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The Geography of Open Dumps in Rural Appalachia

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The Geography of Open Dumps in Rural Appalachia

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Abstract

The dumping of waste into the environment has plagued the mountains of Rural Appalachia for decades. Tire, cars, appliances, and drug producing materials routinely are illegally disposed of via open dumps. The purpose of this research is to reveal the motives of the damaging open dumpsites that damage the beauty of the Appalachian Mountains. The states of Kentucky and West Virginia were analyzed through the use of GIS and descriptive statistics. The distance to refuse centers and application of disposal fees are the leading factors that result to the use of open dumps.

Key Words: Appalachia, open dumps, illegal, dumpsites, litter

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Chapter I

Introduction

Smoke is rising from the earth. The ground surface temperature reaches over 1,500 degrees. No this is not a volcano field in Hawaii; it is in the mountains of Virginia. An un-expecting landowner is clearing his property of brush and debris when he notices his small fire refuses to go out after hours of burning. What he did not know was that buried under his small debris fire was a massive stockpile of car batteries. This battery dump ignited the soil and released toxic vapors into the atmosphere. Weeks later and a quarter of a million dollars later the clean up came to a close. Fortunately, even over 50 years, the batteries never leaked into soil or became a problem the surrounding environment or residents. This is not just an extreme case of someone's trash interfering with landscapes and the lives of people throughout the Rural Appalachian region.

Taking a hike or a drive through the Appalachian Mountains can be a breathtaking experience. The scenic mountains, beautiful valleys, and raw nature provide for an experience of a lifetime. However, many people have seen these ancient mountains' dark side. Rural Appalachia is plagued with open sores called illegal dumpsites. Cars, batteries, tires, and appliances are found in great numbers throughout this mountain landscape. Destroying aesthetic beauty and often polluting watersheds, illegal dumpsites need to be removed from this ancient jewel. You do not have to burn brush to discover a massive pile of trash. No, you just can take a peaceful drive down most mountain roads and look to the side of the road and you will see piles of tires, couches, appliances, and cars. The purpose of this research is to reveal the motives of the

damaging open dumpsites that plague the beauty of the Appalachian Mountains. What factors lead to the distribution of illegal dumpsites in Rural Appalachia?

Chapter II

Literature Review

The Problem Indentified

America's rural landscape has been victim to countless open dumps over the past one hundred years. The further development and use of plastics, rubbers, and metals led to massive amounts of these non-decomposable elements. Tire, bottles, appliances, furniture, and cars have been dumped at an enormous rate in the rural countryside and the primitive back trail of wilderness areas says F. L. Brown and A. O. Lebeck (1976). Open dumps create many problems with the environment, surrounding residents, and the visual aesthetics of a rural landscape. Two major problems arise with environments effected by dumping: 1) Health conditions, such as higher death rates and high amounts of reported lung cancer cases in areas with contaminated air; 2) Aesthetic and recreational value diminishes greatly in areas that have become visually damaged by solid and chemical waste (Brown and Lebeck 1976). According to Brown and Lebeck, the general public is only aware of the first problem. This is because of the quantifiable ability of problematic health issues and the increase in costs of resources. The nature of the open dump makes it difficult to quantify its range of damage.

The view of open dumps has changed of the past century. They were not always looked upon as a problem, hazard, or eyesore in rural communities. Traditionally residents in rural communities disposed of the majority of their waste by burning it. Large objects that could not be burned were buried on the owner's property. However, many did not like to deface their own property so they began to use rivers and roadsides

to dump their waste (Goldberg 1). As these locations became popular dumping grounds, they also became social gathering places, as stated in this government report:

> "The dump serves not only as a disposal site for the public's garbage, but also as a social gathering place for people of all ages. The young kids seem to enjoy driving back and forth over the narrow suspension bridge, and the dump makes a convenient turning-around place. They also like to gather there to talk, drink beer, and shoot crows and squirrels, that seems to be good sport in that town. Some of the older people seem to like these activities too; quite often it seems that while one person's dumping, a friend will pass by on the roadway and stop to talk for a while. The dump's location makes this social gathering place possible; it's just slightly out of town and there's a big wide spot in the road where several cars can pull over at one time" (USEPA Report 1972).

The preexisting documentation on open dumps suggests that the factors of illegal dumping are travel distances to refuse centers, socioeconomic factors, and the requirement of disposal fees. Having a large distribution of landfills is said to entirely eliminate the use of open dumps (Brown and Lebeck 1976). The imposition of disposal fees has made "trash disposal a costly nuisance for communities" (Rosell 191). Finally, the socioeconomic characteristics have been determined to reflect the ability and willingness of people to participate in proper refuse disposal (Henry 2006).

Methods of Research

If waste management is inefficient people often resort to using open dumps as means to dispose of unwanted trash. Rotich Henry, Yonsheng Zhao, and Jun Dong tested

the functionality of Kenya's "collection, transfer, resource recovery, recycling, and treatment" of refuse (2006, 93). They state that USAID reports that authorities of local governments in developing countries spend an average of 30% of their budget on waste management. Although such a high portion of those local governments are being spent on clean up, they are only able to collect 50-70% of MSW (Municipal Solid Waste). By breaking down their research into three stages, they were able to quantify the effectiveness of a government's waste collection. Stage 1 involved the collection of records, documents, and census data. Economic planning was used to gather background information so that a conceptual model of MSW management in Kenya (Henry 2006). Step 2 applied the use of interviews with department heads from: Social Services and Housing, Inspectorate, Water and Sewage, Planning and Environment (Henry 2006). The information that was gathered at this stage was used to update and reinforce the first stage. In the third stage local dumpsites were visited. Interviews were conducted with local residents and even a private MSW handling company. The questions in the interview sought to find the following "1. MSW collection and disposal status and problems; 2. environmental fate of uncollected MSW; and 3. ways to alleviate MSWM problems" (Henry 2006, 94). After doing those three stages of their research they discussed and explained the results. The failure to keep MSW trucks in decent operation. Approximately 1/3 of the MSW collection vehicles are out of service. This is due the age and quality of the vehicle. Also insufficient funds plague waste management, in some cases a simple flat tire can put a truck out of service for months. The reason for this is a poor infrastructure development and underfunding of those agencies. The poor conditions of roads make collection of suburban areas very difficult to impossible.

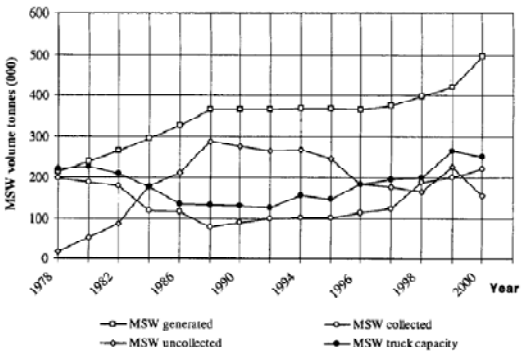


Fig. 1. Comparison of MSW generation and disposal in Nairobi.

Table 3
Status of MSW collection trucks in the local authorities in 1999

Local authority	Total number MSW trucks	Number of breakdowns	Average age of trucks (years)	No. of trucks in demand	% Waste collection
Nairobi	66	34	12	100	30–45
Mombasa	34	14	9	50	34–50
Kisumu	28	14	12	40	28–48
Nakuru	25	10	15	40	35–58
Eldoret	28	11	15	40	36–54

Figure 2.1: Collection efficiency of MSW's **Source: Henry 2006**

Effectiveness of collection was derived by applying the equation of : $E = \frac{TW}{TC}(\%),$

- E = the MSW collection efficiency.
- TW = total waste collected.
- TC = total capacity
- A high E value indicates that a MSW is running properly and near its capacity.
- A low E value indicates a failure to reach a near capacity operation.

These values come from data gathered in the urban cities. In these areas trash has been dumped in rivers and on roadsides. Inadequate infrastructure, outdated equipment, and insufficient funds are factors that result in poor MSW management.

In order to quantify a series of dumpsites in New Mexico, Brown and Lebeck visited each dumpsite in two trips. On the first trip they "estimated the total quantity of refuse, to sample the waste material for composition, and to mark accumulated refuse to distinguish it from future additions" (Brown and Lebeck 1976, 12). The second trip would be taken one to two months later to estimate any additional accumulation. Each dumpsite was sketched according by its dimensions and volumetric accumulations of refuse, direct or estimated measurements were used.

Each dumpsite was divided into twenty locations and five of those locations within the dumpsite were randomly chosen for sampling. Each of the sample sets was thoroughly mixed and a one-cubic-yard portion was weighed to obtain an estimate of the bulk density of the dumps waste. Each of those masses was divided into twelve categories and the waste from each category was weighed. Large objects such as cars, refrigerators, and couches are too difficult to weigh like the other waste, so they were scored numerically on a separate inventory list (Brown and Lebeck 1976).

Abandoned cars were scored by conducting a random sampling procedure in which New Mexico was divided into 400 rectangles, each of 15 minutes latitude by 15 minutes longitude. Of those 400 rectangles 40 were chosen at random. Each location was flown over and abandon vehicles were scored. Three factors were examined for correlation with the frequency of occurrence of abandoned vehicles: 1) area population, 2) area wealth as indicated by the surrogate variable of assessed valuation, 3) urban or rural character. The impact of the open dump site was assessed by quantifying the amount of litter at each dump site and by getting residential interaction through surveys and interviews. As a result of their research they determined that an "open dump is often

the means of ultimate disposal of solid waste in rural and small towns" (Brown Lebeck 1976, 12).

Solutions

Technology is providing the tools necessary to reduce the using of open dumps. Mobile GIS units are proving to be an effective tool in combating open dumps in New Mexico. Dona Ana was the first county in the state to hire environmental code officers. Two officers patrol the desert searching for illegal open dumps and the parties responsible for them. The county faced many difficulties in the early stages of the enforcement program. Hand written notes, low quality aerial photographs, and inaccurate road maps made the officers job impossible to be effective (Baxter 2004). Indistinguishable property boundaries made it difficult to enforce responsibility, since many sites border on county, city, and private boundaries.

With a grant from ESRI and Trimble the county was given a mobile GIS unit. The mobile unit being used by Dona Ana county is the Trimble GeoXT GPS equipped with ArcPad. The biggest advantage of a mobile GIS over a desktop is the elimination of frequent trips back to the office (Baxter 2004). Having intelligent equipment available in the field allows for an efficient streamlining of data. The data that is entered in the unit is organized into three pages. The first page contains the dump sites physical location. The location is read as latitude and longitude or physical address. Once the site is entered, automatically property ownership and boundary information appears. The second page contains information of the materials that are found in the open dump. Items such as cars, appliances, construction debris, and tires are recorded here. The third page

is also referred to as the enforcement information page. This page is valuable for accumulating evidence that can lead to the party responsible for the dumping. A case number can be immediately generated for that site. The cases status and photos can be updated via the mobile unit. This advance in technology has effectively allowed law enforcement to gather resources and track ongoing cases. By streamlining the enforcement process, Dona Ana County is successfully cleaning up New Mexico's scenic landscape (Baxter 2004).

Local and state governments provide very little funds for dump site and environmental cleanup projects. Funds and resources that could be used to cleanup, improve, or build new recreational facilities commonly diverted to other government programs. The U.S. Army Corps of Engineers in the Atchafalaya Basin Floodway System in Louisiana has a program that requires convicted "dumpers" to clean up the dumpsite in 24 hours. They found this to be more effective than just handing out fines, because it changes their outlook on dumping. Chad Pregracke, the founder and president of Living Lands and Waters, states that they "aid in the protection, preservation and restoration of the natural environment of the nation's major rivers and their watersheds" (Rea 2005, 119).

The program also provides the River Bottom Forest Restoration Project and the Adopt-A-Mississippi River Mile programs. These programs were created to produce "results not rhetoric" (Rea 2005). In Washington State the Friends of the Trail removed 900 tons of raw garbage and about 400 tons of appliances, thousands of tires and more than 100 vehicles in eight years. All of this litter was in public recreation areas, hiking trails and waterways (Rea 2005).

H. S. Cannon and M. L. Smith assessed the potential economy of refuse. They offer quantitative analysis that suggests the need to utilize the value of the waste generated annually by Americans. This is done by targeting refuse that is hauled out of town and "dumped onto a convenient piece of land" (Cannon and Smith 1974, 301). These convenient pieces of land range from urban recycling centers to rural open dumps. In the situation of rural dumps, the overall majority of the refuse is reusable products. Automobiles, cans, bottles, appliances, and tires all contain valuable and reusable elements like various metals, glass, plastics, and rubber. Although conducted in the mid-1970s, this research gives an accurate prediction regarding our modern price increases of valuable metals such as steel and copper. The majority of open dumps covered by Cannon and Smith are those that lie within a short distance outside of urban areas. The contents found in the open dumps are objects that were irregular for daily garbage pickup. Their research does not elaborate on the source of refuse nor does it offer a solution. However, it points out the value of the contents that comprise are found in and dumps. At the time of the publication of this research, America legally disposed of 12 million tons of steel and iron. The value of the metals in the 70's was worth one billion dollars. Given the current market price for such metals, that would make 12 million tons worth seven billion dollars (steelonthenet.com).

Chapter III

Background

Every river and open dump in Rural Appalachia contains an excessive amount of tires. People began to throw tires in open dumps and rivers when the "recapping, retreading, and reuse of tires, once a viable business utilizing millions of tires has essentially ceased" (Lassiter 2008). The value of used tires began to decline after the import of cheaper tires became available to consumers (Russell 2001). Now that old tires no longer had value, people began to illegally disposing of the used tires. Disposing of tires at landfills became too expensive and due to the lack of recycling programs, tires began to be dumped over hillsides and into rivers. The Commonwealth of Virginia tackled this problem by legally placing tires in riverbeds and hillsides. This practice was done in order to prevent soil erosion. The overwhelming influx of old tires became such a problem that the state, unable to formulate a solution, unwisely began to dispose of the tires in the wilderness and rural landscapes (Lassiter 2008).

Once the threat of uncontrolled dumping of tires was realized, all unusable tires were termed "hard-to-recycle". Tires had to be cut into sections and also had to be removed from the rim. With the dumping of millions of tires into streams, forest, and it became clear that the government needed to take action. There was a desperate need to prevent dumping, promote recycling, and initiate cleanup programs. In 1989 the General Assembly took the initial steps of a tire cleanup program by requiring a 50 cent fee on each tire sold at retail. Since the enactment of the disposal fee, Virginia's Department of Environment Quality (DEQ) has been responsible for "the transportation and

management of all waste tires generated in the Commonwealth" (Lassiter 2008). The DEQ soon developed a plan of action for controlling Virginia's unusable tires. In this plan the DEQ is greatly involved acquisition and collaboration with any organization that will assist in the cleanup effort.

The DEQ is responsible for developing, assisting, and encouraging local level programs to combat the tire problem. Local level or grassroots level, as it is often referred to, is the most important and effective tool in combating litter prevention and education. The DEQ also has to ensure that programs and businesses have an adequate supply of resources and funds to remain in operation. The Waste Tire Trust Fund was created in order to collect and allocate the necessary funds to effectively dispose of the millions of unusable tires. Through the Waste Tire Fund and various disposal programs, the DEQ began to effectively process and transport millions of unusable tires, thus preventing them from being hauled off into the depths of a rural road or state forest.

Even though the DEQ saw positive results with the newly developed prevention programs, they were left with little money to remove preexisting tire piles. In 2003 the Waste Tire Fund received an increase of funds dedicated strictly to the extraction of tire piles. The General Assembly increased the fee for retailed sold tires to $1.00, which last through June 30, 2008.

§ 58.1-641. Imposition of tire recycling fee.

> There is hereby levied and imposed upon every retailer of tires in the Commonwealth, in addition to all other taxes and fees of every kind now imposed by law, a tire recycling fee of $.50 for each new tire sold by such retailer ending July 1, 2003. Beginning July 1, 2003, and ending July 1, 2008, such fee shall be

> levied and imposed at a rate of $1.00 for each new tire sold by a retailer. Beginning July 1, 2008, the fee shall be levied and imposed at a rate of $.50 for each new tire sold by a retailer. (1989, c. 630; 2003, c. 101; 2006, c. 407.) (www.justia.com 2008).

That additional increase of 50 cents per tire goes entirely to the removal and cleanup of tire piles.

The Kentucky Division of Waste Management reported approximately $52 million was spent to help clean up over 21,000 illegal dump sites, from the years 1993-2003. In 2003 the Kentucky Forest Service spent $30,000 to cleanup 25 dump sites on the Trinity River. The approximate time to complete a project like the Trinity River example is about two weeks (Rea 2005). The state of West Virginia spent $1 million in 2006 on open dump clean up and removal. The Rehabilitation Environmental Action Plan (REAP) has a budget of $3.2 million for tire removal alone.

West Virginia passed legislation that all landfills are required to accept tires. The fee however is subject to the landfill. Putnam County's (WV) landfill charges a steep disposal fee of $10 per tire (Rote 2008). In the year 1991 recycling of tires was at a mere 10 percent. Waste tires that are produced from retail tire dealerships, auto repair shops, car dealerships, and personal daily activity are referred to as "current flow tires". All current flow tires are charged the $1.00 fee. Virginia averages approximately 5.3 million current flow tires annually. That brings in revenue of over $5 million annually. This money supports the Waste Tire Fund, which was founded to save the struggling DEQ tire program and to transform it into a long-term enterprise (Lassiter 2008).

West Virginia's REAP program has teamed up with local law enforcement to increase convictions and punishment of roadside dumpers. The use of hidden cameras has proven to be the most effective in providing incriminating evidence. The cameras put in place by REAP are strategically hidden around frequently used open dumps. They are inconspicuously small and motion sensitive. Most of the cameras put in place by REAP are done so discreetly and incognito. However, some are put in place with warning signs and surrounded by dummy cameras. Having a camera continuously monitoring an open dump greatly increases the capabilities of enforcement, but it still is not always absolute and conclusive. Before the directors at REAP surrender camera evidence to law enforcement, they must have a clear distinguishable visual of the perpetrator and/or the automobile's license tag. Due to the size, inconsistent location, and obstructions contained in many of the open dumps, getting clear and valid evidence is often very difficult.

Cameras are very expensive instruments, costing an average of $7,000 each. With such a high cost for the proper surveillance equipment, West Virginia distributes only one camera to each REAP district. That is only four cameras in operation for the entire state. Despite having only a few cameras to cover such a large area, intimidation is used to dissuade would be dumpers. Media coverage and frequent press release are utilized by the DEP. Most arrests and convictions are publicly broadcasted to warn the public of the chance and consequence of being caught if they use an open dump. By using the tactic of intimidating media, the camera's effectiveness is significantly increased.

Hidden cameras are not the only forms of evidence that lead to convictions. Open dumps often contain large household objects as well as household trash; this material is being used to bring conviction to offenders. The DEP collects any litter that contains information such as mailing addresses, names, and serial numbers in an open dump. If someone can be linked to any of the contents in an open dump, they can be convicted and held responsible for the entire dump. The REAP program, due to its small amount of personnel, greatly relies on the public for information regarding the use and location of open dumps. If a citizen locates an open dump they can contact the West Virginia Department of Environmental Protection (DEP) via a hotline. This hotline is a very important and successful tool for local residents. The hotline is valuable in incorporating the public in the cleanup and protection of their state.

West Virginia's REAP representative Greg Rote says that "using an open dump has become the acceptable thing to do." The tradition and acceptance of dumping proves to be the biggest obstacle for West Virginia's DEP in the fight against open dumping. Many counties in West Virginia do not contain a landfill. In fact, West Virginia only has 22 landfills serving 55 counties. That leaves 33 counties that do not have direct access to proper disposal. The state of West Virginia requires that all homes are subscribed to a garbage collection service or provide a proof of disposal. If garbage disposal is mandatory, why are people still using open dumps to discard their waste?

The REAP program cannot enforce laws or make arrests. Enforcement of the laws set forth by the state can be enforced by state, county, town, and city police. Illegal open dumps are located outside of urban patrolling districts and regularly watched routes. Rote explains that "catching someone using an open dump is just not high in priority".

The geographical isolation of dumpsites further complicates the enforcement process. Catching a violator is often done so by accident. Game wardens account for the majority of arrests made. They regularly patrol rural roads and encounter open dumps. Since open dumping defiles the scenic landscape and wildlife habitat, the Division of Natural Resources (DNR) has an interest in catching violators. West Virginia's game warden program is not designed to reduce dumping on a large scale (West Virginia Division of Natural Resources 2003). According to Rote, game wardens roughly average one officer per country throughout most of the Appalachian states. So catching someone committing a crime is truly just being in the right place at the right time.

Waste found in illegal dumpsites

Open dumps contain a wide variety of waste. The source of illegal waste can originate from household products, small businesses, or poorly planned government projects. Tires, appliances, construction material, wood, car parts, and household waste are the common elements found in almost every open dump (Baxter 2004) [Figure 3.1]. Anything that is regulated with a price or ban at the landfill ends up in the environment (Rote 2008).

Figure 3.1: Scene of an open dump **Source: Author Photo**

Often small businesses will avoid disposal fees of hazardous waste by dumping them illegally into the environment (Wei 2007). The Commonwealth allowed Virginia's scenic environment

to be used as “temporary storage” for old tires. This ill-advised strategy was done in hope that one day tires, which are made of petroleum, would gain value while they sat in storage. The potential energy piles never amounted anything, other than mosquito breeding hot beds and scenic eyesores. Under the state’s encouragement and design, this episode of neglect was legal in the Commonwealth of Virginia until the year 1988. (Lassiter 2008)

Drug use and dealing is a growing problem in Rural Appalachia. The production of methamphetamines leads to many explosions, deaths, and fires in the area. Very flammable gases, strong acids, and bases are needed in order to produce meth. Once produced, the creating elements are disposed in open dumps. Greg Rote says that “every dump we clean up has evidence of meth production and drug use.” Hypodermic needles are also a common item found in open dumps, which makes “cleanup a risky business due to the potential for disease contraction” says Rote. Game animals, mostly deer, are regularly discarded into open dumps (Figure 3.2). The decomposition of dead animals attracts large rodent populations. Living in close proximity to an open dump can expose residents to dangerous illnesses, often carried by rodents. Pauline Addington is a resident living in Rural Virginia. A local open dump was located near her home. She recalls that the “rats were as big as dogs” (2007). They

Figure 3.2: Decomposing deer **Source: Author Photo**

became so much of a problem that they started invading her home as well as the surrounding neighbors. It was one of her neighbors that solved the disgusting nuisance of the illegal dumpers. By recording vehicle tag numbers the neighbors were able to assist in the convictions of this illegal activity. Once the surrounding community got involved the damaging acts of open dumping stopped.

Chapter IV

Methodology

In order to fully analyze the problem of the distribution of open dumps, a three-leveled analysis will be required. I selected the states of Kentucky and West Virginia for a detailed look into the factors contributing to the illegal dumping of waste. These states have involved environmental cleanup programs that monitor and combat open dumping. First, I examined state level data and statistics of Kentucky and West Virginia. After gathering state level data from Kentucky and West Virginia, I performed a detailed small scale analysis of rural Cabell and Wayne counties (WV), surrounding Beech Fork State Park. It must be considered that the data collected throughout this research does not provided representation of every open dump within the two states. Finding and recording an open dump into a database is a difficult task. Open dumps can be obstructed by vegetation and terrain. Also, it is impossible to account for every road within a state.

For Kentucky's analysis I used data that was collected by their Department of Environmental Protection. Through the use of GIS and SPSS, I determined correlation values of the distribution of open dumps. To establish identifying factors over a large scale, I have spatially compared open dumps with the variables of rural population, income levels per capita, and population below poverty. I used Pearson's correlation coefficient to determine the strength of association among the factors. From the Pearson equation each of the factors will be given a correlation value in relationship to 1.00. For the data to have a strong relationship, its value needs to be close to 1.00. I will be looking for a value around .8 or .9 to prove that a relationship exists between two data

sets. The more a value decreases from .8 the weaker the relationship of the data becomes (McGrew and Monroe 2000).

Using location points of open dumps in West Virginia, I examined distance as a contributing factor of dumps. According to my research on probable factors leading to the cause of open dumps, both interviews and literature identified distance as factor. West Virginia contains 55 counties and only 22 landfills serve the state. Using GIS, I ran a network analysis of drive times from each legal landfill. I placed the drive times into 10 minute intervals and calculated the open dumps that are within those zones. By doing this will be able to analysis the relationship between open dumps and their distance to landfills. The data used in the distance analysis was collected by the West Virginia Department of Environmental Protection. In an attempt to achieve a completely accurate assessment of open dumping factors, I personally indentified the dumps of Cabell and Wayne County. Using a hand held GPS unit, I collected a set of open dumps in two counties surrounding Beech Fork State Park. It is absolutely necessary to analyze this problem at a small scale due to the complications of trying to locate each of the tens of thousands of dumps present at the state level. With the data points collected via the GPS unit, I entered those into ArcGIS. In ArcMap I ran spatial and distance analysis on the open dump points. I used dumpsters and landfills as variables for the distribution of the illegal dump sites. The roadside disposal bins and landfills provide surrounding residents with a location in which they can discard of their waste.

I will use the Average Nearest Neighbor Distance Analysis in ArcMap to determine the relationship between the distributions of the data. ESRI, the producers of ArcMap, defines this analysis as the “the average distance between neighbors in a

hypothetical random distribution" (www.esri.com). The distance analysis produces a Z score. A Z score less than 1.00 revels that the data points are distributed in a clustered pattern. If the value is greater than 1.00 it will reveal that the data exhibits a pattern of dispersion (McGrew and Monroe 2000).

Chapter V

Analysis

Using ArcGIS I mapped the open dumps within the state of Kentucky's. I had over 3,000 illegal dump locations for this analysis. The original Excel file for this data contained information on both legal dumping locations as well as the illegal ones. In ArcMap I used the "Select by Attributes" feature to select only the illegal open dump locations. With this information I produced four maps: 1) distribution of open dumps 2) percentage of rural population 4) percentage of population living below poverty 4) income per capita. The images produced in ArcMap provide a good visual comparison of the possible factors that lead to dumping. Socioeconomic characteristics were identified as contributing factors to open dumps in my literature review and from my interview with Greg Rote. The map showed a strong concentration of open dumps in the eastern part of the state. The west contained a cluster of six counties and the north contained three counties of high dump concentration (Figure 5.1).

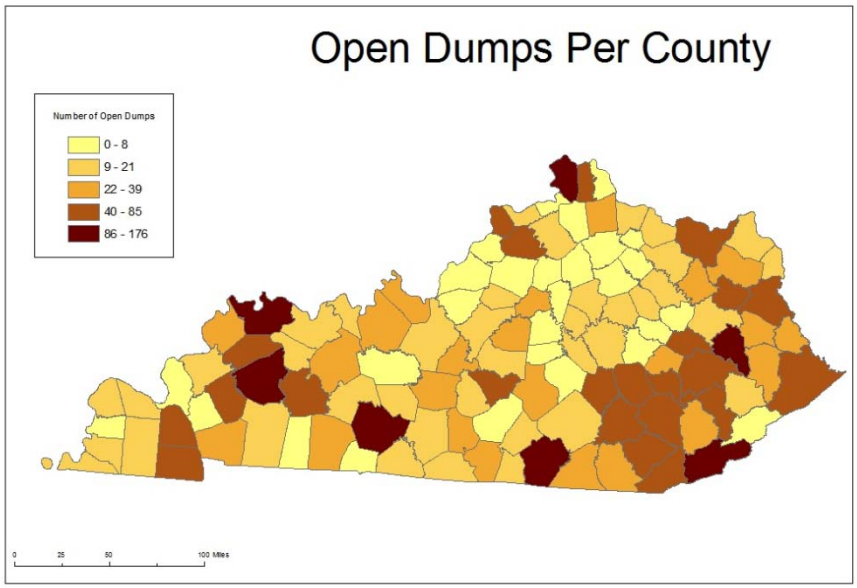


Figure 5.1

Visually there appears to a strong relationship between open dumps and percentage of population living below poverty and the percentage of rural population (Figure 5.2). Both poverty and the rural population dominate the eastern counties.

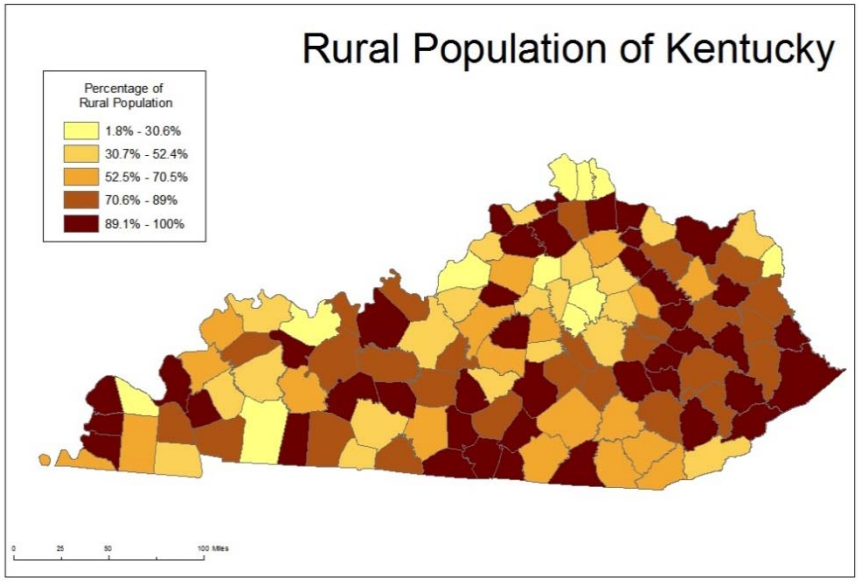


Figure 5.2

The second analysis on Kentucky was a correlation test of the previous factors using SPSS. I chose to compare those factors, which I mapped, with the total number of dumpsites per county. In SPSS I ran a bivariate correlation test on the Kentucky open dump data. Despite the apparent visual relationships produced in ArcMap, the results of SPSS suggest that there is no strong correlation among the test factors. The rural population data only had a correlation value of .093, showing no significant correlation. The income per capita data yielded a correlation value of -.195; which proved to be significant at the .05 level. The highest correlation found in the Kentucky datasets was among the population living below the poverty. Counties living above and below the poverty line had a correlation value of .287, which was significant at the .01 level (Figure 5.3). Even though this data produced significant levels at the .05 and .01 level, the

correlation values are very low. Having weak correlation values suggest that the relationship between those factors is not very strong.

Correlations

		Illegal Dump Count
Illegal Dump Count	Pearson Correlation	1
	Sig. (2-tailed)	.
	N	120
PrecentRural	Pearson Correlation	-.093
	Sig. (2-tailed)	.311
	N	120
PrecentPovBelow	Pearson Correlation	.287(**)
	Sig. (2-tailed)	.001
	N	120
IncomePerCap	Pearson Correlation	-.195(*)
	Sig. (2-tailed)	.033
	N	120

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Figure 5.3

By statistically quantifying the open dumps in the state of Kentucky there doesn't prove to be strong evidence between open dumps and the rural population. This is because of the isolated nature of this problem. Open dumps have to be located and logged into a database before they can be represented in ArcGIS. Vegetation growth and cover disguise many of the older dumps; making them hard to identify from a road. Also, areas closer to larger populations naturally will receive more traffic than less traveled secondary roads. Having a larger traffic flow increases the chances of identification and the eventual reporting of a dump. Areas that receive less traffic and attention are less likely to report an open dump. Viewing this data at the state level does not give an accurate account on the reality of open dumps. The datasets I have for Kentucky and

West Virginia contain thousands of locations for open dumps. However, it is impossible to locate and represent every illegal dump contained within a state. Thousands of miles of roads and geographically isolated areas make it impossible to achieve a complete representation of open dumps.

I took location data of open dumps from the state of West Virginia and analyzed it in ArcMap using distance as a factor. The distance to a landfill appears to be a reasonable factor in the contribution to the illegal dumping of waste. West Virginia only contains 22 legal landfills. These facilities are supposed to accommodate 55 counties. Landfills serve as locations that receive the waste that is regulated by fees and that is not routinely collected by garbage trucks. Some residents live hours away from the nearest landfill, for them dumping illegally is the easiest option.

Using a network analysis I was able to calculate the drive times to the nearest landfill. I mapped the drive times in 10 minutes intervals up to one hour. The mapped drive times only represent travel in one direction; therefore a 60 minute drive time on the map should be viewed as a two hour round-trip. The low number of 22 active landfills serving West Virginia leaves large areas that lie outside of a one hour drive. Large sections in the Southwest and Northeast parts of the state have drive times greater than an hour. For residents living in those areas, they have greater than a two hour drive in order obtain access to a landfill.

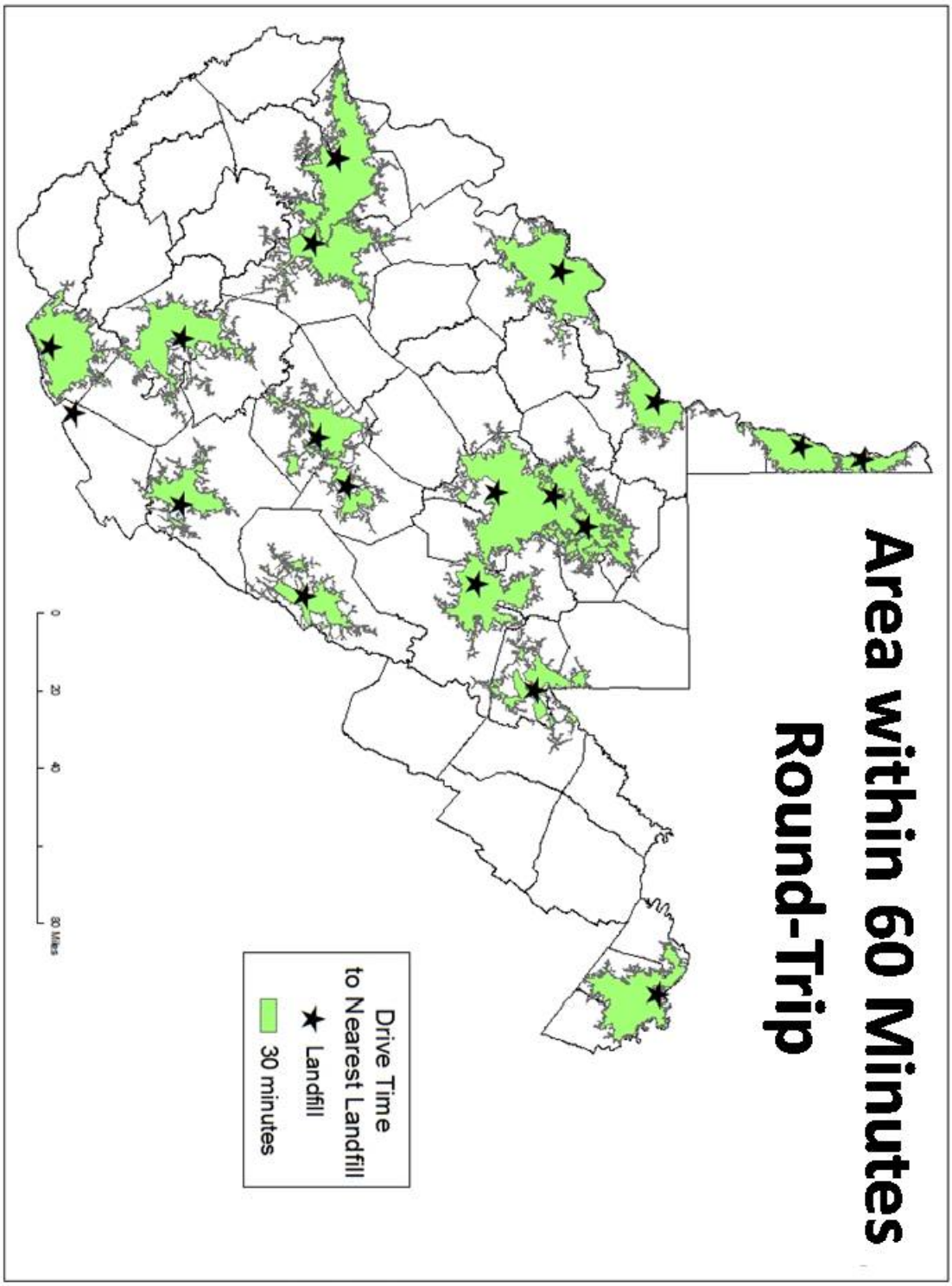
Once I determined the drive times in relationship to landfills, I was able to calculate the number of open dumps that are contained within each travel time zone (Figure 5.4). The results of this network analysis showed that approximately 57 percent of open dumps are located outside of a 30 minute drive time (one-hour round trip).

Open Dump Count According to Drive Time

Travel Time (Minutes)	Number of Dumps	Percentage of Dumps	Number of Dumps (Cummualtive)	Percentage of Dumps (Cummualtive)
0-10	247	8.1%	247	8.1%
10-20	578	19.0%	825	27.1%
20-30	492	16.2%	1317	43.3%
30-40	504	16.6%	1821	59.8%
40-50	362	11.9%	2183	71.7%
50-60	302	9.9%	2485	81.6%
60+	559	18.4%	3044	100.0%

Figure 5.4

Figure 5.5


Area within 60 Minutes
Round-Trip
Drive Time
to Nearest Landfill
Landfill
30 minutes
0
20
40
80 Miles

Having to drive such extremely long distances to discard of waste can be time consuming as well as costly. The temptation of using an open dump has to be great when faced with a drive time that would consume over an hour. That is why the majority of dumps are located outside of the 30 minute parameter (Figure 5.5).

Upon visiting many open dumps, it is apparent that the issue of disposing of bulky objects is certainly a factor. The material contents of open dumps are comprised largely of those objects that are regulated by fees and that is not regularly collected by garbage collection services (Rote 2008). Automobiles, tires, couches, appliances, and furniture dominate the contents of an open dump (Figure 5.6).

Figure 5.6: Contents of an open dump **Source: Author Photo**

For my small scale analysis I collected data points of open dumps and roadside disposal bins. I used the roads surrounding Beach Fork State Park in Cabell and Wayne County, West Virginia as my sample area. I recorded the location points using a handheld Garmin GPS unit. I then placed those points into ArcMap. There I ran the Average Nearest Neighbor Distance Analysis. With this test I was able to determine whether or not the distribution of the open dumps shared a relationship. The data yielded a Z score of 3.23 standard deviations. This is a very high score representing that the open dumps share no clustered relationship and that they are perfectly dispersed. This result is also reflective of the size of my study area. Small area

data samples can appear to no relationship in distribution; but when viewed with at a larger scale, such as the state level, the data can appear to be clustered (McGrew and Monroe 2000). This must be taken into consideration when using this analysis.

For my second analysis on the small scale data I applied a multi-ring buffer around each of the roadside dumpsters located in the two counties. These dumpsters have been put in place by Allied Waste, the sole private waste collection company serving the two counties. I assigned five buffer rings to each dumpster point in 1,000 foot intervals, equaling a total distance of 5,000 feet (Figure 5.7). Of the 43 open dump points I collected 29 fell outside of the dumpster buffer zones. That is 67% of the illegal dumps are approximately one mile beyond a dumpster. That large majority suggest that distance is a possible factor in the disposable of waste. Driving long distances can be expensive and troublesome, therefore resulting in a quicker and cheaper way of discarding waste. However one mile is not very far travel. This implies that local

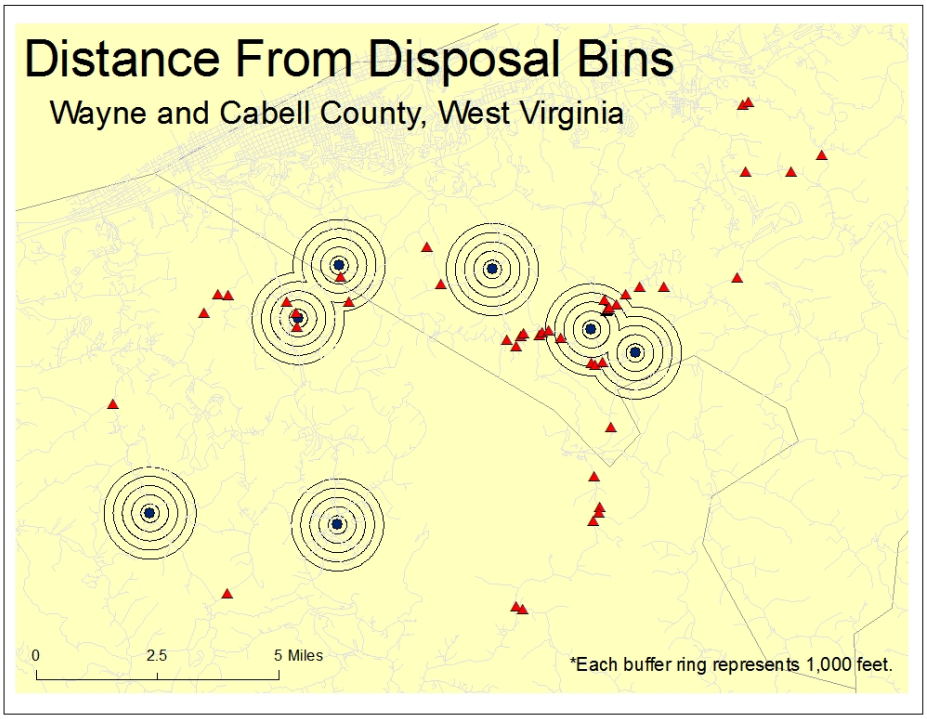


Figure 5.7

residents may not have a good knowledge of dumpster location.

Only two dump locations fell within 1,000 feet of a dumpster. Those two locations are within a close distance, 500 feet, of the same dumpster, which appeared to be new. This suggests to me that the dumpster was placed in that area due a complaint or the waste companies aim to encourage the use of legal dumpsters. I found evidence of new dumpsters being placed in close proximity to open dumps in Wayne County. I collected my data points in the two counties throughout the course of a year. One of the highest concentrations of open dumps is found on Hugh's Branch Road in Wayne County. Throughout the year two new dumpsters have been placed along that road. Both have been strategically placed for clear visibility and easy access.

Chapter VI

Conclusion

The complexity of waste disposal contributes the tons of garbage that is placed into our rural landscapes. Long distances to disposal facilities attribute to the illegal dumping of refuse. For residents living in rural communities of Appalachia, open dumps have served as an easy source for garbage disposal. Travel times to disposal centers must be reduced in order to see the reductions of open dumps. The distribution of waste disposal facilities must be reasonably spaced to serve the surrounding residents (Bagchi 14). The fee for the disposal of tires must be lifted. Very few people are going to drive 30 minutes to a landfill and pay a disposal fee of five dollars per tire. The funds needed for waste tire programs should be applied to the selling of tires, not the disposal.

My three leveled analysis covered the possible factors that contribute to the use of open dumps. Both the large scale and small scale analysis of West Virginia suggests that traveling distance can be a probable factor in the distribution of open dumps. The results found in Kentucky revel that only a low significance level between rural population and income exists in comparison to a high concentration of open dumps. This revels that there is no relationship between socioeconomic status and illegal dumping. Therefore, my research did not reveal a dominate source that contributes to the contribution of open dumps.

The enforcement of laws and regulations are helpful in reducing the amount of illegal dumping activity. However, governmental agencies do not have the resources that are fully needed to conquer this problem. To see a dramatic reduction of open dumps

civilian action is needed. Attitudes towards environmental damage must change in minds of the people. Community action and cleanup programs provide the influence that is capable enough to restore the beauty of Rural Appalachia.

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