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Samuel H. Logan, Editor

THE USE OF PUBLIC LAND AND WATER RESOURCES

Chairman: Kenneth Nobe, Colorado State University

ON LINKING LOCAL RURAL INCOME REDISTRIBUTION TO RECLAMATION INVESTMENTS

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What are some of the research difficulties encountered when attempting an assessment of degree of income shifting among local farmers who are direct beneficiaries of a reclamation project? In this paper, we show that the research is expensive, difficult, and that, as yet, there is no best way to interpret and display the results.

Since a number of studies of income redistribution effects of reclamation investments are now in print, there may be some utility in relating our research to what has gone before. Except in one case [7] earlier work has been concentrated on estimates of the net positive or negative flows of income into the rural sectors or regions where reclamation projects have been undertaken [6, 9, 10].[1/] Such estimates are certainly important for policy purposes, since they provide information about equity and welfare judgments as well as resource allocation. Our focus is on a somewhat different point. We feel it is not enough to know only something about the size and direction of income flows due to the projects; it is also interesting and important to know who the recipients are or are likely to be. Society in general might not be too interested in shifting income to a rural region via public investment in reclamation if the chief beneficiaries are "large" rather than "small" farmers.

We are trying to discover the degree to which small, localized Bureau of Reclamation projects tend to make the primary beneficiaries' incomes more or less equal than originally.[2/] We believe that a greater understanding of what has happened in the past will not only prove useful for predictions of probable consequences of proposed projects, but will also indicate the usefulness of including such considerations in project feasibility analysis.[3/]

Our own research and what we know of others' is still too limited to support generalizations about usefulness of local income changes as a supplementary measure of project feasibility. Whether or not local income distributions have "improved" or "worsened" in past projects is only part of the problem. The possibility of weighting some aspects of future feasibility reports by expected equity shifts also depends upon the significance of the variations. All that we can say is that acting on the possibility is easier said than done. Put in simplest terms, we foresee both measurement and interpretation problems due to the inter-connectedness of family income streams and wealth stocks, technology and management, and local institutions.

Some Underlying Influences

Four factors weigh heavily in dividing up the total bundle of gains flowing from the irrigation component of a localized project: (1) institutional structures, (2) management, (3) resource bases, and (4) technical progress or innovation.

Institutional structures implied by such things as systems of property and income taxes of themselves might or might not be assumed to be equitable. But the real effects on income distribution are quite likely to be observed in personal relationships with local water management groups and Federal, state, and county officials. In these circumstances, choices are limited; we may know it is wrong to assume that this factor presses equally on all local farmers participating in the project. But the alternative may require intimate knowledge of the local population and area to preclude almost certain bias.

The influence a land resource base might have on income is considered later. Here we mention only that through judicious juggling of capital or labor substitutes, a degree of intensive farming might be achieved that would significantly alter the need for large land bases to produce large incomes. Unless the study area encompasses an inordinately large number of farm enterprises, or is highly heterogeneous, it should be possible to isolate any units which are particularly land intensive.

Making allowances for managerial ability is also a problem. The ability to organize resources and incorporate innovations is a key factor in determining the level of subsequent income and its redistribution. And while it is not true that the degree of correlation between farm size, management, and income level is always high, assumptions about ability classifications based on initial size or income ranges may be reasonable.

Technical innovation can either be water or non-water oriented. The influence of new varieties, machinery, or other inputs, well correlated with elapsed time, need to be separated from those innocations that are given life by expanding local water supplies.[4] A presumption might be that those farmers with sizeable wealth holdings are most likely to adopt water-oriented technical change because they are in a position to absorb the risk of losing income better than farmers with a small base. If this notion is not false, it implies that "large farmers" will be favored in any income redistribution process.

If then, by one means or another, some allowance can be made for the influence on distribution of some of these factors, any study results can be more easily attributed to water-induced technical change and the influence of wealth.

Income/Wealth Interactions

At the micro level, wealth can be a major factor in redistributing income. Individuals may increase their wealth position at the expense of current consumption, or they may increase expenditures on current goods and services by converting wealth into dollars. The wealth base held by individuals may be the sufficient condition which allows them to move to higher income groups, thus changing the distribution of income. In view of this conjecture, one might realistically assume that individuals having a larger wealth base are those who take advantage of newly available options to capture a larger proportion of the local income stream. Thus, the development of a water project could cause local income distribution to become more unequal.

Many studies have been addressed to problems of income or wealth distribution without being too concerned with the interaction of the two concepts in the well-being of individuals and families. This approach is justifiable for national or macro level studies because of the relatively small wealth base that each individual on average holds, large numbers, and emphasis on percentage shifts. The same lack of concern is not very appropriate for agricultural families, however, due to the relatively large wealth (stock) component that is required for a successful enterprise. More important, the more circumscribed the definition of the study area, the more difficult or impossible it becomes to ignore the necessary differentiation between wealth and income effects. Some means must be found to recognize interactions and to treat them in an appropriate way.

A moment's reflection is enough to confirm this view. Is it enough to simply rank family incomes when large holdings might be such an influence? Would the direct water impacts be better measured by relating percentage of the acreage to a given percentage of income? Some of our colleagues have said that the real issue is, "Which people are moving from where to where on the Lorenz curve?" These are only a few of the distribution questions that are likely to mixed together in any appraisal of water development impacts at a micro level.[5]

Some Display Choices

Assuming that a decision can be reached on the form of the question and the appropriate data, some scheme must then be selected for displaying the results.

Apparently we must begin with tools and methods little changed since Pareto, Gini, and Lorenz. Most progress in macro level studies appears to be confined to new and better sources of data and to a greater awareness of types of income inequality.

Undoubtedly the Lorenz curve technique is the most used to show income inequality and changes that occur through time.[6] Its major attribute is to indicate the degree of inequality for all ranges of income [4]. The well-known limitation occurs when the curves cross; it is then impossible to say that one entire distribution is more equal or unequal than another. In this situation the Gini coefficient is invoked.[7] The distribution with the smallest coefficient is said to be more equal. Of course, if the curves cross, it is possible to make judgments about relative shifts between groups in the distribution (high,

low, middle). Bowman and Morgan refer to other display methods that might have application under certain circumstances [4, 13].

Inherent in any study based on aggregate income data is a loss of individual or family identity. Whether or not the overall distribution becomes more equal or not through time, it is impossible to follow families who shift positions and to judge whether they are "better" or "worse" off than before. This may be an objectionable feature at the micro level.

To evaluate income redistribution in circumscribed areas, single projects, or in what we term micro situations, some thinking about basic data presentation is required. We have concluded that there are six possible options, divided into two sets. The first set consists of simple before-and-after rankings of data according to family income, income per acre, or wealth holding. A more revealing set is created by identifying the individuals or family groups and following them through time to learn about changes in income per family or per acre or in wealth.[8/]

Tentative Empirical Results

The area of study is a reclamation project located in Emery County, Utah. The project provides supplemental irrigation water to the agricutlural sector. Pre-project (1958) Bureau surveys were used to determine the initial level and distribution of income. These data were augmented with 1970 farm surveys which linked individuals to their 1958 surveys.[9/]

Figure 1 is a Lorenz Curve showing the distribution of gross farm income for the pre-project period (1958) and the post-project period (1970). Comparing income distribution of 1958 with 1970, we can see that 1970's income distribution is more unequal than that of 1958. The Gini coefficient for 1958 is .36 as opposed to a coefficient of .41 for 1970, indicating that the area between the curve and diagonal has increased.

Figure 2 utilizes income data that have been reduced to per-acre values. Lorenz curves plotted for 1958 and 1970 show only a very slight worsening in the distribution of income for 1970. The Gini coefficients for 1958 and 1970 are .28 and .31 respectively. One explanation for a greater inequality is that many of the included acres are low-valued range land which is privately owned or leased. No simple, reliable method is readily available to make allowance for Federal lands grazed. For this reason irrigated acres only are included in the third figure.

Data used to construct Figure 3 were obtained by dividing gross farm income by number of irrigated acres. Lorenz curves are plotted for 1958 and 1970. Income per irrigated acre moved slightly in the direction of a more equal distribution for 1970. The Gini coefficient changed from .29 in 1958 to .27 for 1970, indicating that income on this basis was slightly more equally distributed.

Figure 4 is the Lorenz curves showing the sampled units' distribution of gross wealth for 1958 and 1970. Wealth became slightly more unequal in 1970 than it was in 1958. Because all points of the 1970 curve lie below the 1958 curve there is no need to compute a a Gini coefficient. The wealth picture may not be complete because of aggregating various land qualities and machine and livestock units together. Regardless of how trivial the wealth distribution change is relative to the base period, there exists significant wealth shifts among sampled units in both positive and negative directions from their original endowment (Table 1).

Illustration of Interpretation Issues

The four sets of Lorenz curves are by no means consistent, or mutually reinforcing. Gross income, income per acre, and wealth become more unequally distributed, while income per irrigated acre shows a slight improvement toward more equal distribution. In the absence of experience with several sets of data from similar (dissimilar?) situations, we have few rules of thumb about what to expect. Our original expectation was that gross family or enterprise incomes would distribute more unequally, and Figure 1 seems to bear this out.

For the present we lack any defensible *a priori* expectations about expected shifts in incomes per acre due to the supplemental water. The influence of livestock activities and

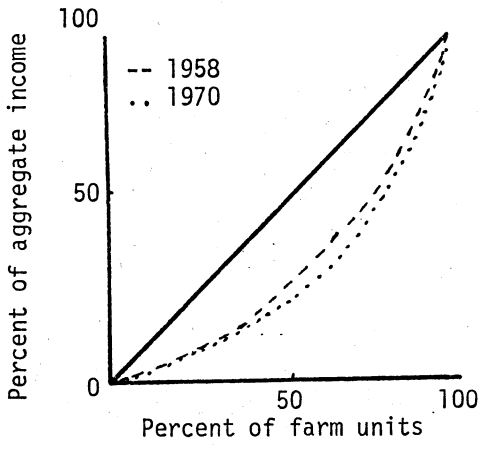

Figure 1. Lorenz Curves, Emery County, Utah, Gross Farm Income, 1958, 1970

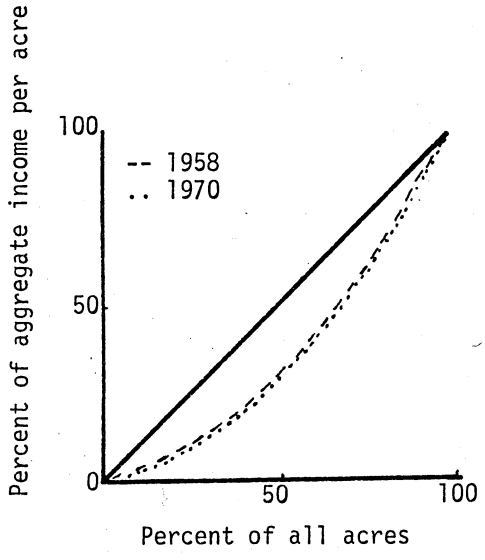

Figure 2. Lorenz Curves, Emery County, Utah, Income per Acre, 1958, 1970

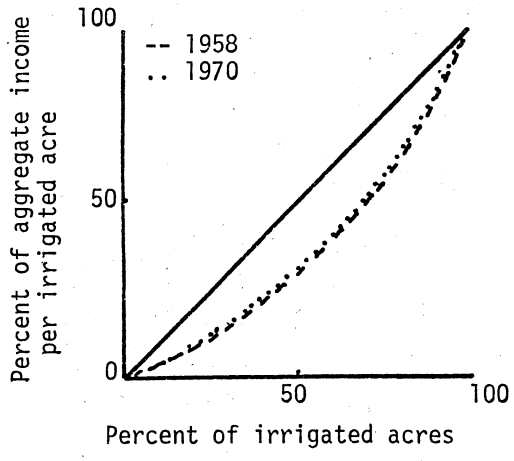

Figure 3. Lorenz Curves, Emery County, Utah. Income per Irrigated Acre, 1958, 1970

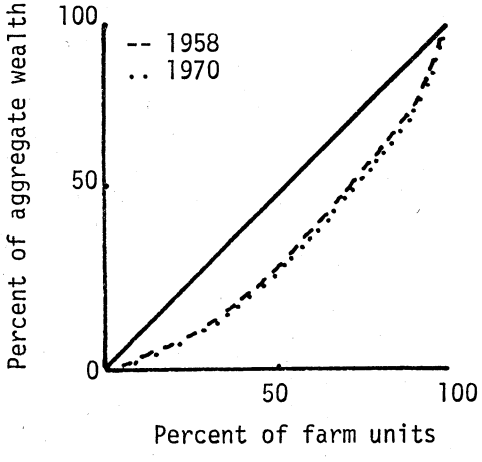

Figure 4. Lorenz Curves, Emery County, Utah. Gross Farm Wealth, 1958, 1970

Federal land rights on many base properties must be incorporated into our underlying presumptions about the initial distribution as well as for expected shifts. The same thing applies for the irrigated acreage; we really have no hypothesis about what "ought" to happen. (Presumably, in this case, the Bureau of Reclamation would welcome the inward shift since the per-acre measurement might be a better or more direct link back to the supplemental water.) We present Table 1 as an initial step in filling this knowledge gap.

Table 1 shows the interrelationship in initial rankings when arrayed on a per-acre, irrigated-acre, and gross-income basis in 1958 and 1970. The shifts for individual families between 1958 and 1970 are also included. Low ranking numbers are associated with low incomes or returns and vice versa. Family no. 2 had the lowest gross farm income in both samples and a ranking of 1 in 1970 and 1958. The same family ranked 29th and 17th in returns per acre in the same years and 20th and 2nd in per-acre irrigated returns. The situation for the other family enterprises can be traced in the same manner.

A possible expectation might be that the smaller acreages would have higher returns per acre. Then if smaller incomes were well correlated, there would be an inverse ranking between gross incomes and incomes per acre. But if this sample means anything, that notion is inaccurate. The variation in ranking shifts is tremendous in both directions; income per acre has actually fallen in some cases (cf. the large ranking change for family no. 21). It may be that the per-acre formulation will serve no greater purpose than to pinpoint operators that might be worth greater study.

Measuring changes in wealth positions appears attractive, not only because we think that relatively low farm sector incomes are offset by relatively greater wealth positions, but because a wealth position measured at one point in time may have integrated the effects of seasonal variations in incomes, crop yields, and special costs. Income measures at a given point in time might be overly influenced by some unusual factors.

No special emphasis is placed on these results at this time. Research in the project area is not complete, and other projects are scheduled for study. More reliable findings should soon be available. It appears that progress can be made if local distribution information is in great enough demand and if suitable precautions are exercised in presenting and interpreting the results.10/

Conclusions

Our long range goal in this research is to analyze the impact of reclamation projects upon income distribution among irrigating farmers. These empirical results are subject to much revision. Nevertheless some conclusions are warranted.

The typical emphasis on income shifts as a method of analyzing inequality and redistribution has some limitations. They are especially noticeable when the research is confined to small areas with emphasis on micro units. Our feeling is that agricultural firms cannot be realistically evaluated without considering the wealth aspect. However, it alone is not likely to prove a sufficient surrogate for income unless it is supplemented with on-site statistics covering management, allowance for technical progress, proper and current land assessments, and the original wealth endowment.

Experience in the field leads us to discount the results of all recent published income distribution studies related to public investment in resource development where anything more than estimates of the total net inward transfer of incomes to the project area is involved. All systems of allocating this lump according to some assumed local distribution that we have reviewed have serious data flaws.

Public records such as land and equipment assessment rolls are difficult to utilize. Water payments may not be traceable to the proper enterprise unit. Even access to income tax records may not help much; all they prove is that it is necessary to study farm income shifts on an enterprise basis even if this involves several families per unit.

There is no obvious and clear cut single measure of changes in local agricultural income distribution. Further research may lead to an acceptable criterion. As of now we are inclined to choose wealth shifts as the most meaningful, however, this choice appears to pose a significant set of data gathering and measurement problems.

Table 1. Comparison of 1970 and 1958 Values and Rankings by Various Measures of Income and Wealth; Emery County, Utah, Sample

Family identification number	Gross farm income				Gross income per acre				Gross income per irrigated acre				Gross farm wealth			
	1970		1958		1970		1958		1970		1958		1970		1958	
	$	(Rank)	$	(Rank)	$	(Rank)	$	(Rank)	$	(Rank)	$	(Rank)	$	(Rank)	$	(Rank)
2	524	(1)	450	(1)	32.75	(29)	17.89	(17)	47.64	(20)	17.98	(2)	5,511	(1)	10,189	(1)
34	1,660	(2)	2,319	(6)	27.66	(22)	21.88	(24)	48.84	(21)	41.41	(23)	19,500	(2)	30,954	(5)
29	2,124	(3)	7,140	(28)	32.68	(28)	12.08	(12)	53.10	(23)	26.44	(9)	34,991	(5)	167,504	(34)
21	2,539	(4)	14,632	(33)	10.85	(8)	43.68	(33)	23.09	(3)	66.51	(31)	126,075	(30)	68,779	(23)
25	2,669	(5)	2,004	(4)	11.12	(9)	8.35	(6)	30.68	(8)	37.10	(21)	52,226	(11)	39,252	(8)
3	2,977	(6)	5,912	(23)	8.53	(5)	29.56	(31)	17.61	(1)	32.84	(16)	73,576	(22)	71,490	(24)
4	3,069	(7)	4,292	(14)	23.61	(19)	22.59	(25)	31.64	(9)	23.45	(6)	68,399	(18)	58,949	(15)
14	3,326	(8)	3,124	(11)	10.39	(7)	11.61	(11)	35.19	(15)	30.63	(15)	67,305	(17)	64,484	(21)
28	3,386	(9)	2,610	(8)	19.69	(16)	15.17	(15)	73.61	(29)	56.73	(29)	25,581	(3)	24,829	(3)
24	3,548	(10)	2,077	(5)	28.85	(25)	14.13	(14)	34.45	(12)	19.41	(4)	86,130	(26)	31,600	(6)
27	3,557	(11)	4,948	(19)	14.23	(11)	13.74	(13)	28.91	(7)	19.03	(3)	53,620	(12)	61,857	(20)
26	3,768	(12)	1,972	(3)	9.92	(6)	4.83	(2)	19.23	(2)	12.40	(1)	63,462	(16)	46,017	(12)
19	4,048	(13)	2,571	(7)	31.63	(27)	20.08	(19)	67.47	(28)	35.22	(17)	50,657	(10)	32,430	(7)
13	4,187	(14)	4,826	(17)	23.26	(18)	17.48	(16)	34.88	(13)	26.96	(11)	38,171	(7)	60,904	(17)
31	4,250	(15)	4,680	(16)	2.12	(1)	22.72	(26)	42.50	(19)	44.15	(24)	71,555	(19)	43,596	(10)
8	4,532	(16)	1,920	(2)	20.66	(17)	8.77	(7)	26.34	(5)	28.23	(12)	60,496	(14)	48,367	(14)
7	4,894	(17)	7,233	(29)	26.74	(20)	28.07	(30)	39.15	(17)	41.10	(22)	59,829	(13)	59,916	(16)
17	5,010	(18)	4,271	(13)	4.62	(3)	3.84	(1)	35.28	(16)	26.53	(10)	79,386	(23)	78,765	(28)
10	5,146	(19)	3,045	(10)	16.08	(13)	8.23	(5)	60.55	(24)	35.82	(18)	73,225	(21)	43,739	(11)
6	5,790	(20)	4,906	(18)	16.08	(14)	11.46	(10)	41.35	(18)	23.47	(7)	87,111	(27)	95,793	(31)
11	6,196	(21)	6,546	(27)	15.48	(12)	18.18	(18)	34.42	(11)	24.70	(8)	100,095	(28)	96,295	(32)
33	6,413	(22)	5,296	(22)	7.46	(4)	9.99	(9)	26.61	(6)	20.69	(5)	71,891	(20)	77,831	(26)
16	7,890	(23)	5,929	(24)	28.18	(23)	21.03	(22)	10.69	(25)	53.42	(27)	80,481	(24)	79,584	(29)
12	8,019	(24)	8,360	(31)	28.63	(24)	5.97	(3)	33.41	(10)	79.62	(33)	46,965	(9)	65,375	(22)
5	8,323	(25)	2,748	(9)	82.40	(34)	25.68	(29)	91.46	(32)	36.64	(20)	41,540	(8)	20,822	(2)
22	9,800	(26)	3,630	(12)	50.00	(33)	30.25	(32)	66.22	(27)	30.25	(14)	37,507	(6)	61,560	(18)
23	10,958	(27)	4,957	(20)	39.14	(31)	23.27	(27)	49.88	(22)	78.69	(32)	80,122	(24)	43,357	(9)
15	12,667	(28)	4,577	(15)	14.07	(10)	7.15	(4)	35.18	(14)	28.25	(13)	148,605	(33)	82,185	(30)
30	13,074	(29)	6,276	(25)	43.58	(32)	20.92	(21)	108.94	(33)	62.76	(30)	100,283	(29)	77,538	(25)
32	13,088	(30)	9,128	(32)	19.25	(15)	25.36	(28)	61.45	(26)	55.32	(28)	125,282	(31)	78,417	(27)
1	13,330	(31)	5,113	(21)	36.32	(30)	20.70	(20)	83.31	(31)	36.26	(19)	61,860	(15)	47,113	(13)
20	16,442	(32)	6,385	(26)	27.13	(21)	21.13	(23)	77.56	(30)	46.27	(26)	32,168	(4)	25,764	(4)
18	17,762	(33)	7,842	(30)	2.19	(2)	8.92	(8)	26.12	(4)	46.13	(25)	173,774	(34)	108,804	(33)
9	33,350	(34)	16,083	(34)	31.10	(26)	51.55	(34)	162.68	(34)	160.83	(34)	125,648	(32)	61,571	(19)

APPENDIX

Intensive study of the efficiency of American water resource policy which began in the 50's was broadened during the middle 60's to include aspects of regional income redistribution and broader social benefits. This is manifest not only from the heavy emphasis on secondary benefits found in Senate Document 97 and in the recommendations of the special task force of the United States Water Council, but from the thrust of reported research [16, 17, 7, 10, 6, 9].

From the water developers' standpoint, this broadening represents a direct response to the requirement to employ higher discount rates in presenting feasibility results as well as the widespread indictment from our profession that many reclamation projects fail to pass muster on efficiency grounds. In practice, these pressures are indistinguishable; either way, reclamation proponents feel the need to include more in the benefit stream.

For the same reasons, it may be assumed that water developers welcome broadened impact studies as a way to supplement B/C ratios with other indicators of feasibility. At least some research is underway to identify "social indices" or "factor profiles" that might be linked to benefits of resource development [1, 2]. In our opinion, it is too early to say very much about the workability of this inclusive approach. We do have the impression that economists have tended to opt for the somewhat more obtainable step of including some distribution-redistribution effects in feasibility studies, leaving the more grandiose ventures to sociologists, political scientists, and engineers.

Even this narrower aim has not been cannonized with respect to necessary value judgments, general approach, or measurement techniques. We can hope only that current studies of distribution effects of already developed projects will eventually help us choose the right questions and the ways to answer them.

In a certain sense, only an appreciation or knowledge of local distribution changes leads to a broadening of the B/C feasibility criterion. Research on the amount of regional or sectorial redistribution really ends in an adjustment of the B/C ratio for the project whereas, regardless of the answer to our question, the B/C ratio is unchanged. In other words, the B/C ratio must be augmented by something other than money numbers before we can say that a feasibility indicator has been added. This distinction demarcates the essential difference in the distribution research which we have undertaken, despite the fact that we are asking a very simple question.

FOOTNOTES

1/ While various techniques have been employed, Bureau of Reclamation estimates of changes in incomes on average type farms, expected tax collections, and so forth, constitute the basic data.

2/ For our purposes, it is not necessary to judge the goodness or badness of a particular shift. However, it may be noted that a shift towards equality (in our opinion) is more likely to be politically and operationally acceptable than the reverse.

3/ An impression easily obtained from the research cited is that including estimates of net income flows or shifts in B/C computations would be a useful extension of feasibility analysis (See Appendix). Also see [16, 17].

4/ There is a distinct possibility of relying on trends in capital/labor ratios to forecast part of technical change. It may also be possible to rely on past experience in "control" areas where water projects are not developed at all or at the same rates as in others.

5/ See the appendix for brief discussions of two studies (of special interest to us for other reasons) which intermix or ignore these notions in a disappointing fashion.

6/ The cumulative percent income (of the study area in question) as held by the cumulative percent recipients is shown by the curve. If each successive 10 percent recipients hold exactly 10 percent, i.e., distribution is equal, the curve will be a 45 degree line. Since graphing is in terms of 0 to 100 percent, the information from various time periods may be displayed simultaneously.

7/ The Gini coefficient is the ratio of the area between the curve and the diagonal to the total area under the diagonal.

8/ Naturally, if all of the observations are completely identified, and are not created through averaging or classification into subgroups or subjected to some other aggregation method, and if the same sample can be used for the initial and final distributions, there is no real difference between the two sets. They collapse together because once the data have been ranked in any kind of graphical analysis, the individual observations are easily identified, and movements between the initial and final positions are readily traced.

9/ From the Bureau's original sample of 122 units, we were able to match up 43 units which were interviewed again in 1970. The 1970 sample could not be random. City lots had to be excluded along with deceased individuals and others who have moved from the area or have given up farming. A farm budget was developed for each of the 43 individuals for both time periods. These provided a basis for estimating farm income, income per acre, and wealth. Income and cost accounting procedures employed for each major resource input and output yielded approximate dollar values. In their present form, the data are prepared for Cobb-Douglas estimates of shifts in factor shares, and we are not yet utilizing net farm returns.

10/ It should be noted that we have not as yet made any adjustments for some of the factors noted earlier and that we plan to switch to estimates of net returns wherever possible.

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ON LINKING LOCAL, RURAL INCOME-REDISTRIBUTION TO RECLAMATION INVESTMENTS: DISCUSSION

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The Water Resources Council's "Proposed Principles and Standards for Planning Water and Related Land Resources," as published in the Federal Register states that:

> The effects of a plan on the real income of classes or groups that are relevant to the evaluation of a plan will be displayed. All effects, both monetary and income in kind, will be included in this display [1].

Public hearings on the proposed standards have been completed, and the comments are now being reviewed by the Council. If this section is neither modified nor removed, then well-being or social-impact analysis will become a formal requirement for water project evaluation. Along with the discount rate, the WRC's proposed well-being objective has been the focus of considerable controversy. Part of the objections raised against inclusion of the well-being account in the evaluation scheme relates to problems of quantification and other technical problems associated with well-being variables. My own impressions are that the more emotional arguments come from persons who object, on philosophical grounds, to the idea of handling equity considerations as a direct variable in the evaluation algebra.

While the economics profession may be split on the question of giving formal analytical stature to equity considerations, the Federal Congress (a majority at least) considers equity to be an economic objective as well as a social and political objective. Statements favoring the inclusion of income distribution effects in resource allocation decisions can be found in a compendium of papers submitted to the Joint Economic Committee of the Congress; especially the paper by Bonnen and Weisbrod [3].

I am a proponent for the broadened scope of analysis which includes equity consideration. Thus, I have no philosophical arguments with Professors Willis and LeBaron in their attempt to measure the income distribution impacts of a reclamation project. I have some reservations about whether the methodology employed and reported in their paper will achieve the objective implied by its title. But first, I would like to comment on another point.

Willis and LeBaron join a large group of other economists, which includes my name as well, by implying that the interest of water developers in an expanded evaluation format is that of identifying a sufficient quantity of new benefits so as to keep ahead of the fast changing non-developers who keep uncovering new costs or increasing the old ones. At the agency level, I would generally concur with this observation. To stop here is looking at the forest without seeing the trees. In my judgement, the need for comprehensive evaluation of project effects relates more to some decision-making notions within the Office of Management and Budget (OMB) rather than the preoccupation of Congress with a benefit/cost (B/C) ratio greater than unity. There is pressure within OMB to use a ranked list of B/C ratios computed for all public programs as an implicit ordering system of funding priorities for federal expenditures.1/ This practice is, of course, consistent with the objectives of an operational Planning-Programming-Budgeting System. While there are numerous conceptual problems with this approach, it has many agency administrators nervous because they can see the time when a B/C ratio of unity or greater is not sufficient to warrant federal approval of a proposed project or program. The sponsoring agency will have to demonstrate also that the proposed project is the best means of achieving the stated objective from a cost-effectiveness standpoint. The crucial question which the Bureau of Reclamation and other water development agencies must face is not whether benefits exceed costs for a proposed project; rather, the question should be whether reclamation projects represent the best means of achieving the same or like effects compared to alternative courses of public action. Unfortunately, the reticence shown by water development agencies to face this question also prevails within our own profession.

Professors Willis and LeBaron used the Lorenz curve in an attempt to measure the income distribution impacts of a reclamation project located in Utah. More specifically, they are interested in the distribution impacts on the incomes of families affected by the

project and, by design, limit their analysis specifically to project farm families. Because they had pre-project and post-project income data for the affected families, they were able to use the Lorenz curve to test for an "improvement" in the income distribution of these families. They claim (at least, implicity) that a uniqueness of their study is access to individual family income data for both the before-and-after periods.

While I have admitted to being an advocate of equity considerations in project formulation, I do not believe equity is limited to income equality within a particular occupational group. In essence, application of the Lorenz curve technique to a single, rather homogeneous occupational group results only in a measure of income equality among members of that group. We do not know whether the group, as a whole, has benefited or has been adversely affected by the project. Because of the several excellent points raised by the authors with respect to factors other than increased water supplies that will affect project family incomes, I'm not sure of the value of knowing whether the incomes of these families have become more equal or less equal over time. (In my judgement, the highlight of the paper is the discussion of technical problems associated with attempts to isolate the real impact of water on farm family incomes.) The greater equity or well-being question in project evaluation is whether the intended beneficiaries of a project have gained ground or lost ground with respect to a regional or national norm. When Christ fed the 5,000 with five loaves of bread, the miracle was not that He could divide the loaves among such a large group; rather, the event ranks as a miracle because the group was filled from what He served. I believe Willis and LeBaron have tested to see how equally everyone is sharing the bread; they have not told us whether it is filling.

How is one to interpret the observation that the income distribution for a group of project farmers has become more unequal (the Gini coefficient has increased over time)? Do we assume that the income distribution for the group is a reflection of the basic opportunities provided by the project to the intended beneficiaries? If so, we would conclude that increased income disparity was the result of some kind of discriminating opportunity function and judge it to be bad. Or, is an income distribution an implicit measure of the productive performance of the various members of the group? That is, did the increased income disparity result because the intended beneficiaries possessed different capabilities for exploiting the enhanced opportunities provided by the project? Unless this distinction can be made, and I don't think it can, the use of the Lorenz curve as a micro-evaluation technique appears to be of limited value. For the reasons Professors Willis and LeBaron suggest and others, the discovery of time-related income distributional shifts within a group of farmers from a single project by the use of the Lorenz curve is practically devoid of any cause-and-effect explanations or policy implications.

FOOTNOTES

1/ See, for example, testimony presented by Jack W. Carlson [2].

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