Application of the Methodology Deflection in Humanitarian Logistics: A Supply approach from Agrifood Chains

Fernando Salazar
Business School
Universidad del Rosario
Calle 12C #6-25, Bogotá, Colombia
fsalazar.network.com@gmail.com

Jordi Poch
Departament de Informàtica, Matemàtica Aplicada i Estadística
Universitat de Girona
Plaça Sant Domènec 3, 17071, Girona, Catalunya, España
poch@imae.udg.edu

Judith Cavazos
Centro Interdisciplinario de Posgrado, Investigación y Consultoría
Universidad Popular Autónoma del Estado de Puebla-UPAEP
Calle 21 Sur #1103, Puebla, México
judith.cavazos@upaep.mx

Loecelia Ruvalcaba
Dirección de Investigación
Universidad Autónoma de Tamaulipas
Matamoros SN, Zona Centro, Ciudad Victoria, Tamaulipas, México
loece@yahoo.com

Abstract

Among the most difficult problems faced by humanity is the shortage of food and diets low in nutrients. Food production has increased in many countries; however, the number of people with major NBI (Unsatisfied Basic Needs) has increased due to rapid population growth and lack of an effective distribution of food; all this is that the food chain is more vulnerable to environmental pollution. As the world population increases, the population is pursued with increasing insistence by the image of the poor and hungry. Today there are over 1.4 billion people suffering from malnutrition and who are under the poverty line; including more than 200 million children under five. This article addresses this issue by addressing food security as paramount and testing a proposed methodology based on Mechanics of Materials that contributes to the process of decision making and make the chains more efficient supply and far-reaching in the food supply; For this it is necessary to clarify the issues involved in achieving them and help formulate and adopt appropriate policies and to reinforce based mainly on the establishment of the necessary measures to ensure access to sufficient and safe food measures, this chain of humanitarian logistics.

Keywords
Deflection, Logistics, Agrifood Chains, Humanitarian Logistics.

Introduction

The continuous expansion in the global production of biofuels, along with the production of food and consumption in developing countries represents a challenge for the planning of food policies and put in doubt whether the goals of sustainable development in a general sense might be reached or not (WCED, 1987). Achieving the 2015 Millennium Development Goals, adopted by the General Assembly of the United Nations in 2000 is the core fundament of world initiatives to increase the humanity welfare and equity (UN, 2007). Among these goals, reducing the population in malnutrition status and extreme poverty is priority; however, up to this date, there are no significant results towards the relief of poverty and starvation. There are different scores depending on the region: some countries in Asia, Pacific, Latin America and Caribbean have achieved results, but South Asia and sub-Sahara Africa are even getting negative results (FAO, 2005). The possibility to be achieved or not the goals of Millennium Development will be uncertain depending on the boom in the production of biofuels in the most poverty countries.

Humanitarian logistics, and its link to supply chain have recently got attention (Kovács and Spens, 2011). It comprises acts of God, as earthquakes, tsunamis, hurricanes, outbreaks, famine and other ones, and also deals with disasters caused by human beings, as terrorism attacks, violence, war, etc., or even combination of both issues (Kovács and Spens, 2009). Humanitarian logistics faces some huge challenges during the issues concerned to the efficient delivery of support and assistance in a safety way (Tzeng et al., 2007; Yi & Özdamar, 2007) and the preparation and fast response during disasters.

Impact of disasters cannot be considered uniform (tatham and Houghton, 2011). Preventing activities can be made in anticipation to some events (for example, hurricanes), but others cannot be predicted, like earthquakes (Regnier, 2008). Therefore, there are some significant differences among the rescue and humanitarian activities. Ludema (2000) proposes a classification of the immediate response to disasters, considering assistance to the most vital issues related to the restoration of the daily life.

In general, developing countries and most poverty communities are the most affected in case of disasters (Rodriguez, Vos, Belwo and Guha-Sapir, 2009). Considering this approach, famine and scarcity of food become one of the critical issues of humanitarian logistics and comprises the main analysis of this paper, starting in the agro chains, theirs development, activities, lands, destination, products and policies of the governments of those countries considered as more vulnerable. New agreements related to lands are not the investment in the agricultural sector that was expected by millions of people. Agro production volume is not enough to satisfy the demand of some internal markets; therefore, food dependency has increased, and there are risk of self-production of food and even sovereignty of some countries (Paz, 2013). Food safety implies that all people have both physical and economical access to enough, safety and nutritive food at all times, in order to satisfy their own requirements to achieve an active and healthy life. Most poverty people are those who suffer the most when there are problems in the competition for land (OXFAM, 2011).

Global investments represent a critical issue in the development and reduction of poverty. Under a responsible management and suitable regulations, job creation and better life, services and infrastructure can be achieved. However, historical data related to investments in lands shows that pressure on land, a natural resources on which food security of millions of poverty people depends on, is rising under risk (ILC, 2011). According to Ericksen (2007), most critical issues related to food security are related to food systems, comprising economic, environmental and social problems. Although income is the main factor to get the status of food security, logistics challenges must also be considered (Balcik et al., 2010).

The focus of this research is to show that logistics plays a key role to satisfaction of people basic needs, focused on the strength of agro food chains which support the reduction of extreme poverty and, therefore, the survival of a global society, under a sustainable approach.

Literature Review

Humanitarian logistics and food safety

The food systems and its related safety on the XXI century are facing social and economic changes; increases in food production, transformation and processing of food; retail distribution and a greater number of urban consumers

(Ericksen, 2007). However, some challenges must also be faced. International prices of some food have increased dramatically on recent years, especially on those basic products like wheat, rice, corn and dairy. A better comprehension about the global agriculture challenges is also needed, including the effects of global warming, oil prices, financial speculation and government policies over it (Conceicão and Mendoza, 2009). Finally, supply chain management related to agro chains and its relationship to food production and distribution must also be considered.

There are a lot of issues affecting the food production in some domestic markets, mostly related to poverty and lack of equal opportunities. Some of them are: low agricultural production, lack of infrastructure, environmental problems and problems in the markets (Conceicão and Mendoza, 2009). Nitzan, Ophir and Amede (2001) evaluate the food security through the availability of safety and nutritive food, the accessibility to enough resources (physical and economic access, social and demographic issues affecting the ability to get food) and how to adjust diet requirements, hygiene practices, water and sanitation. Each case is unique, because location, type of disaster and its size are different (Alp and buyurgan, 2011); therefore, quantity, quality, logistics and segmentation are critical issues on every process of food intervention.

A food system can be considered as a chain of activities related to produce for human consumption, with a special focus on transformation and trade, involving multiple players (Heller and Keolejan, 2003; Lang and Heasman, 2004). Humanitarian logistics considers that food must reach the poorest people in a timely matter. Therefore, some issues related to food are required: preparation, planning, evaluation, movement, transportation, warehousing and distribution (Ozbay and Ozguyem, 2007). Humanitarian supply chains are generally supply chains with a non-profit approach, which coordinate assistantship by providing food, water, medicines, shelter and other supplies required by people under food risk (Beamon and Balcik, 2008).

Coordination in the humanitarian supply chains involves the ability to face the uncertainty, but also offering immediate response and “pushing” the supplies to the location where crisis is under way, in order to prepare reconstruction activities and a strategic inventory to be distributed through a suitable logistics to satisfy the most critical requirements (Kovacs and Spens, 2007). According to Mohan, Gopalakrishnan and Mizzi (2011), humanitarian supply chains can be classified in one of two categories: prepared and ready or, in collaboration with agencies in charge to response to crisis.

Agro-industrial and productive chains comprises a network of firms performing activities related to material supply, transformation to intermediate or finished products and the distribution of these products to the consumers (Calderón and Lario, 2005).

These chains cannot be described by just one lineal-sequence; the product does not follow a direct line between the producer and the final consumer, and some movements among players can occur, making the modeling of the chain a more complex issue. Figure 1 (Stadtler, 2005) shows an example of a productive chain, where the producer attends the wholesaler and the industry in a direct manner, but the retailer receives fresh products from the producer and processed food from the agro-food industry.

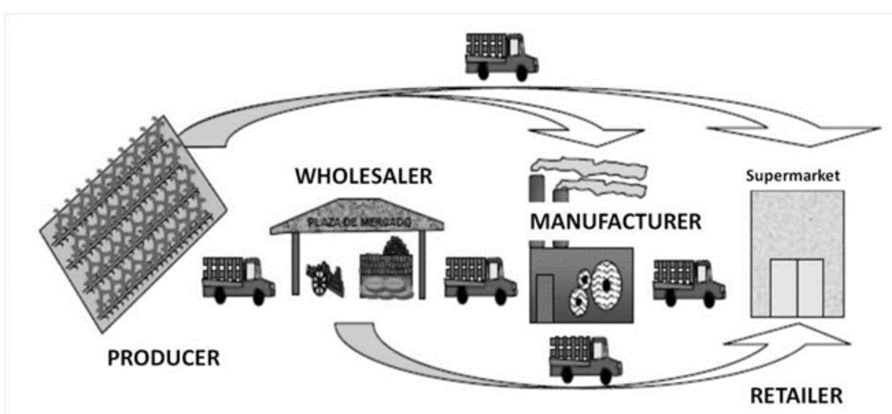

Fig. 1. Agroindustrial Production Chain

This sequence might be different according to the products, thus making independent models for each one (even for the same crop in different regions), and validation must be made by experts in both the crop and the industry. Furthermore, properties of the chains differs according to the type of crops, both perishable and non-perishable (Parfitt, Barthel and Macnaughton, 2010).

The inherent complexity within an agro-industrial supply chain makes necessary to simplify each link, mainly by using summarizing variables, for example, a high performance production per hectare might be explained by technological conditions, equipment, tools, suitable handling of product in the post-crop activities, and environmental issues.
The proposed methodology to evaluate the agro-industrial chains involves four stages (Von Lampe, 2006): Design of the global network; definition of players; construction of the detailed network and design and analysis of some scenarios (Figure 2). This methodology is focused on the validation and verification of the chain, as well as its sensitivity analysis.

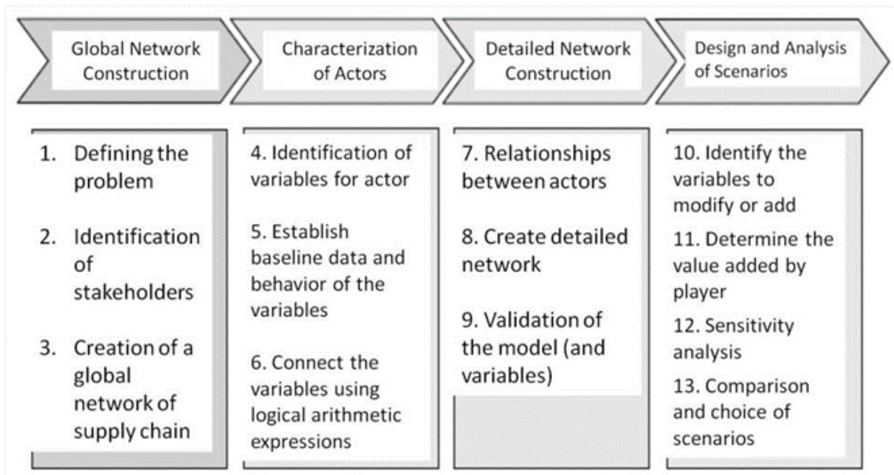

Fig. 2. Definition Methodology for Supply Chain Using Dynamic Networks

The process to take food to people in vulnerable conditions requires optimized agro-food chains. It is well known that almost half of every produced food is wasted before or after reaching the consumers (Lundqvist et al., 2008), thus a better use of the resources within the supply chain are required, including the development of strategies to reduce food to become scrap (Charles et al., 2010).

Parfitt et al. (2010) claim that the main causes of waste in the food chain are: 1) problems in harvest and handling of crops, affecting the quality of food; 2) losses due to bad thresh; 3) scrap of food mainly caused by bad transportation and distribution; 4) shrinkage during warehousing affected by plagues or pollution; 5) losses during the process, packaging and labeled, even threat or rodents; 6) inappropriate handling and transportation of the product; 7) lack of refrigeration and store of the product; 8) education level of the consumer and post-consumer; 9) storage and handling of the product at home; 10) bad techniques in preparing and cooking the food; 11) removing dregs of cattle and poultry and its mix with other waste.

Moreover, the development of these chains might be blocked by some constraints: internal market, shortage of natural resources, high level of imports related to food and oil: lack of economy of scale and vulnerabilities to acts of God (Briguglio, 2003; Angelucci & Conforti, 2010). Other factors affecting are the loss of agriculture lands due to non-sustainable issues (urban growth, erosion, etc.) and the development of the first generation of bio-fuels, which also lead to competitive problems. Therefore, around 70 to 100% of extra food will have to be produced in the same or even lower amount of lands in year 2050, also facing external conditions related to environmental concern, water shortage, pollution and deterioration of soils, loss of biodiversity and the extreme urgent requirement of a sustainable focus under a scientific, engineering and economic approach, modifying the typical agriculture practices and its infrastructure (Charles et al., 2010) within the supply chain (for example, water storage in case of drought or salinity, transportation networks, quality of produced food, etc.).

Experimental Design

Considering the challenges and opportunities within the Humanitarian Logistics and Agroindustrial chains, there are a lot of issues that any organization focused on responses to disaster must face, even considering that there are differences between commercial supply chains and humanitarian ones. Tatham and Pettit (2010) propose that both chains are facing common challenges, thus some successful practices in the commercial environment might be also useful and efficient in the humanitarian scope. Nevertheless, Olorotunba and Gray (2002) claim that considering the own characteristics of the humanitarian help, a direct transfer of logistic issues from the commercial environment might represent a problem, especially because the final consumers are not a component of a common commercial transaction and the final delivery occurs on counties facing serious drawbacks on infrastructure. Gattoma (2006) consider that military and humanitarian logistics are similar, because they both require highly flexible supply chains and involvement from the government (Olorotunba & Gray, 2002).

Most humanitarian organizations coordinate their operations; nevertheless, the most important challenge might be the efficient use of scarce resources (Kovacs & Spens, 2009) and the agility of supply chains under emergency conditions and high stress (Pettit & Beresford, 2009). The United nations Logistics Clusters [UNLCs] has its own platform to centralize information and coordinate the local or foreign purchasing of supplies, generating a close relation among the elements of the response system in order to guarantee coherence and coordination both intra and inter organizations to manage the supply chain (Richey et al., 2010). One example: considering the World Food Program of the UNO, the logistic system is focused on fixing the logistic drawbacks and bottlenecks of the distribution network, also supporting data collection and their distribution among the members of the program, in order to optimize the logistic decisions and coordination of transportation and delivery of supplies (Tatham & Pettit, 2010).

Investments on preparing and responding to the humanitarian events is directly related to the future benefits; for example, an immediate response to the malnutrition of Niger children would have cost around US$1 per day; however, the late actions to support these children until 2005 had a cost of US$80 per day (Meikle & Rubin, 2008). Improving the efficiency of supply chains minimizes the uncertainty, therefore, it is important the integration of all operations within the chain. Strategic planning is suggested to be used, because the lack of strategy reduces the chances that government and agencies achieve an effective network that can respond to the emergencies. Pettit and Beresford (2009) claims that all planning must consider information requirements, coordination, collaboration, capacity mapping, volumes, time and management of a push inventory system, elements that should be useful in the coordination and flow control of the foods within the supply chain. Some relevant aspects to be considered within the process of integrating the agro chain are:

Inventories: the inventory management is different from the commercial supply chain mainly in the value given to the time and fast response, the delivery and the ability to produce, purchase, transport and receive all supplies in the places where the humanitarian support is needed. The response must be supported by a specific infrastructure in strategic locations (Pettit and Beresford, 2009); (ii) Transportation: in the face of any humanitarian emergency, a weak infrastructure might be a problem, thus any available resource must be used (Kovas & Spens, 2009). When transportation capacity is not enough, third-party might be used, even considering local distribution networks, animals, ships or any other available option (Beresford et al., 2002); (iii) Technology: mainly used to manage the available information to speed up the efficient response of all the members of the chain in an unified way, connecting all the players through activities required during the crisis (Pettit and Beresford, 2009); (iv) Chain optimization: flexibility is needed to respond to any unexpected situation; waste reduction, agility in the supply chain cycle and delivery of products must be also optimized. Pettit and Beresford (200) suggest that extra capacity is required in order to react under the changing scenarios facing during a crisis, minimizing the inventories through the supply chain and maintaining agility during all operations.

The Model

The analysis of the methodology proposed in this paper, which is the formulation of a method based on the Mechanics of Materials (Strength of Materials), Physics Mechanical area is now made. This area is a song called "Beam Deflection by Integration", whose analysis leads to measure the capacity of the beams to withstand various types of loads depending on the material from which they are constructed and the geometric shape of it.

Applying these concepts and making appropriate to the field of translation, optimization, and identifying the key variables may play different types of analyzes made for processes in terms of the Supply Chain and Value Chain companies or processes, framed in these concepts that will help them in identifying possible weak links in the chain:

Scheduling production lines, re-allocate production capacity, making outsourcing decisions on production lines or products, modify or adjust planning, monitoring, controlling and evaluating the implementation, improve forecasts, analyze the frequency of orders, analyze inventory costs , profit margins, see market trends and analyze production strategies or the organization as a whole (McNulty, 2005); and thus be able to propose solutions and make decisions that allow the improvement and strengthening of supply chains, logistics as an interesting tool to manage, implement and further research, which will be validated since its inception in Humanitarian Logistics for Agrifood Chains from Latin America as entire region.

In this way and from the specific field of mechanical physical, deformations that this limit no tension as well for safety reasons, maintenance or merely aesthetic. Thus, in most cases, structural elements are measured apart from resistance, limiting maximum tension and RIGIDITY, avoiding that maximum strain exceeds certain acceptable values. In different normatives, acceptable values are defined for several structural elements. Studying the strain of a beam, turns made by the transversal sections around the axis are calculated (qz, qy), along with the displacements or arrows from their gravity point (y,z) (Figure 3).

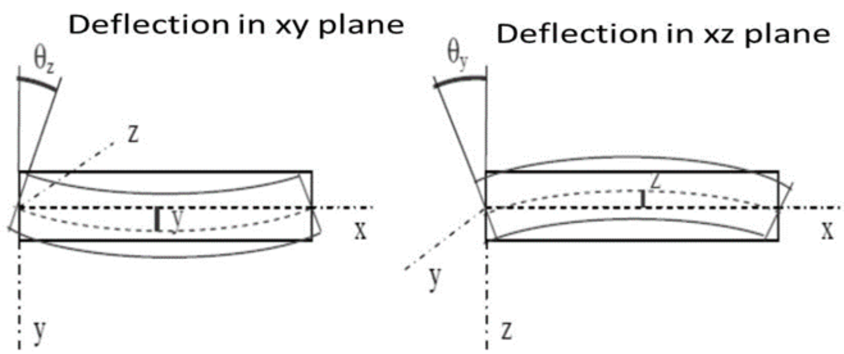

Fig. 3. Flexion in planes xy and xz plane. (Mott 1998).

The method to be used to calculate the strain is based on the Differential Equation of the Elastic Line Method. A beam is considered under simple tension (Figure 4).

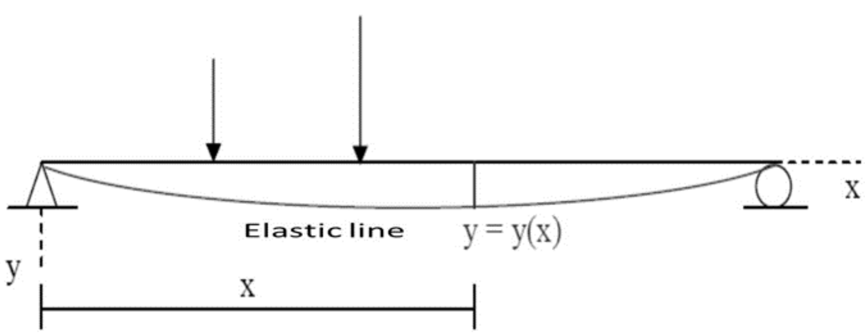

Fig. 4. Deflection and elastic line (Hibbeler, 1995).

The elastic line is "the x axis of the beam (crossing the gravity points of every transversal section) once it is distorted". Then, the equation y=y(x) must be calculated, because this one rules the elastic curve. The product EI is known as the stiffness to the flexion and if it oscillates along the beam, like in the case of a beam of variable section, it must be expressed as a function of "x" before integrating the equation. However, for a prismatic beam, stiffness to flexion is constant, then, using integral:

First integral to calculate the angle or slope or the tangent line to the elastic curve (1)

$$EI\theta \approx EI\frac{dy}{dx} = \int_0^x M(x)dx + C1 \quad (1)$$

Second integral to calculate the arrow or deflection of the beam in a specific point (2)

$$EIy = \int_0^x dx \int_0^x M(x)dx + C1\,x + C2 \quad (2)$$

The constants C1 and C2 are determined from the boundary conditions, ie the conditions imposed on the beam for their support. For three types of beams: Beam simply supported, beam with a section cantilever and cantilever (figure 5).

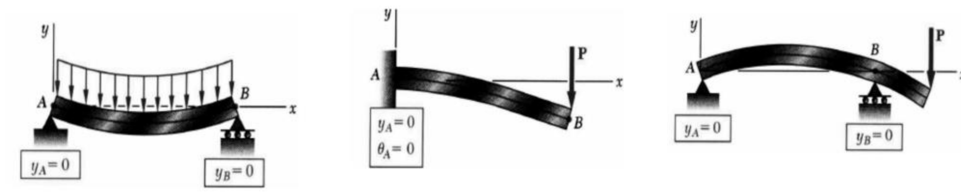

Fig. 5. Beam simply supported, beam with a section cantilever and cantilever (Beer, 1998).

In the previous study that has been done, the analysis of the supply chain will be developed to determine the values represented by the constant E (Modulus of Elasticity) for links in the chain, and are typical of the material are showing ability to absorb forces or stimuli from the external environment. Constant I, which depends on the beam geometry and comes to represent the size of the process, supply chain or business model (Figure 6).

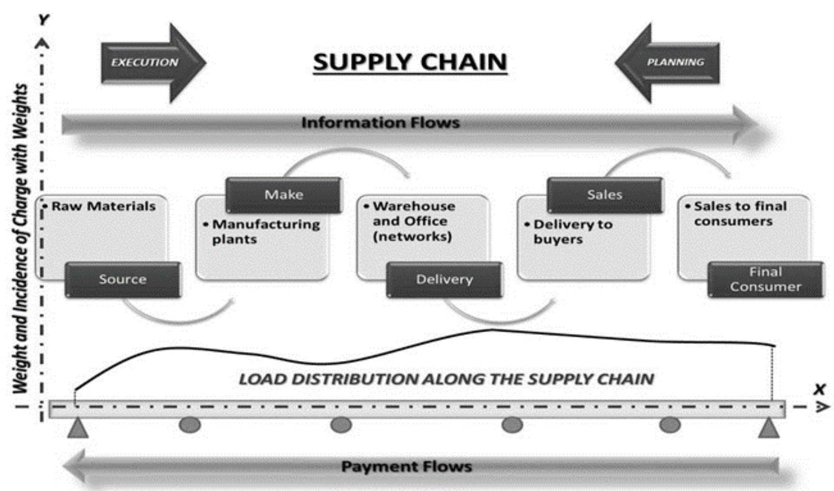

Fig. 6. Weights for analysis of the deflection curve in the Supply Chain.

In the figure, x-axis represents each element of the supply chain. The y-axis is representing the strength of the load or forces affecting the system, in terms of specific weight under the areas or parts or the chain, which can be raw material costs, labor, maintenance, production, subassemblies, third-party production, transportation, distribution, all logistics both in and out the system.

These weights, according to each company or process definition affecting its own supply chain, will make the system to experience a deflection in certain critical points, depending of the size and response of the company.

Once these points or links within the chain are identified (Figure 7), strategic plans might be defined to allow the analysis and effective decisions making process, also solving the problems or possible issues in the future.

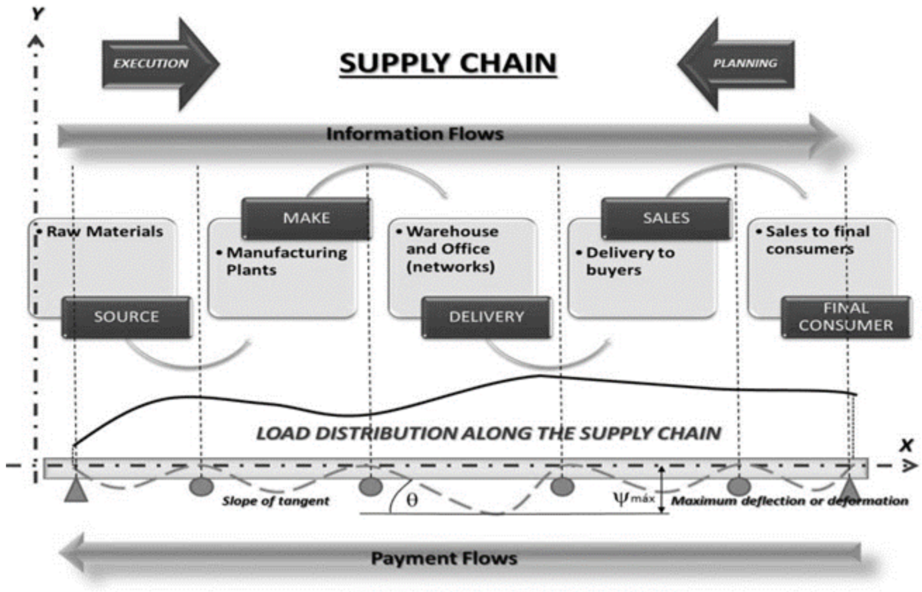

Fig 7. Deflection curve in the Supply Chain.

It depends on the supply chain model, the determination of the specific weights of the forces acting on it, own components supply chain and strong or weak before them, which define the type of curves remaining defined or mapped for later analysis.

Results

This research should provide results after identifying the application of a model based on Deflection by Integration in the analysis of making decisions for humanitarian logistics, focused on agro food chains.

There are some approaches to manage the supply chain; one of these ones is based on the relationship among the business processes among the firms (Ellram and Cooper, 1993). Other approach considers the supply chain as a 3D model, providing fast and efficient multidimensional analysis; this is the so called “Business Intelligence”. However, this last approach must be supported by suitable structures and analytical tools allowing easy and instant access to data (Vitt et al., 2003). Data on multidimensional analysis are typically considered as a cube-storage, composed by mini-cubes or cells, where the main cube, representing the “whole”, is a holistic system.

Conclusions

The literature review detected the following challenges and opportunities faced by the agroindustry and humanitarian chains:

The main challenge is serving as a key detonator in minimizing the import of food to satisfy the domestic demand towards a food self-production, stimulating the integration of all chains fulfilling the requirements to guarantee food safety: sufficiency, security and nutrition. There are also challenges in optimizing the hydraulic systems and the development of risk-management systems focused on agro and ecology issues, the definition and planning of agricultural and forest borders and, finally, the integration of biotechnology and genetic engineering.

Among all the opportunities, some relevant ones are the possibility to exploit all irrigation land available; the integration of women into agricultural issues; usage of both formal and informal commercial systems; value creation of primary sector; reduction of inequality through the integration of small producers into a sustainable agricultural system; the balance between energy and food requirements into the environment and, finally, the development of sustainable public policies.

The main contribution of this methodology presented is to think about the possibility of validating a new way to make the chains more agile, Supply and evolved to meet the needs of the most vulnerable population from food safety, food quality and may lead in time and fair prices can be achieved by these communities commodity of the basket in each country in Latin America, from an application of the Humanitarian Logistics.

References

Alp, M., Byurgan, N. (2011). An aution-based framework for resource allocation in disaster relief. Journal of Humanitarian Logistics and Supply Chain Management, 1(2), 170-188.

Angelucci, F.; Conforti, P. (2010). Risk management and finance along value chains of Small Island Developing States. Evidence from the Caribbean and the Pacific. Food Policy, 35, 565-575.

Balcik, B., Beamon, B.M., Krejci, C.C., Muramatsu, K.M., Ramirez, M. (2010). Coordination in humanitarian relief chains: practices, challenges and opportunities. International Journal of Production Economics, 126 (1), 22-34.

Beamon, B.M., Balcik, B. (2008).Performance measurement in humanitarian supply chains. International Journal of Public Sector Management 21 (1), 4-25.

Beer, F.P, Johnston, (1998). Mecánica de Materiales. México. Mc. Graw Hill, 347 p.

Beresford, A.K.C., Jennings, E. & Pettit, S.J. (2002). Emergency relief logistics: a disaster response model. Proceedings of the 7th Logistics Research Network Conference, Birmingham.

Briguglio, L. (2003). The vulnerability index and Small Island Developing States. A review of conceptual and methodological issues. Working Paper, University of Malta.

Calderón J, y Lario E. (2005). Análisis del Modelo SCOR para la Gestión de la Cadena de Suministro. 9 Congreso de Ingeniería de Organización. Gijón Sep. 2005.

Charles, H., Godffray, J., Beddington, J.R., Crute, R.I., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thoman, S.M., Toulmin, C. (2010). Food Security: The challenge of feeding 9 Billion People. Science 327, 812-818.

Conceição, P.; & Mendoza, R.U. (2009). Anatomy of the Global Food Crisis. Third World Quarterly, 30(6),1159-1182.

Ellram, Lisa M. and Martha C. Cooper (1993), “The Relationship between Supply Chain Management and Keiretsu,” The International Journal of Logistics Management, Vol. 4, No.1, pp. 1-12.

Ericksen, P.J. (2007). Conceptualizing food systems for global environmental change research. Global Environmental Change, 18(1), 234-245.

FAO, note 1 above; and A. Deaton and V. Kozel, (2005). “Data and Dogma: The Great Indian Poverty Debate,” The World Bank Research Observer 20, no. 2: 177-199.

Gattorna, J. (2006). Living Supply Chains. Harlow: Financial Times Prentice Hall.

Heller, M.C., Keoleian, G.A. (2003). Assessing the sustainability of the US food system: a life cycle perspective. Agricultural Systems 76, 1007-1041.

Hibbeler, R.C., (1995). Mecánica de Materiales. México. Prentice Hall, 610 p.

ILC/CIRAD, (2011) Informe de síntesis en publicación acerca del Proyecto de Investigación sobre Presiones Comerciales sobre la Tierra. (Cirad), el Centre for Development and Environment (CDE) at University of Bern, GIGA de la Universidad de Hamburgo.

Kovács, G., & Spens, K. (2009). Identifying challenges in humanitarian logistics. International Journal of Pshysical Distribution & Logistics Management. 39(6), 506-528.

Kovács, G., & Spens, K. (2011). Humanitatian logistics and supply chain management: the start of a new journal. Journal of Humanitarian Logistics and Supply Chain Management. 1(1), 5-14.

Lang, T., & Heasman, M. (2004). Food Wars: The Global Battle for Mouths, Minds and Markets. London: Earthscan.

Ludema, M.W. (2000), Military and civil logistic support of humanitarian relief operations, in Arnold, E. and Walden, D. (Eds), A Decade of Progress – A New Century of Opportunity, Proceedings of the 10th Annual International Symposium of the International Council on Systems Engineering, INCOSA, Minneapolis, MN, 143-150.

Lundqvist J., de Fraiture C., & Molden D. (2008). Saving water: from field to fork—curbing losses and wastage in the food chain. En SIWI Policy Brief. Stockholm, Sweden: SIWI.

McNulty, Eric., (2005). “Justo a tiempo para navidad”, El caso HBR, pp. 29-36

Meikle, A., & Rubin, V. (2008). Living on the Edge of Emergency. CARE International, Desde: http://www.careinternational.org.uk/lote/resources/Living-on-the-Edge-Paying-the-price-of-inaction.pdf

Mohan, S., Gopalakrishnan, M., Mizzi, P.J. (2011). Improving the efficiency of a non-profit supply chain for the food insecure. International Journal Production Economics, 134(2), 322-332.
Mott, R.L., (1998). Resistencia de Materiales Aplicada. México. Prentice Hall, 400 p.
Nitzan, D., Phir, E, & Amede, T. (2001), Food security and nutrition –the Ethiopian case for action. Public Health Nutrition, 5(3), 373-381.
Olorotunba, R., & Gray, R. (2002). Logistics for humanitarian aid: a survey of aid organisations. Proceedings of the 7th logistics Research Network Conference, September, Brimingham.
Ozbay, K., Ozguven, E.E. (2007). A stochastic humanitarian inventory control model for disaster planning. En: Proceedings of 86th Annual Meeting. Transportation Research Board. Washington, D.C.
OXFAM. (2011). Tierra y Poder: El creciente escándalo en torno a una nueva oleada de inversiones en tierras. Oxford, OX4 2JY, Reino Unido, Septiembre de 2011.
Parfitt, J. Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. Philos Trans R Soc Lond B Biol Sci., 365(1554), 3065-3081.
Paz, F. (2013). Indispensable una nueva política de desarrollo agropecuario. Revista Emprendedores, 139, enero-febrero, 19-24.
Pettit, S., & Beresford, A. (2009). Critical success factors in the context of humanitarian aid supply chains. International Journal of Physical Distribution & Logistics Management, 39 (6), 450-468.
Regnier, E. (2008). Doing something about the weather. Omega, 36 (1), 22-32.
Richey, R. G., Roath, A. S., Whipple, J. M., & Fawcett, S. E. (2010). Exploring a governance theory of supply chain management: barriers and facilitators to integration. Journal of Business Logistics, 31(1), 237-256.
Rodriguez, J., Vos, F., Belwo, R. and Guha-Sapir, D. (2009), Annual Disaster Statistical Review 2008: The Numbers and Trends, Centre for Research on the Epidemiology of Disasters (CRED), Louvain. Desde: www.cred.be/sites/default/files/ADSR_2008.pdf
Tatham, P, H., & Pettit, S. (2010). Transforming humanitarian logistics: the journey to supply network management. International Journal of Physical Distribution & Logistics Management, 40(8/9), 609-622.
Tatham, P., & Houghton, L. (2011). The wicked problem of humanitarian logistics and disaster relief aid. Journal of Humanitarian Logistics and Supply Chain Management, 1 (1), 15-31.
Tzeng, G.-H., Cheng, H.J. & Huang, T.D. (2007), Multi-objective optimal planning for designing relief delivery systems, Transportation Research, 43 (6),673-686.
United Nations (UN) Millennium Development Goals. Desde: http://www.un.org/millenniumgoals/
Vitt, E., Luckevich, M., Mismer, S., (2003); "Business Intelligence, Técnicas De Análisis Para La Toma De Decisiones Estratégicas"; 1ª edición; McGraw-Hill/Interamericana; ISBN: 8448139208. ISBN-13: 9788448139209, 25-34 pp.
Von Lampe, M. (2006). Agricultural market impacts of future growth in the production of biofuels. OCDE Report AGR/CA/APM (2005) 24/FINAL, 01/02/2006.
WCED, (1987). The broad definition of sustainable development from the World Commission on Environment and Development (WCED) is: "Humanity's ability to meet the needs of the present without compromising the ability of future generations to meet their own needs." See WCED, Our Common Future (New York: Oxford University. Press, 1987), 8.
Yi, W., & Özdamar, L. (2007), A dynamic logistics coordination model for evacuation and support in disaster response activities. European Journal of Operational Research, 179, 1177-1193.

Biography

Fernando Salazar Arrieta is a Colombian PhD. in Logistics and Supply Chain Management(2011) UPAEP, Puebla, Mexico, CONACyT as fellow Mexican federal government; Master in Strategic Planning and Management of Technology (2008) UPAEP, Puebla, Mexico; Mechanical Engineer (1995) of the INCCA University of Colombia. With capacity and experience for the planning, organization and management. Ability to establish interpersonal relationships, possessing relational capital, teamwork, leadership, problem solving and information management. Currently Research Professor at the University of Rosario (Colegio Mayor de Nuestra Señora del Rosario) in Bogotá, Colombia; he has been Director of the Department of Science and Engineering at the University Iberoamericana-Puebla, Mexico; Director of Industrial Automation Technology Center-CTAI in the Pontificia Universidad Javeriana in Bogotá, Colombia; Professor and Chair of the New Granada Military University, Technological University and School District Central Technical Institute. He has worked for companies such as SIEMENS S.A.; DISTRAL SA (Manager Logistics purchases of materials for construction of Thermo-Barranquilla). Construcel-and Metallurgical Division in Bogotá, Colombia.

Jordi Poch Garcia, is an Associate Professor of the Department of Applied Mathematics Department of Computer Science, Applied Mathematics and Statistics at the University of Girona. Member of the research group Graphics & Imaging Laboratory (GILAB) integrated in the Institute of Informatics and Applications (IIIA). Degree in Mathematics from the Autonomous University of Barcelona (1983) and PhD in Mathematics from the Polytechnic University of Catalonia, Spain (1996). The main lines of research are: (1) Mathematical modeling of adsorption processes in biomaterials and (2) The development and application of ICT tools to support teaching. Responsible for the team and project development ACME awarded the Jaume Vicenç Vives Award for university teaching quality awarded by the Generalitat de Catalunya (2005). Member of scientific committees of various conferences: International Congress of University Teaching and Innovation (CIDUI) 2006, 2008, 2010 and 2012. American Congress of Applied Computing Process Industry (CAIP) 2005, 2011 and 2013. Member of the committee organizer of the 9th European Meeting on Environmental Chemistry. Girona 3 to 6 December 2008 and head of the organizing committee of the 10th Inter-American Congress of Applied Computing Process Industry, CAIP 2011.

Judith Cavazos Arroyo is a fulltime professor in the Interdisciplinary Postgraduate Center in Universidad Popular Autónoma del Estado de Puebla-México. Professor Cavazos holds a Bachelor in Business, an MBA and a PhD. in Marketing. Her research interests include Social Marketing, Humanitarian Logistics and Innovation. She has published journal and conference papers.

Ma. Loecelia Guadalupe Ruvalcaba Sánchez is Research-professor of Research Management in the Autonomous University of Tamaulipas (UAT), she received his Bachelor in Informatics and Master of Science Degrees in Industrial Engineering from Technology Institute of Aguascalientes, and the Ph.D. in Logistics and Supply Chain Management at UPAEP university in Puebla, Mexico. She has published journal and conference papers. Her research interests include software engineering, discrete simulation, computational optimization and algorithms of approximation for logistics, supply chain and industrial problems and statistics methods.