

Economic analysis of farm hazards associated with the use of agrochemicals on agricultural farms

*¹Tekwa, I.J., ¹Ambali, O.Y. and ²Gabdo, B.H

¹Dept. of Agricultural Technology, Federal Polytechnic, P.M.B. 35, Mubi, Adamawa State, Nigeria

²Dept. of Agricultural Economics and Extension, Adamawa State University, P.M.B. 25, Mubi-Nigeria

*Corresponding author: johntekwa@gmail.com

Abstract

This paper assessed the economic implications of farm hazards associated with the use of agrochemicals on some farms in four locations namely; Digil, Gella, Lokuwa and Shuware in Mubi environment between May and December, 2008. Relevant data on socio-economic background of the farmers and the agrochemical farm hazards were sampled using structured questionnaire (80 copies) administered among the target farmers. 72 copies were filled, returned and analyzed for this study. The test-re-test method of data validation was employed. Data collected was also compared using descriptive statistics. The result indicated that the sampled farmers were predominantly middle aged (40-50 years) with farming experiences of mostly 20 years. Of the three principal farm hazards management types (weeds, insects and soil fertility) assessed, insecticides application was accounted as the highest (70%) source of farm hazard, especially in Gella. Simple cost analysis of farmers' health hazard, crop damage and animal health hazard recorded an estimated loss of \$1,007.75; \$32,333.46 and \$7,310.09 respectively. This high loss was notably attributed to poor skills of the farmers. It is therefore recommended that, awareness campaigns and mass trainings on the use, handling and application of agrochemicals should be encouraged in order to achieve effective and safe use of agrochemicals in the study area.

Key words: Agrochemical; associated use; economic analysis; farm hazard; Mubi; Nigeria

Introduction

In spite of the important contributions of agrochemicals in crop improvement for optimum yields, experts have still raised serious questions concerning their deleterious effects on human health and the environment. Agrochemical mishandling perhaps constitute one of the most severe farm operation hazards confronting farmers and their produce. Notable among such operations are wrong application time and dosages, ignorance of safety precautions and the use of adulterated or expired agrochemicals in circulation (Oboh et al, 2006). Agrochemicals encompass fertilizers and agricultural pesticides, insecticides, fungicides, rodenticides, acaricides, molluscides, herbicides, and plant regulators (Ayoola and Idachaba, 1990). The devastating effects of agrochemical mishandling are usually manifested in form of phytotoxicity in crops, contamination of surface and underground water sources, poisoning of livestock, destruction

of soil organisms as well as a threat to farmers' health. (Tekwa, and Apagu, 2008; Amalu, 1998; Don-Pedro, 1990). Human fatalities have been reported due to prolonged exposure to large doses of very toxic pesticides and herbicides as much as death of livestock from grazing on contaminated fields (Wilcox, 2006). Excessive use of nitrogenous (N) fertilizers such as urea could cause eutrophication and other associated life threatening problems to soil biomass and some aquatic lives. Fumigants were also found to pose severe effects on both soil flora and fauna population than any other pesticides (Brady and Wiels, 2002). Recent research works have documented valuable evidences on the hazardous effects of agrochemicals on aquaculture, crops, livestock, environment and human health (Adesiyan 1990; Amalu 1998; Ekpe, 2003; Hassan et al, 2007). Previously, few awareness studies were also conducted on the

Table 1. Distribution of farmers according to their age, level of education and farming experience.

Location	Digil		Gella		Lokuwa		Shuware	
	F	%	F	%	F	%	F	%
Age Distribution								
< 20	-	-	-	-	-	-	1	6
21-40	5	27	6	34	6	34	7	41
42-60	13	68	9	50	10	55	8	47
61-80	2	10	3	16	2	11	1	6
Total	19	100	18	100	18	100	17	100
Level of Education								
Primary school	1	5	3	16	5	28	3	18
Secondary school	6	31	10	55	7	38	4	23
N.C.E	-	-	1	6	2	11	3	18
N.D	7	37	1	6	2	11	4	26
H.N.D	2	11	-	-	-	-	1	6
B. Degree	-	-	2	11	-	-	2	12
M. Degree	1	5	-	-	1	6	-	-
Local training	2	11	-	-	-	-	-	-
Adult Education	-	-	1	6	1	6	-	-
Total	19	100	18	100	18	100	17	100
Farming experience								
1-10	4	21	1	6	4	22	4	24
11-20	7	37	5	28	7	39	5	29
21-30	7	37	7	39	4	22	8	48
31-40	1	5	3	16	1	6	-	-
41-50	-	-	2	11	2	11	-	-
Total	19	100	18	100	18	100	17	100

Source: Field survey (2008)

subject matter with little or no emphasis on its resultant economic implications. In view of the above, this study was therefore designed to examine the economic implications of farm hazards associated with agrochemical utilization on some farms in Mubi environment.

Materials and methods

The Study Area

The study was conducted in Mubi and its environs, all located in the northern part of Adamawa state. Mubi lies between latitudes 9°26' and 10°10'N, and between longitudes 13°11' and 13°44' E. It is belt by the Mandara Mountain ranges to its eastern side; Michika Local Government Area to the North, Hong Local Government Area to the West. The area has a population estimate of 759, 045 at a density of 160.5 persons per square kilometer on a land area of 506.40 square kilometers characterized by undulating topography (Nwagboso and Uyangu, 1999). Mubi has a typical wet and dry climate, with dry season lasting between November and March, while the wet season spans between April and October each year. The mean annual rainfall usually ranges between 700mm and 1050mm (Udo 1970, Adebayo, 2004). Arable crop production and animal rearing constitute one of the primary occupations of the people. Vegetation of the area is basically of Sudan Savannah, implying grass land

interposed with scattered shrubs and trees, mostly Eucalyptus, Acacia and locust bean trees amongst others (Adebayo, 2004, Tekwa and Usman, 2006). The most dominant physical feature in the area is the Mandara Mountains, which initiate run off generation and facilitated by the area's undulating topography.

Field of Study

A field targeted investigation for examining the economic implications of hazards associated with agrochemical usage was conducted in four areas namely; Digil, Gella, Lokuwa and Shuware, all within Mubi environment. Field data on user perceptions were sampled using randomly administered questionnaires (80 copies) among farmer population. Twenty (20) questionnaires were purposively administered in each study area with a total of seventy two (72) copies filled, returned and analyzed in this study.

Data Analysis

The study employed simple descriptive statistics such as frequency distribution and percentages to compare some of the measured parameters such as demographic data, duration of farming and agrochemical use experience, method of treating weeds, insects and soils. Hazardous effects of agrochemicals on crops, livestock and farmers'

Table 2. Distribution of farmers based on their methods of treating weed, insects and soils

Parameters	Digil		Gella		Lokuwa		Shuware	
	F	%	F	%	F	%	F	%
Weed treatment								
Physical	2	11	3	17	4	22	1	5
Chemical	4	21	11	61	3	17	4	24
Both	13	68	4	22	11	61	12	70
Total	19	100	18	100	18	100	17	100
Insect control								
Physical	2	11	1	6	3	17	1	6
Chemical	12	63	13	72	8	44	8	47
Both	5	26	4	22	7	39	8	47
Total	19	100	18	100	18	100	17	100
Soil treatment								
Organic manure	4	21	2	11	2	11	-	-
Chem. Fertilizer	5	26	3	17	4	22	4	24
Both	10	53	13	72	12	67	13	76
Total	19	100	18	100	18	100	17	100

Source: Field survey (2008)

health were valued and computed in monetary terms using simple cost analysis. The farmers' health hazard was estimated using the cumulative number of days that farmers were unable to work as a result of ailment caused by agrochemical usage. This was used as a multiplier of the expected income per day of the affected skilled and unskilled farm labors. Incurred losses from crop damage were equally estimated by multiplying the average market price of each crop with their respective yield loss (difference between the expected yield and the actual yield). Also, measurement of livestock health hazards was carried out in two ways; first, by determining the cost of treating the sick animals and by valuing the monetary worth of dead farm animals.

Results and Discussion

The results generated during the study are presented as follows:

Age Distribution

The age distribution ranged between 21 and 80 years. Farmers were categorized into four groups as adolescent (below 20 years), youths (21-40 years), middle aged (41-60 years) and old aged (61-80). This classification is similar to the earlier reports by Yusuf et al (2006). Majority of the farmers were middle aged with up to 68% in Digil, 50% in Gella, 56% in Lokuwa and 47% in Shuware. The youth farmers' population was second to the middle aged group in all the locations. Only few farmers belonged to the old aged group, especially in Digil (5%), Shuware (6%) and Lokuwa (10%), with relatively higher estimates (17%) in Gella.

None of the farmers belonged to the adolescent group in Digil, Gella and Lokuwa, except for Shuware that had only 6% of the adolescent farmers.

Level of Education

Farmers' educational status was grouped into primary, secondary, tertiary and informal education. The tertiary education include all post secondary school education such as national certificate of education (NCE), national diploma (ND), higher national diploma (HND), Bachelors degree (B.Sc) and Masters degree (MSc), while informal education was categorically the local training and adult education skills. In this study, most of the farmers had secondary school education with 32% in Digil, 56% in Gella, 39% in Lokuwa and 23% in Shuware, followed by those who had tertiary and primary education. Only few attended informal school with even no record of informal education in Shuware (Table 1). This indicated that majority of the farmers interviewed were considerably literates.

Farming Experience

Farming experience categories differed between age boundaries of 1-10 years and 41-50 years. Concentration of farmers was relatively higher in the categories of between 11-20 years and 21-30 years of farming experience. Few farmers had farming experiences of as high as between 41-50 years, especially in Gella and Lokuwa, which tied at 11% each, with even nil in Digil and shuware (Table 1).

Table 3. Agrochemical use experience (years)

<i>Agrochemical type</i>	Digil		Gella		Lokuwa		Shuware	
	F	%	F	%	F	%	F	%
Ranges								
Herbicides								
1 – 5	3	18	2	13	4	29	3	18
6 – 10	7	41	7	47	3	21	8	50
11 – 15	4	23	3	20	5	36	2	13
16 – 20	3	18	2	13	2	14	2	13
21 – 25	-	-	1	7	-	-	1	6
Total	17	100	15	100	14	100	16	100
Insecticide								
1 – 5	1	6	3	18	2	13	9	56
6 – 10	6	35	7	41	7	47	4	25
11 – 15	4	24	3	18	4	27	-	-
16 – 20	6	35	2	11	-	-	3	19
21 – 25	-	-	2	11	2	13	-	-
Total	17	100	17	100	15	100	16	100
Mineral Fertilizer								
1 – 5	-	-	1	6	3	19	3	17
6 – 10	4	27	4	24	3	19	3	17
11 – 15	2	13	1	6	4	24	4	22
16 – 20	7	47	3	19	2	13	2	11
21 – 25	2	13	2	13	1	6	3	17
26 – 30	-	-	2	13	2	13	2	22
31 – 35	-	-	3	19	1	6	1	11
Total	15	100	16	100	16	100	17	100

Source: Field survey (2008)

Method of controlling weeds, insects and soil nutrient management

Table 2 shows that farmers predominantly adopted physical, chemical and/or both methods in controlling weeds and insects. Application of organic manure, chemical fertilizers and their combined forms were the principal soil treatment methods. Chemical control method stood tall among other applications with high impacts on weeds in Gella (61%) and Lokuwa (62%), while insect control recorded higher in Digil (63%) and Gella (72%). This estimates opined that the farmers were considerably engaged in agrochemical utilization in the study area.

Agrochemical application skills

Based on training experience of agrochemical application, farmers were categorized into skilled and unskilled labour. Results presented in Table 2, indicated that farmers from three of the locations namely; Digil, Lokuwa, and Gella had as high as 63%, 67% and 72% of unskilled farmers with poor knowledge of agrochemical usage. This probably contributed to the higher percentage of health hazards recorded in the locations as similarly opined by Hassan et al (2007) for same Mubi area.

Duration of agrochemical use experience

Table 3 presented the distribution of farmers based on duration of agrochemical use experience. The result showed that herbicide application in Shuware had the highest percentage (50%) of experienced farmers (6-10 years), followed by Gella (47%) and Digil (41%), with as low as 21% in Lokuwa. This was followed by 16-20 years experience of herbicides use in decreasing order of 35% in Lokuwa, 24% in Digil, 20% in Gella and 12% in Shuware. Likewise, about half (56%) of the farmers had only 1-5 years of insecticide application experience in Shuware. Duration of insecticide use of between the range of 6-10 years and 11-15 years were higher in Lokuwa than in any other location studied. Only few farmers had up to 21-25 years experience of insecticide application in Gella (12%) and Lokuwa (13%), with even nil in Digil and Shuware. However, fertilizer application appeared the most widely practiced agrochemical farm operation in the locations, except for Digil, which had no record of 1-5 years, 26-30 years and 31-35 years of fertilizer application experiences.

Economic analysis of agrochemical farm hazards

Cumulative losses incurred from agrochemical

Table 4. Estimated values of cumulative losses incurred from agrochemical hazards on agricultural farms

Estimated parameters	Study Location												
	Cum. Unit	Digil AUC (\$)	Total loss (\$)	Cum. Unit	Gella AUC (\$)	Total loss (\$)	Cum Unit	Lokuwa AUC (\$)	Total loss (\$)	Cum Unit	Shuware AUC (\$)	Total loss (\$)	Cum loss (\$)
Farmer's Health Hazard (Days)													
Skilled labour	21	4.46	93.66	14	4.33	60.62	26	4.46	115.96	45	4.33	194.85	465.09
Unskilled labour	39	3.82	148.98	34	3.69	125.46	50	3.69	184.50	22	3.76	82.72	541.66
Total			242.64			186.08			300.46			277.57	1007.75
Crop Damage (Bags)													
Maize	116	44.59	5172.44	52	44.59	2318.68	73	44.59	3255.07	65	44.59	2898.35	13644.54
Beans	30.5	76.43	2331.12	60	76.43	4585.80	31	76.43	2369.33	29	76.43	2216.47	11502.72
Rice	33	38.22	1261.26	5.5	38.22	210.21	29	38.22	1108.38	21.5	38.22	821.73	3401.58
Groundnut	-	-	-	16	89.17	1426.72	15.5	89.17	1382.14	6	89.17	535.02	3343.88
Guinea-corn	-	-	-	6	4.46	26.76	-	-	-	-	-	-	26.76
Bambara nuts	-	-	-	2	63.69	127.38	-	-	-	-	-	-	127.38
Soya-beans	5	57.32	286.60	-	-	-	-	-	-	-	-	-	286.60
Total			9051.42			8695.55			8114.92			6471.57	32333.46
Livestock Health hazard													
Cattle													
Treatment	18	3.29	59.22	30	3.25	97.50	50	3.18	159.00	15	3.12	46.80	362.52
Mortality	12	212.31	2547.72	5	305.73	1528.65	-	-	-	-	-	-	4076.37
Sheep													
Treatment	13	1.86	24.18	15	1.95	29.25	6	2.02	12.12	15	1.97	29.55	95.10
Mortality	12	53.87	646.44	8	35.83	286.64	12	44.06	528.72	4	3.34	13.36	1475.16
Goat													
Treatment	13	1.67	21.71	21	1.64	34.44	11	1.59	17.49	20	1.62	32.40	106.04
Mortality	4	31.85	127.40	21	23.66	496.86	2	15.92	31.84	20	26.94	538.80	1194.90
Total			3426.67			2473.34			749.17			660.91	7310.09

Key: Cum. = Cumulative; AUC = average unit cost.

Source: Field survey (2008)

hazards were estimated from the following parameters:

Farmers' health hazard

The farmers experienced various health hazards in handling agrochemicals, and these have in one way or the other affected their production levels in the area. Most common among these health hazards were convulsion, muscle weakness, dizziness, vomiting, abdominal cramps, diarrhea, excessive nasal discharge, skin and eye irritation, kidney damage, urinary tract-stone formation, swelling of face, eye lids, lips, mouth and throat tissues, and ulceration of mouth. Larry (1989) and Hassan et al (2007) equally reported that various agrochemical ingredients such as organo-phosphorus, phenoxy, organo-chloride, triazine, dinitroaniline and pyrethroid have resultant adverse effects on farmer's health. Results in Table 4 presented the estimated values of losses incurred from farmers' health hazards. The result indicated that farmers in Lokuwa experienced the highest loss of farm labour in work-days, valued at \$300.46, followed by Shuware, Digil and Gella, which had respective losses to the tune of \$277.57, \$242.64 and \$186.08 of valued farm working days. The highest proportion of the loss was recorded from unskilled farm labour. On the overall; farmers' health hazard recorded a cumulative loss of \$1,007.75 (Table 4).

Crop damage

The nature of crop damage principally include partial or complete burn of the whole plant as a result of excessive pesticides and fertilizer applications, especially on leafy plants. Of the crop damage experienced in the four locations studied, highest yield loss was recorded in maize yields (116 bags in Digil, 52 bags in Gella, 73 bags in Lokuwa and 65 bags in Shuware) and beans (30½ bags in Digil, 60 bags in Gella, 31 bags in Lokuwa and 29 bags in Shuware), followed by rice (33 bags in Digil, 5½ bags in Gella, 29 bags in Lokuwa and 21½ bags in Shuware). Only little loss was recorded in groundnut, guinea corn, Bambara-groundnut and soya-bean production. This could probably be due to the low level of agrochemical use application skills during planting and weeding events. The monetary values of the yield losses had similar ranges in the locations with \$9,051.42, \$8,695.55, \$8,114.92 and \$6,471.57 in Digil, Gella, Lokuwa and Shuware respectively. In general, the crop damage amounted to a cumulative loss valued at \$32,333.46 (Table 4).

Livestock health hazards

Table 4 also showed that the livestock affected in the locations were mostly ruminants such as cattle, sheep and goats that consume grasses and other

farm produce. The nature of hazards experienced was manifested in form of sicknesses and death (mortality). Similar lethal cases among aquatic and other animals were earlier reported by Brady and Weil (2002). In this study, a wide variation occurred between the mortality cases of cattle and sheep. Mortality value of cattle (\$2,547.72) was about four times that of sheep (\$646.44), especially in Digil location. Similarly, Shuware had the largest mortality estimates in goat production (\$538.80), which was almost seventeen times more than those of Lokuwa (\$31.84), followed by Gella and Digil with a loss value of \$496.86 and \$127.40 respectively. The financial worth due to sickness in Lokuwa was estimated at \$159.00 in treating cattle alone, while the largest amount in the treatment of sick sheep and goats was recorded at Shuware (\$29.55) and Gella (\$34.44) respectively. This high loss estimates could have likely been due to the considerable concentration of farm animal population raised on available pastures in these locations. On the overall, livestock health hazard recorded a cumulative loss of \$7,310.09.

Conclusion

Economic effects of hazards associated with agrochemical usage were assessed among farmers predominantly of middle ages (40-50 years) with considerable education statuses and farming experiences. Despite their literacy levels which enhanced considerable utilization of agrochemicals over the past two decades, it is still evident that most farmers still lack adequate application skills amidst dangerous hazards associated with agrochemical handling in the area. The cumulative cost implications in terms of total losses incurred from the three primary farm hazards (farmer's health hazard, crop damage and animal health hazards) were respectively valued at \$3,426.67 in Digil, \$2,473.34 in Gella, \$749.17 in Lokuwa and \$660.91 in Shuware locations. These loss estimates compared much higher than those incurred on soil erosion by gully in the same Mubi environment (Tekwa and Usman, 2006). Largest crop damage was recorded on maize farms compared to the least losses recorded on legume farms. Similarly, cost implications of hazards that occurred among ruminant animals, and unskilled human labour stood tall among all other hazards studied (Table 4).

Recommendation

Based on these findings, it is recommended that there should be more awareness campaign programmes that could sensitize farmers on the economic implications of farm hazards associated with agrochemical use in Mubi environment. Hence, farmers should be properly educated on the use, handling and safeties involved in using

agrochemicals towards its beneficial use on farms in the study area.

References

- Adebayo A A (2004) Mubi region: A geographical synthesis, 1st edn. Paraclete publishers, Yola, Nigeria
- Adesiyun S O (1990) Pesticide toxicology and environmental pollution. Paper presented at the 6th national seminar on pesticide usage and environmental pollution, University of Agriculture, Abeokuta, Nigeria, 25-27 June 1990
- Amalu U O (1998) Issues on agricultural and environmental sustainability: Agric research and extension delivery system in sub-Saharan Africa 1st Edn. University of Calabar Press, Calabar, Nigeria
- Ayoola G B, Idachaba F S (1990) Marketing of Agricultural pesticides in Nigeria: Organisation and efficiency. A paper presented at the 8th national workshop on the pesticide industry in Nigeria, University of Ibadan, Nigeria, 5-8 September 1990
- Brady N C, Weil R R (2002) The nature and properties of soil, 13th Edn. Pearson education Ltd, Delhi, India
- Don-Pedro K N (1990) Pesticides in the environment: Biological reason for action. Paper presented at the 6th national seminar on pesticide usage and environmental pollution. University of Agriculture Abeokuta, Nigeria, 25-27 June 1990
- Ekpe E (2003) Hazards associated with pesticide usage: Implications for environmental extension education. *Int J Environ* 1:222-230
- Hassan S, Jesse Y A, Gabdo B H (2007) Pesticides utilization in Mubi area and associated health hazards. *J Sustain Dev Agric Environ* 3:89-95
- Larry P P (1989) Entomology and pest management, 2nd Edn. Macmillan New York
- Nwagboso N J, Uyanga J (1999) Population In: Adebayo A A, Tukur A L (ed) Adamawa State in maps, 1st edn. Department of Geography, F.U.T. Yola, Nigeria
- Oboh V O, Nzenwa G C, Olatunji O (2006) Awareness of environmental hazards associated with agrochemical use among rice farmers in Qusan-pan L.G.A of plateau state: implication for extension education. Paper presented at the 30th national conference of the soil science society of Nigeria (SSSN), University of Agriculture, Makurdi, Nigeria 5-9 December 2006
- Tekwa I J, Usman B H (2006) Estimation of soil loss by gully erosion in Mubi, Adamawa state. Nigeria. *J. Environ.* 1:35-43
- Tekwa I J, Apagu E Z (2008) Ecological effect of surface water contamination in Mubi environment of Northeastern Nigeria. *J Nat Assoc Sci Hum Educ Res*, 6:100-109
- Udo R K (1970) Geographical regions of Nigeria, 1st edn. London, Heinemann
- Wilcox B F (2006) Fundamentals of food chemistry, 1st edn. Paraclete publishers, Yola, Nigeria
- Yusuf H A, Abdusalam Z, Yusuf A A (2006) Role of women in agricultural development: A case study of Giwa Local government area of Kaduna state. A paper presented at the 30th national annual conference of the soil science society of Nigeria (SSSN), A.B.U, Zaria November, 2006