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# **Pesticide Externalities in Andean Potato Production: Integrated Production and Biophysical Models of Groundwater Contamination**

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Advisor: David Lee**

Due to negative externalities, subsidies encouraging pesticide use in developing countries are under criticism. Few studies, however, attempt to quantify the magnitude of these externalities, or the relationship between pesticide subsidy and use. This thesis, part of a larger study by the International Potato Center, examines pesticide use in potato production among sample farms in northern Ecuador.

The thesis is composed of three parts. First, solving the farmer's dynamic optimization problem for a recursive three-stage production process is shown to yield a system of cost-share equations. Seemingly unrelated regression is used to derive production function parameter and demand elasticity estimates. These estimates are shown to be more efficient and more logical than those derived in previous work. Although bias is present, its sources are explained.

Second, a mathematical model for simulating pesticide leaching, LEACHA, is validated and applied to the case considered. This model incorporates data on soil properties, weather patterns and pesticide characteristics. This is the first study to apply such a model to high-altitude soils of volcanic origin.

Finally, the microeconomic and leaching models are linked through the estimates of pesticide demand elasticity and groundwater contamination is assessed. Using multiple 27-year simulations to account for spatial and temporal variability, curves relating contamination risk to price changes are estimated and can serve as a tool for policy analysis. Under the present policy scenario, pesticide contamination is not found to pose a health threat in the watershed studied.

# **Analysis of Factors Influencing Fair Market and Restricted Land Use Values of Farmland in New Jersey's Purchase of Development Rights Program Via Hedonic Pricing Models**

**Nancy S. Lee**

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The need for innovative farmland preservation policies intensified when socioeconomic patterns changed after World War II. This is particularly true in the Northeast where farmland is an important source of open space amenities as well as agricultural commodities. Purchase of Development Rights (PDR) programs are the latest series of creative land preservation techniques whereby development rights are purchased and retired.

The objective of this thesis is to identify determinants of fair market and restricted land use values of farmland in New Jersey and to specify possible appraisal formulas to determine easement values for the state PDR program. Appraisal formulas have been successfully utilized in other PDR programs to minimize costs of appraisals and time needed for manual appraisals to be conducted and reconciled by a review appraiser.

Since the price of an easement is the difference between a parcel's worth in real estate and in agricultural use, the easement formula will be the

difference between the fair market and restricted land use value functions. Four categories of exogenous variables will be used in hedonic price models of fair market and restricted land use values. The categories are parcel specific, locational (distance to the urban centers) municipal and quality of life variables.

The semi-logarithmic and double logarithmic models are best for predicting fair market and restricted use values respectively. The quality of life variables, distance from a parcel to Wilmington, DE and percent of a parcel in wetlands are primary determinants of restricted use value.

A benefit cost analysis shows that the implementation of an appraisal formula is feasible. Since agriculture is quite diverse in New Jersey, it is possible for a base formula to be determined by the State Agriculture Development Committee in which county agricultural boards can modify to capture the special characteristics and needs of their local farms.

NAREA Master's Thesis Award of Merit

# **Conjoint Analysis of Australian Consumer Preference for Pork Products Produced With Genetically Engineered Porcine Somatotropin (pST)**

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In this study, information on Australian consumer preference for pST-supplemented pork products is provided based on a conjoint model of consumer preference. The conjoint model, which was specified to include estimable interactions between pork product attributes, was estimated using GSK weighted least squares to correct for problems stemming from the repeated measures nature of the design.

Results show that Australian pork consumers make a tradeoff between leanness and technology at high levels of fat reduction, and are willing to accept pST-produced pork at fat reduction levels greater than available with current technology.

# Determining the Best Uses of Mangrove Areas: An Application of Dynamic Optimization to the Case of Shrimp Mariculture in Ecuador

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This research aims to determine the best uses of mangrove areas, with special emphasis on the shrimp mariculture industry in Ecuador. Traditionally, mangrove areas have been considered useless resources with no economic value except through development. Consequent conversion or exploitation of mangrove areas for urban infrastructural development, agricultural development and, more recently, shrimp mariculture has been taking place in several developing countries. The growing concern for the environment and sustainable development has stressed the multiple-use nature of mangrove areas and the associated trade-offs of their use. Mangrove ecosystems are being increasingly recognized as important renewable resources capable of producing not only goods and services, but also of providing important natural ecological functions. Economic value may then be associated with mangroves in their natural state.

The centerpiece of this work is a formal model integrating biotechnical, ecological, economic,

and policy factors to determine the characteristics of the economic activities competing for the use of mangrove areas. The competing economic activities included are shrimp mariculture, mangrove forestry and coastal artisanal fisheries. A simple measure of benefits derived from natural ecological functions performed by mangrove areas is also considered. Standard concepts of natural and environmental resource economics, biological population dynamics and management strategies are combined to determine net social benefits generated by alternative uses of mangrove areas. A multi-sector, dynamic bioeconomic model is developed to determine the optimal intertemporal allocation of mangrove areas among the four alternative activities. The model is used to calculate present values of net benefits under four alternative management strategies. The results support a set of policy recommendations for management of coastal resources in Ecuador.