Pak. J. Agri. Sci. Vol. 37(1-2),2000

A STUDY OF RURAL WELFARE INDICATORS IN VARIOUS CROP ECOLOGICAL ZONES OF THE PUNJAB

Bashir Abmad, Muhammad Rafiq, M. Aslam Chaudhry' & Jack A. Sinden"
'Faculty of Agricultural Economics and Rural Sociology, University of Agriculture, Faisalabad
2University of New England, Armidale, Australia

This paper represents an attempt at deriving the welfare scores by using logarithmic transformation. These scores have been used to assess the comparative effects of different policies to improve the quality of life in the rural Punjab, Results of the study show that provision of roads, education and health facilities were the main defieient areas requiring immediate government attention in the needed cropping zone. Similar results, with relatively low seems, were obtained for the cotton- and rice -based cropping zones.
Key words: ecological zones, logarithmic transformation, policy implications, welfare indices

INTRODUCTION

The agriculture sector of Pakistan makes up about 23% of the gross domestic product and engages around 47% of the employed labour force (Anonymous, 1997-98). Approximately 75% of the nation's exports originate in agriculture sector. In terms of earnings in foreign exchange, its share is as high as 80%. Thus agriculture sector makes a substantial contribution to the national economy. Of the total population of Pakistan, over 70% still lives in rural areas. The quality of life in rural areas differs in terms of variation in income, education, health, access to metal roads and other facilities. This is particularly true for various crop ecological zones, since spatial distribution of these facilities is not uniform for various reasons. The study has therefore been conducted with the following objectives:

L To estimate welfare indices of villages lying in various crop ecological zones of the Punjab.
ii. To relate welfare to agricultural characteristics of the zones, and
iii. To analyse the effect of policies on rural welfare and to draw policy conclusions.

METHODOLOGY,

The Study Area: The study is confined to villages located in the three major crop ecological zones of the Punjab Le. the cotton-based cropping, the rice-based cropping and the mixed cropping zones. The districts and the number of villages in each zone are shown in Table 1.

The Economic Model: The welfare(W) of an individual can be expressed as a function of. utility(U) derived from the consumption of various goods and services (Sinden et al., 1997).

$W = F(U_1, U_2 \ldots\ldots Un)$ ..... (1)

Conventionally, utility is measured as the benefit/B) from each good and service. Therefore, equation (1) can be written as

$W = F(B_1, B_2 \ldots\ldots B_n)$ ..... (2)

In a competitive market, the benefit for a given good may be estimated as the quantity consumed(Q) times the market price (P). Thus equation(2) may be written as

$W = (Q_1 P_1, Q_2 P_2, \ldots\ldots Q_n P_n)$, ... (3)

If the different goods and services consumed (V) are appropriately weighted (Wt) then equation (3) can be written *as*

$W = F(V_1 * WT_1, V_2 * WT_2 \ldots\ldots, V_n * WT_n)$ ..... (4)

Equation (4) generalizes the basic utility model of equation (1). The variables in equation (5) were measured in standard Z-scores Le. the number of standard deviations of the particular value above or below the mean for that particular variable. The'se scores were then summarized into an overall index of welfare for each region or district (overall variable i, for each district J).

$W_j = E_i Z_i$ ..... (5)

Equation (5) has two deficiencies Le. first an equal weight is given to each variable and second, it assumes constant marginal utilities for increasing amount. The first deficiency can be overcome by including a weight WT; for each variable. Thus equation (5) can be written as

$W_j = L(Z_i * \sim)$ ..... (6)

The second deficiency can be overcome by transferring the Z -' scores to reflect diminishing marginal utility. This can be done through logarithmic (equation 7) or square root equation (8) transformations.

$W_t = L(\log Z_i * \sim)$ ..... (7)

Table 1. The districts in the study area with the number of villages by ecological zone

Cotton-based cropping zone		Rice-based cropping zone		Mixed cropping zone	
Multan	537	Gujranwala	834	Faisalabad	842
Vehari	779	Sheikhupura	1091	Toba Tek Sa	543
Lodhran	436	Gujrat	974	Jhang	1083
Pakpattan	325	Hafizabad	422	Sargodha	849
Khanewal	679	Mandils"	432	Sahiwal	786
Bahawalpur	706	Sialkot	1578	Okara	933
		Narowal	1316		
Total	3462		6647		5036

a Toba Tek Singh; b Mandi Bahauddin.

Table 2. Weights assigned to different variables

Variable'	Definition	Weights
Total income	(% Agri. households rental)	0.4
Off-farm income	hh with off-farm income(%)	0.05
Other farm income	hh with other farm income(%)	0.05
Income--overall		0.5
Education	average distance to facilities	0.1
Health	average distance to facilities	0.1
Housing	houses complete Pakka(%)	0.1
Transport	average distance to metalled road	0.1
Services	average distance to facilities	0.1
	Total weight	1.0

Table 3. Welfare scores by district/zone -from the best (1) to the worst (19)

District/Zone	Model 1 Standard Z-score	Model 2 Logarithmic transformation	Model 3 Square root transformation
1 Gujrat	234	185	153
2 Bahawalpur	233	184	153
3 Multan	229	183	151
4 Khanewal	226	181	150
5 Sialkot	215	177	147
6 Vehari	213	176	146
7 Gujranwala	211	175	145
8 Pakpattan	204	172	143
9 Faisalabad	203	171	143
10 Narowal	196	167	140
11 Mandi Bahauddin	194	166	139
Mean	189	164	137
12 Sargodha	187	162	137
13 Toba Tek Singh	186	162	136
14 Lodhran	182	160	135
15 Sheikhupura	167	151	129
16 Sahiwal	163	149	128
17 Hafizabad	147	139	121
18 Jhang	102	102	101
190kara	100	100	100
Cotton-based cropping zone	214	176	146
Rice-based cropping zone	195	166	139
Mixed cropping zone	157	141	124
Mean	189	161	137

$$W_t = \sum (\overline{Z\,Y} * WT_i) \quad \text{......(8)}$$

The variables included in the index of welfare were total income, off-farm income, other farm income, education, health, housing, road access and services (Sinden et al., 1997).

The weights assigned to different variables were as given in Table 2 before the application of equations (6), (7) and (8). The majority of the data were taken from secondary sources (Government of Pakistan, 1994, 1996).

RESULTS AND DISCUSSION

The standardized scores on a base of 100, for different districts and three ecological zones are shown in Table 3. It shows that welfare of villages in the cotton- based cropping districts is the highest, while that in mixed cropping districts is the lowest. There is a considerable difference in the quality of life or welfare between districts.

The results by district and the average results naturally follow each other, but the exceptions to the general trend are of interest. For example, the rice-based districts of Gujrat, Sialkot, and Gujranwala are in the top seven and Gujrat is the top-ranked district -- despite the fact that income to cotton-based districts is weighted much more heavily than income to the rice-based districts. In all three of these districts, the values for the housing variable are well abo~e average. All these districts receive heavy rainfall where unbarred mud bricks are unsuitable for house construction, and thus there is a higher proportion of complete Pakka houses in these districts. Indeed, Gujrat has the highest percentage of complete Pakka houses in the sample. These differences are sufficient to raise these three districts in the rice-based cropping zone so that these are placed among the top seven districts.

Similarly, Lodhran is a district in the cotton-based cropping zone but ranks only 14th in the list of Table 3. Despite the high weight on cotton income, the Z-score values on education, health, and services in Lodhran are particularly poor. The villages in Lodhran district are farther from these facilities than the average and so the cumulative effect of these three variables outweighs the effect of the cotton income.

Policy Implications: The welfare scores derived by using the logarithmic transformation were used to assess the comparative effects of different policies to improve the quality of life. It was observed that the improvements in roads increased the welfare scores by a visible margin in the mixed cropping zone, followed by the rice-based and the cotton-based zones. When the effect of providing more schools was modeled by reduction in distance to educational facilities by 10%, the actual and percentage' increases were again the highest in the mixed zone followed by the cotton-based and the rice-based cropping zones. Similar behaviour was observed with a reduction in health facilities in various crop ecological zones. Thus the government should emphasize on providing roads, education and health facilities in. the districts of the mixed cropping zone on priority basis.

REFERENCES

Ahmad, Bashir and M. A. Chaudhry. 1996. Productivity differential between Pakistan and Indian Punjabs: An analysis. Agricultural Social Sciences Research Centre, Faculty of Agricultural Economics and Rural Sociology, University of Agriculture, Faisalabad.

Anonymous. 1997-98. Economic Survey. Economic Advisor's Wing, Finance Division, Government of Pakistan, Islamabad.

Government of Pakistan. 1994. 1990 Census of Agriculture : Province Report Punjab Vol.II, Part 2, Economic Affairs and Statistics Division, Agricultural Census Organisation, Pakistan.

Government of Pakistan. 1996. Pakistan Mouza Statistics 1993 : Settled Areas, Statistics Division, Agricultural Census Organization, Pakistan.

Sinden, J.A., Bashir Ahmad and M.A. Chaudhry. 1997. An econOI~ic comparison of rural welfare in various crop ecological regions of the Punjab. Agricultural Social Sciences Research Centre, Faculty' of Agricultural Economics and Rural Sociology, University of Agriculture, Faisalabad.

$$W = (f) \quad (V1 * W\sim, V_2 \quad * WT_2 \ldots\ldots, V'' * WT_{,,}) \ldots\ldots\ldots\ldots (3)$$

The weights should be proxies for market prices and thus must indicate the relative benefit of a unit of the particular variable or facility. The method should therefore be based on the perceptions of the state of existing facilities. The weights in this study are derived from the quantitative differences and relative ~ating. When variables are ranked equally, the rankmg could be coded in two ways. Consider the case of ten variables, when two rank equal to second. The direct approach is to score variable from one to ten, and score 2 for both of the variables that rank second (call it procedure A). The alternative approach is to score the two equally ranked variables as 2.5 because they occupy second and third places and the average is 2.5 (call it procedure B).

The steps followed in ranking 10 variables for procedure A are as under:

a) Score the ten variables from 1 (the worst facility, or that the most in need of improvement) to 10 (the best facility, or that the least in need of improvement).
b) Sum the rankings (1 to 10) over all G villages for each variable.
c) Divide the sum by G to obtain the average ranking per variable per village. The. variable most in. need of improvement will rank with the lowest number, perhaps at 1.0, and the variable least in need of improvement will rank with the highest number perhaps at 10.0.
d) Take the reciprocal of each average ranking to begin to set the average rankings on a percentage scale.
e) Multiply the reciprocals by 100. This will place the "worst" variable, or that with the highest priority for improvement, at a value of 100. All the other variables will now be percentages, or proportions of 100.

Follow the same steps for ranking procedure B to give a second listing of priorities. For the prioritization of satisfaction, about the various facil~ties, data were collected from the entire sample ?f villages. The satisfaction level was categorised mt? three groups i.e. highly satisfactory, satisfactory and unsatisfactory. Priorities for various facilities were derived by using the following steps:

a) Determine the number of times that a variable is classed as highly satisfactory, satisfactory and unsatisfactory, over the entire sample of G villages. This gives a direct, in general, indication of pri~ties.
b) Rate these three levels of satisfaction in numerical terms such as 3, 2, or 1, respectively.
c) Multiply the number of times (N) that each rating i occurs by its rating R to give a product (N;*RJ There will be three products per variable because there are three ratings per variable.
d) Sum the three products from step (c) per variable over all G villages.
e) Divide the sum from (d) by the number of villages (G), to give the average satisfaction rating. per village per variable. This is a measure of the needed priorities, where 1 = the most in need of improvement because 1 indicates the most unsatisfactory level.
f) Take the reciprocal of the average satisfaction rating for each variable from step (d).
g) Multiply the reciprocals by 100. This will place the "worst" variable, or that with the highest priority for improvement, at a value of 100. All the oth~r variables will now be percentages, or proportions of 100.

To derive the weights from the ranked data, start from the reciprocals of step (d). Sum the reciprocals over the variables of interest. Then divide each reciprocal by the sum to give a set of weights which add to 1.0. The weights are measures of relative benefit of an extra unit of each variable. When the weights are multiplied by the amounts by which a given variable may be improved, the product would indicate the relative benefits of each programme of expenditure.

RESULTS.AND DISCUSSION

The data collected from 30 villages surveyed were compared with the secondary sources. Table 1 shows that the surveyed villages were approximately representative of the Faisalabad district in terms of distance to banks. But they were sUbs~antially closer to post offices, police stations, public call offices and metalled roads, while those were substantially farther from union council offices and field assistant's / stock assistant's offices.

Improvement Priorities: The priorities for improvement, as observed by the villagers are presented in Tables 2 and 3. Improvements. in income were always set as first priority. Both sets of results exhibit several groups of priorities. In the second group fall improvements in health house drainage, and education. In the third' group,

Table 1. Comparison of some characteristics of Faisalabad district and the surveyed villages: Distances from public institutions (km)

Public institution	Faisalabad district[a]	Villages surveyed	
		all 30	When absent[b]
Post office	2.0	1.0	3.8
Police station	7.3	5.5	6.1
Bank	4.3	3.7	4.8
Public call office	4.6	0.8	4.2
Union council office	2.6	3.6	4.7
Field assistant's / S.A.'s office	3.0	4.2	5.3
Distance to a metalled road	1.3	0.5	2.1

a: Source: Government of Pakistan (1996).

b: The column of distances shows the average distance of an institution from the village, when it is absent from the village. For example, there were post offices in 22 of the 30 villages. Thus they were absent from eight villages and, on average, were 3.8 km from these eight villages.

Table 2[a]. Priorities for improvements in welfare, by the ranking procedures

Variable	Ranking procedure A	Ranking procedure B
Top priority		
Income	100	100
Second group of priorities		
Health	33	27
House drainage	30	26
Education	30	25
Third group of priorities		
Agricultural officer	20	16
Field assistant / stock assistant	19	15
Veterinary officer / LPO	19	15
Transport	17	15
Fourth group of priorities		
Services	15	13
House construction	13	12

a: The numbers are standardized on a base where the highest priority scores 100, and the lower priorities are percentages of that base.

Table 3[a]. Priorities for improvements in welfare, by the satisfaction level procedure, with three numerical ratings of the levels[b]

Variable	Ratings of satisfaction levels (1=worst to 3,5, or 7=best)		
	1/2/3[c]	*11315<*	*1/4/7*[d]
Top priority			
Income	100	100	100
Second group of priorities			
Health	88	79	71
House drainage	77	63	53
Education	75	60	50
Third group of priorities			
Agricultural officer	67	50	40
Field assistant *IStock* Assistant	63	45	36
Veterinary officer	60	43	33

Fourth group of priorities			
Transport	53.36		27
Services	50	33	25
House construction	45	29	21

a) The numbers are standardized on a base where the highest priority scores 100, and the lower priorities are percentages of that base.
b) In this set of results, unsatisfactory was rated as I, satisfactory as 2, and highly satisfactory as 3. The priorities were calculated as described above.
c) In this set of results, unsatisfactory was rated as I, satisfactory as 3, and highly satisfactory as 5. The priorities were calculated as described above.
d) In this set of results, unsatisfactory was rated as I, satisfactory as 4 and highly satisfactory as 7. The priorities were calculated as described above.

Table 4. Sets of weights for six variables, by two ranking procedures

Variable	Ranking A	Rankinz B	Average"
Income	0.481	0.519	0.5
Education	0.144	0.131	0.1
Health	0.157	0.139	0.1
House construction	0.063	0.063	0.1
Transport	0.083	0.080	0.1
Services	0.072	0.068	0.1
Total	1.000	1.000	1.0

a: Rounded to one place of decimal.

Table 5. Sets of weights for six variables, by the satisfaction level procedures

Variable	Rating of the three levels of satisfaction		
	1/2/3"	1/3/5[b]	*1/4/T*
Income	0.250	0.312	0.362
Education	0.188	0.187	0.181
Health	0.193	0.195	0.191
House construction	0.112	0.090	0.077
Transport	0.132	0.112	0.098
Services	0.125	0.104	0.091
Total	1.000	1.000	1.000

a) In this set of results, unsatisfactory was rated as I, satisfactory as 2, and highly satisfactory as 3. The priorities were calculated as described above.
b) In this set of results, unsatisfactory was rated as I, satisfactory. as 3, and highly satisfactory as 5. The priorities were calculated as described above.
c) In this set of results, unsatisfactory was rated as I, satisfactory as 4 and highly satisfactory as 7. The priorities were calculated as described above.

improvements have been suggested in approaching the agricultural officers/field assistants / stock assistants, and veterinary officersILPO's. But the second group is substantially behind the first, and the third is substantially behind the second. Health ranks slightly above education as shown in Tables 3 and 4, perhaps because students need to be healthy to get a good education -- as several villagers mentioned to the survey team.

The high priority for education results from dissatisfaction with distances to colleges, high schools, and middle schools especially for girls as indicated by the numerical ratings of 1, 2 and 3. If all villages were unsatisfied, the level of education would have an average rating of 1.0, if satisfied 2.0,

and if highly satisfied 3.0. The average satisfaction ratings for all schools and colleges over the entire set of 30 villages were as follows:

Primary	Girls	2.6	High	Girls	1.5
	Boys	2.6		Boys	1.4
Middle	Girls	1.5	College	Girls	1.0
	Boys	1.9		Boys	1.1

Clearly, access to primary schools is satisfactory to highly satisfactory. But the respondents from all villages opined that access to girls colleges was unsatisfactory, giving the average score of 1.0. Similarly, respondents from twenty-seven villages were of the view that access to boys colleges was unsatisfactory, giving the average score of 1.1. Further, the score for access to high schools was intermediate between unsatisfactory and satisfactory -- more poor results. Residents of a large village in the sample had solved their problem of access to high schools by arranging their own transport for their children.

There are several observations on these priorities.

(a) The low priority to improvements in having access to agricultural officers and field assistants / stock assistants contrasts with the high priority on improvements in income. In rural areas, improvements in income come from improvements in agricultural output and field assistants / stock assistants are an important source of information for such improvements. Perhaps the villagers have had little experience with this kind of information and thus cannot assess their role in improving income.

(b) The current dissatisfaction in reaching the educational institutes rests on dissatisfaction with colleges, high and middle schools. This problem mainly stems from the colleges/schools being at longer distances from the villages.

Recommendations for policies to improve rural welfare must consider all the variables which contribute to welfare. Policies to improve household drainage require simple, inexpensive technology. Improvements to schooling require more schools at all levels above primary level and specific arrangements for transport to existing colleges/schools, which of course appears to be an expensive undertaking. Dispensaries are available in 50% of the surveyed villages. In contrast, for Faisalabad district as a whole, hospitals / dispensaries / rural health centres exist in only 3% of the villages (Government of Pakistan, 1996). The distribution and number of these facilities can only be increased with a large amount of funds.

~The Weights Between the Variables: The priorities were assessed over ten variables, and over eight types of education. The weights were assessed over six variables, sincefor these variables Punjab-wide data are available (Government of Pakistan, 1996). There are no such widespread data available on household drainage, neither on the availability of agricultural officers/field assistants nor for veterinary officers/LPO's as such. The results for the weights between the six variables of income, education, health, house construction, transport and services in general, are shown in Tables 4 and 5.

Income is weighted the highest because of its importance and its use as a standard against which to judge the other variables. The weights from the rankings (Table 4) show that income is some four times as important as the variables of education and health. Since these two rankings are similar therefore the average may be taken. Weights can only be derived from the satisfactory ratings by assuming scores for each level of satisfaction. Accordingly, three sets of scores were assumed, namely 1/2/3, 1/3/5, and 1/4/7, for unsatisfactory, satisfactory, and highly satisfactory, respectively. As shown in Table 5, the weights tend to vary with these assumptions. The gap between the highest income and the lowest level of services naturally widens as the scores widen from 1/2/3 to 1/4/7. Because of the difficulty in knowing which of these sets of rating scores is most appropriate, the weights by ranking appear more relevant than the weights by satisfaction ratings. Indeed, an intuitively plausible set results when the weights by rankings are averaged and rounded to one place of decimal. Nevertheless, the two sets support one another in that the order of variables is the same.

Conclusions

(a) There is, naturally, a widespread dissatisfaction with the levels of income.

(b) The're is a considerable dissatisfaction with household drainage, education and health.

(c) The villagers find only house construction better than satisfactory. Every variable, other than services, is rated as less than satisfactory. There 'is little about rural welfare in this area that may be termed as satisfactory.

The priorities for improvement, naturally, follow the levels of satisfaction or rather the relative levels of dissatisfaction. The villagers are highly concerned

about educational facilities at all levels above primary schools. In the long run, improvements in educational facilities may be the solution to many of the problems of rural welfare. The relatively low priority to improvements in having access to the field assistants/agricultural officerslLPO's is of some concern, because these people are in a position to extend new knowledge about agricultural techniques and livestock production and thus can help to improve income.

REFERENCES

Davidson, B., B. Ahmad and M.A. Chaudhry. 1996. Estimating the extent of poverty in the mixed farming zone of the Punjab. A report prepared for the Agricultural Social Sciences Research Centre, Faculty of Agricultural Economics and Rural Sociology, University of Agriculture, Faisalabad.

Government of Pakistan. 1996. Pakistan Mouza Statistics 1993 : Settled Areas. Statistics Division, Agricultural Census Organisation, Islamabad.

Sinden, J.A., B.Ahmad and M. A. Chaudhry. 1997. An economic comparison of rural welfare in various crop ecological regions of the Punjab. Agricultural Social Sciences Research Centre, Faculty of Agricultural Economics and Rural Sociology, University of AgricultUre, Faisalabad.