

## Characterization of Feed Resources and Body Condition Scores of Pigs under Small Scale Intensive Production in East Shewa, Ethiopia

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**Abstract:** A study was carried out to characterize the feed resources and body condition scores of small scale intensive pig production in three towns of East Shewa of Ethiopia, namely Addis Abeba, Bishoftu and Adama. The three towns were purposively selected to represent highland, midland and lowland agro ecological zone, in that order. A total of 105 representative households were randomly selected and interviewed. Individual interviews using a structured questionnaire and focus group discussions were made to collect the information. Data were analyzed using ANOVA, chi-square and descriptive statistics. The results of the study revealed that the dominant type of pig enterprise was mixed type of operation. Significantly higher ( $p < 0.01$ ) number of pig producers in Bishoftu town utilized commercial feeds than Addis Ababa and Adama towns. The amount of feed offered to individual pig category, i.e. piglet, weaned, grower, sow, boar and fatterer was significantly higher ( $p < 0.01$ ) in Bishoftu compared to feed offered in Addis Ababa and Adama. The EE% and ME% contents of homemade feeds in Bishoftu were greater than Addis Ababa and Adama. The crude protein content of homemade feeds of Adama was lower compared to homemade feeds of Bishoftu and Addis Ababa. The crude fiber content of the composite feeds in Bishoftu was lower than Addis Ababa and Adama. The body condition scores of piglets, weaned, growers, boars and fatterers were significantly higher ( $p < 0.01$ ) in Bishoftu than in Addis Ababa and Adama. Therefore, intervention strategies should be planned and put into practice in view of the diverse feed resources and body condition scores of pigs to increase the income of small scale intensive pig keepers.

**Key words:** Small scale • Intensive production • Homemade feed • Feed chemicals and Body Condition Score • Pig

### INTRODUCTION

The main purpose of pig production in Ethiopia is for income generation [1, 2]. Efficient and profitable swine production depends upon an understanding of the concepts of genetics, environment, herd health, management and nutrition [3]. These factors interact with each other and their net output determines the level of production and profitability.

Feed represents 55-85% of the total cost of commercial swine production, in most tropical countries [4]. The economics of feeding pigs apart from depending on availability of feedstuff also depends on competition for the feedstuff between human and other animals

found in the same locality [5]. The range of feedstuffs that tropical farmers can offer to their livestock is often less limited, but it is vital that the right feed proportions are fed to the animals. A deficiency of an item in the diet may cause ill-health and hence low productivity [6].

For a feed to be regarded as being of good quality, it must contain appropriate levels of carbohydrates, proteins, fats, vitamins and minerals among others. Other secondary considerations include content of anti-nutritional factors and fiber levels [7]. A feed may however contain adequate amount of nutrients in balanced proportions, yet these nutrients may not be available to the animals [8].

This implied that, understanding feed characteristics is vital so as to uphold a profitable pig venture. Despite the large pig population in central Oromia, Ethiopia, there is limited information on feed resources and body condition scores of pigs which might delay to work out intervention strategies and forward movement of pig production. Hence, the present study was aimed at analyzing type of pig operation, feed types, feed sources, amount of feed offered, feed chemical composition and body condition scores of pigs under small scale intensive farming system in central Oromia, Ethiopia. It is perceived that the results of the present research will be utilized by different stakeholders to mainstream this production system as a pathway to improved livelihoods and family food security of smallholder producers.

## MATERIALS AND METHODS

**Description of the Study Area:** The study was carried out in three sites of East Shewa of central Ethiopia that is Addis Ababa, Bishoftu and Adama representing highland, midland and lowland agro-ecologies, respectively. Addis Ababa is positioned at 9° N latitude 38°E longitude and average altitude of 2355 meters above sea level; Bishoftu is positioned at 9°N latitude and 40°E longitudes at an altitude of 1850 meters above sea level; Adama is positioned at 8° N latitude and 39° E longitude 1400 meter above sea level. The study towns have formerly been described extensively [1].

**Data Collection Procedure:** To access information on pig operation, feed types and feed sources cross-sectional questionnaire survey and focus group discussions were performed during January 2014 to April 2015. The questionnaire interview was conducted by data collectors with the involvement of the investigator. The number of respondent's interviewed in Addis Ababa, Bishoftu and Adama was 35, 40 and 30 in that order.

**Focus Group Discussions:** The information obtained using questionnaire interview was cross checked by focus group discussions. Members of the focus group discussions were selected together with the urban agricultural workers. On average six people (ranging from 4 to 11) involved in the discussion.

**Feed Chemical Analysis:** Chemical compositions of feed samples were analyzed in National Veterinary Institute (NVI) nutrition laboratory. Collected pig feed samples were ground to pass through 1mm sieve to determine for dry matter (DM), ash, mineral matter (MM), ether extract

Table 1: Pig Body Condition Scoring system according to Holness [12]

Score	Description	Assessment
0	Emaciated	Exposed, no cover on bones
1	Poor	Bones prominent, little cover
2	Moderate	Bones easily felt without palm pressure
3	Good	Bones only felt with firm palm pressure
4	Fat	Bones cannot be felt with firm palm pressure
5	Glossily fat	Further deposition of fat impossible

(EE), crude protein (CP) and crude fiber (CF) according to AOAC [9] and calcium (Ca) was determined by Talapatra method (precipitation, filtration and titration) according to Mudgal [10]. The metabolizable energy (ME) values of each feed sample were calculated ultimately from EE, CF and ash according to Wiseman [11] as:  $ME (Kcal/Kg DM) = 3951 + 54.4 \times EE - 88.7 \times CF - 40.8 \times Ash$ .

The amount of feed offered per day for different pig class was determined by weighing using a suspended balance of 5 kg capacity.

The number of pigs assessed for body condition score were 30 for each pig category making a total size of 180.

**Statistical Analysis:** Variables in relation to pig operation, feed types and feed sources, amount of feed offer, feed chemicals and Body Condition Scores were analyzed using ANOVA, Chi-square and descriptive statistics of statistical package for social sciences [13].

## RESULTS AND DISCUSSION

**Types of Pig Operations of Small Scale Pig Production in East Shewa:** Figure 1 indicates the types of pig operations of small scale intensive pig production in East Shewa of central Ethiopia. Based on the types of pig operation undertaken, the farmers were divided into two groups. The farmers reported that mixed (71.4%) was the dominant type of pig operation. Mixed had a combination of the three systems (farrow to weaned, farrow to finisher and weaned to finisher). Another category of farmers (farrow to finisher) (30%) had sows and reared the pigs up to when they reached market weight. The other pig operations namely, Farrow to weaned (had sows and reared piglets up to weaned) and weaned to finisher (fattened the pigs before selling for slaughter) were hardly practiced by the farmers of the study area. The complete cycle of pig production model was not available because of poor linkage among the pig enterprises. However, each pig operations could have the potential to create extensive employment opportunities for the youth group of Ethiopia. This implied that the pig production in the

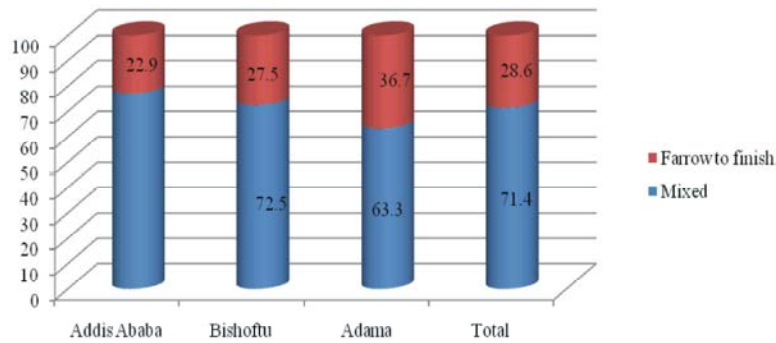


Fig. 1: Types of pig operations of small scale pig productions in East Shewa

Table 2: Feed types and sources for small scale intensive pig production in East Shewa

Feed characteristics	Addis Ababa N (%)	Bishoftu N (%)	Adama N (%)	Total N (%)	Test	
					X <sup>2</sup> -value	p-value
<b>Feed types</b>						
12	1(2.9) <sup>a</sup>	8(20) <sup>b</sup>	1(3.3) <sup>a</sup>	10(9.5)	8.023	0.016
6	2(5.7) <sup>a</sup>	1(2.5) <sup>a</sup>	2(6.7) <sup>a</sup>	5(4.8)	0.761	0.683
4	1(2.8) <sup>a</sup>	1(2.5) <sup>a</sup>	1(3.3) <sup>a</sup>	3(2.9)	0.043	0.979
3, 5, 10, 11	2(5.7) <sup>a</sup>	9(22.5) <sup>b</sup>	2(6.7) <sup>a</sup>	13(12.4)	6.11	0.047
2, 3, 5, 9, 10	18(51.4) <sup>a</sup>	1(2.5) <sup>b</sup>	14(46.7) <sup>a</sup>	24(31.4)	25.261	0.000
3, 5, 9, 10, 11	1(2.9) <sup>a</sup>	9(22.5) <sup>b</sup>	1(3.3) <sup>a</sup>	11(10.5)	9.964	0.007
1, 3, 5, 10, 11	2(5.7) <sup>a</sup>	10(25) <sup>b</sup>	2(6.7) <sup>a</sup>	14(13.3)	7.624	0.022
1, 3, 5, 9, 10	8(22.9) <sup>a</sup>	1(2.5) <sup>b</sup>	7(23.3) <sup>a</sup>	16(15.2)	8.120	0.017
<b>Feed sources</b>						
1, 7	1(2.9) <sup>a</sup>	1(2.5) <sup>a</sup>	1(3.3) <sup>a</sup>	3(2.9)	0.043	0.979
1, 7, 8	3(8.6) <sup>a</sup>	3(7.5) <sup>a</sup>	2(6.7) <sup>a</sup>	8(7.6)	0.085	0.959
7, 8	2(5.7) <sup>a</sup>	2(5) <sup>a</sup>	2(6.7) <sup>a</sup>	6(5.7)	0.088	0.957
1, 8	4(11.4) <sup>a</sup>	4(10) <sup>a</sup>	3(10) <sup>a</sup>	11(10.5)	0.051	0.975
8, 2	15(42.9) <sup>a</sup>	18(45) <sup>a</sup>	13(43.3) <sup>a</sup>	46(43.8)	0.039	0.981
7, 8, 4, 2	4(11.4) <sup>a</sup>	5(12.5) <sup>a</sup>	4(13.3) <sup>a</sup>	13(12.4)	0.055	0.973
7, 8, 2	6(17.1) <sup>a</sup>	7(17.5) <sup>a</sup>	5(16.7) <sup>a</sup>	18(17.1)	0.008	0.996

N (%) depicts number or percent of respondents; <sup>a,b</sup>values with one superscript letter in common are not significantly separated; 1=Kitchen, 2= Restaurant, 3= Concentrates, 4=Abattoir Waste, 5=Grains, 6=Vegetable and fruit waste, 7=Garden, 8=Market, 9= poultry feces, 10=mineral, 11=forage and 12=commercial feeds

current study was not organized in such a way that it could offer better job opportunity and economic benefit to the country. The present results disagreed with reports of Kagira *et al.* [14], who classified that the types of pig operations, in western Nigeria in to four groups (mixed, furrow to finish, weaned to finish, furrow to weaned).

**Feed Types and Sources for Small Scale Intensive Pig Production in East Shewa:** Table 2 shows feeding practices of small scale intensive pig production in East Shewa. Numerous feed types used in pig diets differed ( $P<0.05$ ) with location. Significantly higher number of pig producers in Bishoftu town utilized commercial feed, (combination of concentrates, grains, forage and mineral) and (combination of concentrates, grains, poultry litter, forage and mineral), (combination of kitchen,

concentrates, grains, forage and mineral) compared to Addis Ababa and Adama towns. However, combinations of (restaurant waste, concentrates, grains, poultry litter and mineral) and (concentrates, grains, kitchen, poultry litter and mineral) utilized by significantly lower ( $P<0.05$ ) pig keepers in Bishoftu than Addis Ababa and Adama towns. A small number of respondents in the three towns utilized abattoir wastes for pig production. The abattoir waste included poultry offal's mainly intestines which were paralleled with reports of Iyai, Iyai *et al.* [15, 16] on pig rearing. The focus group discussions noticed that the poultry offal's were boiled and fed to pigs to protect disease transmission from poultry to pig. They further perceived that decisions to include particular feed ingredients in the diet were related to palatability, availability and price in the market [17]. The feeding of

home mixed kitchen, restaurant, associated with concentrates and grains to pigs of all categories was considered as a mechanism of saving feed cost. The price of own-mixed feeds was less than the feed mill factories, because feed manufacturers raised the price of their feeds in order to be able to pay their workers, maintain the feed mill and also make a profit, which was not the case when farmers mix their own feeds [18]. However, these home-mixed feeds have been reported to be nutritionally insufficient [19], hence, resulting in decreased production efficiencies. Major reasons for the poor nutritional quality were the use of inappropriate feed formulae [20, 21] and adulterated feed components [22, 23].

**Amount of Feed Offer of Small Scale Pig Production in East Shewa:** Table 3 depicts amount of feed offered for small scale intensive pig production in East Shewa of central Ethiopia. The quantity of feeding ration allowed to individual pig category, i.e. piglet, weaned, grower, sow, boar and fattener was significantly higher ( $p<0.01$ ) in Bishoftu compared to Addis Ababa and Adama. The present variation in feed offer might be caused by the availability of wider farm size in Bishoftu which might support better feed production and supply to pigs. It was observed that farmers determined the amount of feed allowed to different pig class without understanding the chemical composition of feedstuff and nutrient requirement of the pigs. However, such practice may be insufficient to satisfy to the nutrient requirement of pigs. Sex split feeding was not observed across the study towns throughout the study period. This could suggest that farmers were unable to monitor Nitrogen and Phosphorus wastage in their pig production units. To improve the quality of feeding pigs, it is needed that farmers first know the feed value and requirements of the pigs. Therefore, it will be instrumental to teach the pig keepers on this feature of pig husbandry.

**Proximate Analysis of Composite Feeds of Small Scale Pig Production in East Shewa:** Chemical composition of composite pig feeds used in Addis Ababa, Bishoftu and Adama towns are shown in table 4. The DM%, MM%, CA% contents of composite feeds was similar along the study sites. The EE% and ME% of composite feeds of Bishoftu were superior compared to Addis Ababa and Adama.

The Ether Extract content of the feed sample in Bishoftu was very high compared in Addis Ababa and Adama and would be of benefit to the pigs in Bishoftu.

High fat content can also predispose feedstuff to rancidity. Computed metabolizable energy values of composite feeds were also relatively lower for growing pigs in Addis Ababa and Adama than Bishoftu and this may also have contributed to the lower growth performance obtained in the present study.

The crude protein contents of the composite feeds of Adama were lower compared to composite feeds of Bishoftu and Addis Ababa. The current results were relatively similar compared with previous reports of Okoli *et al.* [24]. The crude fiber content of the composite feeds in Bishoftu was smaller than in Addis Ababa and Adama. The CF content of composite feeds in Addis Ababa and Adama seems higher for monogastric animals like pigs, which means that the proteins were probably locked up in these fiber materials of the feeds and can only be released with the aid of appropriate additive enzymes [5]. However, CF contents of all composite feeds in all study sites were smaller (25%) than the reports of Carter *et al.* [25] in Uganda. The current variation in feed value of composite feeds across the study sites might be due to the inclusion of diverse feed ingredients during formulation of rations for pig production. The feed values of the present study were similar with reports of Ermias *et al.* [26], who studied the chemical composition of composite feeds for chicken production in central Oromia, Ethiopia.

**Body Condition Scores of Small Scale Pig Production in East Shewa:** Table 5 shows the body condition scores of pigs in Addis Ababa, Bishoftu and Adama towns. The body condition scores of pig categories were significantly different ( $P<0.01$ ) among the study towns. The body condition scores of piglets, weaned, growers, boars and fatteners were significantly higher ( $P<0.01$ ) in Bishoftu than in Addis Ababa and Adama. This might be associated with the greater amount of feed offer and better feed quality in Bishoftu weigh against to Addis Ababa and Adama. This in turn explained that there was more appropriate feed and effective delivery system in Bishoftu than in Addis Ababa and Adama. However, the overall results in relation to Body Condition Scores of sows were lower which could increase the number of stillborn piglets in the study towns. Sows with lower Body Condition Scores (less than 3) or amounts of back fat at the end of gestation experienced a significantly higher percent age of stillborn piglets [27]. So, monitoring the Body Condition Scores of Sows through phase feeding might help to decrease stillbirth in the pig herd.

Table 3: Amount of feed offered in small scale pig production in East Shewa

Pig class	Towns				Test	
	Addi Ababa Mean±SD	Bishoftu Mean±SD	Adama Mean±SD	Total Mean±SD	F-value	p-value
Piglets (kg)	0.17±0.02 <sup>a</sup>	0.2±0.00 <sup>b</sup>	0.16±0.01 <sup>a</sup>	0.18±0.02	118.317	.000
Weaned (kg)	0.41±0.06 <sup>a</sup>	0.63±0.05 <sup>b</sup>	0.42±.05 <sup>a</sup>	0.49±0.12	188.006	.000
Growers (kg)	0.63±0.05 <sup>a</sup>	0.80±0.02 <sup>b</sup>	0.63±0.05 <sup>a</sup>	0.69±0.09	248.018	.000
Sows (kg)	1.1±0.10 <sup>a</sup>	1.51±0.11 <sup>b</sup>	1.10±0.10 <sup>a</sup>	1.26±0.22	187.159	.000
Boars (kg)	1.1±.09 <sup>a</sup>	1.51±0.11 <sup>b</sup>	1.13±0.10 <sup>a</sup>	1.28±0.21	174.019	.000
Fatteners (kg)	1.7±0.04 <sup>a</sup>	1.96±.095 <sup>b</sup>	1.73±.045 <sup>a</sup>	1.81±0.14	158.828	.000

SD refers to Standard Deviation; <sup>a</sup><sup>b</sup>values with one superscript letter in common are not significantly separated

Table 4: Chemical composition of feed samples of small scale pig production in East Shewa

Values	Addis ababa				Bishoftu				Adama			
	Com <sub>1</sub>	Com <sub>2</sub>	Com <sub>3</sub>	Com <sub>4</sub>	Com <sub>1</sub>	Com <sub>2</sub>	Com <sub>3</sub>	Com <sub>4</sub>	Com <sub>1</sub>	Com <sub>2</sub>	Com <sub>3</sub>	Com <sub>4</sub>
DM%	89.7	89.5	90	89.9	89.9	89.8	90	89.9	89.7	89.7	90	90
MM%	10.3	9.2	9.3	9.3	9.5	9.8	9.6	9.1	9.1	9.5	11.2	9.6
CF%	12.7	13.9	13	10.8	3.9	3.5	3.7	5.0	12.6	13.4	14	14.8
CP%	12.0	13.0	14.7	13.2	14.0	11.8	17.6	14.3	13.0	15.3	15.7	16.3
EE%	4.0	2.2	3.1	3.1	16.9	9	15.9	8.6	5.9	4.3	4.1	3.8
CA%	2.4	2.8	2.2	2.8	3.2	3.0	3.0	2.9	2.9	2.6	3.0	2.6
ME%	2621.9	2462.4	2581.7	2776.8	4136.9	3558.4	4096.1	3604.1	2783.1	2608.7	2475.3	2453.3

Ca= Calcium; CF= Crude fiber; CP= Crude protein; Com=Composite feed; DM= Dry matter; EE= Ether extract; ME= Metabolizable energy

Table 5: Body Condition Scores of small scale intensive pig production in East Shewa

Pig class	Towns				Test	
	Addi Ababa Mean±SD	Bishoftu Mean±SD	Adama Mean±SD	Total Mean±SD	F-value	P-value
Piglets	2.06±.161 <sup>a</sup>	3.35±.483 <sup>b</sup>	2.13±.346 <sup>a</sup>	2.57±.712	148.848	0
Weaned	2.29±.667 <sup>a</sup>	3.53±.506 <sup>b</sup>	2.07±.450 <sup>a</sup>	2.70±.856	74.502	0
Growers	2.03±.453 <sup>a</sup>	2.73±.452 <sup>b</sup>	2.13±.571 <sup>a</sup>	2.32±.580	22.097	0
Sows	1.69±.530 <sup>a</sup>	2.70±.464 <sup>b</sup>	1.77±.568 <sup>a</sup>	2.10±.701	44.33	0
Boars	2.17±.514 <sup>a</sup>	3.40±.591 <sup>b</sup>	2.17±.379 <sup>a</sup>	2.64±.786	71.545	0
Fatteners	2.73±.450 <sup>a</sup>	3.80±.405 <sup>b</sup>	2.37±.490 <sup>c</sup>	3.02±.772	103.616	0

SD refers to Standard Deviation; <sup>a</sup><sup>b</sup>values with one superscript letter in common are not significantly separated

### CONCLUSIONS

The respondents revealed that there were two types of pig operations in East Shewa namely: mixed and furrow to finish operations. The Feed resources and body condition scores of pigs were influenced by the study sites. This is because feed types, feed sources, amount of feed offer, nutritional composition of composite feeds (%DM, %MM, %CF, %CP, %EE, %CA and %ME) and body condition scores of different pig categories (piglet, weaned, grower, sow, boar and fatterer) varied across the study towns. Therefore, context specific

development interventions should be considered to improve the income of pig producers. Future research should focus on conducting experiment to determine the feed intake, nutrient utilization and performance of pigs.

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