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Economic Evaluation of Investments in Micro Irrigation Structures in Kandi Area of Punjab

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Abstract

Three types of micro irrigation structures, namely small dams (SD), lift irrigation structures (LIS) and Makowal type structures (MTS) were constructed by the Department of Soil and Water Conservation, Govt. of Punjab, Hoshiarpur division in the Kandi area of Punjab depending upon the availability of water at site, during the period 1990-91 to 1996-97. The impact evaluation has shown that the cultivated area has increased by 9.5 per cent, 3.2 per cent and 9.8 per cent and irrigated area by 600 per cent, 1038 per cent, and 253 per cent for SD (from 1991-92 to 2003-04), LIS (from 1993-94 to 2003-04) and MTS (from 1994-95 to 2003-04), respectively in the selected villages of these structures. The income of irrigated hectare has been found higher at Rs 14478 than un-irrigated hectare. Discounted cash flow technique has revealed that the financial internal rate of returns are as high as 20.56 per cent, 38.54 per cent and 27.95 per cent for SD, LIS and MTS, respectively, which are highly satisfactory and encourage more public investments on such type of irrigation structures to enhance the income of Kandi farmers.

Introduction

The sub-mountainous area situated immediately below the Shiwalik hills in the state of Punjab, known as the Kandi Tract, covers an area of about 4600 sq. km, i.e., 9 per cent of the geographical area of the Punjab state. Known for being backward amidst prosperous agrarian state of Punjab, the Kandi belt faces the hex of degraded soil, water and other natural resources. There are 21 major and 120 minor watersheds in the area, which is networked by a large number of rivulets carrying fast currents of rain water along with the sediments of the upper reaches and soils of the lower catchments and depositing all this on the plain culturable lands. The area is classically labelled as 'An Island of Poverty amidst an Ocean of Development'. The rainfall is seasonal; and the mean annual rainfall is 900 mm, of which 80 per cent is received from late-June to mid-September. However, the rainfall is erratic and results in frequent failures of crops (Singh *at el*., 2002). The underground water is deep and difficult to lift up for irrigation and domestic uses. The farm holdings are small, input-use is at low level and thus the land and livestock productivities are lower. Recognizing the sparse development of Kandi area, the state government initiated two ambitious development projects, Kandi Watershed and Area Development Project (KWADP) during the period 1979-80 to 1987-88 and Integrated Watershed Development Project (Hills) [IWDP (Hills)] during 1990-98, financed by the World Bank. Under these projects, irrigation was the major component for the development of this area and the construction of micro irrigation structures was one of the aspects of irrigation component. The importance of irrigation in the development process of agriculture has been clearly brought out by micro as well as macro level studies in India (Gadgil, 1948; Dhawan, 1988; Rath and Mitra, 1989; Vaidyanathan *et al*., 1994).

The inspiration and experiments carried out under the KWADP and IWDP (Hills) projects, made the Punjab government to realize the need to cover those

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areas that remained uncovered during implementation of these projects. The Department of Soil and Water Conservation constructed three types of micro irrigation structures namely, small dams, lift irrigation structures and the Makowal type structures, depending upon the availability of water at site. After completion, these structures were entrusted to local farmers through constituting water management/water users committees of farmers of the village for independent use and distribution of water; collection of water charges and repair and maintenance of these structures.

This developmental activity involved huge investment of public funds as it aimed at improving the productivity of the existing cultivated lands as well as saving and using that land which was facing water erosion. It thus necessitated the estimation of costs and benefits associated with this public investment as well as explore the impact of project on the beneficiary households' income. The specific objectives of the study were:

- To work out the costs and benefits of investment on minor irrigation structures, and
- To study the impact of micro irrigation structures on land-use pattern, productivity level and income of beneficiary households.

Methodology

The study is based on both secondary and primary data. The secondary data were collected from the Department of Soil and Water Conservation of Punjab, Hoshiarpur Division. The department had provided a list of twenty-five structures constructed by it during the period 1990-90 to1996-97. These structures consisted of eight small dams, four lift irrigation structures and thirteen Makowal type structures and for the present study, three structures one from each type; small dam, lift irrigation and Makowal type structures located in the villages Dalewal, Sandhwal and Koi, respectively were selected randomly for detailed information.

A list of beneficiary farm households along with their area under cultivation and area under irrigation during the study period was collected from the village level 'Water Users' Management Committees' and other village key informants of the selected villages. The beneficiary households in each selected village were divided into different farm-size groups, viz. less than 1 ha, 1.01 - 2 ha, 2.0 - 4 ha and above 4 ha. A total of 35 households were selected from each identified village, making a sample of 105 holdings. To make the sample representative, the number of selected holdings was in proportion to their number in each farm-size category. Later, 4 holdings from the village Dalewal having small dam structure (3 from 1.01- 2 ha and 1 from 2.01- 4 ha farm-size groups) were dropped because of inaccurate/incomplete information. Thus, the final sample consisted of 101 beneficiary households, 31 from small dam and 35 each from lift irrigation structure and Makowal type structures.

The primary data on fixed farm assets, land-use pattern, cropping-pattern, input use and productivity level for the irrigated as well as un-irrigated lands were obtained from the sample beneficiary farms for the year 2004-05. The data were collected with the help of specifically designed and pre-tested questionnaires. For the purpose of cost-benefit analysis, benefit-cost ratio, net present worth and the financial internal rate of return were estimated.

Results and Discussion

Structure Description

Small Dams (SD): These dams were constructed at the site where there was maximum flow of rain water, resulting in the creation of reservoirs and then supplying irrigation water to the fields for supplementary irrigation by constructing *pucca* water channels.

Lift Irrigation Structures (LIS): These structures were constructed by developing the so-called *baulies*, where water seeps naturally through the earth. In these structures, *pucca* wells were constructed and electric motors were installed to lift the water and provide irrigation through underground pipelines.

Makowal Type Structures (MTS)*: These structures are the modernized shape of ancestrally so-called *kuhls*. The water naturally seeping from foothills, is channelized through establishing main and sub-branches of underground pipelines and thus, supplying water for irrigation. In some cases, this water is stored in tanks and then supplied to fields, while in other cases, the water is supplied directly to the fields.

* The name of the structure is given after the name of a village, Makowal in which this type of structure was made by villagers themselves in 1950s.

Investments, Achievements and Water Charges of Micro Irrigation Structures

These structures were constructed by the Department of Soil and Water Conservation, Govt. of Punjab during the period 1990-91 to 1996-97. The maximum number of these structures was constructed during the year 1995-96. The investments made by the Department on micro irrigation structure were calculated per structure and per hectare of the catchment command area (CCA) of these structures at current and constant prices (1995-96 prices) and have been incorporated in Table 1. It reveals that the overall investment per structure was Rs 18.46 lakh at current prices and 22.19 lakh at 1995-96 prices. Structure-wise investment indicated that the construction cost per structure was the highest for the SD (Rs 19.45 lakh), followed by MTS (Rs 18.74) and LIS (15.61 lakh).

The average investment per hectare of command area varied between Rs 10,000/ha and Rs 24,000 /ha; overall it worked out to be Rs 13,000/ ha. The variability in investment per structure/per hectare of command area depends on many factors, such as size of structure, command area, length of underground pipes, etc. The per hectare investment on the micro irrigation structures declined with the increase in the command area in each type of structure, higher the command area, lower was the per hectare investment.

The performance of irrigation structures was worked out as the percentage of area irrigated by the structure to the command area of each structure. The average area irrigated by these structures during the previous three-year period (2001-02 to 2003-04) was taken while working out the performance of the structures. As reported in Table 1, the overall 56 per cent of the structures irrigated 50-75 per cent of the target area, followed by 36 per cent structures which irrigated less than 50 per cent of the area. Eight per cent structures irrigated 75-100 per cent of the target area. Across different structures, most of the SDs (62%) irrigated less than 50 per cent of the CCA and maximum of both LIS (75%) and MTS (62%) irrigated 50-75 per cent of CCA. About 15 per cent of MTS irrigated 75-100 per cent of the target area also.

It was observed that 5 structures out of 25 were not functioning and these consisted of 3 SDs and 2 MTS. The Management Committee was consisted of minimum 6 and maximum of 14 members in all the structures. The Management Committee took nominal charges from the beneficiary households for providing water. In the case of small dams and Makowal type structures, the irrigation charges varied from nil to Rs 10 per hour. Water Users Committee provided free irrigation in the case of 30 per cent of these structures and charged as low as Rs 10 per hour in 70 per cent of the cases because these structures were working efficiently and their maintenance costs were negligible. In the case of lift irrigation structure, the charges varied form Rs 15 to Rs 25, which included salary of motor operator, maintenance/repair of electric motors, etc.

Table 1. Salient features of micro irrigation structures, Kandi area of Punjab

Particulars	Small dam	Lift irrigation structure	Makowal type structure	Overall
No. of structures constructed	8	4	13	25
Period of construction	1990-91 to 1995-96	1992-93 to 1995-96	1992-93 to 1996-97	1990-91 to 1996-97
Average investment (in lakh Rs)				
i) Per structure	19.45 (27.02)	15.61 (18.82)	18.74 (20.26)	18.46 (22.19)
ii) Per ha of command area	0.24 (0.34)	0.16 (0.19)	0.10 (0.10)	0.13 (0.16)
Performance in irrigation (% of CCA) percentage of the structures				
i) < 50% of CCA	62.5	25.0	23.1	36.0
ii) 50 – 75%	37.5	75	61.5	56.0
iii) 75 – 100%	-	-	15.4	8.0
iii) Average CCA/structure (ha)	79.88	98.75	191.23	140.78
Irrigation charges (Rs/ha)	Free to Rs 10	Rs.15 – 25	Free to Rs. 10	Free to Rs.25

Note: Figures within the parentheses are investments at constant prices.

The reasons for failure of micro irrigation structures as reported by Water Users Committee were: (i) Wrong selection of site and direction of channels leads to less availability of water at site; (ii) Poor quality/undersize of pipes leads to breakage of pipes; (iii) Lack of follow-up action by the concerned department after the completion/ entrusting of structures to Water Users Management Committees; and (iv) Poor recovery of water charges from farmers, leading to shortage of funds for maintenance/repairs.

Impact of Irrigation Structure on Farmers' Income

The impact of public investment on irrigation structures on farmers' economy was examined at the village level as well as beneficiary household level.

Impact of Micro Irrigation Structure on Village Economy

The impact of irrigation structures on village economy was examined on the basis of shift in land-use pattern and the number of users of these structures. The change in land-use pattern with the construction of micro irrigation structures in the selected villages was studied at two points of time, viz. pre-project period, 1991-92 for SDs and 1992-93 and 1994-95 for LIS and MTS and post-project period, 2003-04 for all the three structures (Table 2). The cultivated area of the sample villages has increased from 144.9 ha to 158.7 ha under SDs; from 687.0 ha to 709.0 ha under LIS and from 226.3 ha to 248.6 ha under MTS; it depicted an increase of 9.52 per cent, 3.20 per cent and 9.85 per cent, respectively during the study period over the base period. The area irrigated increased from 12 ha to 84.0 ha under SDs; from 39 ha to 441.0 ha under LIS; and from 16.6 ha to 58.7 ha under MTS over the period. The percentage increase in the area irrigated over the period was highest in LIS (1030 %), followed by SDs (600 %) and MTS (253 %). The area irrigated by the structures was 59.5 per cent, 43.5 per cent and 100.0 per cent in the respective sample villages out of total area irrigated in the these villages. Most of the users of these structures belonged to marginal and small farm-size categories. In the case of sample village of SD, 78 farm households out of 80 (97.5%) were beneficiaries of the SD. Among these users, 88.5 per cent were marginal farmers irrigating 64.4 per cent of the area from the structure. In the case of LIS, 149 farm households out of 200 were users and marginal and small farmers constituted 87 per cent of the users. In this village, the maximum number of users belonged to marginal-size category. In the case of MTS, all the 88 farm households (100 %) were beneficiaries, as there was no other source of irrigation in this village.

Table 2. Impact of micro irrigation structures on economy of sample villages, Kandi area, Punjab

Particulars	Small dam	Lift irrigation structure	Makowal type structure
Year of construction	1991-92	1993-94	1994-95
Cultivated area (ha)			
(i) Base year	144.9	687.0	226.3
(ii) Study year	158.7	709.0	248.6
(iii) Change over period (%)	9.52	3.20	9.85
Area irrigated (ha)			
(i) Base year	12.0(8.28)	39.0(5.68)	16.6*(7.34)
(ii) Study year	84.0(52.93)	441.0(62.20)	58.7(23.61)
(iii) Change over period (%)	600.0	1030.8	253.61
No. of users size category-wise (%)			
(i) < 1 ha	89	60	83
ii) 1-2 ha	9	27	14
iii) 2-4 ha	2	13	3
Area irrigated by the structure to total area irrigated in the village (%)	59.5	43.5	100.0

Notes: Figures within the parentheses are irrigated area as percentage to cultivated area
*Source of irrigation was only *kuhl*, on which the MTS was constructed.

Impact of Micro Irrigation Structure on Income of Beneficiary Households

Among the identified villages 31, 35 and 35 farm households were selected from SD, LIS and MTS, respectively for studying the impact of irrigation facility on income of the farmers. The average size of operational holding on sample farm households was 0.96 ha, 3.87 ha and 1.03 ha, respectively; among them 74 per cent, 70 per cent and 62 per cent were irrigated from SDs, LIS and MTS, respectively (Table 3).

The cropping pattern of the sample households had depicted that during the *kharif* season maize was a dominating crop in all the three structures on irrigated as well as un-irrigated lands, with the difference that hybrid maize was only grown on irrigated land and local variety on both irrigated as well as un-irrigated lands; followed by paddy on irrigated land. Fodder was grown both on irrigated and un-irrigated area. The pulses and oilseeds were grown on un-irrigated land. During the *rabi* season, wheat was the main crop grown on the irrigated land, followed by fodder crop (Appendix I).

The cropping intensity was higher on irrigated (177 %) than on un-irrigated (147 %) land. It is important to mention here that the cropping intensity of the Punjab state was 188.2 per cent and of the Hoshiarpur district was 178.6 per cent for the study period 2003-04.

Gross returns, variable costs and gross margin varied widely within the structures and across irrigated and un-irrigated area. Per hectare gross returns and variable costs were highest for LIS, followed by SDs and were minimum for MTS households for both irrigated and un-irrigated hectareage. The gross margins on the overall sample farms were Rs 19133/ha and 4655/ha from irrigated and un-irrigated land, respectively (Table 3). The maximum difference in the per hectare gross margins between irrigated and un-irrigated lands was Rs 15517 in the case of LIS, followed by SD (Rs 12726) and MTS (Rs 10311). It is therefore concluded that on the whole, the irrigated hectarage fetches Rs 14478 more than the un-irrigated hectare.

Benefit Cost Analysis

The information regarding the investment made by Soil Conservation and Engineering Department of Government of Punjab for constituting the micro irrigation structures, benefits received by the beneficiary households in term of area irrigated and additional land saved and brought under un-irrigated cultivation and

Table 3. Parameters of sample beneficiary households, micro irrigation structures, Kandi area of Punjab

Particulars	Small dam	Lift irrigation structure	Makowal type structure	Overall
Sample beneficiaries (No.)	31	35	35	101
Average size of operational holdings (ha)	0.96	3.87	1.03	1.99
Area irrigated (ha)	0.71	2.73	0.64	1.39
	(74.0)	(70.0)	(62.1)	(69.9)
Area irrigated by the structure (%)	0.55	1.32	0.64	0.84
	(77.5)	(52.0)	(100.0)	(64.1)
Per cent of marginal and small holdings	90.3	42.8	88.6	73.27
Gross returns (Rs/ha)				
i) Irrigated	27438	36527	22839	32806
ii) Un-irrigated	7524	14424	6164	11848
Variable costs (Rs/ha)				
i) Irrigated	13076	15083	10920	13673
ii) Un-irrigated	5888	8497	4556	7193
Gross margins (Rs/ha)				
i) Irrigated	14362	21444	11919	19133
ii) Un-irrigated	1636	5927	1608	4655
iii) Difference	12726	15517	10311	14478

Note: Figures within the parentheses are irrigated area as per cent to cultivated area.

associated cash flows over the life of the project is provided below:

Investment on Micro Irrigation Structures

Department of Soil and Water Conservation Punjab, Hoshiarpur Division spent Rs 27.0 lakh on SDs, Rs 31.43 lakh on LIS and Rs 24.72 lakh on MTS in the Kandi area of Punjab, and these structures were completed during 1991-92, 1993-94, and 1995-96, respectively.

Benefits of Micro Irrigation Structures

The major benefit derived from the construction of micro irrigation structures was in irrigation which helped in increasing the productivity and returns to the beneficiary households. The additional benefit derived was the land saved from soil erosion and brought under un-irrigated cultivation. The area irrigated by the selected micro irrigation structure in the sample villages is presented in Table 4. Over time, the information relating to the area irrigated by these selected structures was collected from the Department of Soil and Water Conservation, Punjab, Hoshiarpur Division.

On an average 90 hectares of cultivable land in the sample village was brought under irrigation during the first year of irrigation in 1992-93 by small dam structure and after that the area fluctuated from 60 ha to 95 ha up to 2002-03. Then, there was a quantum jump in the area irrigated to 140 ha during the study year of 2003-04. Similarly, the area irrigated reached 100 ha in LIS and 135 ha in MTS. Overall, the performance of the structures in terms of area irrigated as a ratio to the pre-established specifications CCA of these sample structures could reach only 84.85 per cent in SD, 68.18 per cent in LIS and 57.45 per cent in MTS. These performances were almost at par with those of other major dams constructed under the Kandi Watershed and Area Development Project (KWADP) in the Kandi area of Punjab.

The construction of the micro irrigation structures helped in saving the land from soil erosion and sedimentation. This land was reclaimed and brought under un-irrigated cultivation after completion of the structure. The information on this aspect was taken form the village land records from Revenue Department and is summarized in Table 4.

In the sample village of small dam structure, 0.33 ha of additional land was brought under cultivation during the year 1992-93, which increased to 1.67 ha in 1996-97 and remained constant throughout. The

Table 4. Area irrigated by the structures and additional land brought under un-irrigated cultivation, in sample micro irrigation structures, Kandi area of Punjab: 1992-93 to 2003-04

Year	Land brought under irrigation (ha)			Land brought under cultivation (ha)		
	SD	LIS	MTS	SD	LIS	MTS
1992-93	90 (54.55)			0.33		
1993-94	95 (57.58)			0.66		
1994-95	80 (48.48)	100 (45.45)		1.00	0.53	
1995-96	85 (51.52)	115 (52.27)		1.34	1.06	
1996-97	70 (42.42)	118 (53.64)	50 (21.28)	1.67	1.59	0.49
1997-98	65 (39.39)	124 (56.36)	85 (36.17)	1.67	2.12	0.98
1998-99	85 (51.52)	130 (59.09)	75 (31.91)	1.67	2.65	1.48
1999-2000	60 (36.36)	112 (50.91)	95 (40.43)	1.67	2.65	1.98
2000-01	60 (36.36)	125 (56.82)	92 (39.15)	1.67	2.65	2.47
2001-02	65 (39.39)	128 (58.18)	97 (41.28)	1.67	2.65	2.47
2002-03	95 (57.58)	140 (63.64)	117 (49.79)	1.67	2.65	2.47
2003-04	140 (84.85)	150 (68.18)	135 (57.45)	1.67	2.65	2.40

Source: Department of Soil & Water Conservation Punjab, Hoshiarpur Division

Note: Figures within the parentheses are percentages to catchment command area.

additional land brought under cultivation was 2.65 ha under LIS and 2.47 ha under MTS in the year 2003-04.

Estimated Annual Benefits from Micro Irrigation Structures

To work out the annual benefits from the construction of micro irrigation structures, the area irrigated by the structure in a particular year was multiplied by the difference in per hectare returns from irrigated and un-irrigated lands, i.e., Rs 12726 in SDs, Rs 15517 in LIS and Rs 10311in MTS. In addition owing to run-off and hence the soil erosion being checked, some additional area was reclaimed and brought under un-irrigated cultivation, resulting in addition benefits. These were estimated using the per hectare returns from un-irrigated land which were Rs 1636, Rs 5927 and Rs 1608 for the respective structures multiplied by the area brought under cultivation in a particular year. Both the returns were added to get total annual returns for the period 1992-93 to 2003-04 for small dam, 1994-95 to 2003-04 for lift irrigation structure and 1996-97 to 2003-04 for Makowal type structure at 2003-04 prices. These returns were deflated using the wholesale Price Index of 21 commodities (Appendix II) to the base year prices of 1991-92 for small dam, 1993-94 for lift irrigation and 1995-96 for Makowal type structure.

For carrying out the benefit-cost analysis it is necessary to take into account the income stream for the whole life of the irrigation structures. However, since it is difficult to generate cash flows for the entire life-span of the irrigation structures in the absence of observed temporal information on benefit and costs, we made some realistic assumptions for estimating cash flows as under:

- The life period of the micro irrigation structures was considered as 20 years after discussions with Water Users Committee.
- Area irrigated by the sample structure and additional land brought under cultivation during the study period 2003-04 was considered constant over the remaining life of the structures.
- Cash flows were deflated to the base period of the completion of the sample structure.
- After 2003-04, the cash flows were considered constant for the rest of the life of the structures.

Table 5. Estimated cash flows over the life of the micro irrigation structures in Kandi area of Punjab: 1992-93 to 2015-16

(Rs)

Year	Small dam	Lift irrigation structure	Makowal type structure
1992-93	584399		
1993-94	617125		
1994-95	520055	1040189	
1995-96	552790	1198003	
1996-97	455712	1231248	392417
1997-98	423260	1295634	667288
1998-99	553065	1360021	589536
1999-2000	390809	1173165	746874
2000-01	390809	1308117	723964
2001-02	423260	1339259	763145
2002-03	617968	1463830	919873
2003-04	910030	1567639	1060842
2004-05	910030	1567639	1060842
2005-06	910030	1567639	1060842
2006-07	910030	1567639	1060842
2007-08	910030	1567639	1060842
2008-09	910030	1567639	1060842
2009-10	910030	1567639	1060842
2010-11	910030	1567639	1060842
2011-12	910030	1567639	1060842
2012-13		1567639	1060842
2013-14		1567639	1060842
2014-15			1060842
2015-16			1060842

Note: Cash flows were estimated for the base period of 1992-93 for SDs, 1994-95 for LIS and 1995-96 for MTS.

Cash flows for the whole life of the irrigation structures have been incorporated in Table 5. The financial internal rate of returns (FIRR) for the public investment were worked out separately for three structures utilizing discounted cash flow technique. The estimated rate of returns on the investment have been incorporated in Table 6.

The analysis showed that the returns to the public investment were as high as 20.56 per cent, 38.54 per cent and 27.95 per cent in small dam, lift irrigation structure and Makowal type structure, respectively. This analysis revealed that the returns to the public

Table 6. Internal rate of returns on investment in micro irrigation structures in the Kandi area of Punjab

Particulars	Internal rate of returns (%)
Small dam	20.56
Lift irrigation structure	38.54
Makowal type structure	27.95

investment in the irrigation structures are quite promising in the Kandi area of Punjab.

Conclusion and Policy Implications

The difference between the per hectare returns from irrigated and un-irrigated lands being large it has been concluded that construction of micro irrigation structures in the Kandi area of Hoshiarpur district has great bearing on the income of beneficiary households by having access to irrigation facilities, particularly by marginal and small farmers, who constitute 89 per cent of the total users of these structures. Discounted cash flow analysis employed for studying the economic viability of investment in the irrigated structures has shown that the returns to investment are positive and encourage for more such investment to meet and overcome the problem being faced by the inhabitants of Kandi area of Punjab, which is classically labeled as "an island of poverty amidst an ocean of development".

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Appendix I

Cropping pattern and cropping intensity on sample farms, micro irrigation structures, Kandi area of Punjab, 2003-04

(in ha)

Particulars	Small dam		Lift irrigation		Makowal type structure		Overall	
	Irrigated	Un-irrigated	Irrigated	Un-irrigated	Irrigated	Un-irrigated	Irrigated	Un-irrigated
A. *Kharif* crops								
Maize local	0.09	0.03	0.49	0.30	0.43	0.08	0.34	0.14
	(6.52)	(10.71)	(10.45)	(16.76)	(35.83)	(16.0)	(13.82)	(15.91)
Maize hybrid	0.52	-	0.04	-	0.03	-	0.19	-
	(37.68)		(0.85)		(2.5)		(7.72)	
Maize overall	0.61	0.03	0.53	0.30	0.46	0.08	0.53	0.14
	(44.20)	(10.71)	(11.30)	(16.76)	(38.33)	(16.00)	(21.54)	(15.91)
Paddy	-	-	1.13	-	0.04	-	0.41	-
			(24.10)		(3.34)		(16.67)	
Sugarcane	-	-	0.23	-	-	-	0.07	-
			(4.90)				(2.85)	
Oilseeds	-	-	-	0.08	-	0.02	-	0.04
				(4.47)		(4.0)		(4.54)
Groundnut	-	-	-	-	-	0.05	-	0.02
						(10.0)		(2.27)
Pulses & vegetables	-	0.01	-	0.05	-	0.03	-	0.03
		(3.57)		(2.79)		(6.0)		(3.41)
Fodders	0 .06	0.01	0.31	0.16	0.06	0.09	0.15	0.08
	(4.35)	(3.57)	(6.61)	(8.94)	(5.0)	(18.0)	(6.1)	(9.09)
Others	-	0.02	-	0.10	-	-	-	0.04
		(7.15)		(5.50)				(4.55)
Sub-total	0.67	0.07	2.20	0.69	0.56	0.27	1.16	0.35
	(48.55)	(25.0)	(46.91)	(38.55)	(46.67)	(54.0)	(47.16)	(39.77)
B. *Rabi* Crops								
Wheat	0.67	0.19	2.34	1.08	0.55	0.22	1.21	0.51
	(48.55)	(67.87)	(49.89)	(60.33)	(45.83)	(44.0)	(49.19)	(57.95)
Oilseeds	-	-	0.01	-	0.02	-	0.01	-
			(0.21)		(1.67)		(0.41)	
Pulses/vegetables	-	-	-	0.02	-	-	0.01	-
				(1.12)			(1.14)	
Fodders	0.04	-	0.14	-	0.07	-	0.08	-
	(2.09)		(2.99)		(5.83)		(3.25)	
Others	-	0.02	-	-	-	0.01	-	0.01
		(7.14)				(2.0)		(1.14)
Sub-total	0.71	0.21	2.49	1.10	0.64	0.23	1.30	0.53
	(51.45)	(75.0)	(53.09)	(61.45)	(53.33)	(46.0)	(52.84)	(60.23)
Total cropped area	1.38	0.28	4.69	1.79	1.20	0.50	2.46	0.88
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
Cropping Intensity	194.4	112.0	171.8	105.3	187.5	128.2	177.0	146.7

Note: Figures within the parentheses indicate percentages to total cropped area

Appendix II

Wholesale price index of 21 agricultural commodities grown in Punjab

Year	Price index
1990-91	198
1991-92	237
1992-93	251
1993-94	278
1994-95	330
1995-96	342
1996-97	375
1997-98	377
1998-99	440
1999-2000	448
2000-01	439
2001-02	461
2002-03	469
2003-04	493
2004-05	501
2005-06	530
2006-07	594
2007-08	684
2008-09	756