

MENDING THE CHASM OF WEED CONTROL: ADAPTATION OF HERBICIDE APPLICATION ON RAIN- FED RICE PRODUCTION

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ABSTRACT

Traditional weed control measures were time consuming, labour-intensive and generally expensive, alternatively herbicide weed control results in high yield and generate more income to rice farmers, its adoption is in the increase in Europe, Asia and some parts of Africa. This research examine the adoption of use of chemical as a means of weed control practice in rice production, against the traditional manual/mechanical weeding in Kano south senatorial district. Data were collected using structured questionnaire administered to 400 rain fed rice farmers randomly selected across Gaya, Takai, Wudil, Rano and Karaye Local Government Areas in the senatorial district. Analysis of data revealed that 48% of the farmers have no formal education, rain-fed rice production enterprises was dominated by men 63.25% in the study area. Majority of the respondents (38.50%) earned between ₦301,000 to ₦500,000, the gross margin analysis indicated that respondents realized ₦4,305.47k as net income per person per day. It is therefore recommended that Kano state government through KNARDA extension agents give seasonal training on herbicide application, evaluated the commonly available herbicides in the market and encourage use of safety wears during application.

Keywords: Herbicide, rain-fed, weed control, profit margin

1 INTRODUCTION

Rice (*Oryza sativa*) is one of the significant, staple and security crop that meets the food consumption needs globally, it is the most consumed crop in the state and Nigeria [1]. It also contains protein, fat, thiamine, riboflavin, zinc and niacin in minimal amounts, cultivated rain-fed rice area is expected to increase in the future due to shortages in labour and water supply globally [2]. The crop is cultivated nearly in all the agro-ecological zones of the nation [3]. Rice is currently cultivated in rain fed upland and aquatic ecologies in 40 countries in Africa on nearly 10 million ha with about 25 million tonnes production [4]. Rice production in Africa is already a highly strategic and priority element and will continue to be so in the coming decades, be it in terms of food security, poverty alleviation, youth employment and use of scarce resources [5]. Nigeria has 923,768 square kilometres land area with a total of 79 million hectares of cultivable land. An estimated 4.6 million hectares of this land is suitable for rice production but only about 1.8 million hectares or 39% is currently developed for rice cultivation [6]. However, due to the population increase, rice production has to be increased to meet demand of the ever increasing population growth, one of the important things on increasing rice production is to minimize crop loss which is caused by weed

competition because the longer presence of weeds in rice cropping paddy, the greater reduction of grain yield [7]. Weed is a nutrient absorbing competitive plant which grows out of place spontaneously and possesses the characteristics of plentiful growth and reproduction, even under adverse conditions [8], weed severity is dependent on weed density and the age of the rice. Hoe weeding is the predominant weed control method in rice systems in Africa [9, 10], however it is time consuming, labour-intensive and generally expensive. But, the efficacy of hoe weeding is often compromised by the continued wet conditions characteristic of the beginning of the rainy season. Hoe weeding under wet conditions often causes weed to re root and re-establish, necessitating several rounds of weeding to keep the crop weed-free and avert yield losses [11]. More importantly, the increased abundance and diversity of weed populations in different upland agro-ecologies calls for concern. Uncontrolled weed infestation in upland rice accounts for 42% to 100% yield reductions [12]. Alternatively, herbicides applications are quite effective and efficient in suppressing weeds in rice if properly used. The use of agrochemicals for crop production has been on the increase and an estimated 2.5 million tonnes of pesticides are applied to agricultural crops worldwide each year [13]. Herbicides reduce drudgery and protect crops from early weed competition [14]. However, there are many herbicides that can control different kinds of weeds with one application, and their efficacy is further limited when they are used alone [5, 10]. Variation in weed flora composition and their pattern of emergence during growing season is also key factor influencing level of weed control achieved with herbicides[15]. Presently available rice herbicides have narrow spectrum activity and limited efficacy when used alone [16]. In this study, weed density and biomass were investigated after the application of the most commonly used post emergence herbicides in rain fed rice production; the variation is mainly due to the pattern of herbicides application and the composition of active ingredients.

2 LITERATURE REVIEW

Rice is a weak competitor against weeds, and sown at close spacing, which makes mechanical weed control difficult, thus resulting in high yield reduction [17]. *Cultural control* is the use of common practices such as land preparation, planting method, soil fertility management, mulching, mixed cropping, crop rotation, flooding, variation of crop row spacing, competitive rice cultivars, cover crops etc. for the proper management of weeds, water and soil [18]. *Use of weed resistant rice cultivar* [17] found NERICA-1 variety to be of high weed suppressive ability and produced greater grain yield than FARO 46. It might be due to its morphological characteristics such as rapid early growth, drooping leaves, good tillage ability and high specific leaf area. *Mulching* is another cultural weed control method feasible in upland rice but not widely practiced in Africa. Mulching inhibits weed seed germination by shading and through the release of allelopathic substances [12]. *Flooding* is also a method of weed control⁵ reported that maintaining a flood layer of 5 to 10 cm suppressed the growth of most weed species and enhanced the productivity of transplanted lowland rice. *Manual hoe weeding* is the most popular method of weed control in Nigeria. This is however; time consuming, labour-intensive and generally expensive. It is estimated that about 40-60% of production cost is spent on manual weeding [18]. Rice; being a closely sown crop also makes mechanical weeding difficult and some degree of crop damage is unavoidably involved in manual weeding. In addition hand weeding allows weeds with similar morphological characteristics to rice to escape detection and hence removal in direct-seeded rice fields [19]. *Mechanical weed control techniques* manage weed populations through physical methods that remove, injure, kill, or make the growing conditions unfavourable [20]. Some of these methods cause direct damage to the weeds through complete removal or causing a lethal injury. Other techniques may alter the growing environment by eliminating light, increasing the temperature of the soil, or depriving the plant of carbon dioxide or oxygen [21]. *Chemical weed control* is an important weed control method which involves the use of different herbicides applied as pre- plant incorporated, pre and post emergence of crops to control weeds. The adoption of chemical weed control in rice systems has been on the increase in Africa due to its higher profitability, economic benefits, requirement of less weeding time and labour input [22]. But, most farmers lack the knowledge of proper herbicide application due to limited access to information and high level of illiteracy [22]. Hence, there is need to review the adoption of chemical weed control management in rain-fed rice fields under different agro-ecologies in Nigeria,

specifically Kano South district, with a view to identify potential research gaps, and quest effective and sustainable chemical weed control strategies to rice farmers in Nigeria.

3 METHODOLOGY

3.1 The Study Area

The study area Kano state is located in the savannah south of Sahel on Latitude 11° 45' 26.7084"N, and Longitude 8° 39' 36.2124"E (Figure 1), with a population of 20,000,000 people with total land area of 20,131km². Kano state shares its boundary with Katsina state from the northwest, Jigawa state from the northeast, Bauchi state to the southeast, and Kaduna state to the southwest. The state has 44 LGAs, with 5 Emirates divided into three senatorial districts namely; Kano North, Kano Central, and Kano south. Kano south comprises of 16 LGAs. 5 LGAs: Gaya, Albasu, Takai, Wudil, Rano and Karaye LGA were selected from the senatorial district for the purpose of this research.



Figure 1. Map showing the study area

To determine the number of questionnaires to distribute, we use sample size from a given population [23].

$$n = \frac{N}{1+N(e^2)} \quad (1)$$

where, n = sample size; N = Total population; e = margin of error (5%). Number of respondents from each Local Government Area was calculated using [20] table for determining sample size from a given population.

$$n_h = \frac{Nh}{N} \times n \quad (2)$$

where, n_h = contribution of each stratum to the sample; Nh = Total stratum Size; N = Total population; n = sample size. Table 1 shows the contribution of each local government area to the sample size.

Table 1. Contribution of each local government area to the sample size

Stratum	Stratum Population	Sample Size (
Gaya	341,100	93
Takai	333,300	91
Wudil	310,300	85
Rano	243,900	66
Karaye	236,900	65
Total	1,465,500	400

3 RESULTS AND DISCUSSION

Table 2 reveals that 20.50% of the respondents were within the age bracket of 31-35, defined by [7] as economically productive in a population, while 30.75% fell within the age group (above 61 years). This implies that the respondents are still economically active and in their productive ages. Subsistence agriculture as practiced in Nigeria today requires the ability to farm and formal education is not necessary, this why 48% of the farmers have no formal education, while 38.67% were holders of primary school education, most of the respondents (45%) had farm size of between 1 and 5 hectare. Also, the majority (63.25%) of the respondents were males. It can be inferred that male dominated rice farming. In Kano South early marriage and large household size are common practice in the study area, that why 43% have 4 to 6 people in their house. Figure 2 shows the farmers' population using chemical weed control in rice production.

Table 2. Socio-economic status of the respondents

Characteristics	Frequency	Percentage
Sex		
Male	253	63.25
Female	147	36.75
Age		
Below 35	82	20.50
36 – 60	195	48.75
61and above	123	30.75
Marital Status		
Married	210	52.50
Single	109	27.25
Divorced	81	20.25
Education		
None	72	48.00
Primary	58	38.67
Secondary	12	8.00
NCE/Degree	3	2.00
Postgraduate	5	3.33
Family Size		
Less than 3	93	23.25
4 to 6	172	43.00
7 to 9	78	19.50
More than 10	57	14.25

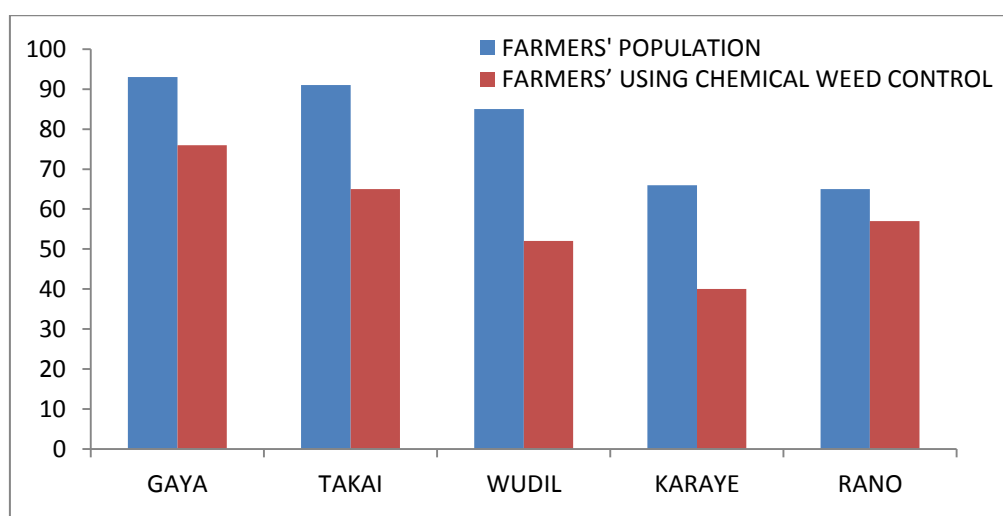


Figure 2. Farmers' population using chemical weed control in rice production

The study reveals that 76 (82%) and 65 (71%) of the farmers in Gaya and Takai LGAs respectively are using chemical weed control in their rice production which proved high adoption of chemical weed control in the eastern part of Kano south, while 40 (61%), 52 (61%) and 37 (57%) of the farmers in Karaye, Wudil and Rano local government areas was an appreciable improvement in the adoption of chemical weed control. Averagely 66.4% of farmers are using adopting herbicide application. Compared to 70% in the rainforest zone [24] and very rare in Nassarawa State [25].

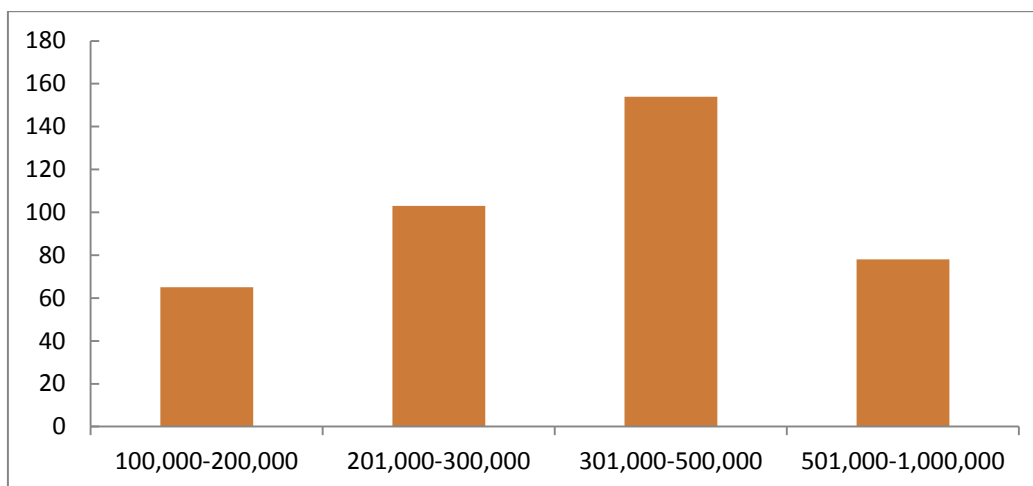


Figure 3. Farmers' Net Income

Majority of the respondents (38.50%) realized between ₦301,000 to ₦500,000. On the average however, the respondents realized an average income of ₦228,190 from chemical weed control in rice production undertaken within nearly two months (53 days).

Table 3. Costs analysis of weed control practice in rice production in Kano south

Items	TFC(₦)	TVC(₦)	TC(₦)	TR(₦)	Gross Margin (₦)	Profit (₦)	RRI
Sample Average	20,033	99,320	108,662	336,852	237,532	228,190	2.1

From Table 3 above the gross margin analysis shows that from one hectare of land cultivated, the total cost of production using herbicide was found to cost ₦108,662, making a gross margin of ₦237,532 which is higher than the hoe weeding gross margin of ₦138, 547.01 obtained by [18]. The farmers realized an average net income (profit) of ₦228,190 using chemical weed control practice within the period of the study. It should be noted that the Critical Period of Weed Control (CPWC) in rain fed rice production is 53days according to (Anwar *et al.*, 2012). Hence, if the Profit (Net Income) is divided by 53 days, then farmers realized ₦4,305.47k (₦228,190/53). Since the average household size is 6, the net income per person per day becomes ₦717.58k (₦4,305.47k/6). This can be translated into \$1.7 per day (as today's ₦422.88/\$). This is above the US \$1 per day suggested by the United Nations as the poverty line. To this end, chemical weed control in rice production holds the potentials of reducing poverty amongst farmers. The Rate of Return on Investment of 2.1 implies that for every one naira invested in rice chemical weed control farming business; a net profit of over two naira can be realized by the farmer.

4 CONCLUSIONS

The study analysed the level of herbicide adoption in rain-fed rice production in the study area to be averagely 66.4% and its profitability using cost-benefit analysis was found to be ₦717.58k per person per day, which showed that chemical weed control was profitable during the period of the study. As weed competition reduce yield in rice production use of herbicides ensures effective weed control; minimize cost of production while increasing output. Policy makers in agriculture should promote the use of certified chemicals for weed control in rice production. Furthermore, farmers should adopt cooperative farming so that land fragmentation will be reduced. However, achieving

season-long weed management is still difficult with herbicides, considering varying growth habits of weed species under changing climatic conditions.

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