Pig Farming for the Sustainable Livelihood of Tribal Women in North East India: A study of Price Determining Factors of the Pig Value Chain

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Abstract: The profitability margin of chain actors and the dominating factors influencing the pricing structure of pigs in Northeast India is understood. The profitability in value addition of pork is highest from producer to slaughterhouses (35%); from producer to trader (36%) and then, from slaughter- houses to wholesalers level (30%); and from wholesalers to retailers' stage (25%) in Assam, Meghalaya and Nagaland respectively. With the application of PCA, it is found that the major price determining factors are the expenditures incurred on Casual Labour (>63%) and Feed (>53%). It is suggested that subsistence farming of pig can only be converted into commercial scale by introducing new organised form of marketing like cooperatives, FPOs, village organisations.

Index Terms: **Livestock, Pigs, North-East India, Value- chain, Price.**

I. INTRODUCTION

India possess one of the largest livestock wealth in the world and a quarter of the agricultural gross domestic product is contributed by the livestock sector. Pig as compared to other livestock species is considered as the major building block for the empowerment of tribal and rural women. Pigs have immense potential to ensure nutritional and economic security especially to women and other weaker sections of the society. It provide income for women, strengthening their role in families as well as in local communities. They can participate in pig raising as it does not require excessive labor and is not too complex in its management. The income from pig sales is helpful in meeting the essential household and farming expenses and provides huge financial independence to the women. The low start-up costs, quick returns and low risk investment are instantly and fairly recovered during the pig rearing period. Pigs additionally can be considered as a store of wealth and a safety net in times of crisis. The objective of the study is to estimate the profit margin of chain actors and to find out the dominating factors influencing the pricing structure of pigs in the market of Assam, Meghalaya & Nagaland for sustainable livelihoods of Tribal women.

II. MATERIALS AND METHODS

To study the sustainable livelihood of Tribal women the paper is divided into two sections.

The secondary data is analyzed in the first section of the paper with the help of simple average and percentage method to understand the changes in the pig farming in the selected states of North- East India. In the second part, the empirical analysis is made with the application of mean method and Principal Component Analysis. Based on the eigen values (>1), the first three components are identified for Assam and Meghalaya whereas, for Nagaland the first four components are taken. For better understanding of data their rotation is made using Promax method that minimizes the number of variables

with high loadings on each factor. To statistically test the degree of association of variables, Kaiser-Meyer- Olkin (kmo) test is done.

2.1. Size of sample:

The study is based on the household survey data collected from the selected districts of Assam, Meghalaya, and Nagaland. With the random sample survey method, total 900 households (300 HH from each state) involving small, marginal, and large pig farmers/ producers were surveyed on basis of the structured questionnaire. The selected 11 variables which affect the prices and profit margins of the producers in these state include(demand and supply side) -herd size, stock purchases like piglets, expenditure incurred on feed, vaccinations, hiring labors, equipment purchases, transportation, land rent, miscellaneous, depreciation and income earned from selling pigs.

III. RESULTS AND DISCUSSION- I

3.1. Overview of the recent pig farming scenario in North East India

The pig population in India is continuously showing declining trends since 2007 and decreased by 18 per cent since then. The decrease in population was in both exotic or crossbreed and indigenous breed. The exotic/ crossbreed population of pig decreased by 22 per cent whereas, indigenous by 8 per cent from 2012 to 2019. The total pigs in the country have decreased by 12% over the previous census from 10.29 million in 2012 to 9.06 million in 2019. The pigs contribute around 1.69% of the total livestock population of the country.

Table 1: Trend of Total Livestock Population and the percent share of Pigs in it.

Livestock census (Years)	Total livestock (million)	Share of pigs in total livestock population (%)
20th (2019)	535.78	1.69
19th (2012)	512.05	2.01
18th (2007)	529.70	2.10
17th (2003)	485.0	2.78

This declining share of pigs in the total livestock population is probably due to the fact that in India, 70% of the pig population is reared under traditional small holder, low-input demand driven production system which means Pig Farming is highly un-organized in India. Pork production in India is mainly concentrated in the north-eastern corner of the country and consists primarily backyard and informal sector producers. Despite being small-scale, its production contributes significantly to the livelihood of most of the North- Eastern pig-rearing tribal belts.

3.2. Scope of pig farming as a source of livelihood in North East India

The North Eastern region of India is characterized by a high proportion of tribal people whose integral way of life is highly dependent upon Pig rearing. Over a quarter of all India's pigs are found in the North Eastern region. It accounts for 46.83 per cent of total pig population of the country. As a result, it is the largest market for pork meat in India. Despite the decrease in India's pig population by over 12.03 per cent over the previous census, its population has increased by almost 8 per cent in North East India as a whole, because of the increase in pig population of Assam and Meghalaya. According to the 20th Livestock Census conducted in 2019, Assam has the highest number of pigs in the country. Assam and Meghalaya stand first and second respectively in the trend of population ranking in the North-East India. And, as per NSSO (2011-12), the per capita consumption of pork in the country is highest in Nagaland. Thus, the study is based on the three North- Eastern states- two highest in pig production and one highest in pork consumption.

Table 2: Trend of Pig population in North East India

SI. No.	State	Population (thousand) 2012	Population (thousand) 2019	Per cent Change
1.	Arunachal Pradesh	356	271	-23.88
2.	Assam	1639	2099	28.30
3.	Manipur	277	235	-15.16
4.	Meghalaya	543	706	29.99
5	Mizoram	245	292	19.18
6.	Nagaland	504	405	-19.65
7.	Sikkim	30	27	-10.00
8.	Tripura	363	206	-43.25

The increase in pig population is in sync with an increasing demand for animal protein in the NE Region. Besides high demand of pork in these states, there are huge market opportunities in the other adjoining NER states. As the major challenge for the people of this region is the economic upliftment, therefore, commercialization of pig farming can be a sustainable way out for the tribal farmers in North East India.

IV. RESULTS AND DISCUSSION: II
4.1. Analysing the profitability margin of pig value chain

Since the per- capita consumption of pork is mainly concentrated in North- East India, and Nagaland being the highest pork consumer in the country, there is a huge pressure on pig producers to cater to the rising demand. The market analysis indicates that there is an excess of pork demand over its limited supply in Meghalaya and Nagaland. This pushes them to fulfil the market demand by importing pigs from Assam, which has the highest number of pigs in the country. The condition in Nagaland is severe as its pig population is on continuous decline (-34%) since 2007. With the assumption of linear relationship among all the key value chain actors, the efficiency of pig value chain is measured based on its cost factors. Since producers sell pigs considering their live weights in the market, live weight per pig is taken as the unit for first two stages i.e., producer and trader. Whereas, the unit from butcher to retailer level is per kg. The value chain mapping with the relative shares, gain and per cent of value- addition at each stage for all the actors in these states is give below-

(The current ruling prices for each value chain actor presented in the table no. 3 is collected from the market survey method from the various districts of Assam, Meghalaya & Nagaland)

Table 3: Measuring Stage-wise Value-Addition of Pork by each chain actor by Difference in Prices and Growth Percent (in-bracket) at each level.

States	Producer	Trader/ supplier	Butcher/ Slaughter-Houses	Wholesaler	Retailer
Assam	125 (live weight)	170 (live weight)	230/kg	250/kg	310 /kg
Differences among value chain actors	Rs 45; 36%				
		Rs 60; 35%			
			Rs 20; 1%		
					Rs 60; 24%
Meghalaya	160 (live weight)	220/kg (live weight)	250/kg	320/kg (cut-meat)	360/kg
Differences among value chain actors	Rs 60; 37%				
		Rs 30; 13%			
			Rs 70; 30%		
					Rs 40; 12%
Nagaland	125 (live weight)*	170 (live weight)*	230/kg*	240/kg (live weight)	300/kg
Differences among value chain actors	Rs 45; 36%				
		Rs 60; 35%			
			Rs 10; less than 1%		
					Rs 60; 25%

Source:
Author's analysis

*Imported from Assam

As discussed earlier, compared to Meghalaya & Nagaland, the concentration of pig is high in Assam. This excess supply of pig has exerted a downward pressure on the price of pig for each value chain actors in Assam. Therefore, in comparison to Meghalaya, the profitability-share of Assam for almost all the value chain actors is less. From Table 3, it can be understood that Assam has the growth of 36% in the value addition from Producer to Trader. Wholesaler has the lowest share of value addition (1%) among all the chain actors. However, the percent growth in the value addition of pig from Producers to the Traders level is slightly more in Meghalaya (37%), as compared to Assam (36%).Meghalaya has the lowest per cent of value addition from wholesalers' level to retailers i.e., 12% while from traders' level to slaughter-houses t is 13%. As Nagaland has reported to be importing their stock of Pigs from the Karbi Anglong district of Assam, the prices for Producer, Trader, and Slaughter- Houses happens to be the same for both Nagaland and Assam but the actual figures for Nagaland commences from Wholesaler level. In Nagaland, the highest efficiency in value addition is found from wholesalers to retailers' level.

4.2. Price determining factors in the pig market through Principal Component Analysis (PCA)

The aim is to identify the factors that influence the determination of price of pig/ pork in the market chain. Table 4 of PCA gives the associated eigen values of all the variables. Components having eigen values below 1 needs to be omitted from the analysis.

Table 4: Total Variance explained using per cent of variance and cumulative per cents of initial eigen values for all the three states.

	ASSAM				MEGHALAYA				NAGALAND		
Component	Initial Eigen values			Component	Initial Eigen values			Component	Initial Eigen values		
	Total	% of variance	Cumulative %		Total	% of variance	Cumulative %		Total	% of variance	Cumulative %
1	5.757	47.98	47.98	1	4.873	44.31	44.31	1	2.436	22.15	22.15
2	1.797	14.98	62.96	2	1.539	13.99	58.30	2	1.583	14.40	36.55
3	1.105	9.21	72.17	3	1.343	12.21	70.51	3	1.405	12.77	49.32
4	0.822	6.86	79.03	4	0.918	8.35	78.86	4	1.330	12.09	61.41
5	0.554	4.62	83.65	5	0.680	6.19	85.05	5	0.999	9.09	70.50
6	0.461	3.85	87.50	6	0.675	6.14	91.19	6	0.865	7.87	78.36
7	0.411	3.43	90.93	7	0.433	3.95	95.13	7	0.632	5.75	84.11
8	0.349	2.92	93.84	8	0.353	3.22	98.35	8	0.528	4.81	88.92
9	0.329	2.74	96.58	9	0.134	1.23	99.57	9	0.463	4.21	93.13
10	0.234	1.95	98.54	10	0.034	0.31	99.88	10	0.436	3.97	97.10
11	0.130	1.09	100	11	0.012	0.12	100	11	0.318	2.90	100

Table 4 explains how much of the total variance is explained by retaining the first three components for Assam and Meghalaya and how much of the total variance is explained by retaininig the first four components for Nagaland. The lower the variance the more appropriate the model is. Total Variance is explained in a following manner-

For Assam, if one accepts only one component 47.98% of the data total variance is explained; by accepting two and three components one recovers and additional 14.98% and 9.21% of the data total variance, therefore a total of 72.17% is a very good result for the ongoing analysis.

For Meghalaya, by accepting only one component 44.31% of the data total variance is explained; but by accepting further two and three components one recovers and additional 13.99% and 12.21% of the data total variance, therefore a total of 70.51% is a very good result for the ongoing analysis. Similarly, for Nagaland, for the result to be favourable we will be accepting first four components for which the total is 61.41%. Therefore, components with total explained variances are included in the analysis to retain the efficiency of the model.

For a better understanding of data Promax method is applied as their rotation is required to minimizes the number of variables with high loadings on each factor. The eigen vectors of all the 11 variables limited to the first 3 and 4 components for Assam and Meghalaya, and Nagaland respectively are given in an unrotated and rotated matrix form and to make the analysis more readable, the absolute values which are below 0.3 are omitted.

- **a-** Assam-The distribution of variables is done by the three components, namely:
- Factor 1 is well correlated with Stock purchase of pigs;
- Factor 2 is also well correlated with miscellaneous expenditures and expenditures incurred on construction and maintenance of pig sheds.
- Factor 3 is strongly correlated with the wages paid to casual labour and transportation expenditure.

- **b-** Meghalaya-Here also, the distribution of variables is done by the three components, namely
- Factor 1 is well correlated with the wages paid to permanent labour, miscellaneous and equipment purchases;
- Factor 2 is strongly correlated with feed purchases;
- Factor 3 is strongly correlated with the wages paid to casual labour, depreciation and net revenue earned from selling pigs.

- **c-** Nagaland- Here, the distribution of variables is done by the four components, namely
- Factor 1 is strongly correlated with the wages paid to casual labour and miscellaneous expenditure;
- Factor 2 is strongly correlated with the net revenue earned from selling pigs.
- Factor 3 is strongly correlated with the transportation charges and land purchases.
- Factor 4 is correlated with feed and equipment purchases.

Therefore, to ascertain the influence of major variables in the determination of pig's price in the market, eleven different variables taken from 900 Pig Producers of Assam, Meghalaya and Nagaland through household survey method was reduced to only 3 and 4 factors. Principal Component Analysisreduced the dimensionality of the data i.e., only three factors have been preserved for Assam and Meghalaya and four factors for Nagaland.

Table 6: Major variables influencing the pig's price in the markets of Assam, Meghalaya & Nagaland

States	Major variables influencing the price in the market	
	Strong correlation (loadings >0.6)	Slightly weak correlation (loadings <0.6 but >0.5)
Assam	Casual Labour, Miscellaneous	Stock purchase of pigs, Transportation, Maintenance/ Construction of shed
Meghalaya	Casual Labour, Feed	Permanent Labour, Miscellaneous, Equipment Purchases, Depreciation, Income from selling pig
Nagaland	Casual Labour, Transportation, Miscellaneous, Land, Equipment Purchases, Income from selling pig	Feed

Out of 11 variables (Table 6) considered for the empirical analysis using PCA, expenditure done on the wages of Casual Labour and other Miscellaneous items have strong influence in determining the price of pig in Assam. Similarly, the expenditure done on the Casual Labour and Feeds are influencing the pig's prices in Meghalaya. And, expenditure done on the Casual Labour, Transportation, Miscellaneous items, Land, Equipment Purchases, expected income from selling pig have strong influence on the price of pigs in Nagaland. The common factor influencing the determination of price of pigs among all these three states is the expenditure done on the wages of Casual labor. This explains that the price is majorly influenced by the variable cost factors in the pig farming industry.

Now, the Kaiser- Meyer- Olkin (kmo) measure of sampling adequacy is done which is a statistic test that indicates the degree of association of the variables. The closer the 'kmo' to 1 the more adequate the sample and more justified the PCA on the chosen variables.

Table 7: Favourable kmo measures for all the 3 states to test the degree of association of variables

States	Kaiser- Meyer- Olkin (kmo) measure of sampling adequacy
Assam	0.7996
Meghalaya	0.7637
Nagaland	0.6177

In our case, KMO test is 0.799 for Assam, 0.763 for Meghalaya and 0.617 for Nagaland. These values are favourable suggesting that factoring is appropriate.

V. CONCLUSION

The study helps in understanding the share of profitability for each value chain actor in the prominent pig producing and consuming states of India. The results concludes that for Assam and Meghalaya, only the first three-component is sufficient to explain the total variability in the price of pigs and for Nagaland, only the first four-component is sufficient to explain the total variability in the price of pigs. The review indicated the high scope of profitable margin in Nagaland but due to the increasing number of rotated loaded variables among the four components its profitability margin of value chain actors is unevenly spreaded as compared to other two states. So, the study suggests that to convert the subsistence farming of pig into commercial scale, participation of the tribal pig producers in organised form of market like cooperatives, FPOs, village organisations and such other feasible business organisations is required so that pig market becomes more efficient by even distribution of income among the chain actors.

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