

Farm level impact of feeding improved diets to pigs in the Jomoro District of Ghana

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ABSTRACT

The economic impact at farm-level for feeding improved diets to grower-finisher pigs in the Jomoro District of Ghana was assessed using partial budgeting techniques. Three diets were considered: the farmers' diet, which contained mainly coconut chaff and cake; a cereal based commercial diet and improved agro-industrial by-products (AIBP) based diet. The category of farmers considered reared mainly large-white pig breed. The study uses growth, feed consumption and price data, obtained from an on-farm feed evaluation studies, which results, in terms of nutrition, growth performance, and economy of gain, have been reported elsewhere. The paper estimates alternative measures of the economics of using improved feed by accounting for the reduction in the time to slaughter (70 kg) in the computation of benefits. The net additional benefit resulting from the use of AIBP diet instead of farmer's diet was €1,879,227. The simple benefit-cost ratio was 1.71. The additional benefit due to the use of AIBP diet is about two times more than the extra cost incurred.

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RÉSUMÉ

AMELEKE, G. Y., RHULE, S. W. A. & NELSON, F. : *L'effet de régime amélioré nourri aux cochons au niveau du champ dans le District de Jomoro du Ghana*. L'effet économique de nourrir les cochons croissance –finisseurs avec les régimes améliorés au niveau du champ dans le District de Jomoro du Ghana était évalué en utilisant les techniques budgétaires partiels. Trois régimes étaient considérés : le régime d'agriculteurs qui contenait surtout la balle et le noix de coco, un régime commercial basé sur la céréale et un régime basé sur les sous-produits agro-industriels améliorés (SPAI). La catégorie d'agriculteurs considérée élevaient surtout l'espèce de cochons gros-blancs. L'étude fait usage de la croissance, la consommation d'aliment et les données de prix obtenues d'étude d'évaluation alimentaire sur le champ, dont les résultats sur le plan de nutrition, de la performance de croissance et de l'économie de bénéfice, ont été publiées ailleurs. Cet article fait des estimations de mesures alternatifs de l'économie d'utilisation d'aliment amélioré en rendant compte de la réduction du temps d'avant l'abattage (70 kg) dans le calcul de bénéfice. Le bénéfice net additionnel qui résulte de l'emploi de régime SPAI au lieu de régime d'agriculteurs était €1,879,227.00. Le rapport coût-bénéfices simples était 1.71. Donc, le bénéfice additionnel dû à l'emploi de régime SPAI est environ deux fois plus que le coût additionnel encouru.

Introduction

Pig production is a thriving business in the Jomoro District in the Western Region of Ghana. The pig business is sustained by coconut oil industry in the District. This provides the major feedstuff, coconut chaff and cake, which are by-products of oil production. Though these are

important feedstuffs for pig production, they do not provide balanced diet when used alone. Yet, for most producers of pigs in the District, these constitute almost 100 per cent of diets fed to pigs. Therefore, the growth rate of pigs fed this diet is slow, and the time they take to reach target market weights is very long. Consequently, farmers may

obtain less income than is possible. However, various authors have shown that it is possible to use agro-industrial by products (AIBP) including palm kernel cake and cassava peels to reduce the cost of production, while obtaining good growth performance and, thereby, improving farmers' incomes (Rhule, 1995a; Rhule 1995b; Adesehinwa, 2007; Zou *et al.*, 2006; Damisa & Bawa, 2007).

In order to help farmers improve the growth rates of their animals and incomes, on-farm studies were carried out in the District. The on-farm experiments served as demonstrations for farmers in the communities in which they were conducted. Pigs were chosen from farms of various small holder pig farmers, who kept large-white pig breed and used intensive methods of production. Measures of growth performance, such as feed conversion efficiency and economy of gain of pigs on the different diets, were used to determine the best diet. Details of materials and methods, regarding the growth performance and nutrition aspects of this on-farm feed evaluation, are reported in Rhule *et al.* (2007). The use of the improved feed packages resulted in the reduction in the time taken by pigs to reach the target market weight of 70 kg from weaning (18 kg) by more than 20 per cent, and also led to an improvement in the economy of gain (reduction in the cost of feed per kilogram liveweight gain).

Feed cost per kilogram weight gain (economy of gain) for a produce (normally for one cycle or batch of animals) has usually been used as a measure of cost and benefit especially by nutritionists (Okai *et al.*, 1993; Nelson, 1993; Rhule *et al.*, 2007). Indeed, this may be legitimate. However, in situations where the time taken to reach market weight is significantly different for different diets, these measures may not provide adequate information for choice of the best diet, or full information on incentives available from the use of a particular diet. In this case, information about the value of time saved in attaining targeted weights may be missing. The study by Rhule *et al.* (2007), which essentially reports the growth performance and nutrition

aspects of the on-farm feed evaluation of the current study, estimated economy of gain (¢/kg weight gain) as 6117.85, 6684.78 and 6112.04 cedis for farmer based diet, cereal based commercial diet, and AIBP based diet, respectively. The respective days to slaughter (70 kg) for grower-finisher pigs fed farmers' diet, cereal based commercial diet, and AIBP based diet were 199, 144, and 140 days. Based on the economy of gain the AIBP diet was considered the best. The AIBP diet also has a lower number of days to slaughter than farmers' diet, hence, it was considered better. However, information regarding the growing and finishing pigs in a shorter time and, therefore, producing more batches of pigs on AIBP diet is not quantified in monetary terms. Quantifying this in monetary terms should give more information or a clearer picture of the incentives or advantages in using the AIBP diet.

Indeed some studies have incorporated such reduction in the number of days on feed (days to market weight) in their analyses of the economics of the use of alternative technologies (production systems, or diets). For instance, Larson *et al.* (2003) and Kliebenstein *et al.* (2003), in analyzing the economics of finishing hogs in hoop structures and confinement, considered the number of times a facility can be turned (used) based on the number of days animals took to reach market weight. Zou *et al.* (2006) also considered the number of batches of pigs, that could be produced in a year with alternative diets, in computing the economic benefit of various diets. Where markets are available for pigs of varied weights, it could be assumed that pigs are fed for the same number of days and the advantages in feeding efficiency and average daily gains are translated into heavier weights (Richardson *et al.*, 1993).

The primary objective of the study, therefore, is to estimate the farm level impact of feeding improved diets to grower-finisher pigs in the Jomoro District of Ghana using methods that capture the value of reduction in time at which pigs attain target market or slaughter weight. The

specific objectives include: 1. To estimate additional cost and additional income due to feeding improved agro-industrial by-product based diet, instead of farmers' diet, to grower-finisher pigs in the Jomoro District of Ghana. 2. To estimate the difference in additional income and the additional cost (i.e. net additional income) due to feeding improved agro-industrial by products diet, rather than farmers diet, to grower-finisher pigs in the Jomoro District of Ghana.

Materials and methods

Impact analysis

Impact implies a movement or change towards some desirable objectives; it is required that such movements are attributable to certain interventions or programmes. Impacts can be indirect, in which case the effects of interventions are measured through their ultimate effects on people. These effects could be in the form of increased production, increased incomes, or reduced environmental impact, or socio-cultural impact (Chisi *et al.*, 1997). In this study the impact of feeding improved diets to grower finisher pigs on the income of a representative farmer was assessed. The effect on income, which arises as a result of the adoption of improved diets, is assessed through changes in production cost and output levels for a given period of time.

Possible costs and benefits that could accrue to a farmer using the alternative diets to grow and finish as many batches of pigs as possible in one year were computed. First, the number of batches of pigs that reached target (market) weight of 70 kg using farmers' diet and improved diets were obtained. If there were some days remaining before one year elapsed, then the weight that could be attained in the remaining period was estimated using equation 1.

$$W_t = W_0 + gN \quad (1)$$

where W_t is the final weight at time t , W_0 is the initial weight of pigs, g is the average daily gain and N is the number of days on feed.

The impact or economic analysis of feeding improved diets was done using partial budgeting techniques. The use of partial budgeting requires tracking only those costs and benefits that occurred because of the intervention (improved diets) introduced to farmers. The elements of partial budgeting according to Kay (1994) include the following:

1. Additional costs (e.g. cost due to feeding more expensive improved diets, incurring additional transportation cost to bring in improved diet). This is given by the difference in feed cost for pigs on improved diet and feed cost of those on farmers' diet.
2. Additional revenue (e.g. more income from heavier animals, and more income from the production of more batches of pigs due to reduction in time taken to reach market weight). This is given by the difference in revenue from pigs on improved diets and revenue from pigs on farmers' diet.
3. Savings in costs (e.g. less total feed cost due to reduction in total feed consumed, or wastage).
4. Reduction in revenue.

The sum of additional costs and reduction in revenue (1+4) constitute total additional (extra) cost due to the use of improved diets. The sum of additional revenue and savings in cost also give total additional (extra) revenue (2+3). The difference between total additional revenue and total additional cost then gives additional (extra) net income due to the use of improved feed. The ratio of total extra revenue to total extra cost gives a simple benefit cost ratio (Cashman *et al.*, 1980).

Growth, feed consumption, and price data

Revenues and costs were computed based on growth data (initial weights of weaners, final weights of pigs, days taken to slaughter or target weight), feed consumption data for pigs on the different diets, and commodity prices. These were obtained from records taken during the feeding (experimental) phase of the study carried out between 2003 and 2004 (Table 1). One of the diets was the farmer's diet and the other two were a cereal based commercial diet and an agro-industrial by product based diet (Table 2). The

TABLE 1
Growth Performance, Feed Consumption, and Prices

	<i>Farmers' diet</i>	<i>Cereal based commercial diet</i>	<i>AIBP based diet</i>
Average daily gain (kg/day)	0.26	0.35	0.37
Mean weaner weight (kg)	17.6	18.1	17.7
Days to 70 kg	199	146	142
Feed consumption (kg)	2089	1171	1131
Feed cost (¢) per bag of 17 kg	648.40	1494.48	1087.57
Price (¢) /kg liveweight	10,000.00	10,000.00	10,000.00

TABLE 2
Ingredients Included in the Diets

<i>Ingredients</i>	<i>Diet</i>		
	<i>(Farmers')</i>	<i>Test diet 1 (cereal based)</i>	<i>Test diet 2 (AIBP based)</i>
Maize	-	√	-
Wheat bran	√	√	√
Cassava peels	-	-	√
Coconut chaff	√	-	√
Copra cake (cottage)	√	-	√
Fish (anchovy)	-	√	√
Soybean meal	-	√	√
Oyster shell	-	√	√
Salt	-	√	√
Premix	-	√	√
Corn chaff	√	-	-

Notes: - denotes non-inclusion of ingredient in diet. √ denotes inclusion of ingredient in diet.

studies were carried out on two farms, and in each farm four animals of similar weights were put on each of the three diets. Thus, 12 pigs per farm and 24 pigs in all were involved. Parameter values for the representative farmer (average values of parameters) were used in the computations (Richardson *et al.*, 1991). Rhule *et al.* (2007) detailed aspects of the methodology used in conducting the on-farm feed evaluation and also discussed aspects of the growth performance of the grower-finisher pigs.

Prices of the diets used were assessed from prevailing ingredient prices in the markets where farmers procure them. Cost of transporting feed or feed ingredients to the pig farms were also obtained through interviews (Table 1).

Results and discussion

Given the average daily gains and the assumption that farmers adopt continuous production, it was possible to produce two batches of pigs in one year on the farmers' diet. The first reached the

target weight of 70 kg in 200 days, and the second attained 61 kg in the remaining 165 days. For pigs on the first (cereal based) and second (agro-industrial by-products (AIBP) based) test diets (Table 2), three batches of pigs could be produced in one year. The first two batches could be finished at the targeted 70 kg in 146 and 142 days on test diets 1 and 2, respectively; the 73 and 81 days that remained for test diets 1 and 2, respectively; the respective third batches could attain 44 and 48 kg (Table 3). The weights for the third batches of pigs were computed based on the average initial weights of about 18 kg and average daily gain of 0.2642 kg, 0.3535 kg, and 0.37 kg, respectively. This findings are similar to Zou *et al.* (2006), who observed that improved

given the number of batches produced in a year, the final weights attained, and produce price of ¢10,000.00 kg⁻¹ live weight. Thus, revenues from production using farmer's diet, test diet 1 (cereal based) and test diet 2 (AIBP based) were 10 million five hundred thousand cedis (¢10,500,000), fourteen million seven hundred thousand cedis (¢14,700,000), and fifteen million cedis (¢15,000,000), respectively (Table 5).

The cereal based diet generated higher feed cost and lower revenue than the AIBP based diet. It also took longer for pigs on the cereal based diet to reach target weight than their counterparts on the AIBP based diet, though the difference was relatively small (4 days). Thus, the AIBP based (test) diet was deemed superior to the cereal based diet. Therefore, further computations of net income were based on the AIBP based test diet and the farmer's diet.

Total extra costs (sum of additional cost and reduced revenue) due to the use of improved diet (AIBP based test diet 2) was two million six hundred and thirty-six thousand nine hundred and thirty-three cedis (¢2,636,933). Total extra income (sum of extra income and reduced cost) due to the use of improved diet (test diet 2) was four million five hundred and sixteen thousand one hundred and sixty cedis (¢4,516,160). Thus, net additional

income (total extra income less total extra cost) was one million eight hundred and seventy-nine thousand two hundred and twenty-seven cedis (¢1,879,227) (Table 6).

The positive net additional income, which is essentially the difference between the net incomes from pigs on test diet 2 and pigs on the farmer's diet, could be attributed in part to the more number of batches that were produced with the test diet. Larson *et al.* (2003) and Kleibenstein *et al.* (2003) also found that hogs could be turned faster in the confinement facility (2.59 times) than in the hoop facility (2.54 times). This contributed to an

TABLE 3

Possible Number of Batches of Pigs Produced in a Year (Production Plan)

Type of diet	Batch No.	No. of days fed	Weight (kg)
Farmers' diet	1	200	70
	2	165	61
Test diet 1 (Cereal-based)	1	146	70
	2	146	70
	3	73	44
Test diet 2 (AIBP-based)	1	142	70
	2	142	70
	3	81	48

diets based on farm residues and agro-industrial by-products shortened the time to attaining market weight from weaning by 1.5-2 months, and made it possible to grow more than two batches of pigs on the improved diet compared to only one batch on the farmer's diet.

Given the production plan (Table 3), the quantity of feed consumed and unit cost of feed (Table 1), and total feed cost for one year were 4.3 million cedis, 8.8 million cedis and 6.5 million cedis using farmer's diet, and test diets 1 and 2, respectively (Table 4). Computations were based on eight pigs per batch. Revenue was computed

TABLE 4
Feed Cost for One Year

<i>Type of diet</i>	<i>Batch</i>	<i>Intake (kg)</i>	<i>Unit cost (¢/kg)</i>	<i>Amount (¢)</i>
Farmers' diet	1	2089	648.4	1,354,507
	2	1244	648.4	806,435
				2,160,942*
				4,321,884**
Test diet 1 (Cereal-based diet)	1	1171	1498.48	1,754,720
	2	1171	1498.48	1,754,720
	3	599	1498.48	897,590
				4,407,741*
				8,815,482**
Test diet 2 (AIBP-based diet)	1	1144	1087.57	1,243,092
	2	1144	1087.57	1,243,092
	3	682	1087.57	741,722
				3,229,408*
				6,458,817**

* Total feed cost for 4 pigs; ** Total feed cost for 8 pigs

TABLE 5
Revenue for One Year

<i>Type of diet</i>	<i>Revenue (million cedis)</i>
Farmers' diet	10.5
Test diet 1 (cereal-based diet)	14.7
Test diet 2 (AIBP-based diet)	15.0

additional annual net income of \$2.75 per marketed hog produced in confinement (Larson *et al.*, 2003).

The simple benefit-cost ratio, which was computed as the ratio of extra total additional income to total extra cost, is 1.71. This means that the additional benefit which a farmer obtains due to the use of improved AIBP based diet is about two times more than the extra cost incurred. Other benefits were also obtained, but these were not quantified. These included savings in labour time due to changes in management practices, and improvement in carcass quality. Improved diets were fed once a day while farmers' diet was fed twice a day. Thus, labour was saved. Also, leaner

meat was produced from the use of improved diets, the sale of which could have been at a higher price.

A number of factors may affect the sustainability of the use of the feeding package (technology) including how easily the feed ingredients can be obtained and what alternative uses they have. The major ingredients in the recommended diet (AIBP-based diet) were coconut chaff and coconut (copra) cake (Table 2), which constituted about 44 per cent of the diet by weight. These are easily available in the area as confirmed by their use in the farmers' diet, where they constituted about 77 per cent of the diet by weight. The other major ingredient in the AIBP diet, cassava peel, which made up about 30 per cent of the diet, is also available, as it is a by-product from a major food crop, cassava. The rest of the included ingredients, wheat bran, fish meal, and soybean meal, can be obtained in major commercial towns like Tarkoradi. The cost of transport required to bring these products to where they will be used have been factored into the computations of the profitability of the technology. An ingredient like maize, which has

TABLE 6

Partial Budget for Feeding Pigs Unbalanced Farmer's Diet versus Feeding Compounded and Balanced Diets Based on Agro-Industrial by Products for 1 Year (Figures are in old cedis; One Gh¢ : €10,000)

<i>Problem: Do richer diets give higher profits?</i>			
Extra costs		Extra income	
Fixed cost		Pig sales	4,516,160
None	-		
Variable cost			
Feed cost	2,136,933		
Transport	500,000		
Reduced revenue		Reduced cost	
None		None	
Total additional cost and reduced revenue	2,636,933	Total additional income and reduced costs	4,516,160

Net additional income = 1,879,227. Benefit-cost ratio = 4,516,160/2,636,933 = 1.71.

major alternative uses as human food and poultry feed, and, therefore, could become scarce and expensive) is not one of the ingredients in the recommended diet, AIBP based diet.

Conclusion

Though the improved AIBP-based diet was more expensive than the farmers' diet, this was compensated for by more batches of pigs that could be turned out at the targeted market weight using the improved diet. Additional income was about twice additional cost incurred due to the use of the improved diet. In a year, a modest additional net income of one million eight hundred and seventy-nine thousand two hundred and twenty-seven cedis (€1,879,227) could be obtained by adopting the improved AIBP diet. The ingredients included in the diet are locally available and are generally not used in competing enterprises. The improved AIBP diets are profitable and their use can be sustained.

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