delivering a memorial lecture is that more you open the memory strata, more emotions pour in to make you nostalgic. I will try to arrange the memorial lecture in following sections.

A Biographical Note

Prof. Jasbir Singh (March 15, 1932 - June 19, 2020) was born at his maternal-ancestral canal settlement near Montgomery, at present in Pakistan. His elders lived at Barnala Kalan Satian village near Nawanshahr from where they migrated to Chanalon village near Kurali in Ropar district in Punjab and thereafter finally settled at Mundebar Jampur village near Jagadhri in Haryana. During his childhood he stayed for long with his maternal relatives as well, hence, he studied at various places. He completed his schooling from Khalsa High School Montgomery. He completed graduation and post-graduation from Government College, Ludhiana under the tutorship of Dr A.N. Kapoor and O. P. Bharadwaj. Dr Jasbir Singh joined Government Mahindra College, Patiala as a lecturer of geography in June 1955. He went to United Kingdom to receive his Ph.D. degree in 1967 from the University of Edinburg under the supervision of the renowned agricultural geographer, Professor J.T. Coppock. Dr Singh joined the Department of Geography, Kurukshetra University, Kurukshetra as a Reader and Head in 1968. Taking into account his research and standing in the field of agricultural geography, he was selected as professor of geography in 1975. He served the department for 24 years and superannuated in 1992. In 1994 recognising his contribution in research and postgraduate teaching in geography the university honoured him with the designation Professor Emeritus.

Prof. Jasbir Singh was a committed teacher and researcher. His keen interest in research is reflected by the number of research projects carried out by him under the sponsorship of ICSSR and UGC. As an outcome of these projects he published various books i.e., Agricultural Geography of Haryana; The Green Revolution in India: How Green It is?; Agricultural Development in South Asia; An Agricultural Atlas of India: A Geographical Analysis; Agricultural Geography; Determinants of Agricultural Productivity: A Sample Study of Operational Holding for Land Use Planning; Dynamics of Agricultural Change; Agro-environmental Units and Agricultural Land Use Planning: Indian Perspective; and Geo-monitoring of Biophysical Environment and Area Development: Haryana A Case Study. He also published several research papers in

the national and international journals of repute such as Geographia Polonica and Asian Profile. Prof. Jasbir Singh supervised seven Ph.D. research scholars and five of them served the Department of Geography, Kurukshetra University, Kurukshetra. During his academic career, Prof. Singh visited several countries like United Kingdom, France, Italy, Switzerland, USA, Australia, China, Bangladesh and Sri Lanka to present his research work.

Apart from his notable achievements in academics Prof. Jasbir Singh was a practicing agricultural geographer as he established Dr. Shamsher Singh Farm at his native village in Haryana. After his superannuation he mostly stayed at Patiala in Punjab but frequently visited his village and agricultural farm. His children were settled in USA and wanted the parents to be with them but he never wanted to leave the motherland. However, his deteriorating health convinced him and his wife to join their children at Fresno, California in USA where he breathed his last on June 19, 2020.

I met Prof. Jasbir Singh for the first time in Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi in 1977. Our common academic interest in the field of agricultural geography was the source of our bonding. Prof. Jasbir Singh was not only senior to me in the professional experience but also older by about a decade. Another commonality that we had agricultural and rural background. I was also born in a village in Sultanpur district of Uttar Pradesh and had my early schooling there. Later on, I shifted to different towns for higher education and teaching. We had the agricultural land in the village but I became only a casual visitor there during vacations.

We met off and on in different places on different occasions for academic meetings,

seminars and discourses. My longest stay with Prof. Jasbir Singh was with regards to a UGC assignment in Pune which lasted for a week. We had very prolonged academic and philosophical discussions which often lasted till the dinner time. He was very deeply influenced and attached to Prof. Mohammad Shafi (1st August 1924- 9th December 2007) of Aligarh Muslim University, Aligarh the senior most agricultural geographer of India and a Ph.D. student of Sir L. Dudley Stamp (9th March 1898- 8th August 1966) of London School of Economics. Prof. Stamp was a veteran geographer who conducted land utilization survey of Britain during 1936-44. As an outcome of this survey, Stamp (1948) published the book entitled, "The Land of Britain: Its Use and Misuse". He was a versatile professor who supervised the Ph.D. thesis of Dr. Mohammad Shafi on agricultural geography and that of Dr. R.L. Singh of Banaras Hindu University, Varanasi on urban geography. Study of land use, for British geographers, was more important for industrial growth and urban expansion rather than for agricultural production. Prof. Jasbir Singh was himself trained under the guidance of a UK professor John Terence Coppock (1968) at Edinburgh University, who published the article "The Geography of Agriculture".

Prof. Jasbir Singh expressed his emotions about Prof. Mohammad Shafi in obituary, as, "Whatever one may become, one always remains indebted to affectionate guide, advisor, and teacher. So, GURU ji was to me. He showed the paths and roads which reach final destination and provide joys and energy which infused revitalization in me" (compiled by Prof. Abha Lakshmi Singh). It showed his devotion to the scholarship of Prof. Mohammad Shafi and accepted him as his

GURU and was always in touch with him. Unlike many of the agricultural geographers, including me, he was a practicing agricultural geographer who not merely taught and studied the subject but also supervised his farm in Yamunanagar district.

Historical Background of Land Measurements

Agricultural geography is an empirical discipline and Prof. Jasbir Singh has made a significant contribution in advancement of its research and studies in India. Historically, agriculture has been a very important source of revenue for the rulers throughout the world. In India, land was managed by different rulers through different practices from Mauryan to Gupta periods. The scientific unit for measurement of land was developed by Raja Todarmal who was first employed by Sher Shah Suri and later joined the Darbar of Emperor Akbar as one of his Navaratna. He evolved the system of land settlement and fixing land revenue to be paid by the peasants. It was started during the reign of Sher Shah Suri who ruled India from 17th May 1540 to 22nd May 1545 (only 5 years) when Humayun, who succeeded Babur but had to escape. Sher Shah Suri entrusted the responsibility of measuring the land and fixing the land revenue to Raja Todarmal.

The historical events went in favour of Humayun who could capture some parts of his lost kingdom in 1555 and ruled only for a year i.e., till 27th January 1556. Akbar succeeded Humayun after his death in 1556. He was guided by Bairam Khan for four years but in 1560 he took over the full authority of his empire and started its consolidation. Akbar adopted the land classification done by Raja Todarmal when he was under the service of Sher Shah Suri. Akbar felt the need of develop-

ing standard measurement for land in order to charge the land revenue in a scientific and judicious manner. Todarmal developed the method of measuring land and its standard unit was termed by him as bigha. The area of bigha was 60X60 yards i.e., 3600 square yards. The yard, according to Ain-e-Akbari was known as 'gaze Illahi', measuring 41 angul (digits) or 33 inches in length. It means that gaze Illahi was shorter by three inches compared to British yard. The revenue was fixed on the basis of the average crop production of last 10 years. This rule of fixing the revenue was known as Aine-dah sala (Qureshi, 2016).

The Britishers introduced a new unit of land measurement. They used Gunter's chain measuring 66 feet (22 yards) and having 10 links and used it for measuring a new unit of land called acre. An area of one chain by one chain (484 square yards) makes one-tenth of an acre. Multiply it by 10 and it becomes an area of one acre i.e., 4840 square yards.

Table 1 shows the land measurement units used in different states of northwest India during recent past. Presently, the land measurement unit used across the states is hectare (ha). The older linear and areal units of measurement (yards, bighas and acres) are no more in use officially with the introduction of metric system. However, the conversion formula is available where one ha equals to 10,000 sq. metres or 2.47 acres or 11959.9 sq. yards.

Land Record Sources and Agricultural Data in Post-independence Period

After the independence of the country, constitutional provision was made for the development of agriculture and animal husbandry Directive Principles of the State Policy under article 48. It reads, "The state shall endeavour to organise agriculture and

Table 1

India: Land Measurement Units Used in some States in north India before Independence

Units	States	Conversion
Bigha-Pucca	Bihar and parts of Uttar Pradesh, Punjab, and Haryana	3025 sq. yard
Bigha	Parts of Himachal Pradesh and Uttarakhand	968 sq. yard
Bigha-Kachha (It's one-third of pucca Bigha)	Some parts of Punjab, Haryana and Uttar Pradesh	1008.33 sq. yard
Biswa-Pucca	Upper parts of Uttar Pradesh, Punjab, Haryana	151.25 sq. yard
Biswa	Some parts of Himachal Pradesh and Uttarakhand	48.4 sq. yard
Biswa (Kacha) (1/20 of Bigha Kaccha)	Lower parts of Punjab, Haryana and Uttar Pradesh.	50.417 sq. yard
Biswansi	Uttar Pradesh, Punjab, Haryana, Himachal Pradesh and Uttarakhand	1 Biswa has 20 Biswansis
Killa (Acre)	Parts of Haryana and Punjab	4840 sq. yard (Acre is also known as killa)
Ghumaon (Acre)	Some parts of Himachal Pradesh, Haryana and Punjab	4840 sq. yard
1 Kanal	Haryana, Punjab, Himachal Pradesh and Jammu and Kashmir	5445 sq. ft. One acre equals 8 and one kanal equals 20 marlaskanal

Source: Compiled by Author

animal husbandry on modern and scientific lines and shall, in particular, take steps for preserving and improving the breeds and prohibiting the slaughter of cows and calves and other milch and draught animals".

The agriculture and animal husbandry were kept in the concurrent list wherein both Central and State governments could make policies for its development. The main problem of this sector was to bring in land reforms. "Land to the tiller" was a popular slogan during freedom movement. The idea of 'land to the tiller' had to be translated on the ground by introducing and implementing land reforms and make legal provisions to achieve the objective. Hence, a number of reforms were introduced, namely (i) abolition of Zamindari system, (ii) introducing the land ceiling, (iii) consolidation of fragmented land holdings, (iv) tenurial reforms, and (v) abolition of forced labour (begaar).

The agricultural data is generated by the revenue department under the control of the Collector of the district (Deputy Commissioner in Punjab and Haryana). There is a hierarchic system whereby at the village level there is an official known as Patwari in north Indian states except Uttar Pradesh where it is known as Lekhpal. This designation in Uttar Pradesh was created by (Late) Choudhary Charan Singh when he was the Minister of Agriculture of Uttar Pradesh. There was strike by the Patwari cadre and the whole cadre was abolished by the ministry and in its place a new cadre of Lekhpal

Table 2

Doi: Critical Values to Determine Combinations (An Abridged Version of Deviation Analysis Table)

	Rank of Element												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	Critical Value												
Cumulative percentage of higher-ranking elements													
95	-	-	-	-	-	-	-	-	-	6.98	6.27	5.68
90	-	-	-	-	-	-	8.84	7.60	6.67	5.94	5.35	4.49
85	-	-	-	12.93	10.00	8.17	6.91	5.99	5.29	4.73	4.29	3.91
80	-	-	13.83	10.00	7.85	6.46	5.49	4.78	4.23	3.79	3.33	3.14
75	-	16.67	10.57	7.75	6.13	5.06	4.32	3.76	3.33	2.99	2.71	2.49
70	27.64	12.25	7.93	5.96	4.65	3.85	3.29	2.87	2.55	2.29	2.08	1.90
65	18.38	8.66	5.63	4.19	3.14	2.77	2.37	2.07	1.84	1.65	1.50	1.37
60	11.27	5.46	3.59	2.68	2.14	1.78	1.52	1.33	1.18	1.06	0.97	0.88
55	5.38	2.68	1.73	1.29	1.04	0.86	0.74	0.64	0.57	0.52	0.47	0.43
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Doi, 1957

was created. The Patwari keeps the land records at village level and maintains two registers namely (a) Khasra Girdawari (containing names of the owners, area and land use of each plot according to their serial numbers as contained in the shijra (village map) drawn on a sheet of cloth); and (b) Jamabandi in Haryana and Punjab and Khatauni in Uttar Pradesh. It contains the information about the land ownership.

Methods of Agricultural Regionalization

The agricultural geographers have done numerous empirical exercises to represent agricultural data and depict its spatial distribution, concentration, specialization and regionalization. Weaver (1954) published his paper to statistically determine the crop combination regions based on the least deviation method. He calculated the area under all the crops covering up to 1 per cent of the gross cropped area in a spatial unit and arranged them in descending order. He decided the theoretical base curve as 100 per cent for monoculture, whereas for two crop region it

was 50-50 per cent, three crop regions 33.3-33.3-33.3 per cent, four crop region, 25-25-25-25 per cent etc. He calculated the deviations of actual acreage under a particular crop from the above theoretical base curve. The negative values became positive due to the squaring for obtaining standard deviation (Singh and Dhillon, 1983).

Doi (1957) developed a critical table based on modification of Weaver's method to assess the "Industrial Structure of Japanese Prefectures". An abridged one-sheet (Table 2) that makes easier to compute crop combination has been used by various scholars to demarcate agricultural regions. Rafiullah (1965) modified Weaver's crop combination method and applied "maximum positive deviation" for the purpose of classification of towns. Besides, crop and enterprise regions have also been studied such as rice region, regions of pulses, oilseeds or sugarcane regions. Regions of plantation agriculture have been studied with particular reference of tea, and coffee and rubber etc. There have been exercises to delineate areas of dryland

farming, shifting cultivation (e.g., Jhuming), and terraced agriculture.

Measurement of Agricultural Efficiency

The measurement of agricultural efficiency has been a matter of intense debate in agricultural geography till 1980s. A number of scholars have come out with various measures of agricultural productivity and efficiency. Prof. Jasbir Singh in the co-authored book (Singh and Dhillon, 1984) deliberated on this issue in details. Bhatia (1967) has identified following four measures which could be used to assess the agricultural efficiency: (i) output per unit of cropped area, (ii) output per unit of labour employed, (iii) output in relation to inputs, and (iv) output expressed in terms of grain equivalence per head of population. He based his calculations on output per unit of cropped area which means it kept into account productivity consider-ations.

Animal husbandry is very important activity adopted by agriculturists in different parts of the country on different scales. But this sector remained a neglected segment in agricultural geography. The supervisor of Prof. Jasbir Singh published a study based on crop and livestock combination (Coppock, 1964) but not many such studies have appeared in geography. Like crops the equivalence of different domesticated animals was also a challenge for agricultural geographers. A method of assessing standard livestock units has been devised by Kamadi (2021) to assess the pressure of animals on land. He converted the livestock animals into standard Livestock Units (LU) on the basis of the body weight of the animals. This technique was used to assess the pressure of livestock on land and also requirement of feed. He used the following norms of conversion (i) 1 dairy cow of 400-500 kg body weight = 1.0 L.U., (ii) 1 bull, steer, heifer of >2 years of age = 0.8 L.U., (iii) 1 bull, calf or heifer of <2 years age = 0.5 L.U., (iv) 6 sheep or goats = 1.0 L.U., (v) 3 pigs = 1.0 L.U., and (v) 200 chickens = 1.0 L.U. In India buffalo is an important dairy animal with higher body weight as compared to cows. The norm can be worked out for Indian animals as our cows are of lower body weight as compared to European dairy cows.

India generates a vast data base through Livestock Census at an interval of 5 years. There are some studies that have modified the LU standardisation method according to Indian conditions. There is a need that more scholars come forward to take up such studies which would help understanding the pressure of animal population on the land as well planning the fodder and feed requirements for maintain-ing good health and increase output of milk and other animal products.

The present generation of geographers is equipped with more powerful tools of mapping and spatial analysis. The maps prepared on GIS platform provide more clear pictures and phenomena. These robust tools of geospatial technology may be used by the young generation of agricultural geographers in measurements of agricultural lands, their regionalization, computing and spatial analysis of agricultural and livestock efficiency.

I pay my sincere tribute to the memory of (late) Prof. Jasbir Singh and humbly acknowledge his valuable contribution in agricultural geography in India.

up for the memorial lecture.

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