Groundwater Depletion Effects on Punjab Agriculture

著者（英）	Daizo Sugimoto
journal or publication title	Senri Ethnological Studies
volume	96
page range	35-46
year	2017-12-15
URL	http://doi.org/10.15021/00008671

SENRI ETHNOLOGICAL STUDIES 96: 35–46 ©2017
Structural Transformation in Globalizing South Asia
Edited by Minoru Mio, Koichi Fujita, Kazuo Tomozawa and Toshie Awaya

Groundwater Depletion Effects on Punjab Agriculture

Daizo Sugimoto
Meijo University

1. Introduction

Punjab, an important Indian production center of wheat and paddy rice, has suffered severe groundwater depletion during the past fifteen years. Many farmers have abandoned the centrifugal pumps they introduced during the Green Revolution, instead sinking longer bores equipped with a submersible pump to achieve a greater lifting height.

The major reason for the state's groundwater depletion is probably the expansion of paddy production. From the 1970s, most Punjab farmers came to follow the crop rotation of wheat in the winter and paddy in the summer, as yields increased through introducing modern technologies and the government paid attractive procurement prices for these crops. Paddy cultivation, whose large-scale introduction in the 1970s was the first in the Punjab region's history, requires a staggering amount of water compared to wheat, a staple crop that has been grown in the region for thousands of years. The expansion of paddy production has imposed considerable pressure on groundwater resources: to respond to the higher water requirements of paddies, Punjab farmers have sunk numerous tube wells serviced by diesel engine- or electric motor-driven centrifugal pumps. The heavily subsidized retail electricity prices have also adversely affected groundwater resources. Today, the sustainability of Punjab agriculture is endangered.

The state's groundwater resources have already been well documented in the literature. However, the effects of groundwater depletion on farmers' farm management choices and on rural economies have not been sufficiently discussed due to a lack of micro-level evidence. Sarkar (2011) and Kaur and Vatta (2015) are among the few studies examining micro-level data obtained through village surveys. Sarkar (2011), who surveyed three villages in Punjab's Amritsar district, describes the plight of small-scale and marginal farmers who lacked the resources to sink new tube wells and, consequently, became dependent on water sellers to irrigate their fields. As the study also reveals, these farmers were finally "compelled to sell out their land at distressed prices" in the "land-labour-water locked relationship" created by water scarcity (Sarkar 2011: 64). Kaur and Vatta (2015) collected data from more than one hundred farmers across nine central Punjab villages. Exploring responses to the water table's decline by farmers of different size holdings, the authors report that small-scale and marginal farmers were late to invest in new tube wells as they lacked resources. These farmers tended to reduce the area under paddy cultivation, presumably due to the higher water requirements. While Sarkar (2011) noticed polarization in the village societies as a result of groundwater depletion, Kaur and Vatta (2015) do not mention such a development. Such differences in views on the effects of water scarcity underscore the importance of accumulating micro-level evidence.

Based on data collected in two village surveys during 2011–2012, this study examines central Punjab's groundwater depletion process and the responses of the region's farmers, according to farm holding size and the total income derived from farming, non-agricultural occupations, remittances, etc. The paper is organized into four sections. The next section outlines the two investigated villages and examines the sample households in terms of agricultural production, occupational structures, and incomes. The third section analyzes the process of shifting from centrifugal pumps to submersible pumps during the 2000s, including the amounts and sources of the required investments, and the characteristics of farmers dependent on buying water for irrigation. The final section is devoted to concluding remarks.

Table 1 Area under various crops and cropping intensities

(acres)

		GB	LNG	GB	LNG
Summer Crops	Total	133.6	284.3	47%	51%
	Paddy (Basmati)	45.4	79.0	16%	14%
	Paddy (Non-Basmati)	69.7	179.9	25%	32%
	Summer Fodders	18.2	24.5	6%	4%
	Other Summer Crops	0.3	1.0	0%	0%
Winter Crops	Total	133.1	271.9	47%	49%
	Wheat	115.5	249.7	41%	45%
	Winter Fodders	14.2	20.6	5%	4%
	Other Winter Crops	3.5	1.6	1%	0%
Sugarcane		16.0	—	6%	—
Gross Cropped Area (A)		282.8	556.2	100%	100%
Net Area Sown (B)		148.5	283.1		
Cropping Intensity (A/B)		190%	196%		

Note: Gaggar Bhana = GB; Langrian = LNG
Source: Village Survey

2. Sample Household Characteristics

Two villages were investigated for this study: Gaggar Bhana village, Amritsar district, and Langrian village, Sangrur district. Water for irrigating all sown areas is sourced from tube wells and/or the Upper Bari Doab Canal (UBDC) in Gaggar Bhana and only from tube wells in Langrian. Both village have been adversely affected by the water table's severe decline. However, the water table is higher in Gaggar Bhana than in Langrian, possibly due to water leakage from the UBDC, which reached the village at the end of the nineteenth century (Singh and King 1928).

Around one hundred diverse households were surveyed in each village, representing various occupations and scales of land holdings. However, to specifically examine the issue of irrigation, this study mainly examined households cultivating the land they own using their own tube wells. In total, 30 households were examined in Gaggar Bhana and 32 in Langrian.[1)] Selection of the sample households aimed to reflect the distribution of land ownership in each village.

Table 2 Workers in the sample households by size class of land owned

Vill.	Size Class of Land Owned (acre)	No. of Households	No. of Family Members	No. of Workers	Percentage Share of Workers			No. of Households with Remittance
					Total Workers	Cultivators	Non-Agricultural Workers	
GB	Less than 1	1	4	1	100%	100%	–	–
	1—2	8	36	11	100%	64%	36%	–
	2—4	9	43	15	100%	80%	20%	2
	4—6	4	28	11	100%	82%	18%	–
	6—8	6	38	12	100%	83%	17%	2
	More than 8	2	10	4	100%	100%	–	1
	Total	30	159	54	100%	80%	20%	5
LNG	Less than 1	1	6	1	100%	–	100%	–
	1—2	2	8	4	100%	75%	25%	1
	2—4	3	17	5	100%	100%	–	–
	4—6	9	50	15	100%	67%	33%	1
	6—8	10	60	19	100%	68%	32%	–
	More than 8	7	50	21	100%	76%	24%	2
	Total	32	191	65	100%	72%	28%	4

Note: Gaggar Bhana = GB; Langrian = LNG
Source: Village survey

The cropping patterns in both villages were found to be fairly typical of Punjab agriculture since the Green Revolution. Table 1 shows that the dominant crops were wheat and paddy rice, which accounted for about 80% of the total cropped area in each village. Cropping intensity exceeded 190% due to the highly developed irrigation facilities.

Table 2 presents the occupational structure of the sample households. First, it reveals that farming was their primary occupation. Second, however, many members were engaged in non-agricultural occupations, even in farming households: 20% of Gaggar Bhana's workers and 28% of Langrian's were engaged in non-agricultural occupations. In Gaggar Bhana, households owning smaller plots tended to have a greater number of family members in non-agricultural occupations. However, such relation was not readily apparent in Langrian, where the members of households with larger holdings tended to be well-educated: a considerable share of them secured steady, well-paid jobs, such as primary school teacher.[2)] Third, remittances sent by family members working outside the villages significantly augmented household incomes: five of the 30 sample households in Gaggar Bhana and four of the 32 in Langrian were found to be receiving remittances (Table 2).

Table 3 Annual incomes per household from different sources

Vill.	Size Class of Area Owned (acre)	Average Annual Incomes (Rs.)						Percentage Share of Annual Incomes					
		Agriculture	Non Ag. Occupations	Pension	Remittance	Others	Total	Agriculture	Non Ag. Occupations	Pension	Remittance	Other	Total
GB	Less than 1	11,880	–	–	–	–	11,880	100%	–	–	–	–	100%
	1—2	85,638	46,250	9,750	–	–	141,638	60%	33%	7%	–	–	100%
	2—4	191,135	10,667	12,000	27,778	200	241,580	79%	4%	5%	11%	0%	100%
	4—6	266,496	50,000	–	–	–	316,496	84%	16%	–	–	–	100%
	6—8	333,921	7,000	–	51,000	–	391,921	85%	2%	–	13%	–	100%
	More than 8	200,265	–	–	275,000	210,000	685,265	29%	–	–	40%	31%	100%
	Total	196,241	23,600	6,200	36,867	14,060	276,908	71%	9%	2%	13%	5%	100%
LNG	Less than 1	72,740	42,000	84,000	–	1,700	198,740	37%	21%	42%	–	1%	100%
	1—2	82,861	–	90,000	150,000	15,750	322,861	26%	–	28%	46%	5%	100%
	2—4	167,252	–	–	–	433	167,252	100%	–	–	–	0%	100%
	4—6	290,109	36,000	22,667	33,333	6,944	382,109	76%	9%	6%	9%	2%	100%
	6—8	340,454	69,000	12,000	–	31,085	443,154	77%	16%	3%	–	7%	100%
	More than 8	772,671	93,643	–	65,143	13,471	931,456	83%	10%	–	7%	1%	100%
	Total	380,138	53,484	18,375	33,000	15,692	491,779	77%	11%	4%	7%	3%	100%

Note: Gaggar Bhana = GB; Langrian = LNG. “Agriculture” includes cultivation and milk production
Source: Village survey

Table 3 presents the average annual income of the sample households by the size class of land ownership and by source, including agricultural production, non-agricultural occupations, pensions, and remittance.[3)] First, it confirms that the wheat-paddy rotation was quite profitable in Punjab. The average annual income derived from agricultural production was approximately 2 lakh rupees in Gaggar Bhana and 3.8 lakh rupees in Langrian, the latter’s higher income reflecting the larger size of its holdings.

Second, income sources other than agriculture are observed to play an important role, even in farming households. In both villages, non-agricultural jobs accounted for a considerable income share in households owning smaller plots. In addition, Langrian households belonging to the large size classes of land ownership reported a considerable amount of income from non-agricultural jobs, reflecting the higher education of some of their members.

Third, remittances can become large if a household manages to send one or more members to foreign countries, although this entails considerable risk for the members working abroad. It is not uncommon to find they are imposed working and living conditions different from what was shown in the contacts they made in advance (Rajan, Varghese, and Jayakumar 2010: 271). The highest remittance amount witnessed in the sample households was 5.5 lakh rupees, received by a household in the largest size class of land ownership in Gaggar Bhana.

Fourth, there is a wide disparity in annual incomes among farming households, despite income source diversification. Annual income tended to increase concomitantly with land holding size, as agricultural income was largely determined by the size of the cultivated area. The wealthiest group in each village earned incomes several times higher than those of the poorer groups. Against the background of unequal income distribution among farmers, they are expected to exhibit different responses to the groundwater depletion. This will be examined in the next section.

3. Groundwater Depletion and Investment in Irrigation

A centrifugal pump cannot lift groundwater when the water table has declined below a certain depth. Generally, in the north-western part of India, the maximum height to which water can be lifted using a centrifugal pump is 40 feet. This is based on the standard pump set used by farmers in the area, equipped with a discharge pipe of 3–6 inch diameter and a low-speed electric motor or diesel engine of 1,440 rpm.[4] Faced with such a fall in the groundwater level, a farmer will deepen the bore and position the pump at a deeper location to draw water. However, many Punjab farmers eventually abandoned these old bores after repeatedly implementing bore-deepening operations because of the burden of the cost and the harmful gases often accumulated in the underground pit where the centrifugal pumps were positioned. In their place, they sank new bores, each furnished with a submersible pump with a high-speed electric motor of 2,880 rpm. The pumping length of a submersible pump is practically unlimited.

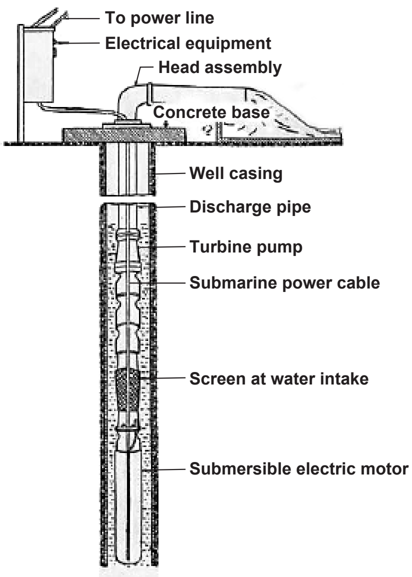

Figure 1 Structure of a tube-well with a submersible pump
Source: (Michael and Ojha 1999: 257)

Figure 1 presents the tube well structure with a submersible pump. The pump is positioned at the top of the discharge pipe, placed inside the well casing, which is inserted into a bore to form the outer wall of the tube well. The discharge pipe length is adjusted according to the water table depth. The discharge pipe can be extended if the water table falls further, provided it does not drop below the depth of the bore. Farmers sink bores much deeper than the current level of the water table, anticipating further declines expected to occur in the near future. It is also noteworthy that a submersible pump must be driven by an electric motor, whereas a centrifugal pump can be driven by either an electric motor or a diesel engine. When their electricity fails due to cut off by the supplier or power outage, farmers can only source irrigation water using an electric generator.

At the time of the survey (2011–2012), 18 of 30 households in Gaggar Bhana and 31 of 32 in Langrian were using a submersible pump for irrigation. Thus, the shift to submersible pumps was almost complete in Langrian, but not in Gaggar Bhana, where the ratio of households with a submersible pump was 60%. It must be recognized that there are regional variations in the decline of groundwater.

Table 4 Depth of water table and length of discharge pipes and bores

Table 4-1 Number of households by depth of water table

	40 ft	45 ft	60 ft	65 ft	Total
GB	10	8	-	-	18
LNG	-	-	9	22	31

Table 4-2 Number of households by length of discharge pipes

	60 ft	65 ft	70 ft	90 ft	95 ft	Total
GB	6	10	2	-	-	18
LNG	-	-	-	24	7	31

Table 4-3 Number of households by length of bores

	150 ft	160 ft	170 ft	175 ft	180 ft	185 ft	190 ft	200 ft	Total
GB	1	3	-	2	8	-	1	3	18
LNG	-	-	1	-	4	1	8	17	31

Note: Gaggar Bhana = GB; Langrian = LNG
Source: Village survey

Regional differences in groundwater depletion are more clearly apparent in Tables 4-1 to 4-3, which present the numbers of households using submersible pumps by the water table depth, discharge pipe length, and bore length. All households with submersible pumps in Gaggar Bhana reported a water table depth of 40-45 feet (Table 4-1). All households in the village used 60–70-foot delivery pipes (Table 4-2). Furthermore, 14 households had bores of 175–200 feet in length. A bore of 175 feet enables a household to extend the delivery pipe to about 150 feet should the water table fall further. It should be noted that the water table may decline further in Gaggar Bhana, leaving many more farmers with no choice but to shift to submersible pumps. In Langrian, the water table was lower than in Gaggar Bhana by approximately 20 feet; consequently, the delivery pipes and bores were, respectively, 30 and 20 feet longer. These figures clearly illustrate that groundwater depletion is more severe in Langrian than Gaggar Bhana.

Table 5 Extent of cultivation of various crops by irrigation well pump type in Gaggar Bhana

		HHs with SP	HHs with CP
Total Households		100	100
Summer Crops	Basmati Rice	56	33
	Non-Basmati Rice	89	75
	Summer Fodders	100	83
	Other Summer Crops	–	8
Winter Crops	Wheat	100	100
	Winter Fodder	100	75
	Other Winter Crops	11	17
Other Crops		39	8

Note: Gaggar Bhana = GB; Submersible Pump = SP; Centrifugal Pump = CP. “Other crops” is sugarcane in most cases.
Source: Village survey

When the water table approaches a depth of 40 feet in an area such as Gaggar Bhana, one would expect some farmers to start using submersible pumps while others continue to use centrifugal pumps. In fact, the ratio of Gaggar Bhana households with submersible pumps was 60%. It is interesting to observe the benefits derived from a deeper tube well with a submersible pump. According to Table 5, all farmers grew wheat, irrespective of the tube well type, but the percentage of farmers growing paddy rice and sugarcane tends to be higher among farmers using submersible pumps. Farmers with centrifugal pumps seemingly struggle to produce crops requiring large amounts of water, such as paddy and sugarcane. Further decline in the water table will compel them to invest in irrigation, if they intend to continue wheat–paddy crop rotation.

Faced with severe lowering of the water table, a farmer with sufficient financial resources will introduce a deeper tube well with submersible pump as soon as possible, given the considerable potential benefits of doing so. Table 6 presents the number of households that have installed a submersible pump by the size class of land ownership and the year of installation. In Langrian, it is notable that most households introduced submersible pumps during 2004–2005, and that small-scale farmers owning fewer than 4 acres tended lag behind in well investment. In Gaggar Bhana, the transition to submersible pumps generally occurred several years later than in Langrian; it also progressed slowly and had not been completed at the time of the survey. These differences possibly reflect regional variation in the fall of the water table.

Table 7 reports the relation between the size class of land ownership and investment

Table 6 Distribution of submersible pump installations by number and installation year

	Size Class of Land Owned (acre)	Year of Installation of Submersible Pumps									
		2001	2004	2005	2006	2007	2008	2009	2010	NR	Total
GB	Less than 1										
	1—2	1					1		2		4
	2—4					2	2	3	1		8
	4—6					1			1		2
	6—8							2	1		3
	More than 8						1				1
	Total	1				3	4	5	5		18
LNG	Less than 1			1							1
	1—2			1							1
	2—4			3							3
	4—6		6	2		1					9
	6—8		5	4	1						10
	More than 8		4	2						1	7
	Total		15	13	1	1				1	31

Note: Gaggar Bhana = GB; Langrian = LNG
Source: Village survey

Table 7 Distribution of each pump type by size class of area owned

	Size Class of Land Owned (acre)	Number of Households:		Percentage	
		with SP	with CP	with SP	with CP
GB	Less than 1	–	1	–	100
	1—2	4	4	50	50
	2—4	8	1	89	11
	4—6	2	2	50	50
	6—8	4	2	67	33
	More than 8	–	2	–	100
	Total	18	12	60	40
LNG	Less than 1	1	–	100	–
	1—2	1	1	50	50
	2—4	3	–	100	–
	4—6	9	–	100	–
	6—8	10	–	100	–
	More than 8	7	–	100	–
	Total	31	1	97	3

Note: Gaggar Bhana = GB; Langrian = LNG; Submersible Pump = SP; Centrifugal Pump = CP
Source: Village survey

in irrigation. The percentage of smaller-scale farmers with submersible pumps is as high as that of large-scale farmers in Gaggar Bhana. Inadequate resources in small farmers do not seem to have hindered the investment. The share of Langrian households with submersible pumps is 100% in most size classes of land ownership, including smaller-scale farmers. Therefore, at least some small-scale farmers have managed to fund sinking a deeper bore and installing a submersible pump. However, smaller-scale farmers unable to do so might find other ways to procure water for irrigation or, ultimately, quit farming.

Table 8 Distribution of households by amount of investment in submersible pumps and investment source

	Source of Investment	Less than Rs. 20,000	~ Rs. 40,000	~ Rs. 70,000	~ Rs. 100,000	More than Rs. 100,000	NR.	Total
GB	Own Savings	1	2					3
	Own Savings + Bank	2						2
	Own Savings + Bank + ML					1		1
	Own Savings + ML	1	1	2	4			8
	ML						1	1
	NR.		1		1	1		3
	Total	4	4	2	5	2	1	18
LNG	Own Savings				5			5
	Own Savings + Bank				4			4
	Own Savings + Bank + ML				2			2
	Own Savings + ML			3	10	1		14
	Own Savings + Relatives			1	4			5
	NR.				1			1
	Total			4	26	1		31

Note: Money Lender = ML
Source: Village survey

The total cost of installing a new tube well with submersible pump is reported to be around 0.4–1.8 lakh rupees,[5)] including the cost of boring, submersible pump purchase, and pipe and pump installation. Table 8 shows the distribution of households by the total investment amount and its sources. The total cost varied from below 10,000 rupees to 1 lakh rupees in Gaggar Bhana, and from 70,000 rupees to above 2 lakh rupees in Langrian. The total cost was averaged 47,941 rupees in Gaggar Bhana and 78,548 rupees in Langrian, although it varied according to the water table depth, volume of works needed for boring operations, and the size and power of the submersible pump. It is apparently difficult for farmers to cover the entire cost with their savings. According to Table 8, only five of 18 households in Gaggar Bhana and 5 of 31 in Langrian spent only their own savings on the installation. Most farmers supplemented their savings with borrowing from banks and money lenders. Notably, more than half of the households depended at least partly on money lenders to fund new tube wells.

That installation requires household savings to be supplemented by outside borrowing, especially from money lenders, suggests that the investment is a considerable burden for farmers. Nevertheless, on close scrutiny of individual-level data, the investment is apparently tolerable for Punjab farmers, except those with small-scale or marginal holdings. As a percentage of total estimated income, the cost of investment was found to average 17% in Gaggar Bhana and 26% in Langrian. For more than 80% of the households investing in a new tube well, its cost was below 30% of total income. These results suggest that irrigation investment is expensive but tolerable for most farmers, especially those owning larger holdings. Incomes derived from the various sources described in the previous section also mitigated the investment burden.

Nonetheless, it must be recognized that the investment might be beyond the means of small-scale and marginal farmers. For example, one Langrian household owning two acres of land invested 2.5 lakh rupees in irrigation: almost 200% of the household's total annual income. It seems likely that, aside from this sample household, a considerable number of the small-scale and marginal farmers chose not to invest and, instead, sought other ways to access irrigation water, or even ceased farming altogether.

Another means to obtain groundwater is to buy it from other farmers. Few studies have elucidated the development of a water market in Punjab. However, Sarkar (2011) observes that small-scale and marginal farmers unable to invest in irrigation have begun to purchase water. Our investigation also revealed that several farmers were purchasing water, although not on the scale described in Sarkar's (2011) study. Only three farmers in Gaggar Bhana and one in Langrian were found to be buying water from other households for irrigation; all were marginal farmers owning less than one acre of land, and their major income sources were non-agricultural occupations or remittances. The magnitude of the water market in the two studied villages is tiny; certainly insufficient to cause the polarization of village societies described by Sakar (2011). However, it is quite natural for small-scale and marginal farmers to choose to buy water instead of investing huge resources in irrigation, considering the size of their farming operations.

4. Conclusion

For farmers to continue the wheat-paddy rotation in Langrian, afflicted by a severe fall in the water table, sinking a new tube well equipped with a submersible pump is a crucially important measure. Even in Gaggar Bhana, which has a higher water table than Langrian, introducing a submersible pump is necessary to maintain the current cropping pattern.

This study's results also suggest that farmers owning larger holdings are in a better position to invest in irrigation. Langrian's large-scale farmers were observed to be somewhat quicker in introducing submersible pumps than small-scale farmers. The investment required for installation was so large that most farmers could not afford it with only own savings; they, therefore, relied heavily on money lenders. But the implication of the potential burden of investment is differ among the farmers. The investment cost was apparently tolerable for medium- and large-scale farmers, even if they had to borrow a considerable sum from money lenders. This investment enabled them to continue wheat-paddy rotation, an activity rendered quite lucrative by central and state government agricultural policies. In contrast, small-scale or marginal farmers would have to shoulder a heavy burden by investing in irrigation. Purchasing water from a tube well owner is among the possible alternatives for these farmers. The survey identified several marginal farmers buying water for irrigation. Farmers' water-purchasing was not on a scale likely to transform social structures in either studied village. However, the study's results indicate that groundwater depletion is likely to eventually affect not only agricultural production but also social structures.

This study rather ambiguously assessed the amount of investment in irrigation as tolerable for medium- and large-scale farmers, in the sense that the investments were small compared to total household income. A more sophisticated means of evaluating the investment is to compare its profitability with the interest rates prevailing in the local village. Research of this type would enable us to examine the efficiency of irrigation investment, as well as the sustainability of farm management. Such research could not be conducted here due, principally, to a lack of data. Examination of these issues is, therefore, a task for future research.

Notes

1) This study examines households cultivating only land they own and those cultivating leased-in land in addition to their own land. Households leasing-out all the land they own and those leasing-in all the land they cultivate are excluded from the analyses.
2) See Sugimoto (2014) for details.
3) See Sugimoto (2014) for details.
4) Based on the author's interview of a pump manufacturing company's officer in Haryana on August 25, 2015.
5) The investment amount is 0.4 to 1.7 lakh rupees according to Kaur and Vatta (2015) and 1.8 lakh rupees according to Sarkar (2011).

References

Kaur, Satvir and Kamal Vatta

2015 Groundwater Depletion in Central Punjab: Pattern, Access and Adaptations. *Current Science* 108(4): 485–490.

Michael, A. M. and T. P. Ojha

1999 *Principles of Agricultural Engineering*, 3rd ed. Vol. 2. New Delhi: Jain Brothers.

Rajan, S. Irudaya, V. J. Varghese, and M. S. Jayakumar

2010 Looking beyond the Emigration Act 1983: Revisiting the Recruitment Practices in India. In S. Irudaya Rajan (ed.) *Governance and Labour Migration: India Migration Report 2010*, pp. 251–287. New Delhi: Routledge.

Sarkar, Anindita

2011 Socio-economic Implications of Depleting Groundwater Resources in Punjab: A Comparative Analysis of Different Irrigation Systems. *Economic and Political Weekly*

46(7): 59–66.

Singh, S. Gian and C.M. King

1928 *An Economic Survey of Gaggar Bhana, A Village in the Amritsar District of the Punjab*. Punjab: Board of Economic Inquiry.

Sugimoto, Daizo

2014 Impact of Non-Farm Employment on Landholding Structures in Punjab: Comparison of Three Villages. In Shuji Uchikawa (ed.) *Industrial Clusters, Migrant Workers, and Labour Markets in India*, pp. 120–148. Basingstoke: Palgrave Macmillan.