COLLEGE OF AGRICULTURE & NATURAL RESOURCES
DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS

RESEARCH BRIEF
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Maryland's Forest Conservation Act and the Impact on Residential Development and Forest Cover Change in Rural Baltimore County

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KEY POINTS

- Large-lot residential development on septic systems causes the majority of forest loss in Maryland.
- Starting in 1993, Maryland's Forest Conservation Act (FCA) mandated afforestation and conservation requirements on parcels undergoing development.
- We analyze the effectiveness of the FCA in rural Baltimore County, including forest cover change for subdivisions in the baseline period prior to the FCA and after the FCA.
- Our results indicate that, after the FCA regulation, forest cover increased by 21% within subdivisions relative to the amount without the regulation.
- Parcels with the highest levels of forest cover continue to have significant forest losses, despite the FCA regulations.
- Because regions with the most intact forest cover are those least protected by the FCA regulations, land-use planners must conserve high priority forested areas using other approaches (e.g., purchase of development rights or conservation easements).

Forest resources provide numerous benefits to the residents of Maryland. Urban forests provide open-space amenities to nearby households, in addition to other environmental benefits such as reduction in air pollution, stormwater runoff, and urban heat island effects. Meeting goals for water quality improvements in local waterways and the Chesapeake Bay has also increased attention on the importance of maintaining and restoring forested areas. Nonetheless, the Maryland Department of Planning forecasts that approximately 162,000 acres of forest land are expected to be converted to development between 2010 and 2040 in Maryland.[1] The vast majority of this forecasted development (77%) is expected to occur as large-lot development in rural areas outside the sewer service areas and priority funding areas (PFAs).

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The Maryland Forest Conservation Act (FCA) was passed as a statewide law by the Maryland legislature in 1991 and implemented locally by county and municipal governments in 1993. The FCA in Maryland is the only statewide forest conservation regulation in the United States that focuses on forest retention and replanting requirements within residential subdivisions. Starting in January 1993, the law applies to any subdivision development with grading over 40,000 square feet (approximately one acre). Under the FCA regulations, afforestation and conservation thresholds are specified according to the zoned land use for the property. The thresholds are designed to reduce forest loss for properties undergoing development.

The landowner must submit two documents prior to development. First, the forest stand delineation must identify and map the existing forest stands, large specimen trees, and sensitive areas. Priority areas for forest protection and restoration include environmentally sensitive areas, such as 100-year floodplains,

[1] American Farmland Trust, Maryland Department of Planning and Land Stewardship Solutions LLC. 2016. "The future of sustainable farming and forestry in Maryland". Report commissioned by The Harry R. Hughes Center for Agro-Ecology, Inc. Queenstown, MD. pp. 134.

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riparian buffers around streams, steep slopes, critical habitat, and wetlands. Second, the forest conservation plan (FCP) specifies the forest conservation requirements on the property, including a plan for retaining existing forest cover and new tree plantings.[2] The FCP must be approved by local planning agencies as part of the overall subdivision approval process for land use and environmental planning.

This report summarizes research that analyzes the effect of the FCA regulations on the probability of residential development and forest cover change, using a spatially explicit dataset of residential subdivisions in rural Baltimore County.[3] Lessons learned from the effectiveness of the FCA can provide research-based information to policymakers and resource professionals in Maryland, as well providing guidance to other regions interested in implementing similar forest conservation measures. For further details, a more complete report of the empirical analysis and discussion of the main results can be downloaded here.

Case Study: Rural Baltimore County

Baltimore County has been a pioneer in using land-use regulations to manage development and preserve forest lands in Maryland. In 1967, the County implemented an urban growth boundary (UGB), also known as the urban-rural demarcation line (URDL). The UGB restricts municipal sewer service to occur solely within the urban region, comprising approximately one-third of the county land area.[4] Because higher density development requires sewer service, the vast majority of the county population resides within the urban region. That said, the UGB does not prevent large-lot development in the rural region where residential subdivisions instead are serviced by septic systems. The majority of the forest acreage converted to development in Baltimore County (and more generally in Maryland) occurs as large-lot development on septic systems in the rural region.

For this reason, the empirical analysis focuses on the effectiveness of the FCA regulations outside the UGB in rural Baltimore County. Resource conservation (RC) zoning was created in 1976 for the rural region and includes three main zoning types (Figure 1). Agricultural (RC2) zoning allows a maximum density of one residential lot per fifty acres and aims to preserve prime agricultural soils and other lands suitable for production. Watershed protection (RC4) zoning allows a maximum density of one residential lot per five acres and is designated to protect the major rivers and watersheds for three large reservoirs (Liberty, Loch Raven, and Prettyboy), serving as the drinking water supply for approximately 1.8 million residents in the Baltimore metro region. Rural residential (RC5) zoning allows a maximum density of one lot per two acres and is designated to allow residential development in the rural region. These three RC zoning types remained unchanged during the study period from 1985 to 2000, with the exception that RC4 zoning mandated clustering for residential lots starting in 1993.

Afforestation and conservation thresholds under the FCA regulations are determined according to the zoned land use type. In our study region, RC2 and RC4 zoning represent the majority of the land area and are considered as agricultural and resource areas under the FCA. RC2 and RC4 zoning have an afforestation threshold of 20% and conservation threshold of 50%. RC5 zoning is considered as medium density residential areas and

[2] Galvin, Michael, Becky Wilson, and Marian Honeczy. 2000. "Maryland's Forest Conservation Act: A process for urban greenspace protection during the development process." Journal of Arboriculture 26(5): 275-280.

[3] Newburn, David and Jeffrey Ferris. 2017. "Additionality and forest conservation regulation for residential development." American Journal of Agricultural Economics, in press.

[4] Outen, Don. 2007. "Pioneer on the Frontier of Smart Growth: The Baltimore County, MD Experience." Smart Growth @ 10 Conference, Resources for the Future, Washington, DC. pp. 49.

has an afforestation threshold of 20% and conservation threshold of 25%. For parcels with less than 20% existing forest cover, the landowner must plant new trees up to the afforestation threshold, even if no trees are cleared during the development process. To avoid replanting requirements entirely, a landowner must retain at least 20% of the existing forest cover above the conservation threshold, known as the break-even point. Forest land cleared below the break-even point but above the conservation threshold must be replanted at one-fourth the amount of forested cleared. Forest land cleared below the conservation threshold must be replanted at twice the amounted cleared below the conservation threshold.[5]

The analysis relies on a spatially explicit parcel-level dataset of residential subdivisions in rural Baltimore County. We used the parcel layer for Baltimore County provided by the Maryland Department of Planning. Using historical archives for subdivision plat maps, we manually reconstructed each subdivision that occurred between 1985 and 2000. We determine the time of the subdivision development based on the year of subdivision approval from the plat map. All parcels in the same subdivision are aggregated to recover the boundaries for the original "parent" parcel. This process allows us to reconstruct the landscape for parcel boundaries at the beginning of the study period in 1985. For the land-use change model, we determine all developable parcels that, as of 1985, were eligible for residential development in the RC zoning area and could be subdivided into two or more buildable residential lots. There were a total of 3,043 developable parcels in 1985, of which 413 residential subdivisions occurring during 1985-2000. Because the FCA regulations were implemented in 1993, we analyze the landowner development decisions on forest cover change during both periods before the FCA (1985-1992) and after the FCA (1993-2000). This includes 230 subdivisions in 1985-1992 and 183 subdivisions in 1993-2000 (Figure 1).

To characterize parcel-level forest cover change, we used forest cover data obtained from the North American Forest Dynamics Project. This is a NASA funded project that used LANDSAT satellite imagery to create detailed forest cover data (30 meter grid cell resolution) starting in 1984 for the Baltimore-Washington corridor and other sites in the United States.[6] Forest cover maps are available in Baltimore County for 12 time periods including the following years: 1984, 1986, 1987, 1988, 1990, 1991, 1994, 1996, 1998, 2000, 2002, and 2004. Figure 2 provides the forest cover map in Baltimore County in 1984. The non-forest cover includes all other land cover types (e.g., urban, cultivated crops, pasture, lawns).[7] Figure 3 provides the forest cover change between 1984 and 2004, including areas of deforestation, reforestation/afforestation, and persistent forest cover. Each snapshot of the 12 forest cover maps was intersected with the parcel boundary layer to create variables for the percent existing forest cover on each parcel, calculated as the amount of existing forest cover divided by the total parcel land area.

Forest cover change is calculated as the difference between the percent forest cover after development and percent existing forest cover before development. We used approximately symmetric time windows (5 to 8 years) for the amount of time elapsed after development. For example, a subdivision development occurring in 1989 would use the existing forest cover prior to development in 1988 and the forest cover after development in 1996 to determine the forest cover change.

Summary Results and Policy Implications

It is informative to compare the average forest cover change for subdivisions occurring before the FCA in 1985-1992 and after the FCA in 1993-2000 (Figure 4). The dashed line in Figure 4 shows the average forest cover change for subdivision in 1985-1992. Prior to the FCA, there was a loss in forest cover on average for all developed parcels across the entire distribution of existing forest cover. For example, parcels with 50% existing forest cover before development had an average loss of 9% in forest cover due to residential development.

[5] For further details on FCA requirements, see the Chesapeake Bay Foundation "A Citizen's Guide to the Forest Conservation Act in Maryland". Available at: http://www.baltimoresustainability.org/wp-content/uploads/2015/12/Forest_Conservation.pdf.

[6] The forest cover data from the North American Forest Dynamics Project is available at: http://daac.ornl.gov/NACP/guides/NAFD_Disturbance_guide.html.

[7] The satellite image for the Baltimore-Washington corridor did not cover the northern portion of Baltimore County; and therefore, this region was not included in our analysis.

The solid line in Figure 4 shows the average forest cover change for subdivisions in 1993-2000 after the FCA regulations were implemented.

The effectiveness of the FCA regulations is determined as the difference in forest cover change after the FCA relative to before the FCA. Figure 4 shows an overall positive difference in forest cover change, suggesting that the FCA increased forest cover significantly above the amount that would have occurred without the FCA. The largest effect occurs for parcels with 50% existing forest cover. This is logical because the majority of developable parcels in rural Baltimore County (RC2 and RC4 zoning) have a conservation threshold set at 50%. The landowner with 50% existing forest cover has the largest incentive to avoid forest clearing. Otherwise, the landowner is required to replant two acres for each acre of forest cleared below the conservation threshold.

Interestingly, there is little or no significant effect for parcels with the highest existing forest cover. Figure 4 shows a similar amount of forest loss on subdivisions before and after the FCA for parcels with existing forest cover around 90-100%. This is logical given the rules specified under the FCA regulations. Consider the landowner with a 100-acre parcel that is completely forested (i.e., 100% existing forest cover) and assume the conservation threshold is 50%. The break-even point is 60% for this parcel. The landowner can clear up to 40% of the existing forest and still not be required to replant under the FCA regulations. In this case, the landowner has little incentive to avoid forest clearing with or without the FCA.

Because regions with the most intact forest cover are those least protected by the FCA regulations, land-use planners must conserve high priority forest areas using other approaches. First, purchase of development rights programs can be targeted to protect those highly forested large parcels that are vulnerable to development. Second, Baltimore County mitigated some forest loss using the mandatory clustering policy adopted for RC4 zoning in 1993. Although the zoned residential density remained at one lot per five acres, the clustering policy created an open space parcel that conserved the majority of the land area on residential subdivisions.

Lastly, the FCA regulations could be revised to create impact fees for development on the most highly forested parcels. It is important to note that the FCA regulations are not allowed to prevent development

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altogether on parcels that are completely forested. This would be a violation of the Takings Clause under the Fifth Amendment in the US Constitution that protects the rights of private property owners. Nonetheless, the FCA regulations could be revised to institute impact fees for forest cleared on highly forest parcels. Basically, the conservation threshold would increase to a level higher than 50%, and the impact fees collected could be used for offsite mitigation to protect forest in other regions. This would provide landowners with highly forested parcels an incentive to avoid some forest clearing, while also providing a funding mechanism to preserve high priority forests in Maryland.

In conclusion, there are limitations and strengths for this analysis. An important caveat is that this analysis was done for the rural area of a single county in Maryland. The effectiveness of the FCA may vary for different counties in Maryland, and the urban region with higher density development may be different from those effects discussed here for the rural region. The NASA satellite imagery data on forest cover is available for the entire Baltimore-Washington corridor and can be repeated for other counties in Maryland. A major advantage of this analysis is that it includes the forest cover change in the baseline period in 1985-1992. An accurate assessment of the FCA effectiveness should consider forest cover change after the FCA relative to the amount of forest cover change that would have occurred in the absence of the FCA regulations. Overall, Figure 4 shows the difference in forest cover has increased due to the FCA regulations but not on the most highly forested parcels. ■

For more information about this research, contact Dr. David Newburn at ***dnewburn@umd.edu.***

Figure 1

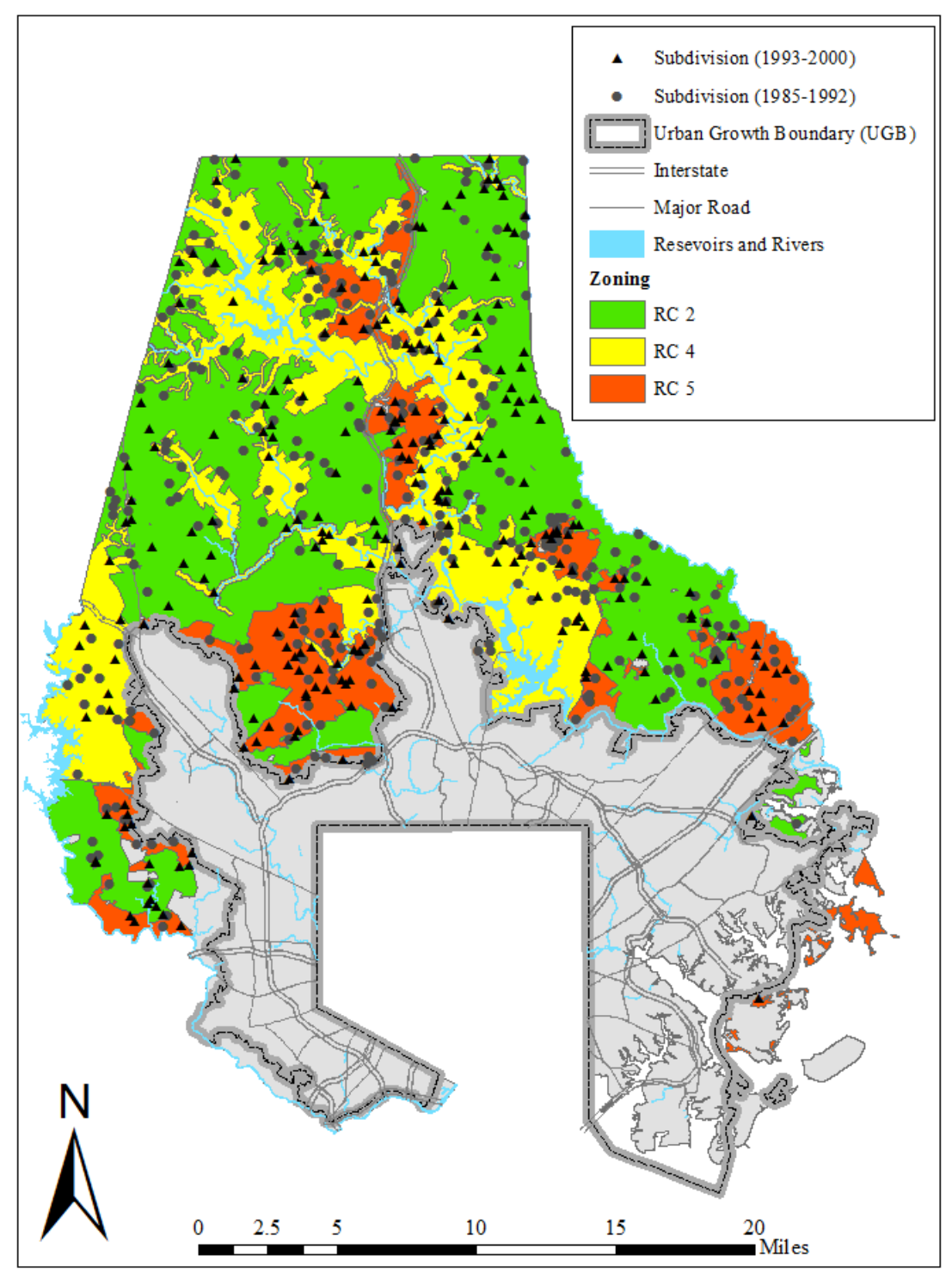

Figure 1. Residential subdivisions in 1985-2000 in rural Baltimore County

Figure 2

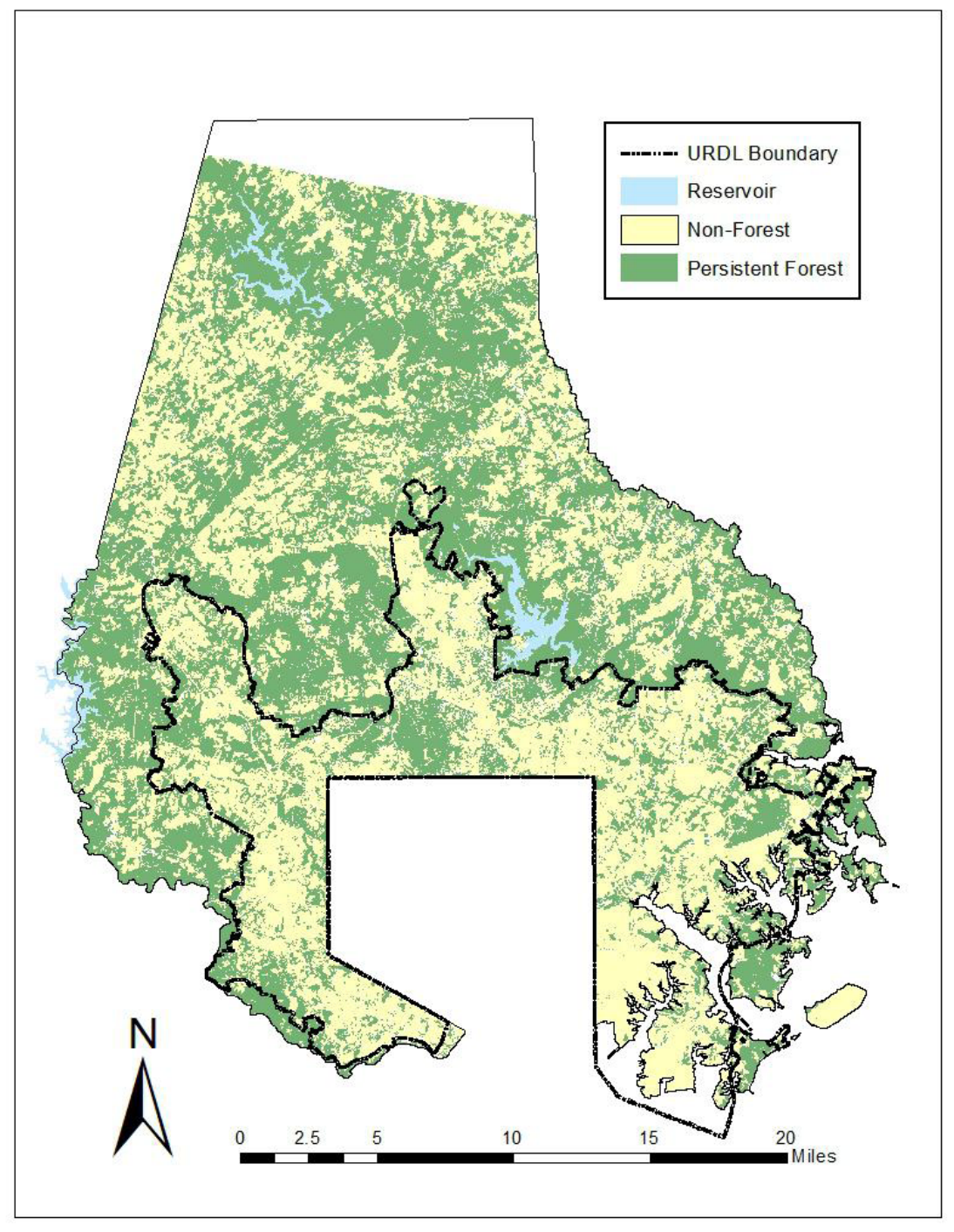

Figure 2: Existing forest cover in 1984

Note: The satellite image for the Baltimore-Washington corridor did not cover the northern portion of Baltimore County; and therefore, this region was not included in our analysis.

Figure 3

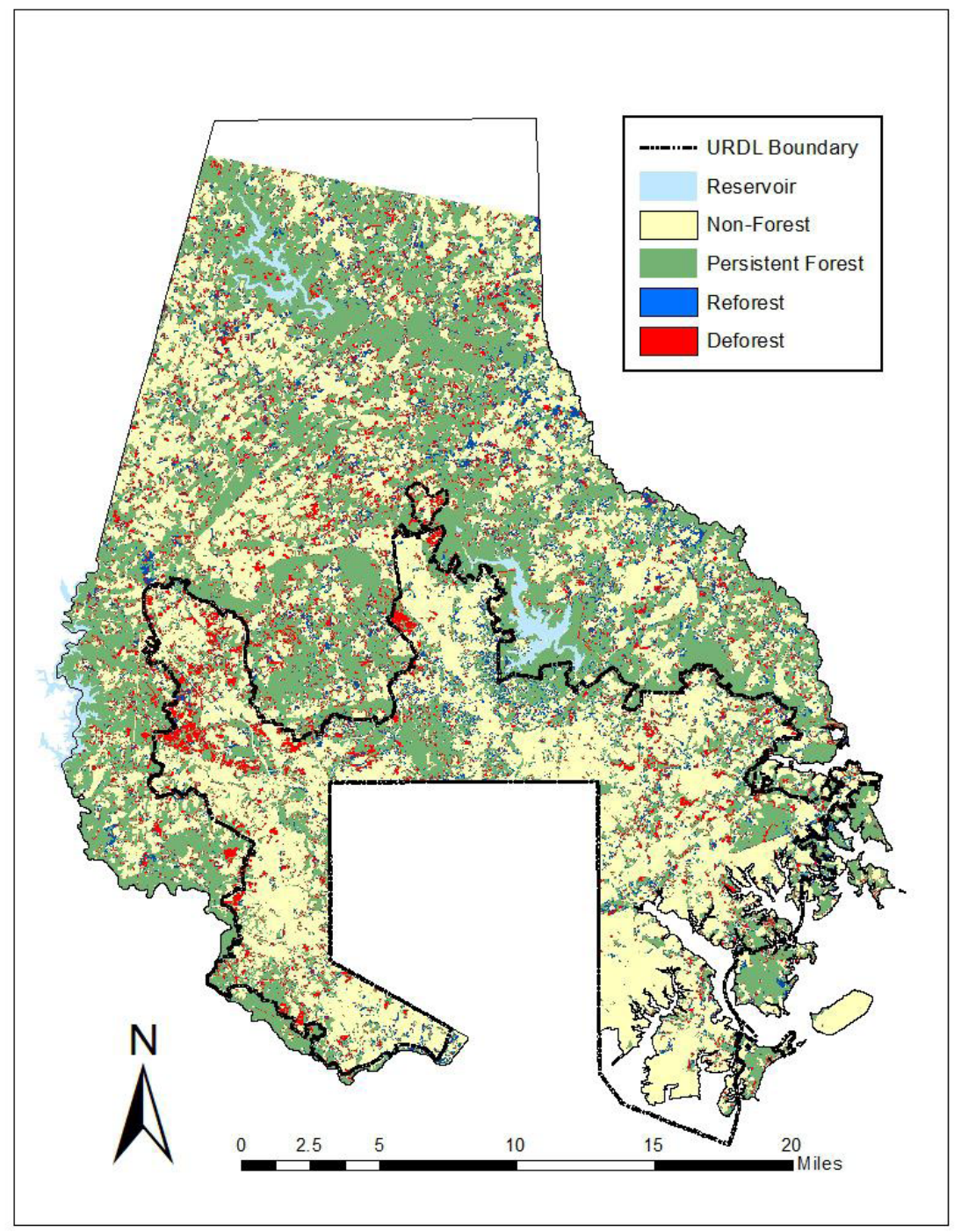

Figure 3: Persistent forest cover, deforestation, and reforestation during 1984-2004

Figure 4

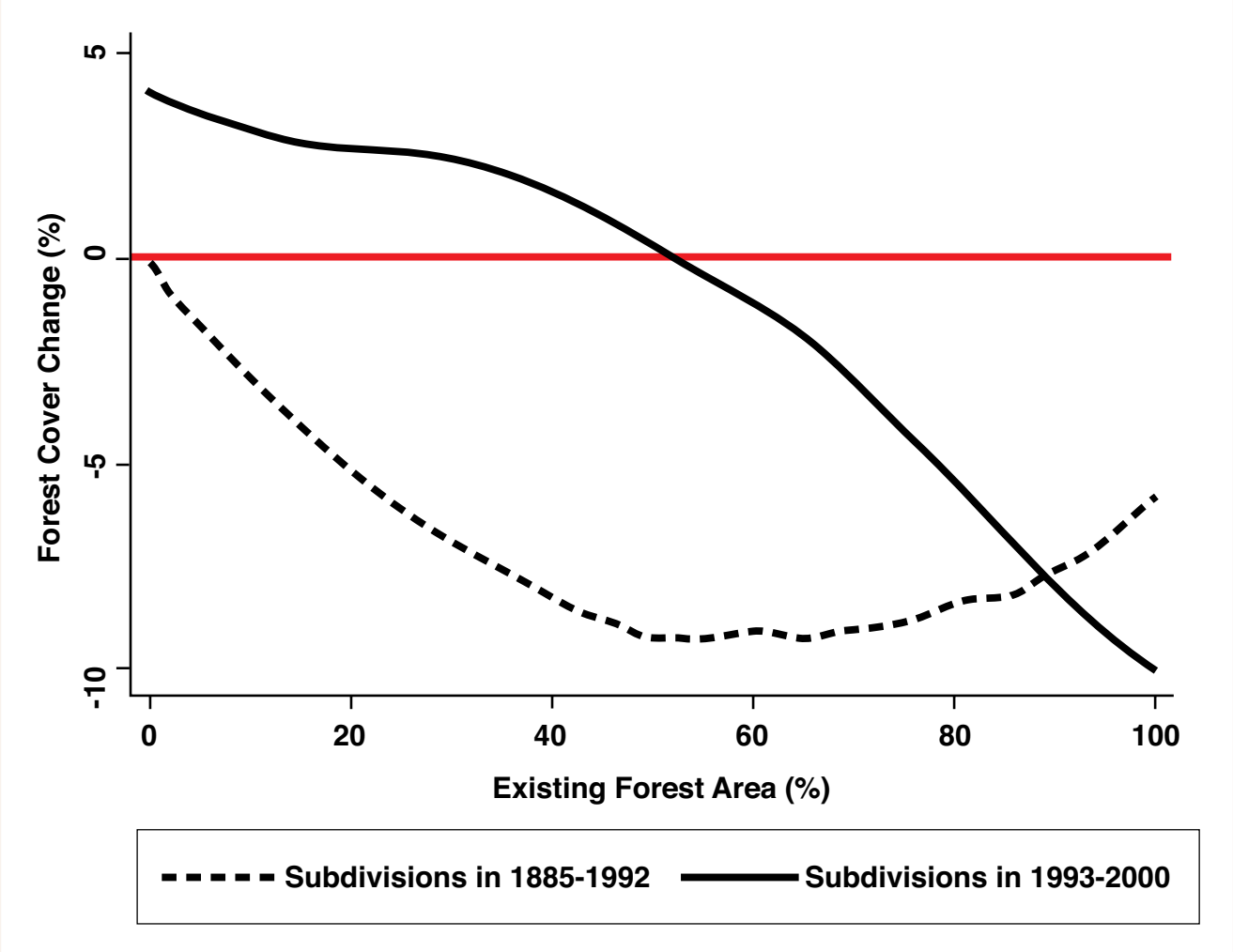

Figure 4. Average forest cover change for residential subdivisions before FCA (1985-1992) and after FCA (1993-2000)

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