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Diversification of Livelihood from Animal Waste and by-Product for Small and Marginal Farmers in India

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ABSTRACT

Background: Utilization of livestock waste and by products are always considered to be an important source of livelihood for environment protection and agricultural development. The study explores the prospective scope of livestock waste utilization by dwelling into the livestock holdings and their health profile, waste management and bio-security practices for sustainable livelihoods of small and marginal livestock farmers of tribal belts.

Methods: With an empirical survey, an analysis is made on the waste management practices in selective states of North East India (Assam, Meghalaya and Nagaland). The percentage and average method were applied to understand the management practices of pig production system. In the qualitative tools mainly Focused Group Discussion (FGD) and Interview methods were used to understand the perception of people on waste management.

Result: It is found that the untreated waste is utilized in field and only 2% of farmers use the manure in pisciculture where waste is used in its integrated form. A comprehensive model of treating and marketing the livestock waste and by products with the application of modern technology can not only contribute in augmenting the income but will also help in quality restoration of natural resources in rural areas.

Key words: Bio-security practices, Livestock, Sustainable livelihood, Waste Management.

INTRODUCTION

In Asia, approximately three hundred million people depends on livestock and related activities for their livelihoods. Majority of households in marginalized groups and tribal areas are dependent on livestock for their livelihoods (Deka and Tharpe, 2008).

Mixed farming, incorporating both crop as well as livestock farming is a common practice carried out in North East Indian states as a primary source of income. Livestock farming facilities play a major role in producing manure which act as an important source of plant nutrients. Manure further can improve soil health, increase its water holding capacity and promote the growth of soil organisms (Scheftelowitz, 2016). This makes the proper disposal and storage of manure crucial for the livestock farming. As the improper storage of manure releases harmful waste products, pollutants and greenhouse gases in the atmosphere. Similarly the land application of manure has to be monitored else it may cause environmental concerns (primarily eutrophication). Research studies are being conducted to explore the diverse management practices and better treatment technologies that will help in mitigating the environmental concerns arising from livestock production facilities and application of waste products released from manure (Feroze *et al.,* 2010).

According to 19th Livestock Census, the livestock population in India is 512.05 million which produces approximately 1095 million tonnes dung per year. The waste from livestock farming includes livestock excreta, feathers bedding material or litter, waste feed and other debris. The most common problem with the livestock waste is that it contributes to large scale emission of Carbon Dioxide thus leading to greenhouse effect. It further pollutes water sources which is instrumental in spreading infectious diseases (Singh, 1997). These released waste must be sustainably treated to diversify the livelihood of small and marginal farmers. Proper management of animal waste is thus required to augment the rural income and restore the clean environment. The animal waste manure and other organic materials could serve as a crucial source of energy production (Kumar *et al.,* 2007).

The waste from the livestock farming can be utilised in resource management, crop production and in reducing the post-harvest losses that will benefit the small famers and rural dwellers by raising the livelihood sources for them. The livelihood of famers can further be diversified as the bio-energy sources released from animal waste and by-

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product can serve as coping strategies to challenges like rising energy demand and fuel prices by providing alternatives for expensive fuels. Further if the animal waste is properly treated, the residues and by-product will provide renewable sources of energy that will support sustainable agriculture while restoring the quality of natural biodiversity (Zhang *et al*., 2013). The present study will act as a catalyst in developing a comprehensive framework where livestock farming and waste management goes hand-in-hand for the diversification of livelihood of small and marginal farmers in rural India. Further, the policy suggestions of the present research will also be utilized by various stakeholders to review the functioning of waste management practices and framework as an important initiative for livelihood diversification of the rural farmers. Therefore, the present study will focus on the scope of business economy of backyard livestock farming in India with special reference to North East states.

MATERIALS AND METHODS

From the study area, total 3000 households from three states namely, Meghalaya Nagaland and Assam were randomly surveyed. Total 1000 households were randomly selected from four districts with a structured questionnaire on the waste and manure management of pig producers. Four villages, with higher concentration of pigs, per district were purposively selected and the detailed information on the following aspects were collected:

1. Socio-economic profile of the farmer.
2. Livestock holdings and their health profile.
3. Waste management and bio-security practices.

The percentage and average method were applied to understand the management practices of pig production system. In the qualitative tools mainly Focused Group Discussion (FDG) and Interview methods were used to understand the perception of people on waste management. Information on farm management practices, live pig market and knowledge of pig health and disease were collected through quantitative and qualitative methods. Three interview teams of two people each were sent for the data collection. The questionnaire was translated from English to the local languages by the data collection team.

Data is analyzed by using Stata 14 (Stata Corp LLC) and Excel (Microsoft Excel, Microsoft Corporation) software. Continuous variables were investigated with means and ranges.

RESULTS AND DISCUSSION

Socio-economic characteristics of pig farmers

Among all the three states, Meghalaya (80.2%) have the highest females followed by Nagaland (78.5%) and Assam (76.4%). Assam (86.9%) has the highest percentage of households who have attained schooling (Primary Education, Lower secondary school and Upper secondary school) followed by Meghalaya (81.6%) and Nagaland (67.1%). Around 73% of the households engage in mixed farming; with Assam being the highest (71.5%) followed by Meghalaya (57.8%) and Nagaland (55.6%). Meghalaya (52.1%) has the highest percentage of females who are either self-employed or engaged in business followed by Nagaland (39.7%) and Assam (7.65%). Meghalaya (83.4%) has the largest concentration of people with average monthly income less than 10000. Among all the three states, Assam has the best average monthly income distribution (Table 1).

Livestock holding and health profile of pigs

According to the latest 20th livestock census, the total livestock in India is 4.54 percent, out of which majority of the population is from rural areas. Among the North Eastern states, Assam has the highest livestock population constituting 74.30 per cent of total livestock in the North Eastern region. The past decade has witnessed significant increase in pig (51 per cent), sheep (25 per cent) and poultry (13 per cent) population in the North East India.

This increase in livestock population is essential for the livelihood diversification of the rural people.

Livestock holding in Assam, Meghalaya and Nagaland

Assam has the highest piglets (69%) followed by sow (12%), fattener (11%) and boar (8%). Meghalaya has the highest piglets (40%) followed by fattener (37%), sow (20%) and boar (3%). Nagaland has the highest fattener (52%), followed by piglets (34%), sow (12%) and boar (2%), (Fig 1).

Other Livestock Preferences in Assam, Meghalaya and Nagaland

Chicken is the most preferred livestock other than pig in Nagaland, Meghalaya and Assam. Ducks are the second most preferred livestock in Assam, Nagaland and Meghalaya. Goats are the third most preferred livestock in Assam, Nagaland and Meghalaya, (Fig 2).

Percentage of pigs vaccinated in Assam, Meghalaya and Nagaland

During 2020-21, almost half of farmers (56%) reported at least one sudden death among their pigs. During the same time-line, the majority farmers (63%) reported the total inflow of pigs, with 7636 additions to the existing herd size through purchase of piglets, gifts from institutions or others and new live births on farm. Though the majority of farmers had knowledge of Classical swine fever, very insignificant number of farmers have got their pigs vaccinated (25%), with Assam being the highest (41.2%), followed by Meghalaya (34.5%) and Nagaland (10.9) (Fig 3).

Prospective scope of backyard farming and waste management practices in North East states

The backyard farming, which acts as the livelihood source for small and marginal farmers, operates under two major challenges. The first challenge encountered by famers is the unorganized structure of the farming which makes it difficult for them to monitor the livestock production. The second challenge faced by the famers is the inefficient management of livestock waste (Smith *et al*., 2000). The

waste from livestock farming includes livestock excreta, feathers bedding material or litter, waste feed and other debris. The most common problem with the livestock waste is that it contributes to large scale emission of Carbon Dioxide thus leading to greenhouse effect (Kumaresan *et al*., 2008).

Irregular supply chain, limited participation in marketing chain, less competitive credit market are some of the major challenges faced by small and marginal farmers under unorganised structure of backyard farming. Restricted application of Public Private Participation model, information gap on scope of organic farming and bio-gas production in agriculture and international market, minimal creation of clusters with the cooperation of Village Organization, Research and Extension units, NGO and financial institutions are some of the major challenges faced by famers under insufficient management of livestock waste released in backyard farming (Fayisa, 2008).

Waste treatment

In the backyard livestock farming, a cooperative model needs to be applied which allows public- private participation to comprehend both the marketing of live products and waste/by products. Pig, cow, goat and chicken/ducks are the common livestock reared in backyard across the major parts of India. Each of the animal waste has different distribution of components which can be combined after treatment for economic solution.

It is inferred from Table 2 that pig manure registered highest phosphorus content (3.3%) and cow dung contains the least (0.43%) whereas pig manure contains the lowest percentage of potassium (0.40%) as compared to waste of cow, goat and chicken. Studies indicate that in pig manure the content of moisture is the highest (26%) which creates limitations for utilizing the waste directly as manure.

From the detailed distribution of nutrients based on three categories (Slurry, Solid and Liquid effluent from lagoon/ponds) it clearly indicates the uneven spread of compounds among the different categories. With the application of advanced livestock waste treatment technology, value added product as fertilizers can be produced which has wide level of utilization in organic farming and biogas production (Table 3).

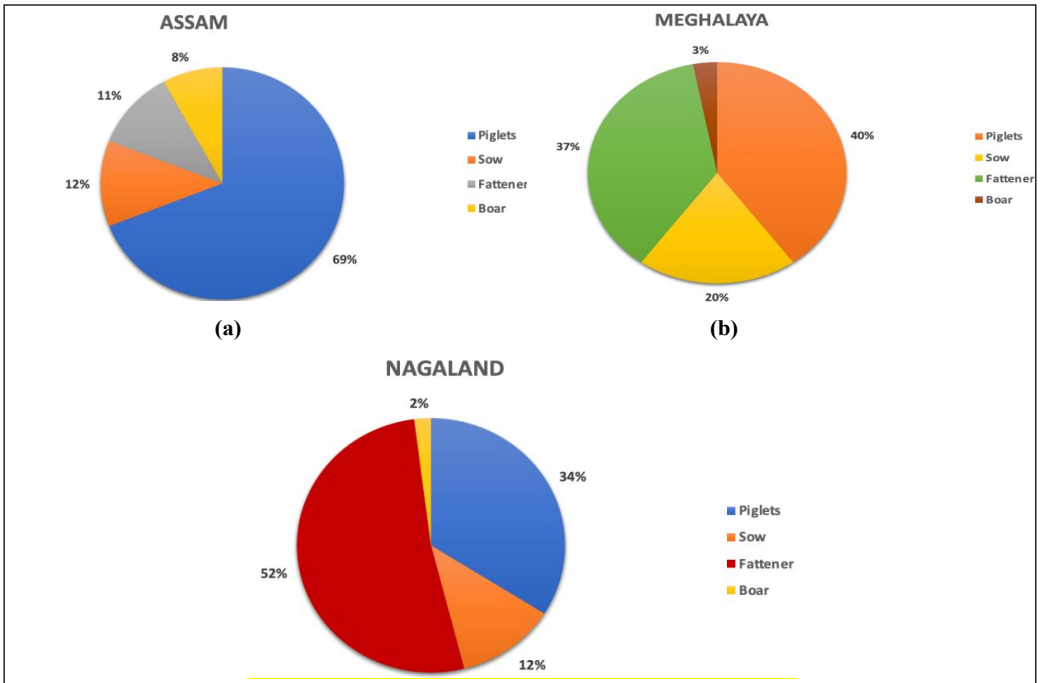
Empirical findings on practice of waste management in North East states

The results indicated that even though majority of the population in North East are engaged in the collection of pig manure, very insignificant percentage of population follows a scientific way of waste disposal. To be specific, Assam is the highest producer of pig and have high access to pig manure, but only 3% of households are found to be

Table 1: Socio-economic characteristics of pig farmers in the livestock keeping households involved in the study.

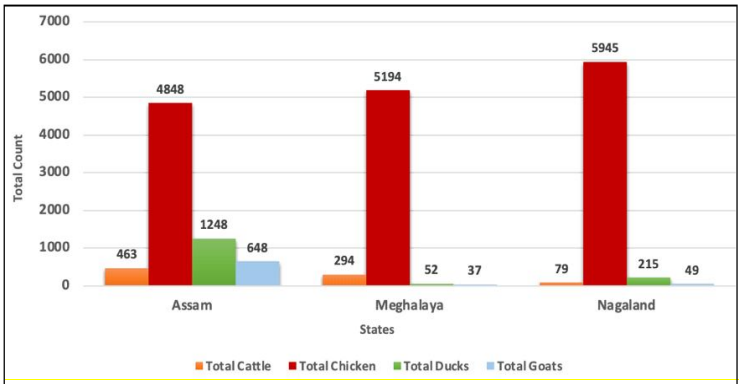
States	Sex ratio	Education level	Primary occupation	Average monthly income (Rs.)
Assam	76.4% are females.	86.9% have attained schooling (Primary education, Lower secondary school and Upper secondary school).	• 71.5% of the households are engaged in mixed farming. • 4.1% of the households are engaged in only pig keeping. • 15.3% of the households are either self-employed or engaged in business out of which 7.65% are females.	• 28.9% of the households have average monthly income less than 10000. • 52.5% of the households have average monthly income between 10000-20000.
Meghalaya	80.2% are females.	81.6% have attained schooling (Primary education, Lower secondary school and Upper secondary school).	• 57.8% of the households are engaged in mixed farming. • 13.2% of the households are engaged in only pig keeping. • 16.2% of the households are either self-employed or engaged in business out of which 52.1% are females.	• 83.4% of the households have average monthly income less than 10000. • 13.2% of the households have average monthly income between 10000-20000.
Nagaland	78.5% are females.	67.1% have attained schooling (Primary education, Lower secondary school and Upper secondary school).	• 55.6% of the households are engaged in mixed farming. • 5.3% of the households are engaged in only pig keeping. • 8.6% of the households are either self-employed or engaged in business out of which 39.7% are females.	• 51.6% of the households have average monthly income less than 10000. • 6.1% of the households have average monthly income between 10000-20000.

Source: Author's own compilation.



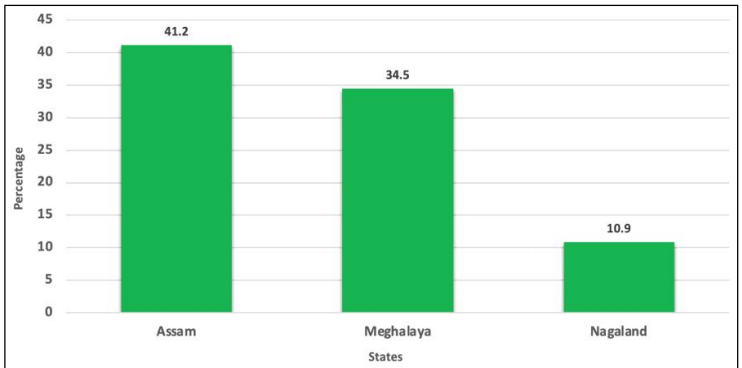
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Fig 1: Livestock holding in Assam, Meghalaya and Nagaland.



Source: Author's own compilation

Fig 2: Other Livestock Preferences in Assam, Meghalaya and Nagaland.



Source: Author's own compilation

Fig 3: Percentage of pigs vaccinated in Assam, Meghalaya and Nagaland.

Table 2: Animal excreta by contents.

Manure	Phosphorus	Potassium	Calcium	Magnesium
Cow dung	0.43	0.53	1.82	1.94
Pig manure	3.30	0.40	1.28	1.30
Goat manure	0.90	1.00	2.17	0.93
Chicken manure	2	0.82	1.14	0.89

Source: National symposium on waste management: KAU, 5-7 June 2011.

Table 3: Nutrient content of manure.

Type of manure	% Dry matter	Ammonium-N	Organic-N	P_2O_5	K_2O
Slurry manure		(lb. of nutrient per 1,000 gallons of manure)			
Dairy	8	12	13	25	40
Beef	29	5	9	9	13
Swine (finisher, wet-dry feeder)	9	42	17	40	24
Swine (slurry storage, dry feeder)	6	28	11	34	24
Swine (flush building)	2	12	5	13	17
Layer	11	37	20	51	33
Dairy (lagoon sludge)*	10	4	17	20	16
Swine (lagoon sludge)	10	6	16	48	7
Solid manure		(lb. of nutrient per ton of manure)			
Beef (dirt lot)	67	2	22	23	30
Beef (paved lot)*	29	5	9	9	13
Swine (hood barns)	57	4	13	20	
Dairy (scraped earthen lots)	46	3	14	11	16
Broiler (litter from house)	70	15	60	27	33
Layer	40	18	19	55	31
Turkey (grower house litter)	70			15	30
Liquid Effluent from lagoon or holding pond		(lbs. of nutrient per acre-inch)			
Beef (runoff holding pond)	0.25	71	8	47	92
Swine (lagoon)	0.40	91	45	104	189
Dairy (lagoon)	2	317	362	674	1082

Source: Koelsch and Shapiro, 2006.

using it for agricultural purposes and only 6% of them are using it for pisciculture activities.

On the contrary, the scope of sustainable pig waste management is optimistic in Meghalaya and Nagaland. Majority of the households in Meghalaya and Nagaland are found to be using their pig manure for agriculture purposes (38.5% households in Meghalaya; 32.3% households in Nagaland), but with limited utilization in pisciculture activities (2% households in Meghalaya; 0.3% households in Nagaland). Assam (4.7%) prefers to discharge the collected pig manure in the fishpond followed by Meghalaya (2.1%) and Nagaland (1.6%). The manure collection from pigs forms an important role in waste management of pig farming. 94.1% of the households in Meghalaya collect manure from pigs followed by Nagaland (69.7%) and Assam (60.3%).

CONCLUSION

Assam despite being the highest producer of pig has only 3% of households utilizing pig manure for agricultural purposes. Meghalaya and Nagaland have demonstrated optimistic approach in adopting sustainable pig waste management practices. Majority of the households in Meghalaya and Nagaland are found to be using their pig manure for agriculture purposes but with limited utilization in pisciculture activities. The integration of suggestive pathway and a comprehensive waste management framework where the capacity building program and the Enterprising model is linked with the community participation and Government intervention will diversify the livelihood sources of the farmers.

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Conflict of interest declaration

No conflict of interest of any kind.

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