NICE
Nanticoke Integration for a Cleaner Environment

Group 6
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Mission Statement

The Nanticoke Integration for a Cleaner Environment (NICE) aims to protect and improve the surface water quality of the Nanticoke River through the management of the non-point sources of pollution (agricultural runoff) and anthropogenic activities. This plan recommends the additional adjustment on existing agricultural policy, and implementation of best management practices that will alleviate problems associated with non-point source pollution from agricultural runoff and human activities in order to restore boatable, fishable waters, and reduce TMDLs by 50% by 2035.

Introduction

The Nanticoke River, which flows for 50 miles from southern Delaware to Tangier Sound in Maryland, is the greatest Chesapeake Bay tributary on the lower Delmarva Peninsula. It gently meanders through wetlands, woodlands, and farmland. Navigable beyond Seaford, Delaware, the river has been crucial to trade and commerce, serving as a water route for early Native American tribes and later for European settlers. The Nanticoke watershed encompasses approximately 725,000 acres, including over 50,000 acres of tidal wetlands, which represent about one-third of all the tidal wetlands in the State of Maryland. The watershed has the largest density of bald eagles in the northeastern United States and is also the most biologically diverse watershed on the Delmarva. According to the 2000 Census, the watershed is home to 42,459 residents. Population density is expected to increase by 19.5% between 2000 and 2020.

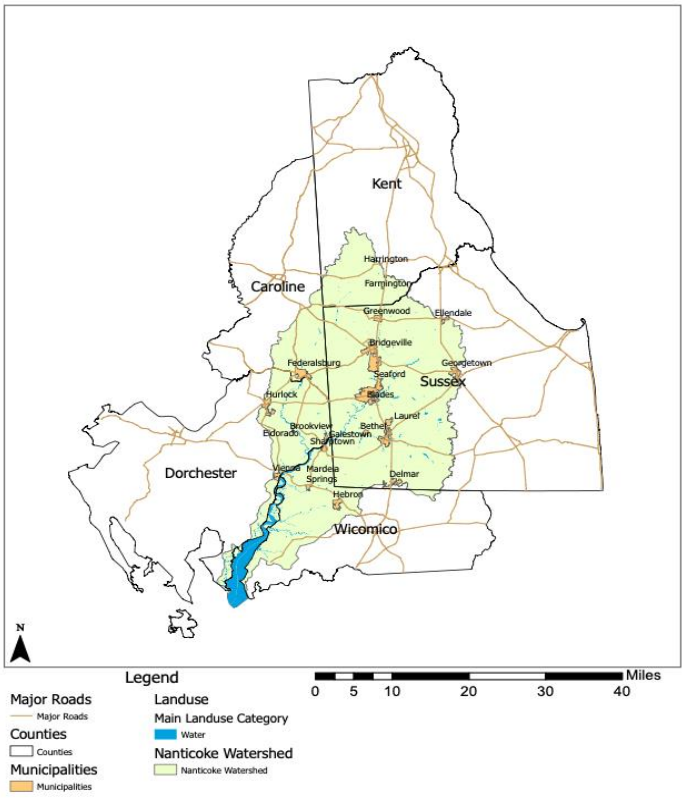

Figure 1: Basemap of Nanticoke River Watershed

General History of Human Use

Humanity has long lived in the area at the mouth of the Nanticoke River. Over 6,000 years ago, the Nanticoke Indians and their ancestors began living alongside the river. However, Captain John Smith's exploration of the Chesapeake Bay and its tributaries in 1608 is the first instance in which a European is known to have visited the head of the Nanticoke. The animosity that grew between the Nanticoke Indians and the English settlers contributed to the slow pace of development along the Nanticoke River. However, development in the area soared after the hostilities were settled. The first known habitation in the vicinity of Seaford was on a sizable parcel of land known as "Martin's Hundred." Jeremiah Jadwin of Virginia received this 1,750-acre parcel of land on January 22, 1672 and this land was bordered by the Nanticoke River and Herring Creek. Despite local development, the river served as the primary route for many years. It wasn't until 1720 that roads began appearing in court records. The area's main economic activity was agriculture, particularly the growing of tobacco, and the predominant way of life was a plantation. In addition to agriculture, however, evidence suggests that the area east of where Seaford now resides was a very busy bog iron area.

William Henry Harrison Ross worked to advance agricultural innovation. Ross owned sizable estates to the north of Seaford when he was elected governor of Delaware in 1850. Seaford experienced division as a result of the Civil War, but as soon as it was over, the town acquired its charter and was founded on April 6, 1865, with a Councilman-Alderman style of government that is still in use today. This change is what made Seaford what it is today and where it is located. With 2,000 residents by the turn of the 20th century, Seaford was one of the peninsula's most significant economic hubs. Due to the introduction of innovative housing and feeding techniques in 1925, the poultry business grew in importance. As Sussex County evolved into the world's largest chicken-producing region, farming practices moved from truck crops to grains and maize for chicken feed. Seaford became renowned as the "Nylon Capital of the World" after the DuPont Company selected the location for the first Nylon facility in the world in 1939. Even now, growth and prosperity are still present as Seaford continues to attract high-caliber businesses and residents. Seaford became renowned as the "Nylon Capital of the World" after the DuPont Company selected the location for the first Nylon facility in the world in 1939. Even now, growth and prosperity are still present as Seaford continues to attract high-caliber businesses and residents.

Ecological Significance

The interaction between land and water that takes place in the Nanticoke watershed has created diverse natural conditions and an abundance of wildlife. The diversity of forests, fields and shallow marshes, provides good habitat for a number of rare threatened or endangered plant and animal species. It has been a focus for protection due to the abundance of rare flora and fauna and distinctive ecological ecosystems there. Neotropical songbirds that hatch and migrate across the watershed each year depend on its forests, including warblers and the American redstart. Other bird species found in the area include: eagles, ospreys, herons, peregrine falcons, owls, wild turkeys, and many different waterfowl and wading birds. The North American Waterfowl Management Plan has designated the Nanticoke as a focal region because it is a crucial habitat for waterfowl. The main migratory game species that breed in the watershed are mallards, black ducks, wood ducks, and Canada geese. It is also home to diverse mammal species such as beavers, raccoons, rabbits, otters, opossums, skunks, and red and grey foxes. Healthy populations of

squirrels, rabbits and deer also provide recreational opportunities for hunting and wildlife observation. One of the uncommon species that lives here is the Delmarva fox squirrel, which was originally widespread over the Delmarva Peninsula. The eastern tiger salamander and the carpenter frog are two other rare amphibians that can be found in this area.

Cultural Significance

Visitors visiting the Eastern Shore can get the chance to explore and discover the region's rich cultural legacy in addition to recreational attractions. The interaction between the Eastern Shore and the bay, with its wealth of natural resources and kilometers of shoreline, has defined and refined the region's history and tradition. The story starts with the region being settled by several Native American tribes 12,000 years ago, continues through the colonial and civil war eras, and ends with the 19th century's growing seaports and agricultural community. The collection of Maryland Heritage Areas on the shore offers an intriguing combination of these stories that are being preserved, interpreted and shared in various museums, attractions, oral histories, trails and events.

Problems/Issues

P1: Decreasing Wetlands

The topography of Nanticoke is best for agricultural activity due to its flat surface and the soils of unconsolidated sands and clays are perfect for crops. Surrounding the Nanticoke Watershed, almost 40% of its total land area is being used for agriculture. The most current distribution of landuse can be seen in Figure 2.

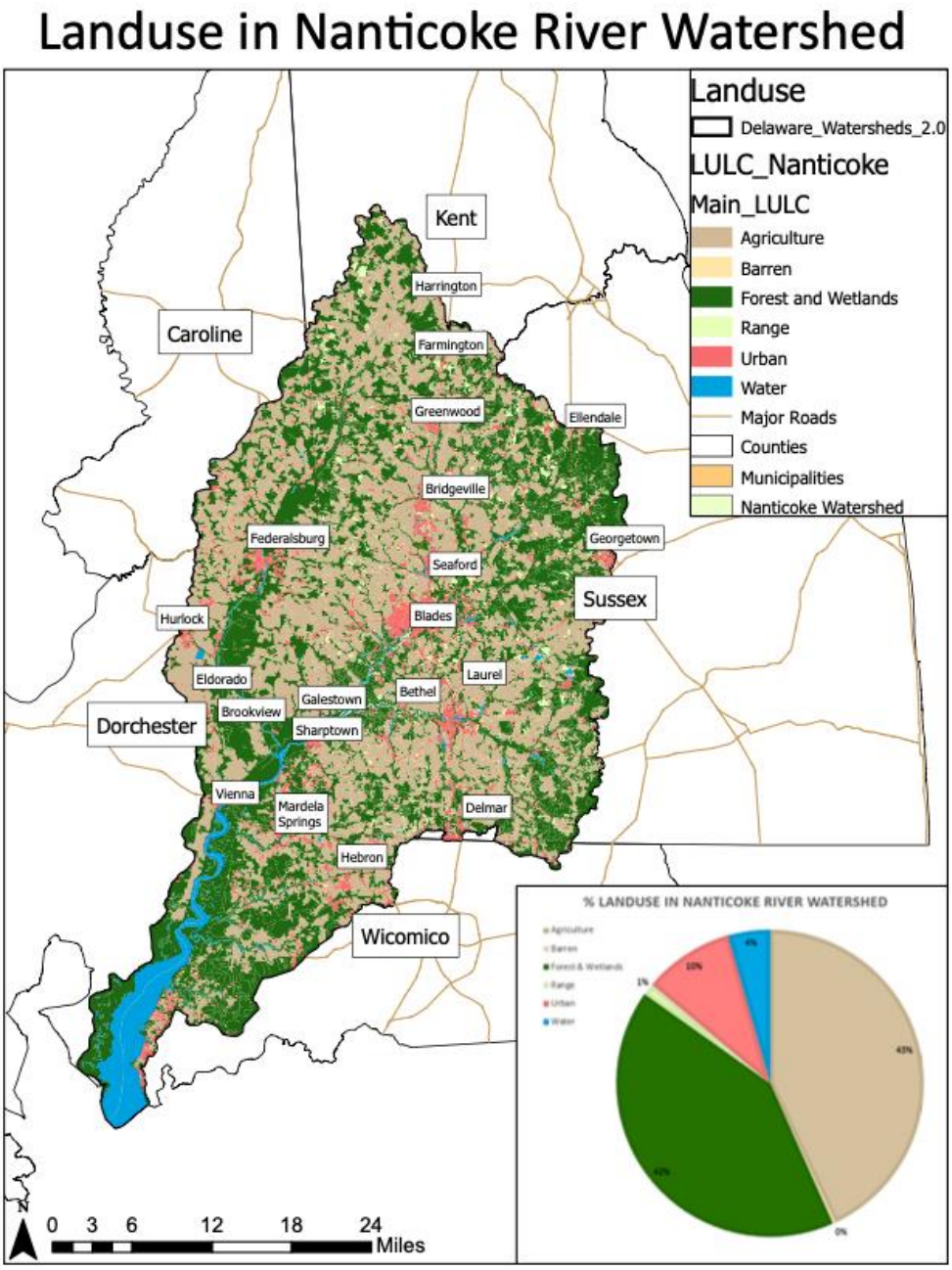

Figure 2: Landuse within Nanticoke River Watershed

Over the future, more urbanized developments are being established in the area that provide more support to intensive livelihood activities like agriculture itself. With these, the wetlands are getting smaller and smaller as time goes by. And soon, it may occupy almost 80% of the total wet area of the watershed. Other developments are being done like drainage system, pipelaying, and other man made activities not including forestry.

There are studies conducted that are related to the Pre-Settlement wetlands percentage of Nanticoke vs roughly data from 1998 on how much the wetland percentage has reduced drastically over time.

Table 1: Wetlands Net Area Change; Pre-Settlement - 1998

Wetland Type	Pre-settlement Area (% of Wetlands)	1998 Area (% of Wetlands)	Net Area Change (% of Pre-settlement)
Estuarine Intertidal	9,569.6 (10.3)	6,849.4 (11.9)	−2,720.2 (−28.4%)
Palustrine Emergent			
Tidal	1,091.7 (1.2)	273.2* (0.5)	−818.5 (−75.0%)
Nontidal	25.7 (<0.1)	2,169.3 (3.7)	+2,143.6 (+8341%)**
Total	1,117.4 (1.2)	2,442.5 (4.2)	+1,325.1 (+118.6%)
Palustrine Forested			
Tidal	2,926.4 (3.1)	3,307.9*** (5.8)	+381.5 (+13.0%)
Nontidal	79,511.8 (85.4)	42,975.5*** (74.8)	−36,536.3 (−46.0%)
Total	82,438.2 (88.5)	46,283.4 (80.5)	−36,154.8 (−43.9%)
Other Palustrine			
Farmed	-0-	1,428.3 (2.5)	+1,428.3 (NA%)
Ponds	-0-	488.0 (0.8)	+488.0 (NA%)
Total	-0-	1,916.3 (3.3)	+1,916.3 (NA%)
Grand Total	93,125.2	57,491.6	−35,633.6 (−38.3%)

* Includes 153.3 ha of riverine tidal wetlands, mostly marshes.
** This increase is an artifact, since the pre-settlement extent of non-tidal emergents could not be accurately established.
*** Includes scrub-shrub wetlands and mixed communities where forested or scrub-shrub wetland was the dominant class.

Table 1 shows data gathered from Tiner, R. (2005). It shows that there are almost 40% changes have occurred to Nanticoke Watershed in terms of wetland occupancy. Contributors to these are man-made activities and natural processes. Movements of these scenarios that are still happening today not only affect the activities present on site, but also livelihood of aquatic species since decreasing wetlands may also result in movement of water from freshwater to saltwater. This is still happening up to date, as there are increasing human activities, dead trees, developed marshes, and some salt-stressed plant system that are being dumped on the watershed. Although it may be difficult for us to prevent problems related to the environment, we could at atleast manage the activities with regards to human intervention.

P2: Channelization

Even the European settlement on the Nanticoke, it is always presented as an area with a wide range of wetlands and aquatic life. Sooner or later, when more civilizations are engaging to the area, more settlements are being present. Either agriculture and anthropogenic activities. It was seen that not only agriculture played a huge role in decreasing the Nanticoke's wetland, but also clearing of streams that lead to more straight channelized systems. These system changes not only affect physical but also biological conditions of an aquatic ecosystem. Physical changes took effect on long term biotic responses that extend over space and time. Results of this stress the growth of individual, abundance, and reproduction of species living in the aquatic environment.

Another factor of channelization is the increasingly impervious surface on the boundary of each watershed or stream. This impervious surface serves as a fast moving output for stormwater runoffs to infiltrate the streams and rivers. This actually has a negative effect on the habitat of the stream, or the watershed itself. Increasing numbers of water runoff from streets and impervious surfaces actually adds pollutants to our water body that results in different negative aspects on the aquatic ecosystem. It starts from killing off the aquatic life present to possible increase of nitrogen and phosphorus pollutants coming

from manure of animals from agriculture. Another possible side effect of channelization, since storm water runoff is very much present and being dumped into rivers, most of the time it induces erosion to the other parts of the stream that is still banked by natural stream.

P3: Increasing loads of Nitrogen and Phosphorus

Nanticoke's water quality is worsening due to increasing loads of Nitrogens and Phosphorus. These nutrients are an essential component of growing crops on farmlands for better output of the crops. Nanticoke's agricultural industry focuses most on the poultry industry, and growing grain crops for feed. It actually accounts for the worsening of the water quality of the watershed. Increasing loads of nutrients like nitrogen and phosphorus may lead to extensive eutrophication. Probable causes that may occur may develop harmful algae blooms that not only affect the water quality, but also the health of the citizens residing near the watershed. Although as of 2019, the grade of Nanticoke Watershed according to the Nanticoke Watershed Alliance increased its grade from C to C+, still low due to the total nitrogen load found on the system. Parts of Nanticoke Watershed, mostly on the upper part, are not anymore susceptible for fishing and swimming due to increased bacteria that may cause sickness to humans, and proper life for the aquatic species.

These problems arise since in the areas surrounding the Nanticoke Watershed, the agricultural lifestyle there is actually important. During the season where farmers place nutrients on their crops, there are times that most of its runoff is running through the rivers that causes nutrient loadings on the aquatic system. Agricultural runoff plays a big role in nitrogen and phosphorus incursion on the rivers since most nutrients that they use on their crops contain this kind of nutrients. There is an existing agricultural policy for Delaware, Maryland, and Virginia in which farmers are being monitored and checked with regards to the usage of nutrients on their crops. It also places our farmers to regularize their crops in order for it not to totally pollute the rivers and streams with their nutrient runoff. Most of this runoff is animal manure, and groundwater flows from farm lands that contain these nutrients. Although not always, most of our farmers are not monitored that much and they are not being sanctioned for the excess nutrients they induce to their crops.

Goals/Objectives

G1: Reduction of Manmade Activities/Use Tools of Monitoring

It may be a good start to promote limitations in terms of manmade activities in the area. The boundary of Nanticoke is already swarmed with agricultural aspects and also urban developments. It may be a good thing to have livelihood beside a watershed since it can benefit the human race on usage of what the watershed offers, but there may come a time that it needs to be managed. People living nearby may have control with this aspect as to where they can see the effects of their activities to the living body near them. In the long run, it may have adverse effects also with regards to their health and human consumption.

Aside from reducing man made activities, one way we can help preserve our wetlands is by monitoring it carefully every time there is probable comotion happening. For example, under the Delaware Estuary, they have established what they call “Mid-Atlantic Coastal Wetlands Assessment” in which they continue to monitor the status of wetlands in their vicinity. They undergo Remote Sensing, Ground Truthing, Intensive Studies, and Station Monitoring. With these, they were able to manage watersheds that had decreasing wetlands. Each one has functions such as with the use of GIS in determining the boundary conditions of each wetland. They also do rapid assessments in which they determine the condition of each shore, wetlands, habitats, and buffers of each stream. Station Monitoring is also a key important factor in which they focus on areas of totally decreased wetland and try to mitigate the best possible way to preserve the area.

Although we may have on-going mitigations with Nanticoke Watershed Alliance, we could say that we could still develop practices that can better protect our watershed. We can get best practices from other states that provide better and effective ways of protecting their wetlands.

G2: Promote Stream Restoration

It may be seen that channelization helps reduce flooding in the area, but it does not thoroughly help the livestock of the ecosystem in the area. Other solutions may be found in order to reduce floods and other water related issues on the land, but stream restoration is also a must. It must be conserved and consider the outcome of life that is present in the aquatic environment. It also promotes improvement on water quality, mitigate habitat loss to protect fish and wildlife. It may also be used for public fishing and other recreational activities once streams are restored to their natural state.

There is a group of people in Maryland that focuses on stream restoration activities. They focus on career individuals who are interested in the field of stream restoration as a profession. They manage talks and opportunities to envelop people to dive into the field in order to share knowledge in providing quality life for aquatic systems through restoration. It is a good way to get involved in their practice and develop such criteria also in restoring some stream areas under Nanticoke River. Since Nanticoke is occupying the greater area of Maryland, it is highly likely to have this organization to get involved also in restoring the streams under this watershed.

They offer seminars and events that are usually on-field, but because of the few restrictions of the pandemic, they have decided to do it virtually for the meantime. They are still active as a group and would be better to join as to preserve what we need to do in order to help the Nanticoke Watershed. I believe the Nanticoke Watershed Alliance has close coordination with them, which makes it more exciting and interesting to drive more for the restoration of each stream..

G3: Macromanagement in Agriculture and Point Source Pollution

It is indeed important to include these nutrients in agriculture, as is to promote good crops on farmlands. We have an existing policy with regards to applying fertilizers in the Delaware, Maryland, and Virginia area, but it may need to be looked upon again and reevaluated. Too much inputs on fertilizer and

excess amounts that drip to the river actually has a negative effect on the water quality. Best management practice in length of application and usage needs to be monitored better. Different local governments in each state and county must double check their regulations and requirements regarding this.

It is best to get involved with the laws and regulations provided by the EPA and what is stated with the Clean Water Act. Most of the time, farmers and even point source polluters do not act accordingly with the provisions provided since they do not get proper sanction with their actions. With much involvement, and thorough review of the current standard, it is best to have an overview into which people would probably dive into their regulations. It is best to get support from state governments even though it is hard to do, since most of the time the state government does not want to get involved in this kind of act that would increase the monitoring and workload for each state. But it is important for them to understand the best practice and consequences of neglecting prioritization in protecting watersheds.

We would like to get involved more with policy making, and drive to further push this with proper funding and a tooth help from the state government. Sooner or later, we could implement this in all states and have better quality monitoring for our watersheds. This will give a better life for our succeeding generations and they would appreciate such effort that will be done.

Regulations

The Nanticoke Watershed Alliance is an inter-state watershed partnership. The alliance includes partners from Maryland and Delaware, with representatives from industry and agriculture, environmental agencies, and businesses in addition to local, state, and federal governmental organizations. Collaboration of shareholders across the watershed is of the utmost importance in preserving the Nanticoke. National and state regulations help guide the alliance in their planning.

Water Quality

At a federal level, The Clean Water Act "establishes the basic structure for regulating discharges of pollutants into the waters of the United States". It is established underneath the Environmental Protection Agency. Statewide, Maryland and Delaware both have departments of natural resources that put forth standards and regulations. Maryland's Department of Natural Resources main objective is healthy watershed lands, streams and non-tidal rivers. Delaware's Department of Natural Resources and Environmental Control prioritizes clean water infrastructure and watershed restoration projects. These entities put forth the state specific regulations necessary to achieve their goals.

Protected Lands

Land within the Nanticoke watershed is protected through different means. Protected lands limit urbanization and help protect the watershed. The National Register of Historic Places, under the National Parks Service, recognizes historic places "worthy of preservation" under the National Historic Preservation Act of 1966. Statewide efforts in Delaware and Maryland preserve additional land for similar reasons. The

Delaware Department of Agriculture has a Preservation and Planning section to "preserve Delaware's agricultural heritage". Maryland has a similar program with their Rural Legacy Program and Agricultural Land Preservation Easements that aim to preserve "large, contiguous tracts of land". Land is also protected in forms of public parks and natural spaces. This is done on the state, county, or municipal levels. Maryland has no land set aside for state parks in the Nanticoke Watershed, whereas Delaware has one. The protected agricultural lands and preserved open space parks can be seen in Figure 3.

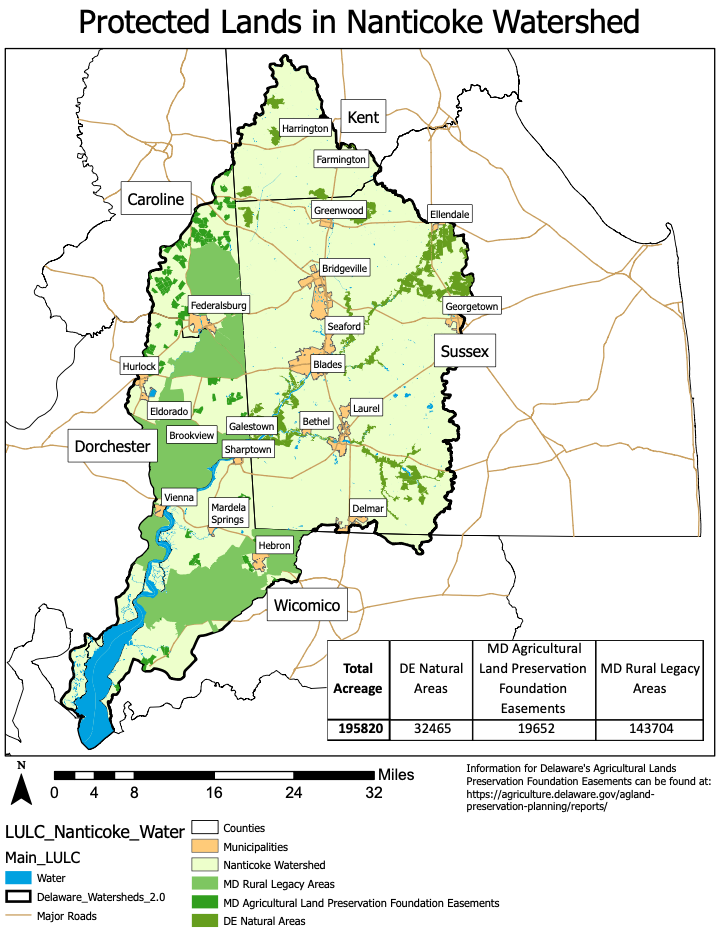

Figure 3: Protected Lands within Nanticoke River Watershed

Recommendations

National and state regulations are crucial to the restoration of Nanticoke watershed from non-point source pollution due to anthropogenic activities and agricultural runoff. In order to effectively reinforce the Clean Water Act and control the chemical release in agricultural runoff, the involvement of farmers, in the process, through education and information provision can help in the effective implementation of the related policies and regulations. This is because the provided information can help the farmers understand the beneficial effects of the provided policies to the environment and their long-term agricultural profit as well. Rather than providing policies and regulations with their correlated sanctions to the farmers, it would be more involving to the farmers if they are provided knowledge and reasoning behind the policies and

regulations. In process, this recommendation can also enhance the mission of the Nanticoke River Alliance as they work with the group of people in Maryland on stream restoration through education and outreach.

There can also be the use of incentives in addition to the penalties. This as a result can help to decrease the number of the reluctant farmers for it can act as a motivational force to follow the policies to attain the associated benefits. As a result, the goal- macromagement in agriculture and non-point source pollution- will be able to progress efficiently. The use of incentives and education to the farmers can promote the effectiveness of the policies and regulations while also involving farmers as secondary shareholders.

In addition, the use of runoff reduction practices such as reforestation, soil restoration, or replacing impervious surfaces with conservation landscaping using native plants can help to control the amount of runoff and help in the prevention of decreasing wetlands and channelization problems. These management practices are practical and can be executed effectively through encouraging volunteerism from the nearby residents and farmers as part of community activities. The minimization of runoff sources can therefore help in the improvement of water quality in Nanticoke watershed while also contributing to the endeavor of land protection within the watershed through national and state efforts.

Conclusion

In conclusion, the effective management of the Nanticoke river is pivotal to the preservation of the benefits of the Nanticoke watershed to the ecology and population from the problems such as loss of wetlands, channelization, and increased loads of nitrogen and phosphorus. Through the reduction of man-made activities, promotion of stream restoration, and macromanagement in agriculture and non-point source pollution, NICE elaborates on previously implemented regulations and policies to overcome the mentioned problems. To reinforce the already applied policies and practices, NICE recommends the provision of education, information, and incentives to farmers to promote the participation of farmers in watershed restoration. There is also the use of runoff reduction methods that can help to improve the water quality and protect the land of the watershed. Effective regulations and policies have to be implemented and reformed to sustain the benefits of the Nanticoke watershed.

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