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**“The Applications of GIS and Remote Sensing In The
Conservation of Watershed: The Case of Pearl River
Watershed In Mississippi”**

By

Dr Edmund Merem* and Dr Yaw Twumasi**

**Jackson State University Mississippi*
Alabama A&M University ****

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Scope of the Presentation

- Purpose of the Research
- Background Information and Issues
- Methodology and the Study Area
- Review of the Studies
- Factors Responsible For The Problems
- Mitigation Efforts
- Findings
- Recommendations and Conclusions

Objectives of the Research

- To assess watershed issues in Mississippi
- To update the literature on watershed management
- To design a tool for guiding decision makers in watershed conservation
- To identify new methods for managing watersheds
- To analyze land-use impacts on water bodies using spatial information technologies

Background Information/the Issues

- Watersheds are nature's boundaries made up of land areas that catch rain and drain into specific water bodies
- Over the years, state agencies adopting watershed approach to restore water quality and to comply with federal policies
- The accurate delineation of watersheds using geospatial technologies plays an important role in conservation of water bodies
- GIS/RMS technologies enabling prompt analysis of land use trends along watersheds
- In Mississippi, the Pearl River, supports variety of wildlife, biodiversity and agriculture activities
- However, many stressors from land use such as toxins threaten the biological integrity of the basin and water quality
- Notwithstanding these problems, very little had been done to analyze pressures from land uses in the basin
- This has resulted altered hydrology, contaminants, habitat disturbance, changes of water level
- In light of these issues, there is an urgent need for a geo-spatial analysis of the basin



Figure 1: Images of Vegetation Along The Pearl River Basin



Figure 2: Images of Recreational Navigation

Methodology and the Study Area

- The research stresses a four step approach involving a mix-scale connected to keyword literature search, descriptive statistics and spatial analysis with GIS and Remote Sensing

- **Step 1: Identification of The literature, Variables, Spatial data and Satellite Images**

- Access to the relevant data bases containing the literature
- Procurement of 2 raw satellite images from NASA for the separate years between 2000-2004
- 2 Landsat Thematic Mapper TM / Enhance Thematic Mapper Plus ETM P

- **Step 2: Preliminary Stages Leading to Design of Data Matrices, Maps and Images**

- Tabular presentation and design of relevant information
- Image processing using ERDAS 8.7 Imagine, enhancement with equalization technique of histogram and classification

- **Step 3: Measure of Descriptive Statistics For the Percentages**

- Display of the percentages, figures and ratios of selected variables

- **Step 4: Mapping and Analysis of The trends With Remote Sensing Technologies**

- The remaining procedure involves spatial analysis and out put covering the study period with ARCHVIEW GIS

The Study Area and the Justifications

- The Pearl River covers 24 counties in east central and southern Mississippi. It stretches 490 miles long and drains an area of 8,760 square miles
- The area constitutes the fifth largest flood plain in the United States
- Choosing the basin stems from ongoing land use issues impacting on water quality
- Land use within the basin is predominantly agriculture (large poultry industry) and forestry
- Erosion and sedimentation from farming and mining contributing to non-point source pollution
- Habitats through out the basin are threatened by the operation of dams or reservoirs
- There are also pressures of urbanization, channelization, silver culture and other factors



Figure 3: Map of The Surrounding Counties Along The Basin

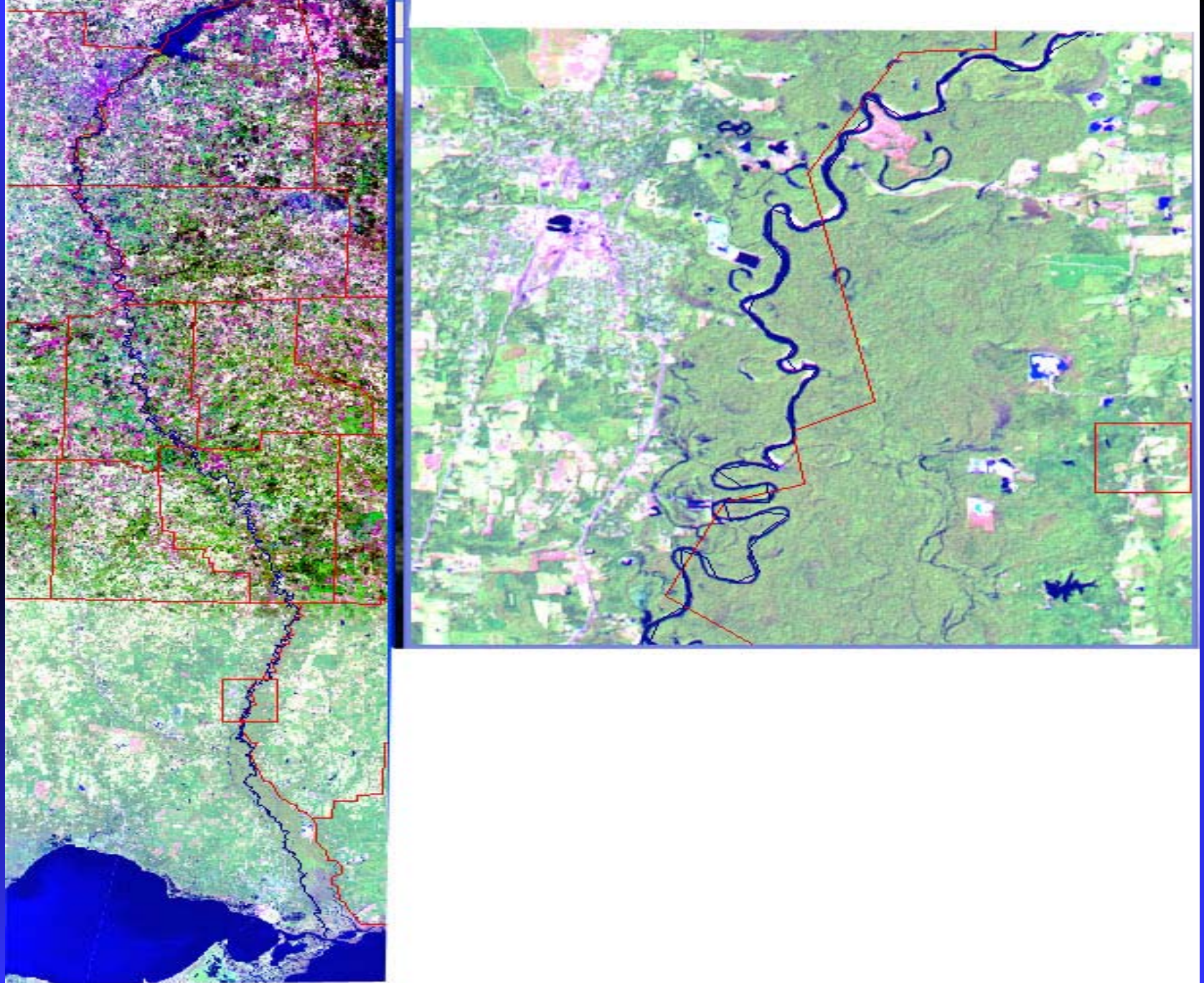


Figure 4: Pearl River With Overlay of The Counties In Red

Table 1: The Existing Land Use Threats

Source of Threat	Threat						
	Altered Composition	Altered Water Quality	Habitat Destruction/ Conversion	Habitat Disturbance	Modification of Water Levels, Changes in Natural Flow Patterns	Nutrient Loading	Sedimentation
Channelization of Rivers or Streams	Xxx	Xxx	xxx	Xxx	xxx		xxx
Construction of Ditches, Drainages, Diversion Systems	Xxx	Xxx		Xxx	xxx	xxx	xxx
Construction of Navigable Waterways	Xxx		xxx				
Incompatible Forestry Practices	Xxx	Xxx		Xxx	xxx		xxx
Mining Practices	Xxx	Xxx		Xxx	xxx		xxx
Operation of Dams or Reservoirs	Xxx	Xxx	xxx	Xxx	xxx		xxx
Operation of Drainages or Diversion Systems	Xxx		xxx		xxx		xxx



Figure 5: A View of Pearl River Across HYW 55 In The City of Jackson and The Threats of Urban Land Use



Figure 6: Ross Barnett Reservoir Creating Reduced Flow of The River



Figure 6b: Marshes In the Lower Pearl



Figure 6c: Great Egret In the Brackish Marsh of the Basin



Figure 6d :Bald Cypress Tupelo Gum Swamps Along the Pearl

Case 1: Assessment of Land Use Impacts On Water Quality (Within Segments of the Basin)

- In 2004 Water quality assessment indicated that 10% of the 23 water body subsegments within the basin were fully supporting their three primary designated uses.
- 78% of the water body not supporting their designated uses for fish, and wildlife propagation.
- Of the 743 of waters (classified in category 5) 63 % (470 miles) are assessed as being biologically impaired.
- Of the assessed stream and river miles approximately 8 % are (in category 2) attaining some uses
- Causes: metals, nutrients, fecal coliform, organic enrichment and low concentration of dissolved oxygen, Ph levels and turbidity
- Sources: home sewage systems, agriculture (particularly pasture lands), silviculture, urban storm water runoff, and surface mining

* See Figure 7 For an image of the pollutants threatening the basin



Figure 7: Pollution Threatening Water Quality Along the Pearl River

Case 2: Assessment of The Total Maximum Daily Load - Fannegusha Creek

- The sub watershed (Table 2.1) consists of 47,289 acres under many land use types including agriculture land, pasture land, and urban land use and forest
- The creek was sampled for physical habitat quality and water quality.
- A stressor identification study showed sediment as the most probable stressor of the water body.
- Contaminants associated with sediment in the area ranged from pesticides to nutrients

Table 2.1: Landuse Distribution On Fannegusha Creek Watershed

	Forest	Urban	Barren	Wetland	Agriculture	Other	Total
Area (acres)	16,854	178	137	8,389	21,700	32	47,209
Percentage	35.6%	0.4%	0.3%	17.7%	45.9%	0.1%	100%

*The Fannegusha Creek watershed is located in Rankin and Scott Counties

Case 3: The General Assessment of Land Use Types With GIS and Remote Sensing In The Study Area

- In the false color image displayed in Figure 8, blue color denote drainage systems in the area,
- Dark and light green are mature and young vegetation and the pink color agricultural areas currently in use.
- The white areas and lines are settlements and roads serving the general population along the urban and rural portions of the basin.
- From the assessment (Fig 9) , the primary land use in the Pearl River basin over the years remains forestry, but land use patterns are slowly changing.
- Traditional row cropland in the Upper basin has been forested and the effects of increased urbanization are becoming evident due to signs of environmental decline.
- The Transition to urban landscape occurring rapidly around the Jackson Metropolitan area. Urban areas make up 1 % of the basin's total land cover (Fig 10)

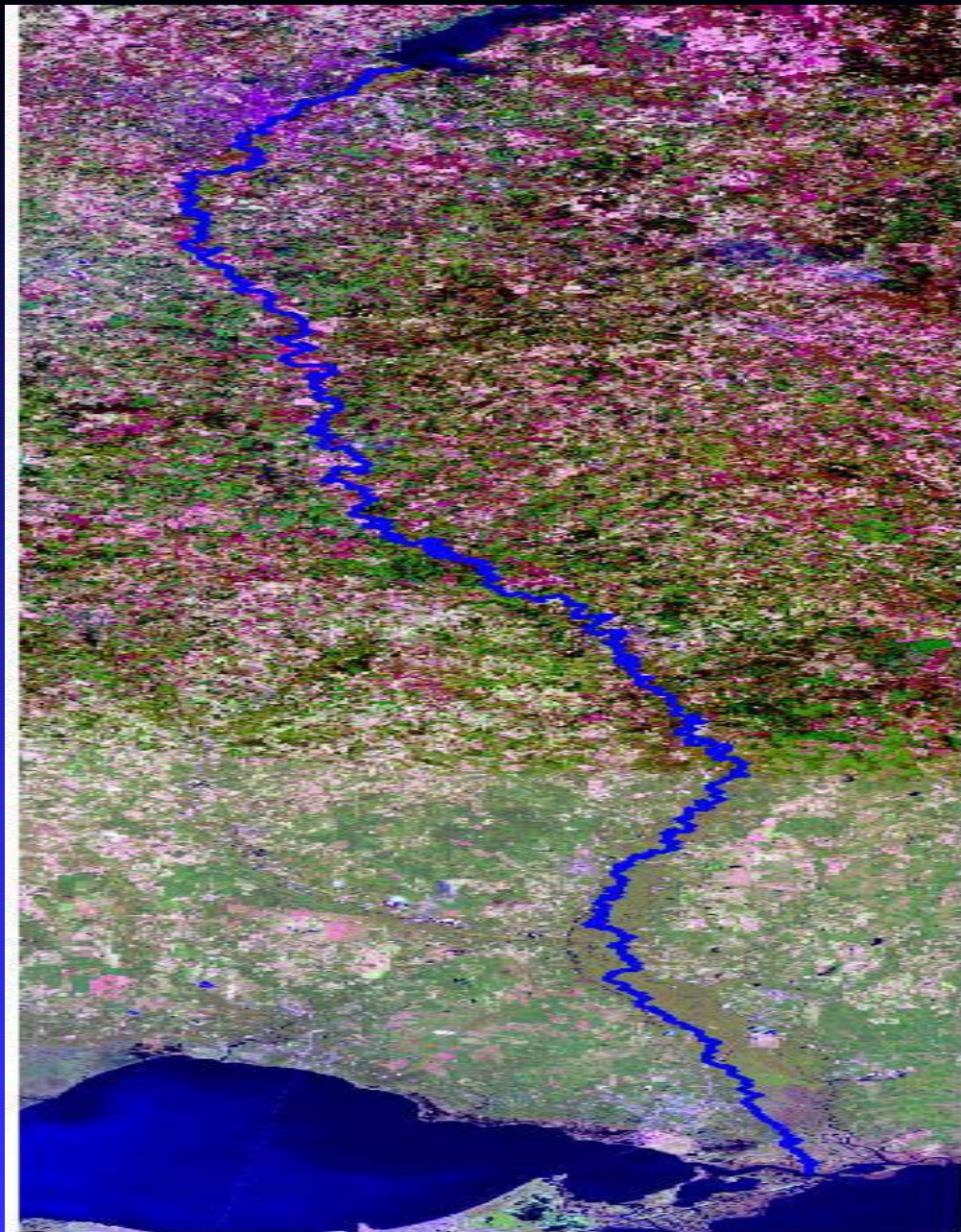


Figure 8: Landsat ETM+ March 3, 2000 False Color Image (Band 542) of Yazoo River and its Environs

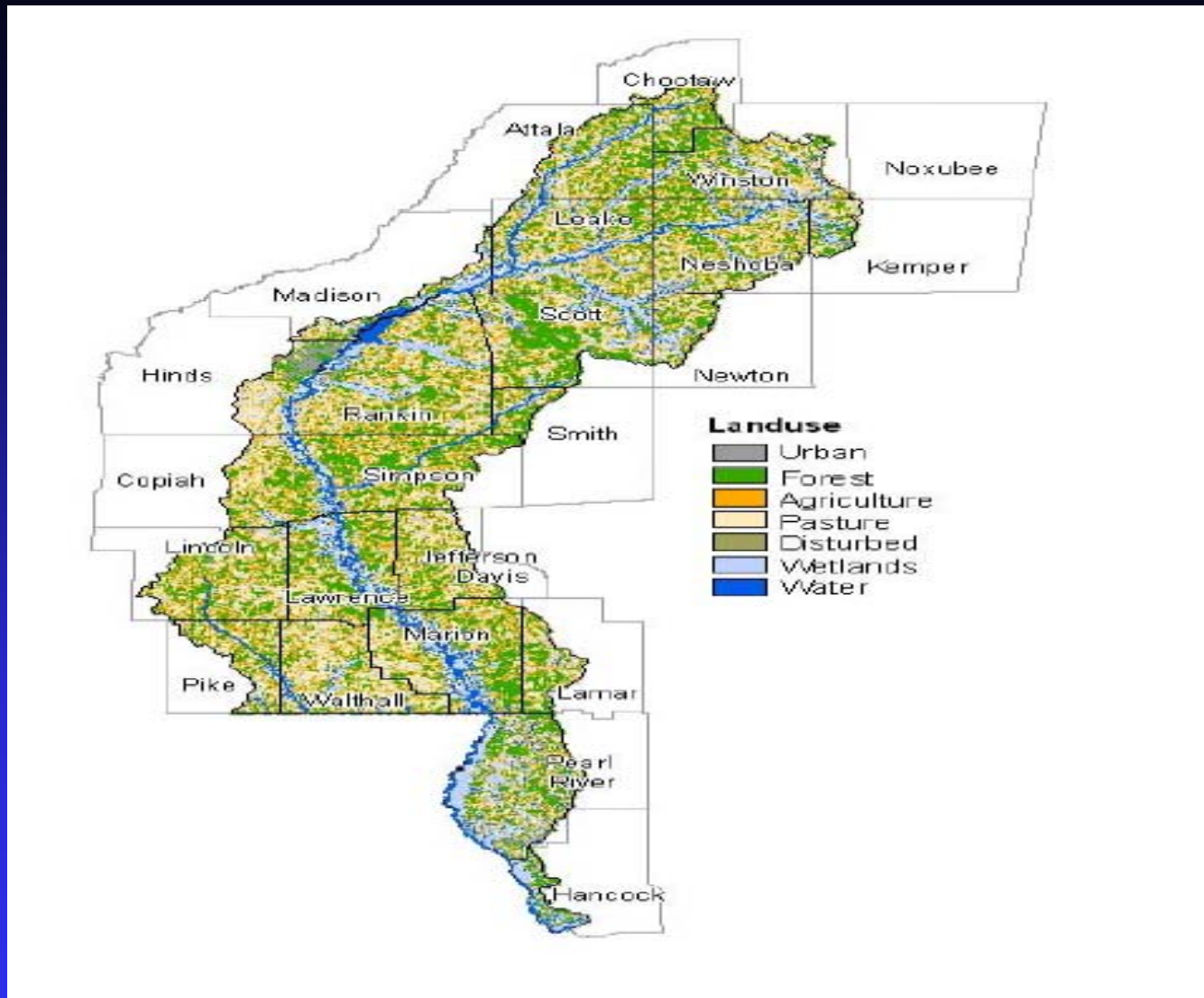


Figure 9: Map of the Various Land Use Types

The Assessment Continued

- Forest areas, evergreen, deciduous and mixed-forests, represent the dominant land cover making up 43 % of the total.

- Wetland areas , water resources streams, lakes, reservoir and estuaries comprise 11 % of the total land cover

- Agriculture and pasture land make up 27% of the land features.

- Disturbed areas including strip mines, gravel pits, sandy areas, barren and transitional areas comprise the remaining 18 % of the basin.

- The various forms of land use (agriculture, urban development, silver culture) in the basin eroding the Pearl river ecology

- Some of the important water issues of concerns in the basin that originate from the dominant land uses include fecal coliform, sediment / nutrient contamination

- These pollutants have various causes or sources across the watershed that may include homeowners, industries, construction and agriculture

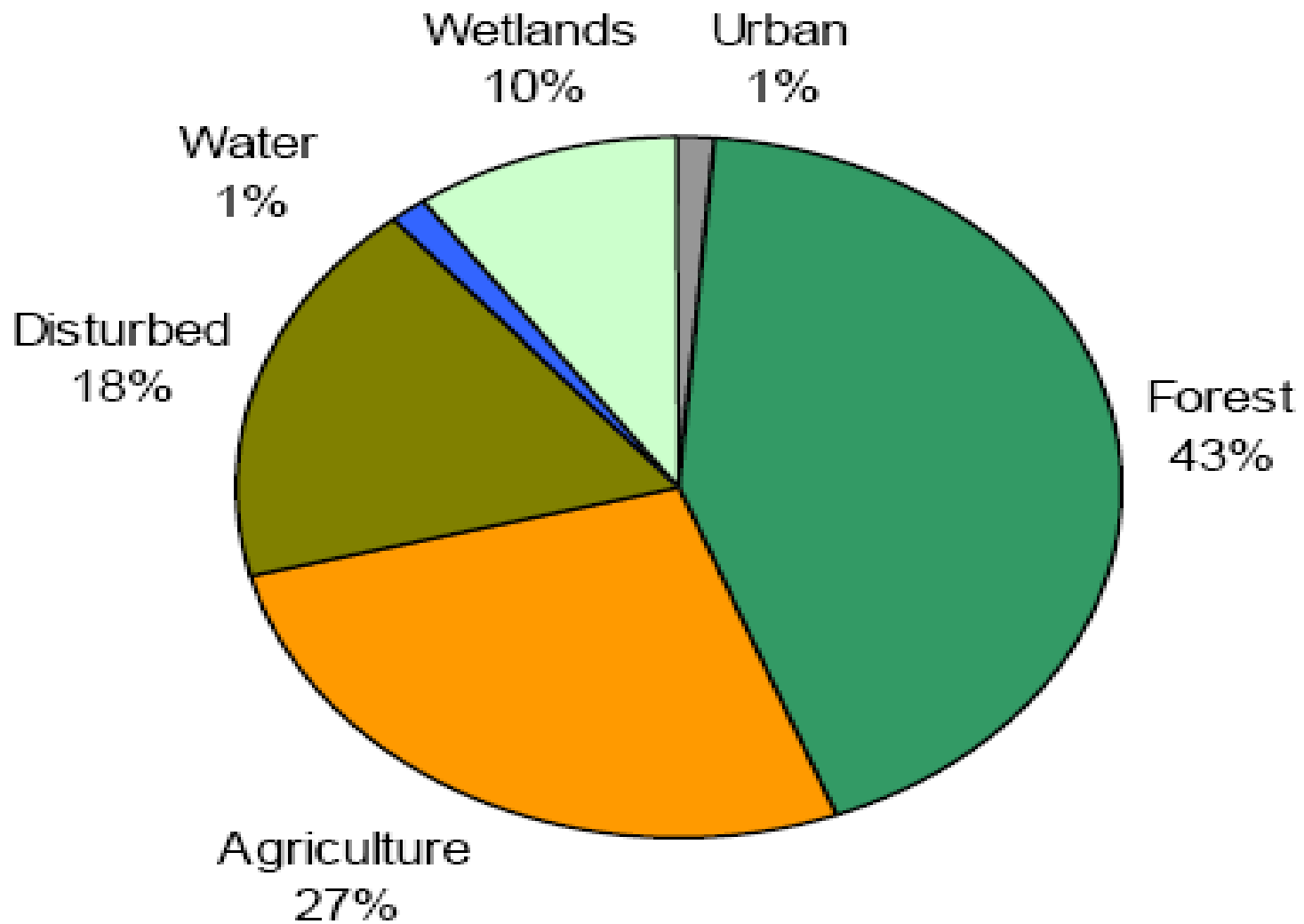


Figure 10: Land Cover Distribution

Factors Responsible For The Problems

■ Infrastructure Development

- The Pearl River Navigation Channel completed in the 1950s impacted on the habitat of the basin.
- Low water sills/navigation locks altered migration routes and life cycles of marine creatures
- Ground level of HWY 10 acts as a dam and have altered the hydrology and increased sedimentation .

■ Agriculture

- A large part of the state's agriculture especially poultry production located in the Pearl River Basin
- Intense farming and the use of agrochemicals and pesticides linked with ecological decline

■ Silviculture

- Decades of improper forest management practices along the basin creating ecological decline
- Forest sector land use linked with pesticides that affect water quality and biodiversity

■ Urbanization and Population

- Urbanization quite rampant along the basin in the counties around the Jackson Metropolitan area
- Meeting the infrastructure design needs of a growing metro area puts pressure on the basin's ecology

■ Impairment From Human /Industrial Activities

- Pollutants or other factors contributing to biological impairment.
- Other causes of impairment noted in the basin are from pathogens, mercury, and PCBs



Figure 11: Development Activities Impacting the Basin's Vegetation



Figure 12: Bottomland hardwood Forests being Converted to Pine Plantation; Diverse Habitats replaced by Less Diverse Types Due To Heavy Equipments From Clear-cut

Summary of Impairment Causes Pearl River Basin Perennial Rivers and Streams

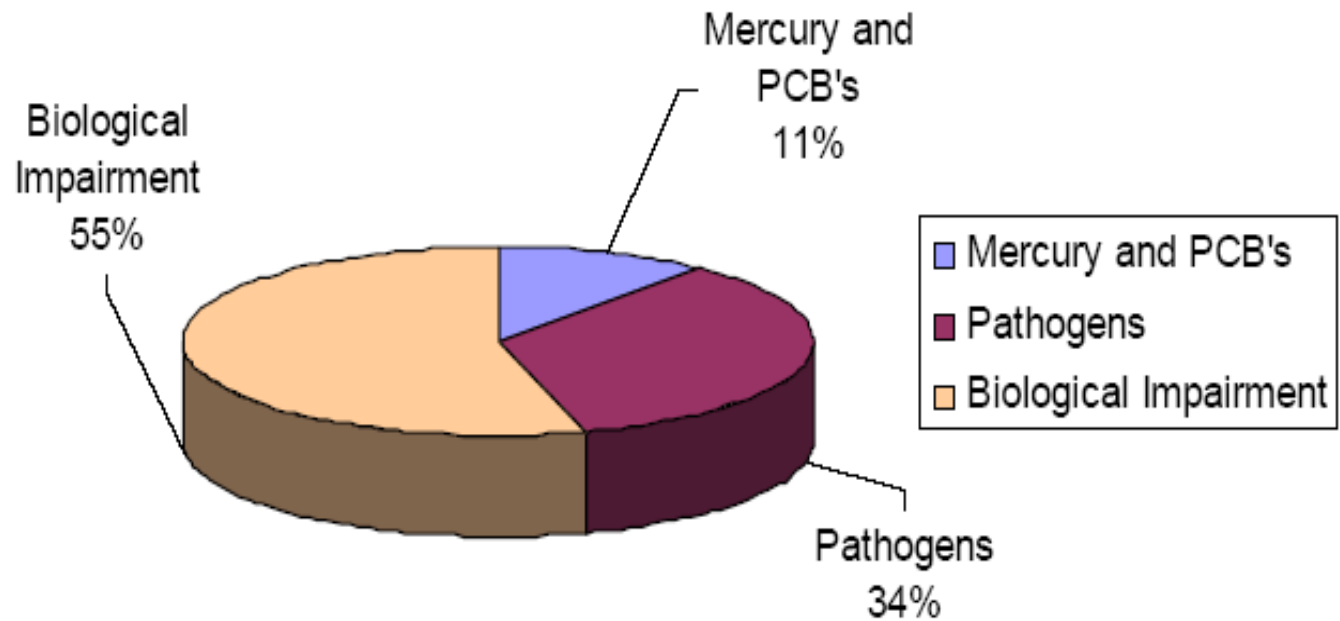


Figure 13: Impairment Causes

Table 3: Impairment Categories and Their Mileages

Cause Categories	Total Miles
PCBs	3
Mercury	120
Pathogens	377
Biological Impairment	595
Total	1,095

Mitigation Efforts

Restoration of Habitat

- The nature conservancy of Mississippi in 2003 purchased and restored 2600 acres of bottom hard wood and aquatic habitat in Hancock county along the Pearl River Basin
- Restored part of watershed providing habitat for Gulf sturgeon, endemic ringed map turtle

Conservation

- The Lower Pearl Partnership worked with agencies and landowners, to protect the ecological integrity of the River and its watershed.
- The Nature Conservancy hosted planning workshops with experts to identify sources of stress
- The results of the workshop are included in the Pearl River Conservation Area Plan

Water Quality Improvement

- Other efforts center on improving quality of water flowing through the watershed and into the critical estuarine sites of Lake Borgne and the Hancock County marshes
- Partial funding from the State's Department of Environmental Quality through the Coastal Impact Assistance Program.

Coordinated Research

- The Mississippi Water Resources Institute promoting research efforts to solve water problems of state and regional significance in the area
- The institute coordinates with water officials in research technology transfer and training program that applies academic expertise to water and land use problems.

Summary of Findings

- The results reveal that the study area experienced some impairments emanating from land use activities
- Growing pressures from land use mounted by human activities in agriculture, development and host of others being felt in the Pearl River watershed
- Increased pressure prompted by land development in the study area impacting the watershed hydrology and ecology
- The practical application of remotely sensed satellite imagery and GIS modeling, facilitated the analysis of the influence of land use activities on the basins watershed ecosystem
- The analysis identified the state and the distribution patterns of various forms of land cover classification variables comprising of forest, hydrology, urbanization and other issues shaping land use impacts around the Pearl river basin environment

Recommendations

- **To address some of the concerns that were identified in the research, five recommendations are presented as part of the remedies**

- **Continue To Encourage Community Participation**

- The authorities of the basin should continue to encourage and support local involvement in the basin

- **Undertake Periodic Impact Assessment and Monitoring**

- Regulators should frequently monitor and assess the state's waters of the Pearl basin for pollutants and make decisions on the use of the water based on these findings

- **Institute an Integrated Watershed Management Program**

- This should involve coordinated partnerships along state, county and institutional lines in order to address water quality issues in the Pearl River Basin

- **Design a Regional Information System**

- The Study area needs a common geospatial data inventory to monitor impacts on watershed ecosystem

- **Promote Education of The public**

- The basin's management should promote awareness programs aimed at educating the public, developers and land users in the area concerning factors fuelling pollution change along the river basin

Conclusions

Six vital conclusions can be drawn from this study

- 1)-The baseline ecology of the Pearl River Basin watershed seems to be under stress
- 2)-From current measures along the watersheds, the conservation of waterbodies remains a vital component of ecosystem management in state.
- 3)- The GIS/RMS applications revealed the nature of land uses influencing the watershed ecology
- 4) - Using geospatial technologies in that manner play a vital role in supporting the data needs of decision makers.
- 5) -Such advances in spatial technologies have great potentials in assisting decision makers adopt conservation measures best suited for watershed management
- 6)- In light of these findings, GIS/RMS applications provides a viable monitoring tool for managers in analyzing the impact of land uses on water bodies of the Pearl River Basin

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