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Farm Size and Land Use Efficiency in Pakistan's Agriculture

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In this paper we analyzed the relationship between the farm size and economies of scale in the extensive and intensive use of land. We found that the definition of farm size in terms of linear aggregation of the irrigated and unirrigated lands leads to the mis-specification bias, resulting in the under-estimation of the degree of homogeneity of the functions. The implications of the above analysis are fairly obvious. First of all, the one-dimensional definition of farm size in terms of total land size without distinguishing between the irrigated and the unirrigated lands not only mis-specifies the functional relationships between farm size, on the one hand, and land use and other economic variables, on the other hand; but, more importantly, it also under-estimates the returns to scale value, thereby leading to over-estimation of possible benefits from the re-distribution of land. Secondly, the division of lands into irrigated and unirrigated brings out the importance of irrigation in determining the levels of the extensive and intensive uses of land and goes a long way in explaining the inter-farm size as well as the intra-farm size variations in land use intensities. Thirdly, explicit estimates of the positive impact of irrigation on land use and productivity clearly indicate that there is an alternative policy for radical land reforms to bring about significant changes in the distribution of agricultural income and assets. That alternative policy is to use irrigation development and distribution, which are predominantly under the direct or indirect control of the government, as policy tools to help the small and marginal farmers.

INTRODUCTION

Production differences by farm size were first brought out by a number of farm management studies carried out in India, Pakistan, and other developing countries during the 1960s and 1970s [Cline (1970); Bharadwaj (1974); Berry and Cline (1979) and references therein]. Most of these studies revolve around the proposition that there exists an inverse relationship between farm size and land productivity. In a recent article, Chaudhry *et al.* (1985) once again confirmed the earlier findings. Recently, Sampath (1989) subjected this strong inverse relationship between farm size and land productivity to a closer scrutiny and found that once a proper account is made of the exogenous land quality variables, the inverse relationship is observed to weaken. This article investigates the empirical validity of

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one of the popular hypotheses often tested by researchers, namely, the inverse relationship between farm size and land use intensity.

DATA SOURCE

The province-wise temporal data and the cross-section data according to farm size used in this study are taken from the three Agricultural Census reports of Pakistan for the years 1960, 1972, and 1980 [Pakistan Agricultural Census Organization (1963, 1975, 1983)]. One main advantage of this data set is that it covers not only the pre-Green Revolution period (1960), as is the case with the earlier studies, and the initial Green Revolution period (1972), as is the case with the later studies, but also the matured Green Revolution period (1980).

LAND USE INTENSITY

Following Sampath (1989), we study the relationship between the farm size and land use intensity in terms of two different definitions of land use, namely, the extensive and the intensive use of land. We measure the extensive use of land in terms of the Net Sown Area (NSA). NSA, by excluding unused lands, estimates properly the extensive use of land that produces crop and, consequently, income for the farmer. The Gross Cropped Area (GCA) evaluates the intensive use of land and differs from the NSA in that it counts as twice or thrice all lands that are double or triple cropped, respectively. We look upon the NSA and the GCA only as proxies to measure the intensity of land use because the ideal definition of land use would go beyond the spatial aspect of land use to include the cultivation practices, use of fertilizer, etc. In defining these variables, we followed the current practice in the literature [Bharadwaj (1974); Salam (1978); Sampath and Gopinath (1979); Berry and Cline (1979); Chaudhry *et al.* (1985); Sampath (1989)].

An operational holding in terms of cultivated land consists of two types of land, namely, irrigated and unirrigated, which have a significantly differing impact on land use and productivity; and usually different farms have different proportions of their holdings irrigated. Thus, while representing the impact of farm size on land use intensity, it is very critical to take into account this distinction between the cultivated area irrigated (IA) and cultivated area unirrigated (UA). Otherwise, the analysis will be seriously flawed. By defining the operational farm size as the linear aggregation of irrigated and unirrigated area, earlier studies have implicitly assumed that one unit of land with irrigation facilities has the same potential for extensive and intensive use of land as one unit of land with no irrigation facilities at all, which clearly is not so. Availability of irrigation is a prime determinant of land use in both its intensive and extensive forms. In the absence of irrigation, Pakistan's rainfall conditions are not conducive for double and triple cropping of a land in a year. In arid and semi-arid regions, irrigation helps in bringing much of the cultivable waste land under the plough. As Sampath (1989) points out, irrigation makes possible a higher extensive and intensive use of land in three ways: (1) it makes it possible to bring new lands that are otherwise fallow/barren under cultivation and thereby increase the net sown area of a farm; (2) it helps growing of crops during the dry season and thereby increases the land use intensity; and (3) it makes possible growing of shorter duration crops (which cannot be grown without adequate and dependable water supply to the crop that irrigation makes possible) and thereby makes multiple cropping possible. Thus, linear aggregation of IA and UA leads to the aggregation (mis-specification) bias in the estimation of parameters and testing of hypotheses.

For 1960 (in which the provincial data are not reported), we used the district-wise data to arrive at the province level data for Balochistan, the North West Frontier Province (NWFP), Punjab, and Sindh. For each of the four provinces, the available data set is comprises nine farm size categories based on the operational farm size.[1] Thus, for each census year, we have 36 observations for a total of 108 observations covering the three census years. Before we discuss the regressional analysis, it is worthwhile to look at some gross figures on the extensive and intensive uses of land across three broad categories of farm size, namely, small (less than 5 acres), medium (5 to 25 acres), and large (25 acres and above). Tables 1 and 2, respectively, provide the estimates of extensive (net sown area/farm size) and intensive (gross cropped area/farm size) uses of land across the three categories of farm size over time, both at the provincial and the national levels [Government of Pakistan (1989, 1990)]. The overwhelming impression one gets from looking at the figures, in Tables 1 and 2, is that, as the farm size rises, the levels of the extensive and the intensive uses of land fall in each of the three census years for each province and for the country as a whole. But then, looking at the figures in parentheses, one also gets the impression that as the size of farm goes up, both the proportion of the cultivated area irrigated and the ratio of the gross irrigated area to net irrigated area decline, indicating an inverse relationship between the farm size and access to irrigation. So, in order to understand the nature of the relationship between farm size and land use, we need to define farm size in terms of its two dimensions, namely, irrigated areas and unirrigated areas.

FUNCTIONAL FORM

Economic theory rarely provides us with precise mathematical forms of eco-

[1]The nine operational farm size categories are:

1:	< 1.0 Acre	4:	5.0 – 7.5 Acres	7:	25.0 – 50.0 Acres
2:	1.0 – 2.5 Acres	5:	7.5 – 12.5 Acres	8:	50.0 – 150.0 Acres
3:	2.5 – 5.0 Acres	6:	12.5 – 25.0 Acres	9:	150.0 Acres and Above.

Table 1

Net Sown Area as a Proportion of Farm Area across Farm Size Groups in Pakistan (1960–1980)

Farm Size	NWFP	Punjab	Sindh	Balochistan	Pakistan
1960					
Small	93.68	88.36	96.49	76.52	89.76
	(45.49)	(64.18)	(91.26)	(52.61)	(64.50)
Medium	90.50	88.85	94.38	71.91	89.48
	(37.66)	(73.29)	(87.74)	(46.82)	(73.01)
Large	81.54	85.87	86.63	48.12	79.21
	(23.60)	(67.85)	(62.88)	(51.74)	(60.74)
1972					
Small	95.88	96.42	98.62	74.10	96.10
	(53.72)	(75.70)	(95.88)	(50.07)	(74.46)
Medium	90.53	95.46	95.46	73.77	94.48
	(44.93)	(78.67)	(92.54)	(50.01)	(79.23)
Large	75.10	93.14	83.11	60.60	87.57
	(40.80)	(68.33)	(80.72)	(34.04)	(64.97)
1980					
Small	98.77	98.38	99.13	84.93	98.17
	(52.52)	(77.79)	(94.63)	(51.51)	(75.64)
Medium	95.41	97.05	97.46	77.75	96.21
	(47.99)	(79.46)	(85.12)	(40.29)	(77.24)
Large	81.56	94.90	92.87	68.27	91.17
	(45.14)	(69.52)	(64.06)	(29.70)	(63.31)

Notes: Small = Less than 5 acres.
Medium = 5 to 25 acres.
Large = 25 acres and above.
Extensive Use of Land = Net sown area/Farm size.
Figures in parentheses are the proportions of irrigated cultivated area to cultivated area.

Table 2

Gross Cropped Area as a Proportion of Farm Area across Farm Size Groups in Pakistan (1960–1980)

Farm Size	NWFP	Punjab	Sindh	Balochistan	Pakistan
1960					
Small	131.34	111.03	131.50	91.90	115.88
Medium	112.16	107.89	117.77	80.19	109.14
Large	88.35	99.19	94.99	49.86	88.97
1972					
Small	145.98	127.73	143.62	86.28	132.75
	(160.21)	(130.65)	(119.17)	(105.79)	(131.56)
Medium	116.57	114.44	123.63	80.96	115.68
	(135.00)	(118.85)	(109.29)	(104.80)	(116.40)
Large	82.47	105.52	97.32	64.37	99.06
	(99.00)	(112.90)	(105.81)	(100.14)	(110.46)
1980					
Small	154.56	143.11	157.13	94.91	146.23
	(162.69)	(149.03)	(142.54)	(117.95)	(148.52)
Medium	126.03	126.57	134.10	84.14	126.40
	(138.08)	(134.11)	(129.21)	(114.02)	(132.55)
Large	90.38	115.39	112.12	72.36	109.16
	(112.04)	(127.67)	(123.10)	(109.72)	(125.46)

Notes: Small = Less than 5 acres.
Medium = 5 to 25 acres.
Large = 25 acres and above.
Intensive Use of Land = Gross cropped area /Farm size.
Figures in parentheses are the proportions of irrigated gross cropped area.

nomic relationships. There is a wide variety of equations to choose from to represent any economic function. In studying agricultural relations, economists predominantly use the linear, quadratic, and Cobb-Douglas forms. The widely accepted procedure is to choose the function that explains best the variation in the dependent variable. Equations having the highest $\bar{R}^2$ and the least residual sum of squares are used to select the best fit [Maddala (1988); Koutsiyiannis (1977)].

In our study, we analyze the relationship between farm size (in terms of total land cultivated) and land use (in terms of GCA and NSA) in terms of the following functional forms:

$$NSA \text{ or } GCA = a_{01} + a_{11}\, TA \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$NSA \text{ or } GCA = a_{02} + a_{12}\, IA + a_{22}\, UA \quad \ldots \quad \ldots \quad (2)$$

$$NSA \text{ or } GCA = a_{03} + a_{13}\, TA + a_{23}\, TA^2 \quad \ldots \quad \ldots \quad (3)$$

$$NSA \text{ or } GCA = a_{04} + a_{14}\, IA + a_{24}\, IA^2 + a_{34}\, UA + a_{44}\, UA^2 \quad \ldots \quad (4)$$

$$Ln\, NSA \text{ or } Ln\, GCA = a_{05} + a_{15}\, TA \quad \ldots \quad \ldots \quad (5)$$

$$Ln\, NSA \text{ or } Ln\, GCA = a_{06} + a_{16}\, IA + a_{26}\, UA \quad \ldots \quad \ldots \quad (6)$$

$$Ln\, NSA \text{ or } Ln\, GCA = Ln\, a_{07} + a_{17}\, Ln\, TA \quad \ldots \quad \ldots \quad (7)$$

$$Ln\, NSA \text{ or } Ln\, GCA = Ln\, a_{08} + a_{18}\, Ln\, IA + a_{28}\, Ln\, UA \quad \ldots \quad (8)$$

$$Ln\, (NSA/U) \text{ or } Ln\, (GCA/UA) = Ln\, a_{09} + a_{19}\, Ln\, (IA/UA) \quad \ldots \quad (9)$$

Where $TA = IA + UA$ and NSA and GCA are as defined before.

In Equations 1, 3, 5 and 7, we define the farm size in terms of the total cultivated farm area, and in Equations 2, 4, 6 and 8 we re-define the farm size in terms of its two attributes, namely, the irrigated lands and the unirrigated lands.

If Equation 1 or 2 turns out to be the best equation, then that would indicate a size-neutral impact on land use since, according to these equations, every unit increase in TA or IA or UA leads to a constant increase in NSA or GCA. If 3 or 4 turns out to be the best equation, then it would indicate economies or diseconomies of scale, depending on whether a_{23}, a_{24} and a_{44} are positive or negative; and, finally, if 7 or 8 turns out to be the best equation, then it would indicate economies or diseconomies of scale, depending upon whether a_{17} and $(a_{18} + a_{28})$ are greater or less than unity.[2]

[2]For a discussion on the implications of different functional forms for land reforms, [see Sampath (1989)].

RESULTS AND DISCUSSIONS

Table 3 presents the estimates of nine regression equations, which relate farm size to the net area sown. According to Rao and Miller (1972), if the equations have the same dependent variable, we can choose the best equation solely on the basis of $\bar{R}^2$. An examination of the first four equations reveals that the variations in *NSA* are better explained by variations in *IA* and *UA* simultaneously, as in Equation 2, than by variations in *TA* (=*IA* + *UA*) alone, as shown by their respective $\bar{R}^2$. Equation 2 shows clearly that the two types of land, *IA* and *UA*, lead to a differential impact on net sown area and, as such, the linear aggregation of *IA* and

Table 3

Farm Size and Net Sown Area

Eq. No.	Dep. Var.	Constant Term	TA	TA^2	IA	IA^2	UA	UA^2	$\bar{R}^2/F$
1	*NSA*	14.5974	0.1413 (0.038)						0.2488 /35.11
2	*NSA*	3.4081			1.0744 (0.0380)		0.015 (0.0103)		0.8921 /443.13
3	*NSA*	0.3968	0.8227 (0.0271)	– 0.0007 (0.00002)					0.9007 /486.09
4	*NSA*	0.5017			1.2075 (0.1350)	0.0024 (0.0010)	0.3423 (0.0798)	– 0.0003 (0.00007)	0.9198 /307.86
5	*LnNSA*	1.7102	0.0059 (0.0013)						0.1607 /20.29
6	*LnNSA*	1.3072			0.0396 (0.0045)		0.0014 (0.0012)		0.4557 /45.78
				LnTA		*LnIA*		*LnUA*	
7	*LnNSA*	– 0.0077		0.918 (0.0148)					0.9732 /3849.07
8	*LnNSA*	0.579				0.7486 (0.0201)		0.2084 (0.0154)	0.9866 /3948.35
					Ln(IA/UA)				
9	*Ln(NSA/ UA)*	0.5085			0.7991 (0.0162)				0.9584 /2440.39

Note: Numbers within brackets are the standard errors of coefficients.

UA is not valid; and doing so will only lead to the aggregation (mis-specification) bias in the estimated parameters and, as such, the estimated parameters are not dependable estimates [Johnston (1987)]. Further, a comparison of Equations 1– 4 clearly shows that the quadratic equations are superior to the linear equations in terms of the explanatory power with statistically significant parameters.

Equations 5, 6, 7 and 8 provide the estimates of semi-log and double-log equations, respectively. Using the residual sum of squares (RSS) of linear Equations 1 and 2, and semi-log Equations 5 and 6, we tested the null hypothesis that the irrigated and unirrigated lands have the same effect on *NSA*. The computed *F*-statistics rejected the null hypothesis for both the linear and semi-log equations at 99 percent confidence level. These results further confirm recent findings [Sampath (1989)].

An examination of the $\bar{R}^2$s of Equations 7 and 8 shows that the double-log equations explain the variations in *NSA* better than the semi-log Equations 5 and 6. Because, between Equations 7 and 8, 8 explains the variation in *NSA* better than 7; further, as there is also the aggregation bias involved in the estimation of Equation 7, Equation 8 should be preferred to Equation 7. Thus, we are finally left with Equations 4 and 8 as the most competitive ones among the eight that we estimated. Since these two regression equations have different dependent variables, we cannot directly compare their $\bar{R}^2$s. So, we estimated the residual sum of squares (*RSS*) of the linear and logarithmic equations by using the standardized values of *NSA* (by dividing *NSA* by its geometric mean). On the basis of the minimum *RSS* criterion, the logarithmic Equation 8 emerged as the better equation between the final two equations.

According to the size elasticity coefficient of *NSA* Equation 7, there exist diseconomies of scale in the extensive use of land since the coefficient is, statistically, significantly less than one (0.9185) at 99 percent confidence level. An examination of the elasticity coefficients in Equation 8 reveals that both (*IA* and *UA*) coefficients are statistically significant at 99 percent level of confidence. Although in Equation 8, the sum of elasticity coefficients is also less than one[3] (0.957), it is greater than the value of the elasticity coefficient in Equation 7. This shows that Equation 7 over-estimates the diseconomies of scale in *NSA*. This under-estimation of returns to scale is the result of the aggregation (mis-specification) bias in the estimation of Equation 7.

Thus, it is likely that, by defining the farm size in terms of an operational farm-holding (defined in terms of the linear aggregation of the irrigated and unirrigated cultivated area), the earlier studies might have under-estimated the homo-

[3]We tested the linear homogeneity of Equation 8 by estimating Equation 9. The *F*-test based on the *RSS* of Equations 8 and 9 rejected the null hypothesis that Equation 8 is linear homogenous.

geneity of the function representing the relationship between farm size and extensive use of land [Chaudhry *et al.* (1985); Bharadwaj (1974); Berry and Cline (1979); Salam (1978)]. So following Sampath (1989), we would also argue that "since lands with and without irrigation facilities are neither equal in their effect on land use nor their distribution is [*sic*] proportional across farm size groups, it is desirable to define the farm size in terms of multiple attributes and analyze the effect of size in terms of the homogeneity of the overall function rather than in terms of a single attribute such as land size alone".

Table 4 provides summary statistics pertaining to 9 regression equations which relate the farm size with gross cropped area. Once again, while comparing

Table 4

Farm Size and Gross Cropped Area

Eq. No.	Dep. Var.	Constant Term	*TA*	TA^2	*IA*	IA^2	*UA*	UA^2	$\bar{R}^2/F$
1	*GCA*	17.3631	0.1605						0.2244
			(0.0290)						/30.64
2	*GCA*	3.815			1.2904		00.76		0.8832
					(0.0473)		(0.0128)		/405.50
3	*GCA*	0.625	0.9637	– 0.0008					0.8563
			(0.0390)	(0.00003)					/319.78
4	*GCA*	1.4156			1.4258	0.0021	0.2522	– 0.0002	0.8940
					(0.1350)	(0.0010)	(0.0798)	(0.00007)	/307.82
5	*LnGCA*	1.9661	0.0056						0.1622
			(0.0012)						/20.51
6	*LnGCA*	1.578			0.0380		0.0012		0.4740
					(0.0041)		(0.0011)		/49.20
				LnTA		*LnIA*		*LnUA*	
7	*LnGCA*	0.3651		0.8570					0.9628
				(0.0164)					/2744.21
8	*LnGCA*	0.869				0.7521		0.1517	0.9817
						(0.0221)		(0.0169)	/2867.61
					Ln(IA/UA)				
9	*Ln(GCA/ UA)*	0.7114			0.8651				0.9417
					(0.0209)				/1710.73

Note: Numbers within brackets are the standard errors of coefficients.

the first four equations, we find that Equations 2 and 4 in terms of *IA* and *UA* have better explanatory powers ($\bar{R}^2$) as compared to Equations 1 and 3 in terms of *TA* (=*IA* + *UA*). As we argued earlier, the estimates of Equations 1 and 3 are not dependable since they define farm size in terms of linear aggregation of the irrigated and unirrigated land which leads to the aggregation (mis-specification) bias in the estimated parameters.

The quadratic term comes out as statistically significant only for the *UA* variable in Equation 4. We tested the null hypothesis that the irrigated and unirrigated lands have the same effect on gross cropped area by using the *RSS* of linear Equations 1 and 2 and the semi-log Equations 5 and 6. We found that the computed *F*-statistics rejected the null hypothesis for both linear and semi-log Equations at 99 percent level of confidence.

As before, a comparison of Equations 7 and 8 reveals that Equation 8 (in terms of *IA* and *UA*) has a higher explanatory power ($\bar{R}^2$). An examination of elasticity coefficients shows that according to Equation 7 the homogeneity of the function is 0.857 in contrast to the 0.9038 indicated by Equation 8. But, then, we know that Equation 7 is mis-specified and, as such, its estimate is not reliable. Thus, once again, we find in the intensive use of land regression Equation also that the conventional way of defining farm size in terms of linear aggregation of *IA* and *UA* leads to the aggregation bias in the estimation of the homogeneity of the function.[4] Finally, in order to choose the most appropriate one between Equations 4 and 8, we used the transformed *GCA* (by dividing *GCA* by its geometric mean) in estimating those two functions. The analysis in terms of the transformed *GCA* once again confirmed that log-linear specification is superior to the linear specification. Thus, an analysis of the results reported in Table 4 once again shows that farm size in terms of linear aggregation of the irrigated and unirrigated land leads to an underestimation of the degree of homogeneity of the function relating farm size to the intensive use of land.

IMPLICATIONS AND CONCLUSIONS

In this paper we analyzed the relationship between the farm size and economies of scale in the extensive and intensive use of land. We found, confirming Sampath's recent findings, that the definition of farm size in terms of linear aggregation of the irrigated and unirrigated lands leads to the mis-specification bias, resulting in the under-estimation of the degree of homogeneity of the functions.

The implications of the above analysis are fairly obvious. First of all, the

[4]We tested the linear homogeneity of Equation 8 by estimating Equation 9. The *F*-test based on the *RSS* of Equations 8 and 9 rejected the null hypothesis that Equation 8 is linear homogenous.

one-dimensional definition of farm size in terms of total land size without distinguishing between the irrigated and the unirrigated lands not only mis-specifies the functional relationships between farm size, on the one hand, and land use and other economic variables, on the other hand; but, more importantly, it also under-estimates the returns to scale value, thereby leading to over-estimation of possible benefits from the re-distribution of land. Secondly, the division of lands into irrigated and unirrigated brings out the importance of irrigation in determining the levels of the extensive and intensive uses of land and goes a long way in explaining the inter-farm size as well as the intra-farm size variations in land use intensities. Thirdly, explicit estimates of the positive impact of irrigation on land use and productivity clearly indicate that there is an alternative policy for radical land reforms to bring about significant changes in the distribution of agricultural income and assets. That alternative policy is to use irrigation development and distribution, which are predominantly under the direct or indirect control of the government, as policy tools to help the small and marginal farmers. For example, the government can adopt a lexicographic ordering in its distribution of canal water, under which the smallest farmer's irrigation needs will be met first, followed by the next largest, and so on. This policy can achieve the same results in terms of reducing the inequity in income and assets as a radical land re-distribution policy, though without the possible dire socio-political consequences and problems that the latter entails. Fourth, the above analysis also shows that similar problems might also exist in other empirical studies conducted on issues such as the levels of economic efficiency across farm-size groups, the returns to scale in the production function across farm groups, etc. This means that further studies need to be conducted wherever researchers had used data which linearly aggregated heterogeneous capital or labour or raw materials into a single homogeneous variable.

REFERENCES

Berry, A. R., and W. R. Cline (1979) *Agrarian Structure and Productivity in Developing Countries*. Baltimore: The Johns Hopkins University Press.

Bharadwaj, K. (1974) Production Conditions in Indian Agriculture: A Study Based on the Farm Management Surveys. Cambridge: Cambridge University Press.

Chaudhry, M. G., M. A. Gill and G. M. Chaudhry (1985) Size-productivity Relationship in Pakistan's Agriculture in the Seventies. *The Pakistan Development Review* 24 : 3 & 4.

Cline, W. R. (1970) *Economic Consequences of a Land Reform in Brazil*. North Holland.

Johnston, J. (1987) *Econometric Methods*. (3rd Edition.) Singapore: McGraw-Hill Co.

Koutsiyiannis, A. (1977) Theory of Econometrics. London: Macmillan.

Maddala, G. S. (1988) Introduction to Econometrics. London: Macmillan.

Pakistan Agricultural Census Organization (1963) *Pakistan Census of Agriculture, 1960*. Vol. II. Karachi: West Pakistan.

Pakistan Agricultural Census Organization (1975) *Pakistan Census of Agriculture, 1972*. Vol. I. All Pakistan Report, Lahore, Pakistan.

Pakistan Agricultural Census Organization (1983) *Pakistan Census of Agriculture, 1980*. Vol. I. All Pakistan Report, Lahore, Pakistan.

Pakistan, Government of (1989) *Agricultural Statistics of Pakistan 1987-88*. Islamabad: Ministry of Planning.

Pakistan, Government of (1990) *Pakistan Economic Survey 1988-89*. Islamabad: Finance Division, Economic Adviser's Wing.

Rao, P. M., and R. L. Miller (1972) *Applied Econometrics*. New Delhi: Princeton Hall of India, Private Ltd.

Salam, A. (1978) Factor Input Use and Farm Productivity on Different Farm Categories in the Punjab. *The Pakistan Development Review* 17 : 2 316–332.

Sampath, R. K. (1989) Farm Size and Land Use Intensity in Indian Agriculture. Mimeo, Department of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO. July 1989, 13 pages. Accepted for publication in Oxford Economic Papers, to appear in October 1992 issue.

Sampath, R. K., and C. Gopinath (1979) Land Distribution in India: Its Nature and Economic Implications. *Margin* 11 : 2 43–70