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Profit efficiency of small-scale farmers participating in USAID markets II in Kano state of Nigeria

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The present research determined the profit efficiency of smallholder farmers participating in USAID MARKETS II in Nigeria's Kano State using undated data collected from 189 farmers drawn through a multi-stage sampling technique. Data elicitations were done through a well-structured questionnaire complemented with interview schedule and both descriptive and inferential statistics were used to analyze the data. The empirical evidence showed an improvement in women folk participation in the program despite strong advocacy of gender stereotype viz. religious and cultural barriers in the studied area. However, this progress owes to the tacit focus of the program on women and youths. Furthermore, it was established that none of the farmer is profit efficient and it majorly owes to extension gap. On the average, a technical unit gained 58.47% of its potential profit, thus lost a profit of N123008 due to inefficient resource mix. Besides, an average farm unit still has the potential to increase his profit efficiency by 41.53%, thus bridging its discrepancy from the frontier surface. Therefore, the study calls on the program promoters to enhance their extension services delivery structure thereby addressing the problem of extension gap that inhibit profit efficiency given its multifaceted influence on risks associated with farmers socio-economic characteristics.

Keywords*:* Profit efficiency, USAID MARKETS II, Small-scale, Rice farmers, Nigeria

INTRODUCTION

Agricultural production is obviously fraught with risks and unpredictability (dry-spell, hailstorms destroying crops, flooding, etc), and high inputs do not always yield high returns (Bidzakin et al., 2014). However, farmers who invest in better seeds, fertilizer, and improved production methods, among other things, are more likely to see changes. Small-scale agriculture faces a number of challenges, including a lack of adequate access to production inputs and competitive produce markets. New innovations, such as improved seed varieties and agrochemicals, have been found to be exorbitantly expensive for the average small-scale farmer, who has limited access to formal credit. This means that small-scale farmers are less likely to implement new innovations, resulting in lower annual yields and incomes. Small-scale farmers continue to use inefficient practices that result in low yields and high post-harvest losses. Some farmers, on the other hand, are making the best of their limited resources and expertise to get out of this predicament. Farmers like these have shown that with better agro-business management, they can help other farmers get out of poverty and become more efficient and competitive (Bidzakin et al., 2014).

Small-scale farmers dominate agriculture in Nigeria, producing the majority of the country's food requirements (Asogwa et al., 2006; Oladeebo and Oluwaranti, 2012). Despite the fact that these small-scale farmers hold a unique and pivotal role, they are among the poorest members of the society (Sadiq et al., 2021) and thus cannot afford to invest heavily in their farms. With reference to

Sadiq et al.(2020), the agricultural sector's poor output is due to a vicious cycle of poverty among these farmers. As a result, resources must be used more effectively, which necessitates the elimination of waste, resulting in increased productivity and revenue.

Many countries' rice yields surpass 2 t/ha, which is substantially higher than that of Nigeria (Sadiq et al., 2020). However, since there is a wide yield difference between research stations and farmer's fields, productivity can be increased. As a result, rice production capacity must be expanded in order to meet increasing demand. One way to do this is to increase the profits earned by the producers. Profit efficiency is described as a farm's ability to achieve the highest possible profit, given the prices and levels of fixed factors on the farm, according to Ali and Flinn (1989); Sadiq and Singh (2015); Sadiq et al. (2017). Profit inefficiency, on the other hand, is characterized as profit loss due to failure to operate on the profit frontier, given farm-specific prices and resource base. Hence, this research is needed in order to contribute to the literature on profit efficiency studies on food crops, especially the USAID Markets II rice production project, which aims to improve the welfare of its beneficiaries-farmers in Nigeria. Therefore, this research aimed at determining the profit efficiency of small-scale farmers participating in USAID Markets II in Kano State of Nigeria.

RESEARCH METHODOLOGY

The co-ordinates of Nigeria's Kano state in the northern region are latitudes 10° 33' to 12° 37' N and longitude 07° 34' to 09° 25'E of the Greenwich meridian time. The vegetations of the northern and southern parts of the state are characterized by Northern-Guinea savannah and Sudan savannah respectively. The annual rainfall in the Northern-Guinea savannah varies from 600-1200 mm and 300-600 mm in the Sudan savannah. Furthermore, in the Sudan savannah region, arable crop growing periods vary from 90 to 150 days; while in the Northern-Guinea savannah region, they range from 150 to 200 days. The state has an approximate estimated population of 9.4 million habitants (NPC, 2006) with a population growth rate of approximately 3.5% per annum. The cultivable land in the state is over 1,754,200 hectares. The state is famous for its commercial activities as majority of the inhabitants engaged in trading of agricultural commodities.

A multi-stage sampling technique was used to draw a representative sample size of 195 participating farmers from the project sites. In the first stage, high concentration of smallholder rice producers was used as a yardstick/ justification for the purposive selection of six (6) participating Local government areas (LGAs) out of the nine (9) LGAs designated for USAID MARKETS II program in the state. The chosen LGAs are Bunkure, Garun-Mallam, Kura, Dambatta, Bagwai and Makoda. Secondly, from each of the selected LGAs, five (5) participating communities were randomly selected. In the third stage, from Bunkure, Garun-Mallam and Kura LGAs each, nine (9) farmers were randomly selected while four (4) farmers were randomly selected from each of these LGAs- Dambatta, Bagwai and Makoda. Thus, a total of 195 farmers formed the representative sample size. However, only 189 questionnaires were found to be valid, thus subjected to analysis. Using an easy cost-route approach, a well-structured questionnaire complemented with interview schedule was used to elicit data of 2018 rice cropping season. The stochastic profit frontier function and descriptive statistics were used for data analysis.

Model Specification

Stochastic Profit Frontier Function: Following Sadiq et al. (2017); Sadiq et al. (2015); Sadiq (2015); Sadiq and Singh (2015); Bidzakin et al. (2014) the stochastic profit frontier (SPF) function is given below: (1)

Given the level of technology at the disposal of a technical unit, the profit efficiency is expressed as the ratio of the actual profit (π) to the corresponding potential profit (π*) and it is given below: (2)

Where πe is the profit efficiency and takes the value of ≤1, with 1 defining profit efficient decision making unit (DMU). The observed profit (π) represents the actual profit while the potential profit (π*) represents the frontier profit level.

The explicit form of the Cob-Douglas functional form of the SPF function is as follow: (3)

Where πi = Normalized profit i th of farmer (N); Pi= cost of farm inputs used: P1 = cost of NPK fertilizer (N/kg), P2= cost of urea fertilizer (N/kg), P3 = cost of family labour (N/man-day), P4 = cost of hired labour (N/man-day), P5= cost of insecticides (N/kg), P6 = cost of herbicides (N/litre), and P7 = cost of seed (N/kg); Zi= Quantity of fixed input: Z1 = Farm size (hectare), and Z2 = depreciation on capital items (N); Vi = random variability in the production that cannot be influenced by the i th farmer also known as uncertainty; Ui = deviation from maximum potential profit attributable to profit inefficiency and also known as risk. β0 =intercept; βk =vector of cost parameters to be estimated; βl =vector of fixed input parameter to be estimated; i=1,2,3,...n farmers; j=1,2,3,...m inputs.

The inefficiency model is:

Where Z1 = gender (male=1, otherwise=0); Z2 = age (year); Z3 = marital status (married=1, otherwise=0); Z4= educational level (year); Z5 = primary occupation (farming =1, otherwise=0); Z6 = secondary occupation (farming =1, otherwise=0); Z7 = Household size (number); Z8 = rice farming experience (year); Z9 = mixed cropping (yes =1, no = 0); Z10 = extension visit (yes=1, otherwise=0); Z11 = length of participation in MARKETS II (year); Z12 = Duration of adoption of urea displacement project (UDP)(year); Z13 = proportion of farm size cultivated under UDP (%); Z14 = co-operative membership (yes=1, otherwise=0); Z15 = total livestock unit (TLU) (Camel=1.0; Horse=0.8; Cattle=0.7; Donkey=0.5; Sheep & Goat =0.1; and, Chicken=0.01); and, Z16 = commercialization index (CI)(ratio of marketed surplus to marketable surplus); δ0 = intercept; δ1-16 = regression coefficient; and, εt = chance.

RESULTS AND DISCUSSION

Socio-Economic Profile of the Farmers

Less than 40% of the women farmers against barely above 60% of the male farmers were involved in the rice production enterprise, an indication of gender inequality due to the manifestation of gender stereotype, thus the resultant poor participation of women folk in the program (Table 1). The enterprise is dominated by able-bodied men as indicated by the mean age of 40 years, thus reflecting a visible active, productive and economic viable farming population. However, these farming population will soon aged, thus a threat to the rice food security if not urgently replaced. Therefore, the program should be incentivized more so as to encourage those within the early youthful stage to venture into the rice program project.

Most of the farmers have family responsibilities to carter for as indicated by the mean marital status of 0.92, thus suggesting that most of the beneficiaries are engaged in the rice project for livelihood sustenance. Evidence showed that the educational level of most of the farmers didn’t exceed primary education as indicated by the mean educational level value of 6 years, thus indicating a fair literate farming population. This low educational level status has the consequence of undermining the speed of the technological transfer packages of this program. Most of the beneficiaries of the rice program project are driven by market-orientation as indicated by the primary occupation proportional value of 0.93. However, a proportion of 0.32 of the beneficiaries as evidenced by the secondary occupation variable have their objective tilted towards farm family food security.

The mean household size of 9 persons indicates large household among most of the beneficiaries,

thus a threat to a sustainable household livelihood- high consumption expenditure for a household composed of high dependency ratio-vulnerable groups. Rice farming experience mean value of 12.4 years reveals that most of the farmers have adequate experience in rice production, thus efficient in resource mix for profit maximization vis-à-vis cost minimization. The proportion of 0.85 for mixed cropping indicates crop diversification among most of the farmers, thus indicating adoption of safety measures-coping mechanism against food insecurity. It was observed that there is adequate provision of technical support as evidenced by the proportion of 0.99 who had access to extension contact. This is expected as the rice project is program driven. Besides, it shows the possibility of the program sustainability as there exists an effective synergy between the clienteles and the program promoters.

The empirical evidences showed that most of the beneficiaries are new entrants into the USAID Markets II program, consequently venturing into the UDP rice project not long ago as evidenced by the mean value of less than 4 years for both length of USAID Markets II and duration of adoption of urea displacement project (UDP) respectively. Most of the beneficiaries devoted half of their farm size to the cultivation of rice under the program as indicated by the proportion of farm size cultivated under UDP rice project mean value of 51.7 %. There is adequate harnessing of the social capital among the beneficiaries as evident by the co-operative association proportional value of 0.94, an indication that the farmers are economically empowered viz. exploration of the pecuniary advantages inherent with co-operative organization. Most of the beneficiaries have high marketable surplus, that is, ability to fend for farm family food security and farm consumption; and sales to the non-farming population. Thus, it can be suggested that most of the beneficiaries eked a sustainable livelihood from participating in this program, thus a plus to the program going concern in the studied area. The average total livestock index (TLU) of 1.22 implies that most of the beneficiaries have low deferred cash reserve as livestock assets. Thus, it can be hedged that most of the program participants are resource poor, thus the need for high credit provision for program sustainability so as to achieve rice food security.

Maximum Likelihood Estimate (MLE) of Stochastic Profit Frontier Function

The maximum likelihood estimation (MLE) of the stochastic profit frontier function shows the variance parameters- sigma-squared and gamma to be different from zero as evidenced by their respective estimated coefficients which were within the acceptable margin of 10% probability level (Table 2). For the former, it implies that the distribution of the specified composite error term is fit and correct while the later indicates that there is presence of inefficiency which owes to differences in the farmers idiosyncratic factors. The gamma coefficient being 0.9364 means that 93.64% of the variation in the normalized profit of rice production owes to disparity in their profit efficiencies. Besides, the critical Chi2 been greater than the tabulated Chi2 as indicated by the generalized log likelihood ratio depicts that the traditional response function viz. ordinary least square (OLS) is not an adequate representation for the data but rather the stochastic frontier viz. MLE (Table 3). Sequel to the foregoing, the estimated parameters are reliable for future prediction with certainty and accuracy.

A perusal of the profit function showed only seed and farm size to be the significant variables that influenced the normalized profit as evidenced by the plausibility of their respective estimated parameters at 10% probability level. The positivity of the seed coefficient indicated how subsidy on improved seed variety enhanced the business turnover, thus enhanced profit margin. Thus, a percent increase in the cost of improved seed will lead to an increase in the normalized profit by 0.38%. Besides, the positivity of the farm size indicated that economies of scale enhanced the normalized profit. Thus, an increase in the farm size by 1% will increase the normalized profit margin by 0.11%.

Though all the remaining variables viz. costs of inorganic fertilizer, human labour and sunk capital were not significant but the signs associated with their estimated parameters connote information. The negativity of the inorganic fertilizers indicated how high cost of fertilizers due to lack of

subsidy coupled with excessive use given the low fertility of the soil affected the business income stream, thus plummeted the normalized profit margin. The positivity of the human labour-family and hired labours indicated how unorthodox use of human labour as it is relatively cheap and free enhanced the business turnover ratio, thus increased the normalized profit margin. The positivity of depreciation on capital items showed how negligible sunk cost due to the use of rudimentary implements that characterized small holding farming in the studied area didn't exert significant influence on the business turnover ratio, thus the increase in the normalized profit margin.

Furthermore, in the inefficiency component, profit inefficiency was affected by gender, marital status, educational level, primary occupation, experience in rice farming, extension contact, length of adoption of UDP, proportion of farm size cultivated under rice project, TLU and CI as evidenced by the plausibility of their respective estimated parameters at 10% significance level (Table 2). The variables-gender, experience in rice farming, extension contact, proportion of farm size cultivated under rice project and TLU decreased profit inefficiency based on the negative sign associated with their estimated coefficients while the positivity associated with marital status, educational level, primary occupation, length of adoption of UDP and CI implied that they increased profit inefficiency.

The negative sign of the gender coefficient implied that gender inequality that owes to access to and control of productive resources among the male farmers against their female counterparts enhanced their profit efficiency. This is expected as religion and cultural barriers have created gender inequality and gender stereotypes thus affecting the financial wherewithal of women farmers in the production of rice, thereby inhibited their profit efficiency due to poor business turnover ratio. Therefore, being a male farmer against woman farmer will lead to a decrease in profit inefficiency by 1.897%. The negative sign of the rice farming experience coefficient implied that experienced farmers-farmers that have spent adequate years farming rice are profit efficiency against those farmers with few/ less experience in rice production. The possible reason may be due to efficient resource allocation among the experienced farmers, thus profit maximization vis-à-vis cost minimization. Therefore, the elasticity implication of a unit increase in the year spent in rice farming by a farmer will lead to a decrease in his/her profit inefficiency by 0.27%.

Agricultural services, a leverage to market-led extension viz. market information and adoption of technologies increased profit efficiency among farmers with access to extension services against their counterparts with no access to change agents as evidenced by the negativity of the extension contact coefficient. Thus, having access to extension service delivery will lead to a decrease in a farmer's profit inefficiency by 5.04%. Farmers with adequate proportion of their farm size cultivated under rice project had marketable surplus as evidenced by the negativity of the estimated coefficient, thus increased their profit efficiency. Therefore, the elasticity implication of a percent increase in the proportion of land cultivated to rice project will lead to a decrease in a farmer's profit inefficiency by 0.019%. Utilization of cash reserve- money from livestock assets viz. investment in farm capital increased profit efficiency as indicated by the negative sign of the TLU index coefficient. Thus, the elasticity implication of a percent increase in a farmer's TLU index will lead to a decrease in his/her profit inefficiency by 0.62%.

The positive sign of the marital status estimated coefficient implied that unmarried farmers faced challenge of increased profit inefficiency against married farmers. The possible reason may be attributed to access to both social and economic capitals that are inherent in marriage in the traditional agrarian community, an investment stimulus viz. credit which in turn increase farm income, thus enhance profit efficiency. Just as money is not wealth, credit is not an income but a catalyst to generate income, a requisite for sustainable business going concern and better household livelihood. This comparative advantage is lurking among unmarried farmers, thus inhibited their profit efficiency. Therefore, the elasticity implication of being unmarried will lead to an increase in profit inefficiency by 1.97%.

The positivity of the educational level coefficient implied that lackadaisical approach towards rice

farming because of engagement in paid salaried jobs affected the profit efficiency of literate farmers. Thus, the elasticity implication of a unit increase in a farmer's educational level by 1 percent-1 year, will lead to an increase in his/her profit inefficiency by 0.30%. The positive sign of the primary occupation coefficient implied that farmers that are not driven by market-orientation i.e. production for household consumption only are profit inefficiency as against those that sees farming as a business-major occupation. Besides, these farmers are liable to marketed surplus against marketable surplus. This is expected as those that engaged in rice farming as a secondary occupation will rely on alternative source of livelihood earning for survival as against farmers that see farming as a de facto business for livelihood sustenance. Therefore, the elasticity implication of taking up rice farming as a secondary occupation will results in a decrease in a farmer's profit efficiency by 0.47%. Market imperfection and policy incentives affected the profit efficiency of farmers with high marketable surplus as evidenced by the positive sign of the commercialization index (CI). Therefore, the elasticity implication of a percent increase in a farmer's CI will lead to an increase in his/her profit inefficiency by 0.396%.

Distribution of Profit Efficiency score

A cursory review of the results showed the deciles distribution of the profit efficiency to range from 0.0015 to 0.8802 with a mean score of 0.5847 (Table 4).

On the average, it entails that an average technical unit achieved a profit efficiency of 58.47%, falling short of 41.53%- a potential profit lost of N 123008 (Table 5) from the profit frontier achieved by the best practiced technical unit facing the same technology and competitive market. This suggests that an average of 58.47% of the maximum potential profit is gained due to economic efficiency while the short fall-discrepancy of 41.53% between the actual profit and potential profit owe to extension gap due to mismatch of resource allocation. Furthermore, the occurrence of the predicted efficiency score above the mean efficiency score of 0.5847 is 58.70%, an indication that more than half of the sampled technical units facing a perfect competitive market were fairly efficient in their cost allocation in the course of rice production. Therefore, it can be inferred that none of the technical unit is profit efficiency; however, more than half of the technical units are fairly efficient as their efficiency score is close to the frontier surface. Besides, the average technical unit lost a potential profit of N123008 while the worst and best inefficient technical units lost potential profits of N110843 and N220.55 respectively (Table 5). Therefore, for the worst farmer to be on the same level with the best practiced and best inefficient farm units, he/her must increase his allocation efficiency- profit efficiency by 99.85% [1-(0.0015/1.00)*100] and 99.83% [1-(0.0015/0.8802)*100] respectively. For the best inefficient technical unit to be on the frontier, he/her needs to increase his profit efficiency by 11.98% [1-(0.8802/1.00)*100].

CONCLUSION AND RECOMMENDATIONS

Based on the findings it was observed that there is improvement in the participation of women folk in the program despite gender stereotype and this strongly owes to the mandate of the program which targets youth and women. Furthermore, the profit efficiencies of all the technical units are below the potential optimum profit level-frontier, thus sub-optimal in profit efficiency. On the average, a technical unit attained a profit efficiency of 0.5847, thus results in a potential profit lost of N123008. Therefore, for an average farm to achieve optimum profit it needs to increase its profit efficiency by 41.53% viz. enhancement of resource allocation. Besides, the profit inefficiency owes to risk viz. reluctance for farming against paid salaried job, market imperfection that affects marketable surplus-extension gap. Therefore, the research advise the program promoters to enhance the structure of their extension service delivery, thus addressing the challenge of extension gap affecting profit efficiency given its multifaceted links with risk.

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