

ABSTRACT

RATIONALE: Firms in East Tennessee reporting to the U.S. Environmental Protection Agency's Toxics Release Inventory were previously found to differ from other companies in Tennessee in their pollution prevention (P2) methods, displaying lower frequencies of self-reported audits, technical assistance and employee participation [Ferguson 2004].

Of the three regions of Tennessee, only East Tennessee is in "Appalachia." Several factors which weigh against the adoption of P2 techniques may be accentuated in Appalachia: dependency on manufacturing industries, geographic isolation, and socioeconomic deprivation. In addition, cultural norms of reticence and humility may discourage employee participation. Still, many Appalachians have a relationship with the environment through hunting, fishing, subsistence agriculture and/or their cultural heritage.

PURPOSE: To test the hypothesis that firms in Appalachia differ systematically from non-Appalachian firms in their P2 practices and toxic emissions.

METHODS: The Appalachian Regional Commission's county-level delineation of Appalachia was used to sort 2002 TRI data for the 13 states which (in whole or in part) are included in Appalachia. Toxic emissions from facilities which are located in Appalachian counties were compared to those in non-Appalachian counties. To minimize the confounding influence of regional variation in governmental policies for P2, comparisons were made within each of the three subregions of Appalachia (Southern, Central and Northern). Differences in P2 methods and toxic releases were assessed using the test for binomial proportions, Fisher's exact test, and Student's T-test.

INTRODUCTION

Previously we found evidence that firms in East Tennessee are less likely to practice pollution prevention than firms in other parts of Tennessee (Figure 1).

Based on this finding, we hypothesized that firms in Appalachia differ systematically from non-Appalachian firms in their:

- toxic releases into the environment
- pollution prevention practices

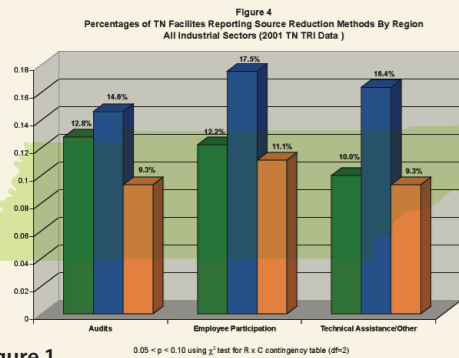


Figure 1.

WHAT IS POLLUTION PREVENTION?

Pollution prevention, also known as source reduction, is the practice of preventing pollution at its source, rather than simply managing it after its production. Source reduction includes any activity that reduces the amount of any hazardous substance or pollutant released into the environment *prior* to recycling, treatment, or disposal.

Pollution Prevention activities may include:

- Reformulation or redesign of products
- Process Modification
- Equipment Modification
- Substitution of raw materials
- Improvements in maintenance, training, or inventory control
- Recycling—if it is part of a continuous production process

Pollution prevention opportunities can be identified using several different methods. These methods are reported in the TRI, and can be grouped into three main categories:

- Audits (T1-3): Internal & external pollution prevention audits, and materials balance audits
- Employee Participation (T4-6): Participative team management and employee recommendations (either independently or under a formal company program)
- Technical Assistance (T7-10): State or Federal government technical assistance programs, trade association/industry technical assistance, and vendor assistance

POLLUTION PREVENTION IN APPALACHIA: INSIGHTS FROM THE TOXICS RELEASE INVENTORY

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METHODS

Step 1. Defined Appalachia and its Subregions

The Appalachian Regional Commission[2] delineates Appalachia as 410 counties across 13 states, from Mississippi to New York. Appalachia is further divided into subregions: Northern, Central and Southern. (See Map, Figure 2).

Certain counties in East Tennessee and Southwest Virginia lie in either Central or Southern Appalachia. Kentucky's 30 Appalachian counties lie entirely within Central Appalachia.

Step 2. Applied "Appalachian" Designations to TRI data

The most recent (2002) data from US EPA's Toxics Release Inventory was downloaded into a set of Excel spreadsheets. Designations for each subregion ("N," "C" and "S") were added

Step 3. Compared P2 Practices and Toxic Releases

Analyses were performed for Appalachia as a whole, between Appalachian and non-Appalachian counties within each subregion, and among the subregions.

Step 4. Compared Potential for Human Exposure

A crude index of the potential for human exposure to toxic releases within each county was calculated:

$$\text{Releases from facilities in a county (lbs)} \times \text{Population density (Persons/sq mile)}$$

This index was calculated for total releases and for the four environmental media reported in the TRI data base (air, water, onsite and offsite land disposal).

Differences in P2 methods and toxic releases were assessed using the test for binomial proportions, Fisher's exact test, and Student's T-test.

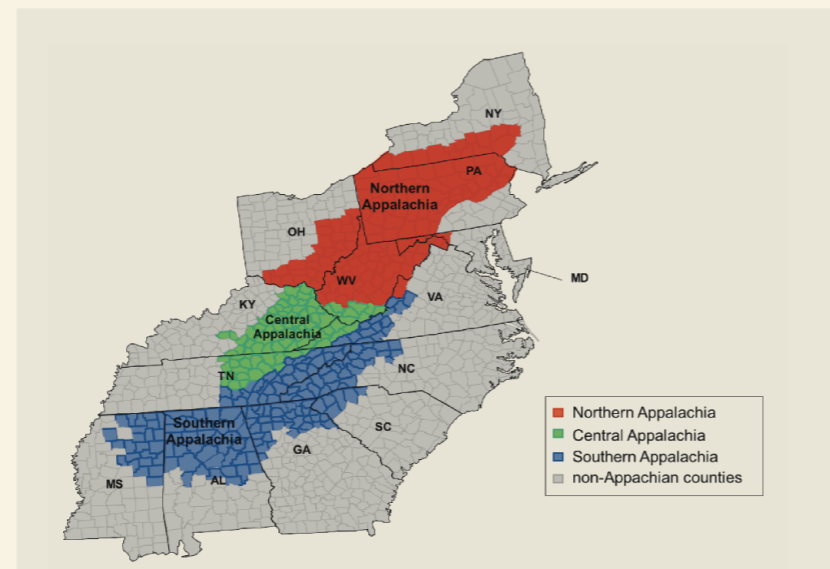


Figure 2.

RESULTS

Toxic Releases

- In the aggregated Appalachian region, average air and total releases on a per facility basis were significantly higher than in the non-Appalachian counties of the 13 states ($\bar{X}_{App} = 151,978$ lbs/facil vs. $\bar{X}_{Non} = 94,176$ lbs/facil, $p < 0.009$).
- These differences were entirely accounted for by facilities in Northern Appalachia where average releases per facility into all media were consistently 3 to 4-fold higher than for facilities located in non-Appalachian counties of the Northern states ($p < 0.044$).
- In the Southern and Central states, there were no significant differences between Appalachia and non-Appalachia in average releases on a per facility basis, for any of the environmental media.

P2 Practices

- Among the three sub-regions of Appalachia, Central Appalachian firms were *least likely* to report practicing some form of source reduction (13.5% vs. 19.0%, $p = 0.056$).
- Firms in Central Appalachia are significantly *less likely* to use worker participatory methods of source reduction than firms located in the non-Appalachian counties of the Central states (5.2% vs. 9.1%, $p = 0.045$) (Figure 3).

- In the Southern states, no significant differences in source reduction practices were observed between firms located in Appalachian counties vs. non-Appalachian counties.
- Firms in Northern Appalachia were significantly *more likely* to report practicing some form of source reduction than those in non-Appalachian counties of Northern states (19.3% vs. 16.5%, $p = 0.042$).
- Firms in Northern Appalachia were *more likely* to use worker participatory methods (10.1% vs. 8.0%, $p < 0.047$) and less likely to rely on technical assistance (3.4% vs. 8.0%, $p < 0.001$) than firms located in non-Appalachian counties of Northern states.

Potential for Exposure

- Central Appalachian counties ranked significantly *lower* than non-Appalachian counties on our index of potential human exposure for all environmental media as well as total releases (all $p \leq 0.028$). Differences were on the order of 10-fold.
- In the Southern region, Appalachian counties had significantly *lower* potential for human exposure than did non-Appalachian counties for total ($p = 0.048$) and air releases ($p = 0.035$).
- There were no significant differences in the potential for human exposure between Appalachian and non-Appalachian counties in the Northern states.

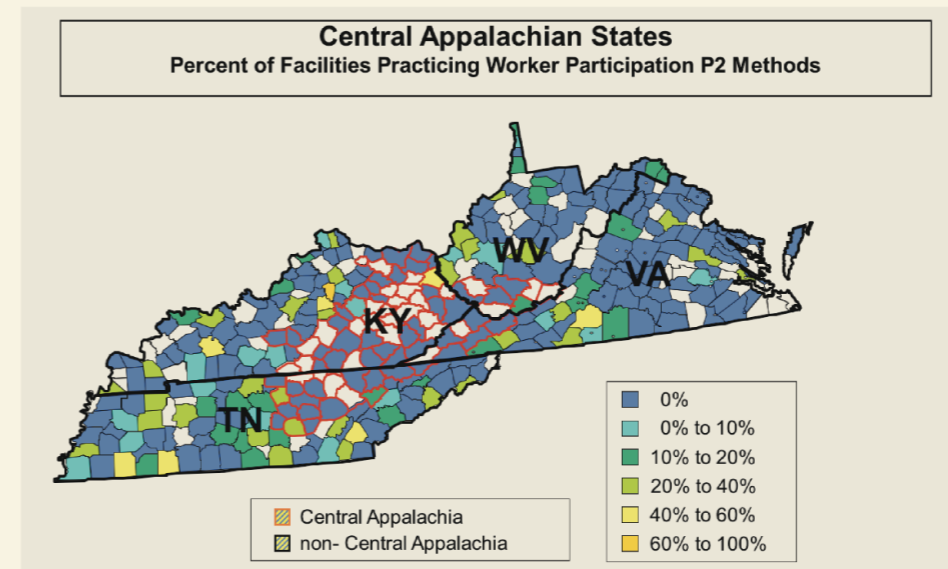


Figure 3.

CAVEATS

TRI Data

- Data in the EPA Toxics Release Inventory have several shortcomings. Principal among these is that they are based on *estimation techniques*, not actual measurements. Further, in a climate of lax enforcement there is a possibility of under-reporting of emissions and over-reporting of P2 practices.

A mitigating factor in this study is the *large sample sizes* for facilities ($N_{App} = 2,564$, $N_{Non} = 5,617$) and counties ($N_{App} = 410$, $N_{Non} = 587$). Random variations tend to average out within large samples.

- Facilities that handle TRI-listed chemicals but do not meet TRI quantity thresholds, or have fewer than ten full-time employees, are not required to report their releases.[3]
- TRI does not include data on toxic emissions from cars and trucks, or from many other non-industrial sources.
- TRI data are not corrected for the *level of economic activity*. For example, no data are provided on the number of employees per facility. Greater emissions in Northern Appalachia, as well as lower emissions in Central Appalachia, are likely confounded by levels of economic activity.

Appalachia has six fewer jobs per 100 people than the rest of the country.

Most rural Appalachian counties have only 82% of the per capita income of such counties elsewhere.

CONCLUSIONS

Average total releases per facility and air toxics emissions are significantly higher in Appalachian counties than in non-Appalachian counties. However, there is marked subregional variation, with Northern Appalachian facilities accounting for the difference. To date, this is the only evidence we have found in the TRI data base of a possible disparate impact of pollution in Appalachia. Interestingly, Northern Appalachian firms are also significantly more likely to be practicing P2 than non-Appalachian firms in the northern states. They also show a significant edge in their use of worker participatory methods.

Southern and Central Appalachian counties ranked lower than the surrounding non-Appalachian counties on a crude index of potential human exposure. This crude measure may correlate with lower levels of public concern about toxic releases in Southern and Central Appalachia. The significant deficit of worker participatory methods in Central Appalachian firms is consistent with this interpretation. However, other socioeconomic and demographic factors not yet considered should be explored. These include: the P2 policies of state governments, worker and community awareness and empowerment, and the availability of investment capital for P2 projects.

KEY WORKS CONSULTED

- [1] Ferguson, D. and Silver, K., Toxics Release Inventory for Tennessee: Pollution Prevention Trends and Opportunities. Primary Care Research Day, Quillen College of Medicine, ETSU, Johnson City, TN September 11, 2004
- [2] Appalachian Regional Commission, "Counties in Appalachia," <http://www.arc.gov/index.do?nodeId=27>, Accessed March 1, 2005
- [3] U.S. EPA, The Toxics Release Inventory (TRI) and Factors to Consider When Using TRI data <http://www.epa.gov/tri/2002_tri_brochure.pdf>