J. ISSAAS Vol. 24, No. 2: 93-104 (2018)

INTEGRATING CLIMATE CHANGE HAZARD ANALYSIS INTO VALUE CHAIN ANALYSIS: ELEVATING EVIDENCES IN FISHERIES INTO PRACTICE

Salvador P. Catelo[1] and Paul Joseph B. Ramirez[2]
[1]Department of Agricultural and Applied Economics
[2]Department of Economics
College of Economics and Management, University of the Philippines Los Baños
Los Baños, Laguna, Philippines
Corresponding author: spcatelo@up.edu.ph

(Received: August 19, 2018; Accepted: November 22, 2018)

ABSTRACT

This paper offers an alternative method of estimating the economic impacts of climate change hazards on individual players and on the entire value chain using primary data that were collected in the months of 2017 from affected tilapia value chain in Pampanga and siganid value chain in Pangasinan. The paper (1) identifies the main features of a fisheries value chain under a climate change hazard scenario, (2) builds a consistent value chain accounting framework, (3) reflects the changes in operation and corresponding value addition arising from the adaptive strategic measures, and (4) assesses the net income accruing to individual players or groups. Direct and indirect effects, and defensive expenditures, were also calculated. Reduced production because of temperature rise was felt by tilapia hatchery operators (46%) and pond operators (32%) while broker-traders experienced 14% reduction in volume bought from growers inside the chain and had to outsource 21% to meet the requirement of wholesalers. For siganid fishers, Typhoon Lando caused a 2.5% reduction in the selling price, a 34% reduction in volume (about PHP 1,340 per fisherman), and additional defensive expenditure of PHP 3,461. Due to the cascading effects of lower catch, the wholesale and retail segments of the siganid value chain suffered an indirect cost of PHP 189,000 and PHP 43,350, respectively, as well as an incremental marketing cost for wholesale (PHP 2.68/kg) and retail (PHP 1.08/kg).

Key words: direct and indirect effects, defensive expenditures, *Oreochromis niloticus* L., *Siganus canaliculatus*

INTRODUCTION

The Philippine fisheries sector has always been a pillar of growth for the country because of its high dependence on both the capture and aquaculture fishery sub-industries to provide employment, generate income, enable trade, and achieve food security (DA-BAR 2016). However, the potential in the fisheries sector has been dwindling and the opportunities are becoming much more difficult to access due to the intensifying impacts of climate change hazards. Climate change is any variation in the average daily weather pattern over an extended period (typically decades or longer) due either to natural variability or because of human activity (Easterling et al. 2007; IPCC 2007).

Many experts and scientists argue that the area and structural complexity of the coral reefs, sea grasses, and mangroves that provide shelter and food for many coastal fish species are altered by rising water temperature, acidification of the ocean, more intense cyclones, changes in sedimentation from new patterns of rainfall, and rising sea levels (Poloczanska et al. 2007; Thresher et al. 2007; Sheaves and Johnston 2008; Bell et al. 2010; Shelton 2014). Climate change hazards can mediate fish production through effects on reproductive success, recruitment processes, and survival and growth of target species and/or their prey. These effects occur both directly and indirectly due to the inherent sensitivities of marine organisms to changing environmental conditions, and influence of climate change on the habitats that support fish or the pathogens that can control their abundance (Brander 2007; Munday et al. 2008). Filipino fishers, in particular, are seen to be directly and severely affected since their livelihoods highly depend on resources that rely on a stable climate. They are more prone to climate change impacts because they are less equipped to adapt to climate-related disasters and weather variations. What makes the situation even more challenging is the fact that fishers' vulnerability to the negative effects of climate change hazards cascades to other players in the value chain. This brings to fore the importance of determining the indirect effects of and response to climate change hazard of every chain player as well as the impact of climate change hazard on the entire value chain.

Meanwhile, input sourcing, production, post-production, and trading involve decisions that deal with actual and what-if scenarios that have direct and/or indirect consequences on economic efficiency. While a breadth of factors along the interrelated segments of the chain already makes the situation complex, the groundwork for decision making becomes even more intricate when climate change hazards exist. The expectation of the adverse effects has changed players' perception and strategy on how to manage their business for viability, stability, and sustainability. In turn, response to climate change hazards and their impacts make it imperative to integrate them in the analysis, suggesting the need for analytics to better understand the situation in order to reduce economic losses.

The impact of policy instruments, promulgated to incentivize the adoption of measures against vulnerability to climate change hazards, can be delineated on a larger scale if the economic implications are clearly presented. An assessment of the adaptive measures of vulnerability to climate change hazards, especially when taken from the lens of a complete lifecycle of a value chain, is important. In the past, the identification of adaptive measures is usually done. The assessment of costs and benefits using the value chain accounting framework, however, has yet to be firmed up and formalized.

The concept of the 'value chain', which was introduced by Porter (1985), enables the analysis of the internal relationships involved in creating more value for a firm's customers leading to competitive advantage. Breaking down the various segments in the chain allows for opportunities to create value added. Faße et al. (2009) found that research conducted on value chains usually consists of six stages. Known as 'vertical' value chain, the stages are input supply, production, processing, marketing, consumption, and recycling.

In the Philippines, value chain analysis (VCA) is better understood now compared to two decades ago when it first emerged as an instrument to analyze the fusion of disconnected chains and economic activities. VCA has become a common tool of analysis in many commodity studies in the Philippines (Brown et al. 2010; Van Duijn et al. 2012; DA-PRDP 2014; Dargantes et al. 2016; Romero 2017; Lantican et al. 2017; Israel and Bunao 2017). In general, the VCA framework was used to: (1) provide an overview and analysis of the different industries; (2) identify, assess, and enhance the relevant roles of players in the chain to improve competitiveness; (3) promote development in a pro-poor and sustainable manner; and (4) provide the basis for the formulation of future development plans. In the Science, Technology, Research, and Innovation for Development (STRIDE) Program, the VCA used the Duke CGGC's Global Value Chain (GVC) framework to examine the Philippines' position in the global coffee, mango, and cocoa industries and identify opportunities for upgrading these sectors (Bamber et al. 2017; Hamrick et al. 2017; Fernandez-Stark et al. 2017). The use of the GVC emphasized the importance of international linkages to create forward and backward linkages to compensate for the narrow base of domestic knowledge.

Incorporating climate change and its economic implications along the stages of the value chain, however, is not yet a conventional part of conducting VCA. To date, there are no other publications which explicitly looked at the method of VCA with climate change hazard analysis (CCHA) as a component. This paper aims to close this gap in the literature by sharing the framework and method used in the DA-BAR–Worldfish Philippines collaborative study on Climate Change Impacts on Tilapia and Siganid Value Chains in Vulnerable Regions in Luzon, Philippines (2018). This paper sought to present a framework and demonstrate a method that integrates CCHA into VCA.

MATERIALS AND METHODS

Value chain is defined as the "full range of activities required to bring a product or service from conception through different phases of production (involving a combination of physical transformation and the input of various producer services), to the delivery to final consumers, and the final disposal after use" (Kaplinsky and Morris 2002; Hellin and Meijer 2006). Climate change hazards, in more ways than one, alter the activities and costs of the economic agents, affecting their income and value added in the value chain. In this study, the economic agent is the value chain player who takes an active role in the inputs and services, production, transformation, and trading and who has ownership of the tradeable inputs or outputs.

This study made use of data from the completed DA-BAR–Worldfish Philippines collaborative study on Climate Change Impacts on Value Chains of Tilapia and Siganid in Vulnerable Regions in Luzon, Philippines (2018). The tilapia (*Oreochromis niloticus* L.) embodies the case of aquaculture, which is a fast-expanding fisheries industry in the Philippines. Siganid or rabbitfish (*Siganus canaliculatus*), on the other hand, represents the catch fisheries. Central in the study was the estimation of value addition, which is the difference between the sale at each stage of the value chain and the accompanying cost of all resources used in the process. Value additions from each of the key players in the chain were estimated using conventional cost and returns analysis. The effects of climate change on the tilapia and siganid industries were estimated based on the direct and indirect damage caused by the identified hazards and the incremental costs associated with climate change hazard adaptation measures. While direct effects include damage to fixed assets, reduction in gross income, and other incidental expenditures, indirect effects include the reduction in traders' volume and frequency of operations because of lower harvests as a result of climate change hazards. As a form of mitigation measure or defense against losses from climate change hazards, the cost which is termed here as defensive expenditure is also included. It represents additional expenses from measures that were implemented to prevent or reduce the effects of climate change hazards. These effects were integrated in the analysis following the VCA framework. The assessment of the impacts of a climate change hazard on the tilapia chain was undertaken under the scenario of increasing temperature in March to May 2014 that affected the tilapia industry players in Pampanga. In the case of the siganid value chain, typhoon Lando that hit Bolinao, Pangasinan in October 2015 was the reference case.

The ability to incorporate CCHA into the VCA allows a more rigorous and in-depth analysis. While the VCA provides the opportunity to understand how to optimize economic activities toward high profit and competitive advantage, the CCHA enables the researcher to capture, measure, and isolate or integrate the economic implications of a climate change hazard and any countermeasures to mitigate it. The CCHA-VCA combination offers an alternative approach in assessing the effects of climate change hazards on the fisheries sector and the climate-resilient adaptation strategies aimed at improving preparedness and resilience to natural disasters.

RESULTS AND DISCUSSION

The Philippine tilapia and siganid industries

As an introduced freshwater fish species in the Philippines, tilapia has a broad appeal among inland fishers because it is easy to produce in ponds at a profit. The production of tilapia has dramatically increased from 145,868 metric tons in 2004 to 267,735 metric tons in 2017. However, increased levels of rainfall, particularly if it occurs as heavier events, increase risks, such as losing fish during floods, invasion of ponds by unwanted species, and damage to ponds through infilling and breaching of walls. Tilapia pond aquaculture farmers are alarmed at the recurrent decline in farm productivity, mass mortality, and fish kill brought about by prolonged dry season, increasing air and water temperature, critical dry spells and drought, frequency of strong typhoons, and heavy rainfalls and thunderstorms, which induce flooding and overflows of aquaculture farms (DA-BFAR 2017).

One of the species that has also contributed to the fisheries sector of the Philippines is capture siganid or rabbitfish (*S. canaliculatus*), more popularly known as *samaral* or *malaga*. Adult siganids are caught from the sea in large quantities and sold fresh in local markets. Medium-sized siganids are cut open, dried, and sold as *danggit* whereas juvenile siganids, locally identified as *barangan* or *padas*, are used as raw material for fermented fish paste or *bagoong*. The siganid industry has a lot to offer economically considering the long stretch of coastal resources where siganids are captured. However, uncertainty due to strong typhoons makes fishing days irregular, alters fishing hours and effort, and increases costs, which in turn, affect the take home pay of fishers and other dependents of the siganid value chain.

Adaptation strategies in tilapia and siganid value chains

Tilapia and siganid value chain players tried to cope with climate change hazards using numerous adaptation strategies. In Bolinao, Pangasinan, the siganid fishers' adaptation measures related to typhoons included extending their fishing grounds and increasing fishing time using motorized boats equipped with 3–12-horsepower gasoline or diesel engines, gillnets, handlines, traps, small ring nets, and other small gears. In Pampanga, a tilapia pond grower used aquashade technology while a handful either planted water hyacinth along the periphery of their ponds to minimize the effects of extreme heat, replaced more frequently the water in their ponds to minimize the effects of high salinity, or reduced their feeding frequency because of the perception that fish start to reduce feeding when there is relatively higher temperature. A trader added blocks of ice in the fish tank during transport. However, these adopted practices produced minimal results, if any, thus, warranting deeper research and development and more evidence-based vetting.[1]

The requisite of business continuity management programs (Goh 2013) to identify critical control points and potential impacts from threats and the institution of proven response plans cannot be emphasized enough. Decisions on whether to adopt a mitigating measure often need to consider the various trade-offs associated with costs and benefits. Climate change hazards and their countermeasures always entail positive and negative economic, business network, environmental, and social trade-offs. This is seen in a value chain where activities are interconnected (*i.e.*, the action of one player has corresponding consequence on the speed, volume, and costs of transactions of other players).

CCH in the tilapia and siganid value chains: The analysis

VCA is the assessment of a portion of an economic system where upstream agents in production and distribution processes are linked to downstream partners by technical, economic, territorial, institutional, and social relationships (Bellù 2013). The purpose of the VCA is to appraise revenues, costs, and margins (*i.e.*, representing value added and net benefits) of each activity, each agent, each segment, and the whole value chain, based on prices paid and received by an economic

[1] Shelton (2014) suggested potential adaptation measures in fisheries and aquaculture although these also encounter certain adoption barriers.

agent. The gross value added of a chain is an aggregate measure of the value added, gross of depreciation, of all economic activities by all players in different segments of the value chain. Similarly, the changes in expenditures, margins, and prices that are induced by a climate change hazard can be detected and imputed in the VCA. CCHA starts with the identification and characterization of the climate change hazards and identification of mitigation measures that are adopted by the chain players. It ends with the analysis of the impact on total value added along the value chain. Knowledge of how value added is shared is vital information for analysts who wish to know the costs, margins, and prices at each stage of the value chain.

Slight variations can be noted between catch fisheries and aquaculture because of production starting points. For tilapia, the downstream is composed of hatchery operators, feed suppliers, and grow-out and pond operators while the upstream is represented by the traders (*i.e.*, wholesalers and retailers). In the case of siganid, the kickoff point is at sea. Thus, the connectivity in value chain is made of fishers, traders, processors, wholesalers, and retailers.

Following the VCA framework (Figure 1), all players in the tilapia value chain suffered from climate change hazards. In Central Luzon, hatchery operators observed a reduction in the production of fingerlings by 46 percent, on the average, while pond operators estimated a 32-percent reduction in production due to the rise in temperature. Likewise, broker-traders experienced approximately 14 percent reduction in the volume bought from growers inside the chain and had to outsource about 21 percent of the regular volume to meet the requirement of their wholesalers (Figure 2). The reduction in supply and additional costs to mitigate the effects of extreme heat have resulted in lower income for chain players with net returns decreasing by at least 19 percent. Of particular interest are the repercussions on retailers who, more often than not, are low-wage earners. Their net income per day decreased from PHP 626 to PHP 476, (USD 1 = PHP 50.87, August 2017) or by approximately 24 percent.

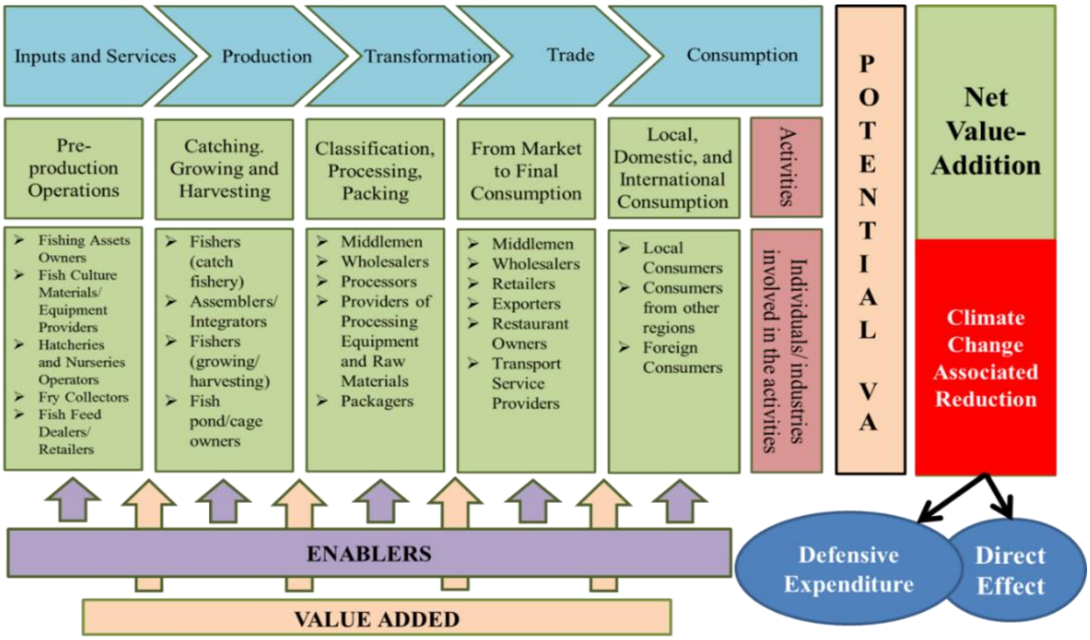

Fig. 1. A framework that incorporates climate change hazard analysis (CCHA) into value chain analysis (VCA**)** Source: WorldFish (2018)

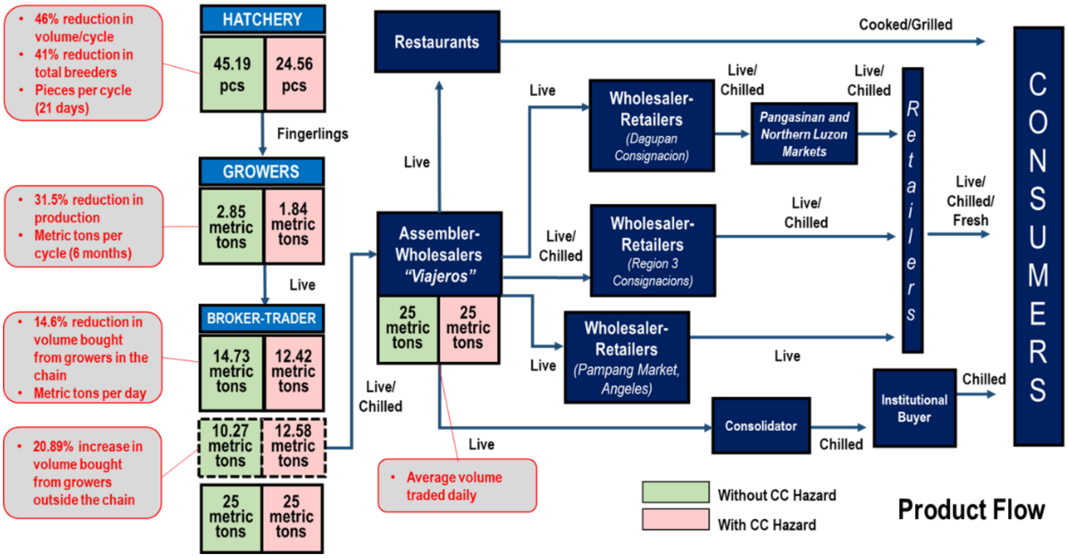

Fig. 2. Tilapia value chain map, selected case in Central Luzon, Philippines, 2017
Source: WorldFish (2018)

The incorporation of CCHA in the VCA deepens the analysis and provides another perspective in analyzing the effects of climate change hazards. For instance, the incorporation of CCHA in the VCA of siganid supplies invaluable economic estimates of the direct and indirect effects of climate change hazards as well as the cost of defensive expenditures.

In the siganid value chain map, the wholesalers served as the main link between the fishers and the retailers. For fishers, the effects of Typhoon Lando caused direct reduction in fish catch and damage to fixed assets, as reflected in increased depreciation. The shortfalls in production were largely due to reduced number of fishing days and trips because of the rough sea and high cost of operating expenses. The typhoon also caused the dry docking of small fishing vessels for repair and maintenance.

Due to Typhoon Lando, fish catch decreased from 338.54 kilograms (kg) to 223.5 kg, or by almost 34 percent (Table 1). This was accompanied by a 2.5 percent reduction in price. These translate to a direct cost of PHP 8,042 for the six fishers in the value chain (Table 2) or PHP 1,340 per fisherman. The typhoon also cost the fishers PHP 3,461 for their defensive expenditure. On the other hand, the costs of indirect effect can be estimated from the changes in volume and frequency of operations of wholesalers and retailers and the incremental cost due to the cascading effects of the typhoon. The wholesale and retail segments of the siganid value chain were found to have suffered an indirect cost of PHP 189,000 and PHP 43,350, respectively, due to the cascading effects of lower fish catch. The aftermath of the typhoon also inflicted an incremental marketing cost of PHP 2.68/kg in the wholesale market and PHP 1.08/kg during retail. On the whole, the cost of impact of Typhoon Lando on this particular value chain was estimated at PHP 247,565. While most literature base the estimates of the impact of a climate change hazard purely on direct cost (*i.e.*, loss in fish harvest), the method proposed here is holistic as it included the indirect costs, which in this case, has been estimated to be 95 percent of the actual total cost.

Table 1. Selected economic indicators in the siganid value chain, by value chain player, in Bolinao, Pangasinan, 2017

Item	Fishers			Wholesaler			Retailers		
	without CCH	with CCH	% Change	without CCH	with CCH	% Change	without CCH	with CCH	% Change
Volume (kg)	338.54	223.50	–33.98	2,865.00	1,290.00	–54.97	645.00	300.00	–53.49
Selling price/kg (PHP)	66.67	65.00	–2.50	120.00	120.00	0.00	130.00	135.00	3.85
Total revenue	22,569.33	14,527.50	–35.63	343,800.00	154,800.00	–54.97	83,850.00	40,500.00	–51.70
Total cost (PHP)	8,209.19	10,609.89	29.24	279,096.89	129,129.05	–53.73	81,230.56	38,105.56	–53.09
Net returns (PHP)	14,360.14	3,917.61	–72.72	64,703.11	25,670.95	–60.33	2,619.44	2,394.44	–8.59
Net returns per kg (PHP)	42.42	17.53	–58.68	22.58	19.90	–11.88	4.06	7.98	96.53
Average net returns per VC player	2,393.36	652.94	–72.72	64,703.11	25,670.95	–60.33	873.15	798.15	–8.59

Source of basic data: WorldFish (2018)
Note: CCH = climate change hazard

Table 2. Estimates of direct and indirect costs (PHP), and defensive expenditure using the VCA with CCHA method, the case of a siganid value chain in Region 1

Cost (PHP)	Fishers	Wholesalers	Retailers	Entire VC	% Share
Direct cost	8,042	-	-	8,042	3.25
Indirect cost					
Cascading effects of decrease in fish catch	-	189,000	43,350	232,350	93.83
Increase in cost due to aftermath of typhoon		3,462	324	3,786	1.53
Defensive expenditure	3,461	-	-	3,461	1.40
Total	11,503	192,462	43,674	247,640	100.00

Source of basic data: WorldFish (2018)

Table 3 presents the estimates of value added in the two scenarios (with climate change hazard and without climate change hazard). In the without climate change hazard scenario, fishers had the biggest share (61%), followed by the wholesaler (33%) then by the retailer (6%). This changed when Typhoon Lando struck, with the wholesaler and retailers' share notching higher values and the fishers' share to total value added decreasing to 39 percent.

Table 3. Revenue, cost, and value added in the siganid value chain in Bolinao, Pangasinan (2017)

Item	Without CCH			With CCH		
	Fishers	Wholesaler	Retailers	Fishers	Wholesaler	Retailers
Revenue/kg	66.67	120.00	130.00	65.00	120.00	135.00
Cost/kg	24.25	97.42	125.94	47.47	100.10	127.02
Value added per kg	42.42	22.58	4.06	17.53	19.90	7.98
% Share in total value added	61.42	32.70	5.88	38.60	43.82	17.58

Source of basic data: Worldfish (2018)
Note: CCH = climate change hazard

CONCLUSION AND RECOMMENDATIONS

The method used in this study allows the incorporation of CCHA into VCA and, in turn, offers a more encompassing economic assessment of the impact of climate change hazards on the fisheries sector. Specifically, the method permits the identification of the main features of a fisheries value chain in the with climate change hazard scenario; builds consistent value chain accounting; reflects the changes in value addition arising from strategic adaptive measures; and, economically assesses the direct and indirect effects of climate change hazards and income effects on individual players or the entire value chain.

A comprehensive understanding of the functionality of the entire value chain during a climate change hazard can help stakeholders reduce opportunity costs. Getting the right strategies to the right people at the right time and connecting those who know with those who need are vital. This is especially true for the vulnerable players in the fisheries sector as their lack of access to resources makes them less resilient. In the face of climate change hazards, the ability of small fishers and other players in the value chain to manage their business network and resource base and facilitate efficient pre- and post-harvest services are essential if they are to generate acceptable returns, contribute to inclusive growth, and reduce poverty.

ACKNOWLEDGEMENT

The authors express their appreciation to the College of Economics and Management, University of the Philippines Los Baños and Worldfish Philippines for the institutional support that has been extended to make this journal article possible. Also, this paper would have not been possible if not for the financial assistance that the Department of Agriculture – Bureau of Agricultural Research has kindly provided.

REFERENCES CITED

Asian Partnership for the Development of Human Resources in Rural Asia (AsiaDHRRA). 2008. Value Chain Analysis Report: Cambodia, Philippines and Vietnam. 84 p. http://asiadhrra.org/activityblogs/2ndlsfmrtw/ lsfmvaluechain2.pdf

Bamber, P., P. Daly, and G. Gereffi. 2017. The Philippines in the coffee global value chain. Center on Globalization, Governance and Competitiveness, Duke University. 72 p. Retrieved from http://industry.gov.ph/wp-content/uploads/2017/08/The-Philippines-in-the-Coffee-Global-Value-Chain.pdf

Bell, J., M. Batty, A. Ganachaud, P. Gehrke, A. Hobday, O. Hoegh-Guldberg, J. Johnson, R. Le Borgne, P. Lehodey, J. Lough, T. Pickering, M. Pratchett, M. Sheaves, and M. Waycott. 2010. "Preliminary assessment of the effects of climate change on fisheries and aquaculture in the Pacific." In Pacific Studies Series (Asian Development Bank), 451–469. Manila: Asian Development Bank, Manila, Philippines.

Bellù, L.G. 2013. Value chain analysis for policy making. Methodological guidelines and country cases for a quantitative approach. Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, FAO. Rome, Italy. 178 p.

Brander, K.M. 2007. "Global fish production and climate change." *Proceedings of the National Academy of Sciences* 104(50): 19709–19714. http://www.pnas.org/content/104/50/19709.full

Briones, R. M., 2014. Small farmers in high value chains: binding or relaxing constraints to inclusive growth? PIDS Discussion Paper Series No. 2014-23. 18 p. https://dirp3.pids.gov.ph/webportal/CDN/PUBLICATIONS/pidsdps1423.pdf

Brown, E.O., M.L. Perez, L.R. Garces, R.J. Ragaza, R.A. Bassig, and E.C. Zaragoza, 2010. Value chain analysis for sea cucumber in the Philippines: Studies and Reviews 2120. The WorldFish Center, Penang, Malaysia. 54 p. http://aquaticcommons.org/4702/1/9789832346777.pdf

Daly, J., P. Bamber, and G. Gareffi, 2017. The Philippines in the natural rubber global value chain. Center on Globalization, Governance & Competitiveness, Duke University. 63 p.

DA-BAR [Department of Agriculture-Bureau of Agricultural Research]. 2016. Climate Change Research and Development and Extension Agenda and Program for Agriculture and Fisheries 2016–2022. Diliman, Quezon City, Philippines: DA-BAR. 3 p.

DA-BFAR [Department of Agriculture-Bureau of Fisheries and Aquatic Resources]. 2008. Commodity Road Map: Tilapia. Diliman, Quezon City: Fisheries Policy and Economics Division, BFAR. 6 p. http://www.bfar.da.gov.ph/files/img/photos/commodityroadmap-tilapia.pdf

DA-BFAR. 2017. "Documentation of Practical Innovative Approaches on Impacts of Climate Change-Local Tilapia Farming Practices in the Philippines." BFAR Aquaculture Technology Bulletin Series No. 02, Mar 2017. 28 p.

DA-PRDP [Philippine Rural Development Project]. 2014. Value Chain Analysis and Competitiveness Strategy: Abaca Fiber Mindanao. Department of Agriculture. Quezon City, Philippines. 87 p. http://drive.daprdp.net/iplan/vca/VCA% 20of%20Abaca% 20(Mindanao).pdf

DA-PRDP [Philippine Rural Development Project]. 2014. Value Chain Analysis and Competitiveness Strategy: Cardava Banana Mindanao. Department of Agriculture. Quezon City, Philippines. 88 p. http://drive.daprdp.net/iplan/vca/VCA%20of%20Banana%20Cardava%20 (Mindanao).pdf

DA-PRDP [Philippine Rural Development Project]. 2014. Value Chain Analysis and Competitiveness Strategy: Carrageenan Seaweed Mindanao. Department of Agriculture. Quezon City, Philippines. 91 p. http://drive.daprdp.net/iplan/vca/VCA%20of%20Seaweed%20 (Mindanao).pdf

DA-PRDP [Philippine Rural Development Project]. 2014. Value Chain Analysis and Competitiveness Strategy: Cassava Mindanao. Department of Agriculture. Quezon City, Philippines. 103 p. http://www.drive.daprdp.net/iplan/vca/Cassava%20Chips%20&%20Granules%20VCA%20 (MINDANAO%20CLUSTER).pdf

DA-PRDP [Philippine Rural Development Project]. 2014. Value Chain Analysis and Competitiveness Strategy: Crumb Rubber Mindanao. Department of Agriculture. Quezon City, Philippines. 110 p. http://drive.daprdp.net/iplan/vca/VCA%20of%20Crumb%20Rubber%20 (Mindanao).pdf

DA-PRDP [Philippine Rural Development Project]. 2014. Value Chain Analysis and Competitiveness Strategy: Davao Del Norte Cocoa Bean. Department of Agriculture. Quezon City, Philippines. 124 p. http://drive.daprdp.net/iplan/vca/Cacao%20Beans%20VCA%20 (DAVAO%20DEL%20NORTE).pdf

DA-PRDP [Philippine Rural Development Project]. 2014. Value Chain Analysis and Competitiveness Strategy: Fresh Cavendish Banana in Maguindanao. Department of Agriculture. Quezon City, Philippines. 58 p. http://drive.daprdp.net/iplan/vca/VCA%20of%20 Cavendish%20Banana%20 (Maguindanao).pdf

Dargantes, B.B., C.C. Batistel, and J.R. Teves. 2016. Rice and vegetable value chains affecting small-scale farmers in the Philippines. Caritas Czech Republic. Prague, Czech Republic. 61 p. https://www.vsu.edu.ph/images/isrds/ CBA2013/Rice-and-Vegetable-Value-Chain-Affecting-Small-Scale-Farmers-in-the-Philippines.pdf

Easterling, W.E., P.K. Aggarwal, P. Batima, K.M. Brander, L. Erda, S.M. Howden, A. Kirilenko, J. Morton, J.F. Soussana, J. Schmidhuber, and F.N. Tubiello. 2007. Food, fibre and forest products." In M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Climate Change 2007: Impacts, Adaptation and Vulnerability, 273–313. Cambridge University Press. Cambridge, UK.

Faße, A., U. Grote, and E. Winter. 2009. Value chain analysis methodologies in the context of environment and trade research (No. 429). Discussion Papers of School of Economics and Management of the Hanover Leibniz University. 64 p.

Fernandez-Stark, K., V. Couto, and G. Gereffi. 2017. The Philippines in the mango global value chain. Duke University Center on Globalization, Governance & Competitiveness. Durham, North Carolina, USA. 70 p. http://industry.gov.ph/wp-content/uploads/2017/08/The-Philippines-in-the-Mango-Global-Value-Chain.pdf

Goh, Moh Heng. 2013. A manager's guide to ISO22301 Standard for business continuity management system: An organizational journey to BC management system. GMH Continuity Architects. Singapore, Singapore. 53 p.

Hamrick, D., K. Fernandez-Stark, and G. Gereffi. 2017. The Philippines in the cocoa-chocolate global value chain. Duke University Center on Globalization, Governance & Competitiveness. Durham, North Carolina, USA. 64 p. http://industry.gov.ph/wp-content/uploads/2017/08/The-Philippines-in-the-Cocoa-Global-Value-Chain.pdf

Hellin, J., and M. Meijer. 2006. Guidelines for value chain analysis. FAO. Rome, Italy. 24 p. http://www.fao.org/3/a-bq787e.pdf

IPCC [Intergovernmental Panel on Climate Change]. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Cambridge University Press. Cambridge, United Kingdom. 987 p. https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4_wg2_full_report.pdf

Israel, D.C., and D.F.M. Bunao. 2017. Value chain analysis of the wood processing industry in the Philippines. Philippine Institute of Development Studies Discussion Paper Series No. 2017-05: 1–38.

Kaplinsky, R., and M. Morris. 2002. A handbook for value chain research. University of Sussex Institute of Development Studies. Sussex, United Kingdom. 113 p.

Lantican, F.A., M.C.M. Molina, J.E. Lapitan, J.C. Padrid, E.C. Suñaz, M.A.R. Cañizares, J.A.G. Lantican, and L.A.M. Carandang. 2017. Dairy buffalo value chain analysis in Luzon, Philippines. SEARCA. Los Baños, Laguna, Philippines. 136 p. http://www.searca.org/knowledge-resources/1603-pre-download?pid=369

Munday, P.L., G.P. Jones, M.S. Pratchett, and A. Williams. 2008. Climate change and the future for coral reef fishes." Fish and Fisheries. 9(3): 261–285. http://www.icriforum.org/sites/default/files/GM24-Munday.pdf

Poloczanska, E.S., R.C. Babcock, A. Butler, A.J. Hobday, O. Hoegh-Guldberg, T.J. Kunz, R. Matear, D. Milton, T.A. Okey, and A.J. Richardson. 2007. Climate change and Australian marine life. Oceanography and Marine Biology: An Annual Review. 45: 407–478. https://www.researchgate.net/ publication/43478329_Climate_Change_and_Australian_Marine_Life

Porter, M.E., 1985. Competitive Advantage. The Free Press/Simon and Schuster Inc. New York, New York. 32 p.

Romero M.G. 2017. Value chain analysis of corn (in-transition to organic) in Region 02. 1 p. http://organic.da.gov.ph/index.php/2016-12-06-07-53-57/2016-12-06-07-59-21/value-chain-analysis-of-fertilizer/15-research-project-on-organic-agriculture/81-value-chain-analysis-of-corn

Sheaves, M., and R. Johnston. 2008. Influence of marine and freshwater connectivity on the dynamics of subtropical estuarine wetland fish metapopulations. Mar. Ecol. Prog. Ser. 357: 225–243.

Shelton, C. 2014. Climate change adaptation in fisheries and aquaculture: compilation of initial examples. FAO Fisheries and Aquaculture Circular No. 1088. 45 p. http://www.fao.org/3/a-i3569e.pdf

Thresher, R., J.A. Koslow, A.K. Morison, and D.C. Smith. 2007. Depth-mediated reversal of the effects of climate change on long-term growth rates of exploited marine fish. Proceedings of the National Academy of Sciences. 104(18): 7461–7465.

Van Duijn, A.P., R. Beukers, and W. van der Pijl. 2012.The Philippine Seafood Sector: A value chain analysis. CBI/LEI: The Hague, The Netherlands. 65 p.

WorldFish. 2018. Climate change impacts on value chains of siganid and tilapia in vulnerable regions in Luzon, Philippines. Final Technical Report for DA-BAR Funded Project. 119 p.