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Economics of Pesticides Use among Maize Farmers in Edo State, Nigeria

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Abstract: This paper estimated the degree of price responsiveness as well as the efficiency of pesticides use on maize farms in Edo state of Nigeria. The results indicated that the demand for pesticides was negatively influenced by pesticide price in consonance with economic theory. Pesticides usage was found to be responsive to changes in pesticides prices and the elasticity estimates were greater than unity, that is, the demand for pesticides was found to be own-price elastic. This result is important in that if the government wished to reduce pesticide usage using levies the results may be very dramatic. Estimates of values of marginal product suggest that pesticides were not efficiently utilized by the sampled maize farmers; as the results imply that profits can be increased by increasing pesticides usage among the respondents.

Key words: Maize, farmers, pesticides, efficiency, elasticity

INTRODUCTION

Maize (Zea mays) is an important cereal being cultivated in the rainforest and the derived savannah zones of Nigeria. It is a very important staple food consumed by millions of Nigerians. Studies in maize production and marketing in different parts of the country have shown an increasing importance of this crop, amidst growing utilization by food processing industries and livestock feed mills. The crop has thus become a local "cash crop" most especially in the south western part of Nigeria, where at least 30% of the cropland has been put to maize production under various cropping systems[3,5]. The economic importance of this crop has been further boosted by the Federal Government-imposed ban on importation of cereals such as rice, maize and wheat since 1986. Local production therefore needs to be stepped up to meet the demand for human consumption, breweries, pharmaceutical companies, baby cereals, livestock feed and other industries.

The continued cultivation of maize as a lucrative agribusiness enterprise is however threatened by a number of problems, including those of diseases and pests. For instance, most of maize varieties grown in Nigeria are highly susceptible to downy mildew disease[9]. Other diseases of the crop include maize rust, leaf blight, maize streak, maize mottle / chronic stunt, curvularia leaf spot, stalk and ear rots. In addition, maize parasitic weed, known as striga has been reported to be a serious threat to increased maize production, thereby causing economic losses in Northern Guinea savanna and some parts of derived southern Guinea. Insect pests, such as stem borers, armyworms, silkworms, grasshoppers, termites and weevils also affect the yield of the crop.

Effective control of these pests and diseases require the use of chemical pesticides, whose level of use has been found to depend on price, risk, credit availability and cropping pattern[12]. Price is particularly important here since most of the chemicals are usually imported into the country. For instance, the low exchange rate of the Nigerian currency against major currencies has been pushing the prices of these chemicals upwards. It is therefore expected that Nigerian farmers will respond to changes in the prices. They are also expected to be efficient in utilizing these chemicals if they were to be rational. The degree of this responsiveness should be important to researchers and policy makers, as it would determine the level of pesticide use in respond to price changes. It is also necessary to determine the productivity of these pesticides in order to justify the expenditure on them by farmers and government (in case of subsidy).

The objectives of the study are therefore two-fold: the first is to determine the efficiency of pesticide usage by maize farmers, while the second is to determine the effect of prices on the demand for pesticides applied by maize growing farmers in the study area.

An economic indicator of the productivity of pesticides is the value of the crop that could be produced from an additional dollar spent on pesticides[4]. Headley[8] indicated that U.S. Agriculture could produce an average of four dollar of additional product for each pesticides dollar expended and Strickland[11] returned a figure of five dollar for England. Alimi and Ayanwale[1] reported N3.21 for every N1.00 expended on pesticides.

The price elasticity of demand of pesticide use in agribusiness enterprises is an important variable in designing an effective policy (such as levies and subsidies) for pesticides. For example, if pesticide use

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at the farm is almost indifferent to price increases of pesticides, perhaps due to a high efficiency of pesticide use, the introduction of levy will generate substantial revenue.

The Department for Environment, Food and Rural Affairs (DEFRA)[6] reviewed several European studies that have estimated price elasticity of demand for pesticides. Although the studies reviewed adopted different methodological approaches, they appear to show that price elasticity of demand for pesticides is quite low. It is also indicated that the elasticity of demand for herbicides is somewhat lower than for other pesticides. A study by Sukume[12] indicated that pesticide usage in Zimbabwe has been responsive to prices and the response tended to be price inelastic. His results showed that a 10% increase in the price of insecticides (holding product and other input prices constant) would on the average lead to a 2.34% decrease in the use of pesticides. He also found that Zimbabwean farmers were efficient users of pesticides. Tijani[13] also reported efficient utilization of pesticides by cacao farmers in south-western Nigeria.

MATERIALS AND METHODS

The study was carried out in Edo state, which lies roughly between longitude 6^0 04'E and 6^0 43'E and latitude 5^0 44'N and 7^0 34'N of the equator. It is bounded in the south by Delta State, in the north by Kogi state, in the west by Ondo State and in the east by Kogi and Anambra states. The agricultural resources in the state consist of food crops, tree crops, forestry products and livestock. The main food crops cultivated include yam, cassava, maize and rice in the Benin lowlands and on the Esan plateau. There is rice cultivation in the flood plain of the River Niger at Agenebode and Illushi.

The study was conducted in four (4) Local Government Areas of the State: Oredo, Ikpoba-Okha, Uhunmwode and Orhionmwom, with sixteen (16) towns / villages sampled in all. The areas chosen were representative of the major food crop producing areas in the state. Out of a total of 80 farmers surveyed, the questionnaire in respect of 74 of the sampled farmers, were found analyzable. The remaining was rejected, as a result of inadequate information supplied by the respondents. The survey was conducted between August 2001 and January 2002 using a pre-tested structured questionnaire as research instrument.

The Model: Pesticides differ from other inputs involved in the agricultural production process. Whereas inputs such as fertilizer and water directly impact on output, pesticides impact on productivity indirectly through their toxic effect on yield reducing pests. In other words, direct productive inputs determine the potential output. Attainment of this potential is affected by prevalence of pests. Application of pesticides determines to what extent this is attained. If pest prevalence is low, then application of pesticides will have little effect on observable yield. Alternatively, when infestations are high, application of pesticides will have significant positive impact on yield. Therefore, demand for pesticides is bound to be very price responsive in production processes that are subject to heavy pest infestations as compared to those with less pest prevalence.

In line with previous studies, the development of the empirical model for the study begins with the typical production equation, using the Cobb-Douglas. Following Lichtenberg and Zilberman (1986), a production function (1) that distinguishes between productivity and protective inputs is utilized:

$$Q = aZ^b[G(x)]^g \quad \ldots\ldots (1)$$

Where:

Q = output;
Z = level of productive input use;
X = level of pesticide use;
G(x) = the pest damage control function, achieved from applying x amount of pesticides; and
α and β = production parameters.

The function G (.) equal zero, if no pesticides nor any other damage control measures are utilized; and equal to 1, if pesticides are used at a level enough to kill all pests. If G (.) is equal to 1, we achieve the maximum output for the given level of productive inputs and this gradually decreases as less and less of pesticides are used.

Assuming a logistic damage control function and the neoclassical profit maximization objective on the part of farmers, Lichtenberg and Zilberman derive the following relationship for pesticides demand and value of marginal product.

Pesticide demand: $X = a_0 + a_1 \ln (PQ/W)$

Value of marginal product: $VMP = PQ \exp \{X - a_0 / a_1)$

The pesticide demand function is used to identify the degree of responsiveness of these farmers to changes in prices of pesticides. The value of marginal product is used to assess efficiency of pesticides applied. If the value of marginal product is equal to the price of pesticide, further increase in the use of pesticide will not increase profits. If the value of the marginal product is greater than the pesticide price,

increase in pesticide usage will increase profits. Conversely, if the value of the marginal product is less than price, a decrease in pesticide usage increases profits. In other words, a deviation of the value of the marginal product from price represents inefficient use of pesticide.

RESULTS AND DISCUSSIONS

Most of the sampled farmers were small holders having farm sizes between 0.1 to 1.5 hectares. The data indicated that majority (67.5%) either rent or lease their farm land. Weed and pest infestations are serious problems confronting all the respondents. Due to the severity of pest infestation, 90.54% of the farmers interviewed sprayed their farms against pests and weeds. Most of the farmers (62.7%), who sprayed their farms, purchased their pesticides from the open market and none from cooperative societies. Supply of pesticides to the state was relatively adequate as majority (73.13%) of them had enough to buy. The estimated pesticides demand models are reported in Table 1.

The results from the table indicate that the fit of the demand specifications ranges from 9.1% (Furadun) to 91.5% (Cymbush + Rigor), that is, explaining as low as 9.1% in the case of Furadun and as high as 91.5% in the case of Cymbush. The hypothesis that the ratio of revenue to pesticide price does not affect pesticide use levels is rejected at 5% level in all cases.

The coefficients are significantly different from zero at 5% level in all the estimated equations. This shows that quantities of all the pesticides used by sampled farmers in the study area were significantly influenced by the prices of pesticides. This implies that farmers in the area of study significantly responded to changes in pesticides prices in their pesticide usage.

Pesticide demand elasticities at their means are shown in Table 2.

From the results contained in Table 2, the demand for Novacron, Furadan, Primextra and Cymbush + Rigor is elastic since the absolute values of elasticity for the pesticides are greater than one. These suggest that for a 1% increase in the price of Nuvacron (holding product and other input prices constant) would yield 2.5% decrease in its use. Also a 1% increase in the prices of Furadan, Primextra and Cymbush + rigor would result in a decrease in their use by 2.26%, 3.16% and 2.53% respectively, holding product and other input prices constant.

These results suggest that sampled farmers were very responsive to changes in the prices of pesticides used. The result is important because it indicates that policy measures that would increase prices of agro-chemicals (such as imposition of levies) would substantially reduce pesticide usage by farmers in the area of study. On the other hand, the provision of subsidy would dramatically enhance pesticide usage by these farmers.

Table 2 also reports values of marginal products evaluated at the means using the formula VMP in the preceding section. For all the pesticides, the values of the marginal products are greater than their respective prices.

Table 1: Estimated Pesticide Demand Functions

Pesticide	Constant (a0)	Natural Log (a1) Revenue/Pesticide Price	Co-efficient of Determination
Nuvacron	- 3.101	1.736	48.3
	(-2.019)	(6.322)	
Furadun	-0.840	0.999	9.1
	(-0.369)	(2.529)	
Primextra (herbicides)	-4.191	1.404	28.3
	(-2.679)	(3.022)	
Cymbush + Rigor	-3.847	1.500	91.5
	(-7.484)	(16.068)	

Note: t-values are in parentheses

Table 2: Pesticides Demand Elasticities and Value of Marginal Products at the Means.

Pesticides	Pest elasticity of Demand	Value of Product Marginal	Pesticide Price
Nuvacron	2.50	813.88	651.74
Furadan	2.26	827.88	691.16
Primextra	3.16	978.39	820.00
Cymbush + Rigor	2.53	756.65	597.69

As noted earlier, if the value of the marginal product is greater than the pesticide price, increase in pesticide usage will increase profits. Also, a deviation of the value of marginal product from price represents inefficient use of pesticide. These results therefore tend to suggest that (i) sampled farmers were not efficiently utilizing pesticides on their maize farms. This may not be unconnected with the escalating cost of pesticides (which are largely imported into the country) occasioned by the devaluation of the naira against international currencies and outright or gradual removal of subsidies on agricultural inputs following the deregulation policy adopted by Nigerian government; and (ii) farm profits can be increased if an average maize farmer can increase pesticides usage in the study area. Government at various levels can assist in this regard by subsidizing pesticides and or providing credit to farmers to purchase sufficient quantities of pesticides to use on their farms.

Conclusions: This study has shown that the demand for pesticides in the area of study was negatively influenced by pesticide price in consonance with economic theory. Pesticides usage was found to be responsive to changes in pesticides prices and the elasticity estimates were greater than unity, that is, the

demand for pesticides was found to be own-price elastic. Also, pesticides were not efficiently utilized by the sampled maize farmers; as the results imply that profits can be increased by increasing pesticides usage among the respondents.

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