THE EFFECTS OF FLOOD PREVENTION MEASURES INSTALLED IN BLUFF TRIBUTARIES ON REDUCTION OF SEDIMENT AND FLOOD DAMAGES IN THE YAZOO RIVER DELTA

By

Wilbur L. Watts
Staff Leader, Watershed Planning Staff
Soil Conservation Service

INTRODUCTION

The part of Mississippi known locally as the Bluff Hills area is a belt varying in width from 3 to 30 miles along the eastern side of the Yazoo-Mississippi Delta extending from the Tennessee line to Vicksburg and south through Natchez to the Louisiana line. This paper pertains to conservation work on that part of the Bluff Hills from Yazoo City to the Tennessee line, a portion of the Yazoo River Basin.

Topography, geology, misuse of the land during the last 150 years, and other factors have caused this to be one of the more severely eroded areas in the United States. Sediment from the hill streams fills channels in the Delta portion of the Yazoo River and its tributaries--causing breaks in levees and general flooding of surrounding areas, inflicting severe damage on farmland, farm buildings, roads and bridges, urban areas, and public utilities. Maintenance costs on ditches, levees and farm drainage systems amount to millions of dollars annually on approximately 425,000 acres as a direct result of sediment and floodwater from the eroded Bluff Hills.

Recognizing this problem area, Congress passed legislation in 1944 which authorized the Soil Conservation Service to work with Soil Conservation Districts, landowners, Drainage Districts, municipalities, and State and Federal agencies to accelerate treatment of the hill areas in the Yazoo River Basin. This work, mostly vegetative treatment of severely eroding areas, was initiated in 1947 and is continuing. In 1954, larger structural measures for control of floodwater and sediment were added to the treatment program. This paper briefly describes the problems in the watershed, treatment planned, measures installed by the Soil Conservation Service through the Flood Control Act of 1944, and, where possible, the effects of these measures. A typical subwatershed, Ascalmore Creek, will be discussed in detail since all planned measures were installed prior to 1963 and studies were made in 1965 on reduction of flow and sediment damages in the Delta portion.

Geology of the Bluff Hills

The uppermost geologic formation of the Bluff Hills is the Loess. It is the Loess that causes the distinctive topography of the Bluff Hills area. Steep-sided hills, deep steep-walled valleys and vertical or sub-vertical scarps are the main features of this topography. The Loess has a maximum thickness of about 25 feet at the Tennessee line and thickens to near 90 feet at the Louisiana line. At all locations the maximum thickness occurs near the Bluff and there is a gradual thinning to the east. The Loess is made up almost entirely of silt size particles.

Underlying the Loess is the Citronelle formation. The Citronelle is composed of sand and gravel and has a maximum thickness of about 100 feet; but the thickness is extremely variable and in places the formation is entirely absent.

The Loess and Citronelle are the only formations that extend over the entire Bluff Hills area. The Kosciusko sand underlies the Citronelle from the Tennessee State line to southern Carroll County. From Southern Carroll County to Yazoo City the Citronelle is underlain successively, in north to south order, by the Shipps Creek shale, Wautubbee sand, and Yazoo clay.

Erosion Damage

Poor land use and lack of conservation practices in the past have caused severe sheet and gully erosion in the Bluff Hills area. It is estimated that sheet erosion has removed three-fourths or more of the topsoil from 80 percent of the uplands. Some of the largest and most damaging gullies in the state are located in Carroll County where erosion has penetrated the Loess into the underlying sandy and easily eroded Kosciusko formation. Fifteen percent of the uplands has been severely damaged by gullying and another fifteen percent of the uplands has received moderate damage from gullying. Streambank caving and head cutting in the bottomlands are also causing land destruction in the Bluff area. The acreage damaged is not large but the damage is occuring on the most valuable land in the area.

In 1961, the Department of Agriculture estimated average annual damages along the Bluff-Hill area at $2,455,000.1/

1/ Report on Surveys and Investigations of Land and Water Resources Part I, Yazoo-Mississippi River Basin. Page 4, 1961.

PLANS FOR TREATMENT OF BLUFF TRIBUTARIES

Plans have been developed by the Soil Conservation Service cooperating with Soil Conservation Districts and local Drainage Districts, for treatment of nineteen subwatersheds in the Bluff Hills section, covering approximately 85 percent of the area. The treatment of eroding areas with the proper vegetation has been given first priority in these plans. After the vegetative treatment is nearly complete, floodwater retarding structures and other structural measures are to be constructed to reduce floodwater and sediment.

We have a close working relationship with the U. S. Army Corps of Engineers so that there is no duplication of effort in planning works of improvement.

Table 1 - Major Measures Planned for Bluff Hill Subwatersheds

Measures	Units
Tree Planting (Loblolly pine)	212,421 acres
Grasses and Legumes	26,556 acres
Desilting Basins	4,512
Diversion	411 miles
Roadside erosion control	687 miles
Pipe overfall structures	2,042
Floodwater Retarding Structures	166

MEASURES INSTALLED IN BLUFF TRIBUTARIES

As of January 1, 1966, the following measures have been installed in the bluff tributaries by individual landowners, the Forest Service, and the Soil Conservation Service.

Table 2 - Major Measures Installed in Bluff Hill Subwatersheds - 1/1/66

Measures	Units	Percent of Planned Treatment Completed
Tree Planting (Loblolly pine)	148,700 ac.*	70
Grasses and Legumes	16,000 ac.*	60
Desilting basins	4,000 *	89
Diversion	300 mi.*	73
Roadside erosion control	420 mi.*	61
Pipe Overfall Structures	1,350 *	64
Floodwater Retarding Structures	114	69

* Approximate number

EXPECTED REDUCTION IN DAMAGES

Studies made during work plan development indicate that an overall reduction of damages from floodwater and sediment of 70 percent can be expected in the Yazoo River Delta. Reductions vary by subwatersheds as shown in the following table.

Table 3 - Expected Reduction of Damages and Percent of Subwatersheds Behind Floodwater Retarding Structures on Selected Subwatersheds in Bluff Hills Area

Subwatershed	Expected Reduction of Damages	Subwatershed Behind FWRS (Planned)	Subwatershed Behind FWRS (Constructed) 1/1/66)
Big Sand Creek	64%	46.4%	28.0%
Pelucia Creek	56%	52.6%	51.0%
Abiaca Creek	63%	56.0%	26.0%
Potacocawa Creek	85%	56.0%	31.0%
Ascalmore Creek	93%	71.0% *	71.0% *
Teoc Creek	88%	87.0%	87.0%
Chicopa Creek	95%	88.0%	22.0%

* Includes Ascalmore, Taylor and Metz Creeks.

The storm of February 9-10, 1966, which produced approximately 7 inches of rainfall in the Bluff Hills east of Greenwood, caused several breaks in levees on Big Sand and Abiaca Creeks, while Pelucia Creek, which lies between them experienced only one minor levee break. As noted in Table 3, the amount of subwatershed behind structures in plans varies from 46.4 percent on Big Sand, 52.6 percent on Pelucia, to 56 percent on Abiaca Creek. The major difference is in the amount of subwatershed controlled by structures on the ground--Big Sand has 28 percent, Abiaca 26 percent, and Pelucia 51 percent. It is assumed that this is the reason that Big Sand and Abiaca levees broke and caused much destruction and Pelucia had a minor break of little consequence.

TREATMENT OF ASCALMORE CREEK SUBWATERSHED

Ascalmore Creek Subwatershed in Tallahatchie County south of Charleston, Mississippi, is typical of the Bluff Hills tributaries. This subwatershed was selected for discussion in detail because it is typical, the planned measures were installed prior to 1963, and it is one of the subwatersheds studied in the Evaluation Studies of the Yazoo-Little Tallahatchie River Watersheds.

A plan was developed in 1953 for treatment of this 24,363 acre subwatershed with vegetation and small structural measures. Landowners, the Forest Service, and the Soil Conservation Service installed these measures. In 1956, at the request of the Ascalmore Creek Drainage District, a plan was developed to supplement the land treatment plan with larger structural measures which would catch sediment and retard the flow of floodwater. As a sponsor, the Ascalmore Creek Drainage District furnished rights-of-way and made other contributions toward the construction of these measures. By 1963 the following measures had been installed:

Table 4 - Measures Installed on Ascalmore Creek Subwatershed Prior to 1963

Measures	Units
Sericea planting	300 acres
Lateral Channel Improvement (V-Ditch)	14 miles
Terracing	150 acres
Crop Rotation	1,856 acres
Pasture Planting	1,490 acres
Tree Planting (Loblolly Pine)	9,474 acres *
Watershed Waterway Improvement	14 miles
Streambank Stabilization	18 miles
Jetties	1 mile
Pipe Overfall Structures	100
Roadside Erosion Control	31 miles
Perennial Grass and Legume Planting	1,544 acres
Kudzu planting	109 acres
Diversion	11 miles
Desilting Basins	148
Floodwater Retarding Structures	7

* Includes 4,157 acres of new planting and 5,317 acres of interplanting.

Table 5 - Land Use Changes in the Hill Portion of Ascalmore Creek Subwatershed

Land Use	1956	1965	Percent Change
Cropland	3,110	1,943	- 37.5
Pasture	2,056	5,130	+149.5
Woodland	12,271	16,424	+ 33.8
Idle	6,926	866	- 87.5

Table 6 - Erosion Study Made in 1956 - Ascalmore Creek Subwatershed

	Gross Erosion	Delivered to Delta
	Conditions 1956	
Sheet Erosion	218,616 tons/year	43,723 tons/year
Gully Erosion	175,380 tons/year	105,228 tons/year
Roadside Erosion	11,100 tons/year	6,660 tons/year
Streambank Erosion	83,800 tons/year	83,800 tons/year
Total	488,896 tons/year	239,411 tons/year
	Estimated Conditions 1973	
	(10 years after installation of all project measures)	
Sheet Erosion	25,050 tons/year	5,010 tons/year
Gully Erosion	8,775 tons/year	5,265 tons/year
Roadside Erosion	1,650 tons/year	990 tons/year
Streambank Erosion	0	0
Total	35,475	11,265 tons/year

EFFECTS OF TREATMENT ON REDUCTION OF DAMAGES ON ASCALMORE CREEK

Ascalmore Creek Subwatershed was selected as one of the Bluff Hill tributaries to be studied in the Evaluation Studies of the Yazoo-Little Tallahatchie River Watersheds. These studies were initiated by the Soil Conservation Service in July, 1964. Studies are to be made to determine the effect of treatment programs on the reduction of sediment production, changes in gross erosion and changes in runoff at Paynes, Mississippi, where the U. S. Army Corps of Engineers maintains a recording stream gage. Sediment transported to the Delta by Bluff tributaries is also being studied. Silt ranges were established from Floodwater Retarding Structure No. 1 to the end of the levee at 2,000-foot intervals in 1964, and will be re-surveyed in 1969. Although these studies are incomplete, we feel that the data from our first surveys will be of interest.

Reduction in Sediment Damages

In 1956, at the time the subwatershed work plan was developed, an estimated 239,411 tons of sediment were being delivered annually into the delta (See Table 6). The cropland along the main channel in the Delta area was protected with levees, which frequently broke during heavy storms. In 1956, 319 acres of valuable cropland had already been severely damaged by sediment deposition and the damaged areas were increasing at a rate of 17.3 acres per year. At that time the average annual damage from sediment was $23,000.

There are still 284 acres damaged by sediment, with an annual damage of $5,287. Practically all of the remaining sediment damage is residual due to deep deposits of sand that had accumulated before the land treatment and structural measures were installed.

Reduction in Peak Flows

At the time the work plan was developed in 1956, the estimated annual damage from flooding was $29,600 (1956 prices). There has been no flooding from the main stream since the project was completed.

A study of rainfall and stream gage records showed about a 50 percent reduction in peak discharge at Paynes, Mississippi for storms in 1958 and 1965 which had similar conditions of ground moisture, duration and intensity of rainfall. Such a reduction is to be expected when 71 percent of the watershed is above floodwater retarding structures (see Fig. 1). The storm of April 29, 1958 produced a peak discharge of 9,800 c.f.s. as compared to 4,600 c.f.s. for the storm of February 9-10, 1965.

On the storm of February 9-10, 1966, a rain gage in the watershed recorded 4.55 inches. Records are not available from the stream gage at Paynes, but visual observation indicated the peak stayed within natural banks and did not get against the levees at Paynes. No breaks were observed.

CONCLUSION

The flooding and sedimentation problems on the 425,000 acres along the Bluff Hill area can be solved with an intensive upstream treatment, coupled with downstream improvements which are authorized projects of the Corps of Engineers on most of the tributaries.

Peak flows can be reduced by 50 percent where 70 percent of a watershed is above floodwater retarding structures.

Gully and streambank erosion constitutes the main source of damaging sediment delivered to the Delta. Spectacular reductions can be achieved by the installation of a combination of land treatment measures and structural measures.

It is essential that there be coordination among the local sponsors, the Department of Agriculture, and the Corps of Engineers in developing overall work plans.

The problem is too big to be solved by local landowners. Technical and financial assistance is essential for success for such a program.

Evaluation studies, initiated in 1964, will give more information about the effects of the flood prevention program on the Bluff Hills area as other phases of the study are conducted during the next eight years.

Acknowledgement

Max R. Goodman, Geologist, and Jack H. Gibson, Hydraulic Engineer, Watershed Planning Staff, Soil Conservation Service, New Albany, Mississippi, assisted in the preparation of data on geology and hydrology for this paper.

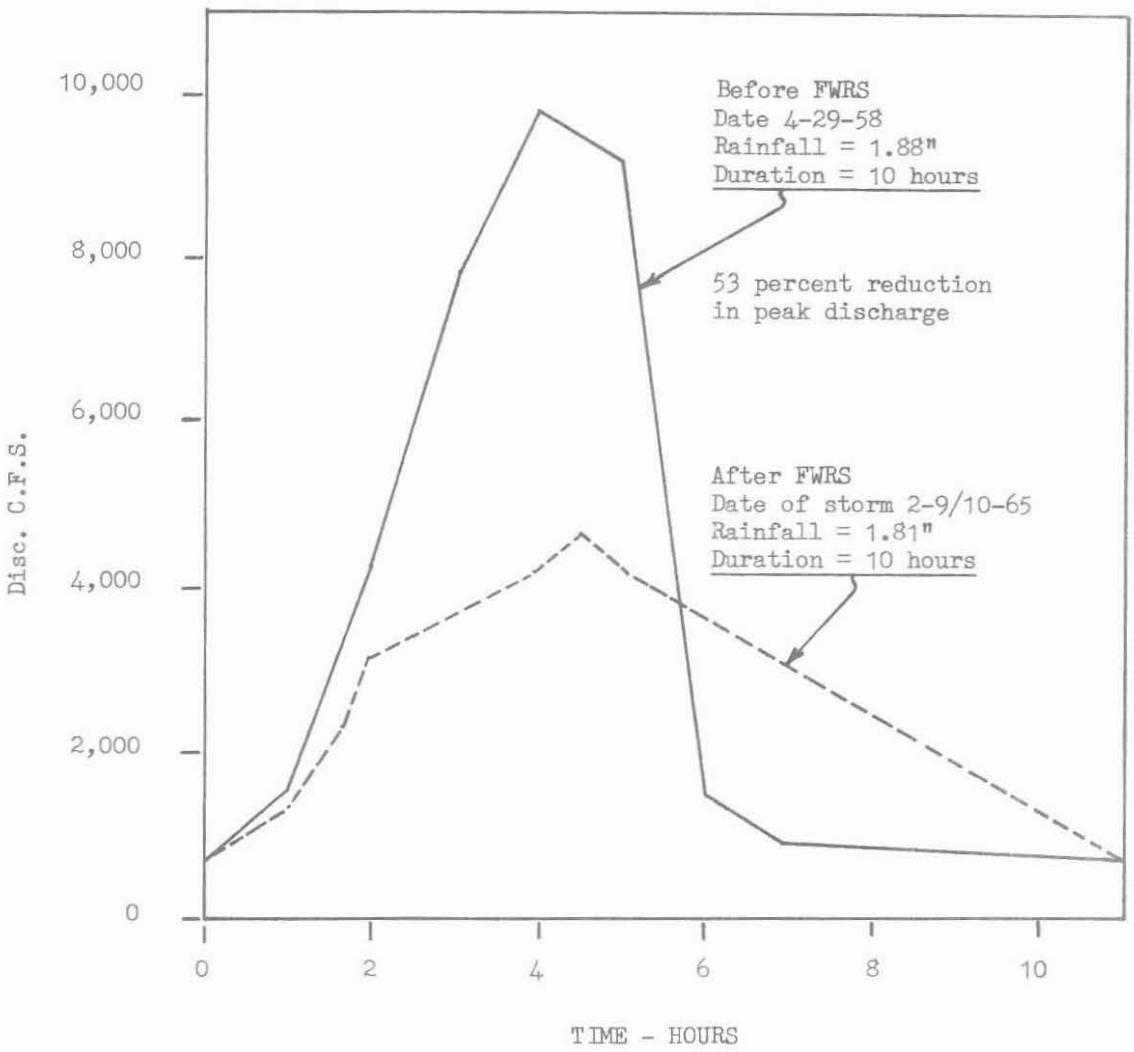

Figure 1 - Hydrographs at Paynes, Mississippi, for Similar Storms Occurring Before and After Installation of Floodwater Retarding Structures. Antecedent Soil Moisture Conditions the Same in Both Storm Events.