USGS
science for a changing world

Estimated Agricultural Pesticide Use for Southeast Stream-Quality Assessment, 2014

Open-File Report 2015–1224
Version 2.1, July 2016

U.S. Department of the Interior
U.S. Geological Survey

Estimated Agricultural Pesticide Use for Southeast Stream-Quality Assessment, 2014

By Nancy T. Baker

Open-File Report 2015–1224
Version 2.1, July 2016

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Director

U.S. Geological Survey, Reston, Virginia
First release: December 1, 2015
Revised: December 14, 2015 (ver. 2.0)
Revised: July 2016 (ver. 2.1)

Suggested citation:
Baker, N.T., 2016, Estimated agricultural pesticide use for Southeast Stream-Quality Assessment, 2014 (ver. 2.1, July 2016): U.S. Geological Survey Open-File Report 2015–1224, 5 p., http://dx.doi.org/10.3133/ofr20151224.

ISSN 2331-1258 (online)

Contents

Figure

Tables

Estimated Agricultural Pesticide Use for Southeast Stream-Quality Assessment, 2014

By Nancy T. Baker

Introduction

One of the goals of the U.S. Geological Survey (USGS) Southeast Stream-Quality Assessment (SESQA) is to characterize contaminants at perennial-stream sites throughout the southern Piedmont and southern Appalachian Mountains. The evaluation of pesticide inputs from agricultural sources will aid in that characterization.

Methods used for calculating county-level pesticide use documented in this report are from methods developed and described by Thelin and Stone (2013) and Baker and Stone (2015). Two methods for calculating estimated pesticide use (EPest) rates—EPest-low and EPest-high—were applied in this study to estimate a probable range in the annual amounts of pesticide used for agriculture in 2014. To calculate watershed-level estimates, county-level use was proportionally allocated to agricultural land within each watershed. Concentrations of 262 pesticide compounds were estimated and compiled for subsequent analysis by the USGS National Water Quality Assessment Program, Southeast Stream-Quality Assessment.

This report provides estimates of annual agricultural use of 262 pesticide compounds for counties and selected watersheds in parts of eight southeastern States for 2014. Estimates of county- and watershed-level annual agricultural pesticide use are provided as downloadable, tab-delimited files for both EPest-high and EPest-low.

Estimation Methods

County-level estimation methods for pesticide use , which are summarized in this report, are described in detail in Thelin and Stone (2013) and Baker and Stone (2015). Pesticide-use data compiled from proprietary surveys of farm operations located within U.S. Department of Agriculture (USDA) Crop Reporting Districts (CRDs)—a collection of contiguous counties within each state—were used to calculate pesticide use per crop acre, or an "estimated pesticide use" (EPest) rate, for each pesticide compound used in a CRD. Pesticide-use estimates at the county level were then calculated by multiplying EPest rates by harvested-crop acres for each pesticide-by-crop combination in each county. The data for annual harvested-crop acres are reported in the USDA–National Agricultural Statistics 2012 Census of Agriculture (Ag Census; U.S. Department of Agriculture, 2014), and the data for each crop harvested in the CRD are reported in the 2014 County Agricultural Production Survey (CAPS; U.S. Department of Agriculture–National Agricultural Statistics Service, 2015).

Two estimates—EPest-low and EPest-high—provide a range of values of pesticide use (Thelin and Stone, 2013; Baker and Stone, 2015) where a pesticide-use rate is not available for a crop from a CRD. Both estimation methods incorporate extrapolated rates and rates reported from surveys of farmers to estimate pesticide use for counties, but EPest-low and EPest-high estimation procedures differ in how they treat situations when a CRD was surveyed and pesticide use was not reported for a particular pesticide-by-crop combination. The EPest-low estimate is zero in the CRD for pesticide-by-crop combinations not listed in responses from surveyed farmers. The EPest-high estimate, which is used for counties in unsurveyed CRDs and in surveyed CRDs with missing or incomplete responses from farmers, was made by using a complex algorithm described in detail by Thelin and Stone (2013). The EPest-high estimate is based on the median of reported pesticide-by-crop use rates from surveyed farmers in neighboring CRDs and, in some cases, CRDs within the same USDA Farm Resource Region (Thelin and Stone, 2013). In some cases, EPest-low annual totals can be greater than EPest-high totals when the EPest-low regional pesticide-by-crop rate is greater than the EPest-high rate. EPest regional pesticide-by-crop rates are determined by using the median rate of a minimum of three CRDs, and, typically, EPest-high regional rates are determined from the median of a greater number of CRDs than EPest-low regional rates, and this occasionally results in a higher rate for EPest-low (Thelin and Stone, 2013).

To calculate watershed-level estimates for pesticide use, county-level pesticide-by-crop use was first aggregated to county-level pesticide use on pasture or hay and on cultivated land. This was done because the National Land Cover Database (NLCD 2011; Homer and others, 2015), which was used to proportionally allocate county estimates to agricultural land within each watershed assigns pasture or hay to NLCD class 81 and cultivated land to NLCD class 82. The NLCD 2011 land-use raster, which has a 30-meter [m] cell size, was then combined with a 30-m cell size rasterized version (JoAnn Gronberg, U.S. Geological Survey, written commun., 2012) of the Topographically Integrated Geographic Encoding and Referencing (TIGER)/Line® shapefile of county boundaries from the 2010 U.S. Census (https://www.census.gov/geo/maps-data/data/tiger-line.html; United States Census Bureau, 2012). Thus, the combined files result in a geospatial raster that includes NLCD class 81 and class 82 for each county (NLCD-CO) located in the SESQA study area. The aggregated pesticide by county values for NLCD 81 and NLCD 82 EPest-high and EPest-low rate was then joined by county code to NLCD-CO. To obtain the NLCD-CO per 30-m cell use rate for each pesticide, the county use was divided by the number of cells within each county and NCLD 2011 class combination (NLCD-CO-EPest). Geospatial vector data of watershed boundaries, developed for 115 SESQA stream sites (Naomi Nakagaki and Sharon Qi, U.S. Geological Survey, written commun., 2015), were then used to extract the NLCD-CO-EPest for each watershed. For each compound, the NLCD-CO-EPest cells within each watershed were summed to obtain the total pesticide use for that compound in that watershed.

Pesticide Use Data

Estimates of annual agricultural pesticide use, by county and watershed, are provided for this report as downloadable, tab-delimited files available at http://pubs.usgs.gov/ofr/20151224/. The results for pesticide use are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty.

County-level high and low estimates, provided for the southeastern states, are listed in table 1. The area of agricultural land (NLCD classes 81 and 82) is provided to show the relative amount of agricultural land in the county. The 16 column headings in table 1 and descriptions are listed below.

	Heading	Description
1.	**STATE_FIPS_CODE**	Federal Information Processing Standard (FIPS) code
2.	**STATE**	state name
3.	**COUNTY_FIPS_CODE**	county FIPS code
4.	**COUNTY**	county name
5.	**STATECO_FIPS_CODE**	combined state and county FIPS code
6.	**YEAR**	year
7.	**COUNTY_AREA_KM2**	area of the county, in square kilometers (km^2)
8.	**LU81_KM2**	area of NLCD class 81 land use, in km^2
9.	**LU82_KM2**	area of NLCD class 82 land use, in km^2
10.	**COMPOUND**	pesticide compound name
11.	**EPEST__HIGH_LU81_KGS**	high estimated pesticide use for NLCD class 81 (pasture or hay), in kilograms (kgs)
12.	**EPEST__HIGH_LU82_KGS**	high estimated pesticide use for NLCD class 82 (cultivated land), in kgs
13.	**EPEST_HIGH_KGS**	high estimated total pesticide use for classes 81 plus 82 combined, in kgs
14.	**EPEST_ LOW_LU81_KGS**	low estimated pesticide use for NLCD class 81 (pasture or hay), in kgs
15.	**EPEST__LOW_LU82_KGS**	low estimated pesticide use for NLCD class 82 (cultivated land), in kgs
16.	**EPEST__LOW_KGS**	low estimated total pesticide use for classes 81 and 82 combined, in kgs

High and low estimates of pesticide use, organized by watershed station identification number, are provided in table 2. The area of agricultural land (NLCD classes 81 and 82) is provided to show the relative amount of agricultural land in the watershed. The 14 column headings in table 2 and descriptions are listed below.

	Heading	Description
1.	**STATION_ID**	watershed identification number
2.	**YEAR**	year
3.	**STATION_DA_KM2**	drainage area of the watershed, in km^2
4.	**LU81_KM2**	area of NLCD class 81 land use, in km2
5.	**LU82_KM2**	area of NLCD class 82 land use, in km2
6.	**COMPOUND**	pesticide compound name
7.	**EPEST_HIGH_LU81_KGS**	high estimated pesticide use for NLCD class 81 (pasture or hay), in kgs
8.	**EPEST_HIGH_LU82_KGS**	high estimated pesticide use for NLCD class 82 (cultivated land), in kgs
9.	**EPEST_HIGH_KGS**	high estimated total pesticide use for classes 81 plus 82 combined, in kgs
10.	**EPEST_HIGH_KGSperKM2**	high estimated total pesticide use, in kgs per km^2 of land in the watershed
11.	**EPEST_LOW_LU81_KGS**	low estimated pesticide use for NLCD class 81 (pasture or hay), in kgs
12.	**EPEST_LOW_LU82_KGS**	low estimated pesticide use for NLCD class 82 (cultivated land), in kgs
13.	**EPEST_LOW_KGS**	low estimated total pesticide use for classes 81 and 82 combined, in kgs
14.	**EPEST_LOW_KGSperKM2**	low estimated total pesticide use, in kgs per km2 of land in the watershed

Watersheds in the southeastern United States that are part of the SESQA study area and for which pesticide use was estimated are shown in figure 1. The SESQA watershed station information is listed in table 3.

Acknowledgments

Several U.S. Geological Survey colleagues are gratefully acknowledged for assisting with various aspects of this investigation. Geospatial vector data of watershed boundaries for SESQA were provided by Naomi Nakagaki and Sharon L. Qi. Geospatial raster data of 2010 county boundaries were provided by JoAnn M. Gronberg. Technical reviews were provided by Aubrey R. Bunch and W. Fred Falls.

Table 1. Estimated pesticide use (EPest)-high and EPest-low estimates, by county, for the southeastern United States, 2014 (available at http://pubs.usgs.gov/ofr/20151224/).

Table 2. Estimated pesticide use (EPest)-high and EPest-low estimates, by watershed, for the southeastern United States, 2014 (available at http://pubs.usgs.gov/ofr/20151224/).

Table 3. Southeast Stream-Quality Assessment watershed station information (available at http://pubs.usgs.gov/ofr/20151224/).

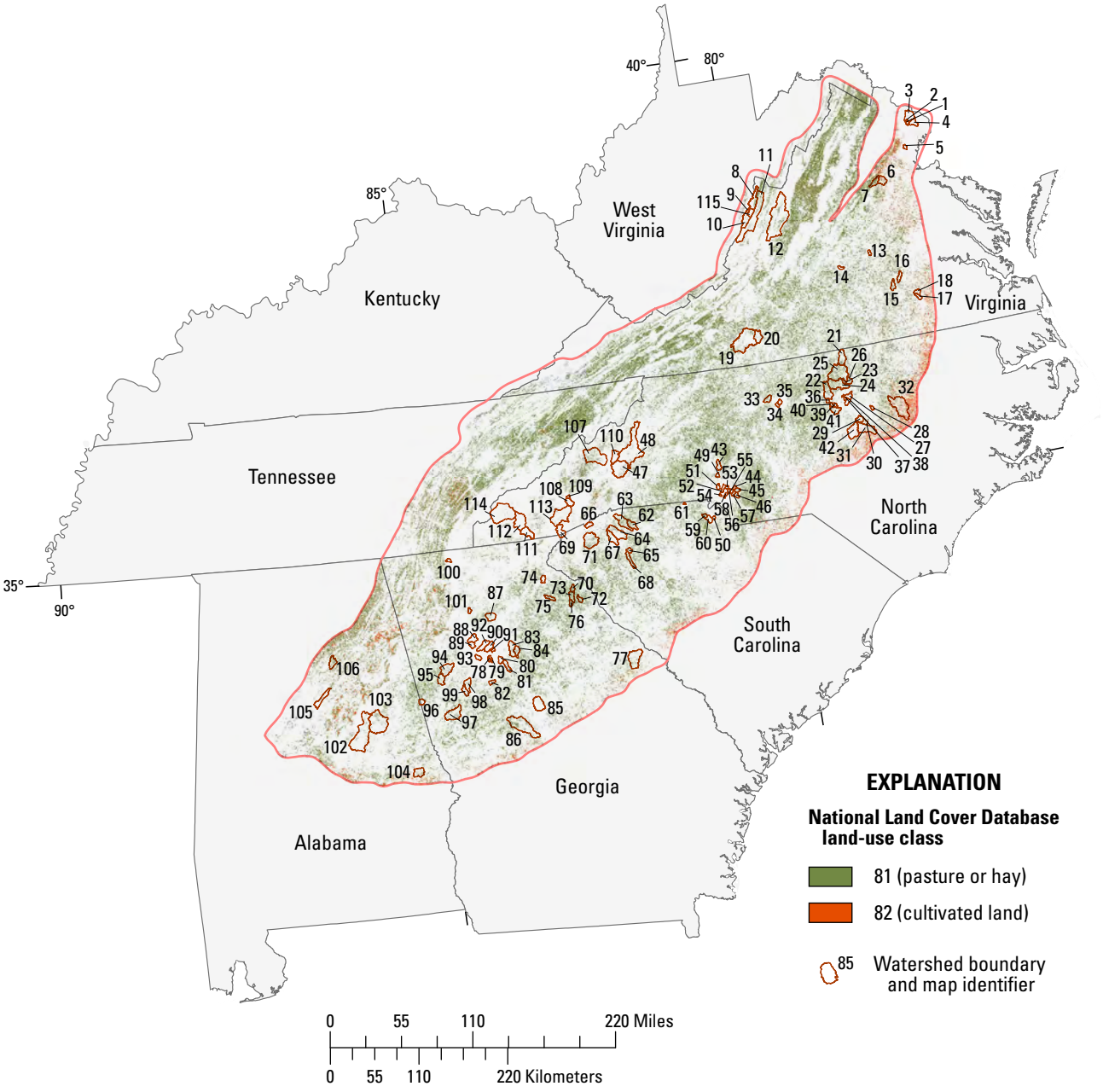

Figure 1. Location of Southeast Stream-Quality Assessment watersheds.

References Cited

Baker, N.T., and Stone, W.W., 2015, Estimated annual agricultural pesticide use for counties of the conterminous United States, 2008–12: U.S. Geological Survey Data Series 907, 9 p., http://dx.doi.org/10.3133/ds907.

Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K., 2015, Completion of the 2011 National Land Cover Database for the conterminous United States—Representing a decade of land cover change information: Photogrammetric Engineering and Remote Sensing, v. 81, no. 5, p. 345–354, accessed November, 2, 2014, at http://www.asprs.org/a/publications/pers/2015journals/PERS_May_2015/HTML/index.html#345/z.

Thelin, G.P., and Stone, W.W., 2013, Estimation of annual agricultural pesticide use for counties of the conterminous United States, 1992–2009: U.S. Geological Survey Scientific Investigations Report 2013–5009, 54 p.

U.S. Census Bureau, 2012, TIGER/Line® shapefiles and TIGER/Line® files: accessed October 15, 2015, at https://www.census.gov/geo/maps-data/data/tiger-line.html.

U.S. Department of Agriculture, 2014, 2012 Census of agriculture, United States summary and state data: U.S. Department of Agriculture, National Agricultural Statistics Service, Geographic Area Series, v. 1, pt. 51, AC–12–A–51, accessed May 2013 at http://www.agcensus.usda.gov/Publications/2012/.

U.S. Department of Agriculture, 2014, 2012 Census of agriculture, county-level data: U.S. Department of Agriculture, National Agricultural Statistics Service, v. 1, chap. 2, accessed October 15, 2015, at http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/.

U.S. Department of Agriculture-National Agricultural Statistics Service, 2015, Quick-Stats—Field crops, 2014: Washington D.C., U.S. Department of Agriculture, accessed April 2015 at http://www.nass.usda.gov/Quick_Stats/.

ISSN 2331-1258 (online)
http://dx.doi.org/10.3133/ofr20151224