TAB E

An Approach for Evaluating Nonstructural Actions with Application to the Yazoo River (Mississippi) Backwater Area

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Abstract

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Leonard Shabman and Laura Zepp

A protocol was developed for estimating the economic benefits and costs of nonstructural actions on frequently flooded farmlands. A computer model using the best available data was developed and used to apply the protocol to evaluation of nonstructural actions for the Yazoo backwater (MS) area. Nonstructural actions included reforestation of approximately 70% of the acres inundated during the 2-year flood event, participation in an income insurance program for farms outside the 2-year flood plain and relocation with local flood protection measures for the limited number of structures in the watershed. A review also was completed of the US Army Corps of Engineers preliminary agricultural benefit estimates for a Yazoo area pumping plant.

Positive national economic development (NED) benefits are expected from implementation of nonstructural actions in the Yazoo study area. Included in the NED analysis are benefits for carbon sequestration and nutrient load reduction. Without these benefit categories NED is negative. However, nonstructural actions also were justified by documenting that significant environmental results are secured for a modest cost to the nation. While nonstructural actions may be warranted, agricultural flood protection benefits for a pump project appear insufficient to justify costs. Also, if the problems and opportunities of the watershed area are to be addressed with federal funds, nonstructural actions can be implemented for budget cost significantly lower than the cost for a pump.

The report concludes that the calculation of economic returns from continued agricultural production on frequently flooded land is critical to an analysis of both structural and nonstructural actions. Therefore, the logic and databases used to calculate agricultural returns under the new protocol and by the Corps in its pump evaluation should be reviewed by the Office of Management and Budget.

The report also concludes that a federal interagency committee should be chartered to refine the proposed evaluation protocol for NED and environmental analysis and to employ the procedures to establish a reforestation/restoration target for the Yazoo backwater area. As part of its work the interagency committee should design an implementation plan to provide incentives for voluntary adoption of reforestation actions for the watershed, to provide farm income assurance and to secure justified local protection and relocation for properties at risk. The implementation plan would involve linkages with state, non-governmental organizations (NGOs) and private sector participants.

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Thanks to the assistance of these people and many others during the course of this study, we believe that the resulting analyses are as representative as possible of the study area economic conditions. Nonetheless, we bear the full responsibility for the work reported here. Any inaccuracies found in this report are the sole responsibility of the authors.

Extended Report Summary

An Approach for Evaluating Nonstructural Actions with Application to the Yazoo River (Mississippi) Backwater Area

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Study Background and Objectives

Areas throughout the Yazoo River (MS) watershed were cleared for crop production early in the century. While little residential or industrial development has occurred in the backwater area, protection from flooding provided by interior channelization, cutoffs and levees, combined with favorable agricultural prices and agricultural and tax policy encouraged the clearing of most of that area's original forest cover for agricultural production. Today, much of the study area remains subject to flooding; by most estimates farming occurs on over 100,000 acres of land that has a 50% chance of being flooded each year (the 2-year flood plain).

A levee and gate structure surrounds the backwater area in the southern reaches of the watershed. The gate is opened after the early spring flows of the Mississippi and Yazoo Rivers diminish. Before the gate is opened, flooding limits the ability of farm operators to plant all their fields at times that allow for maximum crop growth. However, once the water leaves a field the farm operator can employ intensive production practices. In lower elevations, short season soybeans are planted to accommodate the heavy soils and limited growing season. This flooding motivated a Corps of Engineers proposal to build a large capacity pump to transfer water trapped in the enclosed backwater area into the Mississippi.

Critics questioned the justification of a pump as a fully funded federal expenditure and called for nonstructural measures such as expanded crop insurance and removing agricultural activity and structures from flood prone areas. However, no protocol existed for evaluating such nonstructural measures in this watershed or elsewhere in the nation. In response, researchers at Virginia Tech received grant assistance from EPA to

1) adapt existing economic analysis protocols for evaluating non- structural alternatives,

2) demonstrate the analytical protocol with an evaluation of nonstructural actions for the Yazoo River backwater area, and

3) describe an implementation plan that would provide incentives for landowner adoption of nonstructural actions.

A fourth objective emerged during the course of the study when information provided by the Corps made it possible to review the agency's preliminary estimates of agricultural benefits for a pump.

Economic Evaluation

A *nonstructural action* was any action taken to address watershed problems and opportunities that results in no significant change in watershed hydrology. After careful consideration of watershed problems, opportunities and economic conditions in the Yazoo Backwater Area, a nonstructural watershed action scenario was developed. The scenario included: i) voluntary reforestation of approximately 70% of the acres inundated during the 2-year return frequency flood event; ii) farmer participation in an insurance program to compensate for flood damages on land remaining in crop production, and iii) relocation of structures subjected to frequent flood damages or construction of small-scale, localized flood protection works. In the Yazoo study area, reforestation of frequently flooded agricultural lands with native bottomland hardwood tree species has been described as a "nonstructural action" for addressing agricultural flood damage problems and has received particular attention for its ecological restoration values.

Nonstructural actions must be undertaken by private landowners and businesses. A *non- structural plan* was defined as a combination of agency authorities and programs to create financial incentives for landowners to initiate reforestation efforts and to participate in the insurance program. The plan also would include initiatives to reduce the flood risk for the limited number of structures in the backwater area.

The National Economic Development (NED) criterion of the *U.S. Water Resources Council's Principles and Guidelines for Water and Related Land Resources Planning, (P&G)* was adapted to evaluate the economic consequences of the watershed action scenario. The NED analysis included the value of goods and services produced, regardless of whether a market for the service currently existed. The NED evaluation of the watershed action scenario served two purposes for this study: i) to determine whether a nonstructural incentives program to encourage adoption of nonstructural actions would benefit the nation's economy and ii) to provide information for the design of an incentives program.

Justification of the Watershed Action Scenario

Net NED benefits (benefits minus costs) were calculated as the difference between NED returns from the land use in Yazoo Backwater Area with and without implementation of the watershed action scenario. The NED consequences of landowners participating in an insurance program were not evaluated; instead, a subsidized insurance program was treated as a transfer payment that has no NED consequences. Also, it was assumed for the NED analysis that relocation and localized protection actions will be taken until NED costs will be equal to the NED benefits. Therefore, the net NED from residential, commercial and infrastructure protection was set at zero.

The NED results were calculated for the reforestation actions within the watershed action scenario. When evaluating the NED consequences of reforestation actions, NED costs are the market prices paid for the seedlings, labor, machinery and other inputs used

in reforestation. NED costs also include the NED value of the forgone agricultural production on the reforested land.

Once costs are incurred, the NED benefits are the money valuation of the services provided by restored forested land. One benefit is the value to the nation of the pulpwood and saw timber that could be harvested in future years. Forests also provide superior wildlife habitat, sequester carbon (carbon dioxide is the primary greenhouse gas), are less likely to contribute to nutrient enrichment of estuaries and sediment loads. Some of these environmental services were calculated as NED benefits.

The watershed action scenario was determined to be NED justified. The calculated net benefits for the watershed action scenario were over $20 million. Specifically, forgone farm income was $ 30.6 M as an NED cost of reforestation. Timber benefits, net of costs, had a negative NED value of $9.5 million. Other reforestation benefits were positive including habitat for hunting ($6.9 million), sequestered carbon ($9.8 million), nutrient control ($32.2 million), and avoided on-farm non-crop damages ($13.7 million).

Included in the NED analysis are benefits for carbon sequestration and nutrient load reduction. Without these benefit categories NED is negative; however, nonstructural actions also were justified by documenting that significant environmental results are secured for a modest cost to the nation.

Agricultural Returns - A Comparison of Approaches and Results

Estimates of agricultural returns are critical to calculating the NED cost of nonstructural actions. Agricultural returns analysis also is central to the estimates of benefits for structural measures such as the pump project. A comparison of the agricultural returns calculations uncovered significant differences between this study and the preliminary results of the Corps; in addition we identified areas where the Corps benefit analysis may be flawed. Therefore, in the absence of a formal Corps report on the pump, used the agricultural returns model developed for the nonstructural research to estimate the maximum potential flood protection NED benefits from operation of a pump. While nonstructural actions may be warranted, agricultural flood protection benefits for a pump project appear insufficient to justify costs.

Findings and Implications

Because a Yazoo Backwater area project has been authorized the requirement for Office of Management and Budget review of NED analyses under Executive Order 12322 does not apply. Therefore the EPA should make a special request that OMB review the procedures, data and logic used for agricultural returns calculations.

The administration should seek authorization in WRDA 2000 for a federal interagency committee of equal partners (Corps, FEMA, USDA, EPA, CEQ, FWS, and OMB) to address the problems and opportunities in the Yazoo backwater study area. This federal agency partnership should develop formal linkages with state, non-governmental

organizations (NGOs) and private sector participants. Congressional direction for the effort should affirm that implementation, as with the pumps, will be a full federal responsibility.

The interagency committee should refine the proposed evaluation protocol for NED and environmental analysis and employ the procedures to establish a reforestation/restoration target for the Yazoo backwater area.

The interagency committee should develop a coordinated approach with FEMA, USDA and the FCIC to provide farm income assurance for lands above the 2 year flood plain and to secure justified local protection and relocation for structures at risk throughout the watershed.

The interagency committee should design an implementation plan to supplement the Wetlands Reserve Program (WRP) incentives for voluntary adoption of reforestation actions for the watershed. The new program should rely on government easement payments offering landowners the opportunity to earn an up-front payment or predictable annual payment for switching land use from farming to forest production. The payment might be necessary to compensate the landowner for the increased variability in cash flow from forest product sales relative to annual agricultural sales, to address landowner unease over uncertain future timber yields and prices and/or to bridge any gap between forestry returns and the forgone returns from crop production.

If the problems and opportunities of the watershed area are to be addressed with federal funds, nonstructural actions can be implemented for budget cost significantly lower than the cost for a pump. If easement payments to landowners were a full federal responsibility, the budget cost in excess of the existing Wetlands Reserve Program payments would be $26 million, at $650 per acre. To the extent that other sources of funds are secured this budget cost will be reduced. The cost of the income assurance program was estimated at $11.5 million. However, this estimate includes those payments made as disaster aid and crop insurance indemnities, in the absence of the proposed program. The costs that would be incurred in planning and administering these programs were not estimated. The cost for flood protection for structures was not calculated but a perspective on the possible costs can be provided. The Corps reports that there are 1544 structures in the 100 year flood plain. The total market value of those structures was less than $40 million. From this perspective the market value property in the watershed, the full cost of the insurance program and the full cost of the easement program are approximately 1/2 the cost of a $150 million pump.

Section 1. Introduction

1A. Origin and Scope of the Study

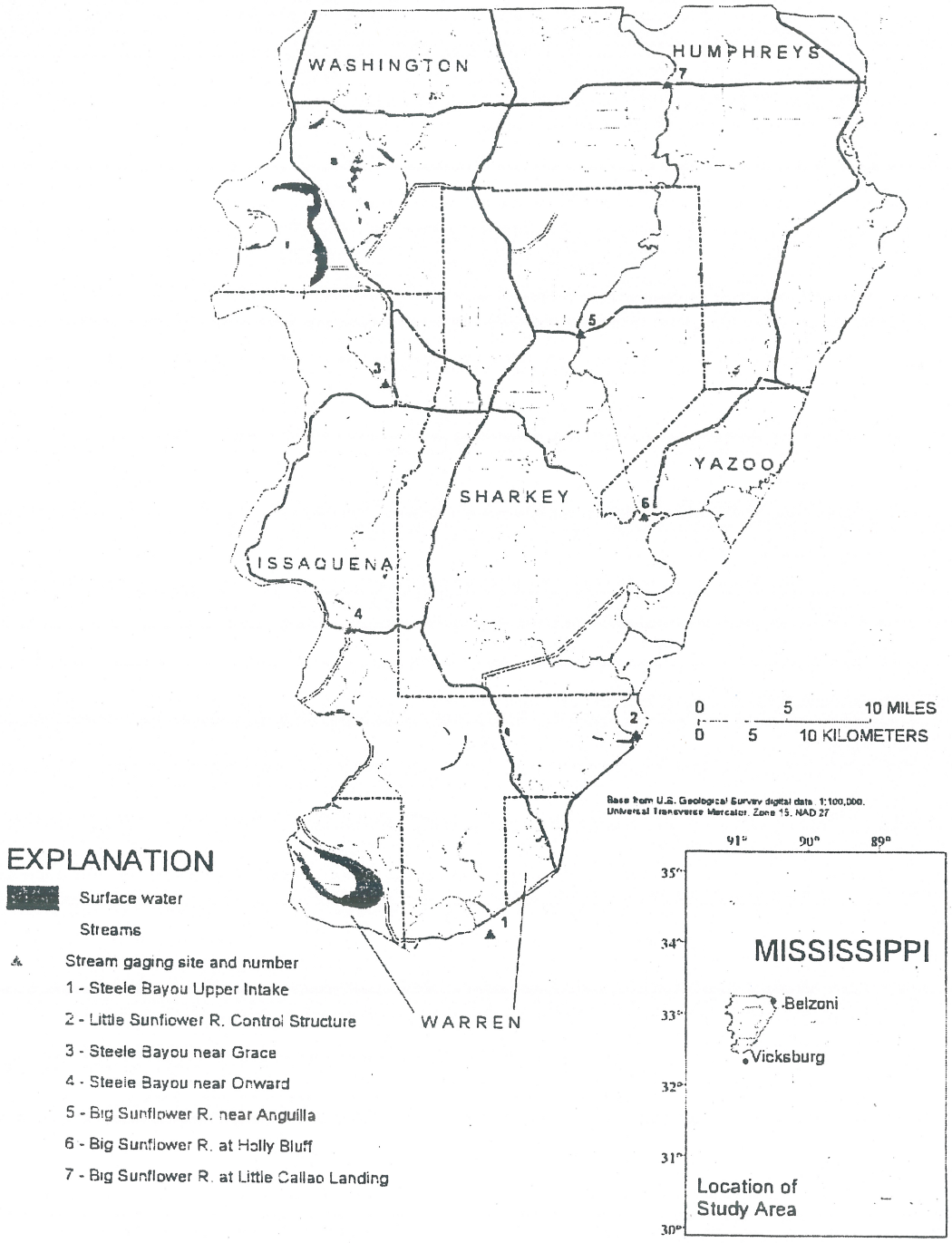
In 1928 the Corps of Engineers was authorized to begin studies and develop plans for flood hazard reduction throughout the lower Mississippi River watershed. The 1941 Flood Control Act instructed the Corps to develop a plan to address flood hazards in the Yazoo River watershed. Following Corps recommendations, the executive branch sought and received Congressional appropriations for implementing levee and channel projects that have protected the Yazoo River Backwater area from flooding originating in both the Yazoo and Mississippi Rivers. Today, the area has a levee on the west along the Mississippi River (the mainline levee) and a levee to the east (the Yazoo River levee). (See Figure 1-1) At the southern end of the area, where the two levees meet, a gate at Steele Bayou can be closed during high river flows in late winter and in the spring to protect the area from the two rivers.

The portion of the Yazoo Backwater Area considered in this study consists of approximately 540,00 acres that make up the southern most tip of the larger Yazoo River watershed. It is in the shape of an inverted triangle, bordered on the east by the Yazoo River and on the west by the Mississippi. It stretches southwards from approximately the latitude of Belzoni Mississippi to its southern-most tip at Vicksburg, Mississippi. (USACE, 1982)

Areas of the Yazoo watershed were cleared for crop production early in the century. While little residential or industrial development has occurred in the backwater area, protection from flooding provided by interior channelization, cutoffs and levees, combined with favorable agricultural prices and agricultural and tax policy encouraged the clearing of most of the watershed's original forest cover for agricultural production. Because water cannot escape until the gate is opened after the early spring Mississippi River flows diminish, the area remains subject to flooding from winter rainfall and runoff from the upper reaches of the watershed. In some years this internal flooding limits the ability of farm operators to plant all their fields at a time that would allow for maximum crop growth. Once the water leaves the field, there is only a small likelihood of flooding later in the growing season. Therefore, while planting may be delayed for a crop, the farm operator can employ intensive production practices once the water is off the field. As a result, in lower elevations short season soybeans are planted to accommodate the heavy soils and limited growing season. Other crops are found in the higher elevations of the watershed.

In 1982, the Corps proposed a project to reduce the duration of this "internal" flooding, citing the 1941 Flood Control Act authorizing language. (USACE, 1982) The agency proposed pumping water collected in the backwater area back into the Mississippi. The pump, if effective, would make an area that has always flooded better suited to agricultural production.

Figure 1-1: Study Area



*(DOI USGS, 1999) Preliminary figure subject to revision as of February 7, 2000

A sequence of congressional and administrative actions followed the Corps' 1982 proposal, creating the conditions under which the pumps proposal is currently being considered. In 1986, Congress adopted generic cost sharing reforms that had the effect of increasing the local sponsors financial responsibility for the proposed pump project [Section 103 (e)(1) of the Water Resources Development Act of 1986 - 33U.S.C.2213 (e) (1)]. Then in 1988, the Secretary of the Army requested a reanalysis of the unconstructed features of the 1941 authorized project for the whole watershed. In 1989, the Office of Management and Budget instructed the Corps to develop a plan for the backwater area that was justified by national economic development (NED) criteria. As the revised plan for the backwater area was being developed, the local project sponsor (the area levee board) advised the Corps that they could not meet the cost-sharing obligation established in 1986. As a result, Section 337 of the Water Resources Development Act of 1996 made flood damage reduction actions a full federal financial responsibility, as it had been in the original authorization.

Critics of a pump as a fully funded federal expenditure agree that the pump will result in a reduction in agricultural flood damages. However, they still have questioned the justification for a pump. In recent years federal policy toward agricultural flooding has shifted from the structural projects to insurance and removing agricultural activity from flood prone areas in the interests of environmental restoration.

It was suggested that, if federal expenditures are warranted in the study area, spending should be for nonstructural actions designed to protect landowner income, while encouraging environmental restoration. The Corps Vicksburg district, while not formally rejecting nonstructural actions, led the federal and state agencies and the project sponsors to believe that such an approach would be economically unjustified, would be inconsistent with the authorization language and could not be budgeted for by the agency.

However, there is no formal protocol comparable to planning procedures established by the Corps for reviewing structural projects exists for evaluating nonstructural actions. In response researchers at Virginia Tech received grant assistance from the USEPA to develop protocols for the economic evaluation of nonstructural actions. The resulting procedures would rely to the maximum extent appropriate on the conceptual and policy logic in the governing document for water planning in the Federal government, the *Economic and Environmental Principles Guidelines for Water and Related Land Resources Implementation Studies* (P&G). The Yazoo backwater study area would then be used as a case study to illustrate how the framework could be implemented. The specific objectives of the study were:

1. to adapt the existing economic analysis protocol for evaluating a non-structural alternative,

2. to demonstrate the analytical protocol with an evaluation of nonstructural actions for the Yazoo River backwater area, and

3. to describe an implementation plan that would provide incentives for landowner adoption of nonstructural actions.

While the study was underway, the Corps District offices in Vicksburg requested the results of the evaluation of reforestation actions. The Corps planned to use these results for justifying a plan that combined reforestation with a pump.[1] At this time, no revised report on a pump alternative is available for review. However, an information exchange with the Corps was initiated to permit a comparison of the agricultural returns analysis common to both the pump and the nonstructural evaluation. The text of the 1982 pump report (USACE, 1982), and preliminary agricultural net returns calculations provided by the Corps district and division offices in response to questions, made it possible to review the agricultural benefits analysis that apparently will be offered for a pump. A comparison of approaches for measuring agricultural net returns became a fourth objective of the study.

1B. Nonstructural Actions and Plans

Traditionally, the response to agricultural flooding has been to build structural water control measures to enhance the economic value of farming in flood prone areas. An alternative is to create attractive insurance programs that provide landowners with monetary compensation whenever flood damages are incurred. The goal of this approach is to protect income from farming, but not to reduce flood damages that are incurred. This means that if the insurance premiums are actuarially sound, and landowners pay the premiums, then landowners would have an incentive to alter land use and damages would fall to the national level. Another alternative encourages landowners to remove agricultural activity from flood prone areas. A combination of governmental payments with sales of services from the new land use (ex. hunting leases might be sold) could enhance landowner income and achieve ecological restoration of the previously farmed land.

Through the middle of the 20th century, structural water control measures were promoted to expand the farming opportunities on poorly drained and flood prone soils. By mid century, in the face of farm surpluses, water policy reviews began to question the economic rationale for expanding the land base (NWC, 1973). By the 1990s the argument was made that water control projects had diminished the ecosystem's capacity to provide terrestrial and aquatic wildlife habitat, sediment and nutrient trapping functions and mediation of hydrologic extremes of flood and drought. Recognition of the possible environmental consequences of the nation's water management approaches led to calls for ecological "restoration" (National Research Council, 1993; FIFMTF, 1992) and to Congressional legislation encouraging restoration actions in watersheds. Restoration is a loosely defined concept, but is generally thought of as the return of a watershed to some previous condition [2] (National Research Council, 1993).

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1 As a result of this request a memorandum was distributed on June 22, 1999 that cautioned against misuse of the work from this study when evaluating a proposal that includes a pump. A copy of that memorandum is included in Appendix G.

2 It is not the case that restoration can only occur through a nonstructural approach. Changes from current hydrology might be needed to restore a historical condition and such changes might be achieved through structural measures. However, such consideration was beyond the scope of this study.

Restoration that involves large scale hydrologic change may be too costly (in both financial terms and through its displacement of existing land and water uses) to be justified. However, in the Yazoo backwater study area, the flooding regime in the lower elevations remains largely as it was at the time of the last significant land clearing. In this area, planting trees to bring back the original forest cover may be equated with restoration.[3] Today farming occurs on over 121,000 acres of land that has a 50% chance of being flooded in any year (the 2-year flood plain). As prices for farm commodities have fallen relative to costs and as public policy has sought to discourage farming these areas through such programs as the Wetlands Reserve Program, reforestation of areas subject to flooding is advocated as both "restoration" and as a "nonstructural approach" to addressing agricultural flood control problems.

While reforestation in the Yazoo backwater area has been equated with a nonstructural approach, nonstructural actions can address all of the problems and opportunities in a watershed. For this study, a *nonstructural action* was defined as any action taken to address watershed problems and opportunities that results in no significant change in watershed hydrology.[4] Nonstructural actions might include relocation of structures, expansion of insurance programs to compensate for the economic losses from flooding and reforesting farmland in the flood plain. In the Yazoo study area, reforestation of frequently flooded agricultural lands with bottomland hardwood tree species has received particular attention for its ecological restoration potential.

Regardless of their environmental or national economic merits, nonstructural actions must be undertaken *voluntarily* by private landowners and businesses, perhaps in response to direct subsidies and tax advantages. A *non- structural plan* is a combination of programs to create financial incentives for landowners to voluntarily implement nonstructural actions. In fact, recommendations to modify agency programs already are permitted as a part of recommended federal water resources plans. The governing document for water planning in the Federal government, the *Economic and*

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3 The term "restoration" is used in this study as it is defined by the US Army Corps of Engineers as part of their "restoration and ecosystem approach" to environmental issues. A definition is provided in EP 1165-2-1, "Digest of Water Resources Policies and Authorities", July 30, 1999, Chapter 19: "Restoration is the process of implementing measures to return a degraded ecosystem's functions and values, including its hydrology, plant and animal communities, and/or portions thereof, to a less degraded ecological condition. The goal of restoration is to return the study area to as near a desired natural condition as is justified and technically feasible."

4 The term "nonstructural" has been defined in different ways in Federal reports. For example, the P&G in Section 2.1.4 defines nonstructural measures as follows: "A modification in public policy, an alteration in management practice, a regulatory change, or a modification in pricing policy that provides a complete or partial alternative for addressing water resource problems and opportunities." The Interagency Floodplain Management Review Committee that evaluated the experience of the 1993 midwest flood (IFMRC,1994) adopted the definition of nonstructural measures prepared by the Federal Interagency Floodplain Management Task Force in 1992 (FIFMTF,1992). "The term nonstructural" measures is used to describe techniques that modify susceptibility to flooding (such as regulation, floodplain acquisition and flood proofing techniques). Both groups considered insurance programs to be compensation for losses that would modify the impact of flooding and also as financial incentives to avoid flood plain locations. Without a clear definition in use, we adopted a definition of nonstructural actions that best characterized the difference between the pump project and what was being considered in this study; that is, the effect of the action on watershed hydrology.

Environmental Principles Guidelines for Water and Related Land Resources Implementation Studies (P&G) states:

> "Plans may be formulated which require changes in existing statutes, administrative regulations and established common law; such required changes are to be identified."

1C. The Case Study Application

Using the Yazoo Backwater area as a case study for implementing a nonstructural evaluation protocol involved a sequence of steps.

- ξ defining water and related land resources problems and opportunities
- ξ formulating (describing) nonstructural actions that would address the problems and opportunities
- ξ evaluating how well the actions contribute to national economic development
- ξ proposing an implementation strategy to encourage implementation of the nonstructural actions were undertaken

At each step, the research relied on insights from different disciplines and synthesized data, study results, meeting minutes and interview notes from academic sources, government reports and experts on agriculture, forestry and the environment.

After careful consideration of watershed problems, opportunities and economic conditions in the Yazoo Backwater Area, a set of three nonstructural actions were considered. These included: i) voluntary reforestation of approximately 70% of the acres inundated during the 2-year return frequency flood event, ii) relocation of structures subjected to frequent flood damages or construction of small-scale, localized flood control structures, and iii) expanded farmer participation in a program to compensate for income losses due to flood damage on land remaining in crop production. Then, using a combination of these three nonstructural actions, a scenario was created for the Backwater Area, termed *the "watershed action scenario"*.

A protocol for evaluating the economic consequences of the watershed action scenario was developed and applied. The results from that work are included in the following sections of this report. The evaluation of the nonstructural outcomes scenario served two purposes: i) to determine whether a nonstructural incentives program to encourage adoption of nonstructural actions would benefit the nation's economy; ii) to provide information for the design of an incentives program.

Each of the three specific actions included in the watershed action scenario were to be voluntary actions undertaken by landowners and communities in the Yazoo Backwater Area. Therefore, a nonstructural plan had to identify policies and programs that would create incentives for landowners to implement actions such as those included in the watershed action scenario. Upon concluding that there was justification for nonstructural actions, a nonstructural plan was suggested that would provide incentives for landowners to either reforest or purchase insurance. In the last section of the report we use the results

from the analysis of the watershed action scenario, a reconsideration of the history of the area and a policy review to propose a possible incentive package that could constitute a nonstructural plan.

"An Approach for Evaluating Nonstructural Actions with Application to the Yazoo River (Mississippi) Backwater Area"

A copy of the full report can be obtained at this web site:

http://www.vwrrc.vt.edu/pdf/report.pdf

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