

## APPENDIX I

Returns to fixed farm resources (per hectare) of  
various crops at four different levels of product  
prices, Zone I

Name of crop	Returns to fixed farm resources (Rs)at			
	P Y1	P Y2	P Y3	P Y4
Wheat (H.Y.)	1256.12	1321.25	2115.18	2069.81
Cotton (Desi)	1062.66	1072.38	1769.31	2035.78
Cotton (American)	1815.09	1933.42	2476.25	3068.59
Paddy (H.Y.)	1088.02	1843.09	1760.37	1754.98
Paddy (Basmati )	1241.40	1107.80	1696.45	1970.30
Paddy (Local)	456.45	773.04	735.25	738.45
Maize (Desi)	757.00	674.72	985.75	1848.34
Sugarcane	2442.27	2044.97	3030.49	3495.35
Groundnut (Irrig.)	1427.40	1456.91	2772.83	2750.22
Groundnut(Unirrig.)	899.80	920.00	1809.80	1809.80
Toria (Irrigated)	1030.15	999.18	1806.38	1726.31
Toria(Unirrig.)	831.44	806.16	1505.62	1441.76

## APPENDIX II

Returns to fixed farm resources (per hectare) of  
various crops at four different levels of product  
price, Zone II

Name of crop	Returns to fixed farm resources (Rs.) at			
	P <sub>Y1</sub>	P <sub>Y2</sub>	P <sub>Y3</sub>	P <sub>Y4</sub>
Wheat (H.Y.)	1600.88	1678.09	2717.12	2660.42
Cotton (Desi)	1060.05	1144.50	1951.72	2266.35
Paddy (H.Y.)	1222.82	2149.03	2070.38	2077.03
Maize (Desi)	661.49	623.52	988.22	1999.63
Groundnut(Irrig.)	1492.37	1200.47	2181.46	2170.56
Sugarcane	3547.01	2584.51	2898.80	3488.09
Groundnut(Unirrig.)	1214.81	980.81	1790.81	1789.81

## APPENDIX III

Returns to fixed farm resources (per hectare) of various crops at four different levels of product price, zone III

Name of crop	Returns to fixed farm resources(Rs.) At			
	P <sub>Y1</sub>	P <sub>Y2</sub>	P <sub>Y3</sub>	P <sub>Y4</sub>
Wheat (H.Y.)	1116.70	1166.11	1924.30	1881.91
Cotton(Desi)	669.09	686.28	1195.31	1389.94
Cotton(American)	2501.41	2379.48	3091.09	3880.08
Paddy (H.Y.)	1023.90	1814.91	1782.90	1873.72
Maize (Desi)	623.43	541.66	807.89	1546.25
Guara (Grains)	414.51	207.34	508.47	812.41
Sarsons	1036.56	974.34	1921.54	1958.20
Bajra	1174.83	716.54	1139.26	1890.58
Gram	1045.19	764.98	1725.60	1635.44

APPENDIX IV

Input-output coefficient used in Linear Programming for the Bench Mark Farm Situation in Zone I.

$C_{j1}$ *	$b_i$	1256.12	1062.66	1815.09	1083.02	1241.40	456.45
		Wheat (H.Y.) P <sub>1</sub>	Cotton (Desi) P2	Cotton (Am.) P3	Paddy (H.Y.) P4	Paddy (Basmati) P5	Paddy (Local) P6
<u>Kharif</u> Land Irrigated (hectares)	6.27	0	1	1	1	1	1
<u>Kharif</u> Land Unirrigated (hectares)	0.13	0	0	0	0	0	0
<u>Rabi</u> Land Irrigated (hectares)	6.27	1	0	0	0	0	0
<u>Rabi</u> Land Unirrigated (hectares)	0.13	0	0	0	0	0	0
Capital (Rs)	4651.37	523.91	203.36	329.44	629.98	599.34	522.22
Labour (Hrs.)	5772	482	786	934	730	1032	430
<u>Kharif</u> Fodders (Hectares)	1.27	0	0	0	0	0	0
<u>Rabi</u> Fodders (hectares)	0.53	0	0	0	0	0	0
(Kgs.)	0	79.77	21.02	48.77	71.36	58.39	86.04
P <sub>2</sub> O <sub>5</sub> (Kgs.)	0	24.12	0	0	3.98	2.21	0.41
K <sub>2</sub> O (Kgs.)	0	1.60	0	0	1.17	0.17	0.20
Groundnut Irrigated Max. (hectares)	0.30	0	0	0	0	0	0
Toria Irrigated Max. (hectares)	0.47	0	0	0	0	0	0
Sugarcane Min. (hectares)	0.20	0	0	0	0	0	0

\*The other three values of  $C_j$ 's are given in Appendix I.

APPENDIX IV  
(Continued)

$C_j^*$	<u>757.00</u> Maize (Desi) P7	<u>2442.27</u> Sugar- cane P8	<u>1427.40</u> G.Nut (Irri) P9	<u>899.80</u> G.Nut (Unirri.) P10	<u>1030.15</u> Toria (Irri.) P11	<u>831.44</u> Toria (Unirri.) P12	<u>0</u> <u>Kharif</u> Fodders P13
<u>Kharif Land Irrigated</u> (hectares)	1	1	1	0	0	0	1
<u>Kharif Land Unirrigated</u> (hectares)	0	0	0	1	0	0	0
<u>Rabi Land Irrigated</u> (hectares)	0	1	0	0	1	0	0
<u>Rabi Land Unirrigated</u> (hectares)	0	0	0	0	0	1	0
Capital (Rs)	311.35	983.23	230.26	201.00	95.35	58.00	110.82
Labour (Hrs.)	676	1467	499	436	291	280	522
<u>Kharif Fodders</u> (hectares)	0	0	0	0	0	0	1
<u>Rabi Fodders</u> (hectares)	0	0	0	0	0	0	0
N (Kgs.)	54.37	79.13	0	0	22.90	11.00	4.04
$P_{25}$ (kgs.)	4.04	0	0	0	5.66	0	0
$K_2O$ (kgs.)	1.01	0	0	0	0.60	0	0
<u>Groundnut Irrigated</u> Max. (hectares)	0	0	1	0	0	0	0
<u>Toria Irrigated</u> Max. (hectares)	0	0	0	0	1	0	0
<u>Sugarcane Min.</u> (hectares)	0	1	0	0	0	0	0

\*The other three values of  $C_j^*$ 's are given in Appendix I.

APPENDIX IV  
(Continued)

$C_j^*$	0	-2.03	-2.86	-0.90	-.05	-.80
	Rabi Fodders	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Capital borrow- ing	Labour hiring
	P14	P15	P16	P17	P18	P19
<u>Khari f Land Irrigated</u> (hectares)	0	0	0	0	0	0
<u>Khari f Land Unirrigated</u> (hectares)	0	0	0	0	0	0
<u>Rabi Land Irrigated</u> (hectares)	1	0	0	0	0	0
<u>Rabi Land Unirrigated</u> (hectares)	0	0	0	0	0	0
Capital (Rs.)	305.73	2.03	2.86	0.90	-1	0.80
Labour (Hrs.)	550	0	0	0	0	-1
<u>Khari f Fodders</u> (hectares)	1	0	0	0	0	0
<u>Rabi Fodders</u> (hectares)	1	0	0	0	0	0
N (Kgs.)	15.38	-1	0	0	0	0
P <sub>2</sub> O <sub>5</sub> (Kgs.)	0.37	0	-1	0	0	0
K <sub>2</sub> O (Kgs.)	0	0	0	-1	0	0
Groundnut Irrigated Max. (hectares)	0	0	0	0	0	0
Urbia Irrigated Max. (hectares)	0	0	0	0	0	0
Sugarcane Min. (hectares)	0	0	0	0	0	0

\*The other three values of  $C_j$ 's are given in Appendix I.

APPENDIX V

Input-output coefficient used in Linear Programming for the  
Benchmark Para Situation in Zone-II.

$C_j$	$b_i$	1600.33	1060.05	1222.32	64.49	1492.27	3547.01
		Wheat (H.I.) P1	Cotton (Desi) P2	Paddy (H.I.) P3	Maize (Desi) P4	Ground (Irri.) P5	Sugar- cane P6
<u>Kharif</u> Land Irrigated (hectares)	7.13	0	1	1	1	1	1
<u>Kharif</u> Land Unirrigated (hectares)	0.74	0	0	0	0	0	0
<u>Rabi</u> Land Irrigated (hectares)	7.13	1	0	0	0	0	1
<u>Rabi</u> Land unirrigated (hectares)	0.74	0	0	0	0	0	0
Capital (Rs)	6632.59	718.69	318.21	333.16	435.23	106.25	1236.05
Labour (Hrs.)	7300	348	926	999	600	450	1628
<u>Rabi</u> Fodders (hectares)	0.45	0	0	0	0	0	0
<u>Kharif</u> Fodders (hectares)	1.45	0	0	0	0	0	0
N (Kgs.)	0	32.46	19.01	91.30	42.03	5.65	69.75
$P_2O_5$ (Kgs.)	0	45.49	0	5.43	20.36	2.63	37.72
$K_2O$ (Kgs.)	0	3.44	0	1.15	1.93	0.39	1.25
Sugarcane Max. (hectares)	0.15	0	0	0	0	0	0

\* The other three values of  $C_j$ 's are given in Appendix II

APPENDIX V  
(continued)

$C_j^*$	1241.81 G.Nut (Unirr) P7	0 <u>Kharif</u> Fodders P8	0 <u>Rabi</u> Fodders P9	-2.08 N P10	-2.86 P <sub>2</sub> O <sub>5</sub> P11	-0.90 K <sub>2</sub> O P12	-0.05 Capital hiring P13	-0.80 Labour hiring P14
<u>Kharif</u> Land Irrigated (hectares)	0	1	0	0	0	0	0	0
<u>Kharif</u> Land Unirri- gated (hectares)	1	0	0	0	0	0	0	0
<u>Rabi</u> Land Irrigated (hectares)	0	0	1	0	0	0	0	0
<u>Rabi</u> Land Unirri- gated (hectares)	0	0	0	0	0	0	0	0
Capital (Rs)	94.57	135.37	480.51	2.08	2.86	0.90	-1	0.80
Labour (Hrs.)	450	460	559	0	0	0	0	-1
<u>Rabi</u> Fodders (hectares)	0	0	1	0	0	0	0	0
<u>Kharif</u> Fodders (hectares)	0	1	0	0	0	0	0	0
(Kgs.)	3.15	5.16	15.97	-1	0	0	0	0
P <sub>2</sub> O <sub>5</sub> (Kgs.)	2.60	1.26	12.50	0	-1	0	0	0
K <sub>2</sub> O (Kgs.)	0.89	0.43	0.14	0	0	-1	0	0
Sugarcane Max. (hectares)	0	0	0	0	0	0	0	0

\* The other three values of  $C_j$ 's are given in Appendix II

APPENDIX VI

Input-output coefficients used in Linear Programming for the  
Bench Mark Farm Situation in Zone-III.

$C_j^*$	bi	<u>1116.70</u> Wheat (H.Y.) P1	<u>669.09</u> Cotton (Desi) P2	<u>2501.41</u> Cotton (Am.) P3	<u>1023.90</u> Paddy (H.Y.) P4	<u>623.43</u> Maize (Desi) P5
<u>Khari f Land Irrigated</u> (hectares)	8.72	0	1	1	1	1
<u>Khari f Land Unirrigated</u> (hectares)	0.91	0	0	0	0	0
<u>Rabi Land Irrigated</u> (hectares)	8.72	1	0	0	0	0
<u>Rabi Land Unirrigated</u> (hectares)	0.91	0	0	0	0	0
Capital (Rs)	5285.86	620.69	215.58	515.16	693.71	262.73
Labour (Hrs.)	6015	554	670	807	1345	709
<u>Khari f Fodders</u> (hectares)	1.23	0	0	0	0	0
<u>Rabi Fodders</u> (hectares)	0.47	0	0	0	0	0
N (Kgs.)	0	71.94	24.29	58.29	46.96	27.37
$P_{25}$ (Kgs.)	0	31.58	22.57	3.72	3.43	1.86
$K_2O$ (Kgs.)	0	3.01	0	0	0	0.48
Cotton Desi Max. (hectares)	0.97	0	1	0	0	0
Cotton American Max. (hectares)	2.60	0	0	1	0	0
Sarson Max. (hectares)	0.39	0	0	0	0	0

\* The other three values of  $C_j$ 's are given in Appendix III.

APPENDIX VI  
(Continued)

$C_j^*$	441.51	1026.56	1174.83	1045.19	0	0
	Guara grains P6	Sarson P7	Bajra P8	Gram P9	Khariif Fodders P10	Rabi Fodders P11
<u>Khariif Land Irrigated</u> (hectares)	0	0	1	0	1	0
<u>Khariif Land Unirrigated</u> (Unirrigated)	1	0	0	0	0	0
<u>Rabi Land Irrigated</u> (hectares)	0	1	0	0	0	1
<u>Rabi Land Unirrigated</u> (hectares)	0	0	0	1	0	0
Capital (Rs.)	72.75	132.17	167.25	81.51	154.05	398.83
Labour (Hrs.)	225	313	427	259	293	570
<u>Khariif Fodders</u> (hectares)	0	0	0	0	1	0
<u>Rabi Fodders</u> (hectares)	0	0	0	0	0	1
N (Kgs.)	0	12.20	35.55	0	15.15	0
$P_{2.5}$ (Kgs.)	0	1.31	0	0	0.25	0
$K_2O$ (Kgs.)	0	0	0	0	0	0
Cotton Desi Max. (hectares)	0	0	0	0	0	0
Cotton American Max. (hectares)	0	0	0	0	0	0
Sarson Max. (hectares)	0	1	0	0	0	0

\*The other three values of  $C_j$ 's are given in Appendix III.

APPENDIX VI  
(Continued)

$C_j^*$	-2.08	-2.86	-0.90	-0.05	-0.80
	N	$P_{205}$	$K_2O$	Capital hiring	Labour hiring
	P12	P13	P14	P15	P16
<u>Khariif</u> Land Irrigated (hectares)	0	0	0	0	0
<u>Khariif</u> Land Unirrigated (hectares)	0	0	0	0	0
Rabi Land Irrigated (hectares)	0	0	0	0	0
<u>Rabi</u> Land Unirrigated (hectares)	0	0	0	0	0
Capital (Rs)	0	0	0	-1	0.80
Labour (Hrs.)	0	0	0	0	-1
<u>Khariif</u> Fodders (hectares)	0	0	0	0	0
<u>Rabi</u> Fodders (hectares)	0	0	0	0	0
N (Kgs.)	-1	0	0	0	0
$P_{205}$ (Kgs.)	0	-1	0	0	0
$K_2O$ (Kgs.)	0	0	-1	0	0
Cotton Desi Max. (hectares)	0	0	0	0	0
Cotton American Max. (hectares)	0	0	0	0	0
Sarson Max. (hectares)	0	0	0	0	0

\*The other three values of  $C_j$ 's are given in Appendix III.

## APPENDIX VII

Notes on the Calculations of Price Indices Used in  
the Fertiliser Demand Functions

The prices of all the products in the parametric programming model change more or less together. The solution quantity of each product did not remain constant over all price changes, presumably because of enterprise substitution.

Thus, in order to give individual products weights that are commensurate with their importance, their prices were weighted by the quantities of individual products generated by the optimum solutions using Fisher's Ideal' formula:

$$P = \frac{P_1 q_1}{P_0 q_0} \times \frac{P_1 q_1}{P_0 q_1}^{1/2}$$

where

P = Price index

P<sub>0</sub> = base price of the product

P<sub>1</sub> = changed price of product

q<sub>0</sub> = based quantity of product derived from the first linear programming solution

q<sub>1</sub> = quantity product when its price is changed

## APPENDIX VIII

Observation Inputs for Fertilizer(N) Demand Functions  
Zone I, Punjab, 1972-73

$D_f$	$P_f$	$P_Y$	K
665.200	2.080	1.000	2.000
665.200	4.470	1.000	2.000
665.200	4.470	1.017	2.000
788.265	2.000	1.116	2.000
665.200	2.080	1.195	2.000
665.200	4.470	1.195	2.000
665.200	4.470	1.248	2.000
665.200	2.080	1.248	2.000
665.200	6.700	1.000	2.000
665.200	6.700	1.000	2.000
665.200	6.700	1.017	2.000
665.200	6.700	1.195	2.000
393.559	2.080	1.000	2.000
332.597	4.470	1.000	1.000
332.597	4.470	1.034	1.000
393.559	2.080	1.017	1.000
393.559	2.080	1.179	1.000
332.597	4.470	1.393	1.000
332.597	4.870	1.587	1.000
393.559	2.080	1.259	1.000
293.489	6.700	1.590	1.000
293.499	6.700	1.000	1.000
293.489	6.700	1.034	1.000
293.489	6.700	1.379	1.000

## APPENDIX IX

Observation Inputs for Fertilizer (N) Demand Functions  
Zone II, Punjab, 1972-73

$D_f$	$P_f$	$P_y$	K
600.060	2.080	1.000	2.000
1089.390	2.080	1.463	2.000
600.060	2.080	1.492	2.000
600.060	2.080	1.437	2.000
597.300	4.470	0.948	2.000
1089.390	4.470	1.479	2.000
600.060	4.470	1.492	2.000
600.060	4.470	1.437	2.000
600.060	6.700	1.437	2.000
597.300	6.700	1.000	2.000
600.060	6.700	0.944	2.000
600.060	6.700	1.492	2.000
494.860	2.080	1.000	1.000
354.860	4.470	1.000	1.000
359.960	4.470	0.921	1.000
481.730	2.080	1.170	1.000
481.730	2.080	1.489	1.000
359.960	4.470	1.486	1.000
359.960	4.470	1.211	1.000
481.730	2.080	1.212	1.000
291.080	6.700	1.209	1.000
286.980	6.700	1.000	1.000
291.080	6.700	0.914	1.000
291.080	6.700	1.482	1.000

## APPENDIX X

Observation Inputs for Fertilizer (N) Demand Functions  
Zone III, Punjab, 1972-73

$D_f$	$P_f$	$P_Y$	K
896.700	2.080	1.000	2.000
952.500	2.080	1.212	2.000
896.700	2.080	1.322	2.000
896.700	2.080	1.526	2.000
896.700	4.470	1.000	2.000
952.500	4.470	1.212	2.000
896.700	4.470	1.322	2.000
896.700	4.470	1.526	2.000
896.700	6.700	1.526	2.000
412.980	6.700	1.00	2.000
423.020	6.700	1.239	2.000
896.700	6.700	1.322	2.000
476.250	2.080	1.000	1.000
415.710	4.470	1.026	1.000
373.330	4.470	1.017	1.000
488.910	2.080	1.139	1.000
476.250	2.080	1.107	1.000
415.710	4.470	1.256	1.000
415.710	4.470	1.603	1.000
476.25	2.080	1.243	1.000
364.360	6.700	1.553	1.000
364.360	6.700	1.000	1.000
280.840	6.700	0.932	1.000
361.320	6.700	1.205	1.000

## Appendix XI

Existing Cropping Plan for Bench-Mark Farm Situation  
Zone-I, Punjab, 1972-73

Name of crop	Area (Hectares)
Wheat	4.72
Toria	0.47
<u>Rabi</u> fodder	0.53
Sugarcane	0.20
Other <u>Rabi</u> crops	0.22
Cotton (Am.)	0.33
Cotton (Desi)	0.46
Paddy (H.Y.)	1.52
Paddy (Basmati)	0.23
Maize (Desi)	0.48
Paddy (Local)	0.32
Groundnut	0.30
Kh.Fodders	1.27
Other <u>Kharif</u> crops	0.18

## Appendix XII

Existing Cropping Plan for Bench-Mark Farm Situation  
Zone II, Punjab 1972-73

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Name of crop	Area (Hectares)
Wheat	6.09
Sugarcane	0.15
<u>Rabi</u> fodders	0.45
Other <u>Rabi</u> Crops	0.44
Paddy (H.Y.)	0.33
Maize (Desi)	1.69
Groundnut	1.48
<u>Kharif</u> fodders	1.45
Cotton (Desi)	1.42
Other <u>Kharif</u> crops	0.40
Cotton (Am.)	0.05

## Appendix XIII

Existing Cropping Plan for Bench-Mark Farm Situation  
Zone-III, Punjab, 1972-73

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Name of crop	Area (Hectares)
Wheat	4.63
Grams	0.51
Sarson	0.89
<u>Rabi</u> fodders	0.47
Sugarcane	0.08
Other <u>Rabi</u> crops	0.37
Paddy (H.Y.)	0.15
Maize (Desi)	0.51
Guara (Grains)	0.87
Bajra (Grains)	0.28
<u>Kharif</u> Fodders	1.23
Cotton (Desi)	0.97
Cotton (Am.)	2.60
Other <u>Kharif</u> crops	0.23
Groundnut	0.01

## V I T A

Balkar Singh Dhillon, the author, was born on April 1, 1941 in the Village of Dogaich district Lahore (West Pakistan) He passed his Matriculation Examination from the D.B.High School, Attari, district Amritsar in 1957 and B.Sc.(Agri.) from Khalsa College Amritsar in 1961 from the Punjab University, Chandigarh.

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