Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*

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General Comments:

The General Provisions (Chapter I) of the Principles and Guidelines (P&G) are well written and provide a broad set of criteria for evaluating new projects. The provisions state that expected output and input price effects should be considered. This is especially important for large projects and projects in areas with specialty crops or other unique outputs. Indirect environmental impacts are also to be considered. This should include such items as increased salinity and drainage problems associated with new irrigation supplies, on farm species protection problems, and in-stream non-point pollution issues.

The general provisions also state that project alternatives should include structural as well as non structural (conservation) activities. This should include market based incentives such as changes in pricing structures for scarce inputs, promotion of markets to allocate resources, and more standard conservation measures such as the Best Management Practices set forth in California's recent Urban Memorandum of Understanding between urban water districts, environmentalists, and state and federal government agencies.

The specific evaluation procedures (see Chapter II of the P&G) fall short of the goals set forth in the general provisions chapter. Rather than account for changes in market prices of inputs and outputs, these sections rely on cost budgeting approaches to estimate costs and benefits. Market effects on production and grower income are ignored. The assumption that any one project will be small allows many over simplifications. Finally, the specific assessment provisions of Chapter III are less inclusive when estimating indirect environmental impacts.

This review of the P&G will focus on the provisions concerning the municipal and industrial benefits accounting methods (Chapter II, Section II) and the agricultural benefits accounting methods (Chapter II, Section III). These provisions lay out specific guidelines for calculating the benefits and costs for each sector of the economy from proposed projects and their alternatives. This information is used in the National Economic Development (NED) accounts.

Municipal and Industrial National Economic Development (NED) Benefits Accounting Method

This section of the P&G outlines methods for estimating benefits and costs to the urban sector from proposed projects and their alternatives. An outline of the procedure is provided in Figure 2.2.4 of the P&G.

Estimating M&I Future Use

The procedure outlined in Figure 2.2.4 stipulates that the estimation of future M&I water supplies and demands be performed separately from assumptions concerning the project and its alternatives. This is useful for predicting differences between the supply and demand for the resource under current conditions. Since considerations of non-structural alternatives, such as conservation measures, are required, estimation of future water demand cannot be performed separately from these alternatives. Performing these calculations separately will lead to over estimation of future water demand. This will encourage unnecessary projects.

It has been shown that user demand for water is responsive to its price. Urban elasticities of demand have been estimated in the economics literature. Any future alternative scenarios that impact water price (tiered pricing, block rate pricing, water marketing) will therefore alter predicted future demand. Since future demand is dependent upon future price, which may be a function of the proposed plan and its alternatives, not considering these alternatives will lead to overestimation of future water shortages. This in turn will lead to over estimation of the demand for and the benefits from new projects.

Use of Water Markets and Trades as a Non-Structural Alternative

Increased attention needs to be given to the use of markets as an alternative to new water projects. Reallocation of existing resources through economic markets can be more economically efficient than increased supplies. Water marketing is receiving increased attention throughout the West. In California, the state is in its third year of operating a restricted water market to meet the critical needs of farmers and communities during drought years. Private water trades and transfers are also increasing. While agriculture to urban transactions receive the greatest attention, trading within these sectors has increased dramatically. There are hundreds of agriculture to agriculture water transactions made every year. Differences in the value of water between sectors creates an impetus for these mutually beneficial transactions. Under restricted conditions, water markets can have a significant role in equating expected supply and demand for water.

To the urban sector, agriculture to urban water transfers serve to increase supply directly through the transaction, and reduce demand through an increase in the price paid by the final users. The third party impacts of these transactions have received much attention recently. Methods to account for and partially mitigate these impacts should be explored.

Calculation of M&I Project Benefits

There is a considerable difference between the goals of the conceptual section (Chapter I) and the computational section (Chapter II, Section II) with regards to the determination of project benefits. In the conceptual section benefits are described as,

> "...society's willingness to pay for the increase in the value of goods and services attributable to the water supply."

This seems to imply that benefits should be computed as the market values of increased goods and services. This could involve adjustments in market prices as quantities change. It should include measures of the changes in both consumer surplus and producer surplus. This definition does not specify that increases in non-market goods such as environmental amenities should be considered. Thus benefits are restricted to those for which economic markets exist.

The benefits calculations described in the computational sections (Chapter II) will not result in a social benefits calculation. The Municipal and Industrial benefits calculations are described in Chapter II of the P&G as,

> "Annualized benefits of the Federal water supply plan are equal to the annualized cost of the most likely alternative."

Calculation of the benefits under this definition does not consider the benefits to consumers, producers, or society in general. It merely states that the benefits are equal to the cost of a foregone activity. No considerations of the merits of that activity are required.

Neither of the above methods can be used to calculate the benefits from many of the potential project alternatives. Non-structural alternatives such as conservation measures, changes in pricing practices, and implementation of water markets cannot be measured within the given framework. Furthermore, the distribution of benefits to various sub-sectors of the economy will also remain unknown.

Actual benefits calculations that break down the benefits and costs to various groups would provide policy makers with more information to make better decisions. The benefits/costs calculation framework developed by Lichtenberg, Parker, and Zilberman (American Journal of Agricultural Economics, 1988) could be modified to effectively provide this type of information. This would allow decision makers to balance the project's impacts on user groups, non-user groups, consumers, and on import and export markets.

Agricultural National Economic Development (NED) Benefits Accounting Method

Calculation of the NED benefits to the agricultural sector is described in Chapter II Section III. Figure 2.3.5 of that section provides a flowchart of the procedures to be used in calculating these benefits. The method of benefits calculation depends upon which of three categories the impacted crop lands belong to: lands with no changes in cropping patterns, lands with changes in cropping patterns that grow basic crops, and lands with changes in cropping patterns that grow non-basic crops. Each of the categories will be discussed separately.

Lands With No Changes in Cropping Patterns (All Crops Treated Equally)

The P&G ignore market impacts from projects where there is no expected change in cropping patterns. Benefits under these conditions are the result of increases in production

(yield), or decreases in production costs. It is assumed that project impacts will be too small to cause changes in prices of outputs and inputs. This may be true for such crops as grains, but increases in yields of specialty crops may increase supply to the point where price changes occur. Changes in costs of production may also increase supply through an increase in lands in production. Not accounting for these changes leads to over estimation of the project's benefits.

There could also be benefits and costs from changes in product quality. Increases in water supply and changes in water quality may effect the quality of the output. This may lead to changes in prices received for the product thus changing growers' revenues and incomes. Finally, there is no accounting of potential changes in production in other regions due to those factors listed above. Changes in yields in the project area may lead to cropping pattern changes outside the project area. Accounting for these shifts would lead to lower benefits assessments as the gains from the project are partially offset by external shifts in production.

Lands With Changes in Cropping Patterns

The methods used to estimate the net benefits to lands with changes in cropping patterns differs by crop type. Crops are categorized to account for potential differences in market effects. The crop types are defined as,

> **Basic Crops:** "Production of basic crops is limited by availability of suitable land," and
> **Non-Basic Crops:** "Production from increased acreage of crops other than basic crops in the project area would be offset by a decrease in production elsewhere."

For basic crops, the P&G ignore market impacts by assuming that any one project will be too small to change production to the point where economic markets adjust. This results from the assumption that production in the U.S. is so large that increases from the project will be absorbed under current market conditions. For non-basic crops, market impacts are eliminated by assuming that an identical number of acres will be used to produce the crop before the project as well as after the project. In other words, a one for one shift in acreage would take place. Further discussion of each type of benefits estimation is presented below.

Basic Crops (Land Constrained)

To calculate the benefits to land with changes in cropping patterns that grow basic crops it must first be determined what crops will be grown. This is done with an ad-hoc formula that uses cropping patterns in similar areas. Per-acre benefits to each crop are then calculated and summed across all acres. The benefits are simply the net farm income with the project less the net farm income without the project. These benefits do not consider changes in consumer welfare, changes in income between groups, and changes that would occur if prices were allowed to shift. Expected changes in prices of commodities from a proposed project would be small. Even so, not accounting for them would lead to over estimation of producer benefits. Consumers will be made better off by an increase in lands

producing basic crops. The increased supply should lower prices, thereby, increasing consumer surplus measures. By not considering potential consumer gains, the benefits will be underestimated. The difference in benefits calculations from including price shifts may or may not be large, but the impacts on different segments of the population may be important. Information concerning losses to producers and gains to consumers is important for proper decision making.

This benefits calculation also does not consider regional impacts from increases in basic crop acreage. Although regional impacts are supposed to be considered in a separate section of the P&G, not considering them up front with the other benefits may mislead decision makers. Producers' gains in one region may cause losses in another region. Consideration of these shifts in producer and consumer welfare is of increasing importance to decision makers and new economic methodologies to elicit these shifts have been developed.

Finally, this benefits calculation does not consider the potential third party costs and benefits to labor, input suppliers, and rural communities. Changes in water supplies and allocations can have significant third party impacts. These impacts can be mitigated if known.

Non-Basic Crops (No Land Constraint)

The calculation of benefits to lands where the cropping mix changes to non-basic crops is represented by the following formula:

$$B = C_O - C_P + AI_O$$

Where:

B = Benefits From The Project,
C_O = Costs of Production on Lands Where Non-Basic Crops Will **No Longer** Be Produced,
C_P = Costs of Production of Non-Basic Crops on Project Lands, and
AI_O = Net Farm Income From Growing Next Likely **Basic** Crop On Lands Where **Non-Basic** Crops Are **No Longer** Produced.

This formula is summed over the project area and discounted over the time period. The formula makes some bold assumptions. First, it assumes that lands brought into production will displace lands already in production. There is no allowance for an increase in supply of the non-basic crop, which would cause subsequent changes in price. The later type of approach is currently used to estimate the impacts of pesticide registration cancellations. It can be easily modified for the above problem. The P&G formula also assumes that non-project lands will shift production to basic crops. There is no justification for this assumption. Again, the aforementioned impact analysis technique would not need this later assumption.

As with the previous formulation for basic crops, this benefits assessment does not consider changes in consumer welfare, and third party impacts. Changes in producer welfare could be separated into groups of users and non users, but it is unclear that this would be done.

None of the above benefits calculations consider the economic adjustments that markets would be expected to make. A framework to calculate these types of adjustments is outlined by Lichtenberg, Parker, and Zilberman in an article in the American Journal of Agricultural Economics, 1988. This framework could be modified to improve the benefits calculations called for in the P&G.

The P&G also ignores the simultaneity of adjustments that may take place. The flow charts (Municipal and Industrial, and Agricultural) describing the calculation of benefits for projects and alternatives divide the analyses into discrete units. Not considering interactions between proposed alternatives may lead to incorrect results.

Other Considerations

The P&G do not explain the calculation of third party environmental impacts. Irrigation projects may lead to increased drainage and salinity problems. These may manifest themselves as toxic evaporation ponds, increases in the water table on project and non-project lands, or as increased non-point pollution. Consideration of these types of impacts is an important part of the costs and benefits estimation procedure.

An additional concern is the operating assumption that market impacts will be small. As we are now finding with pesticides evaluations, cancellation of a single product may produce small impacts while the cumulative effects of several product cancellations may be quite large. Certainly projects such as California's Central Valley Project have had major impacts on the regional and national economy. Several small, unrelated projects may also have regional economic impacts. Consideration of the cumulative effects of proposed projects should be performed.