# A Field Test of Environmental Impact Assessment in the Tensas Basin


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In the years since the passage of the National Environment Policy Act (NEPA) and related legislation, there has been a major effort on the part of all federal agencies to develop regulations, procedures and guidelines for meeting the NEPA requirements for impact assessment. Presently, four different impact accounts are required in response to water development plans. These are the National Economic Development account (NED), the Environmental Quality account (EQ), the Regional Development account (RD) and the Social Well-Being account (SWB). Part of the difficulty lies in the fact that procedures for analysis under the National Economic account have been tested and clarified for over 40 years. The Environmental Quality account has been under development for over 10 years, while the Social Well-Being account has only recently been stressed. The different stages of development of these accounts poses a difficulty for the realization of an interdisciplinary assessment of impacts mandated by NEPA.

One attempt to address this problem is the Water Resources Assessment Methodology (WRAM), Technical Report Y-77-1, U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, Mississippi. WRAM is not a data collecting methodology, but rather a procedure for assessing and evaluating impacts in each of the four accounts by an interdisciplinary team. This paper will report on a field test of the WRAM procedures carried out by personnel of the Waterways Experiment Station, and the Vicksburg District Office of the Corps of Engineers and anthropologists of Mississippi State University (see Figure 1).

## THE TENSAS BASIN

The project selected for the field testing of the WRAM procedures was the Tensas River Basin project in Northeastern Louisiana. The proximity of the site to Vicksburg allowed close and continual access to the study area and to experienced persons who had worked on the development of the project and who were familiar with the area to be impacted. In its present state, the Tensas River winds a meandering course through three northeastern Louisiana parishes. The upper portion of the area, primarily East Carroll and Madison Parishes is currently devoted to agricultural activities. The lower portion, most of which is contained in Tensas Parish, has been engaged in agricultural activities, but also contains a large area of managed bottomland hardwood. In its present state, the Tensas River does not provide adequate drainage to insure flood control. As more of the total land area is converted to farming activities, the flooding problem has become increasingly severe, resulting in significant economic loss to local farming interests as well as constituting an obstacle to additional economic development. In an effort to relieve some of the flooding problem in the lower part of the basin, 61 miles of the Tensas River were cleared and snagged by the U.S. Army Corps of Engineers during 1972. The current project calls for more extensive channel improvement of an additional 99 miles of the Tensas River. The proposed project offers five alternative plans for channel improvement and a "no action" alternative. Each of these "action" plans would facilitate drainage in the upper portions of the river basin, although most of the actual channel work would be in the forested lower half of the basin. These forest lands and their water resources currently provide a refuge for wildlife. It has been anticipated that channel improvement through this area will result in a more rapid conversion of the remaining forest land to agricultural uses.


**Figure 1. ROUTE LOCATIONS OF PLANS BEING CONSIDERED**

## THE INTERDISCIPLINARY TEAM

WRAM procedures call for the formation of an interdisciplinary team minimally represented by the disciplines of ecology, economics, engineering, and sociology/anthropology. Where possible, U.S. Army Corps of Engineers district staff are to be selected to serve as principal members of the team, supplemented by consultants from disciplines not on the district staff. In this field test, the Vicksburg District staff was augmented by representatives of the Waterways Experiment Station, Fish and Wildlife Service, and anthropologists from Mississippi State University. The interdisciplinary team included several district staff directly involved in the early development of the project.

It is essential to WRAM procedures that all members of the team be familiar with WRAM procedures, with pertinent Corps regulations and with the study area before the first formal meeting of the team. This was provided first through study of significant public documents such as an early Environmental Impact Statement and transcripts of public meetings related to the project. Team members with experience in the project area met informally with newer team members to orient them to the area, followed by a "windshield survey" of the study area by representatives of the different disciplines on the team. It is essential that such a full orientation take place prior to the first formal team meeting to determine mandatory and critical variables.

## DETERMINATION OF ASSESSMENT VARIABLES

WRAM procedures call for assembling a preliminary list of mandatory and critical variables for each of the four accounts of the Water Resources Council's "Principles and Standards," as well as considering additional non-critical variables which can be expected to be impacted by the project under consideration. Unlike certain other approaches to impact assessment, the WRAM procedures do not attempt to set up a cookbook variable list, but rather place this responsibility on the interdisciplinary team. This is why it is essential that members of the team are familiar with the laws and regulations affecting impact assessment as well as the project study area before attempting to develop a list of variables for study.

It should also be noted that the study team establishes the variable list operating as a team. The social scientists do not develop a list of variables for the Social Well-Being account while the ecologists develop a variable list for the Environmental Quality account. Rather, the team as a whole develops the variable lists for each of the four accounts under consideration.

Further, the team acting jointly established preliminary weights to each of the variables in terms of the importance of each variable. In most cases, this was accomplished by first considering the broadest categories of variables available, and then by considering relevant subcategories for each variable. It should be clear that the determination of variables and weights was made with reference to the specific project and with a rather clear concensus on the part of the team as to the relative importance of the variables to be considered in assessing the potential impact of the project.

Two important features of the WRAM procedures should be noted at this point. First, since variable selection and weighting is accomplished by the team as a whole, the team is forced to consider the study area as a unit, that is to consider all variables in all accounts. This forces an interdisciplinary perspective on the impact assessment. Secondly, the WRAM procedures note that the weight can provide a guide to allocation of the data collection effort. Most impact assessments must be made with limited time and funds. The weighting procedure focuses attention of the entire team to those variables which appear at the outset to be most important in the initial data collection effort.

An example of the weighting procedure can be taken from the variable list of the Social Well-Being account of the Tensas study. Table 1 displays a forced choice pairing of the major variables under consideration. The more important of the paired variables

**Table 1. Major Variables and RIC for SWB Account**

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Sum | RIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Real Income Dis. | 1 | 1 | 1 | 1 | .5 | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | .21 |
| Life, Health, Safety | 0 | - | - | - | - | - | - | - | 0 | 1 | 0 | 0 | 1 | 0 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3.0 | .08 |
| Educ., Cultural, Recreation Opportunity | - | 0 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | 1 | 0 | 0 | 1 | .5 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4.5 | .13 |
| Emergency Preparedness | - | - | 0 | - | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | - | 0 | 0 | 0 | 0 | 1 | - | - | - | - | - | - | - | - | - | - | 1.0 | .03 |
| Demographic Characteristics | - | - | - | 0 | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | - | 0 | 1 | 1 | 1 | - | - | - | - | - | - | 6.0 | .17 |
| Community Organization | - | - | - | - | .5 | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - | - | - | 1 | - | - | - | 1 | - | - | - | 1 | 1 | 1 | - | - | - | 7.5 | .21 |
| Noise | - | - | - | - | - | 0 | - | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | 1 | - | - | - | 0 | - | - | 0 | - | - | 0 | 1 | - | 2.0 | .06 |
| Esthetic Values | - | - | - | - | - | - | 0 | - | - | - | - | - | - | 1 | - | - | - | - | - | .5 | - | - | - | - | 1 | - | - | - | 0 | - | - | 0 | - | 1 | - | 1 | 4.5 | .13 |
| Dummy | - | - | - | - | - | - | - | 0 | - | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | 0 | - | - | - | 0 | - | - | 0 | - | 0 | 0 | 0.0 | .00 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 36 | 1.00 |

is given a score of 1, and the less important variable is given a score of 0. Scores are then summed and then divided to give the Relative Importance Coefficient (RIC) for each variable. In this study, Real Income Distribution and Community Organization were given the highest RICs by the interdisciplinary team. Table 2 demonstrates how a further breakdown was accomplished using the same procedure. For example, under Community Organization, Cohesion was viewed by the team as most important, followed by Displacement of House-holds and Employment.

Following the variable selection and weighting, the interdisciplinary team divided into three primary sub-teams for data collection: economists for the National Economic Development account, ecologists for the Environmental Quality account and social scientists for the Social Well-Being account. The Regional Development account included many of the variables from the other accounts, but from a regional perspective. Thus members from the three primary sub-teams all contributed to this account.

**Table 2. Detailed Variables, SWB Account**

| Real Income Distribution | | | | | |
|---|---|---|---|---|---|
| Incidence of Benefits | 1 | 1 | - | 2 | .66 |
| Income Expenditures | 0 | - | 1 | 1 | .33 |
| Dummy | - | 0 | 0 | 0 | .00 |
| | | | | 3 | .99 |

| Community Organization | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cohesion | 1 | 1 | 1 | - | - | - | 3 | .5 |
| Employment | 0 | - | - | 0 | 1 | - | 1 | .17 |
| Displacement | - | 0 | - | 1 | - | 1 | 2 | .33 |
| Dummy | - | - | 0 | - | 0 | 0 | 0 | .00 |
| | | | | | | | 6 | 1.00 |

## DATA COLLECTION

By the conclusion of the meeting to determine and weight assessment variables, the interdisciplinary team had developed a general idea of the kinds of additional data which would be necessary to conduct a final scaling of variables for the four accounts. Various members of the team had assumed responsibility for collecting data within their areas of expertise.

In the work on the Tensas River Basin project, the interdisciplinary team met three times over a three-month period during the data collection effort. These meetings provided each member with an update of the progress of other members and a time to share information sources relating to each account. Four aspects of the process merit special attention.

1. As the meetings progressed, the close interrelationship of the four accounts and the value of an interdisciplinary approach became apparent. Members of the team were able to profit from the experience and developing data resources of other members.
2. The team approach permitted each member to maintain perspective on the relative importance of each account and each major variable. For example, the degree of social effects to be expected as a result of the project could be evaluated in relation to the apparently more significant environmental effects.
3. WRAM procedures permitted variation in the development of documentation for each account. Data collection for each of the accounts progressed at different rates due to differences in data collection requirements, but this variation did not affect the team's overall progress.
4. The procedures helped the team avoid premature closure on determining the overall significance of any particular variable. In essence, the meetings of the team were properly used to test rather than defend judgements made by the team during the initial assessment. For example, the initial distinction between bottomland hardwoods and forest wetlands in the initial variable selection did not prove to be an important distinction in terms of this project, so the two separate variables were collapsed.

The data collection effort was not simply a process of building a larger data base and directing further data collection. It was a dynamic process of first establishing the existing data base or baseline condition. Then while this was expanded, data was collected on the area in recent decades to begin establishing trends which would serve to project the without-project condition. As this process continued and was reported at team meetings, the interaction of variables became apparent to team members through recognition of parallel trends in data in different accounts.

For the Tensas Basin, this process could be described as a transition from an area of forests and small farms to an area of cleared land and larger mechanized agriculture. This transition could be described in economic terms of increased productivity, in social terms of increased out-migration, or in environmental terms of decline in forest lands, to give only three examples. The transition was occurring even without the project, but the problem was to determine the differential impact of the action alternatives on existing trends. This involves projection and scaling.

## IMPACT PROJECTION AND SCALING

Once the team had moved beyond establishing past trends to begin determining how these trends apply to the without-project condition, they were entering the area of projection. As indicated above, sharing of projections from their separate accounts was an important means through which individual team members could see better ways of projecting trends within their own accounts. For example, in discussing the difficulty of long-range population of trends within the Social Well-Being account, one of the social anthropologists suggested it was unfortunate that parallel trend data was not available for adjacent river basins with similar flood control measures. While such data was not available for population trends, a team economist discovered that trend data in water quality control had been collected over time for an adjacent basin, thus forming a basis for projection. On the other hand, a discussion by a team ecologist of trends in forest clearing especially as it was proceeding from north to south within the basin, suggested to the social anthropologist that a comparison of population trends between the different parishes within the basin might give a more realistic projection than population trends for the basin as a whole. This proved to be the case.

As analysis of data moved beyond simple reporting of baseline data and projecting without-projection conditions to projection of differing conditions under the different action alternatives, discussion among team members became even more important. In a sense, at this point, team members were actually involved in what might be called preliminary scaling in their data projections, although there was at first no formal assignment of scale values as described under the WRAM procedures. This took the form of simple hypothesis testing or perhaps better a "show me" reaction among team members.

Two forms of scaling were used in the Tensas field test: (1) weighted ranking technique and (2) linear scaling. The weighted ranking technique is similar to the initial weighting technique already presented. It simply matches each alternative for a given variable in terms of the team's judgement based on available data to determine the scale of impact. It is based on the collective professional judgement of the team based on qualitative or only partially quantitative data. Table 3 demonstrates the weighted ranking technique from the final scaling of the variable Recreation under Education, Cultural, and Recreation Opportunities. This technique does yield a scale score for qualitative data, but its weakness is the degree of subjectivity involved in the scale score. It also tends to exaggerate the differences between alternatives.

**Table 3. Scaling by Weighted Ranking Technique**

Variable: Educational, Cultural, and Recreational Opportunities/Recreation

Indicator: Hunting Clubs on Forested Land, Access to the River

| | EXISTING | W/O PROJECT | ALTERNATIVES A | B | C | D | E |
|---|---|---|---|---|---|---|---|
| Recreational Opportunities | Hunting Clubs on Forest Land, Limited | Decline | Accelerated decline | Accelerated decline | Accelerated decline | Accelerated decline | Accelerated decline |
| | Access to River | No Change | No Change | Better Access | No Change | No Change | No Change |
| Scale | | .3333 | .1000 | .2666 | .1000 | .1000 | .1000 |

Solution

| Alternatives | Choice Assignment | | | | | | | | | | | | | | | Choice Total | ACC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W/O Project | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | 5.0 | .3333 |
| A | 0 | | | | | 0 | .5 | .5 | .5 | | | | | | | 2.5 | .1000 |
| B | | 0 | | | | 1 | | | | 1 | 1 | 1 | | | | 4. | .2666 |
| C | | | 0 | | | | .5 | | | 0 | | | .5 | .5 | | 2.5 | .1000 |
| D | | | | 0 | | | | .5 | | | 0 | | .5 | | .5 | 2.5 | .1000 |
| E | | | | | 0 | | | | .5 | | | 0 | | .5 | .5 | 2.5 | .1000 |

An alternative scaling technique when there is qualitative data consists of establishing a linear scale between the largest and smallest impacts. The team found that such a technique could be used when there was an indicator which represented the variable under consideration. Often this proved to be an indirect but quantitative indicator for a qualitative variable, which is the case in Table 4. The team found that where linear scaling could be used, the results were in the same direction as trends measured using the weighted ranking technique, but the range in scale values was much less exaggerated.

**Table 4. Linear Scaling**

Variable: Esthetic Values

Indicator: Net Changes in Forested Acreage

| | EXISTING | W/O PROJECT (2032) | ALTERNATIVES A | B | C | D | E |
|---|---|---|---|---|---|---|---|
| TOTAL (140,669) | 142,600 | 29,700 | 21,319 | 22,864 | 21,338 | 22,294 | 23,154 |
| Induced Clearing | | | 5,081 | 5,136 | 5,734 | 5,046 | 5,046 |
| Losses to Const. | | | 3,300 | 1,700 | 2,628 | 2,360 | 1,500 |
| Net Change | | -112,900 | -8,381 | -6,836 | -8,362 | -7,406 | -6,546 |
| Scale | | .2111 | .1516 | .1625 | .1517 | .1585 | .1646 |

## CONSTRUCTION OF SUMMARY TABLES

The final step in the WRAM process is the construction of a Summary Table for each account listing each variable, the weight assigned each variable, the scale of impact of that variable on each alternative, the product of multiplying the weight and scale scores for each alternative and finally the sum of these products for each alternative resulting in a final score for each alternative. Computation of Summary Tables for each account can be carried out separately for each account and does not require further team review after the team agreed on the final scaling and reviewed initial weighting.

It should be stressed that the final scores for each alternative for each account were not intended to determine the choice of alternatives. Rather, the entire Summary Table should be a guide for decision makers and potentially for public consideration. For example, in the Summary Table for the Social Well-Being account (Table 5) on the Tensas River field test, the Without-Project alternative was superior primarily because of higher

## Table 5. SUMMARY TABLE SWB ACCOUNT

TENSAS RIVER - SOCIAL WELL-BEING ACCOUNT

| VARIABLE | RIC-LEVEL | | | FINAL RIC | ALTERNATIVE CHOICE COEFFICIENTS | | | | | | FINAL CHOICE MATRIX | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | W/O PROJECT | ALTERNATIVES | | | | | W/O PROJECT | ALTERNATIVES | | | | |
| | 1 | 2 | 3 | | | A | B | C | D | E | | A | B | C | D | E |
| Real Income Distribution | .21 | | | | | | | | | | | | | | | |
| Incidence of Benefits | | .67 | | .1407 | .2547 | .1640 | .1592 | .1341 | .1538 | .1341 | .0358 | .0230 | .0224 | .0189 | .0216 | .0189 |
| Income Expenditures | | .33 | | .0693 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0115 | .0115 | .0115 | .0115 | .0115 | .0115 |
| Life, Health, Safety | .08 | | | | | | | | | | | | | | | |
| Life | | .33 | | .0264 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0044 | .0044 | .0044 | .0044 | .0044 | .0044 |
| Health | | .33 | | .0264 | .2111 | .1516 | .1625 | .1517 | .1585 | .1646 | .0056 | .0040 | .0043 | .0040 | .0043 | .0043 |
| Safety | | .33 | | .0264 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0043 | .0043 | .0043 | .0043 | .0043 | .0043 |
| Education, Cultural, Recreation | .13 | | | | | | | | | | | | | | | |
| Education | | .33 | | .0429 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0071 | .0071 | .0071 | .0071 | .0071 | .0071 |
| Cultural | | .33 | | .0429 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0071 | .0071 | .0071 | .0071 | .0071 | .0071 |
| Recreation | | .33 | | .0429 | .3333 | .1000 | .2666 | .1000 | .1000 | .1000 | .0143 | .0043 | .0114 | .0043 | .0043 | .0043 |
| Emergency Prepardness | .03 | | | .0300 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0050 | .0050 | .0050 | .0050 | .0050 | .0050 |
| Demographis Characteristics | .17 | | | | | | | | | | | | | | | |
| Population Change | | .67 | | | | | | | | | | | | | | |
| Short Term | | | .33 | .0376 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0063 | .0063 | .0063 | .0063 | .0063 | .0063 |
| Long Term | | | .66 | .0752 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0125 | .0125 | .0125 | .0125 | .0125 | .0125 |
| Migration | | .33 | | | | | | | | | | | | | | |
| Short Term | | | .33 | .0185 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0030 | .0030 | .0030 | .0030 | .0030 | .0030 |
| Long Term | | | .66 | .0370 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0061 | .0061 | .0061 | .0061 | .0061 | .0061 |
| Community Organization | .21 | | | | | | | | | | | | | | | |
| Cohesion | | .50 | | .1050 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0175 | .0175 | .0175 | .0175 | .0175 | .0175 |
| Employment | | .17 | | | | | | | | | | | | | | |
| Short Run | | | .33 | .0118 | .1655 | .1669 | .1667 | .1668 | .1671 | .1672 | .0020 | .0020 | .0020 | .0020 | .0020 | .0020 |
| Long Run | | | .66 | .0236 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0039 | .0039 | .0039 | .0039 | .0039 | .0039 |
| Displacement | | .33 | | .0693 | .3440 | .0000 | .1200 | .1680 | .1840 | .1840 | .0238 | .0000 | .0083 | .0116 | .0128 | .0128 |
| Noise | .06 | | | .06 | .1667 | .1667 | .1667 | .1667 | .1667 | .1667 | .0100 | .0100 | .0100 | .0100 | .0100 | .0100 |
| Esthetic Values | .13 | | | .13 | .2111 | .1516 | .1625 | .1517 | .1585 | .1646 | .0274 | .0197 | .0211 | .0197 | .0206 | .0214 |
| | | | | | | | | | | TOTAL | .2076 | .1517 | .1682 | .1592 | .1643 | .1624 |

values under four variables: (1) Incidence of Benefits, (2) Recreation, (3) Displacement, and (4) Esthetic Values. Such information might lead in preliminary planning to consideration of modification of aspects of an alternative to make it more desirable, or development of a new alternative. Thus, the total WRAM procedures are a tool rather than a final answer.

## CONCLUSIONS

The Tensas study was a useful field test of the WRAM procedures for processing data by an interdisciplinary team from initial variable selection through data collection and review to determination of final assessment of impacts. The interdisciplinary team proved it was possible for individuals from diverse disciplines to select and weight variables in such a way as to guide expenditure of effort in initial data collection. Review by the interdisciplinary team of all data collection and decisions proved most beneficial. The WRAM team effort allowed division of labor among members allowing each individual to concentrate on their apportioned duty with overall checks and balances being enforced by team interaction. Team interaction enabled each member to maintain perspective on the relative importance of each account and each major variable within the overall impact assessment. Duplication of effort was minimized. Team interaction helped avoid premature closure in determining the overall significance of any particular variable or in the selection of indicators representing variables.

## REFERENCES

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## NOTES

1. This paper is a summary of a report documenting the field test of Water Resources Assessment Methodology (WRAM) to a proposed U.S. Army Corps of Engineers project in the Tensas River Basin, Louisiana, prepared pursuant to Contract Number DACW39-77M-2420 with the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. The conclusions expressed are those of the authors and do not necessarily reflect those of the U.S. Army Corps of Engineers.