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PARTICIPATION IN AGRICULTURAL GOVERNMENTAL COST SHARE PROGRAMS IN THE KENTUCKY RIVER WATERSHED

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ABSTRACT OF THESIS

PARTICIPATION IN AGRICULTURAL GOVERNMENTAL COST SHARE PROGRAMS IN THE KENTUCKY RIVER WATERSHED

The purpose of this study is to review existing literature of factors that influence farmers' decision to participate in conservation programs. This study is also intended to collect county data and information on conservation programs and participation in the Kentucky River watershed region, which can be analyzed and used to draw differences in characteristics of the region that would suggest willingness to participate in a trading scheme for improvements in water quality.

The results suggest that more participation in a trading scheme from some counties than others should be expected. Counties with more farms and larger farms will probably have higher rates of participation in conservation programs.

The cost-share amounts being paid by current government programs must be considered as the minimum staring point to negotiate in a trading scheme. To target the impact of watersheds, such as the Kentucky River in the Mississippi system, that discharges significant amounts of pollutants into the Gulf of Mexico, policy makers and program administrators should be advising and stimulating the adoption of practices with the best abatement performance for such pollutants considering technical complementarity between practices.

KEYWORDS: Conservation programs participation, market incentives, pollution abatement, water quality trading, cost-share.

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2011

PARTICIPATION IN AGRICULTURAL GOVERNMENTAL COST SHARE PROGRAMS IN THE KENTUCKY RIVER WATERSHED

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the College of Agriculture at the University of Kentucky

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Lexington, Kentucky

2011

In memory of my grandfather Sergio Monteiro da Costa

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Chapter 1. Introduction

The market for water pollution allowances could reduce costs of water pollution mitigation, and increase efforts on reducing discharges of pollutants in the Kentucky River Watershed. The intent of this study is to identify characteristics of farmer's, located in the area of the Kentucky River Watershed that explains their participation in government conservation programs. Therefore, suggest successful strategies to help create a permit market for water pollution allowances in the Kentucky River Watershed.

In order to mitigate the pollution in the Kentucky River Watershed and subsequently help achieve major reductions in pollution in the Gulf of Mexico region at low costs, a market based program, Water Quality Trading (WQT) Policy, is being advised by the United States Environmental Protection Agency (USEPA, 2003) to the state of Kentucky. This strategy, although encouraged throughout the country, is far from being successful in achieving reduced costs and in lowering pollution due to low participation of stakeholders (Breetz et al., 2004). Therefore, the need of understanding stakeholders' concerns and actions in order to engage in conservation programs is important.

The Kentucky River watershed carries significant quantities of nutrients and sediment into the Ohio River basin, which is one of the sub-basins that contribute to the discharge of these pollutants to the Gulf of Mexico. This interaction contributes to a hypoxic zone in the gulf, an oxygen-depleted area that cannot support aquatic life. The WQT Policy is being primarily targeted to access the Nitrogen (N) and Phosphorus (P) pollution in this Kentucky watershed region. Industry, commercial facilities, municipal water treatment facilities for example are major contributors to this pollution, and commonly identified as point sources (PS) of pollution. In addition, agriculture and silviculture are also examples of nutrient pollution sources, and are commonly identified as nonpoint sources (NPS) of pollution.

Robust participation by agriculture in a trading program can overcome challenges in programs that might lack the authority or incentives to engage producers in water quality initiatives (Rowles, 2005). To assist in understanding if an economic incentive approach would be feasible in the state of Kentucky, specifically in the Kentucky River Watershed, information on participation of conservation programs in the state can help identify characteristics that explain farmers and landowner's willingness in participating in a WQT program. Information in the area of the Kentucky River Watershed on selected socioeconomic characteristics, county farmland uses, as well as mechanisms of communication and outreach with farmers that tend to reduce mistrust in program administrators, will be assessed to understand the likelihood of voluntary adoption decision of conservation programs.

The first objective of this study is to review existing literature that examines farmer adoption of conservation practices. In particular, the interest of this study will be in the review of studies that specifically address factors that influence farmer's decision to participate on public conservation programs.

The second objective is to review existing literature and identify what potential problems exist when instituting a WQT. Factors identified in the literature can potentially explain farmers' behavior in adopting conservation practices, and their participation in conservation programs. The characteristics of farmers that participate in conservation programs could predict WQT participation in the Kentucky River watershed. Using secondary data, one can identify counties within the Kentucky River watershed that may have the characteristics that may predict a higher rate of participation in Water Quality trading scheme then others.

The third objective is to collect county data and information on conservation programs and participation in the Kentucky River watershed region, which can be analyzed and used to draw differences in characteristics in the forty-six counties that would suggest willingness to participate in a trading scheme for improvements in water quality.

Chapter 2. Background

2.1. Market Incentives for a Water Quality Trading – Historical and theoretical assessment

The right to use a resource relates to property rights as first propounded in a paper by Ronald Coase (1960). Coase observed that it is more cost-effective to install private property rights and make them transferable to let a market determine their price, rather than to impose general limits on pollution, or fixing a price by installing environmental taxes. The general model of tradable property rights, and the idea that markets of pollution rights are an alternative policy instrument to pollution taxes as a way of achieving a target reduction in pollution, was historically proposed a few years later by Thomas D. Crocker (1966) for air emissions and by John H. Dales (1968) for water pollution.

The market treats as demand for the rights of pollution permits the marginal abatement cost curve of each polluter. The demand for pollution permits can be higher or lower depending on the effectiveness of each polluter. If each permit to pollute is seen as needed for each unit of pollution to be discharged, then a regulatory authority can issue a total number of permits. That total number of permits represents the total emissions that the regulatory entity considers optimal in a given area, for a given pollutant, for a period of time.

Polluters may purchase each permit at a given price, which will allow them to emit an amount of pollution. However, if it is cheaper to abate pollution rather than buying permits, then a polluter may consider it is less costly to abate and sell permits. If it is cheaper to buy permits than to abate pollution, then that polluter will have a demand for permits. The market exchange of these permits among polluters will lead to a cost minimization in reducing a unit of pollution. Once the market is established, new entrants will either buy permits from holders of existing permits, or they will invest in pollution control equipment. If the regulatory authority wishes to restrict even further the overall pollution, at a future time, they will issue less permits to reflect the new pollution standard that they wish to impose (Pearce & Turner, 1990).

The emission permit system is illustrated in Figure 1, assuming two different sources of pollution. The marginal cost of pollution control for the second source (C) is higher than the first source (A). Hence, both sources have an incentive to trade. The second source can lower its costs from buying a permit from the first source at a price lower than C. This will be advantageous for the first source if it could sell a permit for a price higher than A. Trades of permits will occur until the marginal value of a permit for both sources (B) is reached, and there will be no more incentives to trade.

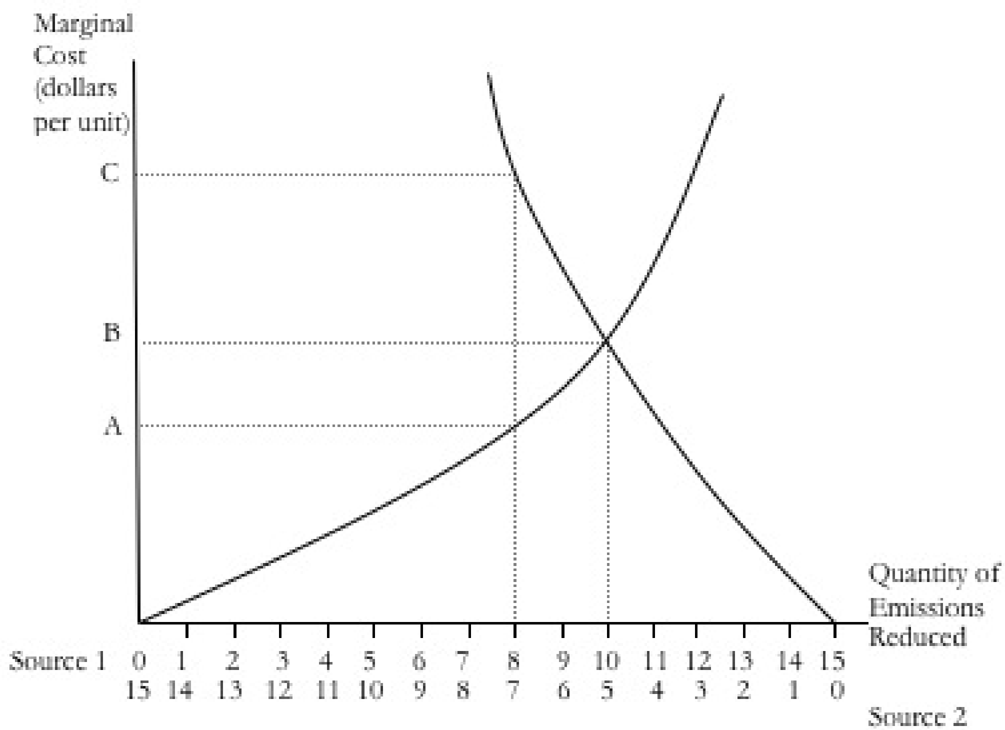

Figure 1.1. Cost-effectiveness and the emission permit system

Source: Tietenberg, Thomas H. (2006)

The Tar-Pamlico in North Carolina and the Dillon Lake in the Colorado are some of the oldest WQT projects in the U.S. These existing programs were designed such that PS polluters purchase emissions allowances from NPS polluters. The amount of allowances purchased depends on the amount of expected runoff to be reduced by NPS polluters. Under existing programs, expected runoff reductions from NPS in the basin occur through installation of best-management practices (BMPs) and the development of nutrient management plans. Under certain conditions, the determined price provides the correct incentive for dischargers to arrange emissions levels such that a cost-minimizing solution is reached. For example, costs of reducing agricultural NPS loads in a watershed may be less than reducing PS loads, especially if PS discharges are already being constrained by a permit program that controls water pollution by regulating PS that discharge pollutants into waters, such as the National Pollution Discharge Elimination System (NPDES) of the Clean Water Act (US EPA, 2003).

First suggested in the 1960s by economists considering how society could achieve long-term reductions in pollution, without causing an undue burden on the economy, the trading scheme allows polluters to re-allocate the right to pollute and decide who actually does the pollution abatement. Those with high costs of abatement pollute more and abate less, and those with low costs pollute less and abate more. To achieve an efficient reduction of N and P pollution required by regulations, the installation of BMPs and/or development of nutrient management plans by sources of pollution can create permits (rights) for pollution emissions that could be traded (sold to) with less efficient sources of pollution.

2.2. The Gulf of Mexico Hypoxic zone

The Upper Mississippi, Ohio, and Lower Mississippi River sub-basins discharge significant quantities of nutrients and sediment to the Gulf of Mexico contributing to the hypoxic zone, an oxygen-depleted area that cannot support aquatic life. The hypoxic zone in the northern Gulf of Mexico refers to an area along the Louisiana-Texas coast, and is the second largest hypoxic zone worldwide. Nutrient over-enrichment from anthropogenic sources is one of the major stresses impacting coastal ecosystems. The excess nutrients and sediments come from a wide range of PS and NPS, including runoff from atmospheric deposition, urbanized land, soil erosion, agricultural fertilizers, animal feeding facilities, municipal sewage treatment outfalls, and industrial discharges (EPA 2002). Figures 2.1 and 2.2 depict maps of the influence of discharges from the Mississippi's basin system and the Gulf of Mexico hypoxic zone, one of the largest in the world.

Figure 2.1. The Mississippi River Basin System

Source: US EPA

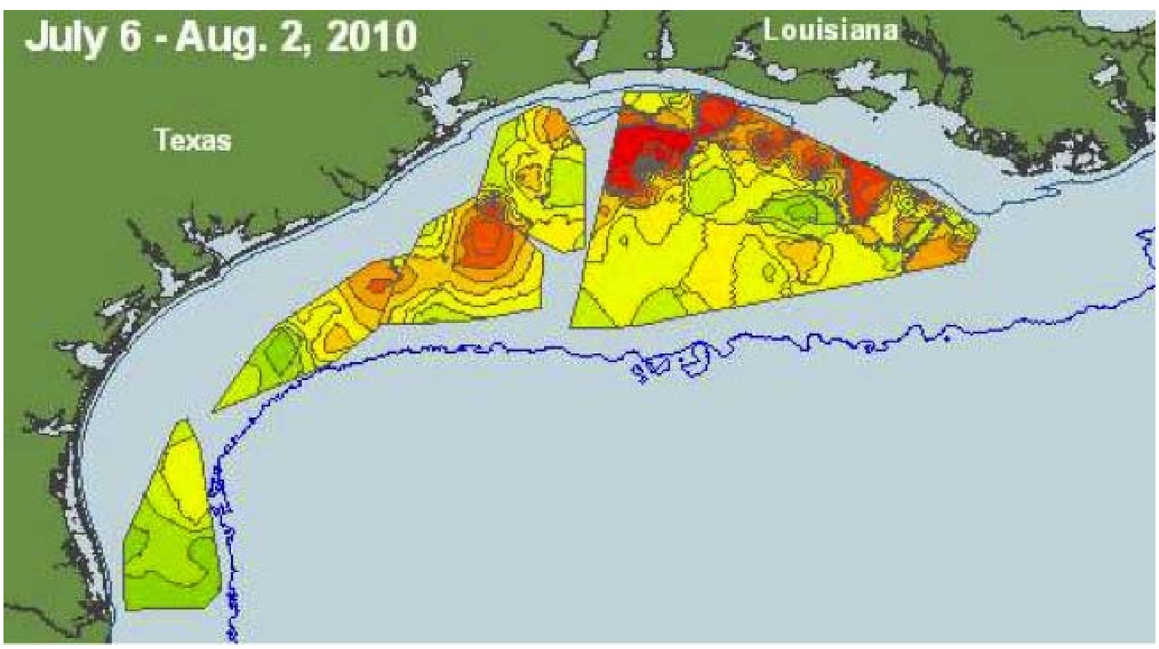

Figure 2.2. Gulf of Mexico hypoxic zone

Source: NOAA Satellite and Information System

Market-based approaches, such as water quality trading, that use innovative programs for trading private property rights to reduce pollution emissions, have the potential to accelerate the restoration of the Gulf of Mexico. Have also the potential to improve the overall quality of water bodies along the Mississippi's basin system, such as the Kentucky River Watershed in the state of Kentucky, and help achieve pollution reduction at lower total costs. Setting pollutant reduction targets and allowing sources to buy and sell credits to meet those targets can make pollution reduction faster, easier, and cheaper to meet water quality standards.

The initial intent of a Water Quality Trading program is for NPS (agriculture) to supply cost-effective nutrient reductions in lieu of anticipated PS loading associated with urban and industrial sources. As agriculture is a major NPS in the whole basin system that impacts the Gulf hypoxic zone, including the Kentucky River Watershed (EPA 2002), it is envisioned that trading opportunities in a water quality market with significant demand will motivate producers to participate in such program. Robust participation by agriculture in a trading program can overcome common challenges in traditional programs that lack the authority or incentives to engage producers in water quality initiatives (Rowles 2005).

A market driver on a possible Water Quality Trading program in the Kentucky River Watershed is the difference between the current amount of discharge, and the targeted discharge amount. Permits will give the targeted discharge amount for PS. The Kentucky Pollution Discharge Elimination System (KPDES) could set these permits. Buyers are those who have to meet the lower pollutant effluent limits than their current discharge, required by the KPDES. Sellers are those who have less discharge to the watershed than their allocated permits; in other words, sellers will have an "over control" or water quality credits. As a result, the product to be traded on the proposed market will be the over control generated by sellers. If sufficient trading potential exists within a watershed, the buyers may be able to lower their cost of reducing discharge by the cheaper option of purchasing water quality credits from the sellers.

2.3. KY WQT drivers

Information from the KPDES shows that there are 256 municipal PS, 7,156 industrial PS, and 2,284 permits for private and commercial PS of discharges in the state of Kentucky with 1,217 total sources in the Kentucky River Watershed. These data demonstrate the initial potential for demand for trading within the state. Moreover, available information from the KPDES program, on the Kentucky Division of Water 2004 Report to Congress on Water Quality (305[b] Report) shows that there are 1477.2 river miles affected by agricultural sources of discharge, 924.7 river miles affected by Resource extraction, 721.3 river miles affected by Urban runoff/storm sewers, 1,059.2 river miles affected by habitat modification, and other sources such as hydro modification, inappropriate waste disposal/wildcat dumping, silviculture, septic disposal, spills, natural and unknown sources that account for 2,496.9 river miles affected. These NPS represent a potential for adoption of BMPs and the development of nutrient management plans to preserve water quality while maintaining the economic value of Kentucky's land resources.

2.3.1. Federal Regulations

The Clean Water Act (CWA) establishes the basic structure for regulating PS discharges of pollutants into the waters of the United States. Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for the industry. It has also set water quality standards for all contaminants in surface waters. Furthermore, the CWA made it unlawful to discharge any pollutant from a PS into navigable waters, unless a permit was obtained from EPA's NPDES (KPDES) permit program that controls discharges. PS are defined as discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES (KPDES) permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. By issuing permits, the authority or regulator allocates rights for emissions that will reduce current pollution, and will create a demand for permits for those PS that are less efficient in an existent pollution trading scheme.

2.3.2. State Regulations

In order to protect surface and groundwater resources from pollution as a result of agriculture and forestry (silviculture) activities, the Agriculture Water Quality Act (AWQA) was created. The AWQA is the Kentucky's water quality legislation, that was also created to develop and improve BMPs in conservation plans, to develop statewide and regional agricultural water quality plans, and to promote soil and water conservation activities. The AWQA requires all landowners, with 10 or more acres being used for agriculture or silviculture operations, to develop and implement a water quality plan based upon its state plan guidance. And according to the AWQA, it is the sole responsibility of each of these landowners and farm operators to develop and implement a water quality plan for their individual operations (KY. REV. STAT. ANN. § 224.71-100).

Although the AWQA legislation forces NPS to comply with the regulations, implementing conservation plans, there are no standards of water pollution based on NPS pollution subject to penalties. This makes the process of creating a WQT system more complicated because the property rights of pollution are not well defined for the NPS. Nonetheless, one can still estimate the NPS current discharges of N and P pollutants, and conceptualize a possible scenario for WQT scheme for the Kentucky River Watershed.

2.3.3. Incentives to comply with regulations - conservation cost-share programs

To help landowners and farmers adjust their operations and cope with costs of compliance to adopt new technologies to prevent pollution, several government conservation programs from different agencies are in place and can help with the adoption of the water quality plans. Government conservation programs can provide financial incentives for farmers' participation on voluntary pollution control, having the potential for significant cost savings when implementing conservation practices (Batte and Bacon 1995). An overview of existing programs offered to NPS, mainly agriculture and silviculture, and its related agencies and the nature of each program, is provided in Table 2.1. In this study, a combination of these programs was tested to offer insight of farmers' compliance with state regulations, and their participation in conservation activities.

One of the programs is the Environmental Quality Incentives Program (EQIP), a voluntary based program that offers technical assistance and financial payments through up to seventy five percent (75%) of cost-share contracts, for implementing conservation practices (BMPs), to livestock, agricultural production, and nonindustrial private forestland. This program is offered through the United States Department of Agriculture (USDA) of the Natural Resources Conservation Service (NRCS), and its contracts generally last from one year after the last conservation practice is implemented to a maximum term of ten years. Also offered through the same agency is the Wildlife Habitat Incentive Program (WHIP), which only differs from EQIP on its eligibility criterion of allowing conservation-minded landowners who want to develop and improve fish and wildlife habitat on agricultural land, nonindustrial private forestland, and tribal land (USDA NRCS Programs).

Another program tested is the Conservation Reserve Program (CRP), which is a program established by the USDA in 1985 that takes land prone to erosion out of production for 10 to 15 years and devotes it to conservation uses. In return, farmers under CRP receive an annual per-acre rent and half the costs of establishing an approved permanent land cover, in exchange for retiring highly erodible or other environmentally sensitive cropland for 10-15 years. The CRP is basically a land retirement program that converts cropland into grasslands or forestlands. The program is funded through the Commodity Credit Corporation (CCC), administered by the Farm Service Agency (FSA), with NRCS providing technical land eligibility determinations, conservation planning and practice implementation (USDA NRCS Programs).

The Wetlands Reserve Program (WRP), the Farmable Wetlands Program (FWP) and the Conservation Reserve Enhancement Program (CREP) are programs included under the CRP program. These programs are voluntary, have specific land eligibility requirements, and offer landowners financial incentives for conservation practices. The CREP is a land retirement program administered by USDA's FSA. By combining CRP resources, the CREP targets conservation limited to specific geographic areas. Also administered by the FSA, The FWP is targeted to producers in all states to restore up to one million acres of farmable wetlands and associated buffers by improving the land's hydrology and vegetation. Under FWP Producers must plant long-term, resource-conserving covers to improve the quality of water, control soil erosion and enhance wildlife habitat on land enrolled in CRP. In return, FSA provides FWP participants with rental payments and cost-share assistance, and its contract duration lasts between 10 and 15 years. The WRP is a conservation easement or a cost-share restoration agreement with the USDA State of Kentucky NRCS, which benefits wetlands on landowners' property. Under WRP, Landowners can choose between agreements of permanent easements, 30-year easements, and restoration cost-share agreements that can last at least 10 years (USDA NRCS Programs).

The conservation practices supported by the several conservation programs can also generate NPS credits under WQT programs. In some cases such as the reduction of N and P pollution, WQT schemes can be an alternative to programs that cannot cover specific pollution standards. WQT schemes not only have the potential to reduce costs of compliance from regulations, but also reduce farmers' dependency on government financial assistance.

Table 2.1. Summary of Conservation Programs offered in Kentucky

	Program	Type	Goals	Mechanisms	Eligibility	Length
1	Environmental Quality Incentives Program (EQIP) - NRCS	Voluntary financial assistance program	Achieve environmental objectives- Improve water quality	Payments to implement conservation practices (BMPs)	Livestock; agricultural production; non-industrial private; and forestland	Up to 10 years
2	Conservation Reserve Program (CRP) - FSA	Voluntary land retirement program	Conversion: cropland into grasslands or forest lands	Receive annual rental payments; and Cost-share assistance for up to 50 % of the costs in establishing approved conservation practices - long -term resource conserving covers on eligible farmland	Agricultural landowners; and certain marginal pastureland (Rip. Buffers)	Contracts last for 10 to 15 years
3	Wildlife Habitat Incentive Program (WHIP) - NRCS	Voluntary financial assistance program	Develop and improve wildlife habitat - Upland, wetland, aquatic and other types	Technical assistance and up to 75% cost-share assistance	Private and tribal landowners	Contracts/ agreements last 1 year after the last conservation practice (BMPs)

Table 2.1. Summary of Conservation Programs offered in Kentucky (Cont.)

	Program	Type	Goals	Mechanisms	Eligibility	Length
4	Conservation Stewardship Program (CSP) - NRCS	Voluntary financial assistance program	Undertake additional conservation activities; conserve and enhance soil, water, air, and related natural resources	Annual land use payments based on conservation performance; and supplemental payment for the adoption of resource-conserving crop rotations	Tribal agricultural land; private agricultural land; non-industrial private forest lands	*Contracts/ agreements last 1 year after the last conservation practice (BMPs)
5	Grassland Reserve Program (GRP) - NRCS	Voluntary rental contract (conservation easement)	Preservation and restoration of native grasslands; supporting grazing operations; protecting grasslands from threats of conversion; maintaining and improving plant and animal biodiversity	Determined by the lowest of an appraisal, geographic area rate cap, or landowner offer; pay a flat rate per acre for the grassland value for each year of the agreement; covers the cost of the appraisal, land surveys, closing and recording fees	Landowners and operators	10, 15, 20 years or permanent
6	Wetlands Reserve Program (WRP) - NRCS	Voluntary technical and financial assistance	Protect, restore, and enhance wetlands	Conservation easement; and cost-share restoration agreement	Landowners	Permanent easements; 30-year easements; restoration cost-share agreements of a minimum 10-year duration

Source: USDA (FSA; NRCS); Kentucky Division of Conservation and Division of Water

2.4. WQT most common uncertainty issues

Even though the federal and state incentives are in place to contribute to the adoption of conservation practices on agriculture land in the state of Kentucky, conservation measures can still create greater uncertainty about future productivity and profitability (McSweeny and Kramer 1986). Farmers are averse to introducing more uncertainty and vulnerability because their economic survival is already subject to a complex series of factors. When farmers make decisions about farm management and conservation practices, such the changes in weather patterns and markets, they might face substantial capital costs for new equipment and opportunity costs, associated with taking land out of production or devoting time to new practices.

2.4.1. Stakeholders low participation in the U.S. WQT initiatives

WQT has been applied for more than 20 years in the US (Breetz et al., 2004; Morgan and Wolverton, 2005), but the great majority of WQT programs have not been very successful. The results of the WQT initiatives including non-point sources are mixed, if not negative, taking in consideration that few of the US initiatives have actually generated more than a few trades (Woodward et al., 2002; Breetz et al., 2004; Morgan and Wolverton, 2005). The examples considered successful were in terms of the implementation of the structure of the programs, but have not succeeded on trading volumes.

Also according to Breetz et al. (2004) survey of all WQT programs in the United States, between all the 40 WQT programs identified, only 12 allow the inclusion of agricultural NPS. From the remaining 28 programs, some are non-agricultural NPS, some other programs intend to include farmers but have not yet developed a trading framework, and for some programs the inclusion of NPS is not allowed. Many of the 12 WQT programs that included agriculture NPS in U.S. have yet to see a single trade, they range from small pilots exploring the feasibility of trading, to sole-source offsets in which a single PS negotiated a permit that included trading, to large programs providing multiple PS with NPS credits.

It was found that the main barriers for the participation of farmers are the lack of awareness of these systems, the lack of science, and no trust in program administrators (Breetz et al., 2005). When approached with the ideas of WQT, farmers fear they will lose autonomy in their farm operations, they also fear increased government oversight, and they may resent the fact of being portrayed as polluters, because they view themselves as stewards of the land and that they have a strong conservation ethic. Farmers also express their resentment towards urbanites. They were reluctant to participate in some WQT programs involving municipalities because they perceived their participation as an indirect way to fund urban growth (Breetz et al., 2005).

Effective stakeholder involvement provides a method for identifying public concerns and values, developing consensus among affected parties, producing efficient and effective solutions through an open and inclusive process. Involving stakeholders builds trust and support for the process and product, shares responsibility for decisions or actions, creates solutions more likely to be adopted, leads to better, more cost-effective solutions, forges stronger working relationships, enhances communication and coordination of resources, and contributes to design parameters that mitigate uncertainty, market distortions, and political transactions (Rowles 2005). Moreover, each stakeholder group is unique, and its makeup and operation will depend on several factors such as the driving forces of the effort, the agencies' internal goals, and the geographic scale, the time frame needed for decision making, the available budget, and the political climate. Before forming a stakeholder group, all of these factors must be considered to determine the best way to proceed in considering a WQT system.

Despite of none or low volume of trading, the programs were initiated by stakeholder coalitions. Past studies and the EPA, identifies the involvement of stakeholders as one of the primary objectives for the success in the development of WQT. Therefore, supplying cost-effective pollutant reductions in lieu of anticipated PS loadings, associated with urban and industrial sources.

2.4.2. Trading ratios

There is a greater uncertainty in the determination of loads and load reductions in trades that involve nonpoint sources due to factors such as the variability in precipitation, variable performance of BMPs, and the effect of soils, cover and slope. The fate and transport characteristics of pollutants also add uncertainty. For example, a pound of P discharged upstream may not arrive as a pound of P at a downstream point due to diversions, sediment deposition, or assimilation by plants. Other factors to consider in trading programs include providing incentives for achieving early loading reductions prior to development of a permit and achieving nonpoint source loading reductions in the absence of any regulatory requirements.

One method to address these factors is to use a trading ratio that is greater that 1:1 between nonpoint and point sources. A trading ratio is the ratio of the mass of pollutant reduced using a BMP to the mass of pollutant that would need to be reduced at a treatment plant through plant upgrades. For example, a trading ratio of 2:1 means that a BMP would have to remove 2 pounds of P for a treatment plant to receive credit for 1 pound of P reduction. It is possible that due to the geographic complexity of the watershed and pollutant fate and transport characteristics, it may be difficult to establish very precise trading ratios between all pairs of buyers/sellers.

Specifically, to determine trade ratios, one or more of the following factors, whenever applicable, may be included:

- Equivalency: Factor applied to pollutant reduction credits to adjust for trading different pollutants or different forms of the same pollutant;
- Distance: Factor applied to pollutant reduction credits when sources are directly discharging to a water body of concern that accounts for the distance and unique watershed features (e.g., hydrologic conditions) that will affect pollutant fate and transport between trading partners;
- Location: Factor applied to pollutant reduction credits when sources are upstream of a water body of concern that accounts for the distance and unique watershed

features between a pollutant source and the downstream water body (e.g., bay, estuary, lake, reservoir) or area of interest (e.g., a hypoxic zone in a water body);

- Uncertainty: Factor applied to pollutant reduction credits generated by nonpoint sources that accounts for lack of information and risk associated with best management practice measurement, implementation and performance; and/or
- Retirement: Factor applied to pollutant reduction credits to accelerate water quality improvement. The ratio indicates the proportion of credits that must be purchased in addition to the credits needed to meet regulatory obligations. These excess credits are taken out of circulation (retired) to accelerate water quality improvement.

To address uncertainty and equivalence, Wisconsin used a formula to calculate site specific trade ratios based on factors such as: is the trade in a targeted area; is the BMP in the same watershed; how close is the BMP to the point source; is the BMP upstream or downstream of the PS (Breetz et al., 2004). Michigan's approach to uncertainty and equivalence is different. Its rules require that a set percentage of loading reductions be contributed to the State to address uncertainty and to provide a net water quality benefit (Breetz et al., 2004). For PS reductions, the rule requires a 10 percent contribution, which is equivalent to a 1.11:1 trading ratio. NPS reductions require a 50 percent contribution, which is equivalent to a 2:1 trading ratio. Additional discounts are applied to the use of credits in certain situations to address equivalence.

For WQT systems that involve NPS and that target N and P pollution, the uncertainty due to a trading ratio and the methods used to define it, greatly influence the decision of stakeholder's involvement. Therefore, a reliably estimated ratio for pollution emission trades should improve with information from GIS models, local and state stakeholder databases, EPA regional offices, and literature reporting trading ratios in comparable regions.

2.5. WQT unintended consequences

Since trading, in effect, allows point sources to discharge above their base effluent limits, it has the potential to cause adverse local water quality impacts. Where necessary, NPDES (KPDES) permits and the trading mechanism should include provisions that limit trading to ensure that adverse local impacts do not occur. There is always risk of catastrophic failure, whether traditional regulations are used or whether trading markets are used. In the case of water quality, a catastrophic risk such as a spill, or an exceptionally large release of nutrients or chemicals into a waterway, are not inherently larger with a trading program. This need not change with pollution trading. There is no reason why safeguards against spills (i.e. fines and other penalties) cannot be used in combination with a trading program to minimize the possibility of a spill, or in the case of an actual spill, to help pay for the cleanup.

A challenge for trading programs, are "hotspots" such as a stream segment below the outfall for a wastewater treatment plant has worse water quality than the stream segments above it (or below the hotspot). To address this possibility, monitoring data, trading ratios and temporal or regional limits on trades should be proposed. These three approaches are not mutually exclusive and can be adopted at the same time.

Monitoring data should be used to verify the location of a hotspot, which requires the permitting authority and the trading authority (if there is any) to examine water quality data on a regular basis to predict the occurrence of a hotspot, based on their best knowledge. This may include modeling and data assessment and determine the availability of assimilative capacity for the pollutant. The presence of low flow areas, impoundments or other environmental factors that would cause the pollutant to persist longer in the water stream should also be considered. Mitigation methods should only be imposed if the regulators can verify, with data, that hotspots actually exist or is unavoidable without the mitigation. For example, if a hotspot is identified below a particular plant, then regulators may want to limit trading entirely or they may want to impose a fairly strict trading ratio for that plant alone. For water quality trading, monitoring data closely will increase the cost of operation but this type of monitoring is essential.

Trading ratios can be an effective way avoiding local impacts. Regulators can adjust trading ratios to encourage and discourage certain trades. The possibility varying trading ratios should be accommodated by the trading mechanism. An accompanying approach regulators may use is to place a cap on the portion of its effluent limit that a point source can replace with credits purchased from other dischargers through trading.

Temporal limits would be appropriate if, for instance, phosphorous is found to be causing the nonattainment problem during low flow periods. If this is truly the case, then regulators can write NPDES (KPDES) permits that make a distinction between high and low flow periods (i.e. winter and summer months), and that allow firms to use nonpoint source pollution credits only during certain months of the year. Water quality authority and trade monitoring authority may also impose regional restrictions of trade, for example allowing only upstream trades. A program design where buyers (PS) can purchase credits only from upstream NPS is a protective limitation of water quality downstream of the point source. Economically, the limitation for upstream credit purchases has two major ramifications for the trading program. First, credit supply and demand becomes localized. In other words, any geographic location in the watershed has its own credit market and all the local markets on the same stream are interconnected. Second, point sources located in the upstream (headwater) areas of the watershed could be in a more competitive market for credits because as one moves upstream, potential credit supply diminishes.

For a successful implementation of a WQT system, a feasibility study including estimated costs of data monitoring, considering the change of trading ratios, the long-term sustainability of the market, and considering implications of certain policies should be conducted avoiding serious undesired consequences such as “hotspots”.

Chapter 3. Literature Review of farmers' participation in conservation programs

3.1. Previous studies

The success of the current incentives from government conservation programs, such as CRP, given to farmers to address pollution abatement can be applied to market based mechanisms, such as WQT schemes. There are a variety of studies that discuss the adoption of conservation practices through conservation programs, its effectiveness, the participation decision of landowners, farmers and other stakeholders. Although adoption of conservation practices does not directly relates to participation in a WQT scheme, it could be useful to identify certain factors which could be relevant in determining farmer decision in addressing the use of technologies that reduce pollution. Understanding the use of conservation practices, also known as BMPs, are important to establish a connection between the decision in addressing pollution abatement and the effectiveness of the current incentives being used.

There are a number of studies that relate the decision to adopt conservation practices, or BMPs, with specific farmer characteristics and land uses. For example, Lynch and Lovell (2003) discuss the factors influencing participation in farmland preservation programs, specifically on both purchase of development rights and transfer of development rights. With a survey of 836 farmland owners from certain counties in the state of Maryland, they found that the farmers' willingness in engaging in a preservation program, increases with farm size, growing crops, farm soils eligibility, the share of income from farming, and if a child plans to continue farming. They also found that if farmers' own land closer to the nearest city, they are less likely to join a preservation program.

Using farmers' characteristics, Breetz et al. (2005) conduct a study analyzing how water quality trading programs in U.S. are related to communication mechanisms. From 12 case studies of WQT programs in the U.S. that involved agricultural NPS, they conclude that by incorporating trusted social relations into water quality trading program such as, trustworthy third parties intermediaries or existing relationships, with education and outreach programs, could reduce farmers' reluctance to participate in conservation programs.

In a survey made to Louisiana dairy farmers, about their characteristics and the uses of their land parcels, Paudel et al. (2008) assess the impact of socioeconomic attributes on the BMPs adoption decision, relative to cost-share and fixed incentive payments. Their analysis of the steps in the adoption decision process of BMPs indicated, that visits between the producers and the U.S. Department of Agriculture–Natural Resource Conservation Service significantly increase likelihood of BMP adoption, and that the low cost-share percentage offered by the EQIP tends to reduce farmers' adoption of conservation practices. Producer willingness-to-pay results indicate that marginal increases in dairy BMP adoption and associated improvement in environmental quality require increased technical and financial assistance. The study also indicated that farmers with a higher level of education attainment, and with lower debt-to-asset ratio, tend to be more likely prone in adopting in certain conservation practices.

Rahelizatovo and Gillespie (2004), examine Louisiana dairy producers' decision adoption of BMPs in terms of the total number of practices implemented up to a certain period. Their results emphasize that producers' would adopt greater number of technologies depending on the information about their awareness of stricter regulations to control water pollution from NPS, their dairy production performance and profitability, the size of their dairy production plant, their risk aversion behavior, having constant contact with Cooperative Extension Service personal, and have a stream running through their properties. On the other hand, the greater the percentage of land owned, and the age of the farmer negatively affects the number of BMPs adopted.

Ghazalian et al. (2009) from a survey on local farmers from Chaudièrie Watershed region in Quebec, Canada, also investigate the determinants affecting producers' adoption of some BMPs. Education, gender, age, belonging to an agro-environment club, and on-farm residence are found to have significant effects on the adoption of some BMPs. Farms with larger animal production would be more apt to implement manure management practices, crop rotation, and riparian buffer strips. Also, farms with larger cultivated acres would be more inclined to implement herbicide control practices, crop rotation, and riparian buffer strips. The price of labor has a negative impact on the implementation of crop rotation cycles, but a positive impact implementing manure management practices.

Suter et al. (2008) analyze participation in land retirement programs, in the binary-choice setting of the Conservation Reserve Enhancement Program (CREP), using data from 218 counties in six states. Their results suggest that landowners react positively to the incentives that are offered from the program. The results also suggests that increases in one-time incentives, offered at the time of signup, are a more cost-effective means to increase enrollment than increases in the incentives offered on an annual basis.

With an empirical study, Chouinard et al. (2008) hypothesize that there are farmers that are willing to forego some profit to voluntary engage in farm practices without monetary incentives. Using a Contingent Valuation Method (CVM), they provide evidence that some farmers are willing to make this sacrifice. Their independent variables include the bid amount the producer is responding to, and producer characteristics. The dependent variable is a response for each bid amount associated with an increased level of stewardship.

Kurkalova et al. (2006) propose a method of directly estimating the financial incentives required for adopting conservation tillage, and distinguishing between the expected payoff and premium of adoption based on the observed behavior. Their method finds that the premium may play a significant role in farmers' adoption decisions. Applying the method to the state of Iowa, they find that if a uniform conservation tillage adoption subsidy program were offered in 1992, over 86% of the subsidy program payments would be an income transfer to existing and low-cost adopters.

Examining the effects of land use policies on watershed ecosystems through their effect on land use, Langpap et al. (2008) study results suggest that land use policies based on monetary incentives and property acquisition programs, can have relatively large positive impacts on watershed health, while policies that change the returns to land use are less effective. Their results also suggest that there is potential for targeting these policies because their impacts vary across watersheds with different land use mixes.

Other than the categories of research on the adoption decision of conservation practices and the participation decision to the incentives offered to farmers, there is the study of Paudel et al. (2003) that investigated the environmental impacts of alternative agricultural practices, within a watershed under different water quality standards. Their results indicated that stricter environmental standards lower total profit potential and litter utilization.

Understanding the factors that influence participation in voluntary programs is important when evaluating existing programs and determining new conditions for those programs as well as when developing new programs. Land uses and farm characteristics, as well as community characteristics are relevant if one wants to determine the probability that farmers will participate in conservation programs.

3.2. Relevant variables identified in the review of literature

From the mentioned studies, it appears that several variables were recognized as being important in determining farmer adoption of conservation practices (Table 3.1 and 3.2). Variables on land, farmer, county and community characteristics, as well as net returns from farming were recognized from the studies of the literature reviewed that collected primary data (Surveys) for analysis (table 3.1). The most used and relevant variables from the land uses category seem to be the number of acres of cultivated land and the farm size. From the farmer characteristics list, the age of primary operator, the education attainment, outreach, such as extension services, and the source of information a farmer receives for its activities, were also relevant in determining farmer adoption of conservation practices.

Similarly, literature reviewed indicated that several studies collected and analyzed secondary data in order to understand farmers' participation in conservation programs. Variables on land, farmer, community characteristics, and net returns from farming were identified (Table 3.2). Farm size, incentive payments from conservation programs, and the land use were the most relevant and used variables. The separation of studies based on primary versus secondary data was made because of the relative difficulty in repeating studies with data primary in other areas of the country without the expense and effort to administer a survey.

The literature reviewed does not address the relationship of the level of cost-share funding from government conservation programs, with specific county characteristics, multi-program participation, and the Extension Service impact on the programs participation, in the Kentucky River Watershed region. Operator characteristics such education attainment and outreach programs seem to help in the adoption of conservation practices, reduce transaction costs, alleviate social constraints such as mistrust in regulators and help with more permanent and cost-effective solutions. The age of the primary operator of a farm can have either a negative or positive impact in the enrollment of a conservation program. This may occur if the older the operator is, the less likely to adopt a BMP, because the operator will be less inclined to plan over a long horizon, and because they may be less aware of the new practices. On the other hand, older producers might have more experience with a wide range of practices therefore, therefore, more likely to adopt BMPs. Larger farms seem to have a positive influence in landowner's opportunity costs of enrollment as well as the number of acres of cultivated land. Farmers with these land uses seem to believe that adopting BMPs is a risk-reducing strategy. The farmers' source of information is of relevance because could provide awareness about the benefits of conservation practices and the conservation programs cost-share. Therefore farmers' source of information could positively impact in the adoption of conservation practices, or impact in the participation of conservation programs.

Table 3.1. Literature Review - Primary data

Data Categories	Significant Variables
Land uses	# Acres of cultivated land
	% Prime soils
	Farm is contiguous to a preserved land
	Farm size = # Acres
	Having a biological/organic production certificate
	Machinery and equipment
	Minimum Acreage eligibility requirement
	Presence of a stream in the farm
	Soil eligibility requirement
	Total # of cows in the dairy herd (farm size variable)
Farmers' characteristics	# Years of family owned farm
	Age of the primary operator
	Child to continue farming
	Gender = Female
	Education attainment
	Membership in an agro-environmental club
	Owning a Farm
	Producers awareness of Govt. regulations to control NPS (CWA)
	Risk aversion on technology adoption
	Source of information
	Whether primary residence is on farm
County characteristics	Distance to the nearest urban area
	Specific County
Net returns	Net Returns from agriculture
	Size/value of animal production
	Low cost-share % offered from EQIP
	Price of labor ($/hour)
	Higher milk yield
	Less than 25% income from farm
	Debt-to-asset ratio less than 20%
	Low cost-share % offered from EQIP
Community characteristics	Building on existing networks
	Outreach
	Third-party facilitation

Table 3.2. Literature Review - Secondary data

Data Categories	Significant Variables
Land uses	Land slope
	Mean of daily max temperature during growing season
	Mean of daily min temperature during growing season
	Variance of daily precipitation during growing season
	Soil permeability
	Soil available water capacity
	% of irrigated cropland/county
Farmers' characteristics	Operators working off-farm/total county farm operators
	Harvested cropland operated by tenants/total county-harvested cropland
	County average farm operator age
	Gender = Male operators/total county farm operators
Net returns	Net returns to conventional tillage of (corn, soybeans and other crops)
	Returns to land use
	Expected growth of returns to each land use
	AVG annual incentive per acre offered to farmers
	AVG annualized one-time incentive less cost of enrollment
Community characteristics	Income/capita
	Population density
	Education attainment
	Unemployment rate
	Republican vote (proportion)
	Voter turnout (proportion)
	Renter households (proportion)
	Urban influence index

Chapter 4. Model development

4.1. Theoretical framework

In the previous section, several variables that affect the participation and level of participation of farmers in conservation programs were identified from the literature. Farm operator participation in a WQT scheme presupposes that the farmers have some positive predisposition toward conservation programs. This predisposition is influenced not only by the size of the farm but also by the type of cultivation undertaken. In a given county, it would be expected that the more the number of farms, the more the participation in conservation programs. Counties with larger average farm size would probably have a higher level of participation. The type of farm activities (crops, pasture, silviculture, etc.) would also affect the participation, and level of participation in specific programs that are targeting certain types of land uses.

In this study, explaining the government payments for conservation practices made in a county based on land uses is of interest. It would then be possible to predict if in a particular county of this study region, there is farmland with features that would make them potentially eligible to participate in a WQT scheme, and also test the interaction between different programs with different criteria for land characteristics eligibility. Information on government payments for conservation practices by county could be explained by the following equation:

$$CRP = \beta_0 + \beta_1\ NFarms + \beta_2\ AVGFarm + \beta_3\ TPCropuse + \beta_4\ TPPastureuse + \beta_5\ EQIP + \beta_6\ WHIP + \beta_7\ EXTENSION + \varepsilon.$$

Where the dependent variable CRP consists of direct payments as defined by the 2002 Farm Bill made in 2007 to farmers in the Kentucky River Watershed; payments from Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), Farmable Wetlands Program (FWP), and Conservation Reserve Enhancement Program (CREP).

The independent variables used in the equation are the number of farms in a county, (NFarms), the average farm size per county (AVGFarm), the total percentage of cropland in a county (TPCropuse), the total percentage of pastureland in a county (TPPastureuse), the dollar amount of EQIP payments made to farmers per county (EQIP), the dollar amount of WHIP payments made to farmers per county (WHIP); and the number of the State of Kentucky Extension Service Specialists contacts to farmers per county (EXTENSION). The parameter estimates of each explanatory variable are represented respectively by β_0 through β_7, and the error term is represented by ε in the equation.

The level of government payments for conservation practices is tested to investigate whether the counties from the study region, that receive more incentives from those programs, tend to receive more EQIP or WHIP payments. The effect that multiple program participation may have on payments could be positive because, information related to adoption of some of the programs is available through the same source, the USDA and the Kentucky NRCS.

The number of farms is also tested to understand if it would positively correlate with payments for conservation practices. One could assume that the more farms adopting a program in a given county, the higher the tendency of the information about program benefits being quickly spread and adopted. Also, the average farm size in a county is being tested to see if positively correlate with government incentives. Larger farms with lower capital costs and higher managerial ability (Alvarez and Arias, 2003) might be more aware of future regulations and are taking advantage of the government benefits offered or more specifically, from cost-share incentives of programs that implement conservation practices.

The percentage of cropland in a county is also being tested to investigate if tends to be positively correlated with government incentives to adopt conservation practices (Lynch and Lovell, 2003; Ghazalian et al., 2009). One could expect that the higher the percentage of pastureland in a county, the lower the payments, because most programs are targeted for land retirement, rewarding financially conversion of cropland into grasslands or forestlands.

Finally, the number of extension contacts, made by the Kentucky State agriculture extension specialists, is tested to investigate whether it has an effect on the level of payments in a county. Previous studies have used similar education and outreach measurements that have positively contributed to a larger participation in conservation (Breetz et al., 2005; Paudel et al., 2008; Rahelizatovo and Gillespie, 2004; Ghazalian et al., 2009).

4.2. The Kentucky River Watershed region

As mentioned before, the region of study of this research is the Kentucky River Watershed (Basin), which comprises the North Fork Kentucky, Middle Fork Kentucky, South Fork Kentucky, Upper Kentucky, and Lower Kentucky sub-watersheds (sub-basins) with their respective hydrologic unit codes (HUC-8) 05100201, 05100202, 05100203, 05100204, 05100205. The Kentucky River Basin (Figure 4.1) extends over much of the central and eastern portions of the state. It includes all or parts of 46 counties and drains approximately 7,000 square miles. One of the state's fastest growing counties (Madison) and one of the most impoverished counties (Owsley) are within the basin. The Kentucky River basin discharges into the Ohio River. The main stem and tributaries consist of more than 15,000 miles of stream in 2,032 HUC-14 watersheds. In 2000, almost 775,000 people lived in the basin. More than 60 municipalities draw water from the Kentucky River.

The North, Middle, and South Fork Watersheds occupy the mountainous terrain of the Eastern Kentucky Coal Field (Figure 4.2). Sources of pollution within these watersheds are often straight pipes and failing septic systems, contamination from runoff in populated areas, as well as from logging, mining, and construction activities. The Upper Kentucky sub basin includes the transition from resource extraction to agricultural production. Sources of pollution include straight pipes and failing septic systems, pathogens and nutrients from agricultural sources, and siltation from agriculture and construction activities. The Lower Kentucky sub basin includes the most heavily populated regions of the basin including Lexington and Frankfort. Sources of pollution in this sub basin are straight pipes and failing septic systems, failing sanitary sewer systems, pathogens and nutrients from agriculture, contamination from runoff in heavily settled areas, and siltation from agriculture and construction activities. Between 2000 and 2003, there were more than 17,000 KPDES pollution violations on the Kentucky River.

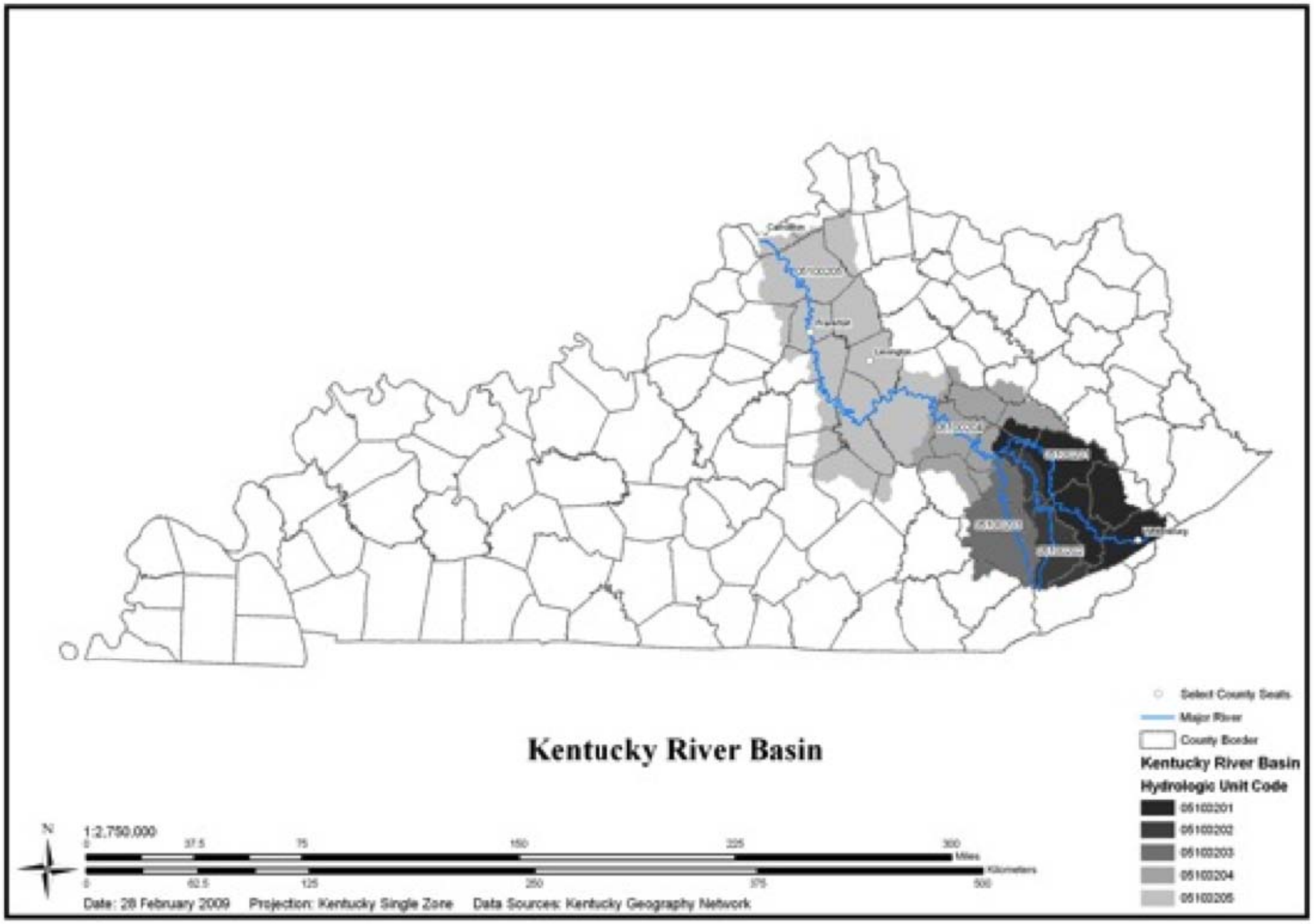

Figure 4.1. Kentucky county boundaries perspective to the Kentucky River Watershed

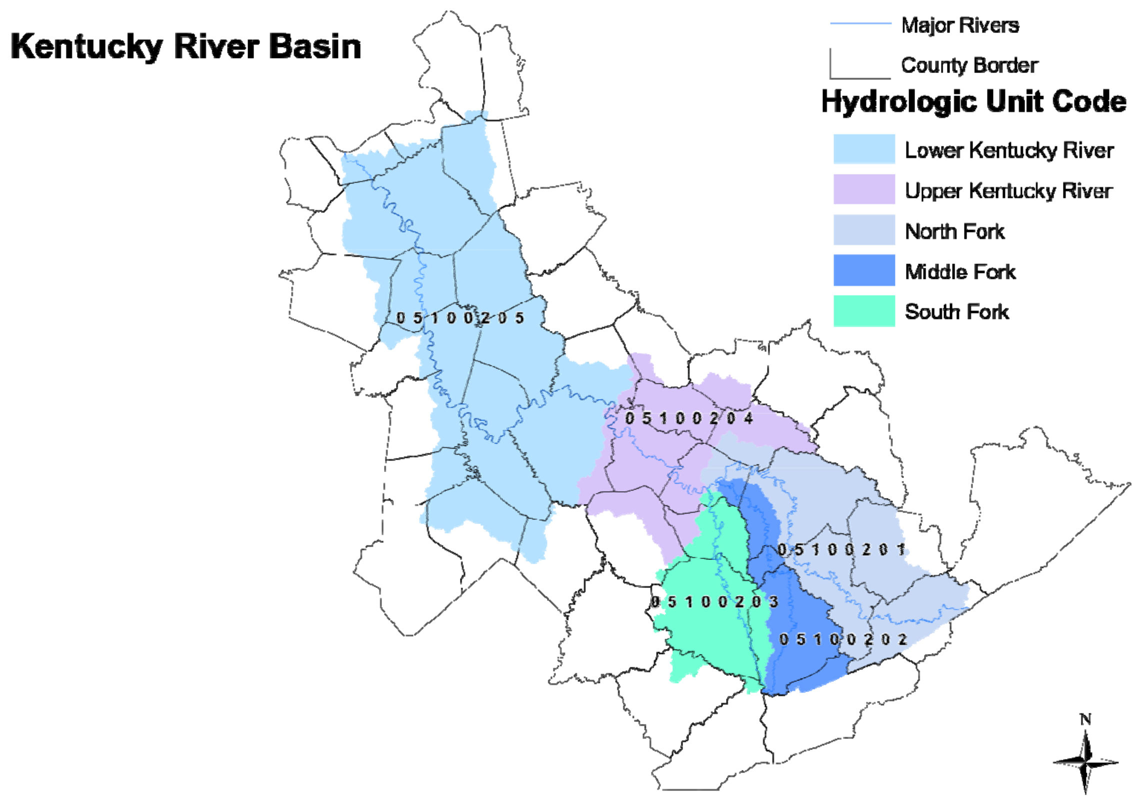

Figure 4.2. Kentucky River Watershed

According to the 2007 Census of Agriculture, County data, from the USDA, National Agricultural Statistics Service (NASS), in all the counties of the study region there are 27,841 farms, which represent 33% of all farms in the State, and 29% of the farmland area in the State. Around 45% of the total area of the Kentucky River watershed is under farmland. From the farmland area, 44% is under crop production and 28% is under pasture, almost 23% is under forestland and around 5% represent other types of land uses (Figures 4.3, 4.4, 4.5 and 4.6). Also according to the 2007 Census of Agriculture, County data, the average size of farms in the entire State of Kentucky is around 164, and in the Kentucky River watershed is slightly smaller, around 148 acres on average.

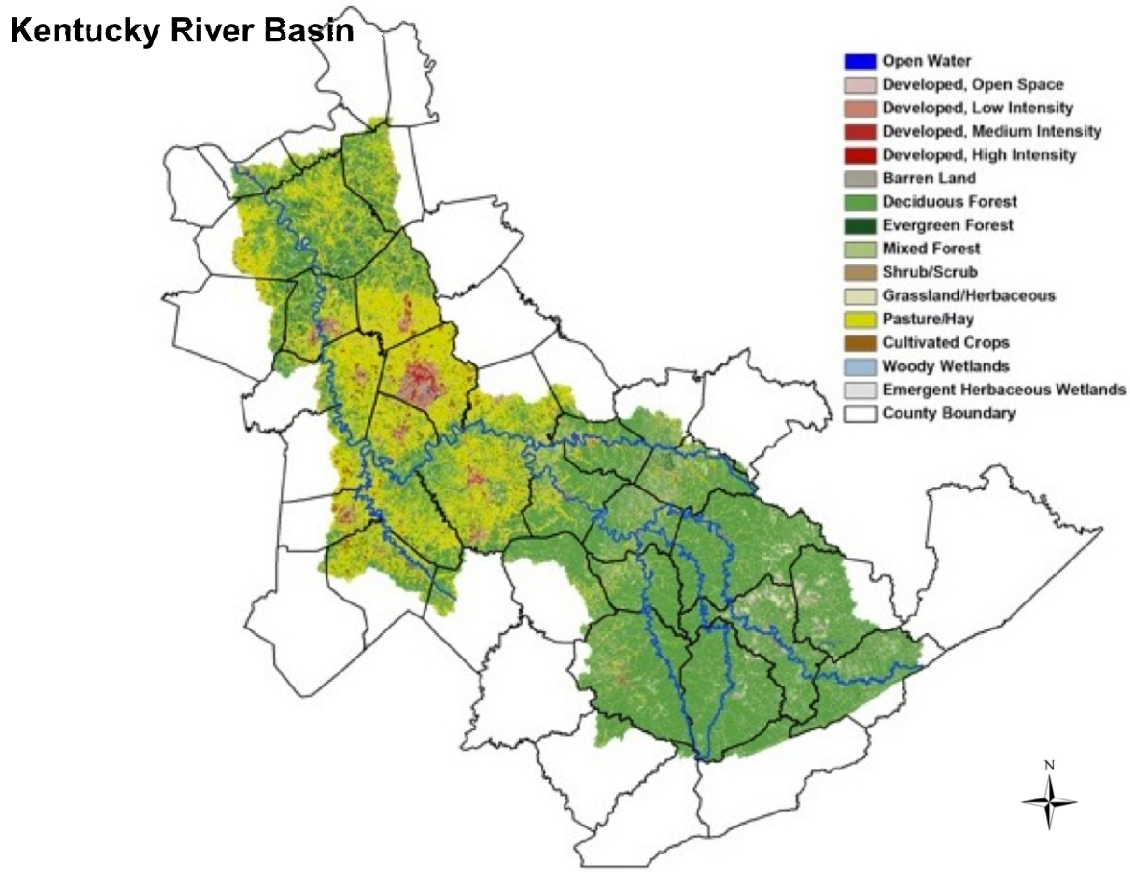

Figure 4.3. Kentucky River Watershed - Land Uses

The diverse characteristics of the Kentucky River basin pose a challenge to a water quality trading program, but they could also support an analysis with a rich coverage of various buyers and sellers of water quality credits including non-industrial private forest land owners, industrial, agricultural, and urban entities.

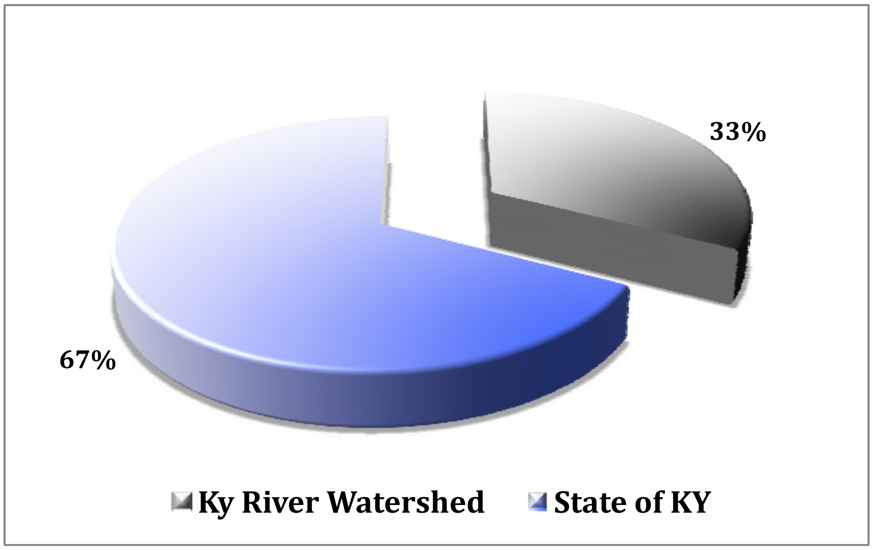

Figure 4.4. Total number of farms

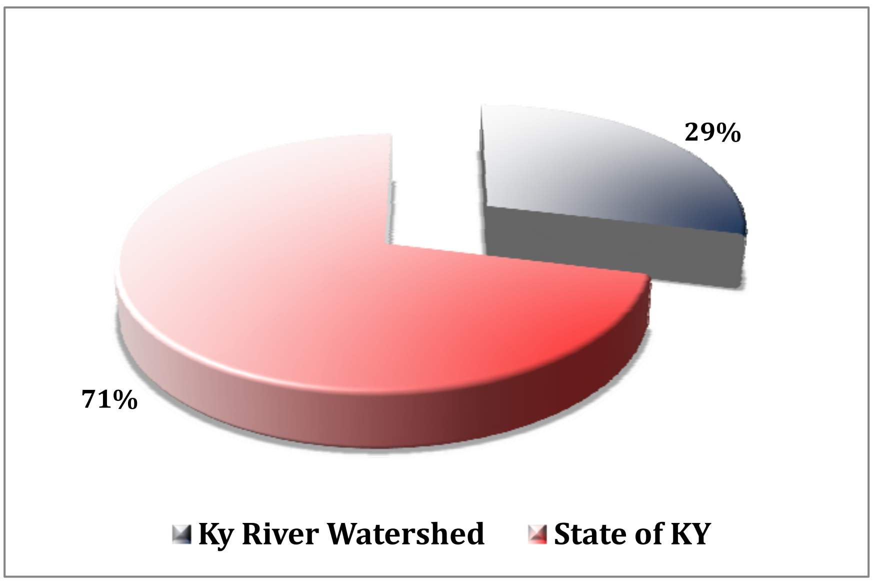

Figure 4.5. Total farmland acreage

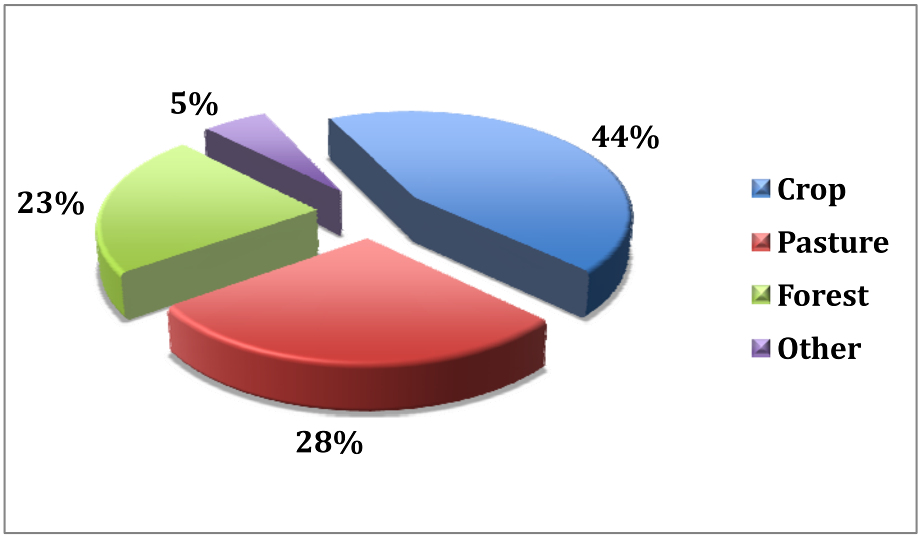

Figure 4.6. Kentucky River Watershed percentage of Land uses

4.3. Descriptive statistics

To examine which land uses can potentially explain farmers' participation of certain counties in the Kentucky River Watershed in conservation programs, county data from the NASS (USDA) 2007 Census of Agriculture of county land uses was associated with data from CRP payments made to farmers for each of the 46 counties in the Kentucky River Watershed area. The CRP data obtained from the Census consisted of direct payments from CRP, WRP and FWP. CREP data was not available for the Kentucky River watershed region because the program is only being offered to farmers and landowners located in the Green River watershed region (KDOC). According to the data collected, there is a diverse range of farm sizes, number of farms, quantity of farmland, and land uses per county in relation to total CRP payments received by county, and average CRP payments received per farm in a county (Table 4.1). For example, the counties of Fayette and Jessamine are similar in the number of farms, in the percentage of farm acreage and lands uses, but differ in the amount of incentives received. The counties of Lincoln, Madison and Mercer have similar cropland percentages but also differ in the amount of incentives received, and differ from Breathitt and Pike counties, which have larger acreages of woodland and low number of farmers. The differences around the region in respect of land uses can be important factors to be considered when participating in conservation.

In order to understand what relationships exist in multi-program participation of farmers in certain counties in the study region, county data of the EQIP and WHIP payments made to farmers from year 2006 to 2009 was acquired from the Natural Resources Conservation Service (NRCS) through Kentucky State Conservationists. The information obtained combined with the CRP payments reveals differences between the payments of the different programs in each county (Table 4.2). Counties that received the largest payments in one of the conservation programs (CRP, EQIP or WHIP) do not necessarily received the highest overall amount of payments. A combination of conservation payments information with land uses in each county can help decide where one program (or more) is more favorable than other, assessing different needs of each county (Table 4.1 and 4.2).

Table 4.1. Kentucky River Watershed land uses in relation to CRP payments

#	Counties	County Area (Acres)	# Farms	Farmland (Acres)	Avg. Farm Size (Acres)	% Farm Land	% Agriculture Land Uses				CRP Payments	Average Per Farm CRP Payments
							Cropland	Pasture	Woodland	Other uses		
1	Anderson	130708	678	87,617	129	67.03%	49.83%	25.51%	20.09%	4.57%	$18,756.00	$2,084.00
2	Bell	231161	69	10,194	148	4.41%	40.07%	6.35%	49.12%	4.46%	$0.00	$0.00
3	Boone	164165	682	74,750	110	45.53%	47.92%	21.43%	24.11%	6.54%	$5,775.00	$385.00
4	Bourbon	186585	918	184,323	201	98.79%	46.94%	42.86%	5.11%	5.09%	$97,370.00	$1,391.00
5	Boyle	116885	649	94,233	145	80.62%	49.38%	28.76%	14.92%	6.94%	$15,720.00	$1,048.00
6	Breathitt	316922	199	43,540	219	13.74%	21.58%	10.82%	60.35%	7.25%	$1,468.00	$367.00
7	Carroll	87882	326	63,708	195	72.49%	40.38%	29.66%	26.13%	3.83%	$9,630.00	$963.00
8	Casey	285243	1,286	191,609	149	67.17%	40.64%	21.72%	34.05%	3.60%	$66,021.00	$1,119.00
9	Clark	163273	907	149,201	164	91.38%	46.22%	39.44%	10.34%	4.00%	$26,271.00	$973.00
10	Clay	301514	336	51,194	152	16.98%	29.23%	9.97%	55.12%	9.97%	$3,500.00	$700.00
11	Estill	163559	456	64,780	142	39.61%	34.80%	22.88%	36.73%	5.59%	$18,960.00	$1,580.00
12	Fayette	182713	810	135,969	168	74.42%	45.39%	39.27%	6.93%	8.41%	$22,080.00	$920.00
13	Franklin	135667	625	76,306	122	56.25%	45.74%	26.02%	23.65%	4.59%	$5,048.00	$1,262.00
14	Gallatin	67019	204	33,816	166	50.46%	46.00%	25.00%	21.00%	8.00%	$268.00	$67.00
15	Garrard	149697	821	121,673	148	81.28%	48.49%	35.96%	11.67%	3.88%	$15,111.00	$1,679.00
16	Grant	166848	959	114,965	120	68.90%	45.74%	28.47%	18.34%	7.45%	$6,648.00	$554.00
17	Harlan	299654	37	3,034	82	1.01%	22.74%	12.89%	59.49%	4.88%	$0.00	$0.00
18	Harrison	198294	1,083	161,777	149	81.58%	46.17%	33.70%	14.98%	5.15%	$48,960.00	$1,530.00
19	Henry	186295	962	146,399	152	78.58%	49.68%	25.98%	17.83%	6.51%	$21,926.00	$1,154.00
20	Jackson	221740	662	82,614	125	37.26%	40.80%	20.20%	33.70%	5.30%	$6,732.00	$561.00
21	Jessamine	111679	711	80,116	113	71.74%	47.08%	35.60%	11.04%	6.29%	$8,708.00	$1,244.00
22	Kenton	105564	481	42,544	88	40.30%	50.50%	24.60%	18.70%	6.10%	$9,562.00	$1,366.00
23	Knott	225800	46	6,937	151	3.07%	38.98%	29.42%	30.47%	1.12%	$0.00	$0.00
24	Knox	248184	376	51,115	136	20.60%	34.96%	23.32%	37.88%	3.84%	D	D

Table 4.1. Kentucky River Watershed land uses in relation to CRP payments (Cont.)

#	Counties	County Area (Acres)	# Farms	Farmland (Acres)	Avg. Farm Size (Acres)	% Farm Land	% Agriculture Land Uses				CRP Payments	Average Per Farm CRP Payments
							Cropland	Pasture	Woodland	Other uses		
25	Laurel	283961	1,012	102,489	101	36.09%	42.16%	26.30%	26.38%	5.16%	$4,602.00	$354.00
26	Lee	135182	186	29,419	158	21.76%	31.43%	14.49%	51.28%	2.81%	$6,479.00	$589.00
27	Leslie	258815	23	5,642	245	2.18%	2.73%	20.56%	63.59%	15.85%	$0.00	$0.00
28	Letcher	216977	66	3,617	55	1.67%	20.93%	16.26%	53.14%	9.68%	$0.00	$0.00
29	Lincoln	215379	1,278	178,315	140	82.79%	47.07%	30.66%	18.60%	3.67%	$50,820.00	$2,310.00
30	Madison	283632	1,328	218,194	164	76.93%	49.77%	31.56%	15.28%	3.40%	$48,375.00	$1,935.00
31	Magoffin	197826	470	61,620	131	31.15%	22.53%	20.01%	51.38%	6.07%	$1,944.00	$243.00
32	Menifee	131771	331	43,110	130	32.72%	34.99%	20.87%	40.51%	3.63%	$918.00	$306.00
33	Mercer	162088	1,111	141,437	127	87.26%	52.96%	32.07%	10.52%	4.45%	$17,052.00	$406.00
34	Montgomery	127246	685	106,957	156	84.06%	50.39%	30.40%	13.78%	5.43%	$32,800.00	$1,640.00
35	Morgan	245578	795	136,303	171	55.50%	30.27%	20.95%	41.02%	7.76%	$16,422.00	$966.00
36	Owen	226702	864	157,932	183	69.66%	43.85%	28.59%	22.10%	5.46%	$15,582.00	$1,113.00
37	Owsley	126889	195	35,857	184	28.26%	27.58%	13.87%	50.28%	8.27%	$513.00	$171.00
38	Perry	219255	57	10,661	187	4.86%	22.46%	17.12%	57.34%	3.09%	D	D
39	Pike	504678	70	14,228	203	2.82%	21.26%	17.61%	59.72%	1.41%	$879.00	$293.00
40	Powell	115254	236	32,763	139	28.43%	41.27%	15.27%	39.72%	3.74%	$6,489.00	$721.00
41	Rockcastle	203559	727	90,435	124	44.43%	35.89%	20.23%	39.66%	4.23%	$16,758.00	$931.00
42	Scott	182651	930	139,044	150	76.13%	44.99%	33.86%	16.20%	4.95%	$7,520.00	$940.00
43	Shelby	246795	1,651	205,286	124	83.18%	60.50%	19.40%	13.10%	7.00%	$99,640.00	$1,880.00
44	Trimble	99976	489	65,098	133	65.11%	39.75%	20.21%	33.44%	6.61%	$14,916.00	$1,243.00
45	Wolfe	142535	342	57,701	169	40.48%	27.06%	14.88%	52.83%	5.22%	$5,980.00	$1,196.00
46	Woodford	122868	712	119,087	167	96.92%	42.61%	41.52%	8.47%	7.41%	$11,136.00	$928.00
	TOTAL	8,896,668	27,841	4,027,609	148	45.27%	44%	28%	23%	5%	$767,339.00	$850.26

(D) Cannot be disclosed

Source: USDA, National Agricultural Statistics Service (NASS) - 2007 CENSUS of Agriculture

Table 4.2. Kentucky Watershed Conservation payments

#	Counties	CRP Payments	EQIP Payments	WHIP Payments
1	Anderson	$18,756.00	$0.00	$4,245.73
2	Bell	$0.00	$0.00	$0.00
3	Boone	$5,775.00	$140,874.55	$32,621.00
4	Bourbon	$97,370.00	$5,158.22	$0.00
5	Boyle	$15,720.00	$107,637.87	$0.00
6	Breathitt	$1,468.00	$0.00	$5,143.52
7	Carroll	$9,630.00	$0.00	$0.00
8	Casey	$66,021.00	$159,084.12	$34,781.70
9	Clark	$26,271.00	$58,841.83	$0.00
10	Clay	$3,500.00	$0.00	$0.00
11	Estill	$18,960.00	$57,427.32	$8,620.00
12	Fayette	$22,080.00	$70,129.53	$0.00
13	Franklin	$5,048.00	$42,929.56	$6,948.20
14	Gallatin	$268.00	$0.00	$8,474.17
15	Garrard	$15,111.00	$0.00	$4,983.20
16	Grant	$6,648.00	$59,469.28	$13,674.50
17	Harlan	$0.00	$0.00	$0.00
18	Harrison	$48,960.00	$264,772.68	$50,136.58
19	Henry	$21,926.00	$109,988.19	$37,393.00
20	Jackson	$6,732.00	$185,492.33	$0.00
21	Jessamine	$8,708.00	$82,897.82	$0.00
22	Kenton	$9,562.00	$116,546.01	$28,470.00
23	Knott	$0.00	$0.00	$0.00
24	Knox	D	$21,719.00	$1,896.40
25	Laurel	$4,602.00	$0.00	$0.00
26	Lee	$6,479.00	$113,257.32	$0.00
27	Leslie	$0.00	$0.00	$0.00
28	Letcher	$0.00	$0.00	$0.00
29	Lincoln	$50,820.00	$0.00	$4,436.00
30	Madison	$48,375.00	$27,369.04	$4,968.21
31	Magoffin	$1,944.00	$0.00	$0.00
32	Menifee	$918.00	$214,315.16	$3,432.66
33	Mercer	$17,052.00	$293,034.98	$0.00

Table 4.2. Kentucky Watershed Conservation payments (Cont.)

#	Counties	CRP Payments	EQIP Payments	WHIP Payments
34	Montgomery	$32,800.00	$36,928.22	$0.00
35	Morgan	$16,422.00	$0.00	$3,415.25
36	Owen	$15,582.00	$22,115.74	$36,113.28
37	Owsley	$513.00	$10,483.67	$0.00
38	Perry	D	$0.00	$0.00
39	Pike	$879.00	$9,212.41	$0.00
40	Powell	$6,489.00	$0.00	$0.00
41	Rockcastle	$16,758.00	$7,806.99	$0.00
42	Scott	$7,520.00	$9,927.99	$0.00
43	Shelby	$99,640.00	$105,251.75	$9,414.00
44	Trimble	$14,916.00	$11,453.00	$0.00
45	Wolfe	$5,980.00	$28,493.87	$7,759.00
46	Woodford	$11,136.00	$100,991.93	$0.00
	TOTAL	$767,339.00	$2,473,610.38	$306,926.40

(D) Cannot be disclosed
Source: USDA, National Agricultural Statistics Service (NASS) - 2007 CENSUS of Agriculture; USDA KY NRCS.

Data from the Kentucky NRCS was also collected on what conservation practices are being used by EQIP and WHIP program adopters, in the counties of the Kentucky River Watershed region, and their relative efficiency towards surface and groundwater quality. The data on the relative efficiency towards water quality, have a scale that ranges from -3 to 5, where smaller numbers (-3, -2 and -1) represent that certain practices can have negative impacts to the quality of the water than the practices represented with higher numbers. Conversely, the practices with higher numbers (1, 2, 3, 4 and 5) show that certain practices can have greater benefits to water quality, and a 0 (zero) value shows that a practice being use does not interfere with the current water quality. Therefore, the smaller the number is, in the water quality efficiency scale for a conservation practice used, the worse the practice is to water quality. Moreover, the higher the number is, the better the practice is for water quality.

The EQIP and WHIP conservation practices are represented in respect of their water quality efficiency to abate N and P pollution (Tables 4.3 and 4.4). Table 4.3 shows EQIP and WHIP conservation practices estimated groundwater efficiency, and Table 4.4 represents estimated surface water efficiency. In both tables an overall efficiency was calculated summing the entire efficiency ranking in the rows of each practice. An estimate of the overall number of efficiency helps to identify what practices are more suitable for N and P abatement on both ground and surface water. The conservation practices Riparian Forest Buffer, Filter Strip, Conservation Cover and Nutrient Management seem to be the most indicated in order to abate N and P for both ground and surface water. In the case of surface water, the practices Access Control, Prescribed Grazing, Critical Area Planting and Grassed Waterway also appear to have a relative good performance.

Table 4.3. EQIP / WHIP conservation practices efficiency estimates of NPS pollution abatement of N and P - Groundwater

Practice Code	Practice Name	Overall Efficiency	Excessive Nutrients and Organics	Excessive Salinity	Harmful Levels of Pathogens	Harmful Levels of Heavy Metals	Harmful Levels of Pesticides	Harmful Levels of Petroleum
391	Riparian Forest Buffer	11	5	1	2	1	2	0
327	Conservation Cover	10	3	1	2	1	3	0
590	Nutrient Mgmt.	10	5	1	2	2	0	0
393	Filter Strip	10	3	1	3	1	2	0
313	Waste Storage Facility	8	3	1	3	1	0	0
528	Prescribed Grazing	8	2	1	2	1	2	0
340	Cover Crop	8	2	1	2	1	2	0
386	Field Border	8	2	1	2	1	2	0
512	Pasture and Hay Planting	7	2	1	1	1	2	0
606	Subsurface Drain	7	1	2	1	1	2	0
472	Access Control	6	2	0	2	1	0	1
342	Critical Area Planting	4	1	0	1	1	1	0
666	Forest Stand Improvement	4	1	0	1	1	1	0
382	Fence	1	0	0	1	0	0	0
561	Heavy Use Area Protection	1	0	0	0	0	0	1
646	Shallow Water Development and Mgmt.	1	1	-1	0	1	0	0
614	Watering Facility	0	0	0	0	0	0	0
516	Pipeline	0	0	0	0	0	0	0

Table 4.3. EQIP / WHIP conservation practices efficiency estimates of NPS pollution abatement of N and P - Groundwater (Cont.)

Practice Code	Practice Name	Overall Efficiency	Excessive Nutrients and Organics	Excessive Salinity	Harmful Levels of Pathogens	Harmful Levels of Heavy Metals	Harmful Levels of Pesticides	Harmful Levels of Petroleum
378	Pond	0	0	0	0	0	0	0
580	Streambank and Shoreline Protection	0	0	0	0	0	0	0
578	Stream Crossing	0	0	0	0	0	0	0
575	Animal Trails and Walkways	0	0	0	0	0	0	0
574	Spring Development	0	0	0	0	0	0	0
655	Forest Trails and Landings	0	0	0	0	0	0	0
395	Stream Habitat Improvement and Mgmt.	0	0	0	0	0	0	0
410	Grade Stabilization Structure	0	0	0	0	0	0	0
412	Grassed Waterway	0	0	0	0	0	0	0
642	Water Well	0	0	0	0	0	0	0
645	Upland Wildlife Habitat Mgmt.	0	0	0	0	0	0	0
643	Restoration and Mgmt. of Rare and Declining Habitats	0	0	0	0	0	0	0
468	Lined Waterway or Outlet	0	0	0	0	0	0	0
490	Tree/Shrub Site Preparation	0	0	0	0	0	0	0
620	Underground Outlet	0	0	0	0	0	0	0
484	Mulching	-1	-1	-1	0	0	1	0

Source: USDA - KY NRCS

Table 4.4. EQIP / WHIP conservation practices efficiency estimates of NPS pollution abatement of N and P - Surface water

Practice Code	Practice Name	Overall Efficiency	Excessive Nutrients and Organics	Harmful Temperatures	Excessive Salinity	Excessive Suspended Sediment and Turbidity	Harmful Levels of Pathogens	Harmful Levels of Heavy Metals	Harmful Levels of Pesticides	Harmful Levels of Petroleum
393	Filter Strip	24	5	0	1	5	5	4	3	1
391	Riparian Forest Buffer	24	4	5	1	4	3	2	4	1
472	Access Control	13	4	1	0	4	4	1	0	-1
327	Conservation Cover	13	3	0	1	3	1	2	3	0
590	Nutrient Mgmt.	13	5	0	1	0	4	3	0	0
528	Prescribed Grazing	12	2	0	2	3	2	1	2	0
386	Field Border	12	3	0	0	3	2	1	2	1
342	Critical Area Planting	11	2	0	0	4	1	2	2	0
412	Grassed Waterway	11	2	0	0	4	1	1	2	1
512	Pasture and Hay Planting	10	2	0	1	2	1	2	2	0
580	Stream bank and Shoreline Protection	9	1	3	0	4	1	0	0	0
313	Waste Storage Facility	9	4	0	2	0	3	0	0	0
340	Cover Crop	9	2	0	0	2	1	2	2	0
484	Mulching	9	2	0	1	2	1	1	2	0
561	Heavy Use Area Protection	7	1	0	0	2	2	0	0	2
646	Shallow Water Development and Mgmt.	7	1	0	0	2	2	2	0	0

Table 4.4. EQIP / WHIP conservation practices efficiency estimates of NPS pollution abatement of N and P - Surface water (Cont.)

Practice Code	Practice Name	Overall Efficiency	Excessive Nutrients and Organics	Harmful Temperatures	Excessive Salinity	Excessive Suspended Sediment and Turbidity	Harmful Levels of Pathogens	Harmful Levels of Heavy Metals	Harmful Levels of Pesticides	Harmful Levels of Petroleum
574	Spring Development	6	0	0	1	1	1	2	0	1
666	Forest Stand Improvement	6	1	0	1	0	1	1	1	1
395	Stream Habitat Improvement and Mgmt.	6	0	3	0	3	0	0	0	0
378	Pond	5	2	0	0	3	0	0	0	0
382	Fence	4	0	0	0	1	3	0	0	0
410	Grade Stabilization Structure	3	0	0	0	3	0	0	0	0
620	Underground Outlet	3	0	0	0	0	1	1	0	1
643	Restoration and Mgmt. of Rare and Declining Habitats	2	0	0	0	2	0	0	0	0
468	Lined Waterway or Outlet	2	0	0	0	2	0	0	0	0
614	Watering Facility	0	0	0	0	0	0	0	0	0
516	Pipeline	0	0	0	0	0	0	0	0	0
578	Stream Crossing	0	-1	0	0	2	-1	0	0	0
575	Animal Trails and Walkways	0	0	0	0	0	0	0	0	0
606	Subsurface Drain	0	-2	0	-2	2	0	0	2	0
655	Forest Trails and Landings	0	0	0	0	0	0	0	0	0
642	Water Well	0	0	0	0	0	0	0	0	0
645	Upland Wildlife Habitat Mgmt.	0	0	0	0	0	0	0	0	0
490	Tree/Shrub Site Preparation	0	0	0	0	0	0	0	0	0

Source: USDA - KY NRCS

However, when comparing the overall efficiency of the practices funded by EQIP and WHIP, with the amounts of cost-share from the programs' payments made to farmers, and the number of times each practice was funded for the period of time the data is representing (Tables 4.5 and 4.6), most of the EQIP and WHIP funding is directed towards less efficient conservation practices in abating N and P, and this is true for both groundwater and surface water quality. This is because technical complementarities among practices. For example, watering facilities may not directly contribute to the reduction of pollution but if used as complements to other practices could help reduce livestock access to streams, which can increase concentrations of bacteria, suspended sediments and associated N and P contaminants. Tables 4.5 and 4.6 also show the conservation practices funded by EQIP and WHIP, separated in categories that are related to the different land uses observed in the 2007 Census of Agriculture county data for the total study region. The top funded and the more frequent funded practices are related to pastureland use, also the majority of the incentives are towards practices that impact conservation in pastureland use.

In addition, estimated unit costs of each practice were added to the analysis (Tables 4.5 and 4.6). Since the majority of EQIP and WHIP incentives cover 75% of these costs, these are the minimum amounts to be considered for possible trading prices. For example, if a farmer intends to reduce N and P pollution adopting a Filter Strip conservation practice, she will be facing a cost of $417.93 per acre, but she will receive 75% of the cost ($313.45) as an incentive if she had applied for WHIP or EQIP.

Table 4.5. Conservation practices efficiency estimates vs. EQIP/WHIP Incentives received - Groundwater

Land Use Category	Practice Code	Practice Name	Number of Contracts	Payments Received	Total Units	Unit Type	Estimated costs/unit	Water Quality Efficiency
Pastureland	614	Watering Facility	220	$1,920,836.34	7,693.4	Each	$2,408.73	0
	516	Pipeline	220	$1,684,264.93	1,080,756.1	Feet	$2.44	0
	382	Fence	147	$1,528,761.61	959,409.9	Feet	$2.45	1
	472	Access Control	80	$654,912.77	13,515.6	Acre	$60.60	6
	512	Pasture and Hay Planting	60	$437,836.90	3,509.7	Acre	$452.16	7
	378	Pond	36	$342,971.38	56.0	Each	$6,623.93	0
	580	Stream bank and Shoreline Protection	6	$254,715.55	5,095.0	Feet	$117.96	0
	313	Waste Storage Facility	8	$233,231.70	10.0	Each	$6,494.17	8
	528	Prescribed Grazing	68	$145,846.00	8,274.0	Acre	$47.75	8
	561	Heavy Use Area Protection	28	$121,644.81	46.9	Each	$864.72	1
	327	Conservation Cover	28	$88,078.57	567.6	Acre	$287.63	10
	578	Stream Crossing	32	$65,842.88	51.0	Each	$3,769.68	0
	575	Animal Trails and Walkways	21	$51,276.32	15,653.0	Sq. Ft	$1.53	0
	574	Spring Development	32	$39,378.50	43.0	Each	$2,301.33	0
	606	Subsurface Drain	4	$3,348.35	3,340.0	Feet	#N/A	7
			990	$7,572,946.61				
Cropland	590	Nutrient Mgmt.	17	$43,971.90	2,113.1	Each	$1,988.51	10
	340	Cover Crop	4	$29,562.51	298.4	Acre	$188.40	8
	342	Critical Area Planting	28	$29,359.19	71.7	Acre	$1,980.81	4
	386	Field Border	5	$3,416.90	29,648.0	Acre	$351.21	8
	393	Filter Strip	8	$1,144.29	506.3	Acre	$417.93	10
	484	Mulching	1	$248.96	73.8	Acre	#N/A	-1
			63	$107,703.75				

Table 4.5. Conservation practices efficiency estimates vs. EQIP/WHIP Incentives received - Groundwater (Cont.)

Land Use Category	Practice Code	Practice Name	Number of Contracts	Payments Received	Total Units	Unit Type	Estimated costs/unit	Water Quality Efficiency
Woodland	666	Forest Stand Improvement	36	$123,431.84	1,028.7	Sq. Ft	$298.89	4
	391	Riparian Forest Buffer	5	$2,923.16	11.4	Acre	$484.05	11
	655	Forest Trails and Landings	1	$905.48	1.0	Acre	$3,112.89	0
			42	$127,260.48				
Wildlife / Other	395	Stream Habitat Improvement & Mgmt.	1	$103,950.00	4.0	Acre	#N/A	0
	410	Grade Stabilization Structure	7	$15,969.46	13.0	Each	$3,434.93	0
	412	Grassed Waterway	7	$12,315.50	7.0	Acre	$5,680.23	0
	642	Water Well	3	$11,828.65	202.0	Feet	#N/A	0
	645	Upland Wildlife Habitat Mgmt.	12	$8,842.54	1,499.9	Sq. Ft	$36.28	0
	646	Shallow Water Development & Mgmt.	1	$5,714.62	2.0	Acre	$2,375.24	1
	643	Restoration and Mgmt. of Rare & Declining Habitats	1	$4,741.88	27.8	Sq. Ft	$184.03	0
	468	Lined Waterway or Outlet	1	$4,400.00	88.0	Lft.	$52.05	0
	490	Tree/Shrub Site Preparation	2	$1,010.80	22.2	Acre	#N/A	0
	620	Underground Outlet	1	$374.98	225.0	Feet	#N/A	0
			36	$169,148.43				
TOTAL			1,131	$7,977,059.27				

#N/A: Information not available

Source: USDA - KY NRCS

Table 4.6. Conservation practices efficiency estimates vs. EQIP/WHIP incentives received – Groundwater

Land Use Category	Practice Code	Practice Name	Number of Contracts	Payments Received	Total Units	Unit Type	Estimated costs/unit	Water Quality Efficiency
Pastureland	614	Watering Facility	220	$1,920,836.34	7,693.4	Each	$2,408.73	0
	516	Pipeline	220	$1,684,264.93	1,080,756.1	Feet	$2.44	0
	382	Fence	147	$1,528,761.61	959,409.9	Feet	$2.45	4
	472	Access Control	80	$654,912.77	13,515.6	Acre	$60.60	13
	512	Pasture and Hay Planting	60	$437,836.90	3,509.7	Acre	$452.16	10
	378	Pond	36	$342,971.38	56.0	Each	$6,623.93	5
	580	Stream bank and Shoreline Protection	6	$254,715.55	5,095.0	Feet	$117.96	9
	313	Waste Storage Facility	8	$233,231.70	10.0	Each	$6,494.17	9
	528	Prescribed Grazing	68	$145,846.00	8,274.0	Acre	$47.75	12
	561	Heavy Use Area Protection	28	$121,644.81	46.9	Each	$864.72	7
	327	Conservation Cover	28	$88,078.57	567.6	Acre	$287.63	13
	578	Stream Crossing	32	$65,842.88	51.0	Each	$3,769.68	0
	575	Animal Trails and Walkways	21	$51,276.32	15,653.0	Sq. Ft.	$1.53	0
	574	Spring Development	32	$39,378.50	43.0	Each	$2,301.33	6
	606	Subsurface Drain	4	$3,348.35	3,340.0	Feet	#N/A	0
			990	$7,572,946.61				
Cropland	590	Nutrient Mgmt.	17	$43,971.90	2,113.1	Each	$1,988.51	13
	340	Cover Crop	4	$29,562.51	298.4	Acre	$188.40	9
	342	Critical Area Planting	28	$29,359.19	71.7	Acre	$1,980.81	11
	386	Field Border	5	$3,416.90	29,648.0	Acre	$351.21	12
	393	Filter Strip	8	$1,144.29	506.3	Acre	$417.93	24
	484	Mulching	1	$248.96	73.8	Acre	#N/A	9
			63	$107,703.75				

Table 4.6. Conservation practices efficiency estimates vs. EQIP/WHIP incentives received – Groundwater (Cont.)

Land Use Category	Practice Code	Practice Name	Number of Contracts	Payments Received	Total Units	Unit Type	Estimated costs/unit	Water Quality Efficiency
Woodland	666	Forest Stand Improvement	36	$123,431.84	1,028.7	Sq. Ft.	$298.89	6
	391	Riparian Forest Buffer	5	$2,923.16	11.4	Acre	$484.05	24
	655	Forest Trails and Landings	1	$905.48	1.0	Acre	$3,112.89	0
			42	$127,260.48				
Wildlife / Other	395	Stream Habitat Improvement & Mgmt.	1	$103,950.00	4.0	Acre	#N/A	6
	410	Grade Stabilization Structure	7	$15,969.46	13.0	Each	$3,434.93	3
	412	Grassed Waterway	7	$12,315.50	7.0	Acre	$5,680.23	11
	642	Water Well	3	$11,828.65	202.0	Feet	#N/A	0
	645	Upland Wildlife Habitat Mgmt.	12	$8,842.54	1,499.9	Sq. Ft.	$36.28	0
	646	Shallow Water Development & Mgmt.	1	$5,714.62	2.0	Acre	$2,375.24	7
	643	Restoration and Mgmt. of Rare and Declining Habitats	1	$4,741.88	27.8	Sq. Ft.	$184.03	2
	468	Lined Waterway or Outlet	1	$4,400.00	88.0	Lft.	$52.05	2
	490	Tree/Shrub Site Preparation	2	$1,010.80	22.2	Acre	#N/A	0
	620	Underground Outlet	1	$374.98	225.0	Feet	#N/A	3
			36	$169,148.43				
TOTAL			1131	$7,977,059.27				

#N/A: Information not available

Source: USDA - KY NRCS

In conclusion, for a potential WQT, the practices to be investigated in order to reduce NPS N and P pollution are the ones with the best performance of abatement cited above. However, technical complementarities will have to be considered, as well as the costs of each practice. Considering the costs of each practice, the amounts of cost-share being offered by EQIP and WHIP will be required for a potential trading scheme.

Data was also collected from the Kentucky Cooperative Extension System reports from the University of Kentucky, College of Agriculture, in the number of extension contacts made by Kentucky state agriculture extension specialists from 2007 to 2009, in order to test if it has an effect on the level of government and CRP payments in a county. This information is used as a proxy in education and as measurement of outreach that might positively contribute to a larger participation in conservation.

Based in the 46 counties from the Kentucky River Watershed region, the information collected to test if land uses, multi-program participation, and the number of extension contacts made by extension specialists and its relationships with the CRP payments in a county offered significant insights (Figures 4.7 and 4.8, and Table 4.7). The average value of CRP payment per county was US$19,675.36, while the EQIP average payment per county was US$53,774.14 and the WHIP average payment per county was US$6,672.31.

Table 4.7. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
CRP Payments (US$)	19,675.36	24,043.65	268.00	99,640.00
# Farms	605.24	403.97	23.00	1,651.00
Avg. farm size (acres)	148.15	35.25	55.00	245.00
% Pasture Land	0.14	0.12	0.00	0.42
% Crop Land	0.22	0.16	-	0.50
EQIP Payments (US$)	53,774.14	74,259.00	-	293,034.98
WHIP Payments (US$)	6,672.31	12,403.89	-	50,136.58
# Extension contacts	13,393.59	14,508.19	-	92,248.00
N = 46 Counties				

Source: Cooperative Extension Service; NASS; FSA; USDA Kentucky NRCS

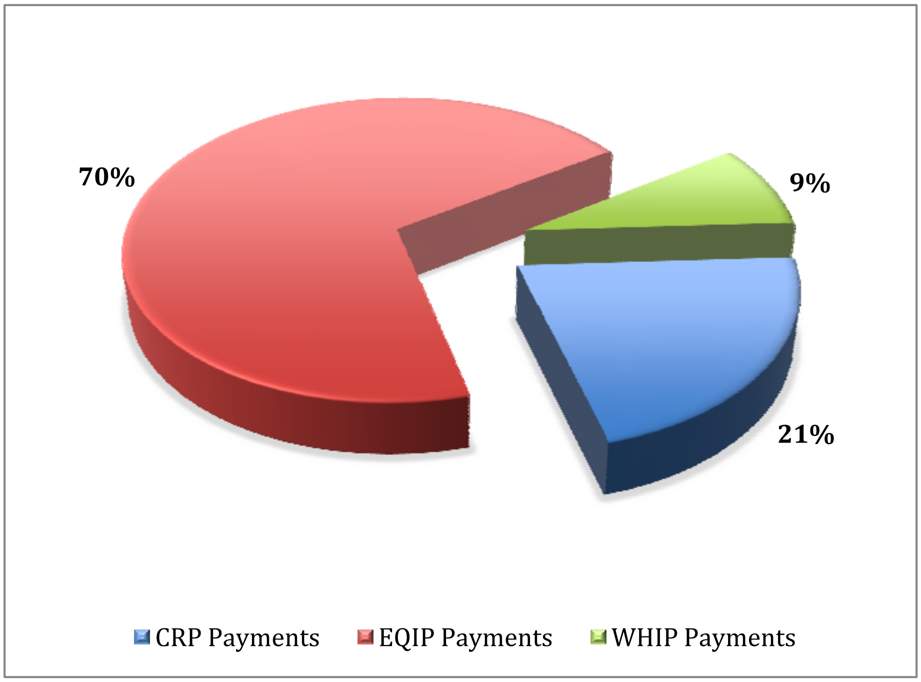

Figure 4.7. Kentucky River Watershed Conservation payments

The land uses in the study region differ from the average farmland uses of each county, only 22% of the total is farmland, and 14% of the total land is under pasture. Forests must characterize most of the land in the region, as well the mountainous terrain from the Eastern side of the state and the urban areas. On the other hand, the average farm size of the study region, at about 148 acres, is very similar throughout the state, which is around 164 acres on average. And finally, the number of contacts made by extension specialists to farmers totals 13,393.59 on average by county from the period of the years 2007 to 2009.

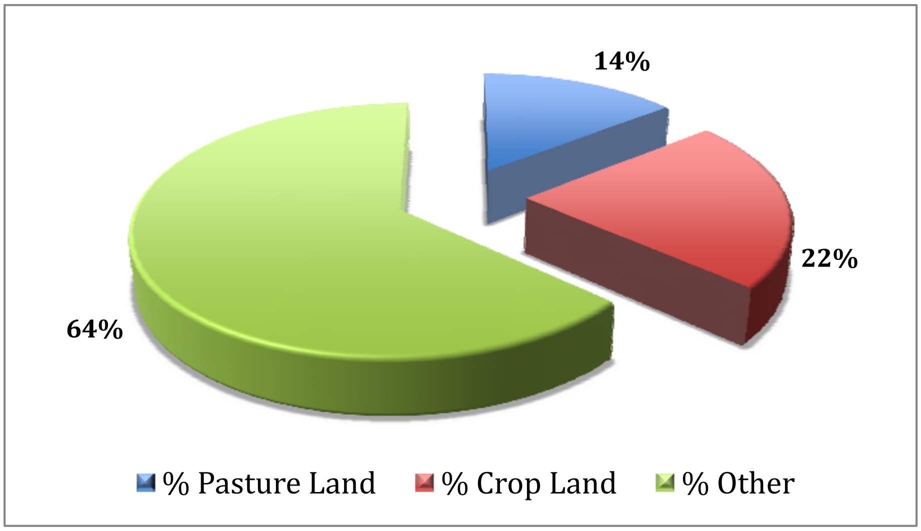

Figure 4.8. Land Uses

The study region has different dispersion of land uses than the state. Studying the specific area of the Kentucky Watershed rather than the entire State of Kentucky, helps understand the peculiarities of communities of important stakeholders in a possible WQT system in this particular region. Aggregating information of land uses, information of different programs participation, and information about education and outreach in the Kentucky Watershed, is crucial. This aggregation of relevant information of this particular region, leads to a series of analysis through an empirical model discussed in the following section, with the intention of providing a comprehensive view in the participation in conservation.

Chapter 5. Model estimation results

In order to identify a relationship of the level of CRP payments made to farmers in each of the counties from our study region, with land uses, multi-program participation and the Kentucky extension service, the payments were regressed on number of farms per county, average farm size per county, percentage of cropland per county, percentage of pastureland per county, EQIP payments per county, WHIP payments per county, and on the total number of extension contacts made by KY state extension specialists on farmers located on the study region.

The model for the equation previously presented is given by:

$$CRP = \beta_0 + \beta_1\ NFarms + \beta_2\ AVGFarm + \beta_3\ TPCropuse + \beta_4\ TPPastureuse + \beta_5\ EQIP + \beta_6\ WHIP + \beta_7\ EXTENSION + \varepsilon.$$

Estimation results of the OLS model for the equation on CRP payments are presented in table 5.1.

Table 5.1. OLS Estimation Results

Variable	Coefficient	Std. Err.
Constant	-63,686.000***	19,383.00
# Farms	44.804***	12.46311
Avg. farm size (acres)	300.919***	110.82851
% Pasture Land	80015.000	55,971.00
% Crop Land	-80604.000	61,539.00
EQIP Payments (US$)	0.005	0.04088
WHIP Payments (US$)	-0.022	0.2329
# Extension contacts	-0.011	0.18999
Adj. R^2	0.544	-
F-Value	7.470***	-

*, **, and *** indicate significant at the 10%, 5%, and 1% significance levels respectively.

Sources: Cooperative Extension Service; NASS; FSA; USDA Kentucky NRCS

The adjusted R2 for the tested model is .544, therefore 54% of the variation in CRP payments is explained by number of farms per county, average farm area, percentage of cropland per county, percentage of pastureland per county, the level of EQIP payments per county, the level of WHIP payments per county, and the total number of extension contacts made by KY state extension specialists. On the other hand, almost 46% of the variation in CRP payments is not explained by the independent variables. The F-test shows that the model is significant at 1% level.

Based on the regression analysis the results show that, the average numbers of farms per county and average farm size per county of the study region have a positive relationship with the participation in the CRP. If two counties from this study region have the same average farm size per county, percentage of cropland per county, percentage of pastureland per county, EQIP payments per county, WHIP payments per county, and total number of extension contacts made by KY state extension specialists, but the number of farms of one of the counties has one more farm than the other, one can predict that that the county with one more farm to have a CRP payment $44.80 higher than the county with one less farm. In addition, holding all other independent variables fixed, if the average farm size of a county increases by one acre, then the CRP payment is projected to increase by $300.92. Thus, counties with more farms, and larger farms, tend to be more responsive to CRP incentives. This result can be explained because CRP sets aside crop acreage as conservation measure.

When comparing the relationship between the land uses, multi-program participation, and the community characteristic of the extension service in the participation of counties in the CRP payments, no significance was found. One may expect to find some level of significance on such variables given the findings observed in the studies from the literature reviewed. One of the reasons for finding insignificant results is the possibility of time lag between the number of contacts made by extension service specialists and the conservation payments being made during similar period. This can be solved by acquiring older periods of data on extension contacts from the Kentucky Cooperative Extension service. Furthermore, one would expect that education and outreach information, delivered from the extension services, would demand more time to be spread and absorbed by communities targeted before the action of engaging in conservation programs, or that maybe farmers already had exposure to these programs from extension. Therefore, further exploration with different education attainment maybe justified, because additional information from extension services on conservation programs would not be relevant to the adoption decision.

Chapter 6. Conclusions

There are 1,217 PS of pollution in the Kentucky River Watershed, and 1477.2 river miles affected by agricultural sources of pollution discharge. With 27,841 farms the Kentucky River Watershed has 33% of all farms in the State, and 29% of the farmland area in the State. Around 45% of the total area of the Kentucky River watershed is under farmland. From the farmland area, 44% is under crop production and 28% is under pasture, almost 23% is under forestland and around 5% represent other types of land uses. The average size of farms in the region is slightly smaller than the state's average.

The diverse characteristics of the Kentucky River basin pose a challenge for a water quality trading program, but they could also support an analysis with a rich coverage of various buyers and sellers of water quality credits including non-industrial private forest land owners, industrial, agricultural, and urban entities. The Kentucky River Watershed has different dispersion of land uses than the state, enforcing the idea of studying the specific area of the Kentucky Watershed rather than the entire State of Kentucky, which helps understand the peculiarities of communities and important stakeholders in a possible WQT.

To achieve an efficient reduction of N and P pollution required by regulations, the installation of BMPs and/or development of nutrient management plans by sources of pollution can create permits for pollution emissions that could be traded with less efficient sources of pollution. The product to be traded on the proposed market will be the over control generated by sellers. WQT schemes can be an alternative to conservation programs that cannot cover specific pollution standards. The involvement of stakeholders is one of the primary objectives for the success in the development of WQT schemes, which not only have the potential to reduce costs of compliance from regulations, but also reduce farmers' dependency on government financial assistance.

However, literature on trading alert that during the last 20 years that these mechanisms are being applied the results of the WQT initiatives including NPS are mixed, if not negative. It was found that the main barriers for the participation of farmers are the lack of awareness of these systems, the lack of science, and no trust in program administrators (Breetz et al., 2005). When approached with the ideas of WQT, farmers fear they will lose autonomy in their farm operations, they also fear increased government oversight, and they may resent the fact of being portrayed as polluters, because they view themselves as stewards of the land and that they have a strong conservation ethic. Farmers also express their resentment towards urbanities. They were reluctant to participate in some WQT programs involving municipalities because they perceived their participation as an indirect way to fund urban growth (Breetz et al., 2005).

Understanding the factors that influence participation in voluntary programs is important when evaluating existing programs and determining new conditions for those programs, as well as when developing new programs. Several studies were identified using primary data of land uses such as soil eligibility, farms' characteristics such as farm size, county characteristics such as being near to an urban area, net returns from agriculture, or community characteristics such as education, that explain behavior towards adoption of conservation practices. Therefore, farmland uses as well as community characteristics are relevant if one wants to determine the probability that farmers will participate in conservation programs.

From the studies that used secondary data to investigate conservation adoption through BMPs, significant factors and features were found that affect participation in voluntary programs towards conservation. Within the most relevant factors, are the farmers' characteristics, such the age of farmer operator, the land characteristics, such as soil and climate, the net returns from farm and land use, and the community characteristics, such as education attainment and population density.

Based on the findings from the literature, this study tested the relationships between CRP participation, with number of farms per county, average farm size per county, percentage of cropland per county, percentage of pastureland per county, EQIP payments per county, WHIP payments per county, and on the total number of extension contacts made by KY state extension specialists on farmers located in the study region.

From the results of this study, one could expect more participation in a trading scheme from some counties than others. Counties with more farms and larger farms will probably have higher rates of participation in conservation programs, since programs like the CRP set aside crop acreage for land conservation.

Relevant variables identified in previous studies that used secondary data on conservation adoption, one can specify an equation that includes factors that influence CRP participation, and conclude that in fact, farmers from certain counties respond to monetary incentives if the right compensation for their opportunity costs is offered. One could also think that, farmers of specific counties can indeed be aware of possible penalties if they do not comply with the mandate of the Agricultural Water Quality Act. Moreover, due to the increases of food commodity, prices the overall costs of conservation programs, such the EQIP, will rise in order to maintain the level of contracts. Perhaps, with fears of not being able to benefit much longer from government cost-share programs, that target standards to reduce pollution, farmers are taking advantage of those programs to reduce their costs of compliance with pollution abatement. Trading schemes that prove to be less costly could be an alternative to some of the incentives these programs provide.

To define a model that would explain participation in a Water Quality Trading scheme, in the Kentucky River watershed, is necessary to obtain farm level information. Farm level information could be obtained from a survey conducted to farmers that would ask their willingness to participate in such a scheme. A survey will also be important to determine the price at which PS of pollution will want to trade with the NPS of pollution, and the NPS will want to trade with PS, if PS has interest in engaging farmers to abate pollution. Other than land use features, as previous studies revealed, farmer characteristics such the age of primary operator, education attainment, the source of information a farmer receives for its agriculture activities, farm income, farm net returns are some examples of factors that can also be crucial in targeting important stakeholders in a WQT, and could be included in a survey.

Accordingly to conservation practices costs of implementation, the cost-share amounts being paid by government programs have to be considered for policy makers and program administrators as the minimum staring point to negotiate in a trading scheme. In fact, to target the problem of excess of N and P, and the impact of watersheds such as the Kentucky River in the Mississippi system, that discharges significant quantities of these pollutants into the Gulf of Mexico, policy makers and program administrators should be advising and stimulating the adoption of practices with the best abatement performance for such pollutants. For example, riparian forest buffers, filter strips, conservation covers and nutrient management seem to be the most indicated in the Kentucky River Watershed. Moreover, practices should be suggested considering technical complementarities between other practices.

Finally, there is satisfactory information with the analysis drawn in this study, about several relationships between agricultural governmental cost-share programs, land uses, farm characteristics, information captured from secondary data on costs of BMPs and its relative efficiency, and with the addition of PS information on their location, the amounts of permits given by authorities for the right to pollute, and with the help of GIS models, that will be helpful to do more reliable inferences on the feasibility of a WQT. For example, given the land uses of each county and the location of the PS, it will be possible to identify areas where there are enough NPS and PS to create a market for tradable permits of N and P pollution. This information could be also used to even discard certain locations because of the risk of creating hot spots given the location of the polluters.

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