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Supply Chain Modelling of Daily Consumed Cereal Grain in Bangladesh

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ABSTRACT

Supply Chain of Rice, Wheat, Corn as in Cereal Grains in Bangladesh are in focus for considerations of food security and climate change impacts. The presence of price volatility, characterized by rapid and unpredictable price fluctuations, further compounds the challenges faced by Bangladesh's supply chain for these commodities. This volatility can stem from a complex interplay of factors, including changes in global demand patterns, geopolitical events, weather-related disruptions, and speculative trading activities. Such fluctuations introduce uncertainty into market dynamics, rendering both producers and consumers vulnerable to adverse economic consequences. This research paper introduces a system dynamics model that focuses on the supply chain of cereal grain products, including rice, wheat, corn and others. The aim is to analyze and manage various scenarios related to supply chain management, extending from farmers to consumers. The goal is to devise effective and sustainable strategies for ensuring the accessibility of these commodities to consumers in Bangladesh. This involves designing policies that optimize supply chain efficiency while considering economic factors and uncertainties. In this paper we analyze how changes in productivity occur during seasonal production, what changes the lead time, and how changes in the variations in demand affect the performance of the supply chain. Drying these crops at the start and maintaining year-round operation of processing facilities can also help stabilize inventory and the overall supply chain for these products. This approach can enhance efficiency and reduce supply chain disruptions for various essential crops. Also, less total supply chain cost from economic operation results in less fuel consumption and hence less contribution to global warming. The model can pinpoint and analyze the most important parts of the supply chain. This helps in building a network that is both efficient and sustainable.

INTRODUCTION

In Bangladesh, wheat cultivation is integrated into intensive rice-based systems. About 80% of wheat grows in a three-crop rotation, 60% as aush rice, transplanted aman rice-wheat, and 20% as jute-transplanted aman rice-wheat. Around 2 million farmers benefit from wheat cultivation, employing 600,000 for 120 days during the wheat season. Over 20 years (1975/76-1995/96), 20 million m tons of wheat worth $3.4 billion were produced. This strategy enhances food security, averting an annual import of about 0.9 million m tons of food grains if the wheat program were absent. In 2023, wheat turnover was around 11 lakh tones. According to Statista, In the marketing year of 2022/2023, the global production volume of wheat amounted to over 781 million metric tons. This was an increase as compared to the previous marketing year. Wheat production in Bangladesh was 1180 thousand tones, as reported by World Data Atlas. Bangladesh has witnessed significant growth in daily consumed crops' production due to advancements in agricultural technology and high-yield rice varieties. However, despite enhanced production and food security, meeting customer demands remains a challenge, resulting in price hikes. This paper proposes a robust supply chain management framework to efficiently source, process, distribute, and sell products, aligning with customer demands. Effective inventory handling is vital for maintaining supply-demand equilibrium, reducing costs, preventing shortages, and optimizing overall efficiency. To achieve this, supply chain models must be designed and simulated to respond promptly to customer needs. Utilizing reference process models offers a valuable strategy for addressing the complexities of adaptive supply chains responsive to demand fluctuations. These reference process models delineate precise sequential work activities across temporal and spatial dimensions, aiding in the synchronization of supply chain responses with demand dynamics. (Davenport, 1993; Verdouw et al., 2010). Reference process models are predefined models used for the construction of other models (Thomas, 2006; Verdouw, Beulensb, Trienekensc, & Wolferta, 2010). Also, the reference process models can be used to construct system dynamics computer models using systems approach developed by Forrester (1968) and Bala (1999). Wheat supply chain in Bangladesh mainly consists of the milling sector, wholesale sector and retail sector. The wheat supply chain involves farmers, traders, and wholesalers supplying the milling sector. Milled wheat then moves to the wholesale sector and eventually to the retail sector for consumer sales. In 2023, wheat turnover is around 11 lakh tonnes.

Wheat provisioning to the milling sector follows a seasonal rhythm with three harvest cycles: autumn (Sept/Oct), winter (Dec/Jan), and spring (Mar/Apr). Retail demand hinges on per capita consumption and population. Key factors include milling sector wheat supply, inventory management, and supply chain costs. Bangladesh's wheat supply chain needs improvement. A computer model is crucial to analyze and enhance it sustainably, creating policies and strategies before implementation (Bala, 1999). Carter and Easton (2011) reported a systematic review of sustainable supply chain management and demonstrated that it is necessary to develop models. Riddals ,Bennett, and Tipi (2000) Conducted a comprehensive assessment of diverse mathematical methodologies employed for the modeling and analysis of supply chains. Operations research resolves tactical challenges. To understand supply chain-wide effects, dynamic simulations like system dynamics are vital. Originating from Forrester, these techniques model intricate systems, including feedback, non-linearities, and delays, enabling thorough analysis of performance dynamics (Bala, 1999; Forrester, 1968). Several studies have been reported on modelling of supply chain of food industry and food supply management (Apaiah & Hendirix, 2005; Apaiah, Hendrix, Meerdink, & Linnemann, 2005; Bosona & Gebresenbet, 2013; Georgiadis, Vlachos, & Iakavou, 2005) and limited studies have been conducted on system dynamics modelling of supply chain of food industry and food supply management (Kumar & Nigmatullin, 2011; Minegishi & Thiel, 2000; Vo & Thiel, 2008, 2011). More recently detailed frameworks of food supply chain assessment and reference process models for sustainable food supply chain have been reported (Manzini & Accorsi, 2013; Verdouwa et al., 2010). This study aims to create a system dynamics-based model for wheat milling supply chains in Bangladesh, applicable to other cereal grains. It analyzes key variables' impact on performance and explores policy options for sustainable development. The paper's structure: Methodology (Section 2), Model (Section 3), Results and Discussions (Section 4), and Conclusions (Section 5)

METHODOLOGY

Managing wheat supply in Bangladesh is complex due to limited resources and population growth. Its intricate nature involves technology, economy, and politics. Experimenting with real-world factors is impractical, but computer models allow simulations for better understanding of this dynamic system Downloaded by [Universite Laval] at 08:15 07 May 2016 INTERNATIONAL JOURNAL OF SYSTEMS SCIENCE: OPERATIONS & LOGISTICS 3 complex systems (Bala, 1999). Complex wheat milling systems require careful modeling before policy implementation. Forrester's system dynamics aids analyzing intricate socio-economic, technological, and environmental interactions (Bala, 1999; Forrester, 1968). System dynamics employs feedback principles, excelling in intricate systems with loops, non-linearity, and time lags. Unlike econometrics, it adeptly handles nonlinear dynamics (Stephens et al., 2013). System dynamics suits continuous processes with feedback-induced dynamic shifts. Discrete event models excel in linear systems. System dynamics proficiently handles intricate problems in this category. A detailed description of the system dynamics methodology is given in Forrester (1968) and Bala (1999).

The research presented in this paper employs the system dynamics methodology to model and analyze the performance of the wheat supply chain in Bangladesh. A causal loop diagram for the wheat supply chain is constructed to hypothesize the reference behavior in the context of Bangladesh. Influential factors encompass wheat inventory, wheat orders, supply chain costs, and pricing across the milling, wholesale, and retail sectors. The diagram comprises two balancing loops and one reinforcing loop for each sector—milling, wholesale, and retail—interconnected sequentially. The milling sector acquires wheat from farmers, traders, and wholesalers, and wheat production adheres to seasonal patterns. Balancing loops X1, X3, and X5 illustrate the flow of orders and wheat within the supply chain, while X2, X4, and X6 depict expectation adjustments with mark-up pricing. Reinforcing loops Y1, Y2, and Y3 signify price adjustments with mark-up pricing. For instance, balancing loop X1 commences from the milling inventory, prompting milling orders to rise, thus increasing demand for wheat from the inventory. This, in turn, affects the rice milling inventory, completing the loop. The mark-up pricing induces an expectation adjustment forming a balancing loop (X2), and similarly, triggers a price adjustment, creating a reinforcing loop (Y1).

The interplay of demand/supply balance with mark-up pricing demonstrates a non-linear relationship. Similar multi-loop structures and non-linearities exist within the wholesale and retail sectors. Wholesale consists of two balancing loops (X3 and X4) and one reinforcing loop (Y2), while retail involves two balancing loops (X5 and X6) and one reinforcing loop (Y3). These intertwined loops collectively form the wheat supply chain, spanning from producer to consumer. Causal loop diagrams in Figure 1 depict the dynamic hypothesis of Bangladesh's wheat supply chain, aligning with operational dynamics. Formulating these loops in STELLA and simulating can yield the reference model behavior. The hybrid approach uses economic order quantity, with retailers, wholesalers, and millers ordering at the reorder point. This simulation, integrating reorder points and economic order quantity, generates supply chain dynamics. Economic order quantity minimizes costs, while the reorder point ensures sufficient stock and timely orders.

The economic order quantity is computed using the following equation (Riggs, 1970)

$$Q = \sqrt{\frac{2DS}{H}} \qquad (1)$$

where
Q = economic order quantity of rice, tons
D = annual demand of rice, tons
S = ordering cost, taka/ton
H = holding and storage cost, taka/ton
and the reordering point for the economic order quantity is computed from the following equation (Riggs, 1970):

$$R = d \times L + z \times \sigma_L \times \sqrt{L} \qquad (2)$$

where
R = reordering point, tons
d = average demand of rice, tons/day
L = lead time, day

The economic order quantity model provides a closed-form optimal solution, and this model has demonstrated effective application within the automobile, pharmaceutical, and retail industries.
(Muckstadt & Sapra, 2010). Another essential technique used in conjunction with the economic order quantity is the concept of the reordering point and safety stock. The reordering point signifies the inventory level that initiates the placement of an order for additional units. In contrast, the safety stock quantity is intended to safeguard against potential stock shortages. (Chen, 1998). In this study, the milling, wholesale, and retail prices are established through price mark-up adjustments driven by shifts in demand/supply equilibrium.(Kpmaier & Voigt, 2013; Teimoury, Nedaei, Ansari, & Sabbaghi, 2013).

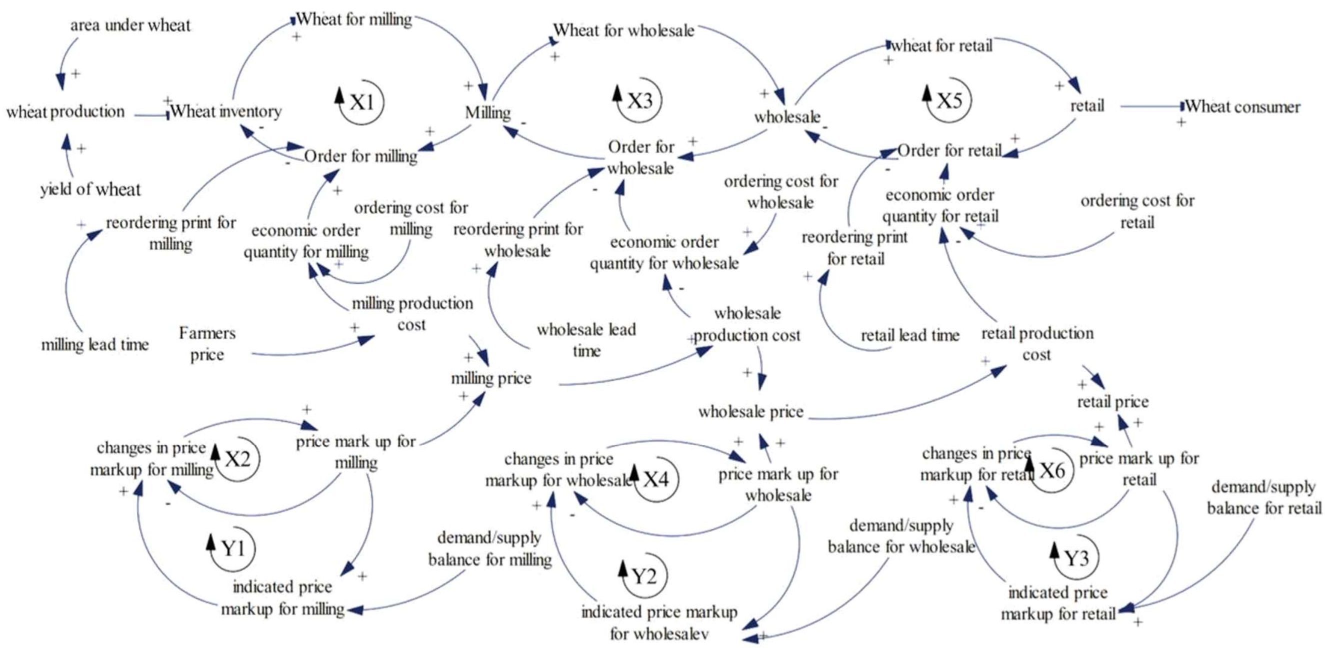

Figure 1: Causal loop diagram of supply chain of wheat in Bangladesh

MODEL

The streamlined STELLA stock flow diagram of the wheat supply chain in Bangladesh is illustrated in ***Figure 2***. The mathematical equations that describe stock and flow structures are represented by integral equations in form:

$$\text{stock}\,(t) = \text{stock}(t_0) + \int_{t_0}^{t} |\text{inflow}(s) - \text{outflow}\,(s)|\,ds$$

where inflow (s) and outflow (s) represent the value of inflow and outflow respectively at any time between the initial time ***t(0)*** and the current time ***t***.

In STELLA,

$$\text{stock}\,(t) = \text{stock}(t - \Delta t) + \text{inflow} \times \Delta t - \text{outflow} \times \Delta t \quad (4)$$

Stock, a pivotal state variable denoting the system's condition at time ***t***, is depicted through rectangular representation. Conversely, flow delineates temporal changes in the stock, symbolized by a valve icon. Arrow-directed inflow and outflow symbols elucidate influx and efflux respectively. Influence lines, embodied by arrow-adorned connectors, signify information propagation. The initiating factor signifies its influence on the concluding factor, indicating directional information transfer.

The foundational equations employed herein are succinctly formulated as follows:
By introducing subscript ***i*** to signify milling, wholesale, and retail aspects, the model accounts for distinct operational segments. The subscripts ***1, 2,*** and ***3*** correspond to milling, wholesale, and retail respectively.

What inventory burgeons via production, while sales diminish it within the milling sphere. This computation materializes as follows:

$$\text{wheat inventory}\,(t) = \text{wheat inventory}\,(t-1) + \text{wheat production rate} \times \Delta t - \text{wheat sales for milling} \times \Delta t \quad (5)$$

Wheat production depends on area under wheat cultivation and yield of wheat and it is calculated as ***wheat production rate = area under wheat × yield of wheat (6)***

Likewise, by taking into account various factors, mathematical equations and logical statements can be formulated. These elements will play a pivotal role in constructing a dynamic model for the wheat supply chain. Here are the equations and statements:

$$\text{inventory order placed}_i = \text{IF}(\text{inventory on order}_i + \text{inventory}_i) < (\text{reordering point}_i)\text{THEN}(\text{inventory to order}_i)\ \text{ELSE}(0) \quad i = 1, 2, 3 \quad (7)$$

$$\text{reordering point}_i = (\text{demand aver}_i \times \text{lead time}_i) + \text{safety stock}_i \quad i = 1,\ 2,\ 3 \quad (8)$$

$$\text{safety stock}_i = \text{safety factor}_i \times \text{standard deviation of demand aver}_i \times \text{SQRT}(\text{lead time}_i) \quad i = 1, 2, 3 \quad (9)$$

$$\text{inventory to order}_i = \text{IF}(\text{inventory}_i) < (\text{reorderingpoint}_i)\ \text{THEN}(\text{economic order quantity}_i)\text{ELSE}(0) \quad i = 1, 2, 3 \quad (10)$$

$$\text{economic order quantity}_i = \text{SQRT}((2 \times \text{demand aver}_i \times \text{ordering cost}_i)/((\text{carry rate}_i/365) \times \text{production cost}_i)) \quad i = 1, 2, 3 \quad (11)$$

$$\text{inventory on order}(t)_i = \text{inventory on order}\,(t-1)_i + \text{inventory order rate}_i \times \Delta t - \text{inventory received rate}_i \times \Delta t \quad i = 1, 2, 3 \quad (12)$$

$$\text{inventory}\,(t)_i = \text{inventory}\,(t-1)_i + \text{inventory received}_i \times \Delta t - \text{inventory sales}_i \times \Delta t \quad i = 1, 2, 3 \quad (13)$$

$$\text{inventory received}_i = \text{DELAY}(\text{rice sales for inventory}_i, \text{lead time}_i)) \quad i = 1, 2, 3 \quad (14)$$

$$\text{inventory sales}_i = \text{IF}(\text{inventory order placed}_{i+1}) > (\text{inventory}_i)\text{THEN}(\text{inventory}_i)\ \text{ELSE}(\text{inventory order placed}_{i+1}) \quad i = 1, 2 \quad (15)$$

$$\text{retail sales} = \text{IF}(\text{consumption rate} >= \text{retail inventory})\ \text{THEN}(\text{retailinventory})\text{ELSE}(\text{consumption rate}) \quad i = 1, 2, 3 \quad (16)$$

$$\text{price}_i = \text{MAX}(\text{production cost}_i, (1 + \text{mark-up}_i) \times \text{production cost}_i) \quad i = 1, 2, 3 \quad (17)$$

$$\text{mark-up}(t)_i = \text{mark-up}(t-1)_i + \text{change in mark-up}_i \times \Delta t \quad i = 1, 2, 3 \quad (18)$$

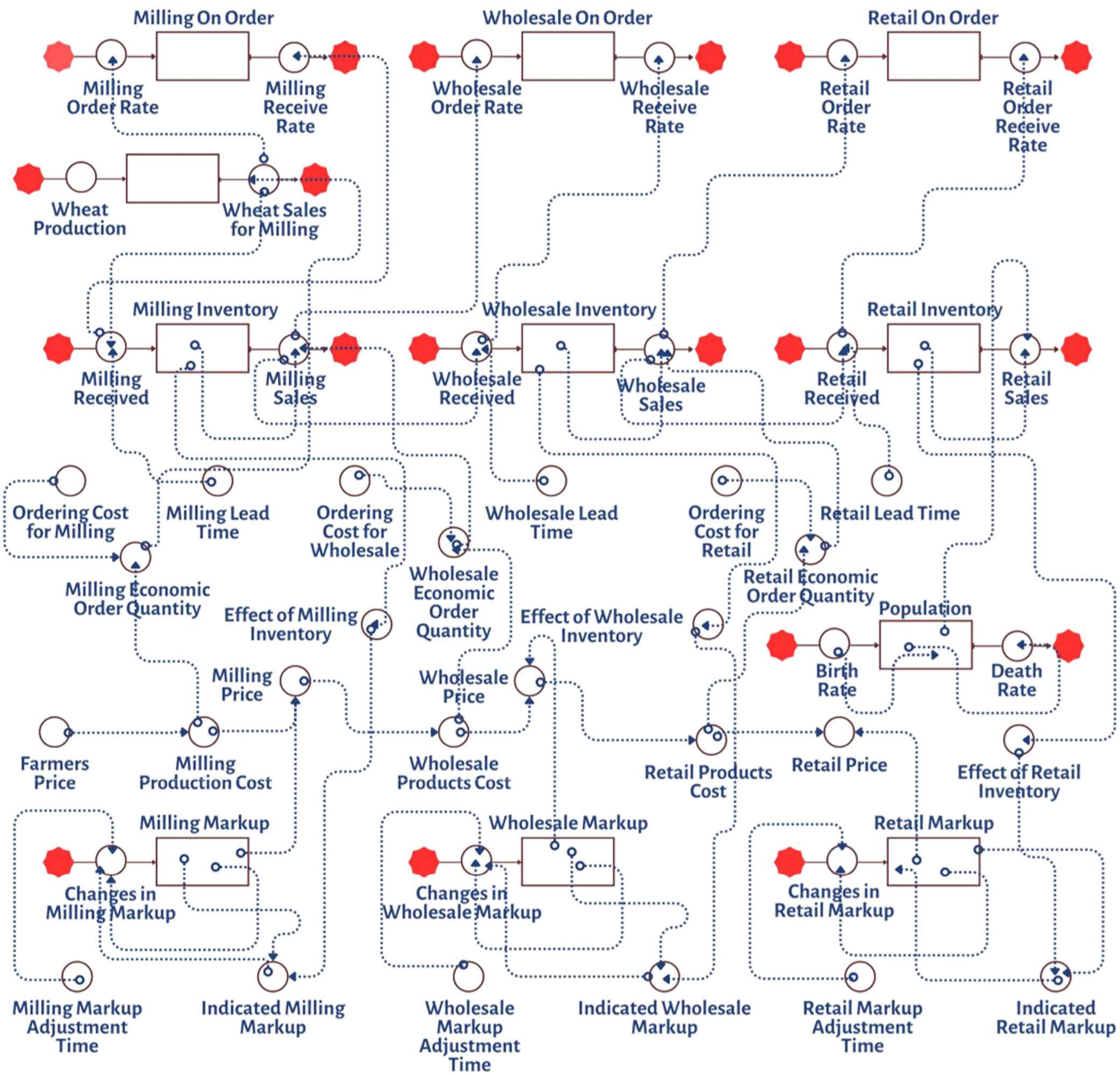

Figure 2: Simplified STELLA stock flow diagram of supply chain of wheat in Bangladesh.

$$\text{change in mark-up}_i = (\text{indicated mark-up}_i - \text{mark-up}_i) / \text{mark-up adjustment time}_i \quad i = 1, 2, 3 \tag{19}$$

$$\text{indicated mark-up}_i = \text{mark-up}_i \times \text{effect of inventory}_i \quad i = 1, 2, 3 \tag{20}$$

The influence of inventory is depicted through a non-linear graphical function tied to the relative inventory coverage of wheat. This price-setting framework encompasses both expectation adjustment and price adjustment mechanisms.

The concept of expectation adjustment, first introduced by Nerlove (1958), has been employed by Meadows (1970) and Bala (1975, 1990) to model price dynamics for agricultural commodities, yielding notable concordance between predicted and reported prices. Numerous software tools, including STELLA, VENSIM, and POWERSIM, facilitate numerical solution of system dynamics equations, proving equally effective in simulating system behavior. The numerical resolution of Equations (5)-(20) was attained through the employment of the Runge-Kutta fourth-order method, utilizing the STELLA software. A time interval (dt) of 0.25 was chosen for solution, ensuring it remains less than half of the shortest first-order delay.

RESULT

The above system showed outstanding results when it was applied to the statistics of rice. The result of it is shown below:

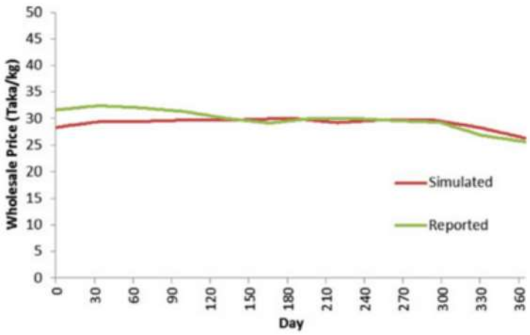

Figure 3. Comparisons of the predicted and reported values of wholesale price in Bangladesh.

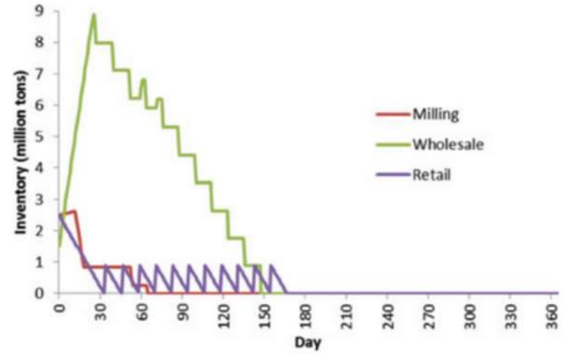

Figure 4. Simulated milling inventory, wholesale inventory and retail inventory under extreme condition of total crop failure.

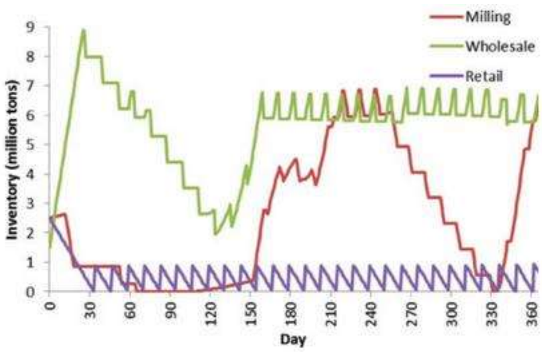

Figure 5. Simulated milling, wholesale and retailer inventory for economic order quantity and reordering point operation of the order rate of milling, wholesale and retailer.

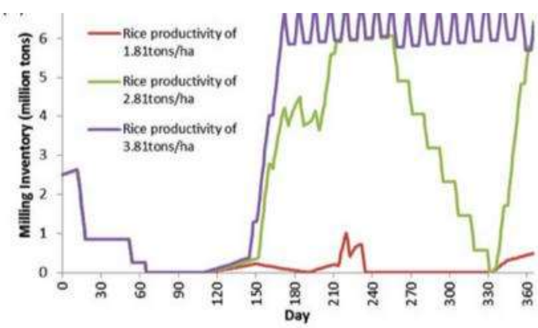

Figure 6. Simulated milling inventory for rice productivity of .8 tons per 2.81ha and 3.81 ha

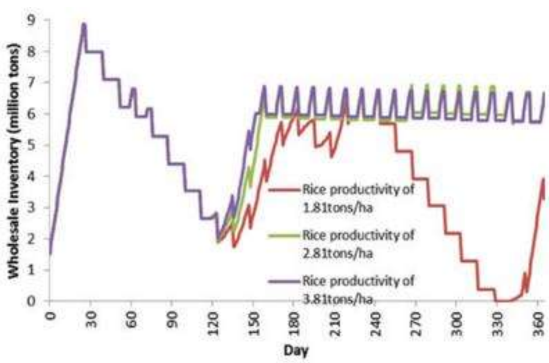

Figure 7. Simulated wholesale inventory for rice productivity of .8 tons per 2.81ha and 3.81 ha

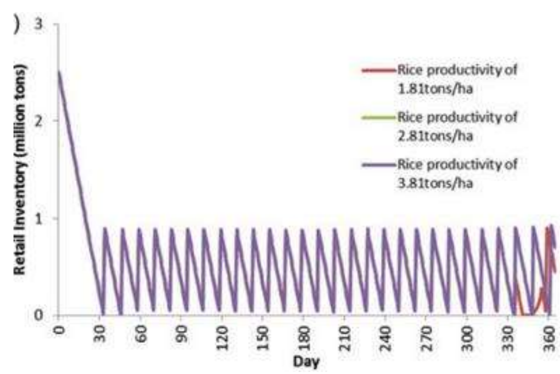

Figure 8. Simulated retail inventory for rice productivity of .8 tons per 2.81ha and 3.81 ha

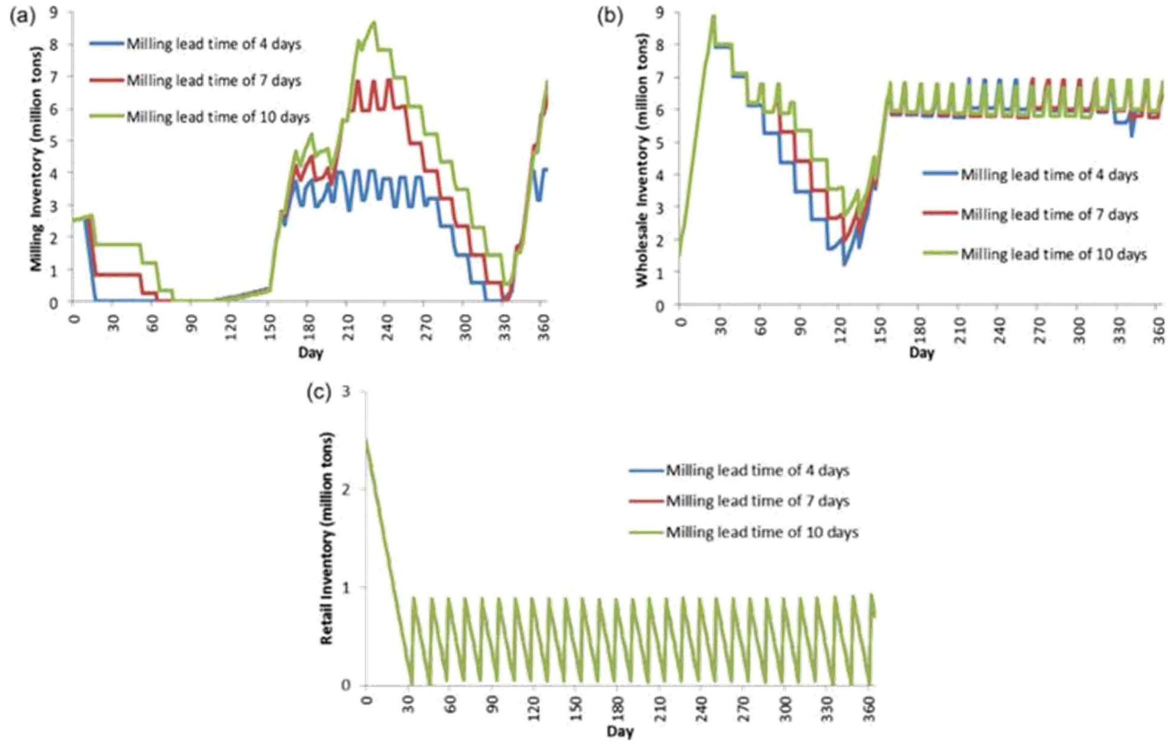

Figure 9. (a) Simulated milling inventory for milling lead time of 4, 7 and 10 days. (b) Simulated wholesale inventory for milling lead time of 4, 7 and 10 days. (c) Simulated retail inventory for milling lead time of 4, 7 and 10 days.

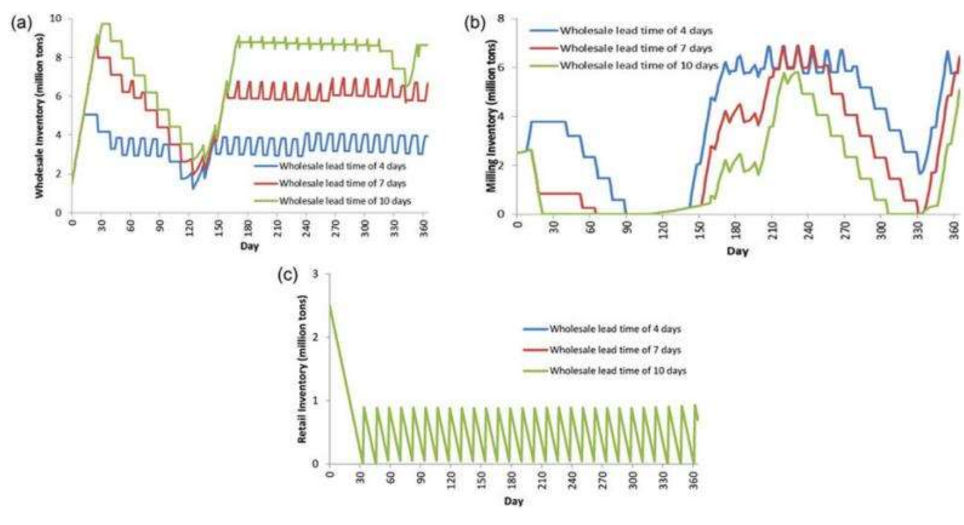

Figure 10. (a) Simulated wholesale inventory for wholesale lead time of 4, 7 and 10 days. (b) Simulated milling inventory for wholesale lead time of 4, 7 and 10 days. (c) Simulated retail inventory for wholesale lead time of 4, 7 and 10 days.

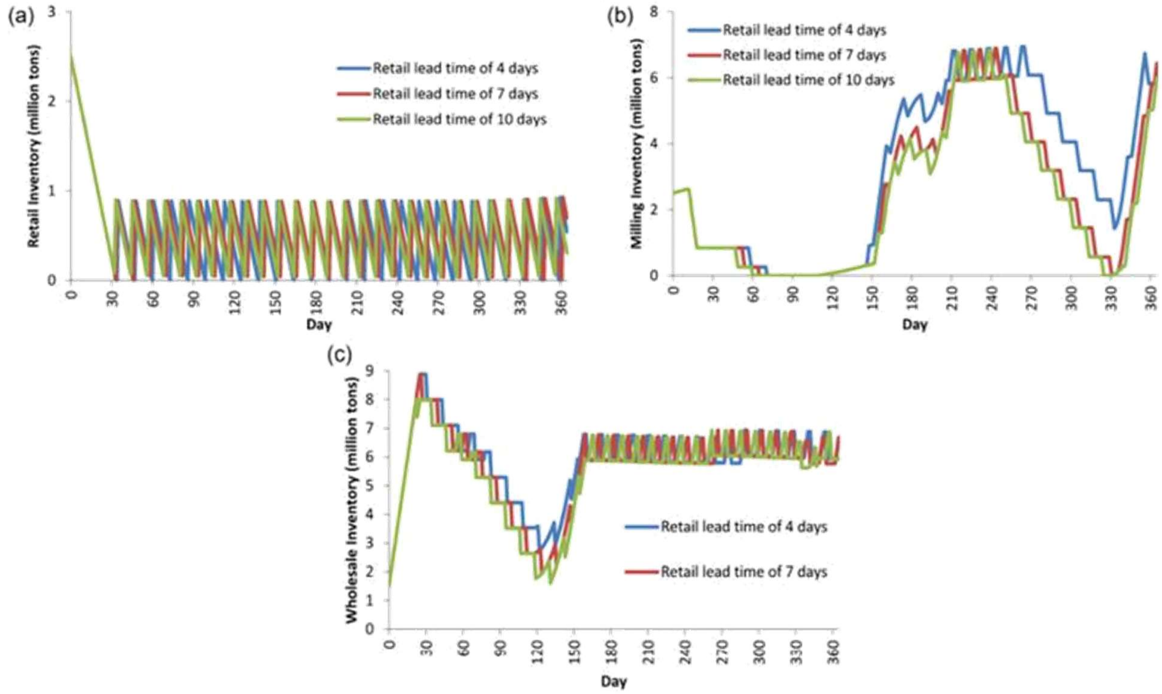

Figure 11. (a) Simulated retail inventory for retail lead time of 4, 7 and 10 days.(b) Simulated milling inventory for retail lead time of 4, 7 and 10 days. (c) Simulated wholesale inventory for retail lead time of 4, 7 and 10 days.

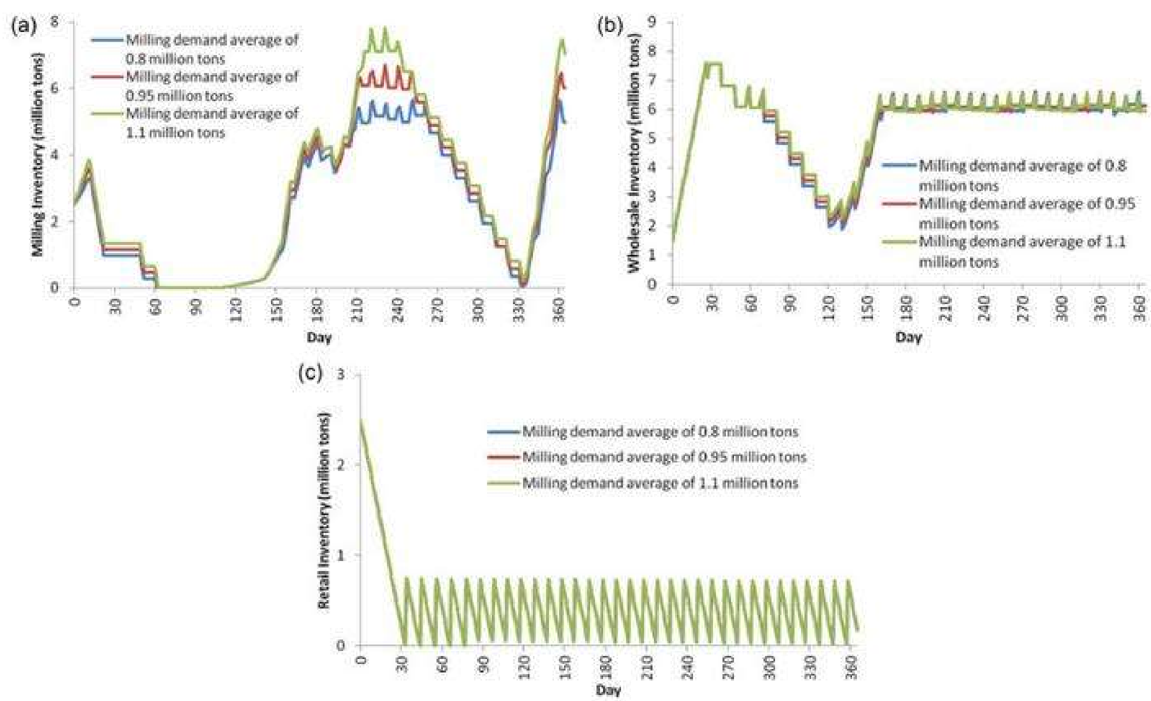

Figure 12. (a) Simulated milling inventory for milling demand average of 800000, 950000, 1100000 tons.
(b) Simulated wholesale inventory for milling demand average of 800000, 950000, 1100000 tons.
(c) Simulated retail inventory for milling demand average of 800000, 950000, 1100000 tons.

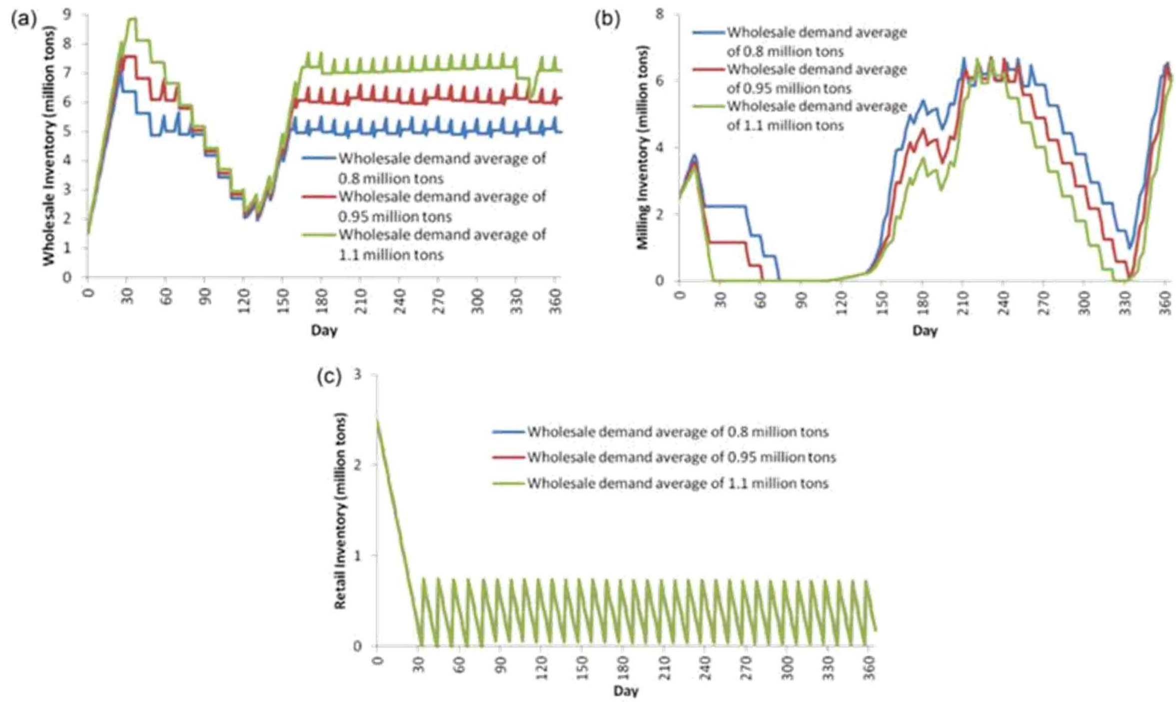

Figure 13. (a) Simulated milling inventory for wholesale demand average of 800000, 950000, 1100000 tons.
(b) Simulated wholesale inventory for wholesale demand average of 800000, 950000, 1100000 tons.
(c) Simulated retail inventory for wholesale demand average of 800000, 950000, 1100000 tons.

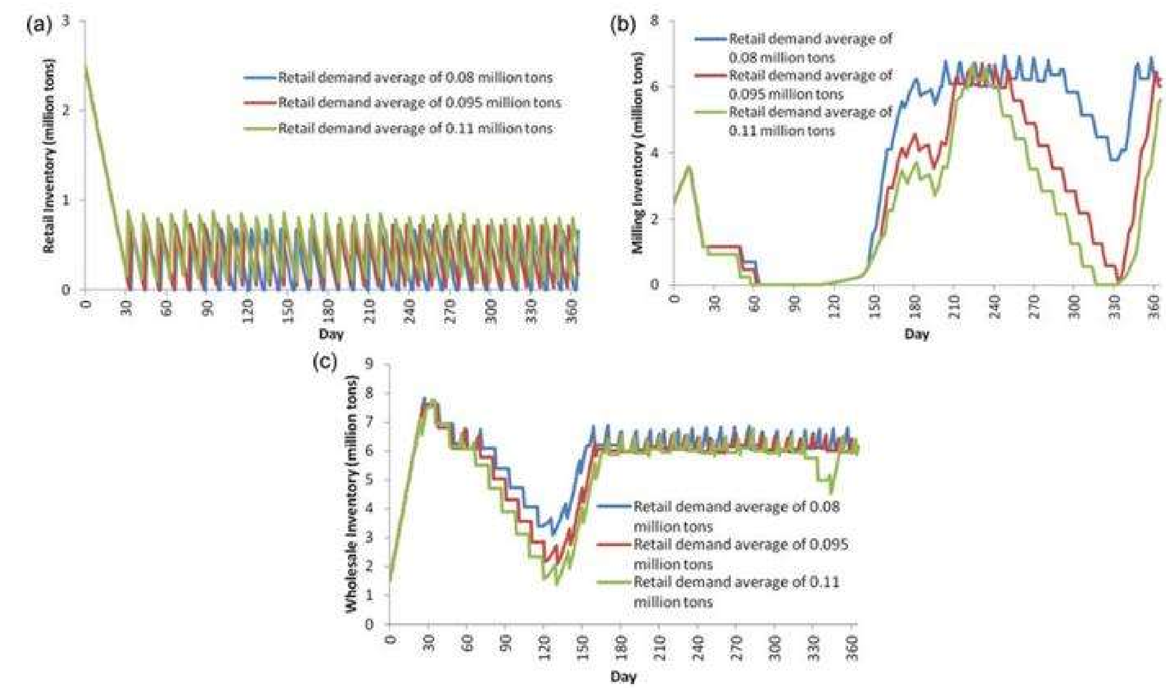

Figure 14. (a) Simulated milling inventory for retail demand average of 800000, 950000, 1100000 tons.
(b) Simulated wholesale inventory for retail demand average of 800000, 950000, 1100000 tons.
(c) Simulated retail inventory for retail demand average of 800000, 950000, 1100000 tons.

DISCUSSION

The system has immense potential as it can be applied to other cereal grains of Bangladesh and the result showed its accuracy to determine the impact on rice of the system.

CONCLUSION

A system dynamics model was developed for Bangladesh's wheat supply chain. Using economic order quantity and reorder points, the retail inventory stabilizes, creating an efficient network. Fluctuations in wheat production affect the whole chain, while lead time changes impact milling and wholesale inventories. Year-round milling and economic operation reduce costs and environmental impact. This optimal policy ensures sustainable supply chain management. The model identifies crucial components, aiding policy creation for an efficient network. It introduces price settling, advancing theoretical understanding. Offering insights and policy scenarios, the model addresses the complexity of the multi-agent wheat supply chain, benefiting analysis and formulation.

REFERENCE

1. B. K. Bala, M. G. K. Bhuiyan, M. M. Alam, Fatimah Mohamed Arshad, Shaufique F. Sidique & E. F. Alias (2016): Modelling of supply chain of rice in Bangladesh, International Journal of Systems Science: Operations & Logistics, DOI: 10.1080/23302674.2016.1179813
2. Ahmed, S. Haggblade, & T. Choudhury(Eds.), Out of the shadow of famine: Evolving food markets and food policy in Bangladesh (pp. 49–72). Baltimore, MD:John Hopkins University Press.
3. Andriolo, A., Battini, D., Grubbstrom, R.W., Persona, A., & Sgarbossa, F. (2014). A century of evolution from Harriss basic lot size model: Survey and research agenda. International Journal of Production Economics, 155, 16–38.
4. Apaiah, K.A., & Hendrix, E.M.T. (2005). Design of a supply chain network for pea-based novel protein foods. Journal of Food Engineering, 70, 383–391.
5. Apaiah, K.A., Hendrix, E.M.T., Meerdink, G., & Linnermann, R. (2005). Qualitative methodology for efficient food chain design. Trends in Food Science and Technology, 16, 204–214.
6. Bala, B.K. (1975). Applications of control theory to the dynamic behaviour of agricultural commodities (M. Eng. thesis). Asian Institute of Technology, Bangkok, Thailand.
7. Bala, B.K. (1990). Applications of control theory to the dynamic behaviour of agricultural commodities. System Dynamics: An International Journal of Policy Modeling, 3(1&2), 87–100.
8. Bala, B.K. (1999). Principles of system dynamics. Udaipur:Agrotech Publishing Academy.
9. Barlas, Y. (1996). Formal aspects of model validity and validation in system dynamics. System Dynamics Review, 12, 183–210.
10. Bangladesh Bureau of Statistics. (2011). Statistical pocket Bangladesh – 2011. Dhaka: Statistics and Information Division, Ministry of Planning, Government of People's Republic of Bangladesh.
11. Bhuiyan, M.G.K. (2014). Milled rice value chain in Bangladesh (Unpublished PhD thesis). Bangladesh Agricultural University, Mymensingh, Bangladesh.
12. Bosona, T.G., & Gebresenbet, G. (2013). Cluster building and logistics network integration of local food supply chain. Biosystems Engineering, 108, 299–302.
13. Cachon, G.P., Randall, T., & Schmidt, G.M. 2007. In search of the bullwhip effect. Manufacturing & Service Operations Management, 9(4), 457–479.
14. Carter, C.R., & Easton, P.L. (2011). Sustainable supply chain management: Evolution and future directions.International Journal of Physical and Distribution Logistics Management, 141, 46–62.
15. Chen, F. (1998). Echelon reorder points, installation reorder points, and the value of centralized demand information. Management Science, 44(12), S221–S234.
16. Dabbane, F., Gay, P., Sacco, N. (2008a). Optimisation of fresh –food supply chains in uncertain environments, part I: Background and methodology. Biosystems Engineering, 99, 348–359.
17. Dabbane, F., Gay, P., & Sacco, N. (2008b). Optimisation of fresh food supply chains in uncertain environments, part II: A case study. Biosystems Engineering, 99, 360–371.
18. Davenport, T.H. (1993). Process innovation: Reengineering work through information technology. Boston, MA: Harvard Business School Press.
19. Fahey, L., & Randall, R.M. (1998). What is scenario learning? In L. Fahey & R.M. Randall (Eds.), Learning from the future:Competitive foresight scenarios (pp. 3–21). New York, NY: John Wiley & Sons.
20. Forrester, J.W. (1961). Industrial dynamics. Cambridge, MA: MIT Press.
21. Forrester, J.W. (1968). Principles of systems. Cambridge, MA: MIT Press.
22. Georgiadis, P., Vlachos, D., & Iakavou, E. (2005). A system dynamics modeling framework for the strategic supply chain management of food supply chains. Journal of Food Engineering, 70, 351–364.
23. Grant, J.W., Pedersen, E.W., & Marin, S.L. (1997). Ecology and natural resource management: System analysis and simulation. Reading: Addison-Wesley.
24. Hossain, M. (1988). Nature and impact of the green revolution in Bangladesh. The Journal of Developing Economics, 19(2), 49–166.
25. Hossain, M., Bose, M.L., & Mustafi, B.A.A. (2006). Adoption and productivity impact of modern rice varieties in Bangladesh. The Developing Economies, XLIV(2), 149–166.
26. Kpmaier, F, & Voigt, A. (2013). Pushing the limits – using system dynamics to forecast short-term commodity price movements [Internet]. Retrieved August 15, 2013.
27. Kumar, S., & Nigmatullin, A. (2011). A system dynamics analysis of food supply chains – case study with non-perishable products. Simulation Modeling Practice and Theory, 19, 2151–2168.

28. Lee, H.L, Padmanabhan, V., & Whang, S. (1997a). The bullwhip effect in supply chains. Sloan Management Review, 38(3), 93–102.
29. Lee, H.L., Padmanabhan, V., & Whang, S. (1997b). Informationmdistortion in a supply chain: The bullwhip effect. Management Science, 43(4), 546–558.
30. Manzini, R., & Accorsi, R. (2013). The new conceptual framework for food supply chain assessment. Journal of Food Engineering, 115, 251–263.
31. Meadows, D.L. (1970). Dynamics of commodity production cycles. Cambridge, MA: Wright Allen Press.
32. Minegishi, S., & Thiel, D. (2000). System dynamics modeling and simulation of a particular food supply chain. Simulation Modeling Practice and Theory, 8, 321–339.

REFERENCE

32. Minten, B., Murshid, K.A.S., & Reardon, T. (2013). Food quality changes and implications: Evidence from the rice value chain of Bangladesh. World. Development, 42, 100–113.
33. Moll, J. (2013). The bullwhip effect: Analysis of causes and remedies (master's thesis). VU University Amsterdam, The Netherlands. Downloaded by [Universite Laval] at 08:15 07 May 2016 INTERNATIONAL JOURNAL OF SYSTEMS SCIENCE: OPERATIONS & LOGISTICS 17
34. Muckstadt, J.A., & Sapra, A. (2010). Principles of inventory management. Heidelberg: Springer.
35. Nerlove, N. (1958). Adaptive expectations and cobweb phenomena. Quarterly Journal of Economics, 72, 227–240.
36. Prahalad, C.K, & Ramswamy, V. (2000). Co-opting customer competence. Harvard Business Review, 78(1), 79–87.
37. Riddals, C.E., Bennett, S., & Tipi, N.S. (2000). Modeling the dynamics of supply chains. International Journal of Systems Science, 31(8), 969–976.
38. Riggs, J.L. (1970). Production systems: Planning, analysis and control. New York, NY: John Wiley & Sons.
39. Sachan, A., Sahay, B.S., & Sharma, D. (2005). Developing
40. Indian grain supply chain cost model: A system dynamics
41. approach. International Journal of Productivity and Performance Management, 54(3), 187–205.
42. Selen, W., & Soliman, F. (2002). Operations in today's demand chain framework. Journal of Operations Management, 20(6), 667–673.
43. Seuring, S. (2013). A review of modeling approaches for sustainable supply chain management. Decision Support Systems, 54, 1513–1520.
44. Seuring, S., & Müller, M. (2008). From a literature review to
45. a conceptual framework for sustainable supply chain management. Journal of Clean Production, 16(15), 1699–1710.
46. Stephens, E.C., Nicholson, C.F., Brown, D.R., Parsons, D., Barrett, C.B., Lehmann, J., … Riha, S.J. (2013). Modeling the impact of natural resource-based poverty traps on l e food security in Kenya: The Crops, Livestock and Soils in Smallholder Economic Systems (CLASSES) model. Food Security, 4, 423–439.
47. Sterman, J.D. (1989). Modeling managerial behavior: Misperceptions of feedback in a dynamic decision making experiment. Management Science, 35(3), 321– 339.
48. Sterman, J.D. (2000). Business dynamics: Systems thinking and modeling for a complex world. New York, NY: Irwin McGraw Hill.
49. Teimoury, E., Nedaei, H., Ansari, S., & Sabbaghi, M. (2013). A multi-objective analysis for import quota policy making in a perishable fruit and vegetable supply chain: A system dynamics approach. Computers and Electronics in Agriculture, 93, 37–45.
50. Thomas, O. (2006). Understanding the term reference model in information systems research: History, literature analysis and explanation. In C.B.E. Al (Ed.), Satellite workshop of BPM 2005 (pp. 484–496). Nancy: Springer-Verlag.
51. Vanclay, J.K., & Skovsgaard, J.P. (1997). Evaluating forest growth models. Ecological Modeling, 98(1), 1–12.
52. Verdouwa, C.N., Beulensb, A.J.M., Trienekensc, J.H., & Wolferta, J. (2010). Process modelling in demand-driven supply chains: A reference model for the fruit industry. Computer and Electronics in Agriculture, 73, 174–187.
53. Vo, T.L.H., & Thiel, D. (2008, July 20–24). A system dynamics model of the chicken meat supply chain faced with bird flu. Proceedings of System Dynamics Conferences, VO153, Athens.
54. Vo, T.L.H., & Thiel, D. (2011). Economic simulation of poultry supply chain facing a sanitary crisis. British Food Journal, 113(8), 1011–1030.