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Full Length Research Paper

Attitude of indigenous chicken farmers towards agricultural insurance in Nyanza, Kenya

Phoebe Bwari Mose[1*], Chrilukovian Bwire Wasike[2], Benjamin Ombok Owuor[3] and Mary Jepkemboi Kipsat[1]

[1]Department of Agricultural Economics and Rural Development, Maseno University, P. O. Box 333-40105, Maseno, Kenya.
[2]Department of Animal Sciences, Maseno University, Kisumu, Kenya.
[3]School of Business and Economics, Maseno University, Kisumu, Kenya.

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Indigenous chicken (IC) contribute significantly to income and food security of rural communities. However, the IC are kept in systems that are characterised by high risk conditions such as diseases, predation, inadequate feeding and poor housing resulting in sub optimal production levels and profitability. Agricultural insurance therefore becomes an attractive option of minimizing these risks. Uptake of agricultural insurance on IC remains low in Kenya. Furthermore, information on agricultural insurance as a tool of minimizing risk is limited. The objective of the study was to investigate IC farmers' attitude towards agricultural insurance with the aim of providing important information to insurance firms and compensation schemes targeting IC. Structured questionnaire was used to collect primary data from 240 IC farmers in Nyanza region using a multi stage sampling procedure. Mean score from a five point Likert type scale was used to analyze agricultural insurance attitude of IC farmers. Results established that IC farmers had a positive attitude towards agricultural insurance. Farmers indicated that agricultural production was faced with a variety of risks and uncertainty and that insurance was beneficial and reduces production related stress. However, they were willing to pay for an insurance scheme publicly owned and that agricultural insurance should be mandatory. Therefore, the study recommends that government and non-governmental organization need to sensitize IC farmers on the importance of agricultural insurance policy. Insurance firms need to reach out to the farmers on their role in mitigating risk, offer their products and services and charge affordable insurance premium to them.

Key words: Insurance, attitude, indigenous chicken.

INTRODUCTION

Indigenous chicken (IC) keeping in Kenya is based on two distinct production systems, namely semi intensive and extensive (free range) systems. The free range system is the most predominant system and is common in rural areas where the chicken are kept on a small-scale using locally available feed resources (Okitoi et al.,

2007; Okeno et al., 2012). The semi intensive system is usually found in the urban and peri-urban areas. The birds are left to scavenge during the day and are confined in shelters of moderate cost at night. They also get supplementation with grains, oil seed cake, food waste and commercial feeds (King'ori et al., 2010). IC contributes significantly to income and food security of rural communities (Thorton et al., 2012; Kyule et al., 2014). However, the largest proportion of the IC are kept in systems that are characterized by high risk conditions such as diseases, predation, inadequate feeding, poor housing and extreme weather changes which hinder them from attaining high economic production level (Ondwasy et al., 2006; Phiri et al., 2007). Risk being the probability attached to the occurrence of the uncertain events of a production or investment decision by a farmer, presents non-determinate probability of occurrence of these events as it is beyond ordinary human control, that is, the probabilities of the possible outcomes are unknown (Hardaker et al., 2004).

Risk management involves choice among existing mitigating alternatives to reduce the effect of risk (Salimonu and Falusi, 2009). A variety of risk management strategies exist. These include enterprise diversification, insurance, forward marketing techniques such as future options and cash forward contracts, sequential marketing, direct sales to consumers, controlling and limiting debt, off-farm work and investments, controlling family consumptions, strategic business planning, keeping cash at hand, and the use of extension services and farmers' cooperatives (Musser and Patrick, 2002; Alimi and Ayanwale, 2005; Salimonu and Falusi, 2009).

Insurance of the IC is one of the attractive options to mitigate risk and enhance productivity. Wenner (2005) asserts that agricultural insurance is one of the best strategies to mitigate the effects of agricultural risks and encourage farmers to adopt modern production practices with greater potential for high and better quality yields. Nyanza region has the largest number of indigenous chicken (approximately 5,682,740 birds) compared to other regions in Kenya (Ministry of Livestock and Development, 2008). In spite of the risks encountered in IC production systems, the rate of uptake of insurance remains unknown and information on farmers' attitude towards agricultural insurance as a tool for managing risk is limited. Yet an understanding of farmers' attitude towards risk insurance is vital for implementation of insurance as an effective risk management tool. Most surveys targeting Kenyan farmers have failed to consider attitude of farmers towards insurance (Korir, 2011; Njue et al., 2014; Tongruksawattana, 2014). Furthermore, previous studies on IC have mainly concentrated on production and marketing of birds with limited information on the behavior of farmers towards insurance (Ochieng et al., 2012; Olwande et al., 2013; Bett et al., 2012). Consequently, empirical literature looking into the attitude of farmers towards agricultural insurance as a way of reducing risk is insufficient. Therefore, this paper attempts to fill the aforementioned gap by exploring the attitude of IC farmers towards agricultural insurance.

It further aims at providing great information to policy makers and researchers in developing appropriate strategies for IC development. A good understanding of the IC farmers' attitude towards insurance will enable insurance service providers reduce farmers' exposure to risk by providing them with most appropriate insurance products that will increase production.

MATERIALS AND METHODS

Study area

The study was conducted in four counties in the Nyanza region, namely, Siaya, Kisumu, Homabay, and Migori. The human population in the counties is 842,304; 968,909; 963,794; and 917,170 inhabitants (Kenya National Bureau of Statistics, 2010). The region is located between latitudes 0° 15'N and 1° 45'S, and longitudes 35° 15' E and 34° E, and borders Lake Victoria from the East, Western region to the north, Rift Valley region to the east and the Republic of Tanzania to the south (GOK, 2012). The total study area is 12,646 km^2. The main source of livelihood in Nyanza is mixed farming and other livelihoods strategies include fishing and casual labor (GOK, 2012). The study area is characterized by bimodal rainfall pattern sufficient for agricultural production with peaks experienced in April/May and October/November. The temperatures vary within the counties depending on altitude and proximity to Lake Victoria. The annual minimum temperatures vary from 17 to 18°C and maximum temperatures vary between 27 and 34.8°C (GOK, 2012).

Data collection

This study utilized mainly data collected from primary sources using questionnaires. Primary data collected included household characteristics (age, gender, education, employment status of household head and spouse, farm size, household size, employment and business status of household members, and number of household dependants); information on the flock size, structure and dynamics, indigenous chicken farmers' participation and their attitudes towards agricultural insurance.

*Corresponding author. E-mail: phoebekem@yahoo.com.

Sampling procedure

A multistage sampling procedure was used to select respondents for the study. The multistage sampling method was helpful in dividing and narrowing down the study into smaller study units. In this approach, at level one, purposive sampling was used to select four counties where TECHNOSERVE (an NGO that promotes business solutions to poverty in developing world by linking people to information, capital and markets) operates in Nyanza region. At level two indigenous chicken farmers who kept more than fifty birds were purposively selected for the study. These are the farmers who kept chicken for both commercial and home consumption. Sixty respondents were randomly selected from the list of farmers who kept more than fifty birds forming a total of 240 respondents.

Data analysis

Determination of insurance attitudes of the indigenous chicken farmers

Likert-type of scale was used in the analysis of farmers' attitude towards agricultural insurance. The scale falls under the criterion-group instrument whereby items were collected and analyzed against a criterion. In this, the farmer's attitudes were determined by requesting them to respond to some attitudinal statements and also to clarify what informs their attitudes. The responses were measured on a 5-point Likert- type scale of strongly disagree = 1; disagree = 2; undecided = 3; agree = 4; and strongly agree = 5. The mean of 3.0 were taken as a cut-off point, such that statements with values above the mean were regarded as implying a positive attitude while those with a mean of below 3.0 were regarded as unfavorable, implying a negative attitude.

The overall attitude of the farmers was established by averaging the scores received over the 8 items, as shown in the formula:

$$\text{Overall attitude} = \frac{\sum response(1-5)}{8}$$

Individual IC farmers who scored less than 3 were considered to have a negative attitude since they generally disagreed with the items tested. Those respondents who scored 3 or more agreed with the tested items and were considered to have a positive attitude.

All the mean scores from the 8 items tested and the overall mean on the attitude of the IC farmers' towards agricultural insurance were further subjected to a one sample t-test to determine whether the sample mean scores from the items and the overall mean were significantly different from the cut- off point.

RESULTS AND DISCUSSION

Farmer demographic information

Table 1 shows the demographic information of the IC farmers. Farmers sampled in this study were mainly 76.3% male farmers. Majority of these farmers had finished secondary education or had post-secondary education (75.4%). This implies that most of the indigenous poultry farmers have had considerable level of formal education background that could enhance human capital development. The respondents were mainly self-employed (77.5%), although 22.5% were on salaried or casual employment. The implication of this result is that the respondents were involved in various income generating activities and this could be attributed to the small scale production of indigenous chicken.

The average farmers' age was 54.27 years. The minimum age of the farmers was 25 years, while the maximum age was 85 years. Most of the indigenous chicken farmers were ageing and this could be contributed to low productivity in their farms. The average family size in the households was 5.9. The minimum family size was 1 member, while the maximum was 15 members. This implies that there was supply of family labor which ultimately leads to reduction of production cost.

The average number of indigenous chicken kept by the farmers is shown in Table 2. In their households, 81.3% of the farmers used semi intensive production system. 18.7% used extensive production system.

The farmers owned an average of 36 cocks and/or 79.94 hens in the households. The total numbers of IC were therefore an average of 117 chickens. The farmers kept the IC for both home consumption and income generation otherwise fewer chickens would have been sufficient for home consumption.

Farmers' attitude towards insurance

Table 3 shows the mean scores of the IC farmers' attitude towards agricultural insurance. Approximately, 30.0% strongly agreed and 56.7% agreed that agricultural enterprise was faced with lots of risks and uncertainty with a mean score of 4.11. These results are in agreement with previous studies by Chinwendu et al. (2012), Chizari et al. (2003), and Ajieh (2010), that most farmers were in agreement that agricultural enterprise was faced with lots of risks and uncertainty. 22.5% strongly agreed and 63.8% agreed that agricultural insurance was very beneficial with a mean response of 4.02. 6.3% for strongly agreed and 59.6% for agreed that agricultural insurance reduces worries and stress with a mean of 3.59. This implies that indigenous chicken farmers had a positive towards insurance. These results concur with previous studies by Al-kouri et al. (2009), Chinwendu et al. (2012), Chizari et al. (2003), and Ajieh (2010), that farmers recognized agricultural insurance as beneficial and a mean of reducing stress and worries. Approximately 14.6% strongly agreed and 47.1% agreed that recovering farmers' losses should be the government responsibility (mean response 3.45). The statement "government responsibility" meant that farmers were willing to pay for an insurance scheme but should be publicly owned. These results support previous studies

Table 1. Farmer demographic information.

Demographic	Number of farmers (N = 240)	Percent
Gender		
Male	183	76.3
Female	57	23.8
Level of education attained		
Primary certificate	59	24.6
Secondary certificate and above	181	75.4
Main occupation of the household head		
Employment	54	22.5
Self employed	186	77.5
Production system		
Semi intensive	195	81.3
Extensive	45	18.7

Table 2. The average number of chicken owned by the households.

Parameter	Average	Minimum	Maximum
Number of cocks owned	36.57	3	500
Number of hens owned	79.94	20	1050
Total number of IC	117.84	50	1350

which found that farmers were in agreement that it was the government responsibility to mitigate their losses (Chinwendu et al., 2012; Chizari et al., 2003; Ajieh, 2010). Most farmers did not feel that losses in agricultural enterprise are acts of God (mean response 2.10). The “acts of God” referred to natural disasters on which humans have no control such as flooding and drought. 35.4% strongly disagreed and 32.1% disagreed that losses in agricultural enterprise are acts of God. Similarly 7.1% strongly disagreed and 62.9% disagreed that agricultural insurance was not beneficial to small scale farmers. Another 8.3% strongly disagreed and 55.4% disagreed that agricultural insurance was not needed to reduce the effects of losses or damage (mean response 2.30). The results support previous studies which found that, farmers having recognized the importance of agricultural insurance disagreed with statements that agricultural insurance was not beneficial to small scale farmers, it does not reduce worries and stress and losses in agricultural enterprise are acts of God (Chizari et al., 2003; Ajieh, 2010).

All the mean scores from the 8 items tested on attitude of the IC farmers’ towards agricultural insurance were significantly different from 3 which was the cut-off point.

Overall attitude of the farmers towards agricultural insurance

The overall attitude of the indigenous chicken farmers towards agricultural insurance is shown in Table 4. 18.3% of the respondents had negative attitudes while 80.8% had positive attitude. The IC farmers had a favorable attitude towards agricultural insurance as confirmed by the Table 3 and by the overall mean score 3.13 which was significantly different from the 3 which was the cut-off point.

Study has revealed that there were significant differences in the overall mean attitude of the IC farmers towards agricultural insurance based on their levels of education and the production system practiced by the farmers. The IC farmers who had attained primary education and below had a greater overall mean score of 3.23 than those who had gone past primary school with a mean of 3.1. The IC farmers become less risk averse as they gain more education leading to decrease in their

Table 3. Mean scores and t statistics of the indigenous chicken farmers' attitude towards agricultural insurance (N = 240).

Items	SD	D	U	A	SA	Mean	t test
Agricultural enterprise is faced with lots of risks and uncertainty	1 (0.4)	11 (4.6)	20 (8.3)	136 (56.7)	72 (30.0)	4.11	22.36***
Agricultural insurance is very beneficial	0 (0)	16 (6.7)	17 (7.1)	153 (63.8)	54 (22.5)	4.02	21.05***
Agricultural insurance reduces worries and stress	3 (1.3)	25 (10.4)	54 (22.5)	143 (59.6)	15 (6.3)	3.59	11.35***
Recovering farmers losses should be government responsibility	14 (5.8)	46 (19.2)	32 (13.3)	113 (47.1)	35 (14.6)	3.45	6.22***
Agricultural insurance should be mandatory	10 (4.2)	92 (38.3)	24 (10.0)	58 (24.2)	56 (23.3)	3.24	2.89***
Agricultural insurance is not beneficial to small scale farmers	17 (7.1)	151 (62.9)	70 (29.2)	1 (0.4)	1 (0.4)	2.24	-19.59***
Agricultural insurance is not needed to reduce the effects of losses or damage	20 (8.3)	133 (55.4)	83 (34.6)	3 (1.3)	1 (0.4)	2.30	-16.57***
Losses in agricultural enterprise are acts of God	85 (35.4)	77 (32.1)	52 (21.7)	20 (8.3)	6 (2.5)	2.10	-13.10***
Overall mean score	-	-	-	-	-	3.13	6.49***

SD: Strongly disagree, D: disagree, U: undecided, A: agree, SA: strongly agree. ***Significant at 1%.

Table 4. Overall attitude of the farmers towards agricultural insurance.

Attitude	Number of farmers (N = 240)	Percent
Negative	44	18.3
Positive	194	80.8
Neutral	2	0.8

attitude towards agricultural insurance.

Farmers who practiced extensive production system had greater overall mean attitude towards agricultural insurance when compared with those who practiced semi intensive shown in Table 5. This is due to the fact that IC are kept under highly risk conditions in extensive production system as compared to the semi intensive system.

CONCLUSION AND RECOMMENDATION

The study determined the attitude of IC farmers towards insurance. The results revealed a positive attitude by the IC farmers towards agricultural insurance. The IC farmers agreed that agricultural enterprise is faced with lots of risks and uncertainty, agricultural insurance is beneficial and reduces worries and stress. However, most IC farmers view that it is the government responsibility to mitigate their losses. The IC farmers were willing to pay for an insurance scheme but should be owned by the government and that insurance should be mandatory to all. The positive attitude is an indication that the IC farmers are willing to take agricultural insurance if they are encouraged to do so. Therefore, the insurance companies should reach out to the farmers to offer their products and services, determine the degree of risk and associated premiums that would be affordable to the IC farmers. Government, non-governmental organization and insurance firms need to sensitize IC farmers on the importance of agricultural insurance policy in mitigating risk.

CONFLICT OF INTERESTS

The authors have not declared any conflict of

Table 5. Tests for differences in the overall mean attitude towards agricultural insurance.

Household characteristic	Mean attitude	t test
Gender		
Male	3.15	1.42
Female	3	
Education level		
Primary	3.23	2.42**
Post Primary	3.1	
Main Occupation		
Employed	3.18	1.3
Self employed	3.11	
Production system practiced		
Semi intensive	3.1	3.139***
Extensive	3.27	

***0.001 and **0.05 significance.

interests.

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Full Length Research Paper

Economic efficiency of milk production among small-scale dairy farmers in Mukurweini, Nyeri County, kenya

Maina Florence[1*], Mburu John[1], Gitau George[2], VanLeeuwen John[3] and Negusse Yigzaw[4]

[1]Department of Agricultural Economics, Faculty of Agriculture, University of Nairobi, Kenya.
[2]Department of Clinical Studies, Faculty of Veterinary Medicine, University of Nairobi, Kenya.
[3]Department of Health Management, Atlantic Veterinary College, University of Prince Edward Island, Canada.
[4]World Agroforestry Centre (ICRAF), Nairobi, Kenya.

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This study aimed at evaluating the economic efficiency of milk production among small-scale dairy farmers in Mukurweini, Nyeri County, Kenya. Data were collected from 91 small-scale dairy farmers previously engaged in a nutritional study in 2013. The farmers had been sampled using purposive sampling technique. Data were collected using structured questionnaires, entered into statistical package for social science (SPSS). Stochastic frontier production and cost functions were analyzed using the MLE technique in FRONTIER 4.1. The results showed that farmers were operating at increasing returns to scale of 1.495. The number of lactating cows, amount of concentrates fed to a cow and the cost of animal health controls had a significant effect on milk production, while the production cost was influenced by the costs of fodder, concentrates, animal health and other operating expenses. The mean technical and allocative scores were 0.687 and 0.913 respectively. The milk production could be increased by 31.3% through proper utilization of the available resources such as fodder and concentrates, while the cost of production can be decreased by 8.7% without affecting the output. It was concluded that through efficient use of the available inputs, like the fodder and present technology, economic efficiency would be greatly increased. The study recommends subsidized prices for concentrates.

Key words: Stochastic frontier, milk production, technical, allocative, economic, efficiency.

INTRODUCTION

In Sub-Saharan Africa, Kenya boasts of having the second largest dairy sector in term of milk production and consumption. The country's dairy sector is vigorous and is of great value to the economy of the country as well as the nutrition of the consumers (Wambugu et al., 2011).

According to Muriuki et al. (2004), the dairy sub-sector solely constitutes the greatest proportion of the agricultural sector gross domestic product (GDP) in Kenya and is a source of livelihoods to thousands of households. The sub-sector contributes 14% of the

*Corresponding author. E-mail: floflomaina@gmail.com.

agricultural GDP and 3.5% of the country's total GDP (Government of Kenya, 2008). The dairy sector relies majorly on small-scale dairy producers who contribute up to 70% of the total milk in the country (Mawa et al., 2014).

However, small-scale dairy farmers produce 3.67 L of milk per cow daily, on average, a sign that their productivity level is low (Wambugu et al., 2011). This low productivity is attributed to poor feeding, poor animal husbandry, the high cost of production and competitiveness between dairy farming and crop farming (Mawa et al., 2014). Tegemeo Institute (2016) also listed low productivity and high costs of production as the major challenges affecting the dairy industry. With an estimated increase of 3 to 4% per annum in milk consumption as a result of urbanization, increase in population and rise in income, there is need to increase dairy productivity in Kenya (Wambugu et al., 2011).

Mutua (2015) noted that daily milk production per cow was 5.46 L instead of the expected over 12 L. Moreover, MoLD (2010) states that yield per cow has remained at 6 L for over 3 decades although there is a capability of 15 L per cow per day. This is an indication of the inefficiency of the dairy industry. The high cost of inputs coupled with the low productivity could be the source of inefficiencies among the small-scale dairy farmers in the country.

There have been several studies done in the country with the objective of establishing the level of milk production (Ngigi, 2002; Omiti et al., 2006; Staal et al., 2008; Nganga et al., 2010; Mugambi, 2014). However, very few studies have concentrated on establishing the economic efficiency of milk production among the small-scale farmers, considering that the level of milk production has remained low and the cost of production has continued to rise.

Moreover, there has not been any study to assess the economic efficiency of the dairy farmers after the nutritional training by the Canadian organization known as Farmers Helping Farmers in 2013. This study aimed at determining the economic efficiency of milk production among small-scale dairy farmers in Mukurweini, Kenya. By so doing, it will pinpoint some sources of inefficiency and thus provide measures of reducing the inefficiency. The increased milk production will help attain the Malabo Declaration goal of ending hunger by 2025. Moreover, the findings will accentuate factors that will increase farmers' production capacity, hence increasing income and living standards of the rural people.

METHODOLOGY

Study area, sampling technique and collection of data

The study was carried out in Mukurweini sub-County, Nyeri County in Central Kenya in April 2017. The area is located in the south-western part of the county and is known for coffee farming. The reliance on coffee farming has however changed over time, with farmers taking up dairy farming as their main economic activity and there are over 6,000 small-scale dairy farmers in the area. The study focused mainly on primary data that was obtained from farmers sampled using the purposive sampling technique. The farmers had been involved in a two months nutritional training trial in 2013 and were sampled using the purposive sampling technique because they had a newborn dairy calf and recently calved dairy cow (Richards et al., 2016). A total of 111farmers were involved in the 2013 study. However, by the time of this study, some had passed on while others had migrated from the area of study. Thus, only 91 farmers were interviewed in the current study. Semi-structured questionnaires were used to obtain farmer characteristics, farm and cow characteristics and cow feeding information. Data were captured in Statistical Package for the Social Sciences (SPSS) and cleaned. FRONTIER 4.1 was used to determine technical and allocative efficiency scores for each farmer. The product of the technical and allocative efficiency scores yielded economic efficiency scores.

Technical and allocative efficiencies

Efficiency measure can be in terms of output efficiency (the difference between actual and the highest expected output for certain inputs) or input efficiency (the difference between the actual and least expected input for a certain output). Technical efficiency is the capability of a farm to produce a maximum output given various inputs and technology while allocative efficiency is the capability of a farm to assign inputs, given their prices, in a cost-minimizing way (Chukwuji et al., 2006). According to Farrell (1957), a farm operating on the interior of the production iso-quant of a given output is technically inefficient while one operating on the production iso-quant is technically efficient but not necessarily allocatively efficient. A farm is economically efficient if it operates at the point of tangency between the production iso-quant and the iso-cost line for a given output.

Stochastic frontier production and cost function

Aigner et al. (1977) composed the stochastic production frontier model that was used in this study. This model has been used by various studies such as Binam et al. (2004) and Sharma (1999) to assess economic efficiency. The production function as shown in Equation 1 is normally used.

$$Y = f\,(x) \tag{1}$$

The equation for the stochastic production frontier can be written as Equation 2:

$$Y_i = f(X_i;\beta) + \varepsilon_i \tag{2}$$

Where:

$\mathrm{f}(\mathrm{X_i};\beta)$ is a suitable function (Cobb-Douglas or Translog), Y_i is milk production in litres, X_i is the quantity of inputs used in milk production, β is the vector of the unknown parameter to be estimated and ε_i is a random error term made up of the sum of v_i and u_i. v_i is the ordinary two-sided error term assumed to have a mean of zero and constant variance. It captures stochastic effects outside the farmers control, such as weather. u_i is the one-sided error term that accounts for the shortfall from the stochastic frontier.

In order to assess the technical and allocative efficiencies, Cobb-Douglas functional form was taken. It has been used to analyze economic efficiency by Masuku et al. (2014) and Sajjad and Khan (2010). According to Kopp and Smith (1980), Cobb-Douglas

functional form is flexible and self-dual and has reduced empirical efficiency effects.

Empirical models

The Cobb-Douglas production function that was used for obtaining technical efficiency estimates was specified as follows;

$$lnY_i = ln\beta_0 + \beta_1 lnX_{1i} + \beta_2 lnX_{2i} + \beta_3 lnX_{3i} + \beta_4 lnX_{4i} + V_i - U_i \quad (3)$$

Where:

ln= natural logarithm to base 10, Y= Total milk production in litres, X_1= Herd size (number), X_2= Fodder in Kgs, X_3= Concentrates in KgsandX_4= Animal health expenditure (Kshs).

The corresponding Cobb-Douglas cost function used to estimate allocative efficiency was specified as follows;

$$\ln C = \alpha_0 + \alpha_1 lnP_1 + \alpha_2 lnP_2 + \alpha_3 lnP_3 + \alpha_4 lnP_4 + V_i + U_i \quad (4)$$

Where:

ln= natural logarithm to base 10, C=Total cost of milk production, P_1 = Cost of feeds, P_2 = Cost of concentrates, P_3 = Cost of animal health, P_4 =Other operating expenses

Technical and allocative inefficiency effects were defined by;

$$\mu_i = \delta_0 + \delta_1 X_{1i} + \delta_2 X_{2i} + \delta_3 X_{3i} \quad (5)$$

Where:

μ_i = Efficiency score for farmer i, X_1= Age (Years), X_2= Education level of farmer (Years of formal education), X_3= Household family size (Number of members).

These variables were included in the model to show their possible influence on the efficiency of farmers. Maximum likelihood estimation (MLE) procedure in FRONTIER 4.1 was used for the estimation of Equation 3 and 4. These two equations were each individually joint with Equation 5 during the estimation using the program FRONTIER 4.1.

RESULTS AND DISCUSSION

Summary statistics

The summary statistics of variables for the cost and production frontier estimation are presented in Table 1. The mean monthly milk production was found to be 492.69 L with a standard deviation 427.51 L. The large variation in milk production could be associated with the difference in herd sizes and lactation periods of the animals. The mean herd size was 2 cows with a standard deviation of 2 cows. Small-scale farmers are associated with small herds of animals that range between 1 and 4. There was a small variability in the amount of fodder fed per animal (68 kg), an observation that could be attributed to the fact that farmers had attended similar training and workshops on how best to feed their animals. The mean cost of fodder was Kshs6, 954.62 per month. According to the farmers, their spending on fodder had increased during the time of the study as the area was experiencing drought and the prices of purchased fodder had been hiked. According to Daily Nation (2017), farmers are incurring high fodder costs due to the decline in land available for the production of fodder. The cost of concentrates was also relatively high with a mean of Kshs4, 286.26 per month. This result implied that the cost of concentrates in the country is relatively high. The mean age of the farmers was 57 years. The UNDP (2013) reported that the average age of a farmer was 60 years.

Efficiency frequency distribution among small-scale dairy farmers

Table 2 indicates a frequency distribution of technical, allocative and economic efficiencies. The average technical efficiency estimate was found to be 68.7%, suggesting that perhaps a 31.3% loss in milk production was as a result of technical inefficiencies. Similar results were obtained by Nyagaka et al. (2009) in a study of efficiency among Irish potatoes farmers. The allocative efficiency scores had a mean of 91.3%. This finding implies that the farmers were keen on saving the cost of production. The economic efficiency score had a mean of 62.6%. Since economic efficiency is a product of technical and allocative efficiencies, it was noted that the economic inefficiencies were as a result of technical inefficiencies rather than allocative inefficiencies. Similar results were reported by Dipeolu and Akinbode (2008) and Nyagaka et al. (2009). The farmers have the capability of being economically efficient by utilizing the available inputs and technology efficiently (Table 2).

Maximum likelihood estimates of stochastic frontier production function

The maximum likelihood estimates of the specified Cobb-Douglas stochastic production function are presented in Table 3. The variance parameter gamma (0.91) was significantly different from zero, suggesting the existence of inefficiencies among the farmers. The gamma value was significant at 1%, hence the null hypothesis that there was the absence of inefficiencies among the farmers was rejected. The gamma also justified the use of a deterministic method (maximum likelihood) to obtain the efficiency estimates. Since the value (0.91) was close to one, it meant there was limited random noise. The likelihood ratio (LR) value exceeded the critical χ^2 (5%, 1 d.f.) value of 3.84 at 5%, hence the alternative hypothesis was accepted that the Cobb-Douglas form of the data was a good fit.

Table 1. Summary statistics of variables used in the production and cost functions.

Variable	Unit	Median	Mean	Std. deviation	Min	Max
Monthly milk production	Litres	420	492.69	427.51	60	2,460
Herd size	Number	2	2	2	1	17
Monthly fodder/cow	Kgs	1560	1,561.44	68.55	1,424	1,700
Monthly concentrates/cow	Kgs	66	93.06	84.34	84.34	456.01
Monthly cost of animal health	Kshs	216.67	308.85	300.14	16.67	1,700
Cost of concentrates	Kshs	4200	4,286.26	1,760.16	1,010	9,250
Cost of fodder	Kshs	4000	6,954.62	9,515.89	0	45,000
Operating expenses	Kshs	250	3,248.68	11,061.16	50	58,700
Age of household head	Years	55	57.21	12.91	33	87
Education	Years	8	8.88	3.14	0	16
Household size	Number	3	3.57	1.69	0	8

Table 2. Efficiency distributions of small-scale dairy farmers.

Efficiency (%)	Technical efficiency			Allocative efficiency			Economic efficiency		
	No.	Percentage (%)	Cum	No.	Percentage (%)	Cum	No.	Percentage (%)	Cum
91-100	5	5.5	100	67	73.6	100	3	3.3	100
81-90	20	22.0	94.5	14	15.4	26.4	12	13.2	96.7
71-80	18	19.8	72.5	3	3.3	11.0	13	14.3	83.5
61-70	19	20.9	52.7	5	5.5	7.7	22	24.2	69.2
51-60	19	20.9	31.9	1	1.1	2.2	21	23.1	45.1
1-50	10	11.0	11.0	1	1.1	1.1	20	22.0	22.0
Min (%)	39.6	-	-	35.6	-	-	31.2	-	-
Max (%)	95.9	-	-	99.9	-	-	94.9	-	-
Mean (%)	68.7	-	-	91.3	-	-	62.6	-	-

Source: Survey data (2017, n=91).

There was a positive relationship between most of the measured variables and the monthly milk production. The coefficients for the amount of concentrates and cost of animal health were significant at 5% while the herd size coefficient was significant at 1%. Not surprisingly, the herd size was found to be the most influential variable on milk production, as a 1% increase in the number of lactating cows would yield 81% increase in milk production, *ceteris paribus*. This result is congruent to that of Mugambi (2014) who found the herd size to have a great impact on milk production.

Milk production has also been found to be influenced by the amount of concentrate fed to a cow. The results suggest that 1% increase in the amount of concentrate fed to an individual cow was associated with a 9% increase in milk production. Richards et al. (2016) found that an additional 1 kg of dairy meal concentrate fed to a cow per day resulted in an increase of 0.53 kg/cow/day in milk output. The difference in the results considering the two studies involved the same sample of farmers could be attributed to the cow's lactation period. Richards et al. (2015) focused on cows in early lactation where milk production is associated with the amount of concentrates fed to a cow, while this study was not specific on the lactation period. Cows in mid or late lactation periods are less sensitive to the amount of concentrates fed to them.

There was also a positive relationship between animal health costs and milk production. A farmer incurring animal health costs represented that the farmer dewormed and treated the animals when ill, which should lead to better milk production. A study by Sanchez et al. (2004) indicated that healthy animals tend to have better milk production. Another study by VanLeeuwen et al. (2012) reported that improved cattle health among dairy farmers in Mukurweini resulted in an increase in milk production.

In the inefficiency model, farmer's age was found to be statistically significant at 5%. This implies that as farmers grow old, they become less efficient. This result is consistent with Sajjad and Khan (2010) who found farmer's age to have a positive influence on inefficiency. The returns-to-scale (RTS) was found to be 1.5, implying that farmers were operating at stage one (I) of production. This stage is usually characterized by inefficiency as it

Table 3. Maximum likelihood estimates of the stochastic frontier production function.

Variable	Parameter	Maximum Likelihood estimates		
		Coefficient	Standard error	*t*-ratio
Constant	β_0	0.8975	3.9268	0.2286
LnHerdsize	β_1	0.8129***	0.1278	6.3628
LnFodder	β_2	0.4303	1.2323	0.3492
LnConcentrates	β_3	0.0949**	0.004	2.4042
LnAnimalhealth	β_4	0.1571**	0.0616	2.5515
Inefficiency model				
Constant	δ_0	-0.1589	0.3359	-0.4733
Age	δ_1	0.0098**	0.0036	2.7518
Years of education	δ_2	-0.0067	0.0114	-0.5845
Size of household	δ_3	0.0034	0.0231	0.1459
Variance				
Sigma square	δ^2	0.0688***	0.0178	3.8712
Gamma	γ	0.9082***	0.0943	9.6298
Log-likelihood function	LH	7.4289	-	-
Log Likelihood ratio	LR	18.47	-	-

Asterisks show significance at the following levels: **5%; ***1%.
Source: Survey data (2017, n=91).

exhibits increasing returns to scale. At this stage, in the short run, an increase in the input would yield more than the proportionate increase in the output.

Maximum likelihood estimates of stochastic frontier cost function

The likelihood ratio (110.74) justified the use of maximum likelihood estimates rather than ordinary least square (OLS) estimates. Also, since its value was greater than the Kodde and Palm critical value of 10.37 for 5 degrees of freedom, the null hypothesis that stated that the farmers were allocatively efficient was rejected. The gamma value showed that 99% of the total variance was due to inefficiencies (Table 4).

A mean of 1.1237in the allocative inefficiency was an indication that 12.4% of costs were associated with inefficiency. Dividing the percentage base of allocative efficiency (which was 100) by the allocative inefficiency value yields the allocative efficiency score. In this study, the mean allocative efficiency score was found to be 89%. The coefficients of all the variables used in the final cost model were significant at 1%. The cost of feeds coefficient had the greatest magnitude of 0.468, which could be attributed to the fact that, due to the drought, many farmers were relying on purchased feeds whose prices had been hiked by the sellers. The coefficient of costs of concentrates (46%) was also quite high and significant. Mbilu (2015) found that cost of concentrates accounted for 45% of the total variable costs in dairy production. The magnitude of operating expenses could vary from time-to-time, depending on repairs and maintenance and purchases made by an individual farmer. A 1% increase in these expenses was estimated to result in a 5% increase in total cost of production *ceteris paribus*.

The coefficient of the intercept in the inefficiency model was negative and significant, suggesting that there were other variables not included in the model that would significantly lower the inefficiency. Years of education and size of household coefficients were found to be positive and significant at 1%; an increase in either of them would result in a rise of allocative inefficiency.

CONCLUSION AND RECOMMENDATIONS

The mean economic efficiency of 62.6% revealed that farmers in the study area had potential to increase their economic efficiency by 37.4%, thus increasing their milk output. The results further indicated that the economic inefficiency that the farmers were experiencing was primarily because of inefficient use of the available inputs and technology. The high mean allocative efficiency score of 91.3% shows that farmers are capable of minimizing costs, thus allocative inefficiency is not a problem among the farmers. Increase in herd size, amount of concentrates and having healthy animals would result in an increase in monthly farm-level milk

Table 4. Maximum likelihood estimates of the stochastic frontier cost function.

Variable	Parameter	Maximum likelihood estimates		
		Coefficient	Standard error	*t*-ratio
Constant	β_0	0.3868***	0.0078	49.836
LnFeedcost	β_1	0.4683***	0.0084	55.481
LnConcentratecost	β_2	0.467***	0.0043	108.68
LnAnimalhealth	β_3	0.0256***	0.0020	12.614
LnOperatingcost	β_4	0.0467***	0.0043	10.906
Inefficiency model				
Constant	δ_0	-2.5824***	0.6715	-3.8457
Age	δ_1	0.0037	0.0096	0.3872
Years of education	δ_2	0.0775***	0.0134	5.8009
Size of household	δ_3	0.2459***	0.0243	10.101
Variance				
Sigma square	δ^2	0.0812***	0.0094	8.615
Gamma	γ	0.999***	0.0000	565459
Log-likelihood function	LH	122.86	-	-
Log Likelihood ratio	LR	110.74	-	-

Asterisks show significance at the following levels: **5%; ***1%.
Source: Survey data (2017, n=91).

output. Since the farmers have increasing returns-to-scale, an increase in these current inputs would yield more than the proportionate increase in the milk production in the short-run.

The cost of fodder and concentrates constitute a high percentage of the total variable cost. The high cost of fodder could be attributed to the hiked prices due to drought as well as the small land sizes owned by farmers. Having small pieces of land leads to an increase in the demand for fodder as farmers have no enough space to grow their fodder. The drought coupled with small land sizes brings about high demand for fodder leading to high prices. Thus, farmers should be facilitated by other stakeholders (County and National governments, NGOs, etc.) to grow drought-tolerant leguminous shrubs (such as Calliandra) and/or store adequate fodder for such situations. For instance, they should construct silage bunkers, pits or tubes and store fodder in bulk during the seasons when fodder is plentiful.

The farmers could also be trained on means of intercropping their fodder with other food crops they grow as well as the new technologies of growing fodder on limited spaces such as hydroponic fodder technology. The government should find means of subsidizing the highly priced concentrates to make them affordable to capital-poor farmers. The youth should be sensitized to engage in dairy farming seeing that inefficiency was higher with older ages. The sensitization could be through better returns for the dairy sector and conducive policy environment. The older farmers could also be sensitized to adopt the new technologies in dairy farming through training, farmer exhibitions and farmer-to-farmer learning. All these findings will enable the policymakers to come up with policies aimed at increasing the small-scale dairy farmers' economic efficiency which will in-turn help improve nutrition and achieve food security.

CONFLICT OF INTERESTS

The sources of funding had no conflicting interest in this research and were not involved in data collection, data analysis and publication.

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Smallholder farmers' livestock production and marketing in Bahir Dar Zuria District, Northwestern Ethiopia

Bimrew Asmare

Department of Animal Production and Technology, College of Agriculture and Environmental Science, Bahir Dar University, Ethiopia.

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The objective of the study was to assess the livestock production and marketing system in smallholder systems of the area. Two kebeles were selected from Bahir Dr Zuria district based on livestock production experience and accessibility to road. Primary data were collected using semi-structured questionnaire and supplemented with key informants and secondary data sources. The average land holding in the area was 0.73 ha of total land with 0.53 ha cropland and 0.2 ha private grazing land. With regard to labor allocation for livestock, family labor was involved in 91.18% of respondents while in the rest hired labor herded, fed and watered livestock. With regard to water sources, the major source of water for livestock in the households was river (89%) while the remaining respondents use dug well for their livestock. Frequency of watering livestock was twice a day (51%) in dry season and once a day (44.3%) in the wet season. Most of respondents (53.65%) sell their live animals during religious festivities followed by selling during the season of critical feed shortage (24.45%).The perception of household heads indicated that the livestock holding in the last five years of the family increased in most of the respondents (51%), followed by decreased condition (33%) and remained constant for the rest of the respondents (16%). Overall, it is important to assist livestock producer to enable them benefit most from livestock and their products.

Key words: Bahir Dar Zuria, Khatadulis, livestock marketing, livestock production.

INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa (Central Statistical Agency (CSA), 2016). The livestock sector has been contributing considerable portion to the Ethiopia's economy immensely supporting economic development of the country. Livestock rearing in Ethiopia not only contribute for economic development but also the livestock products and by-products in the form meat, milk, hides, egg, cheese and butter provide nutritious diet for Ethiopian people (Endalew and Ayalew, 2016). Also, it plays an

E-mail: limasm2009@gmail.com

important role in providing export commodities such as live animals, hides, and skins to earn foreign exchanges to the country. Furthermore, livestock are used as draft power for cultivation for land and crop threshing besides their role as means of transport (CSA, 2016). As livestock is a “near-cash” capital stock, they serve as insurance in times when crop fail to give yield due to droughts (Ehui et al., 2002). Regardless of the huge livestock available, it appears that the country is getting inadequate benefit from this resource, that is, below the potential both at national and smallholder economy levels mainly due to low productivity. Among the major setbacks, feed and water shortage, disease and poor veterinary services, lack of appropriate technology, limited attention, poor extension (Shapiro et al., 2015) and problems related to policy and strategy for livestock development can be mentioned as factors that contribute to underutilization of the resource. The driving forces behind these factors include vulnerability contexts like population pressure, agricultural intensification and degradation of natural resources, shocks through drought and floods and erratic rainfall especially in dry areas. Though knowledge of livestock production is studied earlier, integration of production and marketing of livestock was limited in the study area. Therefore, it is important to conduct assessment on the livestock production system and marketing systems in the study area. The objective of this paper is to assess livestock production systems of peri-urban areas of district northwestern Ethiopia.

MATERIALS AND METHODS

Description of the study area

Bahir Dar Zuria district approximately covers an area of 1,283.6 km, and includes 32 kebeles, three of which are partially included in the study because of their accessibility and resources. The District is bounded in the East by South Gonder Zone, in the West by Mecha and Achefer Districts and by Lake Tana, Yelimanadensa District in the North and South, respectively. The topographic features of the district indicate that approximately 48% can be defined as rolling, 32% hilly, 13% mountainous, and 7% valleys. The altitude ranges from 1,750 to 2,300 m above sea level (m.a.s.l). Agriculture is the main stay of the perop in the study area as it contributes about 100% of the population with in the area depends on this sector of the economy (CSA, 2016). However; it is subsistence, low in production and productivity and backward in its production system and cultural practices involved. In addition to this, land holding of the farmers, which is the main input of agriculture, is small and highly fragmented as a result of increasing population pressure from time to time (Bahir Dar Zuria Office of Agriculture (BDZoA, 2015).

Sampling and study design

Households possessing at least one farm animal in Bahir Dar Zuria district represented the study population. This study was designed to assess the livestock production and marketing status of smallholder farmers in the study area. To undertake this study, descriptive method was employed. This method was selected because the nature of the problems needs a wide description and investigation. In other words, descriptive research helps to describe and interpret the trend of events that are taking place now and practices that have influenced the current once (Bhattacherjee, 2012).

A total of 90 respondent farmers (30 from each *Kebele*) were used to conduct the assessment and sample was determined using the formula:

$$n=\frac{N}{1+N(e^2)}$$ (Yamane, 1967)

Where n is sample size computed, N is the total households in the study area and e is the level of precision.

Methods of sampling

The study was conducted in three Kebele’s which were purposely selected based on livestock population and accessibility. From each Kebele, thirty livestock producers were randomly selected and used for interview. Semi- structured questionnaire was used to collect the data on feed storage and feeding system, feed sources, access to feeds, livestock and livestock marketing problems, trends of livestock holding and perceptions on status of livestock trend. In addition, to questionnaire interview, 4 key informants in each Kebele were used to get additional information to complement the primary data obtained from direct interview. Moreover, district and Kebele agricultural officers were included as key informants for the study. Focus group discussions with a group discussion containing 6 participants were held in each Kebele in public areas on key topics of management, nutrition and watering. The collected data was systematical coded and analyzed with Statistical Package for Social Sciences (SPSS) (version 20 2011). Descriptive statistics such as frequency (%) and mean were employed to present the qualitative variables obtained from the survey.

RESULTS AND DISCUSSION

Household characteristics

The household characteristics of respondents are shown in Table 1. The overall educational characteristics of respondents in Bahir Dar Zuria districts was found with characteristics that the majority of household heads (39%) were illiterate followed by those that can read and write (25.5%) while comparable proportion of respondents completed high school (25%). The report of illiterate class in the three districts is higher than recent reports (Asmare et al., 2016). The overall result of educational characteristics was higher than educational characteristics reported by different authors in Ethiopia (Sisay, 2006; Bedasa, 2012) and percentage of illiterate family members (31.5%) reported in Burie Zuria district, Ethiopia (Adebabay, 2009).

The average age of household heads of respondents was 49.2 years which was higher than Atalay et al. (2015) who reported 43 years for Metekel Zone of Amhara Region and Assefa et al. (2014) who reported an average age 37 years in Oromia Region. The overall educational characteristics of respondents in Bahir Dar Zuria districts was found with characteristics that the

Table 1. Household characteristics of respondents (N=90).

Characteristics of respondents	Percentage [N]
Sex of HH	
Male	65.25 [59]
Female	34.75 [41]
Total	100 [90]
Education level	
Illiterate	39 [35]
Elementary school completed	25.5 [23]
High school completed	28.5 [26]
College graduate	7 [6]
Total	100 [90]

HH=household.

majority of household heads (39%) were illiterate followed by read and write (25.5%) and comparable proportion of respondents were high school completed (25%). The report of illiterate class in the current finding was higher than recent reports in northwestern Ethiopia (Mekuriaw and Asmare, 2014; Asmare et al., 2016). Higher literate class has advantage on the good acceptance of technologies like trainings, improved agricultural technologies and adopting them for better live improvement. It has been stated that low level of education of the households can have an influence on the transfer of agricultural technologies and their participation in development (Mulugeta, 2005). The mean family size of respondents is comparable to earlier reports in northwestern Ethiopia (Mekuriaw et al., 2011; Gebretsadik and Negash, 2016) and comparable to the result of Assefa et al. (2014) for other regions of Ethiopia which was 6-7 per household.

Household income

The major source of income for all households in the study area was crop (64%) followed by crop and livestock (26%) and the remaining (10%) were dependent on livestock as source of income. Moreover, all respondents (100%) reported that their additional income is from the sale of Khat (*Khat adulis*). Respondents also indicated that the income of *Khat adulis* is obtained from fresh leaves selling to merchants. Like many similar areas of Ethiopia, Khat is grown in Bahir Dar Zuria district as the area has suitable altitude and environmental variables appropriate for the plant. In the study area, Khat crop can be harvested around the year, thereby becoming a source of continuous revenue for the farmer. The economically important parts of the plant are its young leaves and tender twigs, which are chewed for their stimulating effect. It is not uncommon to come across many farm ladies selling their plants to willing buyers in the local market throughout the day. Khat chewer population of the area is increasing from time to time in similar fashion with different areas of Ethiopia (Kandari et al., 2014; Assefa et al., 2014).

Land and livestock holding of respondents

The land and livestock holding of respondents is indicated in Table 2. The area is characterized by mixed crop livestock farming system. The average land holding in the area is 0.73 ha of total land with 0.53 ha cropland and 0.2 ha private grazing land. The overall land holding of the study area is lower than 0.98 ha for Debermarkos district (Yayeh et al., 2014). The total land holding of the study area was comparable to the reports of Mekuriaw and Asmare (2014) for Mecha district, northwestern Ethiopia. Generally, the land holding of respondents in the current result is lower than the national average land holding size of 1.6 ha reported by Food and Agriculture Organization - FAO (2008).

The livestock holding of households in TLU (tropical livestock units which represents a mature weight of animals 250 kg) was lower than earlier studies in different areas (Solomon, 2004; Assefa et al., 2014) which were more than 6 TLUs per household in different parts of the country. This small size TLU in the current finding might be resulted mainly attributed to shortage of land to grow feed and lack of knowledge in feeding practices of animals. The general observation indicated that, mixed crop-livestock production system is the dominant farming system in the area livestock being an important component of the mixed farming system and is well integrated with crop production. Livestock species kept by the farmers comprise cattle, sheep, goats, equines and chicken. Cattle are the dominant species, mainly used for draught power, followed by milk and meat

Table 2. The land and livestock holding characteristics of respondents (N=112).

Characteristics	Mean±SD
Total land holding (ha)	0.73±0.32
Crop land holding (ha)	0.53±0.15
Private grazing land (ha)	0.2±0.11
Livestock holding (TLU)	3.5±1.71

Ha=hectare; TLU=Tropical livestock unit.

production, income and manure for maintaining soil fertility. The result is in agreement with reports of Belay et al. (2012) in Dandi district, Oromia region, Ethiopia. In the study area, livestock are integral part of the agricultural systems serving as source of draught power for land preparation, of meat and milk, of income and savings. The purpose of livestock in the current study area is in line with earlier reports for other areas of the country (Assefa et al., 2014).

Labor division in livestock husbandry and marketing

In the study area, family labor was involved in 91.18% of respondents while in the rest livestock are herded, fed and watered by hired labor. Livestock herding was mostly undertaken by the children aged between 6 to 14 years. Adult males and females also herd cattle during the absence of children. Feed collection, milking, health monitoring, selling animals were done by both adult man and woman. Other activities such as milk processing, cleaning cattle shed, selling of milk and milk products, cow dung cake making and calf management were performed mostly by females. It is important to make a difference among the types of responsibility that women have over livestock: ownership, control over decision-making, use rights and provision of labour. In most systems, women provide labour for the various tasks related to livestock but may or may not control the process of decision-making, particularly over the disposal of animals and animal products. Similarly, women may be involved in production, but may or may not own the means of production: livestock, land, water, etc. The majority of live animal marketing except chicken was done by males (97%) while chicken, egg and milk products were sold by females in the household. There are few female respondents (3%) who practice selling of cattle, sheep and equines. Sharing labor for livestock husbandry and marketing of products is in agreement with earlier reports (Assefa et al., 2014).

Livestock feeds and feeding system

The type of available feed resources in the study area includes natural pasture, crop residue, hay and some indigenous and improved fodder trees like *Ficus thoningii* tree. Similar result has also been reported by Sisay (2006) in North Gondar. Overall, feed resources of the district are characterized by grazing natural pasture (54.2%) followed by crop residue (39.1%) with remaining purchased agro industrial byproducts. The management of livestock feeding was both partial grazing and home feeding. This home/homestead feeding is an interesting feature of livestock feeding which in turn has enormous advantage to promote fodder development and using cut and carry system which has importance to reduce free grazing. The feed resources in the study area are in agreement with CSA (2015) report that indicated grazing is the major type of feed (about 56.23%) followed by crops residue that is 35.06%). Hay and by-products were also used as animal feeds that comprise about 7.44 and 1.21% of the total feeds, respectively.

Water and watering system

The livestock water source and watering frequency of livestock is indicated in Table 3. Among the major livestock production factors, water availability and quality are one of the major limiting inputs as it determines feed availability and quality, health and overall productivity of farm animals. The result indicated that the major source of water for livestock in the households was river (89%) while the remaining respondents use dug well for their livestock. Frequency of watering in dry and wet season variable in the study area and was mainly twice (51%) in dry season and once (44.3%) in the wet season. According to McCornick et al. (2003), water availability can be improved through a number of ways such as construction of wells, pumps, canals, boreholes, tanks, cisterns, reservoirs, water yards, dams and water-harvesting structures. While selecting any given method, there is a need to consider the production system and socioeconomic situation of the farmers.

Sources of water for livestock include drinking water, water contained in feeds and metabolic water (McCornick et al., 2003). Water contained in feeds is highly variable from feed to feed depending on the moisture content, which ranges from as low as 5% in dry feeds to as high as 90% or more in wet feeds. For most domestic animals, metabolic water comprises only 5 to 10% of the water intake, but in the case of sheep it may rise to 15% (von Keyserlingk et al., 2016). Drinking water is a very essential need, though it is much less than the water required for animal feed production.

Perception of trends of livestock holding and productivity

The perception of livestock owners on the trends of

Table 3. Watering frequency of livestock by respondents (N=112).

Frequency of watering	Dry season percent [No.]	Wet Season percent [No.]
Once a day	31.2 [28]	44.3 [40]
Twice a day	51 [46]	28.7 [26]
More than twice	18.2 [16]	31 [28]
Overall	100 [90]	100 [90]

Table 4. Perception of respondents on the trends of livestock holding and productivity (N=90).

Characteristics	Percentage [N]
LS holding per HH	
Increased	51 [46]
Decreased	33 [30]
Constant	16 [14]
Total	100 [90]
LS productivity per head	
Increased	38[34]
Decreased	44[40]
Constant	18[16]
Total	100 [90]

HH=Household head; LS=Livestock.

Table 5. Livestock marketing options of respondents [N=90].

Marketing seasons	Percentage [N]
Religious occasions*	53.65 [48]
During feed shortage	24.45 [22]
As demand arises	21.9 [20]
Total	100 [90]

*Religious festivity= Easter, Christmas and New Year.

livestock holding and productivity status is shown Table 4. The trend of livestock holding of respondent indicated there was variation in terms of holding per household. The finding indicated that for most of the respondents the holding increased (51%); holistically, in other respondents there was a decreased (33%) state and in some respondents (16%) there was a decreased state. Nevertheless, the productivity of animals *pe se* remained low as shown in Table 4. The increment in the population of livestock in the study area is in agreement with the reports of CSA (2015). The reason why respondents increased their animals' population might be to compensate livestock productivity through large population of livestock. In other cases, constraints like feed shortage, expansion of crop farming in turn results in lack of pasture land and climate change effects could be the factors that reduce the livestock holdings.

Marketing opportunities

Livestock marketing determinants of respondents is shown in Table 5. Marketing of live animals is an important trade, especially in countries with a large livestock population. During the discussion in groups of different respondents, it has been pointed out that the several destinations of live animal markets were Bahir Dar, Tiss Abay, Debre Tabor, Estie, and Hamusit. The majority of respondents (53.65%) sell their live animals during religious festivities followed by selling during the season of critical feed shortage (24.45%). Common avenues for disposal of slaughter cattle are public terminal markets, local auction sale, sale directly on the farm or feedlot, and sale at buying stations. The choice of the most suitable market is not a simple one, and there are no rules for making such a decision. This result is in agreement with earlier reports by different authors (CSA, 2015; Moges and Assefa, 2017).

In the study area, livestock especially fattening cattle and sheep are purchased using subjective visual judgment and price negotiation. The livestock marketing in the study area did not use scientific methods of animal marketing such as live animal grading and price fixation whose marketing is in agreement with earlier reports (Alemayehu, 2003). Although marketing of livestock and livestock products is a major important activity of the household, most of the livestock producers do not have exact market information. However, the respondents have experience of when to fetch high price with producers trying to sell livestock during festive and annual occasions.

Conclusion

The study area is characterized by mixed crop livestock production in which land cultivation with oxen was a common practice. Although livestock are important in the livelihood of farmers, they are affected by changes in climate which in turn determines production and productivity of animals. The majority of household heads and local livestock experts do have information about the proper market information and hence, the marketing

practice is based on the traditional information on the probability of high prices in festivity and annual holidays. Hence, it is important to assist livestock producers to get information how produce livestock and livestock products in reasonable cost and fetch high market price.

RECOMMNDENDATION

This study has only highlighted information about the awareness of livestock producers on livestock holding, productivity and market information and was not a detailed one which encompassed relatively small size respondents and no modeling of production system.

Hence, it is recommended to have detailed study on the issue to design appropriate livestock production and marketing in the study area.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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Full Length Research Paper

Small scale entrepreunership of seaweed in Serewe Bay, East Lombok, Indonesia: Challenges and Opportunities

Achmad Zamroni

Research Center for Marine and Fisheries Socio Economics, Ministry for Marine Affairs and Fisheries, Jakarta, Indonesia.

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Improving the livelihoods and socio-economic conditions of coastal communities is important to make people more secure and less vulnerable to both external pressures and inevitable socio-economic changes. This study aims to describe the characteristics of small-scale entrepreneurs based on seaweed and market characteristics, describe the challenges and opportunities of seaweed business, and find out the government intervention and potential recommendation. Structured and semi-structured questionnaires were prepared to obtain qualitative and quantitative data. Interviews were conducted with seaweed farmers and other related actors involved in seaweed value chains. The finding shows that SMEs of seaweed in Serewe are dominant in production activity (farming) by using floating longline in small-scale under bonding with local collector. Developing seaweed industry in East Lombok has some obstacles related to low seeds quality, disease attack (that is, *ice-ice*), post-harvest quality, high dependency of farmers on traders, unstable financial capital, less advocacy from extension service, and natural impact of climate change, and market. Therefore, some collaborative actions between central government and local government need to be taken to improve diversification of seaweed for value-added product, capacity building, and encourage dissemination of research products (that is, seed and technology) to local community to achieve better seaweed farming production and prices.

Key words: Small-medium scale entrepreneurs (SMEs), Seaweed, Serewe Bay.

INTRODUCTION

Aquaculture development policy in West Nusa Tenggara Province (*NTB*) aims to improve aquaculture production, using three (3) main approaches, namely;

(1) Regional based aquaculture development
(2) Top priority commodities based development, and
(3) Small-scale enterprises development.

E-mail: roni_socio@yahoo.com.

West Nusa Tenggara Province is divided into three development regions, namely;

(1) Lombok Island was prioritized for mariculture development, freshwater fisheries, and brackish water aquaculture.
(2) The Sumbawa Island was prioritized for brackish water aquaculture, mariculture, capture fisheries, inland fishery and freshwater aquaculture.
(3) Eastern part of Sumbawa Island was prioritized for capture fisheries, brackish water aquaculture, mariculture, inland fishery and freshwater aquaculture.

Minister of Marine Affairs and Fisheries issued the Minister Regulation (*Permen-KP*) number 12/men/2010 regarding *Minapolitan Program* mentioned that *Minapolitan* concept is based on the principles of integration, efficiency and quality. *Minapolitan* region is a part of a region that has an economic primary function consisting of production, processing, marketing of fishery commodities, shipping services, and/or other supporting activities. The minister regulation above was followed up by Regional Regulation (*Perda*) number 2/2012 regarding the Spatial Planning of East Lombok District for 2012 to 2032, which set up a *Kawasan Strategis Kabupaten*-KSK or District Strategic Region for economic interests; *Minapolitan* region involved the village of Keruak, Jerowaru, Batu Nampar, Sukaraja and Pemongkong.

The main issue of developing seaweed farming in coastal village of Lombok was associated with seeds supply. Since 2010, the problem of seed supply was due to the fluctuation of *K. alvarezii* production in Lombok and seaweed production decreased as a result. In post-harvest process, several problems still exist in both places (Gerupuk and Serewe), including;

(1) Lack of financial capacity for investing in drying and processing equipment or facilities such as drying rack *(para-para)*.
(2) Poor awareness to quality control that affects the production price.
(3) Poor market information and price. Furthermore, there were a small number of seaweed processors for value added, which produce sweets, jellies, crackers, tortilla and other derivatives in small-scale. Many of those involved were originally corn processors (making tortilla-style crackers).

Therefore, this study focuses on three objectives;

(1) To describe the characteristics of small-scale entrepreneurs based on seaweed and market characteristics in Serewe Bay.
(2) To describe the challenges and opportunities of seaweed business, and
(3) To find out the intervention and potential recommendation.

MATERIALS AND METHODS

Study area

This study was located in Serewe Village in West Nusa Tenggara Province East Lombok (Figure 1). West Nusa Tenggara Province is divided into 8 (eight) districts and two cities (Table 1); with a total population of around 4.5 million (DKP NTB, 2013 in Figure 1) distributed in 20,153.15 Km^2 (Figure 1).

Data collection and samples

Data collection was conducted from April to September 2015. The total sample was selected randomly from Serewe Villages; 57 respondents were involved with seaweed business. In Serewe, individual interviews were conducted and utilized enumerators with 40 respondents of seaweed farmers and 10 respondents of seaweed collectors and traders. The purpose of individual interviews was to collect individual information from seaweed farmers, seaweed collectors, traders and wholesalers. Then, 10 of 40 respondents were selected for in-depth interviews. In-depth interviews were conducted to explore information about farming techniques, post-harvest techniques, marketing and market players, and any problems occurring in the seaweed farming business. Focus Group Discussion (FGD) was conducted during field surveys to cross-check the validity of information derived from individual interviews. Many opinions of developing seaweed culture in Serewe Village have been explored during the discussions. Discussions clarified the supply chain that consists of producers, collectors and wholesalers. Secondary data consist of statistics, scientific reports, scientific publication and other reports were collected from *Dinas Kelautan dan Perikanan*-DKP in West Nusa Barat Province, East Lombok District and in *Balai Budidaya Laut Lombok* in Gerupuk and Sekotong. Secondary data were used to support the information of primary data.

Data analysis

The data were analyzed using simple statistical methods of descriptive statistics to derive percentage, arithmetic mean, number and standard deviation. Descriptive statistics is the branch of statistics that focuses on collecting, summarizing and presenting a set of data (Levine and Stephan, 2005). Descriptive statistics essentially aims to provide a better understanding of how frequent the data value, and how much variability there is around a typical value in the data (Fernandes, 2009). A significance level of $p>0.05$ was set for the statistical analysis in this study. The results obtained from field observation, key informants opinions, and informal investigations were used to support the analysis. A Likert-type scale analysis was used when the respondents were asked to point out their perceptions about the obstacles and opportunities of seaweed business. Descriptive analysis focuses on socio- economic condition of respondents and the research locations, small-scale entrepreneurs and market characteristics, which include input suppliers, producers, processors and buyers.

RESULTS AND DISCUSSION

Characteristics of seaweed farming in Serewe Bay

Mariculture commodities in West Nusa Tenggara Province consist of seaweed, pearls, groupers, lobsters, etc. Seaweed is one of the developed commodities,

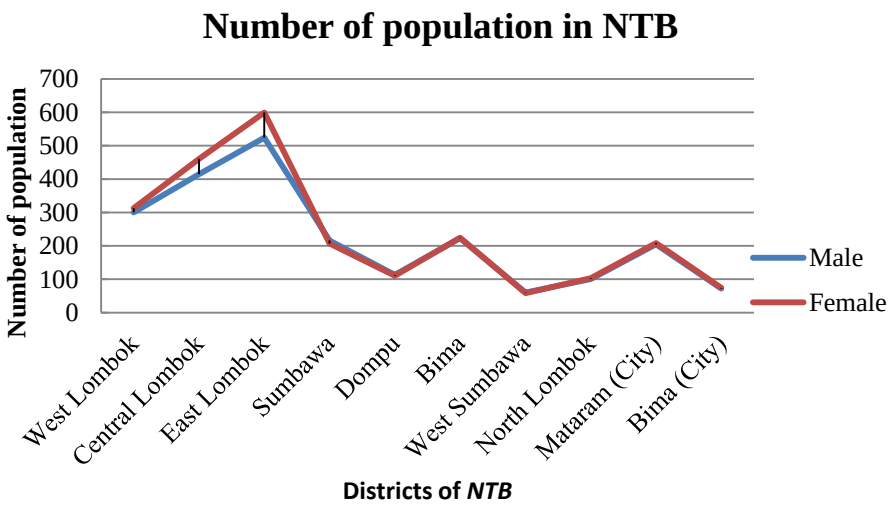

Figure 1. The number of population in NTB province (2013).
Source: (NTB, 2013) in Figure 1.

Table 1. Total area of Nusa Tenggara Barat province.

S/N	District/City	Number of Sub. District	Number of Village	Area (Km^2)	Percentage
1	West Lombok	10	122	1.053,92	5.23
2	Central Lombok	12	139	1.208,40	6.00
3	East Lombok	20	254	1.605,55	7.97
4	Sumbawa	5	33	809,53	4.02
5	Dompu	24	166	6,643,98	32.97
6	Bima	8	81	2.324,60	11.53
7	West Sumbawa	18	198	4.389,40	21.78
8	North Lombok	8	65	1.849,02	9.17
9	Mataram (City)	6	50	61,30	0.30
10	Bima (City)	5	38	207,50	1.03
Total		116	1.146	20.153,15	100

Source: NTB in figure (2013).

which have potential area of 41,000 hectares and potential production of 1,800,000 tons. Currently, utilization of areas that are potential for seaweed only produces as much as 657,757 tons, thus there is 54.46% of seaweed potential area remaining untapped in West Nusa Tenggara Province (Table 2).

The aforementioned data provide an overview of business opportunities in the field of mariculture fisheries in the West Nusa Tenggara Province and may also be able to motivate potential entrepreneurs to manage areas that have not been utilized to the fullest. Seaweed farmers in the Jerowaru Sub District amounted to 1,392 farmers. The numbers of aquaculture facilities are 7,542 units with an area of 5,224,340 million m^2, aquaculture using longline, stakes and rafts system. The ownership of farming areas was measured between 2,500 m^2 to 17,500 m^2, with an average size of 5000 to 10,000 m^2. There were 375 households in Serewe Village, of which 80% of the households are seaweed farmers or 300 people. A total of 221 farmers or 73.7% have ties with collectors. Wet seaweed production of each farmer in Serewe Village was less than 10 to15 tons in averge (1 unit = 4-5 tons). Almost all (0± 95%) of the seaweeds in Serewe Village were sold as dried products. Seaweed processing is still under developed and produced by two groups that process seaweed in Serewe Village namely the group of “Putri Nyale Selatan” and the “Putri Mandalika”.

The processed products of seaweed in East Lombok District were produced traditionally and small scale business, such as sweets and crackers. Seaweed in East Lombok has the opportunity to be developed as an alternative livelihood of fishermen that can be used as a solution when the fish catches are declining. However, low production costs and the market are still opened for development. Meanwhile, the problems are still faced by

Table 2. Potency of fisheries resource in NTB province.

S/N	Commodity	Potency area (Ha)	Potency of resource (Tons)	Utilization (Tons)	Percentage
1	Seaweed	41.000	1,800,000	657.757	36.54
2	Pearl/Oyster	25.000	1.5	0.1	6.67
3	Groupers, lobster and others	17.000	30.000	451.31	1.5

Source: Dinas Kelautan dan Perikanan NTB (2014) (Data update on February, 2014).

the fishermen related to the quality of seaweed, low price from buyer. Seaweed farming is particularly prone to bottom and bust cycles given the large number of small scale price-takers in the industry (Valderrama et al., 2015). Indeed, Valderrama mentions that seaweed farmers, traders and processors frequently make decisions based on speculations or misinformation.

Input supply

In average, seaweed farmers in Serewe Village have 2 to 3 plots of seaweed farm, which produces 2.5 tons of wet seaweed per crop (30 days) or equal to 1.2 tons of dry seaweed. Dried seaweeds are sold to collectors in sub-village level and then sold to next collector in the village level and then wholesalers in Jerowaru Sub District. The production of seaweed per plot was 2 tons wet or 170 kg dry (1 ton wet = 85 kg dry).

The yield of each harvest is as much as 300 - 400 Kg per month (dry) at a price of IDR. 7500/kg, which means a monthly income of seaweed farmer, was IDR 3,000,000. Based on the achievements of the *Minapolitan* program of 2009 to 2013 in West Nusa Tenggara Province, there was an increase in the supply component of seaweed that includes width area, number of farmers, production volume, productivity which increases revenue (Table 3). Indonesian Government has embraced seaweed industry as one of the key economic drivers in fisheries sector by improved production (The Economist, 2013).

Dinas Kelautan dan Perikanan-DKP (Marine and Fisheries Office) of West Nusa Tenggara Province) have provided assistance in the form of racks for drying seaweed and longlines or ropes to create the aquaculture plots. Racks are very helpful to maintain seaweed cleanliness from dirt or debris. The materials of racks are made from woods, measuring 10 m x 10 m x 3 m, with construction costs of 1 unit around IDR. 6,250,000, - (Table 4).

In addition, the Marine and Fisheries Office of the East Lombok District had given assistance to farmers such as seaweed seedlings, racks and drying floors through *KUR* (*Kredit Usaha Rakyat*/SMEs Credit). However, seaweed farmers were more likely to have access to wholesalers compared to other resources to get financial capital. Seaweeds in Serewe are mostly harvested for 30 days. According to respondents (farmers), they are harvested in 30 days for three reasons;

(1) Weather
(2) Household financial source
(3) Diseases.

Hurtado et al. (2014) emphasize production in “wet season” is lean; this occurs in Indonesia from October to March. It is different from other countries that is, Malaysia (November to March) and the Philippines (July to October). This statement matches with the condition in Serewe-East Lombok. Changes in the period of monsoon seasons in Indonesia in recent years influence the planting season of seaweed as well as production pattern. The price of seaweed is determined by collectors/traders, especially for seaweed farmers that have ties with collectors. In addition, farmers also set seaweed price based on agreement between collector-traders and seaweed farmers. This is done by seaweed farmers who do not have ties with the collectors.

Farming technology

Seaweed farming in Lombok has utilized the raft method since the 1990s up to 2006. Since 2007, the use of the longline method has increased while that of the raft method is diminishing till date. However, a problem that later arose was the insufficient supply of seed stocks for seaweed cultivation. The shortage is due to crops being sold without leaving any seeds for further cultivation. To overcome that problem, farmers sought seaweed seed stocks from the surrounding villages. The Government, through the Agency for Marine and Fisheries Research and Development (AMAFRAD) is still conducting field trials for applying farming method using the net culture system. This technique was tested in Serewe Village with four plots (4 plots x 200 lines) or 800 lines. The comparison of financial utilizations between raft and longline methods can be seen in Table 6.

The method of seaweed farming in Serewe-East Lombok utilizes the floating longline method. Seaweed farming has been going on since 1975. The size of each plot is 50 x 20 m. The longline method in seaweed

Table 3. Achievement of supply component of seaweed.

Indicator	Year	Unit	Target	Realization	Percentage
	2009	Ha	6.953.42	3.523.94	50.68
	2010	Ha	5.664.00	4.719.94	83.33
Area	2011	Ha	12.248.00	10.637.69	86.85
	2012	Ha	12.248.00	11,914.10	97.27
	2013	Ha	15.000.00	14.536.09	96.91
	2009	Persons	13.852	13.852	100.00
	2010	Persons	15.237	14.102	92.55
Number of seaweed farmer	2011	Persons	16.776	14.645	87.30
	2012	Persons	16.776	14.823	88.36
	2013	Persons	17.456	16.500	94.52
	2009	Tons	150.000	147.251	98.17
	2010	Tons	250.000	221.046	88.42
Production	2011	Tons	500.000	457.914	91.58
	2012	Tons	750.000	657.700	87.69
	2013	Tons	1.000.000	765,335	75.64
Productivity					
Bamboo raft	-	Tons/Ha	45	43,50	96.67
Longline	-	Tons/Ha	20	17.00	85.00
Patok	-	Tons/Ha	80	70.00	87.50
Average income	-	IDR/Yr	40.000.000	47.700.000	119.25

Source: DKP NTB (2013).

Table 4. Cost component for making drying rack or *"para-para"*.

Components	Cost
Lumber (1 M^3)	IDR. 4.000.000
Bamboo (25 sticks) @ IDR. 50.000	IDR. 1.250.000
Operational cost and etc	IDR. 1.000.000

Remarks: 1 USD = IDR 13,294.
Source: Primary data (2015).

farming was used since 2011 though it was introduced by the DKP of East Lombok District with individual ownership status. Materials for manufacturing cages consist of nylon rope, weights, large and small buoys. The longline and raft methods are generally applied to areas with the following characteristics: the depth of the waters ≥ 3m at low tide, quite sheltered from the waves / big waves, away from areas with high sedimentation, areas of water with good visibility (≥ 2 m) and not in a shipping line (ships or boats). While the stakes method is applied to tidal regions with a minimum depth of 0.5 m at the lowest tide, has a sandy sea floor or sand mixed with corals. The longline and raft methods were most widely used in Central Lombok District (Teluk Gerupuk, Teluk Bumbang and Teluk Awang) and East Lombok District (Ekas Bay and Serewe Bay) (Purnomo, et al. 2014). In the longline method, the required seeds for one plot are 1 ton with a price of IDR. 2000/Kg (Table 7).

There are 2 (two) wage systems for harvesting seaweed: the contract and rope systems. A total of 94.7% of farmers in Serewe Village use the rope calculation system, while the remaining 5.3% or as many as 25 people still use the contract system. Seaweed farming in East Lombok District was still not balanced between dried seaweed and processed products. Developing product diversifications or combination of two types of product diversification could be as an alternative livelihood. The role of livelihood diversification through the development of value-added seaweed has been able to lift the fishermen economy, even replacing fishing as the main source of livelihood (Zamroni and Yamao, 2011).

Supporting production and services

Seaweed farming in Serewe requires boats and fuel (gasoline). Those facility is used by fishermen to transport seaweed from the beach to farm area for daily control and cleaning of seaweed from dirts and mosses. The fishermen need 1 to 2 L of gasoline every day,

Table 5. Price comparison between two types of seaweed in Serewe village.

S/N	Seaweed	Wet (IDR/Kg)	Dry (IDR/Kg)
1	*E. Cottonii*	2000 to 2500	6.000
2	Spinosum	1.500	5.000

Remarks: 1 USD = IDR 13,294.
Source: Primary data (2015).

Table 6. Comparison of investment cost between two farming methods.

S/N	Investment components	Longline method	Bamboo raft method
1	Initial Investment	IDR. 5.000.000/Unit (*Petak*)	IDR. 500.000/Unit (Raft)
2	Technical life	5 Yrs	2 Months
3	Number of line	200 units	40 Units
4	Line space	40 cm	20-25 cm
5	Space between seed points	25-30 cm	25-30 cm
6	Number of main buoy	20 units	-
7	Number of small buoy	800 unit (4 btl/line x 200 line)	-
8	Number of bamboo	-	6 units (@ IDR 20.000)

Remarks: 1 USD = IDR 13.294.
Source: Primary Data (processed) (2015).

given its location not far to the beach. Planting sites are located on 1 to 2 km from the beach. Fishermen select the seaweed farm area by following two main considerations;

(1) Location should be protected from large waves
(2) Rich nutrients
(3) Pollution-free, and
(4) Location is not far from the beach to reduce operating costs for fuel.

Several post-harvest facilities are needed to develop the seaweed in Serewe; for example, drying racks or drying floors and warehouse. Seaweed production facilities such as ropes and buoys are still insufficient due to limited financial capital; some farmers are still having an average of 30 lines which in turn causes low income.

Characteristics of seaweed market

According to interview with market players of seaweed in Central Lombok and East Lombok, the profit of each market channels is described in Table 9. Marketing network for value-added products needs an advanced strategy. This strategy can take advantage of the role of middlemen to reduce frictions in seaweed market (Masters, 2007). Production diversification and marketing opportunities can open up more job opportunities. In order to maximize the seaweed for fishermen's livelihood, Smith and Renard (2002) suggest that the integration of technology, ecology, sociology and economics is an appropriate strategy approach. Seaweed market in Serewe is still dominated by middlemen who buy dried seaweed. Seaweed farming cycles in Serewe Bay is divided into three seasons a year. In terms of peak season, farmers can harvest the seaweed 4 to 5 times, with an average yield of 3 to 4 tons/harvest/unit. It usually occurs from June to September. In low season, they harvest at least 4-5 times and it usually occurs during the rainy season or from January to May with average production of 1 ton/unit/crop. The season with moderate production occurs from October-December, with average yield of 1.5 ton/cycle/unit (figure 2). The problem of low prices has become a "trademark" of seaweed from Serewe. In addition, the factors affecting low price of seaweed are as follows;

(1) Seaweed under 45 days or mainly from 25 to 30 days
(2) Dry method does not pay attention to hygiene standards, that is, they are dry on the ground which is likely the mixing of dirt or debris with seaweed.
(3) The seed quality slowly declines. The *thallus* growth is slow and easily broken.
(4) Low quality of post-harvest handling by seaweed farmers.

Bonded system (*ijon*) between seaweed farmers and middleman is affected by the seaweed price (Table 5). The existence of bonded system is driven by farmers' expenditure. In other words, the debts of farmers to collectors are not mostly used for business matter (Table 9 and Figure 3).

Table 7. Cost component for seaweed farming in Serewe village.

S/N	Cost components	Quality	Unit	Price per unit (IDR)	Total (IDR)
1	Rope (5 mm)	150	Kg	42.000	6.300.000
2	Main rope (14 mm)	30	Kg	42.000	1.260.000
3	Anchor rope (8 mm)	50	Kg	42.000	2.100.000
4	Raffia rope	200	Kg	450	90.000
5	Anchor	48	Units	5.000	240.000
6	Seedling workers	200	Lines	1.000	200.000
7	Open raffia workers	200	Lines	1.000	200.000
8	Longline setting workers	200	Lines	750	150.000
9	Maintenance workers	1	crops	100.000	100.000
10	Harvest	30	persons	75.000	2.250.000
11	Remove seaweed from line (post-harvest)	200	Lines	1.000	200.000

Remarks: 1 USD = IDR 13.294.
Source: Primary data (processed) (2015).

Table 8. Profit and/or value-added (absolute or % contribution to total).

Profit	(P) IDR (.000)/kg	Own sales (%)	Collector sales (%)	Value added (%)
Seaweed farmer	2	20	80	20
Seaweed collectors	2	10	90	5
Seaweed processors				
Sweets	10	85	15	75
Tortilla	10	85	15	70
Crackers	10	85	15	73
Sticks	10	85	15	66
Rengginang	10	85	15	71
Wholesaler	4	90	10	30

Source: DKP NTB (2014) and Primary data (2015) (Processed).

Table 9. Market characteristics of seaweed in Serewe.

Components	East Lombok
Volumes	74.953.60 Tons
Values	IDR. 524.7 M
Prices	IDR. 7000/Kg
Products and product development	Dry and food processed products
Competitors	Local collectors and wholesalers
Demand characteristics	Good quality of dry seaweed for food product processing Local market (West Nusa Tenggara Province)
Regulation and policy	Improving quality of dry seaweed, improving added value products
Key institutions	DKP of East Lombok and West Nusa Tenggara Province, Mariculture institute at Lombok, Buyers, Ministry of Marine Affairs and Fisheries and other local government offices

Remarks: 1 USD = IDR 13.294.
Source: Primary data (2015).

Low season					3-4 ton (*E. cottonii*)				*Moderate*			
					Peak season				1,5 ton (*E. cottonii*)			
Prod: 1 ton (*E. cottonii* (green) atau *sakul*)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Figure 2. Seasonal production of seaweed farming.

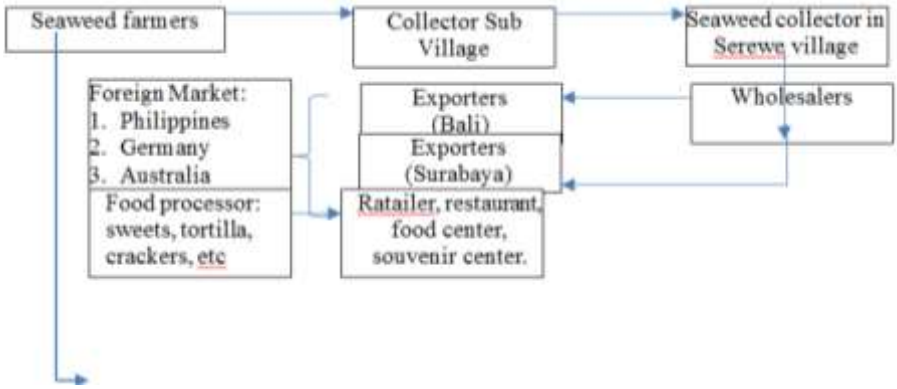

Figure 3. Marketing map of seaweed in Serewe.
Source: Primary data (2015).

The challenges and opportunity of Seaweed Business

Seaweed is one of the top priorities of fisheries commodity in West Nusa Tenggara with a relatively high and stable production; it has a wide potential area. Seaweed has a good prospect, because it is supported by several factors:

(1) Extensive farming area
(2) High demand
(3) Low cost
(4) Jobs opportunity
(5) As an alternative livelihood, particularly for coral-miner, mangrove loggers.

Bindu and Levine (2011) predicted that the seaweed cultivation in tropical countries will continue due to the high production values realized, coastal villages need for alternative livelihood, and increased demand of carrageenan in global market (Table 10). However, the problem/barriers obtained based on the field interviews are as follows:

(1) Pests and diseases are affecting the aquaculture communities.
(2) Harvesting of young seaweed and drying the seaweed with unrequired water content would deteriorate during storage and transportation.
(3) The seaweed price determined by buyers.
(4) Lack of financial sources.
(6) Small number of instructors and inequality in the growth of expanded farming area.
(7) Climate change impacts on farming activities.

In the future, there will be the opportunity to use good quality seeds or commonly referred to tissue culture method from *E cotonii* in East Lombok. The advantages of using tissue culture seeds are;

(1) They are tougher in terms of disease resistance
(2) Withstand strong wave
(3) Have more *thallus* and
(4) Look fatter compared to the existing seeds
(5) Harvest yields are greater than ordinary seeds.

However, provision of tissue culture seedlings is still limited, and it has not been widely distributed to seaweed centre, especially in the area of East Lombok. Therefore, it is necessary to develop a strategy and technology for the provision of tissue culture seedlings as a solution to overcome the problem of seed quality. Scoones et al. (2007) argued that sustainability of seaweed has been examined with several considerations, namely; durability under internal value chain stress, stability in the face of internal value chain shocks, robustness under external

Table 10. Factors influence to seaweed industry in East Lombok.

Factors	Internal	External
Factors affecting sourcing	Price is fluctuation, availability is depending on climate situation→5 times production per years	Seasonal is unpredictable Water pollution in certain months/seasons
	Productivity is slowly decrease because of seeds quality	Drying in the rainy season
	Business management is poor	Low ability of seaweed farmers for re-investment
Factors affecting making/producing	Value added product is need to develop	-
	Quality is under standard (under 45 days harvest)	-
	Altering type of farming technology from raft to longline	-
	Dirty Drying method	-
Factors affecting delivery/sales	Delivery: 2 Ton per 2 weeks (dry seaweed)	No storage system No Business consorsium
	Long distribution channels.	Only ± 30% of raw material utilized by SMEs

Source: Primary data processed (2016).

Table 11. Infrastructures needs for farming activities.

S/N	Activities	Type of Infrastructure
1	Fisheries business	Research institute→ Producing high quality seeds Farming technology and processing technology Cold storage
2	Mariculture	Handling space for mariculture product Landing place and parking area for boats
3	Processing	Drying place (*para-para*) for seaweed Storage and other post-harvest handling
4	Marketing	Marketing and promotion

value chains stress and resilience in the face of external value chain shocks.

Intervention toward seaweed industry development in West Nusa Tenggara

At present, the obstacles of seaweed farming development are as follows;

(1) “Ice-ice” (white spot syndrome virus) disease
(2) Low quality of seeds
(3) Lack of post-harvest management
(4) Less of optimal harvest time (that is, 30 days in average)
(5) One price for all quality of dried seaweed
(6) Limitation of freshwater resource
(7) Zoning and carrying capacity is not established yet.

In order to improve quality and productivity, post-harvest management and supporting infrastructure facilities should be top priority for seaweed development in the future (Table 11). The Marine Affairs and Fisheries Minister Decree *No. KEP.02/MEN/2007* regarding Good Fisheries Practices, and the Director General of Aquaculture Decree *No. KEP.44/DJ-PB/2008* regarding Implementation Guidelines for *CBIB* (Best aquaculture practices) Certification are the strong commitments from central government or Ministry of Marine Affairs and Fisheries in developing aquaculture industry. Based on the results of analysis, the actions can be divided into 3 aspects;

(1) Aquaculture
(2) Product processing and
(3) Social and economics.

In terms of aquaculture, the actions that need to be taken by government consist of;

(1) Supporting the production infrastructures, that is, drying racks and line

(2) New variety of seaweed introduced by *BBL* in Lombok
(3) Water monitoring for farming activities related to water environment, desease and standard of operation for mariculture.
(4) Farming license for mariculture development
(5) Integrated spacial planning for coastal area
(6) Training for desease prevention to seaweed farmers
(7) Empowering fisheries cooperative, and
(8) Seaweed seeds-park.

Improving value added and price, central government might collaborate with provincial government to provide low-power food processing equipment. Socially and economically, the following actions can be taken;

(1) Provide scholarship program for fishermen's children
(2) Trainning and education for main fisheries players actors
(3) Marine and fisheries advocation, and
(4) Improving particiption level of farmers and seaweed processor groups.

Seaweed Industry development in East Lombok might focus on post harvest management. Post harvest management can start from improving the quality of seeds, wet seaweed, and dry seaweed. Seed of seaweed could be developed using tissue culture method.

Barrios (2005) reported that vegetative tissues have high growth rates, asexual reproduction capacity through fragmentation, resistance to grazing and colonization by fouling organisms make seaweed-*Kappaphycus* a potential invader to new environments. Therefore, local government should make collabotaration work with other related institutions to develop non-food products using seaweed as a raw material. Establishing seaweed storage and good management could protect seaweed farmers from speculators' act and improve the dry seawed quality. Provincial government could support local companies to produce non-food products using seaweed as a raw material.

Based on the development plan of the West Nusa Tenggara Province, increased productivity and added value is a major concern. Improving connectivity in the regions is the best follow up action to optimize local resource and minimize the problems of seaweed farming in East Lombok. However, the strategy should focus on the following actions:

(1) Farming area development. It is a priority to manage the coastal zone, conserve the coastal area, and enhance community based management.
(2) Optimizing mariculture resources through integrating activities in research and development encourage government to collaborate with related public and private sectors toward competitiveness improvement of fisheries resources and their products.
(3) Improving adaptation to climate change impacts through implementation appropriate aquaculture technologies and using high-quality seeds.
(4) Social and economic empowerment of farmers through enhancing the role of local communities, improving effective procedure for resource utilization, improving community participation, improving small economics activity.
(5) Infrastructure and facilities for the utilization of mariculture fishery resources, including a guidance and improving data and information for farmer's group.

Valderrama et al. (2015) suggest that minimum farm lines are still necessary to ensure adequate economics returns, and greater farming plots to improve the potential economy of under-performing systems. Finally, there should be colloboration work among cross sectors and different levels of institutions. This means that the central and local government collaboration is absolutly required for developing seaweed industry in East Lombok.

Conclusions

Small-scale entrepreneurs of seaweed in Serewe are dominant in production activity (farming) by using floating longline. In average, each farmer can harvest the wet seaweed of about 10-15 ton per crop and sell dry seaweed (95%) to wholesaler through collectors at Sewere Village. Seaweed farmers are mostly trapped on tie system with collectors as well as wholesalers at local level. As consequence, farmers are helpless about price determination. Food products made from seaweed are potentially alternative income sources for household, but people still do this job and consumers depend on their orders. Developing seaweed industry in East Lombok has some obstacles: low seeds quality, *ice-ice* disease attack, post-harvest quality, high dependency of farmers on traders, unsustainable financial capital, less advocacy from extension service, and natural impact of climate change. In food processing, the obstacles faced by food processors are:

(1) Marketing of processed products depends on consumers' order
(2) Low quality of post-harvest handling for seaweed
(3) Low quality of manpower on products processing
(4) Low financial capital, and
(5) Small-scale entrepreneurs develop slowly.

There are 3 (three) issues in socio- economic aspects: traditional knowledge in East Lombok, *awig-awig* need of improvement in their roles as a community based natural resource management; creativity of fish farmers and seaweed farmers to diversify the products to be developed; horizontal conflict among stakeholders in fisheries activities due to coastal uses problem. However, there are several opportunities why seaweed industry

needs to develop. First, tissue culture method has found the new generation of *Eucheuma cottonii L* that has an advantage compared with elder generation. Second, dry seaweed can produce *Alkali Treatment Chips* (ATC) that could improve value-added. Third, farming area is located close to the beach, which could save the operational cost. The actions need to be implemented by collaboration between central government and local government, which includes several activities; supporting post-harvest infrastructures, dissemination of new generation seaweed, arranging coastal utilization, and capacity building for farmers and institution. Value added can be improved by producing seaweed-chips to supply food and non-food industries. Finally, government should provide scholarship program for fishermen's children, training and education for main fisheries actors, advocating for farmers, and improving participation level of groups

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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