

# **Socio-Economic and Environmental Success through Effective Poultry Forward and Reverse Supply Chain Process**

Mohammad SHAMSUDDOHA, *Ph.D.*  
*Associate Professor of Marketing*  
*University of Chittagong*  
*Bangladesh*  
*mdsdoha@gmail.com*

## **Abstract**

*Bangladesh is a densely populated country having countless socio-economic and environmental problems. Business entrepreneurs are struggling to get adequate supports from Government and financiers to develop their business efficiently. In this situation, no one will be interested to be eco-friendly or contribute to society by spending his/her own money. In this situation, researchers need to come forward to find a way to develop such processes which will give extra monetary benefits to the owners as well as provide welfares to the society and its environment. This research has chosen poultry industry as case and forward and reverse supply chains as research domains. Bangladesh poultry adopted long forward and reverse supply chain. The perception is that this chain can be taken advantage of in achieving economic, social and environmental sustainability utilizing forward chain and waste resources.*

**Keywords:** *Forward Supply Chain, Reverse Supply Chain, Poultry, Bangladesh.*

## *Introduction*

Bangladesh is struggling to operate their livestock businesses like poultry with zero environmental hazards. Moreover, they have an important experience of economic and social instability especially in employment, education and industrialization. This study takes both a theoretical and a practical focus within the poultry industry in Bangladesh. The study utilizes existing knowledge in the field of supply chain and enhances and augments this knowledge by implementing sustainability, forward and reverses supply chains. Strong awareness is growing in favor of implementing sustainability and waste management through 3R (reuse,

recycle, reduce) at the industry level.<sup>1</sup> Lack of scientific knowledge on waste management results in tons of poultry wastages being discarded in the lowlands, rivers and vacant lands. This kind of practice damages the environment hazardously as Bangladesh is a densely populated country. As a result, environment issues are increasingly important because of population pressures, limited land resources, food crises and drastic climate changes.<sup>2</sup> A substantial research gap exists in the implementation of a proper supply chain framework to this particular industry operation. This research proposes a simulation based model for the poultry industry which includes the concept of reverse and forward supply chains along with sustainability. In this research, the environment and society get priority and the focus is for the industry to reuse their wastage to create valuable output as well as achieving substantial positive social changes. The proposed simulation model will be able to examine economic, social and environmental impacts in Bangladesh society. Moreover, this study observed the implications and benefits of various inputs in this industry rather experimenting in the real life situation.

### *Research Objectives*

The objectives of this paper are:

1. To review related literature and develop a conceptual sustainable supply chain model for the poultry industry
2. To build the model in the simulation environment
3. To run the simulated model to find out the socio-economic and environmental benefits can be achieved

### *Methods*

This study covers a literature review on sustainability, triple bottom line, 3R, supply chain (forward and reverse) and the Bangladesh poultry industry. Both primary and secondary information are used in this study. Primary information was collected in October 2011 mainly through in-depth interviews with the sample respondents from the poultry case industry. This research used in-depth interviews and observations to gain insights and develop a sustainable environment friendly poultry supply chain model. The total respondents included the top ten executives

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<sup>1</sup> Hari Srinivas, *The 3r Concept and Waste Minimization* (2007), accessed February 11, 2011, <http://www.gdrc.org/uem/waste/3r-minimization.html>.

<sup>2</sup> Mohammad Shamsuddoha, "Applying Reverse Supply Chain in the Poultry Industry," in *Emerging Research Initiatives and Developments in Business: CGSB Research Forum 2011, Perth, Australia*, ed. Therese Jefferson, Mohammad Shamsuddoha and Ellen Young (Curtin University, 2011), 13.

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from reputed poultry industries in Bangladesh. The respondents were nominated based on their extensive understanding on Poultry industry in Bangladesh. Secondary information was collected from various books, referral journals, conference papers, statistical yearbooks and company record and reports. This study adopted a positivist ontology, empirical epistemology, and quantitative methodology based on real supply chain cases of poultry processes. The design science methodology was chosen for this study. Design science is concerned with “devising artefacts to attain goals”.<sup>3</sup> DSR is based on “build and evaluate” an artefact of a model.<sup>4</sup> Here, an artefact means designing and developing soft or hard objects that can meet specific purposes and goals.<sup>5</sup> A simulation package was used as a tool to analyse poultry processes in order to investigate the research objectives. The simulation package SIMUL8 (version 17) was used to build and conduct trivial analyses of existing poultry processes in order to investigate the research objectives.

### *Literature*

Processing raw material to finish goods creates environmental and social burden throughout different stages of production.<sup>6</sup> Unemployment, inadequate wages, continuous loss and disinterest to be dynamic entrepreneurs are belongs to social problems. Dumping industry wastage (poultry litter, culled bird and intestines, etc.) towards vacant lands, river water and open field cause severe environmental damage. In both cases economic losses are involved. For this reason, Elkington<sup>7</sup> denotes that organizational sustainability consists of three

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<sup>3</sup> Herbert A. Simon, *The Sciences of the Artificial* (MIT Press, Cambridge, Massachusetts, 1969).

<sup>4</sup> S. T. March and G. F. Smith, “Design and natural science research on information technology,” *Decision Support Systems*, 15(4), (1995): 251–266.

<sup>5</sup> John R. Venable, “A Framework for Design Science Research Activities,” in *Information Resource Management Association Conference* (Washington, DC, USA, 2006); John R. Venable, “The Role of Theory and Theorising in Design Science Research,” in *1st International Conference on Design Science (DESRIST)*, ed. A. Hevner and S. Chatterjee (Claremont, California, USA, 2006)

<sup>6</sup> Stefan Seuring and Martin Muller, “From a Literature Review to a Conceptual Framework for Sustainable Supply Chain Management,” *Journal of cleaner production* 16 (15) (2008): 1699-1710.

[http://sfx.lis.curtin.edu.au/sfx\\_local?sid=google&auinit=S&aulast=Seuring&atitle=From%20a%20literature%20review%20to%20a%20conceptual%20framework%20for%20sustainable%20supply%20chain%20management&title=Journal%20of%20cleaner%20production&volume=16&issue=15&date=2008&spage=1699&issn=0959-6526](http://sfx.lis.curtin.edu.au/sfx_local?sid=google&auinit=S&aulast=Seuring&atitle=From%20a%20literature%20review%20to%20a%20conceptual%20framework%20for%20sustainable%20supply%20chain%20management&title=Journal%20of%20cleaner%20production&volume=16&issue=15&date=2008&spage=1699&issn=0959-6526). C. J. Corbett and P. R. Kleindorfer, “Environmental Management and Operations Management: Introduction to the Third Special Issue,” *Production and Operations Management* 12 (3) 2003: 287–289.

<sup>7</sup> J. Elkington, “Enter the Triple Bottom Line,” in *The Triple Bottom Line: Does It All Add Up?* ed. A. Henriques and J. Richardson (London: Earthscan, 2004), 1-16.

components: environment, society, and economic performance. Again, Sustainability, supply chain and the environment are intricately related in the corporate arena.<sup>8</sup> The triple bottom line of social, environmental and economic aspects are dealt with sustainability which is an essential dimension that companies need to maintain.<sup>9</sup> Contrariwise, it is complicated for the industry to incorporate sustainability and supply chain concept in their traditional production process due to so many harsh reality.<sup>10</sup> Real Government policy, financiers attitude, market demand, over / under production, disease, improper treatment, lack of scientific knowledge, lack of training facilities with updated methods, inability to forecast future calamities as well as potentials, market price, continuously money devaluation with price increasing raw materials are the main real scenario in the poultry sector of Bangladesh. Major companies are under tremendous pressure by stakeholders to practice triple bottom line and sustainability theory for the benefit of society and environment. Stakeholders want to see that companies are caring and investing resources for the sake of society and environment. In this situation, it is now an appropriate time to combine triple bottom line, sustainability and supply chain concepts within their operation.

#### *Supply Chain: Forward and Reverse*

Diverse definitions have been offered in existing supply chain literature which has gained intense recognition. Supply chain is the process that starts from the initial raw materials to the ultimate consumption of the finished product linking across suppliers and user companies.<sup>11</sup> The Supply Chain Council uses the definition: “The supply chain term is increasingly used by logistics professionals that encompass every effort involved in producing and delivering a final product, from the supplier’s supplier to the customer’s customer.”<sup>12</sup> Supply chain links the partners in one string including internal departments and the external partners and

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<sup>8</sup> Corbett and Kleindorfer, “Environmental Management and Operations Management.”

<sup>9</sup> Hau L. Lee, “The Triple-a Supply Chain,” *The 21st-Century Supply Chain*, Harvard Business Review (2004), 102-112.

<sup>10</sup> Mohammad Shamsuddoha, “A Sustainable Supply Chain Process Model for Bangladeshi Poultry Industry,” in *Doctoral Students Colloquium 2010, Perth, Australia*, 1-7 (Curtin University: Curtin Business School, 2010), <http://ssrn.com/paper=1702070>.

<sup>11</sup> J. F. Cox, J. H. Blackstone and M. S. Spencer *Apics Dictionary* (8th Ed.) (Falls Church, VA.: American Production and Inventory Control Society, 1995).

<sup>12</sup> The Supply Chain Council, 1997, <http://www.supply-chain.org>.

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this includes suppliers, carriers, third-party companies, and information systems providers.<sup>13</sup>

Green practices such as implementation of reverse supply chains helps both the company and environment. Particularly, reverse supply chains is the process of retrieving and reversing used product or wastages into valuable by-products.<sup>14</sup> On the other hand, the forward supply chain (FSC) is the procedure of converting raw materials to finished goods.<sup>15</sup> In this process, economic and social impact is created through effective distribution and further processing. The main purpose of this research is to see how sustainability, forward and reverse supply chain practices can be carried out with an overall objective of achieving triple bottom line and sustainability success.

Reverse supply chain includes the consideration of product design, manufacturing by-products, by-products produced during product use, product life extension, product end-of-life, and recovery processes at end-of-life.<sup>16</sup> Sustainability is seen as possible resource depletion, fluctuations in energy costs and pollution and waste management.<sup>17</sup> There is the similar concept of ‘3R’ that refers to reduce, reuse and recycle in an operation. In contrast, the forward supply chain (FSC) can create a smooth distribution channel that accommodates new employments and economic benefits for society. Both the concepts can be used for economic sustainability. The literature shows that a number of studies have been conducted in the field of supply chains. However, literatures pertaining to forward and reverse supply chain are relatively scarce in the livestock sector in Bangladesh.

*Bangladesh Poultry in light of Forward and reverse Supply Chains*

Bangladesh poultry industry does not maintain a structured sustainable operation based on the triple bottom line of social, economic and environment dimensions. Internationally, there are numerous large companies like Wal-Mart,

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<sup>13</sup> Rhonda R. Lummus and Robert J. Vokurka, “Defining Supply Chain Management: A Historical Perspective and Practical Guidelines,” *Industrial Management & Data Systems* 99 (1) (1999): 11-17.

<sup>14</sup> Canan Kocabasoglu, Carol Prahinski and Robert D. Klassen, “Linking Forward and Reverse Supply Chain Investments: The Role of Business Uncertainty,” *Journal of Operations Management* 25 (2007): 1141-1160.

<sup>15</sup> Kocabasoglu *et. al.*, “Linking Forward and Reverse.”

<sup>16</sup> Jonathan D. Linton, Robert Klassen and Vaidyanathan Jayaraman, “Sustainable Supply Chains: An Introduction,” *Journal of Operations Management* 25 (6) (2007): 1075–1082.

<sup>17</sup> Shrivastava, “The Role of Corporations in Achieving Ecological Sustainability,” *Academy of Management Review* 20 (4) (1995): 936-60.

Nokia, and Toyota applying reverse supply chain concepts in considering environment, customer satisfaction. These practices are not always non-profit oriented. In the poultry industry, there are few opportunities for product retrieval, return or reconditioning in the usual sense, as most chicken products are perishable.<sup>18</sup> However, there are immense opportunities to reuse or recycle poultry wastage. By reusing poultry wastage, industries can make valuable products like fertilizers, bio-gas, pillows, charcoal, and bakery items. This kind of wastage conversion will help to maintain a sustainable environment.<sup>19</sup> Until now, sustainability, Environment, FSC and RSC have not received proper attention by the poultry stakeholders.

Bangladesh has a long history of poultry rearing under traditional backyard farming practices.<sup>20</sup> The poultry industry of Bangladesh plays a significant role in economic growth and employment creation.<sup>21</sup> Poultry rearing is dominated by backyard local chickens (Desi or local), which mostly live through a natural scavenger system.<sup>22</sup> Instead, poultry is also one of the alternative income generating activity for the rural poor people in Bangladesh.<sup>23</sup> The poultry industry, a fundamental part of animal production, is committed to supplying the nation with a cheap source of good quality nutritious animal protein in terms of meat and eggs.<sup>24</sup> Number of poultry owners practices the triple bottom line framework of sustainability (social, economic and environment) but not in an organized way.<sup>25</sup> Various by-products can be made from poultry wastages for home and industry use that is socially, economically and environmentally viable within the Bangladesh context. This approach has the potential of creating new windows of opportunities and creates small and medium enterprises that will contribute

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<sup>18</sup> Mohammad Shamsuddoha, "Building a Conceptual Simulation Supply Chain Model for Sustainable Environment Friendly Poultry Industry," Sustainable Poultry Industry Research. (Graduate School of Business, Curtin University, Perth, 2011).

<sup>19</sup> Mohammad Shamsuddoha, "Applying Reverse Supply Chain in the Poultry Industry," in *Emerging Research Initiatives and Developments in Business: CGSB Research Forum 2011* (Perth, Australia), ed. Therese Jefferson, Mohammad Shamsuddoha and Ellen Young, 159-167 (Curtin University, 2011).

<sup>20</sup> Reneta, *Reneta Statistical Yearbook of Bangladesh* 21 (2005).

<sup>21</sup> Mohammad Shamsuddoha and Mir Hossain Sohel, "Poultry Rearing - an Alternative Income Generating Activity for Rural Women Development of Bangladesh," *The Chittagong University Journal of Business Administration, Bangladesh* 20 (1) (2008): 119-132.

<sup>22</sup> Hanne Nielsen, *Socio-Economic Impact of the Smallholder Livestock Development Project in Bangladesh: Results of the Second Impact Survey* (Stamholmen, Denmark, 2007).

<sup>23</sup> Mohammad Shamsuddoha and Mir Hossain Sohel, "Problems and Prospects of Poultry Industry of Bangladesh: A Study on Some Selected Areas," *The Chittagong University Journal of Business Administration* 19 (2004): 273-286, <http://ssrn.com/paper=1295343>.

<sup>24</sup> Shamsuddoha, "A Sustainable Supply Chain Process Model."

<sup>25</sup> Shamsuddoha, "A Sustainable Supply Chain Process Model."

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towards more employment opportunities.<sup>26</sup> Poultry owners are currently integrating foreign technology and breed in their commercial farms and this has the potential to make the industry more profitable and sustainable. There are still huge opportunities to utilize poultry wastages as there are currently not many farmers capitalizing on waste management practices. Poultry rearing can play a significant role in keeping the environment intact, generating income through making by-products from poultry wastage, eliminating poverty, empowering rural women, enhancing nutritional needs, providing food and protein security.<sup>27</sup> All these areas have great potential to meet social, economic and environmental aspects that will make the industry and society more sustainable.<sup>28</sup>

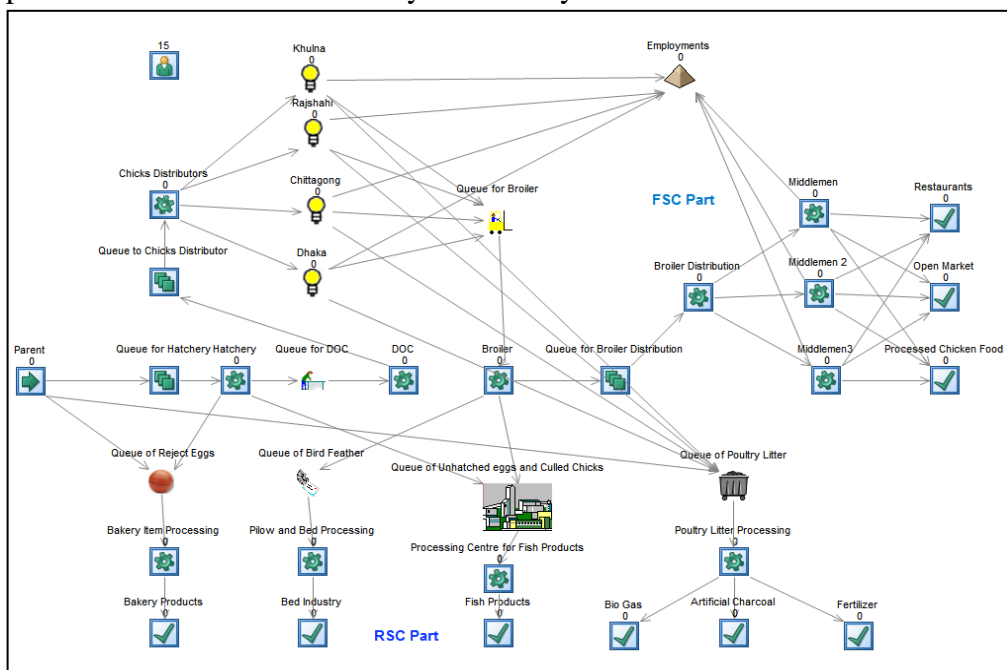


Figure 1: Sustainable Poultry Supply Chain Model in Simulation Environment

*Simulation Model for the Poultry Industry*

Companies are now building different supply chain model to accommodate sustainability, 3R, triple bottom line, forward and reverse supply chain in their existing operation. These concepts are being implemented due to sustainability concern, environmental recovery, customer satisfaction and government

<sup>26</sup> Shamsuddoha, “Building a Conceptual Simulation.”

<sup>27</sup> Shamsuddoha, “Building a Conceptual Simulation.”

<sup>28</sup> Mohammad Shamsuddoha, “Reverse Supply Chain Process as Environmental Sustainability in the Poultry Industry of Bangladesh,” in *Doctoral Colloquium 2011, Perth*, ed. Jenny Goodison (Curtin Business School, Curtin University, 2011).

pressure.<sup>29</sup> The researcher developed a simulation based model that accommodates forward and reverse supply chain in light of sustainability and triple bottom line theory. Figure one shows three different areas of conventional, forward and reverse supply chain in the case industry which was modeled used Simul8 – a simulation modeling package. The Mainstream component includes the general supply chain of the poultry industry that starts from the parent (mother of chicks) and ends up with the finished product of meat and eggs. The forward supply chain component of this simulation model consists of distributor, farmers, and middlemen of processed and mature birds. This is the area where employment and other socio-economic benefits can be achieved based on the volume of bird transacted or reared.

The reverse supply chain components consists of managing poultry wastes as it is evident that different poultry wastes including litter, feed waste, feathers, broken and rejected eggs and intestines are available. Among those, poultry litter can be used for artificial charcoal, fertilizer, bio gas, and fish feed; feathers can be used as raw materials for the bed industry; broken eggs and intestines can be used for the bakery and fish industry respectively.<sup>30</sup> This aspect of waste conversions helps to maintain sustainable environment in a profitable way.<sup>31</sup> A range of environmental practices that help the poultry farm remain free from diseases and allows it to achieve economic and environmental benefits through creating by-products from wastes.<sup>32</sup> The simulation model is efficient enough to evaluate the volume of wastes that can be used as the input of by-products. Industrialist can simulate the different distributions in various work centers like parents, hatchery, broiler, distributors, farmers and other processing centers to gain a better understanding of potential outcomes and to gain insight with respect to potential opportunities.

### *Results*

The researcher collected historic data from case farm and gave provided input to the different objects or artifacts. Such artifacts can be designed as work entry, queue, work center and work and work exit. In this model, a parent is used

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<sup>29</sup> Shamsuddoha, "Building a Conceptual Simulation."

<sup>30</sup> Shamsuddoha, "Applying Reverse Supply Chain."

<sup>31</sup> Shamsuddoha, "Applying Reverse Supply Chain in the Poultry Industry"; Mohammad Shamsuddoha, "Using Reverse Supply Chain (Rsc) Process to Achieve Environmental Sustainability," *Sustainable Poultry Industry Research*, Graduate School of Business (Curtin University, Perth, 2011).

<sup>32</sup> Shamsuddoha, "Applying Reverse Supply Chain."



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as work entry that produces on an average of 140,000 hatchable eggs/week. These eggs go directly to the queue for hatch in a hatchery. There are 80 incubators available to hatch these eggs by rotation. Twenty one days are needed to hatch eggs that then produce broiler chicks. Day old broiler chicks are called day old chicks (DOC). DOC supplied to the distributors to distribute in different division of Dhaka, Chittagong, Rajshahi and Khulna. Numbers of sub-distributors are employing under each distributor house and each sub-distributor has attached with bunch of ultimate farmers. These farmers rear to grow up the day old chicks (DOC). After 25-35 days, DOC becomes mature chickens ready for supply to the open market, restaurants and processing centers.

Reject eggs, feather, culled birds and litter are generating after a certain interval in the process. All these maintained an individual supply chain to produce different by-products. The participant farms procure and process several by-products of poultry litter, broken and damaged eggs and culled birds. Bio gas, artificial charcoal and fertilizer generates from litter. Different technologies and methods are using to recycle, reuse and reduce the various poultry wastes. There are so many KPIs in the result area of simul8 package. The KPIs showed the output of chicken, eggs, wastage, by-products, employment created which is very essential for the policy maker to understand the ongoing business impacts. By seeing this result, policy makers can tune their policy to get further better result than existing result which will guide a company to achieve sustainability. In this paper, the researcher included only a few of them. There are various ways to compare and contrast the objects / artifacts results and these include graphs, pie charts, random runs, trials run etc. This model runs through five random trials and table one in appendix represents one, three and five trial and the average of all results. Different trial runs give different results with variations that might be useful for the decision makers. Slight variation can sometime save time, money and other resources. The simulation model provides many indicators in the KPI zone such as waiting, working, block and stop percentages of an object, standard deviation, average queue time, minimum and maximum queue time, completed jobs, blocked jobs, etc. Entrepreneurs or decision makers in using the information can easily find out where to tune their industry by using the virtual model. This kind of model does not require real life experiments. It is noted that researcher avoid actual time, monetary unit and individual measurement unit initially. The model was run through entering number of eggs as throughput and broiler chicken as output. Within the process, it assesses the number of employment generation and unit of various by-products. The model simulated for a week and units are

measured based on throughput. Note that this model also can able to calculate carbon emission by power consumption and so forth.

Simulation Object	Performance Measure	Run 1	Run 3	Run 5	Average	95%
Broiler Distribution	Waiting %	0.0047	0.00388	0.00511	0.00464	0.00547
	Completed Jobs	139919	140104	139966	139969	140091.55
Chicks Distributors	Waiting %	21.36	21.41	21.51	21.46	21.54
	Working %	78.63	78.58	78.48	78.53	78.61
	Completed Jobs	110062	110082	109859	110000	110128.85
Queue for Broiler	Items Entered	108760	108724	108572	108679	108786.29
Queue for Broiler Distribution	Average queue Size	80398.57	80115.14	79833.42	80102	80390.38
	Maximum queue	393000	392704	391933	392526	393112.9
	St Dev	1.4923	1.49126	1.48789	1.4892	1.49225
	Items Entered	532919	532808	531899	532496	533055.15
Queue of Bird Feather	Items Entered	5392	5423	5488	5471.8	5560.30
Queue of Poultry Litter	Items Entered	2142	2177	2152	2150.4	2171.87
Queue of Reject Eggs	Items Entered	8215	8330	8376	8324.6	8424.45
Queue of Unhatched eggs and Culled Chicks	Average	2454	2479.71	2492.57	2481.14	2522.32
	St Dev	0.93606	0.93296	0.94371	0.94143	0.95257
	Items Entered	26170	25984	26132	26096.4	26222.020
Restaurants	Completed Job	33455	33361	33671	33528.2	33687.858
	St. Dev.	1.48963	1.49087	1.4932	1.48987	1.49273
Parent	Number Entered	140030	140070	139999	140058	140122.78
Hatchery	Completed Jobs	137636	137631	137497	137615	137702.01
Employments	Completed Job	1572	1617	1599	1588.6	1665.58

*Table 1: KPI's of Different Objects of Poultry Model*

### *Concluding Remarks*

This paper has already shown the way of getting maximum socio-economic and environmental benefits through effective poultry supply chains. Though this

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paper added new dimension in poultry literature but still sensitivity, optimization, reality check are absent. This kind of test will give better understanding to the concern people. Simulation is such programming which can give us forecasting and assumption to take or reject the decision or policy. Any kind of extreme situation and changing behavior of existing condition can be given input in such modeling. This is how policy makers or entrepreneurs can depict or get an idea of their upcoming futures though exact future behavior cannot be replicated. This research paper is the inception of developing poultry simulation model. There are so many unexplored things that can be explored through further research on waste management, individual parties in different chains, impact of individual parties etc. It is expected that future research will unearth so many burning questions and problems.

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