1.8 IMPROVING SMALLHOLDER INCOME GENERATION BY INTEGRATING DMC BY-PRODUCTS INTO PIG RAISING ACTIVITIES

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Abstract

Development of cereal/legumes association in DMC system with smallholder farmers needs to provide direct economic benefits in addition to soil fertility improvement and weed control. Thus, no till maize associated with pigeon pea (Cajanus cajan) has been promoted in Sayaboury province of Lao PDR in order to improve the conventional maize monocropping system, provide farmers with additional raw material for pig raising and reduce local dependence on imported soybean meal. However, the use of grain legumes in pig nutrition has been limited due to high concentrations of secondary plant metabolites. The aim of this study is to investigate the effects of three dietary treatments on the technical and economic performances of short-term pig fattening systems. Treatments were based on different protein sources - i.e. soybean meal (Group 1), inclusion of raw pigeon pea seed (Group 2), and inclusion of boiled pigeon pea seed in a ration (Group 3). The results of these trials show that the quantity of pigeon pea meal used does not affect pig growth. Average daily growth obtained after 150 days with pigs reared with an inclusion of pigeon pea seed meal were significantly higher for Group 2 and 3 (523 g.day-1; 529 g.day-1) than those reared with protein concentrate only (464 g/day). Feed intake composed of 18% of pigeon pea enabled a reduction of 13% in the total cost of feed production. On average, the pigs fed with an inclusion of pigeon pea provided a net profit increase of 24 USD per head with no need meal preparation (boiling). Additional experiments should attempt using larger amounts of pigeon pea seed meal in the feed intake in order to evaluate the impact of higher content of antinutritional factors on growth performance.

Keys word: Pigs, feed intake, protein, pigeon pea, no-till, Direct seeding Mulch-based Cropping system, Sayabury province, Lao PDR

Introduction

In the four southern districts of Sayaboury province, farmers' livelihoods depend primarily on rainfed maize cultivation. In average, maize production contributes to 66% of the farmers' annual incomes. This contribution even reaches 80% in Paklay district. The current farming systems – based on intensive monocropping and mining practices (i.e. ploughing on steep slopes, hybrid seeds, and heavy use of pesticides) – involve high production costs and engender a rapid decline in agricultural yields. In order to remedy to this situation and improve farmers' livelihoods, the Ministry of Agriculture and Forestry of the Lao PDR launched the PASS-PCADR project with financial support from AFD. The main objectives of this project were related to: (i) soil and environmental conservation, (ii) improvement and diversification of farmers' incomes,

and (iii) improvement of agricultural marketing. Alongside extension activities in relation to conservation agriculture (Direct Seeding Mulch-Based Cropping systems), PASS-PCADR has also been working at improving smallholder pig raising systems. All the production factors (i.e. pig pen, feed, health and genetics, deep bedding litter – mixture of soil and rice husk) were targeted for improvement with different levels of intensification depending on farmer strategies. Technical and economic performances were monitored in 2006 and 2007 with 32 families involved in short-term fattening of 155 pigs.

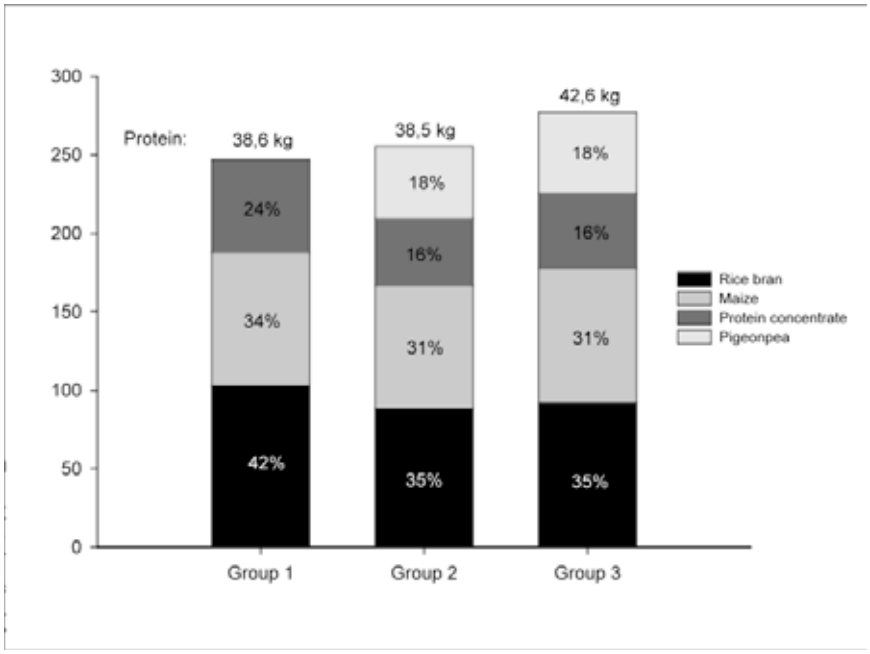
Before the inception of PASS-PCADR activities, most of the farmers of the study area were engaged in an intensive system involving the use of exotic breeds and a protein concentrate (soybean meal) in the feed intake. While good results can be obtained with this system – i.e. an average of 30 USD/head net profit for the more intensive system, the protein concentrate imported from Thailand represents an important production cost. In order to reduce this cost, PASS-PCADR engaged in experimentations aimed at replacing the protein concentrate additive by DMC by-products. The trials involved incorporating pigeon pea (Cajanus cajan) seed meal into the daily pig feed rations. This leguminous crop is produced in DMC systems and associated with maize in order to improve conventional monocropping systems. Pigeon pea seeds have a great potential as an important protein source (Oshodi et al., 1993). The use of alternative legume seeds is encouraged to supply a constant plant protein source in animal feed and to reduce dependence on soybean meal imported to Laos. The nutritional and growth performance features of Pigeon pea seed meal has been studied widely (e.g. Cheva-Isarakul, 1992; Mekbungwan et al. 1999). Although its use is limited by a high content of anti-nutritional factors such as trypsin and chymotrypsin inhibitors (Batterham et al. 1993), Ene-Obong (1995) has reported that such anti-nutritional factors do not cause problems in animals based on in vitro protein digestibility. Moreover, anti-nutritional factors can be eliminated by seed processing (Singh, 1988; Simoongwe, 1998; Mekbungwan and Yamauchi, 2004), resulting in improved protein and starch digestibility (Rani et al., 1996). The aim of this study is to investigate the effects of three dietary treatments, based on different protein sources (i.e. soybean meal, inclusion of raw or boiled pigeonpea seed in a ration), on the technical and economic performances of short-term pig fattening systems.

Materials and methods

Animals and housing
Sixteen 30-day-old hybrid (Landrace × Large white; average body weight 6.5 kg) piglets were used in this study. The experimental design consisted of three dietary treatment groups with four (group 1) to six piglets (group 2 & 3) per group. Each group was placed in a pen with a 1.5 m^2 floor area per piglet and given ad libitum access to water. Pigs were reared on deep bedding with a mixture of soil and rice husk as substrate.

Diets and feeding
Short-term pig fattening trials (5 months) were conducted with 3 groups of piglets, selected at random, and fed with 3 different kinds of feed intake. A control group (Group 1) received feed composed of rice bran, corn and protein concentrate. Group 2 received feed composed of rice bran, maize, protein concentrate (soybean meal) and raw pigeon pea seed meal. Group 3 received the same feed composition as Group 2 but pigeon pea seed was boiled in order to eliminate anti-nutritional factors, which can potentially occur when legumes are directly incorporated into animal feed. Diets 1 & 2 were formulated to contain in average 210 g kg-1 of pigeon pea seed meal that refer, according to Batterham et al. (1993), to low levels of trypsine and chymotrypsine inhibitors. The variety of pigeon pea was imported from the extension center of Loei province in Thailand. It has been assumed for this study a protein content of 180 g kg-1 for pigeon pea raw seed and 80 g kg-1 for rice bran and maize. The protein concentrate

(40%) was bought from KKT company in Thailand. Total feed used during fattening was 247 kg per pig for G1 with 42% of rice bran, 34% of corn and 24% of protein concentrate. For G2 and G3 total feed was255 kg per pig and 279 kg per pig, respectively, with 35% of rice bran, 31% of corn, 16% of protein concentrate and 18% of pigeon pea seed meal. All food rations were composed in such a way as to contain the same protein rate (15.6%). However, feed intake of G3 was higher than the others groups and represented a protein increase of 4 kg per pig for 150 fattening days (graph 1).



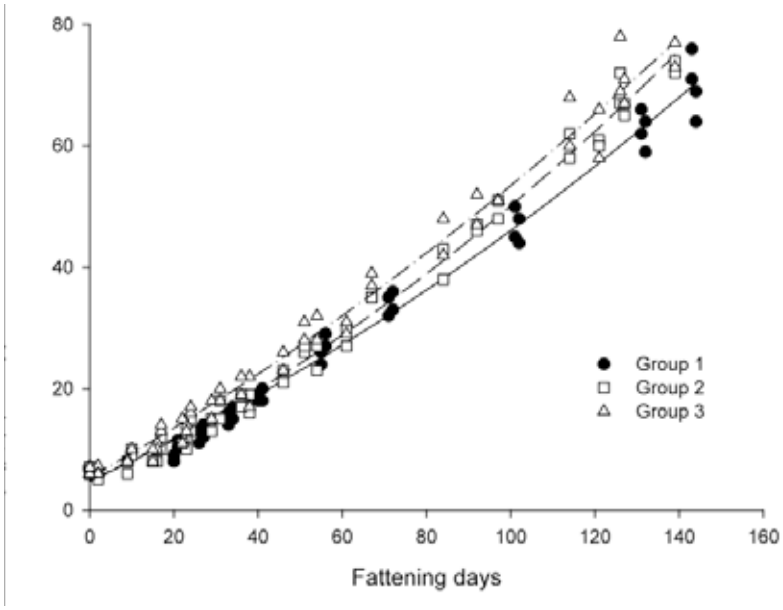
Graph 1: Nutrient intake for the three dietary treatments, fattening period of 150 days. Total protein intake is given on top of each bar.

In addition, the condition of 30 piglets receiving the control feed was also monitored under small farm conditions. For each group, feed intake, weight gain, feed conversion ratio (FCR) and daily feed costs were measured.

Statistical analysis
Data on growth performance were statistically analyzed by using one-way analy¬sis of variance (ANOVA), and significant difference among the treatments were determined with Duncan's multiple range test (i.e. differences were found significant at $p<0.05$).

Results

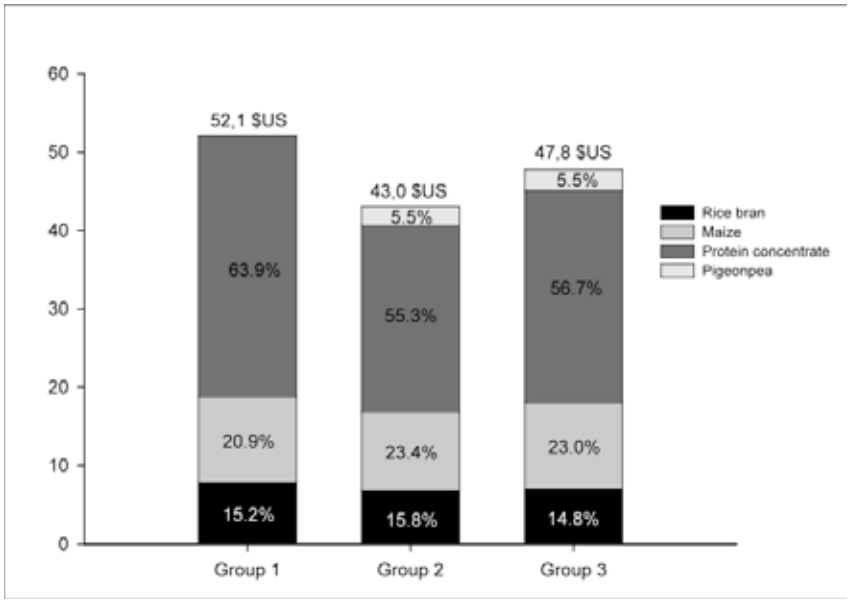
Growth performance
The results of these trials show that the inclusion of pigeon pea seed for pig feed did not have negative impacts on the average daily growth (ADG) rate (Graph 2). Quite the contrary, the ADG obtained after 150 days with Groups 2 (523 g/day) and 3 (529 g/day) were significantly higher ($p<0.05$) than those obtained with Group 1 (464 g/day) and with the 30 piglets raised under small farm conditions (480 g/day, data not shown). Rather positive results were also observed for Feed Conversion Ratios (FCR, Table 1), which give us a better observation of technical performances, with 3.2 and 3.3 for Groups 2 and 3, and 3.6 and 3.5 for Group 1 and the piglets raised under small farm conditions.



Graph 2: Growth rate of piglets for three dietary treatments (Group 1, 2 and 3) for 150 days of fattening.

Economic performance

Furthermore, feed intake composed of 18% of pigeon pea enabled a 20-30% reduction in protein concentrate use and, hence, a 8-17% reduction in the total cost of feed production for 150 days of fattening (Graph 3). The pigs fed with an inclusion of pigeon pea and sold after 150 days of fattening provided an average net profit increase of 24 USD per head (Table 1).



Graph 3: Cumulated feed cost for the three dietary treatments (Group 1, 2 and 3) and for 150 days of fattening.

	Control (G1)	Pigeon pea (G2)	Pigeon pea boiled (G3)
ADG (gr/day) 7 – 25 kg	330	348	395
ADG (gr/day) 25 – 100 kg	559	628	602
ADG (gr/day) 150 days	464 (+/- 30)	523 (+/- 28)	529 (+/- 50)
FCR	3,6	3,2	3,3
Weight at 150 days (kg)	76,6	85,5	86,4
Net profit (USD)	33,9	58,1	56,9

Table 1: Average daily growth, feed conversion rate and net profit of the three dietary treatments.

Discussion and Conclusion

This study provides encouraging results and suggests that the inclusion of pigeon pea seed meal into pig raising activities can effectively help increase smallholder incomes. This integration appears particularly appropriate in view of the continuous rise in protein concentrate prices. The quantity of pigeon pea seed meal used does not affect pig growth. Indeed, the ADGs measured for the groups fed with boiled and raw pigeon pea seed did not exhibit significant differences ($p<0.05$). Additional experiments should attempt using larger amounts of pigeon pea seed meal in the feed intake (up to 30%) in order to evaluate the impact of higher content of antinutritional factors on growth performance. As suggested by Phengsavanh and Stür (2006) and Phengsavanh et al. (2008), other tropical legumes could also be used as protein source by Lao farmers. *Stylosanthes guianensis* (CIAT 184), for instance, could represent an efficient source of protein for the small-scale farming systems of the Lao PDR.

The improved production system developed by PASS-PCADR provides other benefits. Pigs were reared on deep bedding with a substrate of soil and rice husk. This natural litter has many positive effects on the welfare of pigs, including improved physical comfort of the floor and reduced stress resulting from concrete floors (Warnier and Zayan, 1985). It also functions as an important stimulus and outlet for exploration, foraging and has a favorable effect on pig behavior (Tuyttens, 2005). Armstrong et al. (2007) reported that pig bedding litter produced marked improvements in the dry matter production, grain yield, soil physical structure and chemical parameters.

With regard to the cropping system finally, the use of pigeon pea - as others legumes cover crops - associated with maize increases the yields by controlling weed pressure and improving soil fertility (i.e. average increase of 500 kg.ha-1 after two years) while giving average yields of 1.2 t.ha-1 of pigeon pea grain.

In the end, improved pig raising - using legumes (grains and leaves) produced locally, deep-bedding technique, genetic improvement and water distribution - can be a good opportunity for farmers to diversify and increase their annual income. Fattening activities with ten pigs would generate higher benefit - i.e. about 500 USD - than cultivation of one hectare of maize - i.e. an average of 300 USD.ha-1 in the area (2008 data from PASS-PCADR) for the same production time (5 months). However, production costs remain quite high (i.e. 100 USD per pig) and farmers would clearly benefit from micro-credit as well as technical support to start this kind of activity.

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