Impact of goat population management strategies on goat meat production in Bangladesh

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Abstract

To increase goat-meat production, this study has been aimed to evaluate goat-meat production potentiality using different management strategies of goat-population rather than goat-meat productivity management in Bangladesh. Simulation Matrix (SIMM) model was used under three scenarios of goat-population management strategies such as Scenario1(Base rate): 2 kids/year production with 30% kid mortality, Scenario 2: Production of 6 kids/year with 30% kid mortality and Scenario 3: Production of 6 kids/year with 10% kid mortality to analyze their impact on goat-meat production in Bangladesh. Results showed on average only 270.09 thousand ton /year of goat-meat can produce at the existing rate (2 kids Production/year with 30% kid mortality). If it is possible to increase kid production up to 6 then can produce on average 23714.4 thousand ton/year of goat-meat. Further, it is possible to reduce the kid mortality rate up to 10%, goat-meat is the highest 932430.0 thousand ton/year. Result indicated a great positive impact of goat-population management strategies on goat-meat production. Therefore, 10% kid mortality rate with 6 kids/year production of goat-population management could be suitable management or best strategy for higher goat-meat production in Bangladesh.

(**Key words:** Goat meat-production, Goat-population management, SIMM model.)

Introduction

Goat farms are important component for goat-meat production in Bangladesh. Black Bengal Goat (BBG) is famous for its high birth rate, delicious & low fat meat and super quality skin. It plays an important role by producing meat, milk and skin in the national economy of Bangladesh for alleviating poverty. Livestock share of GDP was Tk.2.41 million (BBS, 2013). Some attempts have made through ensuring appropriate housing, feeding, health management, marketing and breeding for productivity increase. The supply of balanced rations to animals, infra-structural development and adoption of modern conservation practices with adequate veterinary coverage, availability of inputs and credit are some of the measures to increase goat production across the country. Ershaduzzaman (2007) studied on the disease and mortality pattern of goats under farm conditions and some factor affecting mortality and survival rates in Black Bengal kids. Mortality rate of goat were found changed significantly with different farm categories (Sayeed, 2005). Overall adult mortality was 12.69. Higher (43.45%) mortality was observed under farms and rural condition. Kid mortality reduced from 35% at low level of feeding to 5.5% at high level of feed of dam during gestation (Chowdhury *et al,* 2002).

It is really a gigantic task requires comprehensive approach to develop the sector through genetic improvement of goat. In fact, slow growth rate of goat meat

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production is related to the number of goat-population. Lower number of total female breeding stock goat may be the main reason for lower number of total goat population. Higher rate of kid mortality and lower number of kid production are the reason of lower number of total goat-population. Consequently, the rates of kid production and kid mortality are the main effective inputs for increasing goat-meat production. If appropriate improved management strategies would be undertaken by increasing kid production rate and reducing kid mortality rate in Bangladesh, there would have a bright prospect for improving the conditions of the rural poor farmers and the national economy through goat-meat production. So, if problem factors can be removed there will be a possibility for higher level of goat-meat production. The only way left to promote the goat-meat industry is increasing female breeding stock of goat through improved management because this only can produce higher number of total goat-population and encourage in increase the goat-meat production in future. Therefore, there is a need to examine the appropriate kid production and kid mortality rate of goat-population and their impacts on the probability of goat-meat production for the future.

Goat-meat production can increase by applying management strategies of rising productivity and rising number of goat-population under stall feeding, semi-intensive and intensive farming. A number of researches have done meat productivity management. A very few research on goat-population has done. Yasmin, *et al.* (2000) reported that if increased yearly 30 thousand importation of beef cattle female breeding stock at 15% slaughter rate can increase beef production up to more than 30% by the year 2015. The impact of 30 thousand imported female breeding stock at 10% slaughter rate can increase the beef production up to more than 40% by the year 2015 in Malaysia. Yasmin *et al.* (2001) studied among different management strategies such as, yearly 25 thousand heads of each beef cattle, dairy cattle and buffalo female breeding stock importation with higher calving rate (70-80%), Slaughter rate (15-20%) and lower mortality rate (1-2%); would be the best strategy for the highest beef production and 100% achievement of beef self-sufficiency in Malaysia.

In case of Bangladesh, government has taken initiatives to increase goat-meat production for poverty alleviation. In order to alleviate poverty, Bangladesh needs to increase her goat-meat production through higher total goat population in future. Since there are dynamic changes in the goat sub-sector, the simulation approach at different rates may provide valuable policy measures of goat-meat production in near future for poverty alleviation. In 2004, Yasmin studied about that the mutton production for future Bangladesh. But no study has been done on management strategy of goat-population. In Bangladesh, goat-population managements for different rates of kid production and mortality requires SIMM model to examine their impact on goat-meat production. On the above background, the present study was undertaken to evaluate the impact of different goat-population management strategies on goat-meat production in Bangladesh.

Materials and Methods

Theoretical Framework

System Simulation

For the model system simulation, a system can be defined as a collection of components and their interrelationships which have been grouped together for the purpose of studying some part of the real world. In this study system approach includes such ideas as those of the system philosophy and the way of thinking about solving production problem in terms of a system simulation. System analysis is a technique used in analyzing the system and, the system approach itself is the style of managing the system. Subjective assessment explains simple graphical display of model-output in relation to the controllable and uncontrollable exogenous variables and possible relative to real-system output.

The general system may be represented in a schematic fashion as in Figure 1.

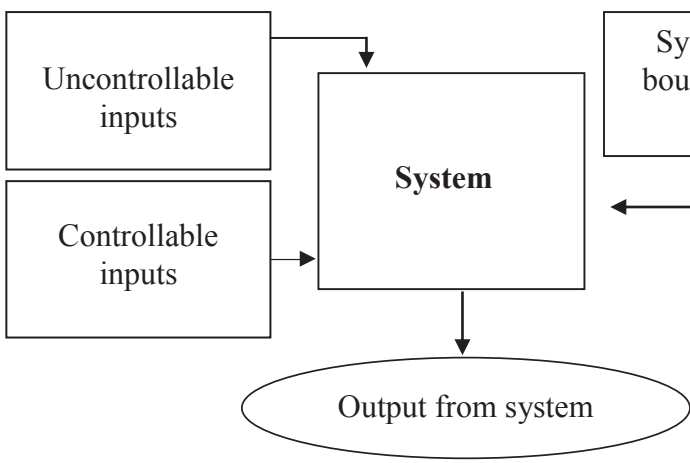

Figure 1: The Concept of a System

The level is a major component of a system whose changing values are particularly concerned. The rate directly brings about changes in the value of the level while the auxiliary represents factor may influence rates. The goat production from the system is dependent on the stream of kidding rate and mortality rate imposed upon the system. Simulation is a procedure simulation of equations for computing successive time increments. In doing so this process traces a time path representing the dynamics of the system.

An ex-post model validation test is used in order to determine whether the model is a valid mimicry of the real system simulated. The structural and behavioral relationships in the model are theoretically accepted, internally corrected and made consistent in a logical and programming sense. The procedure involved a series of computer runs with different variables. This analysis is similar to the analysis of the real world data, but there are some differences because randomness enters in a very complicated form in simulation experiment (ex-ante simulation). Several strategies have been tested in order to determine the effects of those strategies on production, to implement production policies (Yasmin, 2001).

The change of kid production and mortality rate in a real goat production system would change an output of goat-meat, than the same direction of change should happen in the output-model.

Analytical Framework

Simulation Matrix (SIMM) Model

The models for the estimating goat-population are considered using Livestock System Modeling: Simulation Matrix (SIMM) model; a Technology of Policy Analysis developed by Yasmin (2001) as follows:

Goat-population Model

A. Female Goat

Model for Female Goat:

$$FG_{(t+DT)} = \int_{t}^{t+DT} [FG_t - SFG_t - MFG_t]dt \ldots\ldots \quad (1)$$

Where,

DT = Increment of time

FG (t+DT) = Current number of female goat for each age

FG_t = Previous number of female goat for each age

SFG_t = Previous number of slaughtered female goat for each age

MFG_t = Previous number of death female goat for each age

a) $SFG_t = A_1 * FG_t \ldots$

Where,

A_1 = Slaughter rate for each age

The total number of slaughtered female goat generated by multiplying previous number of female goat at annual slaughter rate (A_1).

b) $MFG_t = A_2 * FG_t$

Where,

A_2 = Mortality rate

The total number of died female goat are generated by multiplying previous number of female goat at annual mortality rate (A_2).

Model for Total Female Goat

The grand total number of female goat is the sum of female goat for the current year.

$$TFG_{(t+DT)} = \sum_{i=1}^{n} FG_{i(t+DT)} \ldots\ldots\ldots \quad (2)$$

Where,

i = 2, 3,……., n (years)

TFG(t+DT) = Total female goat of different ages in a current year

Model for Female Kid

$$FK_{(t+DT)} = NFK + \int_{t}^{t+DT} [FK_t - MFK_t]dt. \quad ..(3)$$

Where,

DT = Increment of time

NFK = Current new born female kids

$FK_{(t+DT)}$ = Current number of female kids for each age

FKt = Previous number of female calves for each age

MFKt = Previous number of death female kids for each age

a) $MFK_t = C_2 * FK_t.$

Where,

C_2 = Mortality rate

The total number of death female kids are generated by multiplying previous number of female calves at annual mortality rate (C_2).

Model for Total Female Kid

The total number of female kids is the sum female kids for the current year.

$$TMK_{(t+DT)} = \sum_{i=1}^{n} MK_{i(t+DT)} \quad \text{.........(8)}$$

Where,

i = 1, 2….., n (months)

TFK (t+DT) = Total female kids of different ages in a current year

B. Male Goat

The Model for Male Goat

$$MG_{(t+DT)} = \int_{t}^{t+DT} [MG_t - SMG_t - MMG_t]dt \ldots(5)$$

Where,

DT = Increment of time

MG (t+DT) = Current number of male goat for each age

MGt = Previous number of male goat for each age

SMGt = Previous number of slaughtered male goat for each age

MMGt = Previous number of death male goat for each age

a) $SMG_t = A_1 * MG_t$

Where,

A_1 = Slaughter rate for each age

The total number of slaughtered male goat generated by multiplying previous number of male goat at annual slaughter rate (A_1).

b) $MMGt = A_2 * MG_t$

Where,

A_2 = Mortality rate

The total number of died male goat are generated by multiplying previous number of male goat at annual mortality rate (A_2).

The Model for Total Male Goat

The grand total number of male goat is the sum of male goat for the current year.

$$TMG_{(t+DT)} = \sum_{i=1}^{n} MG_{i(t+DT)} \quad \text{......................(6)}$$

Where,

i = 2, 3,……., n (years)

TMG(t+DT) = Total male goat of different ages in a current year

The Model for Male Kid

$$MK_{(t+DT)} = NMK + \int_{t}^{t+DT} [MK_t - MMK_t]_{dt} \ldots(7)$$

Where,

DT = Increment of time

NMK = Current new born male kids

MK (t+DT) = Current number of male kids for each age

MKt = Previous number of male kids for each age

MMKt = Previous number of death male kids for each age

The following equations define the structure of the system:

a) $MMK_t = C_2 * MK_t$

Where,

C_2 = Mortality rate

The total number of died male kids are generated by multiplying previous number of male kidss at annual mortality rate (C_2).

The Model for Total Male Kid

The equation: The total number of male kids is the sum of male kids for the current year.

$$TMK_{(t+DT)}=\sum_{i=1}^{n} MK_{i(t+DT)} \quad \text{.....(8)}$$

Where,

i = 1, 2….., n (months)

TMK (t+DT) = Total male kids of different ages in a current year

Empirical Framework

Data collection and design

Actual data on goat-population and meat-production from the year 1985 to 2001 were collected from various issues of Bangladesh Bureau of Statistics (BBS).

Data adjustment

Female goat, male goat, female kid and male kid data were categorized using 35, 20, 23 and 22% rate respectively (Honhold, 2001).

Estimation Procedure

Simulation Matrix (SIMM) model was used from 1985 to 2015 for goat in Bangladesh based on System Approach Method.

Ex-post SIMM model

System approach has been formulated and validated for the year 1985 to 2001 under an ex-post SIMM before performing an ex-ante SIMM experiment for the year 2002 to 2015.

Ex-ante SIMM model

After that an ex-ante SIMM estimation has been used to allow IF and THEN statement under different scenarios of goat-population and goat-meat production. The ex-post SIMM model for goat production system from 1985-2001 was used as a base to simulate the ex-ante component by changing the rates of kid production and kid mortality for the year 2002 to 2015.

Goat-population Management Strategies

Kid Production

From different studies it is clear that kid production varies from 2 to 4 kids/year. Zeshmaran, 2007 mentioned BBG give birth twice a year or more commonly thrice in 2 years. Benefit of raising BBG mainly because of diseases are relatively less than other domestic animal and female goat become pregnant twice a year and give birth 2-3 baby goat each time (www.rayfarms.com/blackbengalgoat). BBG is very popular in Bangladesh because of its very low demand of food and very high baby production rate. The BBG gain sexual maturity very fast. The female goat becomes pregnant twice a year gives birth to 3-4 baby goat every time (www.wikipedia.org/wikiblackbengalgoat).

Mortality Rate

From different studies it is clear that kid mortality almost 30%. House-hold Survey of Animal Health Research Division of BLRI showed a kid mortality (0-6 months) of 29.9% which were similar those for village goats in Nepal and Zimbabwe (Honhold, 2001) Growing goat mortality was 22.1% and about 30% kid mortality was observed by Chowdhury *et al.* (2002) under semi-intensive conditions. That is why existing kid mortality has considered as 30%.

On these backgrounds for analyzing the impact of goat-population management

strategies on production of goat-meat under 3 scenarios have taken as follows:

Scenarios

For every scenario, slaughter rate of castrated goat is 100% and culling rate of female goat is 100%.

Scenario 1: (Base rate): Production of 2 kids/ year with 30% kid mortality

The lowest number of kid production (2 kids/year) and the highest kid mortality rate 30% considered under Scenario 1.

Scenario 2: Production of 6 kids/year with 30% kid mortality

Increasing kid Production from 2kids/year to 6kids/year with remaining 30% kid mortality considered under Scenario 2.

Scenario 3: Production of 6 kids/year with 10% kid mortality

Decreasing kid mortality rate from 30% to 10% with remaining kid Production 6kids/year considered under Scenario 3.

Results and Discussion

Impact of goat-population management strategies under different scenarios

Goat-population management strategies under different scenarios

Appropriate management system can successfully increase the number of goat in Bangladesh. Table 1 shows that only at 6 kids per year and 30% kid mortality, goat-

Table 1. Estimation of goat-population (Million heads) under goat-population management scenarios in Bangladesh

Year	Scenario 1 (Base rate)	Scenario 2	Scenario 3
2002	47.0	87.1	75.6
2003	50.7	131.8	138.5
2004	54.6	221.3	319.1
2005	58.7	361.4	565.3
2006	63.3	593.1	1039.1
2007	68.1	970.3	1871.8
2008	73.4	1593.1	3410.6
2009	79.0	2610.5	6175.0
2010	85.1	4282.0	11218.9
2011	91.6	7020.1	20344.3
2012	98.6	11512.1	36930.2
2013	106.2	18875.9	67000.6
2014	114.4	30952.1	121592.5
2015	123.2	50752.6	220629.7
Av.	**79.6**	**9283.1**	**35093.7**

Note:
Scenario 1(Base rate): 2 kids/year with 30% kid mortality (Yasmin, 2004)
Scenario 2: 6 kids/year with 30% kid mortality
Scenario 3: 6 kids/year with 10% kid mortality

population increased from 87.1 million heads in 2002 to 50752.60 million heads in 2015 under scenario 2 whereas at 10 % kid mortality rate, goat-population is 75.60 in 2002 to 220629.7 million heads in 2015 under scenario 3. From 2002 it increased rapidly under scenario 3 compared to scenarios 2 (Table 1). At the base/existing rates (2 kids per year with 30% kid mortality), goat-population is the lowest. Scenario 1, 2 and 3 show that goat-population increased from 47.00, 87.10 and 75.60 in 2002 to 85.10, 50752.60 and 220629.70 million heads in 2015 and on an average 79.6, 93283.10 and 35093.70 million heads respectively. Therefore, changing kid production and kid mortality can increase the number of goat-population.

It is true that increasing goat-population can increase the production of goat-meat in future. The effects of changing the number of goat-population on goat-meat production are shown in Table 2. Scenario 1, 2 and 3 show that goat-meat increased from 161.5, 171.5 and 175.8 in 2002 to 419.1, 129667.4 and 524862.1 thousand tons in 2015 and on an average 270.9, 23714.4 and 93,243 thousand tons respectively. Goat-meat production shows an increasing trend due to increasing number of goat-population (Table 1). Under different management strategies, scenario 2 shows the higher amount of goat-meat production. It is less compared to scenarios 3. Scenarios 2 and 3 show that goat-meat production increased rapidly up to 2015 due to higher kid production and for lower kid mortality. The simulated results illustrate that the highest and higher amount of goat-meat production in the year (2015) is possible only under scenario 3 and scenario 2 compared to

Table 2. Estimation of goat-meat production (Thousand MT) under goat-population management scenarios in Bangladesh

Year	Scenario 1 (Base rate)	Scenario 2	Scenario 3
2002	161.5	171.5	175.8
2003	171.4	391.7	199.5
2004	186.6	518.3	667.1
2005	199.6	952.6	1432.4
2006	215.5	1486.4	6387.4
2007	231.9	2502.6	4534.7
2008	249.7	4050.4	8030.7
2009	268.9	6686.2	147687
2010	289.5	10925.3	26604.9
2011	311.8	17946.6	48469.8
2012	335.7	29401.0	87763.7
2013	361.5	48231.9	159443.7
2014	389.2	79069.1	289142.6
2015	419.1	129667.4	524862.1
Av.	**270.9**	**23714.4**	**93243.0**

Note:
Scenario 1(Base rate): Production of 2 kids/year with 30% kid mortality (Yasmin, 2004)
Scenario 2: 6 kids/year with 30% kid mortality
Scenario 3: 6 kids/year with 10% kid mortality

scenario 1 (base rate) respectively.

The results cast that the lowest kid mortality rate with the highest kid production per year of goat-population has a great impact on the goat-meat production.

Conclusion

Not only in small amount but slowly the production of goat-meat can be increased by increasing productivity using special feeding, housing and care which is not the actual solution of meet-up goat-meat demand in the context of Bangladesh. The results of SIMM technology indicated only higher number of total female goat maintain higher number of goat-population, so in order to increase goat-meat, the rates of mortality will have to be reduced from 30% to 10% and the number of kid production needs to increase from 2 kids to 6 kids/year. In order to reach the targets efforts need special care for reducing kid mortality and breed development for higher kid production. Therefore, to increase total goat-population government should create; vaccination, heath and medical care facilities for reducing kid mortality rate and opportunities to produce/supply high breed goat for higher kid production.

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