



Labor and Globalization

Christoph Scherrer, Katja Radon (Eds.)

Occupational Safety and Health Challenges in Southern Agriculture



Rainer Hampp Verlag

Christoph Scherrer, Katja Radon (Eds.):
**Occupational Safety and Health Challenges
in Southern Agriculture**

Labor and Globalization, edited by Christoph Scherrer, Volume 15,
ISBN 978-3-95710-247-8, Rainer Hampp Verlag, Augsburg, München 2019, 195 S., € 24.80

Occupational safety and health (OSH) is a core element of the ILO's Decent Work Agenda. Despite hazardous working conditions in agriculture, unfortunately, OSH issues in agriculture are frequently ignored. This volume's contributions from Brazil, Colombia, Costa Rica, Ecuador, Ghana, India, Nicaragua, and Pakistan as well as from various disciplines highlight

- the prevalent patriarchal norms and practices which expose women to more health risks;
- the lack of training and education which leave smallholders and farm workers frequently unaware of the health hazards involved in handling machinery and pesticides;
- the lack of protective gear and access to health services among smallholders;
- the undermining of OSH standards by the competitive pressures of global supply chains on their participants;
- the restriction of certifications' impact mostly to higher hygiene standards.

Key words: Occupational safety and health, agriculture, smallholders, farm workers, Global South

Christoph Scherrer, economist and political scientist, is Professor of Globalization & Politics at the University of Kassel, Executive Director of the International Center for Development and Decent Work, and chairmann of the steering committee of the Global Labour University.

Katja Radon, epidemiologist and environmental engineer, is Chairwoman, Center for International Health and Professor of Epidemiology at the Institute for Occupational, Social, and Environmental Medicine at the Hospital of the Ludwig-Maximilians-University, Munich.

Labor and Globalization

Volume 15

Edited by Christoph Scherrer

Christoph Scherrer, Katja Radon (Eds.)

Occupational Safety and Health Challenges in Southern Agriculture

Bibliographic information published by the Deutsche Nationalbibliothek

Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at <http://dnb.d-nb.de>.

ISBN 978-3-95710-247-8

Labor and globalization: ISSN 2196-5382

First published 2019

Cover photo: Coconut picker on Palawan, Philippines. Christoph Scherrer

© 2019 Rainer Hampp Verlag Augsburg, München
Vorderer Lech 35 86150 Augsburg, Germany
www.Hampp-Verlag.de

All rights reserved. No part of this publication may be reprinted or reproduced or utilized in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying and recording, or in any information storage or retrieval system, without permission in writing from the publisher.

In case of complaints please contact Rainer Hampp Verlag.

Table of Contents

Acknowledgments.....	ii
Contributors.....	iii
Introduction	1
<i>Christoph Scherrer</i>	
Part I: Dimensions of Occupational Safety and Health in Agriculture	
1. Modern Agricultural Practices in India: Impacts on Occupational Safety, Health, and Environment	10
<i>Praveen Jha, Gurpreet Singh, and Nivedita Sharma</i>	
2. Gender Dimensions of Occupational Health Risks among Non-standard Agricultural Workers in Ghana.....	35
<i>Angela D. Akorsu, Emmanuel Y. Tenkorang, and Loretta Baidoo</i>	
3. Occupational Health Risks in Agriculture: Instruments of Measurement and Protective Strategies in Central America	51
<i>Alberto Bárcenas Reyes</i>	
4. Occupational Health and Safety in Pakistan’s Sugar Mills.....	65
<i>Anjum Munir, Abdul Ghafoor, Waseem Amjad, Adeel Ashraf, and Oliver Hensel</i>	
Part II: Occupational Safety and Health on Plantations	
5. Prevalence of Respiratory Symptoms among Ecuadorian Banana Plantation Workers	78
<i>Juan Pablo Piedra González, Leonardo Briceño, and Katja Radon</i>	
6. Export-led Development and its Impact on the Health and Labour Conditions of Workers: the Apparel Industry in El Salvador and the Palm Oil Industry in Colombia	87
<i>Daniel Hawkins and Oscar Gallo-Velez</i>	
7. Occupational Health and Safety of Melon Workers in Brazil’s Rio Grande do Norte	113
<i>Valdênia Apolinário, João Matos Filho, Thales Augusto M. Penha, and Letícia Amaral</i>	
8. The Impact of Quality Certifications on Working Conditions in the Context of Fresh Fruit Global Value Chain: The Case of Melon Production in Rio Grande do Norte, Brazil	132
<i>Walter Belik and Thales A. M. Penha</i>	
Part III: Occupational Safety and Health on Smallholdings	
9. Occupational Health, Risk and Vulnerability: Conditions of Farm Labour on Independent Tea Plantations in India.....	156
<i>Debdulal Saha</i>	
10. Social Upgrading and Occupational Safety and Health: a Case of Pakistan’s Mango Industry.....	171
<i>Mubashir Mehdi and Bilal Ahsan</i>	
11. Waste Water Irrigation and Occupational Health and Safety of Agricultural Labor	181
<i>Saira Akhtar, Shabbir Ahmad, and Abdul Ghafoor</i>	

Acknowledgments

This book is a product of the collaboration the International Center for Development and Decent Work (ICDD) and the Center for International Health (CIH).

The ICDD is a global multidisciplinary network of eight partner universities across four continents with its head office at the University of Kassel (Germany). The ICDD contributes to the global fight against hunger and poverty through research and education on the Sustainable Development Goal #8 “to promote inclusive and sustainable economic growth, employment and decent work for all.”

CIH is an interdisciplinary and international network with the head office located at the hospital of the Ludwig-Maximilians-University Munich in Germany. CIH has partners in Latin America, Africa, and Asia, as well as alumni in more than 25 countries worldwide. Its vision is to empower health professionals across the globe through training and research.

Both centers belong to Centers of Excellence for Exchange and Development (exceed) program managed by the German Academic Exchange Service (DAAD) using funds from the German Federal Ministry for Economic Cooperation and Development (BMZ).

For a better understanding of the occupational safety and health conditions in agriculture, CIH and ICDD not only brought researchers from Bolivia, Brazil, Chile, Colombia, Ecuador, Ghana, Guatemala, India, Mexico, Nepal, and Pakistan together for a conference in November 2017, but also from various disciplines such as agricultural sciences, economics, engineering, epidemiology, management, medicine, political economy, political science, and sociology. We are very grateful to Javier Becerril and Claudia Davila from the Autonomous University of Yucatán and their dynamic team for hosting our conference so perfectly. We are grateful to all contributors, who have made this volume possible by writing insightful chapters.

Since most of us are not native English speakers, we are very thankful to Madhuparna Banerjee for a superb job in copy editing. Special thanks to Jahnvi Rao for formatting the chapters. Many thanks also to Rainer Hampp at HamppVerlag who has been extremely supportive as always. Financial support was granted by the ICDD.

Christoph Scherrer / Katja Radon

Kassel / München

February 2019

Contributors

Shabbir Ahmad, University of Agriculture, Faisalabad, Pakistan, and PhD Candidate (Development Studies) at China Agricultural University China.

M. Bilal Ahsan completed his Master of Science in Agribusiness from the University of Agriculture Faisalabad and currently working as lecturer (contractual) in the University of Agriculture Burewala Campus, Burewala, Punjab, Pakistan. His research interests are value chain analysis, rural development and market research.

Saira Akhtar is Associate Professor and Chairperson at the Department of Rural Sociology, Faculty of Social Sciences, University of Agriculture, Faisalabad, Pakistan. She holds a PhD in Sociology. Her current research focus is on the issues relating to poverty alleviation, community development and women empowerment. Some of her recent publications include Role of Women in Social and Agricultural Decision Making in the Rural Areas of the Southern Punjab (co-authored), SSRG International Journal of Humanities and Social Sciences, 2018. An Analysis of Wastewater irrigation Practices and its impacts on the livelihood generation and food chain contamination in Faisalabad District, Pakistan (co-authored), ISABB Journal of Health and Environmental Sciences 2018. Women in Agriculture - Lack of Access to Resources (co-authored) SSRG International Journal of Economics Management Studies, 2018.

Angela Dziejdom Akorsu (PhD) is a Senior Research Fellow and Head of the Department of Labour and Human Resource Studies, University of Cape Coast, Ghana. Her current research is around informal economy organising, decent work along agricultural value chains as well as gender and rural women's livelihoods. Her most recent publication is: Akorsu, A. D. & Britwum, A. O. (2018) Trade Union's Response to Decent Work Deficit among Agricultural Workers in Ghana. In C. Scherrer & S. Verma (eds.), Decent Work Deficits in Southern Agriculture: Measurements, Augsburg: Rainer Hampp Verlag.

Letícia de Souza Amaral is a student of the Master Program in regional economics at the Federal University of Rio Grande do Norte (UFRN), Brazil. Her research interests include public policies for agriculture, agri-food system, family farming, sustainable agriculture and gender issues in agriculture. Her recent presentations include 'The Family Agriculture Insertion in the Contemporary Agri-food System: Reflections from the Experience of the Family Agriculture Central Cooperative in Rio Grande do Norte' in XXII CCSA Research Seminar (2017); 'Public Policies for the Family and Business Agri-food System: Challenges and Perspectives' in XXII CCSA Research Seminar (2017).

Waseem Amjad is Assistant Professor at the Department of Energy Systems Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad Pakistan. He holds a Ph.D. in Agricultural and Biosystems Engineering from University of Kassel, Germany. His research areas are design, modelling and thermal engineering, analysis of different renewable energy technologies, computer simulation of conventional and new thermal processes. His recent publications are 'Hyperspectral Imaging for the Determination of Potato Slice Moisture Content and Chromaticity During the Convective Hot Air Drying

Process' Biosystems Engineering 166:170-183 (2017); 'Postharvest monitoring of organic potato (cv. Anuschka) during hot-air drying using visible-NIR hyperspectral imaging' in J Sci Food Agric (co-authored 2017); 'Thermodynamic analysis of drying process in a diagonal-batch dryer developed for batch uniformity using potato slices' in Journal of Food Engineering. 169: 238-249 (2016).

Valdênia Apolinário is Professor at the Department of Economics, Federal University of Rio Grande do Norte (UFRN/Brazil). She is an economist and holds a PhD in Production Engineering from Federal University of Rio de Janeiro (UFRJ). She is a member of RedeSist - research network focusing on Local Productive and Innovative Systems (UFRJ). She coordinated and/or developed networked research supported by: BNDES, SEBRAE, Social Observatory Institute (IOS), ICDD. Her research interests include gender issues, occupational health and safety, decent work and local/regional development. Her recent publications are: 'APLs como instrumento de promoção do desenvolvimento local e regional no Norte e no Nordeste'. E-Papers, v. 1, p. 349-369 (2017); 'APLs em serviços de saúde'. E-Papers, v. 1, p. 237-364 (Co-authored, 2017); 'Desafios sindicais frente às práticas trabalhistas e ambientais'. In: Recortes Analíticos. v. 1, p. 79-112 (Author, 2016); 'Análise do toyotismo e dos seus princípios racionalizantes aplicados à gestão da produção e do trabalho'. In: Interface, v. 13, p. 5-19 (Author, 2016); 'A terceirização e a Agenda do Trabalho Decente da OIT'. In: Revista da ABET, v. 14, p. 78-98 (Co-authored, 2015).

Adeel Ashraf is a researcher in the Department of Farm Machinery and Power, University of Agriculture, Faisalabad.

Loretta Baidoo holds an Mphil in Development Studies from the University of Cape Coast, Ghana. She previously served as a research intern at the Centre for Gender Research, Advocacy and Documentation, University of Cape Coast. She is currently a Project field Officer with the Department of Nutrition and Food Sciences, University of Ghana. Her research interests are in gender and rural women's livelihoods.

Alberto Bárcenas Reyes is an industrial engineer and expert in Human Factors and Ergonomics with a MSc in Industrial Engineering from the National University of Engineering in Managua, Nicaragua. He holds a Ph.D. in Occupational Health and Safety from the University of Kassel, Germany. He has worked for many years as scientific assistant at the Institute of Work Sciences - IFA at the University of Kassel and has lead research projects in Central America. Currently he works as freelance for the consulting firm ATG GmbH in Kassel. His research interest includes occupational health and safety systems, risk assessment in organizations and participatory ergonomics. Some of his publications deal with the analysis of labour accidents in Nicaragua; e.g. in Revista de Temas Nicaragüenses 92:68-79 (2015).

Walter Belik is Full Professor at Institute of Economics, University of Campinas, Sao Paulo, Brazil. His current research interests and focuses include food security and nutrition, food system, food policy, food value chains. His recent publications include: 'Milling Capacity and Supply Competition on Sugar-Ethanol Industry in São Paulo, Brazil' in Geografia (Rio Claro. impresso), v.42, p.39 - 56, (2017); 'A

trajetória dos polos de fruticultura irrigada da Nordeste face as transformações do sistema agroalimentar mundial’ in Revista eletrônica Documento/monumento. v.20, p.208 (co-authored, 2016); ‘Políticas Públicas e a Construção de Novos Mercados Para a Agricultura Familiar: Analisando O Caso Da Alimentação Escolar No Município De São Paulo’ in Raízes (UFPB). v.36, p.70 - 81, (2016).

Leonardo Briceño Ayala is Senior Professor at the Medical and Health Sciences School of the Universidad del Rosario in Bogotá, Colombia and is teacher within the MSc in International Occupational Safety and Health Program of the Center for International Health at Ludwig-Maximilians-University in Munich, Germany. He holds a PhD in Political Sciences from the Universidad Externado de Colombia. His research area is occupational health. Recent publications include health effects of child labour (e.g., Occupational injuries among children and adolescents in Cusco Province: a cross-sectional study. BMC Public Health 2014;14:766) and pesticide exposure (e.g., Exposure to pesticide mixtures and DNA damage among rice field workers. Arch Env Occ Health 2016;71:3-9).

João Matos Filho is Professor at the Department of Economics in the Federal University of Rio Grande do Norte (UFRN), Brazil. He holds a PhD in economics from the Institute of Economics of the University of Campinas (Unicamp). His research areas include public policy; agricultural policies; rural development and global agri-food systems. He is Coordinator of the Interdisciplinary Group on Studies and Evaluation of Public Policies (GIAPP), where he develops research in the field of public policies, agricultural and agrarian policies, and rural development. His recent publications include ‘Análise comparativa entre o Rio Grande do Norte e os principais estados exportadores de frutas do Nordeste entre 1999 e 2010’ in Estado E Economia Do Rio Grande Do Norte, CDU 33, p. 176-196 (co-authored 2017); ‘Desigualdade nas políticas de desenvolvimento rural no Brasil: o caso do Programa Nacional de Fortalecimento da Agricultura Familiar (PRONAF)’ in Maria Arlete Duarte de Araújo; Richard Medeiros de Araújo. (Org.), Políticas públicas: segurança alimentar e nutricional e desenvolvimento rural no Rio Grande do Norte. 1ed.Natal: Edufrn (co-authored 2016).

Oscar Gallo Vélez is a teacher at the Instituto Superior de Formación Docente Salomé Ureña, Dominican Republic. He has a PhD in History from the Universidad Federal de Santa Catarina, Brazil and a Masters in History from the Universidad Nacional of Colombia. He has undertaken research on culture and public policies, medical processes, Bio-politics, Governmentality, occupational health medicine, health-illness, labour legislation and social security. Some of his recent publications are: (Editor), with Eugenio Castaño, La Salud Laboral en el Siglo XX and XXI: de la negación al derecho, Escuela Nacional Sindical (2016); A objetivação médica e legislativa das doenças profissionais na Colômbia, 1931-1945, Historia Crítica Vol. 66, October: 87-107 (2017).

Abdul Ghafoor is Lecturer at the Department of Farm Machinery and Power, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad. His area of research in the recent past has been in renewable energy in agriculture sector. His recent publications include: ‘Development of hybrid solar distillation system for essential oil extraction’ in Renewable Energy 113:22-29 (co-authored 2017); ‘Solar desalination of water using evaporation condensation and

heat recovery method' in *Desalination and Water Treatment* 68:80-90 (co-authored 2017); 'Current Status and Overview of Renewable Energy Potential in Pakistan for Continuous Energy Sustainability' in *Renewable and Sustainable Energy Reviews*, 60:1332-1342 (2017).

Daniel James Hawkins is the Director of Research at the Escuela Nacional Sindical (ENS) of Colombia. He holds a PhD in political science from the University of Kassel and completed a Post-Doc at the Center for Global Workers' Rights in the School of Labor and Employment Relations at Pennsylvania State University. His research interests include worker and union rights, the impacts of free trade agreements on workers and the informal economy. His recent publications include 'The Formalization and Unionization Campaign in the Buenaventura port, Colombia', in *Informal Workers & Collective Action: A Global Perspective*. Cornell University Press, Ithaco/ILR Press, 57-100, (2017); 'El tema Laboral en las Negociaciones de los TLC: Lecciones de las Experiencias de Colombia Frente a los TLC con los Estados Unidos y la Unión Europea', *Revista Controversia* N°207, (2016).

Oliver Hensel is Professor at the Department of Agricultural and Biosystems Engineering, University of Kassel, Germany. He holds a PhD in Agricultural Engineering from Hohenheim University (Germany). His areas of expertise are Postharvest Technology and Food Processing, Renewable Energy in Agriculture, and Sensors / Electronics for farm implements. His recent publications include 'Hyperspectral Imaging for the Determination of Potato Slice Moisture Content and Chromaticity During the Convective Hot Air Drying Process' in *Biosystems Engineering* 166:170-183 (co-authored 2018); 'Real-Time Acoustic Monitoring of Cutting Blade Sharpness in Agricultural Machinery' in *IEEE/ASME Transactions on Mechatronics* 22(6):2411-2419 (co-authored 2017); 'Biomass waste-to-energy valorisation technologies: A review case for banana processing in Uganda' in *Biotechnology for Biofuels* DOI10.1186/s13068-016-0689-5 (co-authored 2017).

Praveen Jha, Professor of Economics at the Centre for Economic Studies and Planning (CESP) and Adjunct Professor at the Centre for Informal Sector and Labour Studies (CISLS), is with the School of Social Sciences, Jawaharlal Nehru University, New Delhi, India. He has been a Visiting Fellow to several Institutions/Universities, including University of Bremen, Germany; Tianjin University of Finance and Economics, China, Rhodes University, South Africa and Sam Moyo African Institute for Agrarian Studies (SMAIAS), Zimbabwe; International Labour Organisation (ILO), Geneva and Kassel University, Germany. He has also been associated with several research studies with the UN institutions such as the ILO, the UNICEF, the UNDP, the FAO etc. He is one of the editors of the Journal, *Agrarian South: Journal of Political Economy*. His major areas of research and teaching include: Political Economy of Development, with particular reference to Labour, Agriculture, Natural Resources, Public Finance, Education, and History of Economic Thought. His most recent books include *Labour in Contemporary India* (OUP, 2016) and (edited with Sam Moyo and Paris Yeros) *Reclaiming Africa: Scramble and Resistance in the 21st Century* (Springer, 2019)

Mubashir Mehdi is Assistant Professor at the Institute of Business Management Sciences University of Agriculture, Faisalabad, Pakistan. He holds a Ph.D. in

agribusiness. His research focuses on agricultural marketing, management and overall supply chain analysis. He has been actively engaged in industry focused R&D and capacity building activities. His recent publications include: ‘Analyzing Farmers’ Preferences for Traditional and Model Cattle Markets in Punjab, Pakistan’ in *J. Agri. Sci.*, Vol. 54(4) (co-authored 2017); ‘Spatial differences in rice price volatility: A Case of Pakistan’ in *The Pakistan Development Review*, Vol.56 (3) (co-authored 2017).

Anjum Munir is Associate Professor/Chairman, Department of Energy Systems Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad Pakistan. He holds a Ph.D. in Agricultural and Biosystems Engineering from University of Kassel, Germany. His focus research areas are solar energy, renewable energy, solar distillation system and its application for the value addition to agricultural products. His recent publications include ‘Hyperspectral Imaging for the Determination of Potato Slice Moisture Content and Chromaticity during the Convective Hot Air Drying Process’ in *Biosystems Engineering* 166:170-183 (co-authored 2017); ‘Downdraft Gasifier Structure and Process Improvement for High Quality and Quantity Producer Gas Production’ in *Journal- Energy Institute* (co-authored 2017); ‘Development of Hybrid Solar Distillation System for Essential Oil Extraction’ in *Renewable Energy* 113: 22-29 (co-authored 2017).

Thales Augusto Medeiros Penha is Assistant Professor at the Department of Economics, Federal University of Rio Grande do Norte, Brazil. He received his Ph.D. in Economic Development from the Institute of Economics of the University of Campinas (Unicamp). He has developed his area research around the issues of governance of the agricultural markets, specifically on the aspects of the global agricultural production supply chains of fresh fruits and their socioeconomic impacts in the Northeast Region of Brazil. Some of his research publications include ‘Decent Work in Global Agricultural Production Systems: an interdisciplinary conversation’ In: *The future of food and challenges for agriculture in the 21st century* (co-authored 2017); ‘Trabalho Decente em Sistemas Agroalimentares Globais: Reflexões sobre Condições de Trabalho e Gênero’ in *XXII Encontro Nacional de Economia Política* (co-authored 2017); ‘A Trajetória Dos Polos De Fruticultura Irrigada Do Nordeste Face As Transformações Do Sistema Agroalimentar Mundial. Revista Eletrônica’ in *Revista Eletrônica Documento/Monumento*, v. 20, p. 208-225 (principal author 2016).

Juan Pablo Piedra González is physician holding an MSc International Occupational Safety and Health from Ludwig-Maximilians-University in Munich, Germany. After several years of expertise in the Ecuadorian Labour Ministry, different enterprises and the Ecuadorian Social Security Institute, he is currently he working as occupational safety and health consultant in Ecuador.

Katja Radon is Chairwoman of the Center for International Health at Hospital of the Ludwig-Maximilians-University in Munich Germany. She was trained in Berlin, Montreal and Munich. Her research interests include occupational and environmental epidemiology with focus on Latin American countries. Recent publications include ‘Working Below Skill Level as Risk Factor for Distress Among Latin American Migrants Living in Germany’. In *J Immigr Minor Health*.

2018. and ‘Estimating the Causal Impact of Proximity to Gold and Copper Mines on Respiratory Diseases in Chilean Children’ In *Int J Environ Res Public Health*. 2017;15(1).

Debdulal Saha, economist, is Assistant Professor at the Centre for Labour Studies and Social Protection, School of Social Sciences and Humanities, Tata Institute of Social Sciences (TISS), Guwahati, India. He holds a PhD in social sciences from TISS, Mumbai. His research interest and current focus include labour and employment, informal economy, livelihood, labour market institutions, public policy, and value chain. Some of his recent publications include ‘Informal Markets, Livelihood and Politics: Street Vendors in Urban India’, Routledge (2017); ‘Work, Institutions and Sustainable Livelihood: Issues and Challenges of Transformation’, Palgrave Macmillan (co-edited 2017); ‘Employment and Labour Market in Northeast India: Interrogating Structural Changes’, Routledge, (co-edited, 2019).

Christoph Scherrer, economist and political scientist, is Professor of Globalization & Politics and Executive Director of the International Center for Development and Decent Work at the University of Kassel and Adjunct Member of the Political Science Graduate Program Rutgers, The State University of New Jersey. He holds PhDs in political science from the FU Berlin (Dr. habil.) and the U of Frankfurt (Dr. phil.). Recent English language publications include: *Decent Work Deficits in Southern Agriculture: Measurements, Drivers and Strategies*, co-edited (2018); *Public Banks in the Age of Financialization: A Comparative Perspective*, edited (2017); *Trump’s Trade Policy Agenda*, in: *Intereconomics* 52 (6), 364-369, co-author (2017).

Nivedita Sharma is an independent researcher in New Delhi. She did her Post Doctorate from Centre of Economic Studies and Planning, JNU and Doctorate from IIT Roorkee. Her area of interest is agricultural marketing and value chains. She has several publications in reputed national and international journals.

Gurpreet Singh is an Associate Fellow at Centres for International Projects Trust, New Delhi. He did his Doctorate from Centre for Economic Studies and Planning, JNU. His broad area of research is labour, rural non-farm employment and agricultural value chains. He has several publications in national and international journals.

Emmanuel Yamoah Tenkorang is a Senior Research Fellow at the Department of Environment, Governance and Sustainable Development and the Dean of the School for Development Studies, University of Cape Coast, Ghana. He holds a PhD in Environment and Development from the same School. His research interests are generally in Environment and development and his recent focus has been in the extractives - gold mining, oil and gas as well as occupational health, safety and environment issues.

Introduction

Christoph Scherrer

The Occupational Safety and Health (OSH) risks in agriculture deserve more attention. While about a quarter of humankind is still laboring in agriculture providing for the other three-quarters and themselves the necessary food for human survival, their health risks in the pastures, fields, plantations and stables go mainly unnoticed to such a degree that not even comprehensive statistics are available. Case studies and estimations suggest that occupational accidents in agriculture happen significantly more frequently than in the other economic sectors. The situation is especially severe in the Global South. For example, a study for sub-Saharan Africa estimated 22.5 accidents per 100,000 employees in agriculture, 16 in industry and 18.7 in services; for Latin America 30.3 in agriculture, 13.4 in industry, and 10.8 in services in the period of 1995 to 1997 (Hämäläinen, 2006). Despite the prevalence of accidents in agriculture, the Global Plan of Action on Workers' Health (2008-2017) of the World Health Organization (WHO) mentions agriculture only once (WHO, 2007). Fortunately, the WHO 2018 report "Preventing disease through a healthier and safer workplace" covers agriculture quite extensively (Wolf et al., 2018).

The International Labor Organization (ILO) has formulated a range of conventions, recommendations, and code of practices on OSH in general and on agriculture in particular,¹ but even the general Occupational Safety and Health Convention of 1981 (No. 155) was ratified by only 67 nations and more shockingly, the specific Safety and Health in Agriculture Convention of 2001 (No. 184) was ratified by as few as 16 countries. Convention 184's late entry into force (2003) is indicative of the lack of importance the international governmental community gives to the working conditions of those who provide the world's food. As LaDou et al. have succinctly stated: "the WHO and the ILO are given monumental tasks but only trivial budgets" (2018: 1).

Correspondingly, the situation is no better at the national level. A recent review of OSH in 10 sub-Saharan states revealed that most of the laws did not pertain to the agricultural sector. The study concluded: "Existing OSH laws are gender insensitive, fragmented among various government departments, insufficient, outdated, and non-deterrent to perpetrators and lack incentives for compliance" (Ncube & Kanda, 2018: 365). The WHO reports a lack of capacity to inspect and monitor workplaces by most ministries of health. A third of the ministries surveyed in 2006 had not even hired staff to deal with workplace health issues (WHO, 2007: 10; see also Mischke et al. 2013 review article).

¹ See: https://www.ilo.org/safework/industries-sectors/WCMS_219011/lang-en/index.htm

Lack of enforcement of the ILO conventions is not only indicated by the few resources dedicated to addressing OSH risks but also by an econometric study of 51 countries located in the Global South. This study revealed that the ratification of the ILO conventions is not correlated to the amount of work-related fatalities in 1985 and 2002 (Kerrissey & Schuhrke, 2016); i.e., more ratifications do not lead to fewer fatalities.

Preventative measures are scarce; so too is insurance coverage. According to ILO estimates, only 44% of all people living in rural areas enjoy legal health coverage (Scheil-Adlung, 2015). For sub-Saharan Africa, the number is much lower; in most of its countries, with the exception of Ghana, Kenya, and South Africa, it is below 3% of the whole population (in the years 2011-2016; Demographic and Health Surveys). Furthermore, financial deficits in health expenditures deny 63% of the rural population adequate access to healthcare services and 52% cannot access health services because of an insufficient number of health service providers (Scheil-Adlung, 2015).

Reductions in occupational health risks on farms can also not be expected from the introduction of more modern agricultural techniques. The use of machinery increases the severity of accidents (Patel et al., 2010) and pesticides are frequently applied without knowledge of appropriate handling and the provision of personal protective equipment (Dalvie, et al., 2014; Kumari & John, 2018). The already-mentioned econometric study of 51 countries suggests a different panacea. It revealed a positive relation between stronger collective labor rights and fewer fatalities (Kerrissey & Schuhrke, 2016).

Our anthology focuses on the OSH challenges in the Global South where not only OSH deficits are more severe but where most of the people employed in agriculture actually live. In sub-Saharan Africa more than half of the working age population is still employed in agriculture, in South East Asia, and the Pacific agriculture's share is about 30% and in Latin America and the Caribbean about 14% in 2018 (ILO World Employment and Social Outlook Data Finder). We assembled contributions from various places in the Global South in order to explore the many dimensions of the OSH challenge. The spectrum of the challenges is very broad, therefore, there are no simple ways to minimize the OSH risks of smallholders and farm laborers. The contributions confirm the high risk of accidents and health hazards in agriculture as well as the neglect of addressing these risks by most of the employers and governments. In addition, they highlight the following dimensions:

- due to the prevalent patriarchal norms and practices, women are especially exposed to health risks;

- owing to a lack of training and education, smallholders and farm workers are frequently unaware of the health hazards involved in handling machinery and pesticides;
- protective gear and access to health services is mostly missing among smallholders;
- insertion in global supply chains has ambiguous effects on OSH conditions on farms. Overall, the competitive pressures of global supply chains on its participants are not conducive for improving OSH standards. If certification is required, hygiene standards are better but further progress in OSH measures depends on the commitment of the respective governments and on the existence and power of workers' organizations and smallholders' associations.

Our contributors offer a range of valuable policy pointers but more research on context-specific preventive measures is certainly required. Our volume is, therefore, primarily concerned with raising awareness about the OSH challenge in the Global South.

Introduction of Chapters

The book is divided into three broad areas, namely: introduction to the different dimensions of OSH in agriculture (chapters 1–4), OSH on plantations (chapters 5–8), and OSH on smallholdings (chapters 9–11).

The first chapter, “Modern Agricultural Practices in India: Impacts on Occupational Safety, Health and Environment,” by *Praveen Jha, Gurpreet Singh, and Nivedita Sharma*, places the OSH challenges in agriculture in a larger context, showcasing the example of the country with the world’s largest agricultural employment. It argues that while the so-called Green Revolution of the late 1960s addressed the colonial legacy of insufficient food availability successfully, the adoption of mechanical and especially chemical agricultural practices came at the expense of the environment and the people living there. The central and state-level governments largely ignored these adverse consequences. The laws, programs, and standards concerning OSH do not cover agriculture. A nationwide repository on farm-related accidents and injuries is missing. The authors have listed a number of case studies on accidents in Indian agriculture which reveal not only the prevalent improper use of pesticides and the resulting harmful exposure to pesticides but also the risks involved in handling agricultural machinery. Agricultural machinery is the major cause of accidents due to lack of training, poor design of the machinery, and work-related stress. The authors propose a multidimensional response to OSH crisis in agriculture which includes legislation, awareness raising, responsible public provisioning, and infrastructure development.

The second chapter, “Gender Dimensions of Occupational Health Risks among Non-standard Agricultural Workers in Ghana,” by *Angela D. Akorsu, Emmanuel Y. Tenkorang, and Loretta Baidoo*, explores gender differences in health risks. Its core argument is that besides the vulnerability created by informality, the gendered nature of agricultural production further intensifies vulnerability to OSH risks. In Ghana, as well as elsewhere, gender remains one of the important markers determining access to resources such as land, and the nature of agricultural tasks an individual performs. Consequently, the differences in the health and safety problems that agricultural women and men face at work, emanate largely from the differences in the types of work they do. The authors’ qualitative analysis of gender roles of contract workers, smallholders, and outgrower farmers on an oil palm plantation reveals that women are often affected by musculoskeletal disorders among other health problems because their agricultural tasks tend to be labor-intensive and laborious. In addition, women suffer poor psychosocial working conditions because of their double burden of paid and unpaid work eliminates free or leisure time. Given that gender differences in health risks are part of society’s structural discrimination, the authors argue for holistic OSH interventions that account for women’s multiple roles.

In the third chapter, “Occupational Health Risks in Agriculture: Instruments of Measurement and Protective Strategies in Central America,” *Alberto Bárcenas Reyes* discusses how occupational health risks in agriculture can be measured and how such knowledge can be used for remedial action. The author lists a catalog of risks and hazards in agriculture followed by an outline of a procedure for carrying out risk assessment. On the basis of his experience in Central America, the author pleads for participatory ergonomics for initiating improvements in OSH of agricultural workers. Given the heterogeneous tasks involved in agriculture, the author calls for the participation of specialists from various fields. Farmers and agricultural workers should not only participate in the data-gathering phase, but also in the evaluation of the obtained results. In addition, remedial action requires a national plan for addressing OSH issues, improved monitoring of OSH compliance, and educational measures.

The last chapter in this section, “Occupational Health and Safety in Pakistan’s Sugar Mills,” by *Anjum Munir, Abdul Ghafoor, Adeel Ashraf, Waseem Amjad, and Oliver Hensel*, looks beyond the field at the processing stage of sugarcane where injuries are especially pronounced. The chapter begins with a general overview of the OSH risks in Pakistan’s agriculture which includes pictures of unsafe handling of agricultural machinery. The core of their chapter rests on a comparison of the risk levels at six sugar mills. Their investigation revealed high levels of accidents, prevalence of musculoskeletal disorders, unhealthy noise levels, and unsafe drinking water. Workers did not receive sufficient

protective gear and were not adequately trained to handle the machinery. Proper first-aid facilities were absent. However, some mills had invested in preventive maintenance programs which resulted in lesser accidents and injuries. Therefore, the authors see many opportunities to lower OSH risks and they conclude with a list of recommendations.

Part II of the book covers OHS issues on plantations. *Juan Pablo Piedra González, Leonardo Briceño, and Katja Radon* present their case study on the health impact of pesticides in the fifth chapter “Prevalence of Respiratory Symptoms among Ecuadorian Banana Plantation Workers.” They carried out a cross-sectional study among banana plantation workers and banana packers in Ecuador. Exposed to the spraying of fungicides, a significant part of plantation workers were suffering from wheezing. Prevalence was higher than among banana packers. Therefore, the authors call for the monitoring of exposure levels to fungicides and risk awareness campaigns.

In the sixth chapter, “Export-led Development and Its Impact on the Health and Labor Conditions of Workers: the Apparel Industry in El Salvador and the Palm Oil Industry in Colombia”, *Daniel Hawkins and Oscar Gallo-Velez* analyze the link between the export model of development in the Global South and its association with the intensification of labor and its effect on workers’ health and livelihood. They examine the growth of the export-oriented apparel industry in El Salvador and Colombia’s expanding palm oil sector. The two cases, examined via field research in both countries, allude to the negative health impacts of the export-enclave model of development. Workers are denied their fundamental right to union freedoms and they are also pressured into situations where the innate instability of employment and the precarious socio-economic context that surrounds them leads them to prioritize slight increase in wages whatever risk this may bring to their health. Corporate social responsibility programs and sanction-free workers’ rights chapters in trade agreements have not prevented the deterioration of working conditions. Therefore, the authors call on development agencies to channel their resources into projects that are geared towards concretely enhancing workers’ rights, especially union freedoms, and efforts to promote the importance of health at work and health as a basic human right and necessity.

The seventh chapter, “Occupational Health and Safety of Melon Workers in Brazil’s Rio Grande do Norte,” by *Valdênia Apolinário, João Matos Filho, Thales Augusto M. Penha, and Leticia Amaral*, is based on field research in an area with large plantations of melons destined for exports as well as smallholders producing for the domestic market. Their research revealed that workers at large fruit farms have access to personal protective equipment, an organized work environment, and a regular schedule of working hours—as provided by Brazilian legislation and international certifications. Nevertheless,

the effects of exposure to sun, rain, venomous animals, use of chemicals, handling of heavy tools, and equipment, among others, bring about significant OSH risks to these workers. Quite in line with the findings concerning Ghana, female wage workers struggled to reconcile fixed working hours with domestic duties. Among the smallholders, women are additionally exposed to pesticides, the careless disposal of chemical residues, and domestic violence. The provision of health services in the rural areas is insufficient. The authors propose to close the gaps in basic policies such as health, education, and security.

In the eighth chapter, “The Impact of Quality Certifications on Working Conditions in the Fresh Fruit Global Value Chain: Melon Production in Brazil’s Rio Grande do Norte,” *Walter Belik and Thales A. M. Penha* study the same melon-producing area as mentioned in the previous chapter. Their focus, however, is on the impact of certifications of food production processes on the OSH of workers involved in these processes. After explaining the role of certifications in the coordination of global fresh fruit value chains, the authors present their case study findings. Workplace safety and health conditions appear to have improved mostly thanks to certification requirements but also as a result of trade union activities as well as federal labor legislation. However, in order to satisfy the international buyers’ demand for flexibility, exporters frequently rely on the use of subcontractors who produce melons in violation of certification requirements. These requirements emphasize, mostly, a reduction in exposure to pesticides rather than examining working conditions. The authors call for more studies isolating the effects of certification on working conditions.

In the last part of the book attention is given to smallholders. In the ninth chapter, “Occupational Health, Risk and Vulnerability: Conditions of Farm Labor on Independent Tea Plantations in India,” *Debdulal Saha* highlights a fairly recent phenomenon in the long history of Indian tea plantations, the emergence of the so-called tea gardens of small independent tea planters. The small tea plantations secure their owners’ livelihood though they receive lower prices for their tea leaves than the traditional large tea estates. Saha’s extensive study investigated the impact of the smallholders’ relatively more precarious market position on the workers they employ primarily for plucking leaves, spraying, and pruning. Not only do the plantation workers receive pitiful wages, they are also exposed to manifold health hazards with hardly any access to health service facilities. The level of their vulnerabilities is much determined by their gender, caste, religion, education levels, and age. Due to low literacy rates and lack of state support, workers often do not know their basic rights, including preventive measures which are related to health. As a remedy, the author proposes that the labor welfare division of the tea board of India recognizes the workers on small tea plantations and introduces various welfare measures for them.

In the tenth chapter, “Social Upgrading and Occupational Safety and Health: a Case of Pakistan’s Mango Industry,” *Mubashir Mehdi and Bilal Ahsan* investigate the OSH situation on mango farms. Because of ample labor supply, as yet few farms have mechanized. Mechanization has been adopted more by the export-oriented farms and especially those focused on destinations which require certification. The authors observed significant differences in OSH conditions between certified and non-certified mango orchards. In the certified orchards, hygiene conditions are better and the workers use their right for collective bargaining to obtain training and protective gear. The non-certified orchards employ mainly migrant or seasonal workers whose OSH risks are much higher. These workers receive little training and no institutional support from the government which has yet to include the agricultural sector in the general labor legislation. In addition, the government lacks a national strategy for addressing the OSH deficits and the professional staff for providing competent advice on OSH risks. Therefore, the authors recommend, as a first step, to develop a national OSH program.

In the final chapter of the book, “Waste Water Irrigation and Occupational Health & Safety of Agricultural Labor,” *Saira Akhtar, Shabbir Ahmad, and Abdul Ghafoor* report on the hazards of wastewater irrigation in the district of Faisalabad in Pakistan. Since the irrigation of crops using tube well water is costly, many farmers in the peri-urban areas prefer wastewater irrigation for vegetables. They perceive waste water as beneficial because of its nutrients. However, most of the industrial wastewater is directly discharged into the canals without treatment. It contains hazardous chemicals which when used for irrigation affect the food chain and thus human health. Fieldwork revealed that farmers are not aware of the hazards of wastewater irrigation. Therefore, the authors call upon the government to enforce a policy for treating wastewater.

References

- Dalvie, Mohamed Aqiel, Hanna-Andrea Rother, and Leslie London. 2014. “Chemical Hazard Communication Comprehensibility in South Africa: Safety Implications for the Adoption of the Globally Harmonised System of Classification and Labelling of Chemicals”, *Safety Science*, Vol. 61: 51–58.
- Demographic and Health Surveys of the United States Agency for International Development. Retrieved from <https://www.statcompiler.com/en/>. Accessed 8.2.2019.
- Hämäläinen, Päivi, Jukka Takala, and Kaija Leena Saarela. 2006. “Global Estimates of Occupational Accidents”, *Safety Science*, Vol. 44: 137–56.
- Kerrissey, Jasmine and Jeff Schuhrke. 2016. “Life Chances: Labor Rights, International Institutions, and Worker Fatalities in the Global South”, *Social Forces*, Vol. 95(1): 191–216.
- Kumari, Dev and Siby John. 2018. “Safety and Occupational Health Hazards of Agricultural Workers Handling Pesticides: A Case Study”, N. Siddiqui, S. Tauseef, and K. Bansal

(eds), *Advances in Health and Environment Safety*. Singapore: Springer Transactions in Civil and Environmental Engineering, Springer.

LaDou, Joseph, Leslie London, and Andrew Watterson. 2018. "Occupational Health: a World of False Promises", *Environmental Health*, Vol. 17: 81.

Mischke, Christina, Jos Verbeek, Jenny Job, Thais C. Morata, Anne Alvesalo-Kuusi, Kaisa Neuvonen, Simon Clarke, and Robert I. Pedlow. 2013: Occupational safety and health enforcement tools for preventing occupational diseases and injuries. *Cochrane Database of Systematic Reviews*, Issue 8. Art. No.: CD010183.

Ncube, France and Artwell Kanda. 2018. "Current Status and the Future of Occupational Safety and Health Legislation in Low- and Middle-Income Countries", *Safety and Health at Work*, Vol. 9(4): 365–371.

Patel, S.K., M.R. Varma, and Adarsh Kumar. 2010. "Agricultural Injuries in Etawah District of Uttar Pradesh in India", *Safety Science*, Vol. 48(2): 222–229.

Scheil-Adlung, Xenia (ed.) 2015. "Global Evidence on Inequities in Rural Health Protection—New Data on Rural Deficits in Health Coverage for 174 Countries", Geneva, ILO: Social Protection Department, Extension of Social Security Series, No 47.

WHO - World Health Organization. 2007. *Workers' Health: Global Plan of Action 2008–2017*. Retrieved from http://www.who.int/occupational_health/WHO_health_assembly_en_web.pdf

Wolf J, Prüss-Ustün A, Ivanov I, Mudgal S, Corvalán C, Bos R et al. *Preventing disease through a healthier and safer workplace*. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

Part I: Dimensions of Occupational Safety and Health in Agriculture

1. Modern Agricultural Practices in India: Impacts on Occupational Safety, Health, and Environment

Praveen Jha, Gurpreet Singh, and Nivedita Sharma

Modern agricultural practices have unleashed multiple adverse consequences with respect to environment, health, and in several other areas of human well-being across the globe, which has come to be recognized widely. There has been a burgeoning literature on these issues for several decades now, particularly from 1950s onwards. Nonetheless, even today, large gaps continue to exist with respect to appropriate research as well as policy responses, more so in developing countries, and India is no exception. The country stares at humongous deficits in terms of the relevant challenges at hand. Inadequate attention to investments in theoretical and scientific endeavours, callous disregard for the costs associated with “modernity”, inter alia, throw some light on the prevailing sad state of affairs. Sure enough, these need to be contextualized in the political economy of development characterizing the country, particularly since independence from British colonialism.

In case of India, the so-called modern agricultural practices (drawing on major industrial- chemical advancements of the 19th and 20th centuries) are associated with the advent of the Green Revolution (henceforth, GR) in the late 1960s, at a point when the country appeared to be almost a “basket case”, given its inadequate food availability, widespread hunger, and partial reliance on “ship to mouth”. As is well known, British colonialism in India had extremely debilitating consequences for the Indian agriculture and food availability for the masses. To cite just one number: per capita annual food availability in the country had declined precipitously from approximately 200 kg in 1900 to around 136 kg by the early 1940s, which was a major contributor to the infamous Bengal Famine (Sen, 1977; Patnaik, 2007; Digby & Naoroji, 2014). The Indian state, after independence, did try to put in place the necessary measures to accelerate food production but the progress was not quite commensurate with the pressing needs confronting the country, which set the stage for the adoption of the GR, without paying much attention to the necessary health and safety precautions, as discussed later. However, before we come to these issues, it would be useful to flag some of the major challenges in engaging with mapping and assessing the relevant environmental and other issues, which is attempted briefly in Section I. Section II of the chapter provides a sketch of the background and important characteristics of the GR as it unfolded from the early 1960s onwards. Section III provides a brief account of the legal framework for occupational safety and health in India, which is followed by a focus on some of the relevant issues and challenges in Indian agriculture, in Section IV. The subsequent section flags the important

implications, pertaining to occupational safety, health, etc., for farmers and workers. Section VI concludes the chapter and offers some policy pointers.

Some Theoretical Challenges

As hinted earlier, there has been a veritable explosion of literature across several disciplines (both in the so-called natural and social sciences) as regards understanding the impact of technological changes, their interface with ecosystems, and consequent direct and indirect linkages, etc. on the overall well-being of human-beings in the short- to long-run trajectories of socio-economic transformations. The task at hand is an exceedingly complex one, necessarily contested, and offers little hope of finding universally or even widely acceptable answers. In fact, one may even argue that in spite of an impressive array of conceptual and empirical contributions across disciplines, the relevant subject may still be in a state of infancy. This is primarily because mapping and accounting of the entire spectrum of costs and benefits, including for ecosystem goods and services, needs acceptable valuation frameworks. The obvious question then is: what is an acceptable framework? The search for an answer necessarily brings the tools and kitbag of economics into play and a word or so on what economists can offer may be in order here.

As is well-known, to answer questions of optimal evaluation, the framework in mainstream economic analysis is that of a “perfectly competitive self-regulating market economy”. The contours of such a framework had come into place by the 1870s (especially through the remarkable book by Leon Walras titled *Theory of Pure Competition* published in 1874), but it took economists quite some time to put in place, a mathematically rigorous manner, that is, the necessary structure for such an economic system. Of course, it is not possible to get into the relevant details here. However, the point worth emphasizing is that a system of perfectly competitive, ideal market structure, which results in efficient allocation of resources (through optimal assessment of the relevant costs and benefits) requires a set of extremely demanding assumptions, which include well-defined property rights; rational behaviour and sovereignty of individual economic agents; free-flow of perfect information; perfect mobility of resources; large number of buyers and sellers, among othersⁱ. If these assumptions do not hold, the entire exercise of mapping and accounting gets into an extremely slippery and uncertain zone.

As it happens, in the absence of perfect markets, the conventional mainstream economic perspective offers only one solution: that of “imitating” the markets, which as critiques have argued, tends to put the subject fundamentally on wrong track. Extremely serious challenges with respect to mapping and valuation of the impacts of technologies, whether in direct ways or through their indirect implications (e.g. via hydro-sphere, stratosphere, lithosphere, etc. that is the

entire natural eco-system), can hardly be resolved through mimicking the markets. Problems of pervasive externalities (i.e. differences between social and private costs/benefits associated with any economic activity), impossibility of “perfect foresight” for an economic agent, particularly in an inter-temporal framework, inadequate and incomplete information, assignment of property rights to eco-systems, etc., have been discussed at great length in the relevant literature, which fundamentally insist on the impossibility of seeking solutions through a reliance only on market mechanism. Such challenges necessarily point to the significance of deepening of our analysis for revelations of costs, benefits, values, impacts, etc., and such efforts must put at the centre stage requirements of sustainable, democratic, progressive, socio-economic trajectories. Clearly, there are no easy solutions and the terrain will remain a difficult one but it is important to emphasize that a worthwhile engagement with these issues must take into account the challenges noted above.

In passing we may note that there was substantial churning and dissent even *within* mainstream economics tradition itself from the 1920s onward, given the evolving global conjuncture, in particular the Great Depression (of the 1920s and '30s), the emergence of socialism, decolonisation of the third world, etc., which contributed to the powerful sub-discipline of Development Economics, soon after the Second World War, that enjoyed considerable influence in policy discourses during the 1950s and '60s. Although this sub-discipline (e.g., Development Economics) was methodologically largely rooted in mainstream economics, it drew substantially on insights and arguments from classical economics, including the Marxist tradition. In fact, with the adoption of nationalist development planning in the newly de-colonised countries, there was indeed much creative academic investment in blending of ideas from different traditions, in search of ‘meaningful’ policy options, resulting in the so-called ‘heterodox’ economics. In fact, India became one of the important centres in this regard, as its ‘development plans’ invited considerable attention and scrutiny. These plans, as should be obvious, engaged in substantive and serious ways, with quite a few issues and challenges confronting the agricultural sector. However, most of the problems, relating to environment, issues of health, occupational safety, etc., in contemporary Indian agriculture, were paid lip-service at best, although they were occasionally part of the discourses even during the 1950s and '60s (for details, see ICSSR, 1980; Chakravarty, 1987; Shiva, 1993; Byres, 1994, 1997).

A Brief Backdrop to the GR in India

Indian agriculture on the eve of independence was in a state of shambles, largely on account of the British colonial policies of plunder and neglect (Banaji, 1972; Bagchi, 1984, 1991; Patnaik, 1999; Roy, 2002). It was a major

priority for policymakers to revitalize this sector by addressing the multidimensional challenges, both institutional and technocratic, within the broad framework of planned economic development. For reasons of space, it is not possible to get into a detailed consideration of the relevant discussions, debates, strategies, and policy responses vis-à-vis agriculture after independence. Suffice it to note, in the overall development framework, agriculture played “second fiddle” in the envisioned strategy of rapid economic transformation, which was supposed to have been driven by state-led industrialization. Given the spirit and the thinking of the times, there was widespread endorsement of the idea that in developing countries, public sector-led rapid industrialization had to be at the centre of overall strategy of development to usher in the era of prosperity and modernization. One of the famous statements by the first prime minister of India, Pt. Jawaharlal Nehru, captures this central thrust very well: “we are trying to catch up, as far as we can, with the industrial revolution that occurred long ago in Western countries” (quoted by Chatterjee in Byres (ed.), 1997). Agriculture was visualized as a sector which, with some support, would rise to the challenges of the overall strategy of modern economic transformation.ⁱⁱ

Given such a backdrop, the key policy components, soon after independence, included (limited) policies of land reform, institutional innovations like the Community Development Programme (CDP), substantial expenditure by the union and state governments on power and irrigation projects, as well as direct public expenditure on agriculture. Large outlays for agriculture, medium and minor irrigation, and power projects, both at the central and state levels, were included in the First Five-Year Plan (1951–56). However, despite all talks about taking care of agriculture, there were serious lacunae and policy failures in both institutional and technical respects. Consequently, in spite of a significant increase in its growth rate as compared to the period of British colonial rule, the agricultural sector performed well below its potential in the first two decades after independence and the problem of serious food inadequacy continued to haunt the country. In fact, as hinted above, to supplement the food availability from domestic production, the country had to rely on aid and imports, the famous U.S. PL 480 being a much talked about vehicle as the American administration threatened to cut it off in the wake of India’s conflict with Pakistan in 1965 (Jha, 1976).

Also, it is worth emphasizing that almost the entire expansion in agricultural output up to the mid-1960s was driven by expansion of area, with productivity increase playing a minimal role. In short, India’s overall strategy of agricultural transformation and output expansion was way below its potential and, more importantly, what was required for delivering adequate food security as well as sustained and robust overall economic expansion. Furthermore, in addition to

the internal weaknesses of the development strategy in operation, performance of the agricultural sector (and of course, the economy) suffered seriously due to several exogenous shocks. The two military engagements in quick succession (in 1962 with China and 1965 with Pakistan) led to major cutbacks in public investments throwing almost every sector in a state of chaos. The situation was compounded massively due to two successive monsoon failures in 1965 and 1966, which led to drastic reductions in food production (by almost 20 percentage points) and availability. Thus, it was a situation of veritable agrarian crisis, and food riots were reported from several states in India, which were obvious grim reminders of the country's failure in one of the most important sectors for the well-being of the masses.

The immediate impact of these catastrophic jolts was so powerful that the country effectively abandoned five-year economic plans and, for three years (1966–69), there were annual plans essentially as budgetary exercises to cope with the emerging challenges. It is at this juncture that the new prime minister, Indira Gandhi, and her policy advisors ushered in several critical policy measures towards a strategy of “pulling up” agriculture; the so-called “Green Revolution” (GR) was the centrepiece of this strategy. The GR, with its demanding complementary input package (seeds, fertilizers, pesticides, water etc.), required substantial government support.

To promote the GR package, public expenditure on agriculture was enhanced considerably. Although the GR was limited to a few regions and crops in the 1970s, it became much more widespread in the 1980s. The nationalization of banks in 1969 and the subsequent provision for priority-sector lending in agriculture were of critical importance in enabling farmers to adopt new production processes. Further, subsidized provision of fertilizers and other inputs, substantial public expenditure on research and extension services, and an overall supportive public policy regime were crucial in spreading and deepening the GR. The objective of increasing food grain production and availability was very much put on track. In terms of both crop coverage and geographical coverage, the annual average growth of agricultural GDP accelerated to 4.7% in the 1980s, as compared to only 1.4% in the 1970s. We may also note that the per capita food availability increased from around 140 kg at the time of independence to more than 180 kg by the late 1980s.

However, the success of the GR also had a “dark side” to it in terms of increasing degradation of soil, water, and overall natural resource environment, along with growing health concerns. Much of it was already evident in the early GR areas such as Punjab and Haryana but the policymakers largely chose to remain impervious to these adverse and deleterious consequences. Furthermore, with the ascendancy of the neo-liberal macroeconomic policy regime, since the early 1990s, Indian agriculture has entered a phase which has subjected it to

multiple whammies emanating from the new regime along with continued negligence and worsening of the environmental challenges as well as occupational safety and health concerns endemic to the sector. In fact, the most gruesome manifestation of the crisis has been farmers' suicides. Several regions of the country, including even prosperous states like Punjab, Kerala, and Maharashtra, have reported a large number of farmers' suicides. Factors such as substantial reduction of rural development expenditure, increased input prices, vulnerability to price fluctuations in the world market due to greater openness, inadequate (or non-existent) crop insurance, and substantial weakening of the rural credit system, especially credit to small and marginal farmers, who constitute more than 80% of the total farming community (GoI, 2014a), along with governmental apathy towards farmers' demands for remunerative prices for their produce, are among the obvious causes of the present agrarian crisis (Patnaik & Chandrasekhar, 1995; Shiva et al., 1999; Patnaik, 2007; Bhalla & Singh, 2009). The continuing agrarian crisis has tended to worsen the ecological situation as there is a scramble for unsustainable harvesting of water and other natural resources along with intensification of chemical/industrial agriculture, etc.

Occupational Safety and Health Legal Framework in India

The Constitution of India ensures provisions for a range of rights for its citizens through its "Directive Principles of State Policy". These principles provide for securing the health and strength of employees against entering the avocations unsuited to their age or strength, engaged in hazardous employment and ensuring the just and humane conditions of work, fixed hours of work, etc. (Rao, 1949). These principles are presumed to be the basis for policy framework of the GoI in terms of policy designs for the welfare of workers and the government is expected to regulate all economic activities with a view to ensure that every employee is provided with safe and healthy working environment.

To ensure occupational safety and health (OSH) at workplace, GoI has promulgated various Acts,ⁱⁱⁱ however, comprehensive safety and health statutes for regulating OSH at workplaces exist only with regard to four sectors, namely, mining, factories, ports, and construction, and even there it subsists in a patchy manner. No serious legal attempt has been made to address the health and safety issues in Indian agriculture.

There are a few legislations which are supposed to be applicable to specific aspects of agricultural operations, important amongst them being the Insecticides Act, 1968 and the Dangerous Machines (Regulation) Act, 1983. The Insecticides Act, 1968 deals with manufacturing, packaging, labelling, distribution, handling, and use of insecticides. The Dangerous Machines (Regulation) Act aims to regulate trade and commerce relating to production,

supply, distribution and use of the product of any industry producing dangerous machines, with a view to secure the welfare of labour operating any such machine and for payment of compensation for death or injury. Both the Acts are supposed to be enforced by the State Agriculture Departments as far as their applicability to the agricultural operations are concerned.

At the national level, the National Policy on Safety, Health and Environment at Workplace was notified in 2009 with the objective of reducing work-related injuries and improving data collection to facilitate monitoring, enhancing community awareness on OSH, and creating “green jobs” contributing to sustainable enterprise development. The Bureau of Indian Standards also constituted a committee to formulate the National Standard on Occupational Health and Safety Management System. The standard encourages organizations to develop a practical approach to the management of safety and health by providing requirements and guidelines for use. The OSH management systems may also be integrated with the management of other aspects of business performance to minimize risks to employees, improve productivity and establish a responsible image at the marketplace. The adoption of the standard is voluntary and is applicable to any organization that wishes to implement it. Apart from national and state-specific regulations, ILO provides recommendations on the roles of the competent authorities, employers, workers and their organisations in promoting OSH in the agricultural sector through its standards and codes of practice.

On the whole, India’s agricultural sector has been neglected in terms of establishing legal framework against occupational hazards and risks despite the fact that this sector involves lot of risks. A number of studies and reports have documented and recognized these, which are due to the nature of operations involving agricultural handtools and implements, farm machinery, chemical agents, climatic agents, electricity, animal exposure, and psychological stress due to socio-economic problems (GoI, 2011). Despite acknowledgements and a few aforementioned steps by the government, safety and health statutes are limited only to the mining, factories, docks, and construction sector. There is indeed a strong need for an umbrella legislation covering safety and health in agricultural sector which employs a majority of workers and provides livelihood to the masses. The subsequent section highlights further some of the major health and safety risks in the agricultural sector in India.

Health and Safety Risks in Agriculture

Occupational Accidents, Injuries, and Diseases in Agriculture

Farming activities generally involve working in liaison with biological and mechanical systems in adverse weather conditions and poor infrastructure. Since agricultural operations are seasonal, farmers, thus, work under extreme

pressure making injury inevitable (Huston & Smith, 1969). Globally, agriculture is the most hazardous occupation which accounts for more accidents than the industrial sector (Kumar & Dewangan, 2009; Patel et al., 2010). Also, agriculture accounts for the highest death rate amongst all industries (Pickett et al., 1999; Patel et al., 2010; Das, 2014). Increasing farm mechanization has resulted in increased production and productivity on the Indian farms but the associated health hazards cannot be ignored. Farm mechanisation involves sophisticated operations which makes workers work for long hours and requires skilled training (Monk et al., 1986). Moreover, the maintenance of agricultural machinery is completely an individual responsibility and is constrained by limited capabilities. All these factors inevitably contribute to increasing incidence of accidents and injuries in agriculture. An injury is a double blow to an Indian farmer as he/she is generally not formally trained for any other economic activity, which then may cause loss of livelihood (Knapp, 1965). Also, a farm injury may lead to physical disability or even loss of life and thus worsen the living conditions of the families which barely eke out their living from meagre resources. Since Indian agriculture is almost entirely informal, there is lack of nationwide repository on farm-related accidents and injuries. Moreover, in India, where medical facilities are sparse in rural areas, injuries are usually treated at home and go unreported (Varghese & Mohan, 1990). In short, severity of agricultural injuries gets exacerbated due to lack of infrastructure, poor healthcare facilities in rural areas, non-maintenance of machines, long working hours, and lack of adequate formal training to operate the machines (Knapp, 1965).

The literature pertaining to accidents in agriculture is very limited in India due to paucity of the data. The few epidemiological studies which have been conducted provide, at best, a glimpse of agricultural injuries and deaths (Appendix Table A1). These studies have reported that majority of the agricultural accidents happen during the use of agricultural machinery. Among various reasons, unskilled workforce, poor light arrangements, drug/alcohol abuse, fatigue, poor designing, and lack of orientation to work on machines have been cited as major reasons behind accidents. These injuries have long-term impact on workers' health, agricultural productivity and work performance. There is significant positive correlation between injuries and loss of working days for both male and female. The permanent crippling injuries or loss of life of breadwinners of the households severely affects the livings of the poor families in the developing countries. Indian agriculture, which is largely informal, unsecured and uninsured, lacks injury prevention programmes. Further, lack of rehabilitation programs and compensation provisions against the accidents make the livelihood prospects more vulnerable. Hence, accidents and injuries often turn out to be major shocks for the rural poor (farmers and labour) resulting in loss of livelihoods and assets.

Environmental Degradation and its Impact on Human Health

Pesticide poisoning

Intensification of agriculture in an attempt to increase production and productivity has turned out to be adverse for the environment and human health. Undoubtedly, the productivity has increased with the increasing use of pesticides and forms an integral part of agrarian culture as it protects the crop from weeds, diseases and insect pests. However, there is an overwhelming evidence of potential risk to humans and other living beings and threats for the environment (Forget, 1993; Jeyaratnam, 1985; Aktar et al., 2009). The most affected individuals are found to be agricultural workers who are directly exposed to pesticides. The high use of pesticides, along with environmental and social factors, is responsible for the high concentration of pesticide residues in the food chain. Moreover, many banned and restricted pesticides are still being used in many parts of the country, warranting strict periodical health checkups and other interventions (Mittal et al., 2013). Constant and regular contact with pesticides, dust, and other chemicals may not show any immediate symptom but may have profound repercussions on health in the long term (Shepherd, 1998). Workers lack adequate preventive measures and appropriate treatment. Furthermore, excessive exposure to pesticides and chemicals have been reported to be responsible for complications in pregnancy, miscarriage, premature birth, and spontaneous abortions, immune suppression, hormone disruption, diminished intelligence, and cancer (Hurley et al., 1998; Aktar et al., 2009).

Health problems pertaining to pesticide use are difficult to treat properly in most developing countries due to inadequate medical facilities, inherent poverty conditions, and improperly trained medical personnel. The vulnerable population who are generally exposed to pesticide and other chemicals tend to ignore the impacts on health due to financial constraints and lack of awareness. Use of pesticide in India began in 1948 when dichlorodiphenyltrichloroethane (DDT) and Benzene Hexachloride (BHC) were imported for malaria and locust control (Devi, 2007). The production of BHC began in 1952 with the establishment of a plant in Kolkata (Aktar et al., 2009) and India now ranks second in the production of pesticide in Asia after China, and fourth globally in 2017 (CARE, 2017). The pesticide residues in food in India are reported to be amongst the highest in the world (Devi, 2007; *The Economic Times*, 2015). It may also be noted that the pattern of pesticide usage in India is different from that of the rest of the world in general. In India, 76% pesticide used is insecticide, as against 44% used globally (Aktar et al., 2009). The main use of pesticides in India is for cotton crops (54%), followed by paddy (17%), and fruits and vegetables (13%) (Devi, 2007).

After the first reported incidence of pesticide contamination in Kerala in 1958, when nearly 100 people died after consuming wheat flour contaminated with Folidol (Karunakaran, 1958), a special committee on the harmful effects of pesticides was constituted by the Indian Council for Agricultural Research, New Delhi. This has been followed by quite a few supervisory and regulatory interventions by governments; however, significant levels of contamination have been reported from across different regions in the country. For instance, the All India Coordinated Research Project on Pesticides Residue (AICRPPR) conducted a research on 4,111 samples from various states in India between 1986–96 and found that around 55% samples were contaminated and about 10% exceeded their Maximum Residue Limit (MRLs). In general, milk, fruits, and vegetables in India are the most contaminated food items. Likewise, the Indian Council of Medical Research analysed 487 samples of milk and baby food from 14 different states. Majority of the milk samples were found to be contaminated with residues of either DDT or HCH or both, and invariably, these exceeded their prescribed MRL levels (Down to Earth, 2003).

Devi (2007) has argued that pesticide use is unscientific at all levels—from selection of chemicals to handling practices and leads to health damage to the tune of Rs 38 per day per individual. However, this estimate is conservative as it does not consider chronic illness and public expenditure on health. The wheat-paddy monoculture in Punjab has also led to increased use of these chemicals to maintain the yield levels (Sidhu et al., 2007), which has led to a gradual build-up of chemicals in soils and groundwater. The Malwa region of Punjab has been described as India's “cancer capital” due to abnormally high number of cancer cases, which have increased three-fold in the last 10 years. The unusually high incidence of cancer has been linked to the use of pesticides by cotton farmers, among other factors. Likewise, several studies have shown pesticide residues in breast milk, bovine milk, fruits, and vegetables from Punjab (Kalra et al., 1994). In short, almost every food item that traverses the journey from farm to table gets contaminated with these chemicals and poses serious threats to human health.

Straw burning

Among the recent, and a major environmental concern associated with the adoption of modern agricultural practices is paddy straw burning^{iv} which has been reported in the northern regions of India. Crop residue generated in the fields is usually left for burning as it is a quick and convenient way of disposing the agricultural waste. The incineration of straw exposes people to extremely high levels of Particulate Matter (PM) concentration in the immediate vicinity and also contributes between 12 to 60% PM concentrations in the regional pollution as per various source apportionment studies (Mukherjee, 2016). It is also a source of greenhouse gas emissions (GHGs) and other chemically and

radiative trace gases and aerosols such as CH₄, CO, N₂O, NO_x, and other hydrocarbons (GoI, 2014b; Jain et al., 2014). Besides environmental degradation, these emissions have serious repercussions on human health such as coughing, chronic bronchitis, heart diseases, drowsiness, headaches, nausea, asthma, and lung disorders (Kumar & Joshi, 2013; Kumar et al., 2015; Lohan et al., 2018). Several studies have ascribed greater threats for human health such as leukemia, blood bone marrow disease, vertigo, aplastic anemia, and pancytopenia (Duarte-Davidson et al., 2001; Chandra & Sinha, 2016). In addition, it causes loss of vital components such as nitrogen, phosphorus, sulphur, and potassium from the topsoil layer, making the land less fertile and unviable for agriculture in the long run (Mukherjee, 2016).

The combine-harvester technology which is more common in wheat and paddy leaves behind a large quantity of residue in fields and is difficult for the farmers to dispose off the same (Gupta et al., 2004). India annually produces gross crop residue of 371 million tons of which paddy and wheat residues contribute 51–57% and 27–36%, respectively. Cereal crops such as wheat, paddy, maize, and millets contribute 70% of the residue of which paddy is the major contributor. However, 84 % of the crop residue burning is from wheat and paddy (Lohan et al., 2018). The pioneering states of GR technology are the major contributors in straw burning and rice, wheat, and sugarcane are the major crops subjected to on-farm burning (Jain et al., 2014; Lohan et al., 2018). Punjab, alone produces about 20 million tons of rice straw and 17 million tons of wheat straw every year of which around 81% rice straw and 48% wheat straw is burnt in the open fields (ENVIS, 2017).

Besides leading to loss of soil fertility, it causes severe air pollution especially during the months of March–April and October–November. Majority of the research on crop burning focuses on Punjab and Haryana where the problem is critical. For instance, Punia et al., (2008) assess that total stubble burnt area in Punjab was around 4,315.35 km² as on 15 May 15, 2005. Crop burning is done by two methods: partial burning which involves running of combine harvester followed by burning of small stalks; second is complete burning in which the entire field is burnt. The latter process, which is more polluting, is more commonly practiced. As per the report by National Policy for Management of Crop Residues, the generation of crop residue is highest in Uttar Pradesh followed by Punjab and Maharashtra (See Appendix Table A1). As noted earlier, cereal crops (rice, wheat, millets, maize) contribute 70% in the residue, while rice alone constitutes 34% of the total share. The problem of “on-farm” burning of crop residue is increasing due to higher cost burden on the farmers, which is connected to the transition to mechanized harvesting, along with short-time duration between harvesting of one crop and sowing of the next crop (GoI, 2014b).

Groundwater depletion and contamination

Assured and adequate irrigation is critical to agriculture anywhere; however, it remains a challenge in large parts of the country due to lack of development of irrigation infrastructure and vagaries of the monsoons (Vaidyanathan, 1999; Dev, 2016); in fact, much of the Indian agriculture is, thus, rain-fed. Since the adoption of GR, there has been a significant increase in groundwater irrigation, especially in north-western India (Shah, 2007). This increase was mainly influenced by the production of water-intensive crops in the non-flood regions and partly by the use of subsidized power to pump groundwater from tube wells. Approximately, 90% Indian agricultural households are dependent on groundwater irrigation (Shiva, 1993; Joshi et al., 2004; Zaveri et al., 2016). Despite the stagnant area under cultivation, the use of water for irrigation purposes is rising substantially since the last three decades. Therefore, groundwater has played an important role in meeting the rising water demand for irrigation purposes which has led to widespread over-exploitation of this resource. Since 1980, the groundwater table has gone down from 8m to 16m in north-western India while it dropped from 1m to 8m for the rest of the country (Zaveri et al., 2016).

A number of studies have argued that decline in the water level can lead to increase in deprivation and threat of food security. It has serious implications for small farmers in terms of rising cost of capital replacement over the years as deepening of tube wells required due to fall in groundwater levels. The change in technology has also played a role in escalating the cost of cultivation. Such is the case for shift from centrifugal to submersible pumps (Singh, 2009). The cost of deepening of wells and buying submersible pumps is increasing but there are no worthwhile options left for farmers. These developments can be viewed as strategies to save the cultivation as their livelihoods.

Apart from the problem of over-exploitation of water, its contamination has emerged as a major issue concerning health hazards of population, in general and farmers, in particular due to increasing chemicalization of agriculture through fertilizers and pesticides, the latter possibly causing more damage (Singh, 2000; Kulkarni & Shankar, 2010; Kulkarni & Shah, 2013). The factors affecting water pollution with pesticides and their residues include drainage, rainfall, microbial activity, soil temperature, treatment surface, application rate as well as the solubility, mobility, and half-life of pesticides. Reports from Delhi, Bhopal, and other cities, and some rural areas have indicated the presence of significant level of pesticides in fresh water systems as well as bottled drinking mineral water samples (Agrawal et al., 2010). Pesticide consumption increased rapidly in India through the GR and into the mid-1990s, reaching 74.32 billion metric tons in the year 1995. Pesticide residues are often retained in soil for long periods of time and leach steadily into groundwater

thereby, affecting its quality. In Howrah district of West Bengal, for example, the groundwater of many areas is unfit for drinking due to elevated pesticide levels (Chakraborti et al., 2011).

The proportion of overstressed groundwater units in Punjab and Haryana, however, are the first and third highest in India at 77% and 59%, respectively (Gorton, 2017). North-east India has significantly lower levels of groundwater dependency for irrigation compared to the North-west and South India. For instance, only 19 % of units were found to be ‘critical’ or ‘semi-critical’ in West Bengal. The West Bengal Groundwater Resources Act 2005 states “no user shall sink any well for extracting or using groundwater without obtaining a permit” (The West Bengal Groundwater Resources Act, 2005). West Bengal is a unique state in India in which opportunities remain for sustainable groundwater expansion. However, northeast India also has its own share of problems with groundwater quality; it has the highest concentration of iron (>1.0 mg L⁻¹) in majority of these states along with a very high level of arsenic in groundwater, particularly in a substantial number of districts in West Bengal, which has been an area of major concern (Central Ground Water Commission 2010; Chakraborti et al., 2011). Contamination at this level poses serious health and water security risks to the population, including the heightened risk of cancer. Therefore, northeast India’s large groundwater reserves might not be usable without costly treatment for water contaminants.

It may also be noted that groundwater salinity is a growing problem in several Indian states, particularly in coastal areas, where previously sweet (fresh) groundwater sources are becoming saline due to overexploitation. In a number of states, instances of inland salinity have been documented, resulting mainly from excessive groundwater use for irrigation. In India, it has been estimated that about 2 million hectares of land are now affected by saline water. In some areas of Rajasthan and Gujarat, groundwater salinity is so high that it is utilized for salt production. The groundwater of 21 of 26 districts of Gujarat and 27 of 33 districts of Rajasthan is found to be too saline for consumption (Chakraborti et al., 2011). Nevertheless, the declining water table and contamination has direct impacts on health, it also has indirect implications on the lives of agrarian population through threat to the livelihoods. Thus, as should be evident from our brief discussion in this section, there are several critical challenges confronting Indian agriculture which include declining water table, contamination of groundwater, etc.

Highlighting Some Major Implications for Labour

The adoption of the modern agricultural practices in India brought a number of challenges for agricultural labour. Amongst these, two have obvious serious implications, namely, replacement of manual tasks with machinery and direct

exposure of agricultural workers with hazardous chemicals and machinery, which has been touched upon in the preceding section. The adoption of labour-saving technologies, particularly farm machinery, and use of herbicides and insecticides have displaced human labour to a great extent. In spite of increase in area under cultivation, cropping intensity, irrigated area, and a significant shift in cropping pattern, the demand for labour has gone down due to fast mechanization of various farm operations. There has been a tremendous increase in a number of tractors, tube wells, threshers, harvesters and other modern implements of agriculture. It is worth noting here that during 1960–61, 651 million-person days was the total labour requirement of agriculture in Punjab which declined to 638 million-person days in 1970–71, and subsequently came down to almost half in the next three decades (Singh & Singh, 2006).

Bhalla (1991) in her state-level analysis has shown that there is inverted u-shaped relationship between the usage of labour and the growth of agriculture. In the initial stages of adoption of modern agricultural techniques, there is an evidence of labour absorption, however, subsequent increase in yield accompanies decline in labour demand (Bhalla, 1991). The labour usage also depends upon gender, crop, and the specific agricultural operation (Vaidyanathan, 1986; Reddy et al., 2015). Operations such as weeding and harvesting are mostly female labour-intensive ones and when they are being mechanized, female labour is the most affected one (Agarwal, 1981). Agricultural workforce in some Indian states such as Andhra Pradesh experienced negative growth during the last decade and a half (Venkatanarayana, 2013). Various explanations have been put forward to explain this decline such as absorption of labour in non-farm pursuits, etc., but the trend indicates that the overall work participation rate (WPR) has declined which is beyond the explanation of increase in opportunities in other sectors (Reddy et al., 2015).

On the other hand, the supply of labour in agricultural sector has increased overtime due to a number of reasons such as increase in population and workforce, slow growth of non-farm employment opportunities, etc. (Jha, 1997, 2016; Singh, 2017). Thus, the total workforce mainly or partly dependent on agriculture doubled in the last four decades (GoI, 2013). This helps in keeping the pace of rural wage very low. There are a few activities left which are labour intensive, mainly where mechanization is still not possible, such as cotton picking. The overall human labour use for the major crops, particularly wheat and paddy has gone down significantly during the past three decades. The increasing gravity of the situation of unemployment and underemployment has been one of the fallouts of modern agricultural growth.

Due to mechanization of farm operations, etc., use of other labour-saving technical inputs, increased monoculture in cropping pattern, seasonality of employment has also increased (Shiva, 1993; Singh, 2002; Singh, 2012), which has been seriously detrimental for workers. One obvious causality is regular farm work, which was quite common a few decades ago, but vanishing rapidly. Most workers, who were generally hired for year-long agricultural operations, are hired on piece rate work. Seasonality of work has also increased the seasonal, multi-locational, and pluri-activity migration of labour (Jha, 1997, 2004, 2007; Srivastava, 2000; Deshingkar & Start, 2003). Workers migrate from one region to another depending upon the timings of harvesting/sowing in different regions. Therefore, these workers migrate to multiple locations which invite various problems such as health ailments, displacement, sociological issues, etc. (Deshingkar & Farrington, 2009).

As one of the outcomes of seasonality, the share of casual labour in total human labour use has increased. A study conducted by Reddy et al. (2015), which estimated casualisation in agriculture for various crops and states of India, revealed that almost 54% of the total labour use in Indian agriculture is casual. As far as the crops are concerned, casualisation ranges from sugarcane (67.1%) followed by paddy (51.9%), cotton (49.5%), maize (42.7%), chickpea (38.8%), and wheat (35%). As far as states are concerned, the extent of casualization for all the crops is relatively high in Andhra Pradesh, Karnataka, Tamil Nadu, Bihar, Maharashtra and Punjab, while lower in Rajasthan, Madhya Pradesh, Uttar Pradesh, and West Bengal. Overall, incidence of casual labour use is observed to be well below national average for all crops in Rajasthan and Madhya Pradesh; this might be due to lower population pressure on agricultural land and slower pace of mechanization of agriculture in these two states (Reddy et al., 2015).

The erosion of livelihood due to mechanization and adoption of modern agricultural techniques has been much talked about. But we also need to note that agrarian structures under modern agricultural practices have also experienced a significant change; the distribution of land, especially, operational holdings, has been moving in favour of top-sized groups resulting in increased land concentration in India, particularly in agriculturally advanced states (Nair & Banerjee, 2012). The farmers in the bottom-sized groups have slowly shifted out of agriculture to other sectors of the economy for a variety of reasons, especially after the ascendancy of neo-liberal economic reforms. There has been a significant increase in the share of medium and large operational holdings through leasing out of land by marginal and small farmers. A number of studies have pointed out this phenomenon as reverse tenancy. Gill (2002) has shown a shift of land from the small and marginal farmers to the medium and large farmers since the 1970s for Punjab. Grewal and Rangi (1981) have

confirmed that most of the leasing out is by the small owners and leasing in is by the big operators. This is starkly evident from the increasing land concentration in the GR belt of India, in the north-western region.

The surplus labour force of small and marginal farmers either undertakes multitasking and gets involved in irregular wage labour, or comes up with small-scale often uneconomical, self-employed activities in rural regions (Singh, 2017). Slow growth of the non-farm sector, marginalization of holdings and an increasing number of cultivators becoming agricultural labourers are aggravating the situation. Other factors such as globalization of agricultural prices due to liberalization have exposed farmers to global competition and have put them in a precarious situation (Raju et al., 2015). In such circumstances, it is not surprising that there are increasing demands for safety-net programs not only for agricultural labourers but also a substantial section of farmers as well.

Concluding Remarks

As discussed, India adopted GR strategies in the late 1960s to cope with severe challenges of food availability and higher food grain production has been achieved through the adoption of chemical agricultural practices. At the current juncture, the agricultural sector is facing multiple risks such as groundwater depletion and contamination, loss of soil fertility, air pollution, viability issues, etc. These risks are ultimately affecting the health and safety of agricultural workers and farmers through intensive use of pesticides and fertilizers, contamination of water, air pollution, etc. Loss of livelihood due to marginalization and reverse tenancy is the indirect consequence of adoption of modern agricultural techniques. During the four decades of GR, Indian agriculture has experienced a lot of changes including bio and mechanical technology and institutional innovations to boost up its growth; however, occupational safety measures still seem to be at a primitive stage. It would, hardly be an exaggeration, taking into account all the above-noted risks and challenges, that the country is confronting an enormous “silent crisis” which is screaming for policy attention.

There are several challenges in improving OSH in Indian agriculture. Majority of the workers in agriculture are in the informal sector, hence, they are largely devoid of any social security or safety provisions that could cover health hazards at the workplace. This gets compounded given the nature of the country’s federal structure, where agriculture is a state subject, but union government gives guidance and occasional assistance to the states. The responsibility of implementation of any program rests with the state governments. Apart from deficient public-sector provisioning on OSH, the private investment on safety gadgets have been negligible partly due to

subsistence scale of farming in India (about 84% are small and marginal farmers, having less than 2 ha land).

Currently, India's occupational safety needs can be classified under four broad heads—legislation, awareness, responsible public provisioning, and infrastructure development. These challenges can be dealt with essential prerequisites of a firm legislative base, user regular guidance, and strong data base on farm practices. Taking into consideration the importance of data and information on the causes and consequences of agriculture-related hazards, one of the key suggestions is to incorporate questions in the already existing data sets related to agriculture such as NSSO, Agricultural Census, and CACP, etc. This will help understand the extent and the regional aspects of hazards related to agriculture, and region-specific policies can be drawn to enhance safety. Second, since the agricultural sector in India is led by self-employed small and marginal farmers, the challenges in this sector cannot be solved only by focussing on the large players. Third, to disseminate the precautions, guidance, and advisories to the farmers and agricultural workers, the existing agricultural extension institutions can be utilized efficiently such as Krishi Vigyan Kendra (KVKs).^v To move in the direction suggested here, it is absolutely necessary that governments in India, at different levels, coordinate with well-designed interventions in multiple areas with a long-term vision.

References

- Agarwal, B. 1981. "Agricultural Mechanisation and Labour Use: a Disaggregated Approach", *International Labour Reserves*, 120(1): 115–27.
- Agrawal, A., R.S. Pandey, & B. Sharma. 2010. "Water Pollution with Special Reference to Pesticide Contamination in India", *Journal of Water Resource and Protection*, 2(5): 432–48.
- Aktar, M.W., D. Sengupta, & A. Chowdhry. 2009. "Impact of Pesticide Use in Agriculture: their Benefits and Hazards", *Interdisciplinary Toxicology*, 2(1): 1–12.
- Bagchi, A.K. 1984. "Towards a Political Economy of Planning in India", *Contributions to Political Economy*, 3(1): 15–38.
- Bagchi, A.K. 1991. "From a Fractured Compromise to a Democratic Consensus: Planning and Political Economy in Post-Colonial India", *Economic and Political Weekly*, 26(11/12): 611–28.
- Banaji, J. 1972. "For a Theory of Colonial Modes of Production", *Economic and Political Weekly*, 7(52): 2498–2502.
- Bhalla, G.S., & G. Singh. 2009. "Economic Liberalisation and Indian Agriculture: a State-wise Analysis", *Economic and Political Weekly*, 44(52): 34–44.
- Bhalla, S. 1991. "Speeding up Agricultural Growth: Implications for Labour Absorption", in *National Seminar on Rural Development (26–27 April 1991)*, Lucknow; accessed on 2 May 2018 at <http://isid.org.in/pdf/speeding.PDF>.
- Byres, T.J. (ed.). 1997. *The State, Development Planning and Liberalisation in India*. Delhi; New York: Oxford University Press.
- CARE. 2017. "Executive Summary, Outlook of Indian Pesticide Industry", <http://www.careratings.com/upload/NewsFiles/SplAnalysis/Outlook%20of%20Indian%20Pesticide%20Industry.pdf>. Accessed on 30 September 2018.

- Central Ground Water Commission. 2010. "Annual Report 2010–2011", <http://cgwb.gov.in/Annual-Reports/Annual%20Report%202010-11.pdf>. Accessed on 20 May 2018.
- Central Ground Water Commission. 2016. "Ground Water Scenario in India", Ministry of Water Resources, Govt of India. http://cgwb.gov.in/Ground-Water/GW%20Monitoring%20Report_January%202016.pdf. Accessed on 20 May 2018.
- Chakraborti, D., B. Das, & M.T. Murrill. 2011. "Examining India's Groundwater Quality Management", *Environment Science and Technology*, 45(1): 27–33.
- Chakravarty, Sukhamoy. 1987. *Development Planning: The Indian Experience*. Delhi: Oxford University Press.
- Chandra, B.P. & V. Sinha. 2016. "Contribution of Post-harvest Agricultural Paddy Residue Fires in the NW Indo-Gangetic Plain to Ambient Carcinogenic Benzenoids, Toxic Isocyanic Acid and Carbon Monoxide", *Environment International*, 88: 187–97.
- Chatterjee, Partha. 1997. "Development Planning and the Indian State", in T.J. Byres (eds), *The State, Development Planning and Liberalisation in India*. New Delhi: Oxford University Press, pp. 82-103.
- Das, B. 2014. "Agricultural Work-related Injuries among the Farmers of West Bengal, India", *International Journal of Injury Control and Safety Promotion*, 21(3): 205–15.
- Deshingkar, P., & D. Start. 2003. "Seasonal Migration for Livelihoods in India: Coping, Accumulation and Exclusion", Working Paper no. 220. London: Overseas Development Institute.
- Deshingkar, P., & J. Farrington. 2009. *Circular Migration and Multilocational Livelihoods Strategies in Rural India*. New Delhi: Oxford University Press.
- Dev, S.M. 2016. "Water Management and Resilience in Agriculture", *Economic and Political Weekly*, 51(8): 21–24.
- Devi, P.I. 2007. "Pesticide Use in the Rice Bowl of Kerala: Health Costs and Policy Options", Working paper No. 20–07", South Asian Network for Development and Environmental Economics (SANDEE), Nepal, https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/4284/764_PUB_work_ingpaper_20_indira.pdf?sequence=1. Accessed on 16 May 2018.
- Digby, W. & D. Naoroji. 2014. "Bengal Famine of 1943", *Economic & Political Weekly*, 49(11): 71–75.
- Down to Earth. 2003. *Pesticides in Our Food*. <http://www.downtoearth.org.in/coverage/pesticides-in-our-food-13861>. Accessed on 24 May 2018.
- Duarte-Davidson, R., C. Courage, L. Rushton, & L. Levy. 2001. "Benzene in the Environment: an Assessment of the Potential Risks to the Health of the Population", *Occupational and Environmental Medicine*, 58(1): 2–13.
- ENVIS. 2017. *Air Pollution from Agricultural & Domestic Practices*, ENVIS Centre Punjab, <http://punenvis.nic.in/index2.aspx?slid=5971 &mid=1&langid=1&sublinkid=1140>. Accessed on 25 May 2018.
- Forget, G. 1993. "Balancing the Need for Pesticides with the Risk to Human Health", in *Impact of Pesticide Use on Health in Developing Countries: Proceedings of a Symposium Held in Ottawa, Canada, 17–20 September 1990*. Ottawa, ON, Canada: IDRC.
- Gill, S.S. 2002. "Rapporteur's Report on Institutional Reforms for Agricultural Growth", *Indian Journal of Agricultural Economics*, 57(3): 637–52.
- Gite, L.P., A. Khadatkhar, & K.K. Tyagi. 2010. "Farm Machinery Accidents in Indian Agriculture", Conference Paper, https://www.researchgate.net/profile/Abhijit_Khadatkhar/publication/262457121_Farm_machinery_accidents_in_Indian_agriculture/links/57872bcc08aef321de2c79e2/Farm-machinery-accidents-in-Indian-agriculture.pdf. Accessed on 16 May 2018.

- GoI. 2011. Report of The Working Group on Occupational Safety and Health for The Twelfth Five Year Plan (2012 to 2017). New Delhi: Ministry of Labour and Employment.
- GoI. 2013. Key Indicators of Employment and Unemployment in India, 2011–12, 68th Round, National Sample Survey Office, New Delhi: Ministry of Statistics and Programme Implementation.
- GoI. 2014a. “All India Report on Number and Area of Operational Holdings. Agricultural Census, 2010–11”, Department of Agriculture and Cooperation. New Delhi: Ministry of Agriculture and Farmers Welfare.
- GoI. 2014b. National Policy for Management of Crop Residue. New Delhi: Ministry of Agriculture and Farmers Welfare.
- Gorton, C. 2017. “India’s Groundwater Crisis: the Consequences of Unsustainable Pumping”, Strategic Analysis Paper. Future Directions International, <http://www.futuredirections.org.au/publication/indias-groundwater-crisis-consequences-unsustainable-pumping/>. Accessed on 30 May 2018.
- Grewal, S.S., & P.S. Rangi. 1981. “Analysis of Agrarian Structure in the Punjab”, *Indian Journal of Agricultural Economics*, 36(4):173–83.
- Gupta, P.K., S. Sahai, N. Singh, C.K. Dixit, D.P. Singh, C. Sharma, and S.C. Garg. 2004. “Residue Burning in Rice–wheat Cropping System: Causes and Implications”, *Current Science*, 87(12): 1713–1717.
- Hurley, P.M. 1998. “Mode of Carcinogenic Action of Pesticides Inducing Thyroid Follicular Cell Tumors in Rodents”, *Environmental Health Perspectives*, 106(8): 437–45.
- Huston, A.F., & C. Smith. 1969. “Farm Accidents in Saskatchewan”, *Canadian Medical Association Journal*, 100(16): 764–69.
- ICSSR. 1980. Alternatives in Agricultural Development (An ICSSR Working Group Report). New Delhi: Allied Publishers Pvt, Ltd.
- Jain, N., A. Bhatia, & H. Pathak. 2014. “Emission of Air Pollutants from Crop Residue Burning in India”, *Aerosol and Air Quality Research*, 14(1): 422–30.
- Jeyaratnam, J. 1985. “Health Problems of Pesticide Usage in the Third World”, *British Journal of Industrial Medicine*, 42(8): 505–6.
- Jha, D.C. 1976. “US Policy towards India”, *The Indian Journal of Political Science*, 37(1): 41–70.
- Jha, P. 1997. *Agricultural Labour in India*. New Delhi: Vikas Publishers.
- Jha, P. 2004. “Continuity and Change: Some Observations on the Landscape of Agricultural Labourers in North Bihar, India”, *Journal of Agrarian Change*, 4(4): 509–31.
- Jha, P. 2007. “Some Aspects of the Well-being of India’s Agricultural Labour in the Context of Contemporary Agrarian Crisis”, *Indian Journal of Labour Economics*, 49(4): 741–64.
- Jha, P. 2016. *Labour in Contemporary India*. New Delhi: Oxford University Press.
- Joshi, P.K., A. Gulati, P.S. BIRTHAL, & L. Tewari. 2004. “Agriculture Diversification in South Asia: Patterns, Determinants and Policy Implications”, *Economic and Political Weekly*, 39(24): 2457–467.
- Kalra, R.L., B. Singh, & R.S. Battu. 1994. Organochlorine Pesticide Residues in Human Milk in Punjab, India, *Environmental Pollution*, 85(2): 147–51.
- Karunakaran, C.O. 1958. “The Kerala Food Poisoning”, *Journal of the Indian Medical Association*, 31(5): 204–7.
- Knapp, L.W. 1965. “Agricultural Injuries Prevention”, *Journal of Occupational and Environmental Medicine*, 7(11): 553–745.
- Kulkarni, H., & M. Shah. 2013. “Punjab Water Syndrome”, *Economic and Political Weekly*, 48(52): 65–73.
- Kulkarni, H., & P.V. Shankar. 2010. “Sustainable Groundwater Management: Challenges for the 21st Century”, in *International Conference on Dynamics of Rural Transformation in Emerging Economies*, New Delhi.

- Kumar, A., J. K. Singh, D. Mohan, & M. Varghese. 2008. "Farm Hand Tools Injuries: A Case Study from Northern India", *Safety Science*, 46(1): 54–65.
- Kumar, G. P., & K.N. Dewangan. 2009. Agricultural Accidents in North Eastern Region of India, *Safety Science*, 47(2): 199–205.
- Kumar, P., & L. Joshi. 2013. "Pollution Caused by Agricultural Waste Burning and Possible Alternate Uses of Crop Stubble: a Case Study of Punjab", in Sunil Nautiyal, K.S. Rao, Harald Kaechele, K.V. Raju, Ruediger Schaldach (eds), *Knowledge Systems of Societies for Adaptation and Mitigation of Impacts of Climate Change*. Berlin Heidelberg: Springer Science & Business Media, pp. 367–85.
- Kumar, P., S. Kumar, & L. Joshi. 2015. *Socioeconomic and Environmental Implications of Agricultural Residue Burning: a Case Study of Punjab, India*. Springer Open.
- Lohan, S.K., H.S. Jat, A.K. Yadav, H.S. Sidhu, M.L. Jat, M. Choudhary, & P.C. Sharma. 2018. "Burning Issues of Paddy Residue Management in North-west States of India", *Renewable and Sustainable Energy Reviews*, 81(1): 693–706.
- Mittal, S., G. Kaur & G.S. Vishwakarma. 2013. "Effects of Environmental Pesticides on the Health of Rural Communities in the Malwa Region of Punjab, India: a Review", *Human and Ecological Risk Assessment: An International Journal*, 20(2): 366–87.
- Mittal, V.K., B.S. Bhatia, & S.S. Ahuja. 1996. "A Study of the Magnitude, Causes, and Profile of Victims of Injuries with Selected Farm Machines in Punjab", Final Report of ICAR Adhoc Research Project, Department of Farm Machinery and Power Engineering, Punjab Agricultural University, Ludhiana, India.
- Mohan, D., & R. Patel. 1992. "Design of Safer Agricultural Equipment: Application of Ergonomics and Epidemiology", *International Journal of Industrial Ergonomics*, 10(4): 301–9.
- Monk, J., & C.S. Alexander. 1986. "Free Port Fallout: Gender, Employment, and Migration on Margarita Island", *Annals of Tourism Research*, 13(3): 393–413.
- Mukharji, Anjan. 2002. *An Introduction to General Equilibrium Analysis: Walrasian and Non-Walrasian Equilibria*. New Delhi: Oxford University Press.
- Mukherjee, P. 2016. *Crop Burning: Punjab and Haryana's Killer Fields*. Down to Earth, <http://www.downtoearth.org.in/news/crop-burningpunjab-haryana-s-killer-fields-55960>. Accessed on 15 May 2018.
- Nair, K.N., & A. Banerjee. 2012. "Structural Changes in Land Distribution and Its Implications for Improving Access to Land", in D. Narayana and Raman Mahadevan (eds), *Shaping India: Land, Population, Institutions and State in Historical Perspective*, New Delhi: Routledge, pp. 46–66.
- Patel, S.K., M.R. Varma, & A. Kumar. 2010. "Agricultural Injuries in Etawah District of Uttar Pradesh in India", *Safety Science*, 48(2): 222–29.
- Patnaik, P., & C.P. Chandrasekhar. 1995. "Indian Economy under 'Structural Adjustment'", *Economic and Political Weekly*, 30(47): 3001–13.
- Patnaik, U. 1999. *The Long Transition: Essays on Political Economy*. New Delhi: Tulika Publishers.
- Patnaik, U. 2007. *The Republic of Hunger and Other Essays*. Gurgaon: Three Essays Collective.
- Pickett, W., L. Hartling, R.J. Brison, & J.R. Guernsey. 1999. "Fatal Work-related Farm Injuries in Canada, 1991–1995", *Canadian Medical Association Journal*, 160(13): 1843–48.
- Punia, M., V.P. Nautiyal, & Y. Kant. 2008. "Identifying Biomass Burned Patches of Agriculture Residue Using Satellite Remote Sensing Data", *Current Science*, 94(9): 1185–90.
- Raju, S.S., A. Suresh, R. Chand, & S. Chauhan. 2015. "Pattern and Trend in Labour Use in Indian Agriculture: An Analysis across Major Crops and States", *Economic Affairs*, 60(1): 99–108.

- Rao, T.N. 1949. "Directive Principles of State Policy", *The Indian Journal of Political Science*, 10(3): 16–18.
- Reddy, A.A., C. Rani, & G.P. Reddy. 2015. "Labour Scarcity and Farm Mechanisation: A Cross State Comparison", *Indian Journal of Agriculture Economics*, 69(3): 347–58.
- Roy, T. 2002. "Economic History and Modern India: Redefining the Link", *Journal of Economic Perspectives*, 16(3): 109–30.
- Sen, A. 1977. "Starvation and Exchange Entitlements: a General Approach and Its Application to the Great Bengal Famine", *Cambridge Journal of Economics*, 1(1): 33–59.
- Shah, T. 2007. "The Groundwater Economy of South Asia: an Assessment of Size, Significance and Socio-ecological Impacts", in Mark Giordano and Karen G. Villholth (eds), *The Agricultural Groundwater Revolution: Opportunities and Threats to Development*. Colombo: International Water Management Institute, pp. 7–36.
- Sharma, V. 2013. *Farm Accidents and Financial Assistance Provided to Victims in Punjab*. Chandigarh: Institute for Development and Communication.
- Shepherd, A. 1998. *Sustainable Rural Development*. New York: Palgrave.
- Shiva, V. 1993. *Monocultures of the Mind: Perspectives on Biodiversity and Biotechnology*. London, New York & Malaysia: Palgrave Macmillan.
- Shiva, V., A. Emani, & A.H. Jafri. 1999. "Globalisation and Threat to Seed Security: Case of Transgenic Cotton Trials in India", *Economic and Political Weekly*, 34(10–11): 601–13.
- Sidhu, R.S., J.S. Sidhu, & A.S. Bhullar. 2007. "Dynamics of Natural Resources Use and Economic Outcomes in Punjab Agriculture Degradation, Causes, Impacts and Management Strategies", in *International Conference on 21st Century Challenges to Sustainable Agri-Food Systems: Biotechnology, Environment, Nutrition, Trade and Policy*, 15th-17th March, 2007, New Delhi: IK International Pvt Ltd., p. 354.
- Singh, G. 2012. *Depeasantization in Punjab: Processes and Determinants*. Germany: Lambert Academic Publishing.
- Singh, G. 2017. "Rural Nonfarm Employment in India Since the Early 1980s: A Comparative Study of Punjab and Bihar". New Delhi: Unpublished thesis submitted at Jawaharlal Nehru University.
- Singh, G., & J. Singh. 2006. "Green Revolution and Economic Plight of Agricultural Labour in Punjab", *The Indian Journal of Labour Economics*, 49(4), 855–62.
- Singh, Karam. 2009. "Agrarian crisis in Punjab: High Indebtedness, Low Returns and Farmers Suicides", in D. Narasimha Reddy & Srijit Mishra (eds), *Agrarian Crisis in India*. New Delhi: Oxford University Press, pp. 261–84.
- Singh, R.B. 2000. "Environmental Consequences of Agricultural Development: a Case Study from the Green Revolution State of Haryana, India", *Agriculture, Ecosystems & Environment*, 82(1–3): 97–103.
- Singh, R., A.K. Sharma, S. Jain, S.C. Sharma, & N.K. Magu. 2005. "Wheat Thresher Agricultural Injuries: a By-product of Mechanised Farming", *Asia Pacific Journal of Public Health*, 17(1): 36–9.
- Singh, S. 2002. "Contracting Out Solutions: Political Economy of Contract Farming in the Indian Punjab", *World Development*, 30(9): 1621–38.
- Srivastava, R. 2000. "Changes in Contractual Relations in Land and Labour in India", *Indian Journal of Agricultural Economics*, 55(3): 253–82.
- The Economic Times. 2015. *High Pesticides in Vegetables and Other Foods: Government Report*. <https://economictimes.indiatimes.com/news/economy/agriculture/high-pesticides-in-vegetables-and-other-foods-governmentreport/articleshow/46108223.cms>. Accessed on 30 September 2018.
- Tiwari, P.S., L.P. Gite, A.K. Dubey, & L.S. Kot. 2002. "Agricultural Injuries in Central India: Nature, Magnitude, and Economic Impact", *Journal of Agricultural Safety and Health*, 8(1): 95–111.

- Vaidyanathan, A. 1986. Labour Use in Rural India: A Study of Spatial and Temporal Variations, *Economic and Political Weekly*, 21(52): A130–A146.
- Vaidyanathan, A. 1999. *Water Resource Management: Institutions and Irrigation Development in India*. New Delhi: Oxford University Press.
- Varghese, M., & D. Mohan. 1990. Occupational Injuries among Agricultural Workers in Rural Haryana, India, *Journal of Occupational Accidents*, 12(1–3), 237–44.
- Venkatanarayana, M. 2013. Prospects of Employment Growth in Andhra Pradesh. MPRA Paper, (48381). https://mpa.ub.uni-muenchen.de/48381/1/MPRA_paper_48381.pdf. Accessed on 27 May 2018.
- West Bengal Act XVIII. 2005. The West Bengal Ground Water Resources (Management, Control and Regulation) Act, 2005.
<http://www.indiawaterportal.org/sites/indiawaterportal.org/files/The%20West%20Bengal%20groundwater%20resources%20%28management%2C%20control%20and%20regulation%29%20act%20%282005%29.pdf>. Accessed on 1 October 2018.
- Zaveri, E., D.H. Wrenn, & K. Fisher-Vanden. 2016. Water in the Balance: The Impact of Water Infrastructure on Agricultural Adaptation to Rainfall Shocks in India, in 2016 Annual Meeting, July 31-August 2, 2016, Boston, Massachusetts (No. 236216). Agricultural and Applied Economics Association.

Appendix

Table A1: A summary of studies on accidents in Indian agriculture

Study	Region(s)	No. of Accidents Reported	Type of accidents	Major reasons
Mohan and Patel (1992)	Haryana, Punjab and Uttar Pradesh	576	87% minor, 1% moderate, 2% severe	Power operated fodder cutters, tractors
Mittal et al. (1996)	Punjab	36	8.3% fatal 91.7% non-fatal	Tractors
Tiwari et al. (2002)	Madhya Pradesh	17,480	9.2% Fatal 90.8 non-fatal	Tractors and snakebites
Singh et al. (2005)	Punjab	52	Amputation of the upper limbs	Thresher
Kumar et al. (2008)	Punjab and Haryana	576	Non-fatal	Hand tools and other farm machinery
Patel et al. (2010)	Uttar Pradesh	106	Fatal	Tractors and other farm machinery
Das (2014)	West Bengal	323	Non-fatal	Hand tools and farm machinery
Sharma (2013)	Punjab	8760	Non-fatal	Tractor and its related implements, combine harvesters, threshers, and chaff-cutters
Gite et al. (2010)	Various Indian states	2290	6% fatal 94% non-fatal	Tractors, threshers, electric motor, pumps tillers, sprayers

Source: Authors' compilation

Table A2: State-wise Crop Residue (in Million Tonnes)

States	Residue generation	Residue surplus	Residue burnt
Andhra Pradesh	43.89	6.96	2.73
Arunachal Pradesh	0.40	0.07	0.04
Assam	11.43	2.34	0.73
Bihar	25.29	5.08	3.19
Chhattisgarh	11.25	2.12	0.83
Goa	0.57	0.14	0.04
Gujarat	28.73	8.90	3.81
Haryana	27.83	11.22	9.08
Himachal Pradesh	2.85	1.03	0.41
Jammu & Kashmir	1.59	0.28	0.89
Jharkhand	3.61	0.89	1.10
Karnataka	33.94	8.98	5.66
Kerala	9.74	5.07	0.22
Madhya Pradesh	33.18	10.22	1.91
Maharashtra	46.45	14.67	7.42
Manipur	0.90	0.11	0.07
Meghalaya	0.51	0.09	0.05
Mizoram	0.06	0.01	0.01
Nagaland	0.49	0.09	0.08
Odisha	20.07	3.68	1.34
Punjab	50.75	24.83	19.65
Rajasthan	29.32	8.52	1.78
Tamil Nadu	19.93	7.05	4.08
Uttarakhand	2.86	0.63	0.78
Uttar Pradesh	59.97	13.53	21.92
West Bengal	35.93	4.29	4.96
Total	501.73	140.84	92.81

Source: GoI (2014b).

ⁱThere are a large number of excellent references that interested readers may refer to for an adequate discussion of these issues; Mukharji (2002).

ii We may also note here that given India's Constitution (adopted in 1950), which laid out a framework for fiscal and financial federalism, several sectors and areas came primarily within the jurisdiction of the state (provincial) governments; agriculture was one such area. Hence, it is not only the historical legacy in different provinces of the country vis-à-vis agriculture, on the eve of independence, but the differences in policies and budgetary priorities across states, which are critical in understanding the trajectory and performance of this sector since independence.

iii The Mines Act, 1952; The Factories Act, 1948; Dock Workers (Safety, Health and Welfare) Act, 1986; The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996; The Dangerous Machines

(Regulation) Act, 1983; The Insecticides Act, 1968; The Shops and Establishments Act of State Governments; The Beedi and Cigar Workers' (Conditions of Employment) Act, 1966; The Municipal Solid Waste (Management and Handling) Rules, 2000 notified under the Environment (Protection) Act, 1986; The Manufacture, Storage & Import of Hazardous Chemicals Rules, 1989; The Electricity Act, 2003; etc.

iv Water-saving regulations ban transplantation of paddy before 15 June to match the monsoon period so that the extent of groundwater irrigation can be minimized.

However, this practice leaves little time for farmers to harvest paddy and prepare the field for the next crop-wheat before 15 November (which is the suitable time for sowing of wheat so that it matures in the mid-April, when the temperature is suitable for its harvest). Further, it involves cutting cost and does not provide any economic incentive since paddy straw cannot be used as cattle feed due to high concentration of silica and lignin which are indigestible for cattle.

v Krishi Vigyan Kendras (KVKs) are agricultural extension centers created by ICAR (Indian Council for Agricultural Research) and its affiliated institutions at district-level to provide various types of farm support to farmers.

2. Gender Dimensions of Occupational Health Risks among Non-standard Agricultural Workers in Ghana

Angela D. Akorsu, Emmanuel Y. Tenkorang, and Loretta Baidoo

Globally, the agricultural sector employs half of the world's labor force with an estimated number of 1.3 billion workers being active in the segment (Johnson, 2016). In developing countries, about 63% of the population is involved in agricultural activities (Pyykkönen & Aherin, 2012). These contributions notwithstanding, agricultural work is known as one of the most dangerous sectors due to its associated occupational health and safety concerns. According to ILO, “agriculture is one of the three most dangerous sectors in terms of work-related fatalities, non-fatal accidents, and occupational diseases” (2013: 23).

Though the promotion of safe livelihoods embedded in equitable agricultural production systems remains an age-old concern, it has become even more pertinent in view of recent global developments in the world of work (Standing, 2011). Economic growth, associated with joblessness in the formal sector in the Global South, indicates the growth of informal economy activities or non-standard work forms, even among plantation agricultural workers. Non-standard work forms are characterized by insecurities, precarity, social risks, and indecent working conditions. According to Siegmann and Schiphorst (2016), non-standard work is the new global norm. Today, agricultural workers, especially non-standard agricultural workers, are among the marginalized occupational groups with poor working and living conditions (ILO, 2013; Yiha & Kumie, 2010).

There exists, in addition, differences in the experiences of agricultural workers' safety and health conditions. The differences arise from variations in social identity markers such as gender, age, class, migration status, and rural/urban location (Chaturvedi, 2001). Gender, however, remains one of the important markers determining access to resources and the nature of agricultural tasks an individual performs. Agricultural production, particularly, is so much controlled by patriarchal systems that safety and health challenges are gendered with different implications for males and females.

Even more pertinent to this discourse is that several authors allude to the fact that women's health and safety situations receive very little attention in mainstream literature generally, regardless of the contextual variations (Kane, 1998; London et al., 2002; Messing et al., 2003; Habib et al., 2014). Kane (1998) mentions severity comparisons often made between women and men's injuries as well as the aggregating of data as plausible explanations to the neglect of women's occupational health issues in academic discourse. In addition, though safety and health issues confronting males in agriculture have been relatively well studied and reported, their safety and health experiences are

hardly linked to their gendered position regardless of the strong connection (Messing et al. 2003).

Ghana's economy can still be described as agrarian considering the significant contribution of the agricultural sector to the nation's Gross Domestic Product (GDP), foreign exchange earnings, and employment. In 2015, the estimated contribution of the agricultural sector to Ghana's GDP was a little over 20% (GSS, 2013; MoFA, 2016). The sector generates about 75% of the country's foreign exchange earnings and employs about 70% of its rural workforce (GSS, 2013). While women in agriculture in Ghana constitute 52%, they tend to be landless, peasant farmers, and unpaid household laborers, performing various gendered tasks on their husbands' farms, bearing the adverse consequences on their health and safety (Duncan & Brants, 2004; Britwum et al., 2014; Britwum & Akorsu, 2016). For Ghana, ignoring the safety and health conditions of females in agriculture means disregarding the safety and health issues of a majority of its agricultural labour force. This includes 70% of the predominantly subsistence labour force and 95% of the operators in food distribution, agro-processing, and marketing as estimated by the World Bank (2008).

The need for knowledge creation around the gendered nature of agricultural production and its ensuing health and safety issues for diagnostic and policy purposes cannot be overemphasized. The core argument is that besides the vulnerability created by informality, the gendered nature of agricultural production further intensifies vulnerability to occupational health and safety risks. If the agricultural production relations (APRs) are gendered, safety and health issues will be gendered. The focus of this chapter is to explore the gendered nature of APR (which is culture specific) and the ensuing gendered nuances in occupational health and safety (OSH) issues. The chapter further shows that, without the conceptual link between APR and OSH, a critical analytical gap remains in the literature; and OSH concerns remain intractable and unresponsive to policy efforts.

The chapter is organised into six sections, including this introductory part, which sets the background by briefly presenting existing discourses on women's situation in agriculture and the need to interrogate the issue further. The second section reviews literature on APRs. The study context is the third section and provides a brief background of Twifo Oil Palm Plantation (TOPP). Sections four and five are discussions on the gendered differences in agricultural activities performed and how these differences impact occupational health and safety respectively. Conclusions and policy implications constitute the sixth section.

Gender and Agricultural Production Relations (APRs)

APRs is a concept that addresses the interaction among labour, means of production and production forces such as skills and knowledge needed for production. As indicated by Potts, Vella, Dale, and Sipe (2014), theorists like Auguste Comte, Herbert Spencer, Emile Durkheim, Talcott Parsons, and Robert Merton have all contributed to the discourse on production relations and have argued that production relations exist separate from human agency. Individuals, therefore, have expectations of others' actions and reactions to their own behaviour and these expectations are informed by the accepted norms and values of the society. Although an individual may fulfil any role within the production system, individuals are expected to conform to the norms governing the system. Poststructuralists such as Marx and Engels (1968), Hennessey and Ingraham (1997), Cohen (2000), and Laibman (2006), however, argue that production relations exist with the aid of human consciousness so that humans have the potential to form and reform production relations. These theorists claim that production relations are based on the primacy of economic forces, made up of human activities, which continue to transform the world until it reaches the height of communism. Human agency, therefore, plays an important role in shaping production relations.

Gender has been acknowledged as the underlying factor that influences these production relations (Agarwal, 1994; Apusigah, 2009; Nazneen, 2010). The differences in the patterns of female and male participation in agriculture, as attributable to patriarchy, a socio-political system which maintains male dominance over females in every aspect of their relations, has long been reported globally (Boserup, 1970). Over the years, however, the patriarchal source of these differences has been emphasised (Young 1993; Bryceson, 1995). Paltasingh and Lingam (2014) have described patriarchy as the spine of unequal gendered differences in production activities within household relations and community relations.

Agricultural production in Ghana has shown patriarchal influences in determining access to productive resources (Koira, 2014) and in determining the roles performed. First, land allocation is carefully governed by patriarchal customary structures and leaders who make up 78% of Ghana's allodial land ownership (Bugri et al., 2016). The implication is that females' access to land is restricted to usufruct rights (Manuh et al., 1997; Kotey & Owusu-Yeboah 2003; Minkah-Premo & Dowuona-Hammond, 2005; Tsikata, 2008; Britwum et al., 2014). For instance, they can only use land but not exercise control over it or own it and are therefore in no position to exercise decisions-making rights involving the use of the land. Regarding safety and health, therefore, a woman cannot decide to opt for a safer-to-cultivate crop; for instance, she cannot even decide to substitute a hazardous chemical with one that is safer, such decisions

are the prerogative of men—the owners of capital. Britwum and Akorsu (2016) found that even when women have received land from their husbands for personal farms, production decisions are often left to the men.

The second patriarchal influence in agricultural production is the culturally ascribed sexual division of labour. Women and men are expected to grow different crops, rear different livestock, perform different tasks, and in different sequences, even when they work together (Doss, 2002; Apusigah, 2009; Britwum, 2009; Britwum & Akorsu, 2016). According to Apusigah,

...the social positioning of women and land-labour ascriptions in the farm household are important determinants of their livelihoods im/possibilities. As members of farm families, their livelihoods options and choices are determined largely by the cultural constructions of their labour in relation to land (2009: 65).

Existing literature captures sex segregated and sequential divisions in crop and livestock production in Ghana, not because of biological dispositions, but owing to social relations (Duncan, 2004; Duncan & Brants, 2004). Social relations between women and men resemble relations between the proletariat and bourgeoisie in the sense that both are underpinned by power and the control of productive resources or otherwise. Women's agricultural activities are perceived as supplementary to those of men, informed by the assumption that males are the primary breadwinners. This legitimising assumption has meant that women can only access smaller and less fertile tracts of land for their agricultural production and are left to assist husbands on their farms which is potentially the root cause of all the gendered differences in safety and health.

The Study: Context and Methods

Oil palm is a non-traditional export crop in Ghana and it is next in line to cocoa, in terms of economic importance (Danyo, 2013). Currently, the total cultivation space of oil palm is approximately 436,270 hectares and the production level is 2,529,510 metric tonnes (MoFA, 2016). After post-colonial governments failed several times to perpetuate plantation production due to wrongful acquisition of land and resistance from local communities, oil palm is now mainly cultivated by small-scale farmers on up to 83% (363,540ha) of the estimated total space (MoFA, 2016). Some of the government-established commercial producers (GOPDC, BOPP, TOPP, and NORPALM) are still in operation even though all of them are either fully or partially privatised due to the advent of structural adjustment in 1983. Altogether, these four producers have cultivated an estimated 71,740 hectares (16.4% of the total area) and produce 845,730 (33.4% of the total production) metric tonnes (MoFA 2016). Based on this, it can be concluded that oil palm production is mainly carried out through two main systems—small-scale private farmers and large commercial plantations (Ofosu-Budu & Sarpong, 2013).

TOPP was established by the government of Ghana in 1977 as a special agricultural project. Its operations started in August 1978 and with time, Unilever came to own a 40% share. The estate is situated at TwifoNtafrewaso/TwifoMampong area 39 miles north of Cape Coast and 212km (133 miles) north-west of Accra. Production per annum is currently reported at 20 metric tonnes of oil and 5,000 metric tonnes of palm kernel; 51% of the fresh fruits are obtained from the plantation, 12% and 37% from organised smallholders and outgrowers, respectively. Smallholders are the farmers who obtain small plots of land from TOPP's concession, while the outgrowers farm on their own plots of land. Ideally, as in other plantations, both groups of farmers are to be given inputs like seedlings, chemicals, and extension support. The costs are calculated with interest and debited to the farmers. Repayments are made to the company with fresh fruit bunches given.

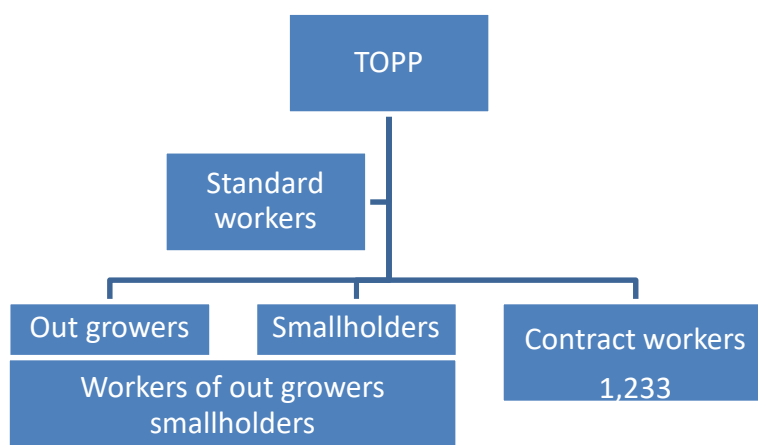
At TOPP, only the outgrower scheme exists in a tripartite agreement involving the National Investment Bank (NIB) as the third party, with the role of financing the scheme. In this instance, instead of the company issuing inputs, the bank offers money to the farmers to finance their input needs with an interest rate of 11.5% per annum. Farmers in this agreement constitute what the company calls assisted outgrowers and those on their own are the non-assisted outgrowers. Together, these individual farmers are about, 1, 016 in number.

The smallholder scheme at TOPP has collapsed since 1986. According to the company, they had to reclaim most of their lands from the smallholders because they were mostly unproductive due to old age and were often distracted from farming due to litigations over the successive ownership of the land. This is regardless of the fact that the smallholder scheme was obligatory. The acquisition of the land used for the plantation induced the displacement of many communities and the smallholder scheme was initially thought of as a way of partly compensating the farmers who had lost their farms and sustaining livelihoods within the affected communities. Currently, though there are still plots bearing the name of some 255 farmers, TOPP does the cultivating and shares the profit with these farmers.

The current total number of standard or regular staff is 384 (49 and 335 senior and junior staff, respectively). The company did not utilise casual workers since Ghana's labour law, Act 651 of 2003 prohibits the continuous hiring and rehiring of the same casual workers over a period of six months or after three successive times. The company, however, utilises 1,233 contract workers, another form of informal or non-standard work. Though TOPP officials insist that they have resorted to the use of contract workers to address the issue of seasonality in agricultural production, indications are that it helps to reduce labour cost. The company has obligations towards the less than four hundred regular workers only. The thousands of contract workers are not considered as

employees of TOPP and so are not entitled to paid sick, maternity, and annual leaves as well as pension contributions or any other benefits apart from their rather low daily wages. As for the thousands of the workers that work on the individual outgrowers' farms, they are completely invisible to the company. Yet, these are the people, who sustain the company. Figure 1 depicts the distance between the company and the work forms. The more the distance is stretched, the more the vulnerability to OSH issues, the vulnerabilities of which are further intensified by gender.

Figure 1: Work forms and their detachment from the company



Source: Field data, 2017

This study employed a qualitative case study approach to interrogate the issues of concern. The case of interest is TOPP and the target population is the non-standard farm workers. Data was obtained from key persons such as the company's human resources manager, safety manager, outgrower manager, and a field supervisor. The interest in non-standard farm workers (i.e., contract, smallholder, and outgrower farmers and their wives) lies in the assumption that the occupational health and safety vulnerability can be attributed to the highly informal character and this needs further interrogation as well. Specific data-gathering methods were observation and interviews using semi-structured and unstructured interview guides. Apart from the primary data gathered with these instruments, data gathered from secondary sources like TOPP company documents in the form of samples of collective bargaining agreements (CBAs), safety policy, Human Resource Management (HRM) policy, and organogram complimented the data. The researchers had the occasion to tour the mill as well as the plantation to observe workers at work. Data collection was first conducted in October 2017 and follow-ups were done in May 2018 with individual farmers and their workers. The data analysis was guided by two main research questions; namely, what are the gendered differences in agricultural production among farm workers at TOPP and what are the gendered differences

in occupational health and safety risks at TOPP? By means of a manual open coding, themes were identified and subjected to analysis.

The Gendered Nature of Agricultural Production in Oil Palm Production

One important determinant of a gendered agricultural production is sex differential in the tasks performed. Evidently, the tasks performed, even among farmers associated with TOPP, were highly gendered. The company perceives some activities as male and others as female tasks and recruitment is undertaken accordingly. Women and men were found to engage in different activities as shown in Table 1.

Table 1: Male and Female Tasks at TOPP

Activity	Male	Female
Loose fruits picking		X
Application of fertilizer		X
Carrying fresh fruit bunches to wheel barrow		X
Picking of empty food bunch as manure		X
Pegging		X
Weeding	X	
Spraying and application of insecticides and pesticides	X	
Harvesting fresh fruit bunches	X	
Pushing fruits to loading point	X	
Pruning	X	
Digging	X	
Drains digging	X	
Planting	X	X

Source: Field data, 2017

With the exception of planting, all other activities on the plantation are segregated by sex. We found such display of sexual division of labour in agricultural tasks among the individual outgrowers as well. These farmers rely mainly on family labour and occasionally on hired labourers. The farmers and the supervisors at the plantation are clear about the male and female tasks which rest on the traditional norms regarding gender roles; sex stereotyping; and the position of males and females within the typically patriarchal agricultural production systems. It is noteworthy, however, that, while food processing is traditionally a female task, at TOPP, the workers at the mill are predominantly males. The reason is that it is highly mechanised and requires some sophistication in skill. Oil production among the individual outgrowers is still done by females, using indigenous methods.

Traditional norms regarding gender roles are at the root of all sexual division of labour in oil palm production. In almost all societies, women and men perform distinct gender roles. These roles are not based on natural talents and capabilities but on what society considers appropriate for each sex, based on perceived differences between the sexes. Novarra (1980) states that the six key tasks [that] performed by women in nearly all societies are: provision of food, homemaking, childcare, nursing the sick, teaching, and manufacture of clothing.

These activities are usually not considered productive work and are therefore under-valued. Thus, whenever women have had to engage in productive work, the tendency has been to restrict them to similar activities, which are perceived as light work.

Sex stereotyping within TOPP is partly responsible for the sexual division of labour on the plantation. Sex stereotypes reflect commonly held beliefs about people's capabilities. These beliefs are held by both women and men. Women themselves tend to accept society's view of their abilities, accept these, and act in harmony with these as part of their gender identity. This is what Tandon (2016) describes as the psychology of the self. An interview with a female loose picker, for instance, depicts women's view of their work in relation to men's tasks as well as the company's view of male and female tasks.

Q: Why don't you opt to do harvesting since it has higher wage?

A: Me? I cannot harvest, it is men's work.

Q: But you can learn it and do it as a female?

A: No, the company won't even let me do it, so I won't even learn it.

Q: But what makes it a men's task?

A: It is hard work.

Q: But is yours not also hard work?

A: Hmm. It is hard, but they say that one is harder.

Also inherent in the above discussion is how company decisions regarding the assignment of tasks on the plantation are influenced, to a considerable extent, by the existing gender orders in the communities. As gendered beings, the managers and supervisors of the company are aware of society's views of women and men, and these slip into interactions.

In this study, we found that the individual outgrowers are predominantly male, and this is the result of the patriarchal agricultural production system, which inhibit female access to land and facilitates male access, control, and even ownership of land. This is consistent with studies, which have highlighted women's limited access to land in Ghana, and also confirms the assertion made by Britwum and Akorsu (2016) that cash crop production is mostly persevered for men, while women tend to cultivate food crops. This distinct sexual division of labour in terms of the type of crop one can cultivate has implications, not only for the rules underlying access to and control over land, but for women's disadvantaged position in the production relation. Decision-making, which is closely linked to the control one has over land, is exercised by males. Since women can only access land and not control land, they are often not in positions to decide what crop to grow, which chemicals to use, what investments to make regarding health and safety, and so forth. Also, women's involvement in oil palm production activities is often viewed as supplementary to those of men based on the assumption that males are primarily responsible for family

provisioning. At all levels, women are under-represented in the decision-making traversing occupational health and safety issues as well.

Assumptions about what is safe for the sexes also emerge as a determinant of what tasks are assigned to males and females. “Education has taught us that it is not safe for women to spray weedicides. It affects women negatively therefore they are not supposed to do it.” From the perspective of the outgrower farmer, spraying is not safe for women and that is the reason why they are not allowed to engage in that activity. However, the fact that spraying is high risk even for men but is ignored is suggestive of an underlying gendered reason, which is that men as a whole are less vulnerable vis-à-vis women. It is such gendered assumptions, we argue, that determines the type of tasks performed by females and males and which predisposes men to higher risks as well.

Gender Differences in Occupational Safety and Health

The gendered differences in OSH in oil palm production arise mainly from the differences in tasks performed by women and men, which is endogenous to the gendered nature of the production relations. There are, in addition, other sources exogenous to the production relation, deriving purely from gendered relations. The subsequent sections address these.

Task Assignment and Exposure Differences

To a large extent, different activities performed by women and men create different risks. Some of the different activities, however, generate the same type of risk. Joint and body pains, for instance, are experienced by both females and males regardless of the differences in tasks. From the perspectives of both the female and male workers/farmers, the safety manager and a field supervisor, the most dangerous activity in oil palm production is harvesting.

Harvesting is the most dangerous because, they use the Malayan knife which is a pole with a knife and for young plants, they use chisels. These objects are sharp, very sharp and so it is very easy to experience cuts...The risks with harvesting are higher when the palm tree is tall since it increases the chance of Fresh Fruit Bunches and debris falling on the harvester to cause eye injuries (Field Supervisor).

The major risks associated with harvesting, pruning, spraying, drains digging and carrying of fruits are hernia, debris falling on the eye, cuts, falls, and joints and body pains(ergonomics) because these are hard work (Safety Manager).

Here, we see a stereotyped assumption that the work females do are light work and less problematic compared to those of men and therefore come with less body pains. Meanwhile, female loose-fruits pickers are equally prone to joints and body pain problems due to excessive and prolonged bending and actually do admit to experiencing such pains on a regular basis. Though men’s exposure to risks maybe higher and more severe as often reported (e.g., Habib et al.,

2014), we bemoan the minimal attention given to women's health and safety issues in mainstream discourse.

An activity like loose-fruit picking, though considered as light and less dangerous work, was found to be associated with biological attacks such as bites and stings from snakes, scorpions, and insects, which can be fatal within hours. Prolonged bending at the initial stages of pregnancy was also cited by one loose picker as equally fatal for the unborn child and for this kind of risks, unlike those associated with harvesting, PPEs cannot provide protection; the only protection available for the female loose-fruit picker who happens to get pregnant is to stay away from work till she is safe to work. Loose-fruit pickers sometimes experience skin irritations around their hands due to contact with weedicides. The interaction with the outgrowers revealed that:

The women use their bare hands... On our own farms, we allow a month after spraying before we harvest, it is ours. But for the company, they harvest fortnightly and therefore cannot allow much time between the spraying and the harvesting (Outgrowers' Focus Group Discussion, May 2018).

While the company insists that the workers are encouraged to wear gloves, the workers report that the contractors do not regularly provide them with gloves and that even when the gloves are provided, it was hard to pick fast enough with gloves on. This revelation raises issues around the suitability of the kind of gloves supplied to the workers for the specific activities. Meanwhile, as indicated in the above quotation, workers are under pressure to pick as fast as possible, if they are to maximize their earnings.

Sharma and Singhvi (2017) report that chemical components in fertilizer can easily penetrate into a worker's blood stream through inhalation and dermal contact, and with adverse effects on the eyes, skin, and respiratory organs. Though these are regardless of whether or not a person is pregnant, the only intervention around a female task, like fertiliser application, according to the Safety Manager is that "pregnant women are advised not to apply fertiliser to prevent miscarriages". This intervention is justifiable because for pregnant and nursing mothers, the harm potentially extends to the foetus. However, there is need for interventions to protect all workers and the fact that the women are only advised to desist from the activity also raises another concern, which is adherence. Here, a trade-off between protection and earning income is clearly seen. The tendency that a pregnant woman will ignore this advice is relatively high in view of the fact that income generation for immediate survival for them, supersedes any perceived future harm to an unborn child.

Even though spraying is considered a male task, women assist in spraying by fetching and supplying water for mixing the chemicals. This raises some gendered concerns as well. Indications from the FGDs are that the men doing the spraying are always in overall, but the women are not.

During spraying, we all go to the farm. The women only fetch water into containers at the pad to dilute the chemical. They don't come too close since the chemicals can contaminate them as they are not protected as we are. During spraying, we wear overalls, wellington boots, nose masks, goggles.

The extent to which women traverse boundaries on the farm to supply water during spraying is hard to ascertain. Even for the men, who claim they are well protected, some exposure to risks can be deduced from the following statement: "I feel weak after applying these chemicals. However, the duration of the weakness depends on the type of chemical used. When I use them, I develop some catarrh from some of them for a few hours before they subside later."

It is not at all surprising that a male worker reports feeling weak because these farmers buy the PPEs from the open market and may not be using the correct ones. Indications are that they do use nose mask but not always the appropriate one. Some may be using dust masks instead of gas masks, which are designed with adequate filters to filter the fumes from the chemicals.

The processing of palm fruit into oil among the individual outgrowers is still done by females, using indigenous methods which are labour intensive and highly risky due to exposure to open fire and smoke inhalation. The greatest danger to entire farm families and even consumers of palm oil is the storage of palm oil in washed chemical containers, perpetuated by women out of ignorance. We found that some females re-used the chemical containers after subjecting it to what they consider a thorough wash with water and soap. This practice, it is known, does very little in cleansing the containers of chemical residues. Also, though females may avoid spraying on the farm due to the dangers, washing chemical containers with their bare hands presents equally dangerous consequences to their skins and health. The risk of contamination to unsuspecting consumers of the palm oil stored in such containers cannot be overemphasized.

Most of women's exposure to hazards even comes from the performance of their domestic roles. Women farmers, it was found, are also full-time wives and mothers with a host of socially ascribed roles. An important feature of women who assist their husbands in farming is the role of serving meals on the farm, not only to the husbands but also to hired labourers. The preparation and serving of the food may take a minimum of two hours depending on the type of food. Some women indicated that travelling the distances between their homes and the farms alone is tedious. Thus, fatigue and stress from female reproductive roles contribute to or intensify their safety and health problems.

Differences in Information and Knowledge

The secondary position of women in production relation also means they are hardly targeted for training and information sharing about OHS or any other

thing. FAO (2013) notes that gender differences in extension services tend to be more pronounced than other resources and this is confirmed in our case. Knowledge about safety and use of personal protective equipment is more pronounced among males than females as expressed in the following words during the FGD.

We have more safety knowledge than the females because most of the workers in the oil palm plantation are males, so at the health and safety meetings we get to know more than the women. In addition, it is mostly the men who go to buy the weedicides from the agricultural extension office or shop. The extension officers or salesmen will direct us as to how to use the chemicals safely, contributing to our knowledge.

It was observed that both male contract workers and outgrower farmers have more knowledge about their work hazards and the associated risks than their female counterparts. One reason has to do with the perceptions about male and female vulnerability to risks. The misconception that the kinds of tasks female do are less risky has resulted in a situation where they are ignored in training, and information sharing about health and safety. A second reason is their position as landless farmhands. When smallholders and outgrowers of TOPP are called for training, males predominantly participate as landholders and a third reason for the female safety knowledge gap has to do with the time burden of women. They tend to be preoccupied with their reproductive roles, giving less attention to such matters.

Differences in Responses

As regards responses to safety issues, we found that the exemption of women from certain tasks was key. For instance, they could not spray because it is dangerous for them and pregnant women cannot apply fertilizer because it could affect the unborn child. Yet, when it came to risks pertaining to male tasks, there are a host of protective apparels and avoidance was never an issue. This can be traced to the gendered assumptions that men are responsible for family provisioning and that women's income are supplementary. If female workers stayed away from work temporarily because it is too risky, it would not hurt them too badly since the husbands' income would extend to them. In the event of having health problems, it was found that women tend to ignore ill health for much longer than their male counterparts. This was reported by both women and men. While the men think this stems from ignorance and sometimes negligence, the women insist that it stems from the lack of time to even care for their personal and health needs. They said, "When we are sick, the children must eat, their fathers must eat. If we remain in bed things will go bad so we carry on till we can't anymore."

This suggests that women cannot afford to respond quickly to their health needs, for when they do, their reproductive roles suffer and the members of the family suffer. Having said that, they inadvertently confirm the claim made by

the men that they fail to respond to their health quickly due to ignorance, as indicated in the following statement. “The thing is you sleep in bed at the slightest hint of sickness, the sickness gets much control over the body and you feel worse.”

Differences in Equipment and Apparel

In the hierarchy of risk management, the provision of protective equipment and apparel is not among the initial interventions and should be used as the last resort, in the short term and in addition to other controls. Protective equipment and apparel, however, constitute an important component in the prevention of accidents among agricultural workers and is emphasised at TOPP. The most common of apparel, we found, include wellington boots, helmet, respirators, and overall. Remarkably, these are designed for and used by male farm workers and not females as is evident in the style and sizes. The Safety Manger intimated that they supply the women with the smaller sizes. Again, this is derived from the assumption that men do the dangerous things on the plantation. It seems that both the company and the individual smallholder and outgrower farmers perceive harvesting as the most dangerous of the activities. The use of hand gloves was probably the only apparel that females could use because it is used among loose-fruit pickers, who are predominantly females. Yet, the women interviewed intimated that they prefer not to use the gloves, as the gloves are usually too big for their little hands; making it not only inconvenient and difficult to use, but retards the act of picking and their earnings by extension since payment is on piece-rate basis.

Gendered Sexual Harassment

Though sexual harassment is widely reported among farm workers, it seems sexual harassment is not widespread or common in our case. Several reasons account for this. We found that female and male workers hardly work alone or are isolated on the plantation. They usually worked in teams in a section of the plantation at any given time. Also, the activities of the contract workers are time bound and linked with wages so much that wasting time on any other interest would mean financial loss. According to one male supervisor, the workers are often focused on their work. Here is an interesting revelation that making time to harass a co-worker is a luxury, which these workers cannot afford to have. One female contract worker, however, indicated that “as you know, the slightest chance some of the men get, they try to make sexual moves ... but generally, they don’t, the thing is, they don’t even have time.” This seems to suggest a gender dimension to sexual harassment. In the few instances of its occurrence, the tendency is toward male perpetrators and female victims. Understandably, sexual harassment is not an issue among outgrower farmers and this is due to the strong presence of the wives of the outgrowers.

Concluding Remarks/Reflections

Evidently, female vulnerabilities are often trivialised due to faulty perceptions and because their injuries are often not as obvious as those of their male counterparts. Contrary to misconceptions that women's work is less physically and mentally demanding, a deeper interrogation reveals that women may be even more vulnerable. Female vulnerabilities are, however, different and are hardly dramatic. The differences in the health and safety problems that agricultural women and men face at work, emanates largely from the differences in the types of work they do. Women are often affected by musculoskeletal disorders (MSDs) because their agricultural tasks tend to be labour intensive and laborious; and stress because of the combination of their paid and unpaid work, in tandem with the near absence of free or leisure time. Thus, the combined or multiple risk exposures from both their reproductive and productive roles, which are not mutually exclusive in a typical farming household intensifies female safety and health problems.

As has been demonstrated in this chapter, gender analysis in health and safety research transcends simply disaggregating and comparing injury rates among women and men. It requires an interrogation of the nature of the agricultural production system which determines access to productive resources and, therefore, control over decision-making, as well as the kinds of work women and men do. By this, the nature of hazards, the sources of the hazards, information and knowledge of patterns, response patterns, as well as equipment and apparel needs are understood. This understanding helps in placing women's occupational safety and health issues in the right perspective, as part of a systemic or structural discrimination in the societies within which farm families operate. It also helps in taking a holistic approach to OSH interventions in ways that account for women's multiple roles. This is where this chapter makes a modest contribution—explaining the gendered agricultural production system and its ensuing gendered safety and health issues. This is at the core of maximizing the efficacy of safety and health interventions that reach all farm workers regardless of their sex.

References

- Agarwal, B. 1994. Gender and command over property: a critical gap in economic analysis and policy in South Asia. *World Development* 22(10): 1455–1478.
- Apusigah, A.A. 2009. “The Gendered Politics of Farm Household Production and the Shaping of Women's Livelihoods in Northern Ghana”, *Feminist Africa*, 51-68.
- Boserup, E. 1970. *Women's role in economic development*. London: Allen and Unwin.
- Britwum, A. O. 2009. “The Gendered Dynamics of Production Relations in Ghanaian Coastal Fishing”, *Feminist Africa*, 12,2.
- Britwum, A. O. & Akorsu, A. D. 2016. ‘Qualitative Gender Evaluation of Agricultural Intensification Practices in Northern Ghana.’ Report prepared for the *International*

Institute of Tropical Agriculture (IITA) Africa Research in Sustainable Intensification for the Next Generation (Africa RISING).

- Britwum, A. O., D. Tsikata, A.D. Akorsu, and A.M. Aberese. 2014. *Gender and Land Tenure in Ghana: A Synthesis of Literature*. Accra, Ghana: Institute of Statistical, Social & Economic Research (ISSER).
- Bryceson, D. F. 1995. "African women hoe cultivators: speculative origins and current enigmas". In D.F. Bryceson (Ed.) *Women wielding the hoe: lessons from rural Africa for feminist theory and development practice*. 3-32. Oxford: Berg Publishers.
- Bugri, J., E.Yeboah, and C.Agana. 2016. "Women's Land Rights and Access to Credit in a Patriarchy: Evidence from North-East Ghana". In *2016 World Bank Conference on Land and Poverty*. Washington DC: World Bank.
- Chaturvedi N. 2001. Ethnicity as an epidemiological determinant— crudely racist or crucially important? *Int J Epidemiol* 30:925 – 927.
- Cohen, G.A. 2000. *Karl Marx's Theory of History: a Defence*. Oxford: Clarendon Press.
- Danyo, G. 2013. Oil Palm and Palm Oil Industry in Ghana: A Brief History. *International Research Journal of Plant Science*, 4(6), 158-167.
- Doss, C. 2002. "Men's Crops? Women's Crops? The Gender Patterns of Cropping in Ghana", *World Development*, 30,11.
- Duncan, B. A. 2004. Women in agriculture in Ghana. Accra: Friedrich Ebert Foundation.
- Duncan, B. A. & C.Brants. 2004."Access to and Control over Land from a Gender Perspective: a Study Conducted in the Volta Region of Ghana", *Supported by the Food and Agriculture Organization of the United Nations (FAO)* .
- FAO (Food and Agriculture Organization). 2013. The gender and equity implications of land-related investments on land access, labour and income-generating opportunities in Northern Ghana: the case study of Integrated Tamale Fruit Company. Rome: FAO.
- GSS (Ghana Statistical Service). 2013. 2010 Population and Housing Census. Ghana Statistical Service, Accra.
- Habib, R.R., S. Hojeij, and K. Elzein. 2014."Gender in Occupational Health Research of Farmworkers: a Systematic Review", *American Journal of Industrial Medicine* 57:1344–67.
- Hennessy, R, & Ingraham, C. (1997). Introduction. In R. Hennessy & C. Ingraham (Eds.), *Materialist feminism: A reader in class, difference and women's lives*. 1–14. New York: Routledge.
- ILO (International Labour Organisation), 2013. Making Progress against Child Labour. Global Estimates and Trends 2000–2012. International Labour Office (International Programme on the Elimination of Child Labour - IPEC): Geneva.
- Johnson, D. G. (2016). *World agriculture in disarray*. Springer
- Kane, P. 1998. "Introduction—Women and Work in a Changing Environment", P. Kane (ed.) *Women and Occupational Health*. Geneva: World Health Organisation (WHO).
- Koira, A.K. 2014. Agribusiness in sub-Saharan Africa: pathways for developing innovative programs for youth and the rural poor. Mastercard Foundation Working Paper, 23.
- Kotey, N. A. & M. Owusu-Yeboah. 2003. Peri-urbanism, land reforms and women in Ghana. Accra: GTZ Legal Pluralism and Gender Project (Land Law Focal Area).
- Laibman, D. 2006. The end of history? The problem of agency and change in historical materialist theory. *Science & Society* , 70,2. 180-204.
- London, L., S. De Grosbois, C. Wesseling, S. Kisting, H. A. Rother, & D. Mergler. 2002. Pesticide Usage and Health Consequences for Women in Developing Countries: Out of Sight Out of Mind? *International Journal of Occupational and Environmental Health*,8, 1. 46-59.
- Manuh, T., J. Songsore, and F. Mackenzie. 1997. Gender and land: the interface between legislative initiatives, customary tenure and land use management in Ghana, Ottawa: IDRC

- Marx, K., & Engels, F. 1968. *Karl Marx and Frederick Engels : selected works in one volume*. New York: International Publishers.
- Messing, K., Punnett, L., Bond, M., Alexanderson, K., Pyle, J., Zahm, S., Wegman, D., Stock, S. R. & de Grosbois, S. 2003. Be the Fairest of Them All: Challenges and Recommendations for the Treatment of Gender in Occupational Health Research. *American Journal of Industrial Medicine*, 43: 618-629
- Ministry of Food and Agriculture. 2016. Women in Agricultural Development(WIAD). Third Quarter Report July-September 2016. Brong Ahafo, Ghana.
- Minkah-Premo, S. and C. Dwuona-Hammond. 2005. *Recommendations for integrating gender issues into land administration project: review of land and gender studies and identification of resources in Ghana*. Ministry of Lands and Forestry, Accra: Ghana.
- Nazneen, S. 2010. Rural livelihoods and gender: Asia-Pacific Human Development Report Background Papers Series. New York: UNDP
- Novarra, V. 1980. Women's work, men's work: the ambivalence of equality. Marion London: Boyars Press.
- Ofosu-Budu, K., & Sarpong D. 2013, Oil palm industry growth in Africa: A value chain and smallholders study for Ghana, In A. Elbehri (ed.) *Rebuilding West Africa's Food Potential*. Rome: FAO/IFAD.
- Paltasingh, T., & L. Lingam. 2014. "Production' and 'Reproduction' in Feminism: Ideas, Perspectives and Concepts", *IIM Kozhikode Society and Management Review*, 3, 1: 45-53.
- Potts , R., Vella, K., Dale, A., & Sipe, N. 2014. Exploring the usefulness of structural–functional approaches to analyse governance of planning systems. sagepub.co.uk/journalsPermissions.nav
- Pyykkönen, M., & Aherin, B. 2012. Occupational health and safety in agriculture. In *Sustainable Agriculture*. 391-401. Uppsala: Uppsala University Press.
- Sharma, N. & R. Singhvi. 2017. Effects of Chemical Fertilizers and Pesticides on Human Health and Environment: A Review. *International Journal of Agriculture, Environment and Biotechnology*, 10, 6. 675-9.
- Siegmann, K. A., & Schiphorst, F. 2016. Understanding the globalizing precariat: From informal sector to precarious work. *Progress in Development Studies*, 162, 111-123.
- Standing, G. 2011. *The Precariat: The New Dangerous Class*. London: Bloombury.
- Tandon, T. 2016. Women Empowerment: Perspectives and Views. *The International Journal of Indian Psychology*, 3, 3. 6-12
- Tsikata, D. 2008. Women's land interests in Ghana: continuities, changes and persistent inequalities. *Afriche e Orienti X*: 3–4.
- Yiha, O., & Kumie, A. 2010. Assessment of occupational injuries in tendaho agricultural development SC, afar regional state. *Ethiopian Journal of Health Development*, 24,3.
- Young, K. 1993. *Planning development with women: making a world of difference*. Macmillan, London, UK.
- World Bank, FAO and IFAD. 2008. *Gender in Agriculture Source Book*. Washington DC : World Bank.

3. Occupational Health Risks in Agriculture: Instruments of Measurement and Protective Strategies in Central America

Alberto Bárcenas Reyes

With increasing occupational health risks (OHR), many consider agriculture now as a dangerous occupation (Cuevas & Gabarda, 2015: 20-24). In developed, that is, wealthy countries, few persons are employed in agriculture, unlike in many countries of the Global South. In 2014, 18.5% of the working population was active in agriculture in Latin America (CEPAL, 2017: 17). In absolute numbers, accidental deaths in agriculture has been estimated to be as high as about 170,000 per year, that is, 10.7 deadly accidents occur per 100,000 agricultural workers (OIT, 2015).

The principal risks experienced by agricultural workers are:

- musculoskeletal injuries owing to carrying heavy load or working in bad posture;
- accidents caused by operational malfunction of machines (tractors, harvesting machines, etc.);
- allergies, skin diseases, bacterial and viral infections, respiratory disorders, zoonotic infections, parasitical disorders caused from animals or contact with plants;
- intoxication from use of agrochemical compounds;
- skin cancer from exposure to solar radiation.

On the basis of my experience in Central America on participatory ergonomics, this chapter discusses how OHR can be measured and how such knowledge can be used as one of the most viable ways to initiate an improvement of occupational health and safety of agricultural workers in Central America.

Health and Work Safety in Central American Agriculture

The agricultural sector is huge in Central America with approximately 5 million people representing 26% of the economically active population, which forms the majority in Guatemala and Nicaragua (PEN, 2014: 35). However, this sector, in most countries, does not attract much attention as most people are drawn towards the commercial, manufacturing, and building sectors, thereby leaving those involved in the agriculture sector languish in poor living and working conditions without access to good education. The examples of Nicaragua and Guatemala, having the highest poverty index and the lowest human development index, indicate that the rural areas of the Central American countries are still the poorest.

In most of these countries, agriculture receives the least attention with regard to basic services of workplace health and surveillance of working conditions. The

labor force, including a large number of migrants, has a high percentage of people working with precarious contracts, who are not even considered by health services and surveillance (Partanen & Aragón, 2009: 16). Especially, in the Central American region, official statistics published by the ministries of work and health, lack a sub-register for notes on labor accidents occurring in agricultural work. Furthermore, the differences concerning indicators and the basis of used calculations for measuring the accident rate complicate comparisons between countries (OISS, 2012). Although institutions for social security only cover a part of the economically active population by diverse modifications for securing work risks for laborers, their publications offer, however, the most reliable figures and data about health and work safety at a national level, especially about the occurrence and analysis of labor accidents (occurrences at the workplace), accidents while commuting (occurrences between the workplace and the residence of the workers), and work-related illnesses and diseases. This limitation in covering the labor force having access to and benefiting from social security, which is based on the contribution of employers and workers to social systems for health and work safety, gives reasons to assume that labor risks for persons active in agriculture are probably higher than those registered by institutions.

Almost all Central American countries lack data related to the state of health and work security of their workers, especially those in informal employment. Fortunately, the publication of the results of the first Central American survey of work and health conditions (IECCTS by its Spanish acronym; English language summary: Benavides et al., 2014), for the first time, allows to analyze, with some degree of detail, the levels of occupational accidents and diseases, as well as mental health issues in Central American agriculture (OISS, 2010–12). The survey reveals that risk factors such as heat, solar radiation, chemical substances, and non-ergonomic devices affect the agricultural sector more than the industrial sectors. Psychosocial risk factors affect between two and five out of 10 workers irrespective of gender; three to four workers out of 10 are aware of bad physical and mental health conditions (Carmenate-Milián et al., 2014: 37). A second survey (IIECCTS) was initiated in the second half of 2017 with the intention of assessing changes that might have occurred during these years of rapid economic and social growth in the region. Unfortunately, the results of this survey have not yet been released.

Some data and comments concerning the health and work safety of two neighboring countries—Nicaragua and Costa Rica—having different socio-economic development in Central America, are presented to illustrate some of the typical problems faced in the agricultural sector. These two countries stand for the region. Nicaragua belongs to the so-called CA4 countries together with Guatemala, Honduras, El Salvador. Their Human Development Index is lower

than that of Costa Rica and Panama. While agricultural employment engages approximately only one-eighth of the population in Costa Rica, it makes up one-third of the economically active population in Nicaragua. In both countries, agricultural employment has increased in absolute numbers, but in Costa Rica, the share of the agricultural workforce of total employment has decreased continually (MIDEPLAN, 2017: 76). By 2015, agriculture in Nicaragua contributed approximately 20% of the Gross Domestic Product (GDP, at constant prices) and 40% of the exports (in order of importance: coffee, tobacco, peanuts, and beans). In Costa Rica, their share has been less than 10% of the GDP and a little more than 25% of the exports (in order of importance: bananas, pineapple, coffee, melons, and cassava).

Table 1: Country statistics for Costa Rica and Nicaragua 2015

Country statistics	Costa Rica	Nicaragua
Human Development Index – HDI	0.776 (high)	0.645 (medium)
Gross Domestic Product per capita - GDP (U.S.\$)	10,307	2,096
Total population	4.83M	6.26M
Economically active population	2.24M	3.25M
Employed persons	2.03M	2.96M
Employed persons in agriculture ^(a)	245,281	929,440
Employed persons in agriculture (%)	12,1 %	31,4 %
Insured persons against risks at work	1,298,936	700,922
Persons in agriculture insured against risks at work	102,816	71,912
Persons in agriculture insured against risks at work (%)	42 %	7,7 %
Non-fatal accidents at work	115,817	37,180
Non-fatal accidents at work in agriculture	20,577	4,605

(a)Agriculture includes hunting, forestry and fishing in accordance with ISIC, Rev.2.

Sources: Prepared by the author based on CSO, 2015; MIDEPLAN, 2017; INSS, 2016; Anuario Estadístico 2015, Nicaragua; Banco Central de Nicaragua – BCN: Nicaragua en cifras (2016), Managua, Nicaragua. Instituto Nacional de Estadística y Censos – INEC (2017): Anuario Estadístico 2014-2015, San José, Costa Rica

Historically, Costa Rica has a high percentage of economically active population covered by social security programs and insurances against occupational risks: in 2015, 73% were covered by health and pregnancy insurances and 64% by old-age and disability pensions and death benefits (CSO, 2015a; León Espinoza, 2018; INEC, 2017). Recently, especially between 2010 and 2015, Nicaragua has also increased the social security coverage, but it has yet to reach more than 25% of the economically active population (INSS, 2016: 319).

While in Costa Rica about 42% of the workers in agriculture (102,000 of 245,000) are covered by occupational risk insurance, in Nicaragua it is only 7.7% (see Table 1). Thus, an overwhelming majority of agricultural workers in Nicaragua is neither insured against occupational risks nor covered by social security schemes. Owing to significant higher insurance level, more accidents are reported in Costa Rica than in Nicaragua (see Table 1). None of the two

countries publishes specific data about mortal accidents in the agricultural sector.

In both countries, informal labor markets and underemployment affect the coverage of social security systems. An analysis of the state of occupational health in agriculture, based on publications referring to the period between 2010 and 2015, can be summarized in the following way (CSO, 2015):

- Most accidents are hits or cuts with objects and tools, falls or overstrain. Overstrain is related to the transportation of loads and uncomfortable work positions (OISS, 2010–12). It leads to musculoskeletal disorders.
- Most occupational accidents occur among unskilled agro-industrial workers, unskilled builders, manual packers, and other unskilled staff in manufacturing industries.
- The *weighted incidence index*, which ranks incidence rate of accidents according to the number of affected workers, reveals that agricultural tasks performed in sugar cane, bananas, coffee, and cocoa fields are the most risky activities for workers.
- Long working hours increase the risks. More than one-third of the agricultural workforce works more than 48 hours a week.
- Commuting time has to be added (CSO, 2014; Benavides et al. 2014).
- Risks due to environmental factors that have been identified as most important are in the following order: solar radiation, humidity, extreme temperatures, noise, vibrations, toxic substances, and chemical substances. Among these, solar radiation affects at least one-third of the labor force (especially in the agricultural sector); at the same time, noise affects one-fifth of the workers during their workday. Mental health risks have been little studied (cf. Benavides et al., 2014; Aragón & López, 2013: 32-33).
- In both countries, the average incapacity for work due to occupational accidents is between 15 and 25 days for unskilled agro-industrial workers (CSO, 2014: 29-31).

Government calls for occupational risks prevention have led to the establishment of departments and commissions for occupational health within enterprises and organizations. Nevertheless, as it is also the case in more developed countries, the decisive factor remains to be the size of the enterprise or the institution. In both countries, approximately 85% agricultural enterprises have less than 10 workers, 50% less than five. Producers and workers in small agricultural production units receive almost no advice on occupational hygiene and safety. In both countries, less than 5% of agricultural enterprises have more than 50 workers. Only in the larger companies one finds occupational health

departments and commissions (CSO, 2016: 14–16).¹ In general, in Costa Rica as well as in Nicaragua, more occupational health commissions are required for the protection of workers.

Assessing Occupational Health Risks in Agriculture

The analysis of the agricultural process in general and the agricultural tasks in particular from the point of view of health and work safety proves more difficult considering that these agricultural activities take place outdoors in most cases, extend across large territories, and their results have to be evaluated over a long period of time. To these intrinsic conditions for the agricultural process, the effects of the occurrence of the unforeseeable phenomena and variable relevance (e.g., extreme climate conditions, plagues, and contagious illnesses) have to be added. To evaluate the labor risks and hazards of agricultural work, it is essential to consider the crop and animal reproduction cycles in all their aspects. The final objective of the analysis is to offer a detailed diagnosis of the existing conditions and recommendations for more occupational safety in agriculture.

The scientific literature on occupational health provides the criteria for the selection and evaluation of the procedures of workplace analysis based on fundamental OSH principles: the prevention of risks and hazards, tackling of risks at their sources, and the preference of general methods of protection for individuals. Depending on the coverage and desired profundity of the procedures or methods of the diagnostics of agricultural tasks, all or some of the following factors have to be considered; for illustration, a few relevant examples are mentioned.

General catalogue of risks and hazards:

- Mechanical hazards: e.g., objects with dangerous superficies, objects with unprotected mobile parts, transport and moving of work materials, falling down from same or different heights
- Electrical hazards: e.g., electric arcs, flow of electricity
- Dangerous substances: e.g., gases, aerosols, liquids, solid substances, and reactions of dangerous substances
- Biological hazards: e.g., intended, targeted handling, unintended handling of biological agents
- Hazards of fire and explosion: e.g., fire and explosion risks
- Thermal hazards: e.g., hot substances, cold substances
- Climate: e.g., climatic stress, thermal stress
- Illumination: e.g., lighting intensity, lighting distribution, glare

¹Prepared by the author based on CSO – Costa Rica and INSS – Nicaragua data and statistics.

- Noise: e.g., continuous noise, impulse sound
- Vibration: e.g., vibrations of the whole body, vibration of the hand-arm-system
- Radiation: e.g., ionic and non-ionic radiation, electromagnetic fields
- Perception and handling: e.g., optical and acoustic signals, handling of gadgets and tools, handles, control devices, displays, moving space
- Physical factors: e.g., heavy dynamic work, unilateral dynamic work, static work
- Mental factors: e.g., monotonous work, low mental workload, stress and excessive mental workload, attention and concentration, responsibility and decision
- Organizational factors: e.g., working hours, cooperation and communication, hierarchy and participation, working process, available space
- Social conditions: e.g., social conflicts, job security, qualification
- Other hazards: e.g., road users, hazards connected with other persons, dirt, individual protective equipment, lack of standards in hygiene and work safety.

The methods of risk assessment are based on typical procedures for carrying out risk assessment. This includes clearly defined steps based on the evaluation of a catalogue of specific risks and hazards for agricultural tasks (crop cycle, cycle of animal production, etc.):

- fix the frame of study and tasks (tasks, cultivation, etc.) to be analyzed,
- determine and evaluate the risks and hazards by comparing with wished standards and define objects of protection in quantity and quality,
- adapt methods and implement them,
- prove the effectiveness of the adapted methods, and
- document the results.

The decisive phase, that is, the evaluation phase, provides a challenge in less industrialized countries like Nicaragua and Costa Rica, where there are no legal guidelines on how to evaluate occupational risks in agriculture. For example, the handling of loads of coffee involves the consideration of issues like the maximum load to be transported, differentiation between sexes, interruption of these tasks by breaks, or alternation of different tasks. It is obvious that all this requires the establishment of standards, not just in terms of quality but also of quantity. Without them, it is difficult to know if the objectives of protection in the field of occupational health can be reached.

It is equally important to understand the forms of work organization and their influence on the development and duration of agricultural tasks. The techniques of gathering the necessary data, primarily qualitative, require precise and long-

term work by investigators, farmers, and agricultural workers, analyzing the diverse phases in the production process. The final concern is to reach an understanding of the condition of agricultural work so that it can be changed or ameliorated. Following this, a posterior analysis, which can be called *work histories*, helps to discover discrepancies between planning and execution, identify critical situations, detect the forms in which risks and hazards occur and, finally, formulate ways to prevent such occurrences and cope with the identified problems (Bárceñas, 2008: 28–47).

Participatory Ergonomics

The possible interventions of specialists in health and work safety with the intention of ameliorating work conditions in agriculture have to consider the existence of a marked investigation deficit about risk and hazard factors of agricultural tasks. It is necessary to integrate the contribution of specialists in other fields connected with agriculture with the role of farmers and agricultural workers as the main actors in this amelioration process. This implies that the participation of different occupational groups must be promoted by means of adequate techniques adapted to the professional qualification of each of these work groups. In practice, that means organizing the process of participation not only during gathering data and information, but also during evaluation of the obtained results and development of means of correction. All this facilitates the establishment of a dialogue between specialists and farmers and agricultural workers. In accordance with the grade of profundity of the intended intervention, this might also mean the necessity of integrating the so-called *agricultural counsellors*, who assess the products, with workers in many different aspects of the agricultural production process (legal, technical-administrative, organizational, economical, ecological, etc.).

Participatory methodologies have often been presented as the appropriate way to develop ergonomics in developing countries (Kogi et al., 1999; Shahnava, 2000). Participatory ergonomics is defined as “the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both process and outcomes in order to achieve desirable goal” (Haines et al., 2002). Imada (1991) points out three major arguments in support of worker involvement in ergonomics.

First, because ergonomics was an intuitive science, which in many cases simply organized knowledge that workers were already using. Second, people were more likely to support and adopt solutions for which they felt responsible. Involving users and workers in the ergonomic process has the potential to transform them into makers and supporters of the process rather than passive recipients. Finally, developing and implementing technology enabled workers to modify and correct problems continuously (Taveira & Smith, 2012: 274–97).

The analyses of participatory design actions show multiple practices, often crowned by success but sprinkled with failures. The participatory design was sometimes used without real awareness of the inherent challenges of its mode of operation: some companies seized this attractive idea (democracy against authoritarianism), omitting the previous phase of construction of user intervention. However, participation does not carry in itself its conditions of success: it needs social and individual prerequisites and it must have a concerted methodology. On the other hand, many actions encounter the problem of decision-making; the real power remains, in spite of everything, with the management (Darses & Reuzeau, 2004: 405–20).

One of the methods focusing on the analysis and amelioration of the working conditions in agriculture from an ergonomic point of view, which emphasizes the role of the participation of persons dedicated to agriculture, has been published by the International Labour Office (ILO) in the form of a manual titled *Ergonomic Checkpoints in Agriculture* (ILO, 2014). In this ILO publication, 100 ergonomic checkpoints are shown which belong to the following 10 groups: storage and handling of materials, workstations and tools, machine safety, agricultural vehicles, physical environment, control of hazardous chemicals, environmental protection, welfare facilities, family and community cooperation, and group organization and working schedules. This manual illustrates each of these checkpoints, highlights the reasons why these aspects have to be examined, helps to establish priorities, shows the practical form by promoting the cooperation of the agricultural workers and farmers and, in addition, favors the implementation of ameliorations at low costs. This important contribution to global investigation of occupational risks can also serve as a basis for initiating a reflection by parts of occupational groups affected by the risks.

There are many instruments that can be used to support the work of these agricultural counselors. Among them, there is a publication that deserves to be mentioned because of its scope and depth—The ILO code of practice *Safety and Health in Agriculture*. This comprehensive document is presented as

This code of practice is devoted to improving OSH in agriculture and complements the Safety and Health in Agriculture Convention 2001 (No. 184), and its supplementing Recommendation (No. 192), and provides further guidance for their application in practice. It provides guidance on appropriate strategies to address the range of OSH risks encountered in agriculture in order to prevent—as far as is reasonably possible—accidents and diseases for all those engaged in this sector. It also provides guidance on the roles of the competent authorities, employers, workers and their organizations in promoting OSH within this sector. Its provisions are based on principles contained in Convention No. 184 and many other ILO Conventions and Recommendations (ILO, 2011: 1).

One of the main arguments against participatory methods has always been that they involve many resources (in terms of money, time and materials etc.) to produce results (van Eerd et al., 2010). Falzon points out:

the explicit discourse of management theorist advocate the need for continuous knowledge development in organizations. However, real practice is quite contradictory. Workers have less and less time to complete their tasks; any activity that is not immediately productive is seen as a waste of time and as something to be eliminated (Falzon, 2005: 1–8).

More research is needed to develop methods for implementing participatory ergonomics programs in agriculture.

A main challenge for OSH analysis is the heterogeneity of tasks performed by the people active in agriculture, which include, for example, everything from planning the cultivation of small independent producers to the harvest done by temporarily employed agricultural workers. Therefore, elaborate methods are necessary for identifying the competencies of different occupational groups and to focus on the prevention of labor risks and hazards faced by these groups.

Competence in prevention, in general means training the occupational groups (i.e., farmers as well as agricultural workers) to be aware of everyday problems in the production process, for example, the handling of loads or the use of pesticides, with the aim of ameliorating their working conditions, avoiding damages to health and well-being. The concept of prevention competencies also integrates elements of four groups of basic competencies: technical, personal, methodological, and social. Counselors and advisers in the field of occupational hygiene and health define the concept of capacitation for prevention (Consejeros en materia de Higiene y Salud Ocupacional). This concept forms part of the studies on the working conditions in Nicaragua (Bárceñas, 2002: 191–201). These concepts were developed by implementing the principles and methodologies of participatory ergonomics in Nicaraguan companies. The main objectives of these training concepts for the personnel of the companies were to:

- Acquire a basic knowledge about Nicaraguan labor law on health and safety (e.g., occupational health and safety regulations and labor laws).
- Be informed about their role as counselors or advisers and feel motivated to participate (e.g., tasks and functions of the work and safety committees in the companies).
- Gain basic knowledge about health-promoting conditions at work (e.g., explanatory models for the causes of accidents, occupational diseases, and work-related illnesses).
- Possess the basic knowledge about the methods of risk and hazard assessment and their application (e.g. definitions about risk, hazard, danger, load, and strain).

- Strengthen their social skills, especially in the process of decision-making (e.g., communication and cooperation through discussion and negotiation techniques).
- Gain the basic knowledge about the design of work activities (e.g., relationship between workplace, work environment, and work organization).
- Develop their ability to develop and implement occupational safety measures in companies (e.g., development of solution strategies and control of the developed solutions).

The design of a specific plan for training in companies depends on the political willingness of the companies, but is based on the legal provisions in force in the labor legislation in Nicaragua. In addition, this training concept adapts and uses methodologies aimed at the analysis of working conditions in companies and helps in framing solutions.

Coordinated Actions for Ameliorating Working Conditions

High levels of occupational risks of agricultural tasks and few available resources for the investigation of working conditions force to concentrate all means on social actors to ameliorate working conditions. The governments, organizations of employers and workers, the tripartite actors in the field of health and work safety, require the guidance of scientific institutions and specialists in the mentioned field to define actions for specific and efficient interventions. They need a major field investigation, without which a reduction of levels of danger in the agricultural sector cannot be achieved.

The tripartite actions have played, at the national level, a decisive role in the promulgation of laws, acts, and rules aimed at the amelioration of working conditions. In addition, the tripartite action has promoted the foundation of national commissions for occupational health in less industrialized countries like Costa Rica or Nicaragua. This national legislation is complemented with its ratification by the states and specific international agreements like the case of ILO convention 184 on safety and health in agriculture, 2001, an agreement that recognizes the particularly dangerous character of agricultural work. Unfortunately, this process of ratification progresses is slow. So, for example, Convention 184 has not been ratified in Costa Rica and Nicaragua, yet (NORMALEX, 2017).

It is important to mention that in recent years, these tripartite commissions have been developing a series of specific documents in the field of agriculture. In Costa Rica, for example, the Occupational Health Council has published a comprehensive document on the control of occupational risks in pineapple cultivation. The objective of this document is to provide a guide for easy

implementation in occupational health for pineapple producers, with the interest of promoting compliance with current regulations in this area, where the employer is directly responsible at the workplace. One of the methods used to make a general assessment of the risks is explained and presents examples of forms that can be filled; this is an important guide for planning the prevention and protection measures that can be implemented later. Another relevant aspect is training in general and that workers should receive in occupational health or occupational risk prevention. A risk profile is proposed where the risk factor, the generating source, and the possible consequences on workers' health are identified. There is also a list of good practices, recommendations, preventive measures, safety standards or control measures, in order to prevent work accidents and improve the work environment of companies in the pineapple sector (COSAP, 2012).

Another document of great importance is the National Plan of Occupational Health 2025, called PREVENSO 7.5, which proposes in Costa Rica a national goal for decreasing the rate of occupational accidents, from 10.3 in 2013 to 7.5% in 2025 (CSO, 2015b). This document defines the intervention priorities in occupational health and establishes specific actions that seek to reduce incidences of accidents in the country, through coordinated action among various social actors related to occupational health. The actions proposed in it will be evaluated and permanently monitored to determine its continuity, effectiveness, and extension. In comparison, the Nicaraguan government has not yet published any document that defines a long-term objective regarding health and safety at the national level or by economic sectors.

Recommendations

The high level of occupational risks in agricultural activities is an undisputed and serious fact, which needs to be reduced through the common action of all social actors. In this context, a strategy for ameliorating occupational health and safety in agriculture has to start with broader and more profound investigations of agricultural tasks.

In this chapter, some instruments have been mentioned that affirm the benefits of the concept of participatory ergonomics towards the improvement of occupational health and safety in agriculture in Central America. In cooperation with producers and workers it is possible to start the analysis of occupational risks and control problems related to agricultural work based on the results obtained in recent experiences such as cultivation and production of pineapple in Costa Rica. In particular, agricultural peasant communities could be interested in initiating a process of changes in their forms of agricultural work and ensure occupational health and safety of their inhabitants. Finally, based on his experience, the author considers that this process of participation is the

starting point for the development of the necessary competencies of individuals and groups for the prevention and control of work-related illnesses and injuries in the agricultural sector.

To improve working conditions and to decrease occupational risks and hazards, governments in Central America should undertake actions as detailed below (Monge et al., 2010: 90-91).

Organizational measures:

- Define national politics for occupational health and elaborate on the steps to be taken in fields like investigation, inspection, formation, development of human resources, etc.
- Create a public institution which coordinates the work of institutions dealing with issues of occupational health and work risks (ministries of work, ministry of health, national insurance institutes, national councils for occupational health, national social security institutes).

Measures of statistical information about work risks:

- Establish an updated statistical information system which allows comparison of available information with that of other countries.

Investigational measures:

- Strengthen coordination and cooperation with national and foreign institutions with the aim to develop investigation programs about working conditions in different productive fields.
- Set up field programs with the aim of ameliorating working conditions in areas with the highest labor accident rate (agriculture, building, industry).

Legal measures in occupational health:

- Promote actions allowing the raise in the coverage of workers with the help of labor risk insurances.
- Strengthen the actions of work surveillance to ensure the compliance of the laws and rules in the field of occupational health.

Educational measures:

- Promote a culture of prevention of work risks at workplaces with special focus on vulnerable groups (child labor, migrants, etc.)
- Coordinate actions in the formation and training of occupational health with other public or private institutions (for example, Ministry of Education, private training centers, etc.).

References

- Aragón, Aurora and Indiana López 2013: Perfil de salud ocupacional Nicaragua. Heredia, Costa Rica: Programa Salud y Trabajo en América (Serie Salud y Trabajo; no. 15).
- Bárceñas, Alberto. 2002. *Arbeitsschutz für Nicaragua*. Kassel: Kassel University Press.
- Bárceñas, Alberto (ed.) 2008. Fragebogen zur Sicherheitsdiagnose - Cuestionario destinado al diagnóstico de la seguridad laboral. Kassel: Kassel University Press.
- Benavides, Fernando G, Catharina Wesseling, George L Delclos, Sarah Felknor, Javier Pinilla, Fernando Rodrigo 2014: Working conditions and health in Central America: a survey of 12,024 workers in six countries. In: Occupational and Environmental Medicine [20 Mar 2014, 71(7):459-465]
- Carmenate-Milián, Lino et al. 2014. “Perfil de Salud Ocupacional América Central”, Heredia, Costa Rica. Programa Salud y Trabajo en América (Serie Salud y Trabajo; no. 20).
- CEPAL. 2017. Statistical Yearbook for Latin America and the Caribbean 2016. Santiago de Chile.
- Comisión de Salud Ocupacional (COSAP). 2012. Control de riesgos laborales en el cultivo de piña. Costa Rica, San José.
- Consejo de Salud Ocupacional (CSO). 2014. Estadísticas de Salud Ocupacional - Costa Rica 2015. Costa Rica, San José.
- CSO. 2015a. Estadísticas de Salud Ocupacional - Costa Rica 2015, Anexo, 1: 47.
- CSO. 2015b. Plan de acción de la política nacional de salud ocupacional 2016–2019, Prevenso, 7.5: 2025.
- CSO. 2015c. Estadísticas de Salud Ocupacional - Costa Rica 2015. Costa Rica, San José.
- CSO. 2016. Estadísticas de Salud Ocupacional - Costa Rica 2016, Comisiones y oficinas de salud ocupacional. Costa Rica, San José.
- D. Van, Eerd et al. 2010. “Process and Implementation of Participatory Ergonomic Interventions: a Systematic Review,” *Ergonomics*, 53: 1153–66.
- Darses, F. & F. Reuzeau. 2004. “Participation des travailleurs à la conception des systèmes et dispositifs de travail,” in P. Falzon (ed.), *Ergonomie*. Paris: Presses Universitaires de France.
- Falzon, P. 2005. “Ergonomics, Knowledge Development and the Design of Enabling Environments.” Proceedings of the Humanizing Work and Work Environment Conference, Guwahati, India.
- Cuevas Monzonís, Nuria and Cristina Gabarda Méndez 2015: Siniestralidad Laboral en Europa y Latinoamérica: Una Visión Comparada (2015). Universidad Internacional de Valencia – VIU, Informe VIU, Capítulo 6. Valencia, www.viu.es.
- Haines, H., J.R. Wilson, P. Vink, & E. Koningsveld. 2002. “Validating a Framework for Participatory Ergonomics (the PEF),” *Ergonomics*, 45: 309–27.
- International Labour Office (ILO). 2011. Safety and Health in Agriculture. ILO Code of Practice.
- ILO. 2014. Ergonomic Checkpoints in Agriculture: Practical and Easy-to-implement Solutions for Improving Safety, Health and Working Conditions in Agriculture. Geneva.
- Instituto Nacional de Estadística y Censos (INEC). 2017. *Anuario Estadístico 2014-2015*. Costa Rica, San José, pp. 180 y 336.
- Instituto Nicaragüense de Seguridad Social (INSS). 2016. Anuario Estadístico 2015, Cuadro III.1, Cuadro VII.2, and Cuadro VII.52, Managua, Nicaragua.
- Kogi, K. et al. 1999. “Impact on Productivity of Low-cost Work Improvement in Small Enterprises in a Developing Country,” in P.A. Scott, R.S. Bridger, & J. Charteris (eds), *Global Ergonomics*. Amsterdam: Elsevier.
- León Espinoza, Diana. 2018. “La Seguridad Social en Costa Rica,” *Análisis*, 5 (2018): ISSN 2413–6611, Fundación Friedrich Ebert. Costa Rica, San José.
- Ministerio de Planificación Nacional y Política Económica (MIDEPLAN). 2017. Estadísticas regionales de Costa Rica 2010-2015, Cuadro 37. San José, Costa Rica.

- Monge, Patricia, Lino Carmentate, Nancy Piedra, Aurora Aragón, Timo Partanen 2010: Condiciones de Salud y Trabajo en América Central. *Arch Prev Riesgos Labor* 13(2): 84-91.
- NORMALEX. 2017. "Ratifications of C184 - Safety and Health in Agriculture Convention, 2001 (No. 184)," Information System on International Labour Standards, ILO, Geneva.
- Organización Iberoamericana de Seguridad Social (OISS). 2010–12. I Encuesta Centroamericana de Condiciones de Trabajo y Salud—IECCTS, Informe General—Estudio cuantitativo, Capítulos: Condiciones de empleo, Condiciones de trabajo, www.oiss.org.
- OISS. 2012. Recopilación de los principales indicadores de siniestralidad laboral y enfermedad ocupacional utilizados en Iberoamérica. Capítulo 3.11 Costa Rica y Capítulo 3.17 Nicaragua.
- OIT. 2015. Salud y seguridad en trabajo en América Latina y el Caribe, www.ilo.org/americas/temas/salud-y-seguridad-en-trabajo, Ginebra, Suiza.
- Partanen, Timo & Aurora Aragón. 2009. Perfiles de salud ocupacional en Centroamérica: informe regional, Sectores importantes. Heredia, Costa Rica: Programa Salud y Trabajo en América (Serie Salud y Trabajo; no. 9).
- PEN - Programa Estado de la Nación en Desarrollo Humano Sostenible (2014): Estadísticas de Centroamérica 2014, Indicadores Sociales - Fuerza de Trabajo, p. 35, San José, Costa Rica.
- Shahnavaz, H. 2000. "Role of Ergonomics in the Transfer of Technology in Industrially Developing Countries," *Ergonomics*, 43(7).
- Taveira, A. & Smith, M. 2012. "Social and Organizational Foundations of Ergonomics," in G. Salvendy, G. (ed.), *Handbook of Human Factors and Ergonomics*, 4th Edition. New Jersey: John Wiley & Sons, Inc.

4. Occupational Health and Safety in Pakistan's Sugar Mills

Anjum Munir, Abdul Ghafoor, Waseem Amjad, Adeel Ashraf, and Oliver Hensel

Rate of accidents at workplaces in Pakistan is high and investigations post accidents remain superficial. These investigations identify only one of the operators/workers or machine failure as the cause. They refrain from looking deeper and addressing the system-related flaws. Only few sectors are covered by health and safety-related laws: Safety in Drilling & Production Regulation (1974), Pakistan Nuclear Safety and Radiation Protection Ordinance (1984), and Regulations (1990). It is to be hoped that the recently enacted Punjab Occupational Safety and Health Law of 2016 will lead the way in lowering occupational safety and health (OHS) risks in Pakistan.

The agricultural sector reports of almost half of the occupational injuries and accidents, and in Pakistan, Sugarcane cultivation stands out with a particular high level of injuries. Injuries are especially pronounced in the processing stage of sugarcane. We have therefore chosen to investigate the risk levels at six sugar mills. While the number of injuries declined in the first decade of the current millennium, they nevertheless remained quite high. Differences among the sugar mills allow for the identification of better practices.

The chapter begins with a general overview of OHS deficit in Pakistan, followed by the results from our case study on sugar mills. The chapter concludes with OHS recommendations.

General Lack of Safety Consciousness and Measures

A major issue is lack of proper knowledge and skill training of the workforce. Semi-skilled and un-skilled workers often do not realize the severity of occupational health risks and, therefore, neglect safety measures and instructions for occupational health. Hence, the nature and rate of severe injuries is high. On an average 70 workers per year die from electric shock in Water and Power Development Authority (WAPDA) sector due to poor safety measures. Most of the injuries and deaths are caused during repair of high voltage electric transmission lines. The unsafe method adopted for repair of electric transmission lines is shown in Figure 1.

Figure1. Repair of electric transmission lines without safety measures



Source: published in *The Express Tribune*, August 21, 2016

Another major sector of fatal injuries in Pakistan is the transport sector where a larger number of injuries and deaths are reported during road accidents for not adopting safety measures and traffic rules. Most of the industrial labor and workers come on daily basis from rural areas using local transportation. Generally, proper safety measures are not adopted by local transporters due to which the rate of road accidents is high thereby affecting the labor and working class. Mostly, industries provide their own transport within a limited area for the mobility of workers and labor. However the condition of the means of transport needs considerable improvement. Many accidents have been reported due to over speeding, disregard for traffic signals, lack of proper inspection of vehicles, dangerous overtaking, sleeping during driving, wrong side driving by drivers of the transport industry, and so on (Kazmi, 2017).

Pakistan, being an agricultural country, produces wheat as a major crop. Majority of the farmers use mechanical threshers for wheat threshing. A lot of severe injuries and deaths are reported during this process. Likewise, fodder chopping in Pakistan is performed using conventional fodder chopping (toka) machines. Unsafe design and operation of toka machines have also resulted in severe injuries in the farming community (see Fig.2), for example, cuts on finger and hand during crop threshing and fodder chopping due to fast moving mechanical parts (cutting shaft, blades, pulley and belt etc.), damage from electric shocks, eye infection caused by fine straw particles, and lung infection due to continuous work in dusty environment.

In sum, the lack of advanced machines, proper machine knowledge, and skill training of workers in these industries have led to immense damages and deaths. Moreover, the uncomfortable environment in terms of emissions and heat generation of machines has also affected the health of the employees.

Figure 2. Unsafe operation of mechanical thresher and toka machines causing serious injuries



(a)



(b)



(c)



(d)

The Case of Sugar Cane Processing

A case study was carried out in 2012–13 during the cane crushing season of different mills to study and analyze the ergonomics and occupational health status of workers in the sugar processing industries. Six sugar mills—Alhuda, Crescent, Hussain, Haseeb Waqas, Hunza, and Shah Taj—where workers suffered from varying degrees of injuries were selected (see Fig.3). Within the mills the following sections of sugar processing were identified:

- Cane Handling and Preparatory Units
- Mills House
- Process House
- Boiler House
- Power House
- Workshop

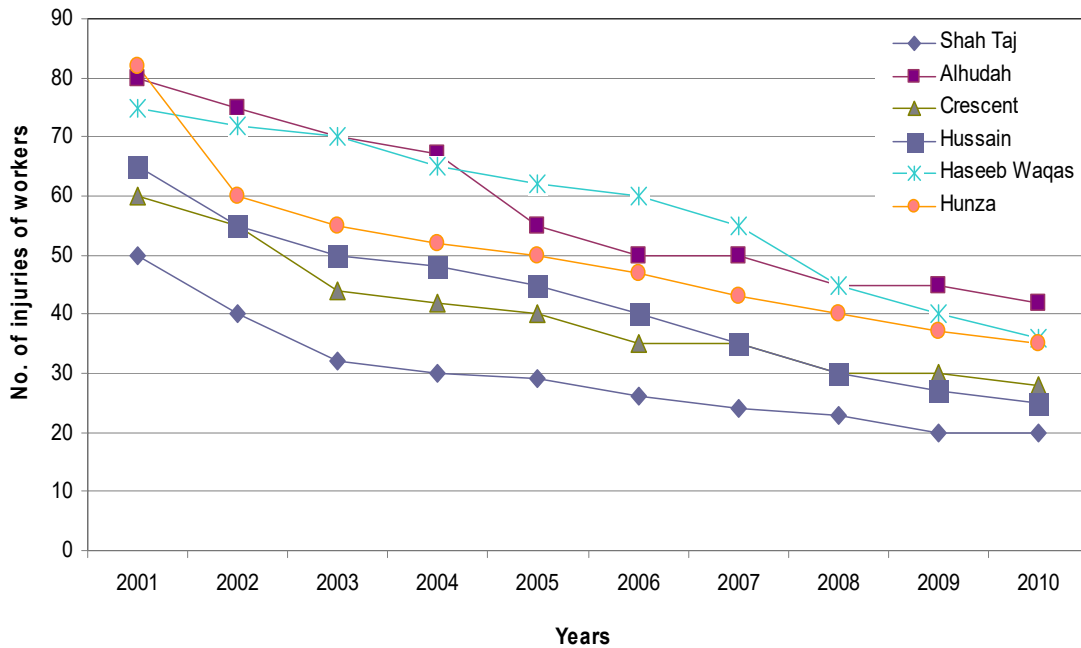


Figure 3. Injured victims from 2001 to 2010 in selected sugar mills

The data shows that sugar industries are trying to minimize level of injuries amongst workers by building up more comfortable working environment, handing out safety equipment, replacing outdated machines and parts, and providing safety instructions and short-term training programs. Fig. 3 shows that instances of workers' injuries have reduced with time; Shah Taj sugar industries recorded the minimum number of injuries. In 2001, the maximum number of injured workers was found in Hunza sugar mills, but with time and the improvement of working conditions, such injuries decreased. In recent times, the trend of adopting new technologies and automation has increased in sugar industries, which has brought them at par with international standards. Nevertheless, as our investigation has shown, much room for improvement still remains.

The data were collected keeping in view the following parameters:

- Level of worker injuries in different sections of industry
- Musculoskeletal disorders (MSDs) symptoms in workers
- Measurement of noise level at different sections
- Standard and quality of drinking water
- Percentage of workers provided with safety equipment
- Number of skilled, semi-skilled, and unskilled workers

The following instruments were used during collection of data from different sections of the industry:

- pH meter
- CO detector

- Noise meter
- Oxygen (O₂) detector
- Hardness Test Kit

The data were recorded in terms of total number of workers, skilled workers, semi-skilled workers, and unskilled workers in different sugar industries, as shown in Figure 4.

Figure 4. Skill status of workers in selected sugar mills in Pakistan

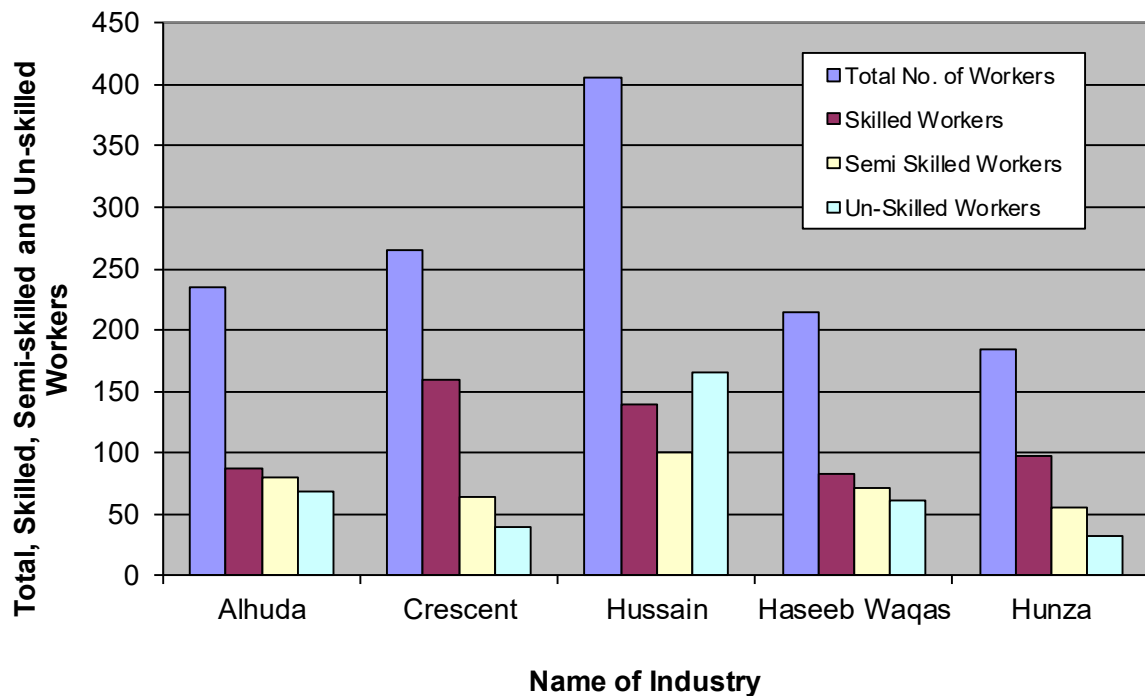


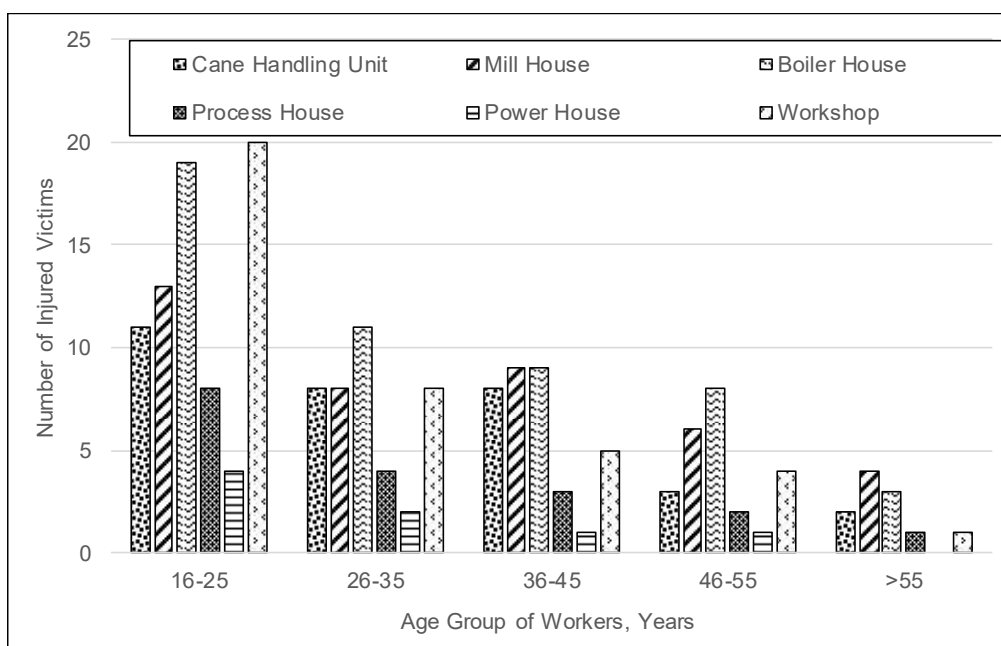
Figure 3 shows that the number of unskilled workers in Hussain sugar industry was higher than skilled workers. Similarly, the sum of semi-skilled and unskilled workers was higher than skilled workers in Alhuda, Hussain, and HaseebWaqas sugar industries. The percentage of unskilled workers in Alhuda, Crescent, Hussain, HaseebWaqas, and Hunza sugar industries was found to be 29%, 15%, 41%, 28%, 18%, and 28%, respectively. The maximum percentage of unskilled workers was found to be 41 in the Hussain sugar industry. This shows that serious injuries can be avoided through skill training of the unskilled workers.

To collect the data, a questionnaire was developed. During data collection, the poor condition of different sections of the process house including bursting of rusted pipes, breakage of belts and pulley, was noted (see Fig. 5).

Figure 5. Interview of injured victims in sugar mills



Figure 6: Injured victims at different sections of sugar mills



After collection of the data, it was analyzed in terms of details of injured victims in the different sections of the sugar industry in terms of different age groups of the worker as shown in Fig. 6.

Data revealed that the maximum number of injuries was reported in the age group 16–25 years who had less experience and skill in the operation of machines; however, those above 45 years and with more experience suffered from lesser injuries. With the passage of time, young workers became more experienced and skilful in operating machines, thereby being able to avoid injuries. Majority of the injuries happen because of the lack of safety equipment. It was also found that the major parts of the body exposed to injuries included the right-hand elbow, fingers, face, and legs. The main parts of the machines and factors causing injuries were: belt and pulley drive due to missing covers, cane cutter and leveler, broken chains, leakage from boiler tubes, turbine blades, electric shocks, lath, drill and grinding machines.

A comparative chart of injured victims across various sections in the six sugar mills studied is compiled in Fig. 7.

Figure 7. Injured victims in different sections of six sugar mills

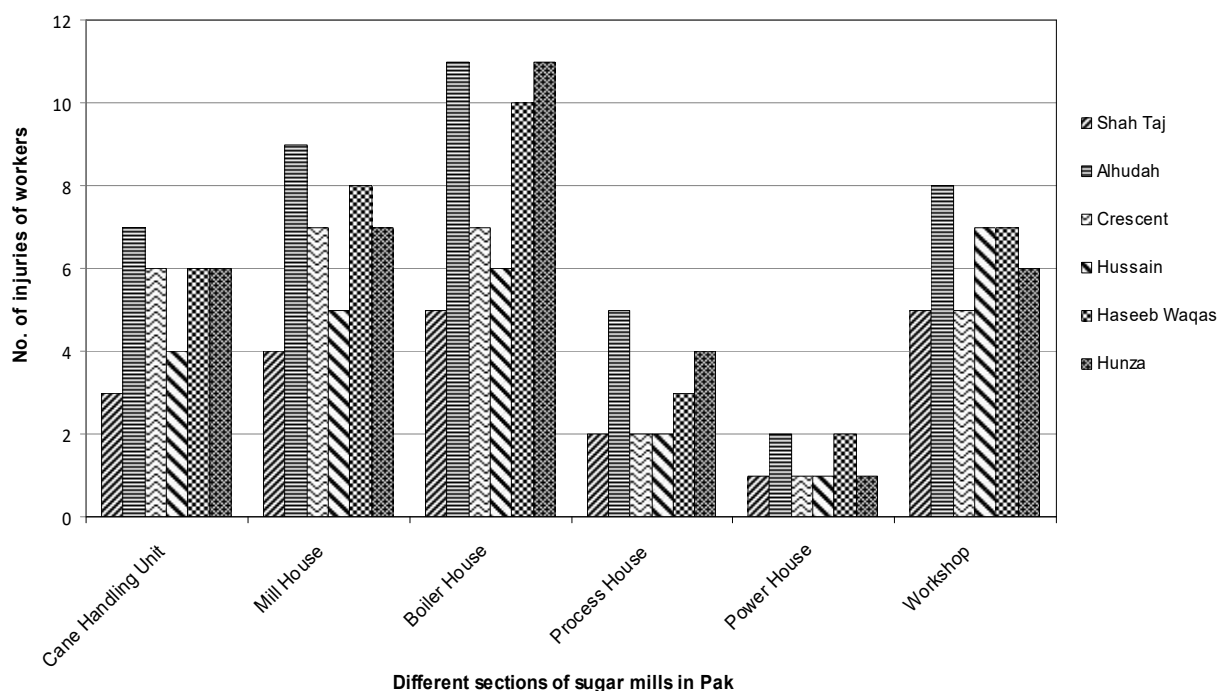


Fig. 7 shows that maximum injuries were caused in the boiler house and workshop section of the industries. All sections of the Alhuda sugar industry reported maximum number of injuries; for other industries, the injuries were randomly distributed. The major reasons of injuries in boiler house and workshop is again because of absence of safety equipment as well as owing to lesser distance between workers and machines, lack of proper training for operation of machines for welding, cutting or brazing operations, higher noise level, vibration of machine parts, poor lighting, and ventilation.

Workers’ Musculoskeletal Disorders (MSDs) Symptoms

Musculoskeletal disorders (MSDs) cause permanent disabilities in different parts of the body. Musculoskeletal disorders not only affect individuals but also his associated family members and the industry as a whole. The poor working conditions, extra workload, and lack of machines result in high MSD rates especially in developing countries. The major reasons of MSDs are heavy load lifting; lowering, lifting, and carrying loads during travelling; pushing and pulling of loads; as well as awkward working postures.

During the data collection process, it was revealed that 437 workers suffered MSDs in selected sugar industries of Pakistan (see Fig. 8).

Figure 8: Number of victims having MSDs in different parts of the body

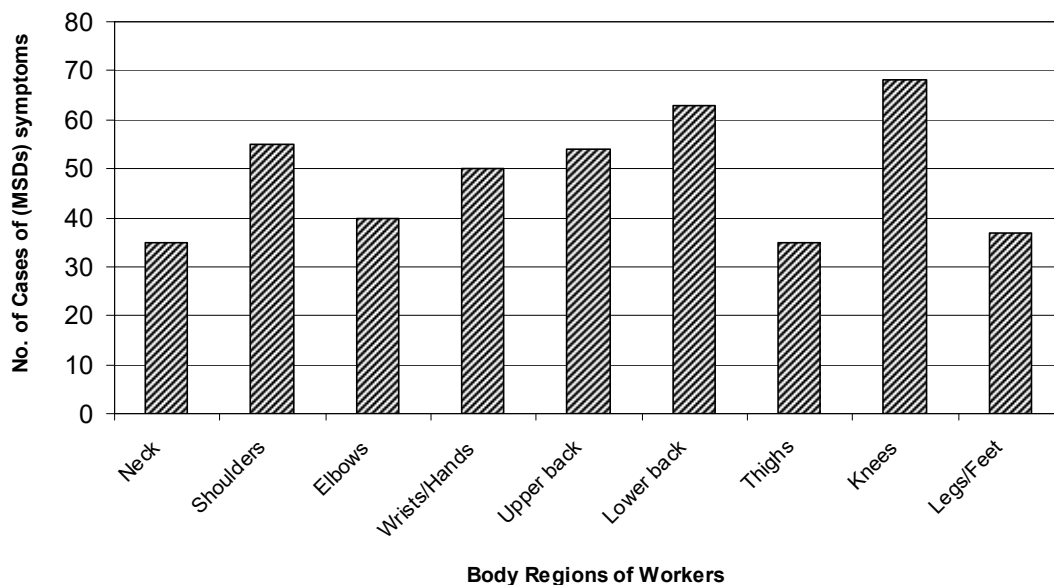


Fig.8 shows that the major affected parts of the body include knees, lower back, and shoulders.

Unhealthy Noise Levels

The acceptable noise level is important for ensuring comfortable working environment. Higher noise levels not only affect the working environment but may cause permanent hearing loss for the workers (if the noise level is beyond 90 db). In industries different types of large-sized machines operate which with each passing year may emit a higher noise level if proper repair and maintenance of machines are not taken into account. The Environmental Protection Agency (EPA) in Pakistan has set noise standards for industrial workers, according to which workers should not be exposed to a noise level of 85 dB for more than 45 minutes and of 88 dB for 23 minutes; noise level above 91 dB is considered unsafe for workers.

The maximum exposed time of workers for different noise levels, as prescribed and guided by EPA, is explained in Table 1.

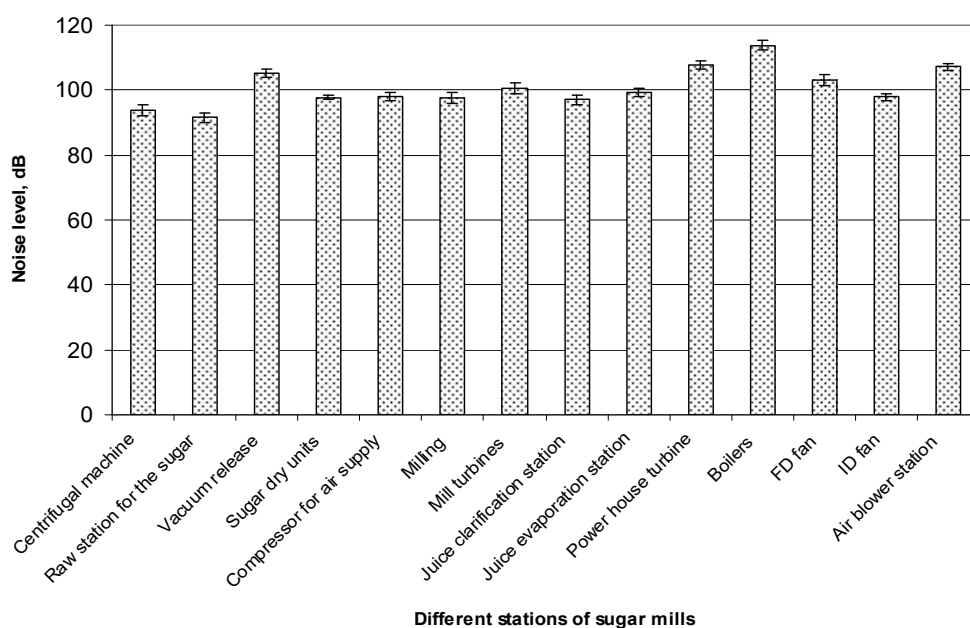
Table 1: EPA limits for maximum noise exposure

Noise Level in Decibel (dB)	Limit of EPA Noise Exposure
70	24 Hours
79	03 Hours
82	01 Hour 30 Minutes
97	03 Minutes
102	53 Seconds
107	16.7 Seconds
117	1.7 Seconds

Source: EPA Pakistan

For the collection of data on noise levels in different sections of selected sugar industries, noise meters were purchased. The noise level in different sections of the sugar industry is tabulated in Fig. 9.

Figure 9. Noise level at different sections of sugar mills



From Fig.9 it has been clear that each section of the industry was producing a noise level above the safe mark as prescribed by EPA. The maximum noise level was found in the boiler section in the sugar industry of Pakistan.

Unhealthy Water Quality

The continuous use of hard water as drinking water can cause stomach and kidney problems amongst workers, while in industrial applications, it can damage cooling towers, pumps, flow pipes, and other associated equipment. To determine the quality of water used in different industries, the water hardness kit and pH meter were used. It was found that water hardness ranged between 120–180 mg/liter which was not fit for drinking purposes and industrial applications. Though the water used in the boiler was treated to avoid damages in the boiler; for other applications, such remedies were not opted. Similarly, the analysis of water in terms of pH value showed that some sugar mills have pH values above permissible limits which ultimately affected the health of the worker. The poor health status of the workers was a clear indication of the bad quality water used in the industries. The values of pH and hardness for different sugar mills have been given in Table 2.

Table 2: Hardness and pH of water used in the industries

Parameter	Sugar Industry						WHO Standards
	Shah Taj	Alhudah	Crescent	Hussain	Haseeb Waqas	Hunza	
pH value	7.2	7.95	7.79	8.3	9.2	8.9	6.5 to 8.5
CaCO ₃ (ppm)	132	159	153	159	162	156	< 75 (soft water) 75-150 (Moderately hard) 150-300 (Hard) > 300 Very hard

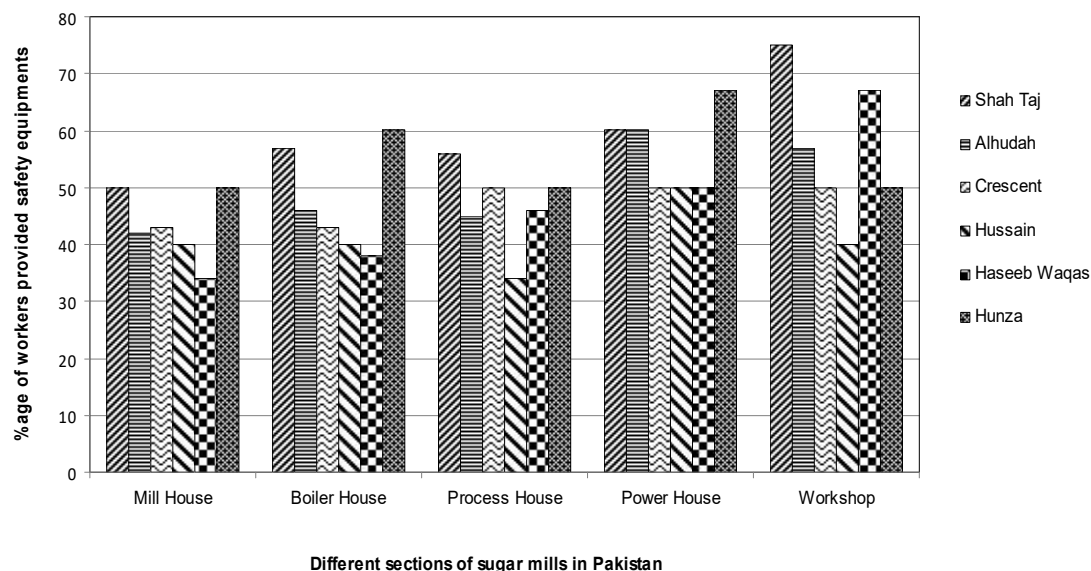
Insufficient Provision of Safety Equipment

The data were collected in terms of safety equipment (SE) provided to the workers. For each section, the percentage of workers provided with SE was calculated as:

$$\% \text{ of workers with SE} = \frac{\text{Number of workers provided with safety equipment}}{\text{Total number of workers}} \times 100$$

The percentage of workers provided with SE in different sections of the selected industries is outlined in Fig.10.

Figure 10. Percentage of workers provided with safety equipment in different sections of sugar mills



As Fig. 10 shows in most cases, the percentage of workers provided with safety equipment was less than 50%. Fig. 10 also shows that among the selected industries, the Shah Taj sugar industry has higher safety equipment in each section of the mills. In the workshop section of the industry, 75% workers of the Shah Taj sugar industry had safety equipment.

Conclusion and Recommendations

The study concludes that most of the sugar mills as well as other agro-based industries are running without proper ergonomics and occupational health measures. No formal training programs were arranged by the industries. Further, there were no proper first-aid facilities, ambulances, as well as allied dispensary and hospitals available as an essential part of the organizational set-up. A few progressive sugar mills, however, have adopted some preventive measures which reduced the number of accidents. The study concludes that these causalities, accidents, and mishaps can be minimized by the proper adoption of safety and ergonomics measures as implemented in developed countries. To ensure a healthy work environment, which is the basic right of workers, educational and training programs are strongly recommended for industrial labor and workers. Furthermore, the following measures are recommended to reduce occupational health issues in the industries:

- Safety instruction should be placed on machines, working places, corridors, and dining rooms.
- Provision of safety devices such as aprons, gloves, glasses, and footwear should be provided to workers. At least 2% of the industrial income should be spent on safety measures.
- Emergency alarms, exit signs, and first-aid facilities should be provided. Safety and warning signs should be written in the local language of the workers.
- Noise meters should be installed, and its normal and maximum exposure standards should be provided in machinery areas.
- The equipment required for lifting and carrying loads like mini trolleys/trucks and rail system, as well as chain drive for lifting and lowering loads should be provided to avoid musculoskeletal disorders.
- Workers should be provided with sufficient breaks to relieve stress caused by repetitive-motion tasks.
- The provision of clean water, toilets, and washrooms should be provided to the workers in relevant sections of the industry to avoid extra movement inside the industry.
- Proper lighting, ventilation, and temperature control should be ensured for comfortable working environment.
- Incentives may be provided to workers who are fully complying with safety instructions to encourage other workers of the industry to adopt safety measures.
- There must be a “preventive maintenance section” in each sugar mill and other agro-based industry where a competent, trained, and skilled team might be engaged and deputed for frequent monitoring and inspection of

different sections of the industry to avoid unforeseen problems and minimize accidents and mishaps.

References

Kazmi, J.H and S. Zubair 2014. Estimation of vehicle damage cost involved in Road Traffic Accidents in Karachi, Pakistan: A Geospatial Perspective, Fourth International Symposium on Infrastructure Engineering in Developing Countries, IEDC 2013, Procedia Engineering 77: 70 – 78

Part II: Occupational Safety and Health on Plantations

5. Prevalence of Respiratory Symptoms among Ecuadorian Banana Plantation Workers

Juan Pablo Piedra González, Leonardo Briceño, and Katja Radon¹

Respiratory diseases are a global problem which affect workers as well as the general population. According to the World Health Organization (WHO), it is estimated that 235 million people world-wide suffer from asthma and 64 million from chronic obstructive pulmonary disease (COPD) (World Health Organization). The prevalence of asthma is estimated to be 4%, while the prevalence of wheezing, the main asthma symptom, is around 9% (To et al., 2012).

In the workplace, dusts, allergens, and chemicals might cause respiratory symptoms, asthma, and COPD (3). Pesticides, globally used to control pests and known to be toxic to humans as well, were shown to be associated with respiratory outcomes in workers and residents (Doust et al., 2014; Mamane, Baldi, Tessier, Raheison, & Bouvier, 2015; Mamane, Raheison, Tessier, Baldi, & Bouvier, 2015; Mostafalou & Abdollahi, 2017; Nordgren & Bailey, 2016).

Conventional banana production is one of the agricultural sectors with a prevalent use of a wide and varying range of pesticides,; mostly fungicides, followed by insecticides, nematicides, and herbicides (Deknock et al., 2019). Of the global 18.1 million tons of banana exports in 2017, one third was produced in Ecuador. Bananas are conventionally produced in large scale monocultures on farms hiring workers on a temporary basis (Brisbois, Harris, & Spiegel, 2018). Among the large variety of tasks workers perform, pre- and post-harvesting pesticide applications are common. In addition, aerial fumigation while workers are on the fields was described - affecting not only the workers but also the neighbours and the general environment (Brisbois et al., 2018; Deknock et al., 2019). Safety training and provision of personal protective equipment are frequently lacking on these farms. Other factors impacting farm workers' health are lack of education, low and precarious income, as well as poor housing conditions (Brisbois et al., 2018). To our knowledge, so far, few studies have investigated the potential effect of pesticide use in banana plantations and respiratory symptoms of the banana workers (Fieten, Kromhout, Heederik, & van Wendel de Joode, 2009; Schenker et al., 2004). Therefore, the objective of this study was to compare the prevalence of respiratory symptoms among banana farm labourers in Ecuador to banana packers working on the same farms as the banana farm laborers, but that do not spray pesticides.

¹Thanks to DAAD / EXCEED / CIH which have financially supported the entire process of conducting this study and to Dr. Diana Salvador Guerra, who directly supported the fieldwork.

Material and methods

Study Population

In 2015, a cross-sectional study was carried out in three Ecuadorian provinces (Los Ríos, Guayas, and El Oro; Figure). 5,143 banana plantations are located in these provinces, on which about 118,977 men and women work (data provided by the Banana Unit of the Ministry of Agriculture Livestock, Aquaculture and Fisheries, Ecuador). Using a list of all banana farms in the region, the 20 largest banana plantations were chosen and 400 of their farm labourers and packers invited to participate in the study. Only workers who worked at least six months on a farm were selected to control for the high turnover of workers. Each worker received a letter explaining the purpose of the study and inviting the worker to answer an interview-based questionnaire. Interviews were carried out by 20 interviewers employed by the Regional Coordination of Safety and Health at Work of the Ministry of Labor of Guayas and previously trained by the main author. Of the 394 participating workers, 264 were 'banana farm laborers,' involved in tasks including pesticide spraying, such as: watering, fertilizing, defoliation, deflowering, separating hands from the banana bunch, fumigating, cleaning, reseeding, harvesting, moving the bunch, and controlling the crown and the weeds. 130 workers, called 'banana packers, were in packing or administrative activities that did not involve spraying pesticides, such as: selecting, weighing, packing, labeling, palletizing, sealing, inspecting, and administering.

Questionnaire Instrument, Variable Definition and Statistical Tools

Questionnaire items were taken from a survey instrument recommended for epidemiological studies on working conditions and health (Benavides et al., 2010). Respiratory symptoms were assessed using items of the validated European Community Respiratory Health Survey (Burney, Luczynska, Chinn, & Jarvis, 1994). In order to assess the acceptance of the instrument and to validate its comprehension in the study population, a pilot survey was carried out among 20 workers.

For the current analyses, the following variables were considered as potential predictors of respiratory health or potential confounders in the association between job type and respiratory health: sex (male, female), age (18 to 29 years, 30 to 39 years, 40 to 49 years, and 50 years and older), number of paid jobs (from 0 to 1 and 2 to 9), educational level (less than complete primary education, complete primary to incomplete secondary education, and at least complete secondary education), and smoking behaviour (never smoker, ex-smoker, and current smoker). Number of weekly working hours were divided into four groups (<40 hours, 40 hours, 41 to 48 hours, and 49 to 80 hours). In order to assess the workers' awareness of their exposure to potentially harmful

substances, they were asked whether they handled noxious or toxic substances during their work. In addition, workers were asked whether they used personal protective respiratory equipment such as filter masks.

Respiratory outcomes included asthma (asthma attack in the last twelve months prior to survey or use of any asthma medication including inhalers or aerosols), wheezing (wheezing without a cold during the twelve months prior to survey), wheezing at work, and absence from the workplace because of respiratory sickness (respiratory sickness absence).

For data analysis, EpiInfo Version 7 (<https://www.cdc.gov/epiinfo/index.html>) was used. Absolute and relative frequencies were calculated and stratified for job type (banana farm laborers vs. packers). Independence between groups was assessed using Chi² / Fisher exact tests. Crude and adjusted logistic regression models with 95% confidence intervals between job type and outcome variables (asthma, wheezing, wheezing at work, and respiratory sickness absence) were calculated adjusting for those variables with a $p < 0.10$ in the bivariate analyses.

Results

The majority of workers in both groups of banana workers were men (82%) 89% were never smokers (table 1). Comparing the two groups, banana farm laborers were statistically significantly older than packers ($p=0.004$), were more likely to have less than primary education (30% vs. 10%; $p < 0.001$), work more than 1 job (22% vs. 13%; $p=0.05$), and work less than 49 hours per week on the farm (83% vs. 71%). About half of the banana farm laborers were aware of exposures to toxic substances, while 28% of the banana packers reported being exposed to chemicals at the workplace ($p < 0.001$). About one third of both groups reported use of personal respiratory protection (38% vs. 33%; $p=0.30$).

The prevalence of the respiratory outcomes was higher among banana farm laborers compared to banana packers (table 2). Differences reached statistical significance for work-related wheezing (15% vs. 6%; $p=0.01$) and respiratory sickness absence (17% vs. 3%; $p < 0.001$). Among the co-variables, lowest level of education was associated with higher prevalence of all outcomes except for work-related wheezing. In addition, prevalence of symptoms was highest in the highest age category, reaching statistical significance for wheezing and work-related wheezing.

Logistic regression analyses confirmed the higher odds of respiratory outcomes among banana workers for work-related wheezing (odds ratio 2.5; 95% confidence interval 1.1-6.5) and respiratory sickness absence (5.1; 1.7-15.0) (table 3).

Discussion

This study of a relatively large group of Ecuadorian banana workers indicates a high prevalence of work-related respiratory symptoms and respiratory sickness absence in workers involved in pesticide spraying compared to those not involved in spraying activities. Only half of those spraying pesticides were aware that they were using toxic substances during their work. Only one third reported using personal respiratory protection.

Participation was high and might be considered a strength of the study. This was achieved thanks to the support of the banana unit of the Ministry of Agriculture, Livestock, Forestry, and Fisheries of Ecuador. At the same time, the involvement of the ministry might have resulted in some reporting bias, especially as interviewers were involved. The double data entry made by different people reduced data entry error. In order to increase validity of the results, validated questionnaires were used. However, we could neither implement any objective measure of exposure nor outcome. Furthermore, around a quarter of the banana plantation workers also held another job, potentially with other types of exposure. Likewise, two of our outcomes referred to lifetime prevalence, while our workers worked only at minimum 6 months at the current job. Therefore, symptoms might have occurred due to a different job, as job rotation is very common in Ecuadorian banana plantations. We may assume that many of our participants always worked in banana production; however, we do not have any data on that.

Our findings are comparable to those found in African countries among agricultural workers involved in mixing and spraying activities, thus confirming previous findings, although outcome definitions varied (Negatu, Kromhout, Mekonnen, & Vermeulen, 2017; Quansah et al., 2016; Wunschel & Poole, 2016). In addition, different groups of pesticides and methods of application used in different countries and applied to different crops might have different effects.

In conclusion, this cross-sectional study compared the prevalence of respiratory symptoms among banana farm laborers and packing workers. A high prevalence of wheezing at work and inability to work due to respiratory problems among workers involved in fungicide spraying was demonstrated, while the risk awareness and use of protective equipment was low. Efficient training and exposure reduction are warranted to protect against respiratory disability in this population.

Table 1: Sociodemographic characteristics by group of banana workers

			<i>Farm</i> labourers (N=264)	Packers (N=130)	
Variable	Category	N _{missing}	n (%)	n (%)	p _{Chi²}
Sex	Men	11	215 (81.4)	100 (76.9)	0.49
	Women		43 (16.3)	25 (19.2)	
Age group	18 - 29 yrs	2	67 (25.6)	49 (37.7)	0.004
	30 - 39 yrs		70 (26.7)	38 (29.2)	
	40 - 49 yrs		62 (23.7)	30 (23.1)	
	≥ 50 yrs		63 (24.1)	13 (10.0)	
Educational level	< Complete primary	2	78 (29.7)	13 (10.1)	<0.001
	Complete primary to incomplete secondary		128 (48.7)	70 (54.3)	
	≥ Complete secondary		57 (21.7)	46 (35.7)	
Cigarette smoking	Never smokers	19	226 (90.4)	109 (87.2)	0.39
	Ex-smokers		7 (2.8)	7 (5.6)	
	Current smokers		17 (6.8)	9 (7.2)	
Number of paid jobs	0 – 1	23	196 (78.1)	104 (86.7)	0.05
	2 – 9		55 (21.9)	16 (13.3)	
Weekly working hours	< 40 hours	42	40 (17.1)	23 (19.5)	0.034
	40 hours		95 (40.6)	36 (30.5)	
	41 - 48 hours		60 (25.6)	25 (21.2)	
	49 - 80 hours		39 (16.7)	34 (28.8)	
Manipulation of toxic substances	Yes	11	129 (49.6)	34 (27.6)	<0.001
Use of respiratory protective equipment	Yes	37	91 (39.1)	41 (33.1)	0.30

Figure 1: Study region: Los Ríos, Guayas, El Oro provinces (Wikimedia Commons)



Table 2: Prevalence of respiratory symptoms by potential risk factors among 264 farm labourers and 130 packers working on 20 Ecuadorian banana farms

Variable	Category	Wheezing			Asthma			Work-related wheezing			Respiratory sickness absence		
		n	%	p _{Chi²}	n	%	p _{Chi²}	n	%	p _{Chi²}	n	%	p _{Chi²}
Group of workers	Farm labourer	35	13.6	0.16	20	7.7	0.16	39	15.0	0.01	44	17.1	<0.001
	Packer	11	8.6		5	3.9		8	6.2		4	3.1	
Sex	Men	34	11.0	0.44	19	6.1	0.48	35	11.3	0.25	42	13.6	0.36
	Women	11	16.4		6	9.0		9	13.4		5	7.5	
Age group	18 - 29 yrs	11	9.6	0.001	6	5.2	0.18	13	11.3	0.01	8	7.0	0.06
	30 - 39 yrs	6	5.7		3	2.9		11	10.4		18	16.8	
	40 - 49 yrs	10	11.1		6	6.7		6	6.6		9	10.1	
	≥ 50 yrs	18	24.3		8	10.5		17	22.7		13	17.8	
Educational level	< Complete primary	19	21.4	0.003	11	12.1	0.04	15	16.5	0.16	14	15.7	0.05
	Complete primary to incomplete secondary	14	7.3		8	4.1		23	11.9		28	14.6	
	≥ Complete secondary	13	12.8		6	5.9		8	7.8		6	5.8	
Cigarette smoking	Never smokers	39	11.9	0.42	21	6.3	0.87	38	11.4	0.17	41	12.4	0.33
	Ex-smokers	2	14.3		1	7.1		0	0.0		0	0.0	
	Current smokers	1	3.9		1	3.9		5	20.0		4	15.4	
Number of paid jobs	0-1	41	14.0	0.03	21	7.1	0.19	41	13.9	0.13	39	13.3	0.70
	2-9	3	4.4		2	2.9		5	7.1		8	11.4	
Weekly working hours	< 40 hours	8	13.1	0.63	2	3.2	0.09	8	12.9	0.20	4	6.8	0.62
	40 hours	12	9.4		8	6.2		11	8.4		15	11.5	
	41 - 48 hours	11	12.9		3	3.7		8	9.8		9	10.8	
	49 - 80 hours	11	15.3		9	12.3		13	17.8		10	13.7	
Manipulation of toxic substances	No	26	12.1	0.95	16	7.4	0.32	25	11.4	0.61	22	10.1	0.10
	Yes	19	11.9		8	4.9		21	13.1		25	15.8	
Respiratory protective equipment	No	21	9.6	0.34	13	5.9	0.60	31	14.0	0.17	32	14.6	0.14
	Yes	17	12.9		6	4.6		12	9.1		12	9.2	

Table 3: Crude and adjusted odds ratios for the association between the potential risk factors and respiratory symptoms among 264 farm labourers and 130 packers working on 20 Ecuadorian banana farms

Variable	Category	Wheezing		Asthma		Work-related wheezing		Respiratory sickness absence	
		cOR 95% CI	aOR 95% CI	cOR 95% CI	aOR 95% CI	cOR 95% CI	aOR 95% CI	cOR 95% CI	aOR 95% CI
Group of workers	Farm labourer	1	1	1	1	1	1	1	1
	Packer	1.67 0.82- 3.40	1.40 0.62- 3.16	2.02 0.74 - 5.51	1.68 0.60- 5.10	2.70 1.20- 5.90	2.45 1.10- 6.50	6.50 2.30- 18.40	5,10 1,74- 15,00
Age group	18 - 29 yrs	1	1			1	1	1	1
	30 - 39 yrs	0.57 0.20- 1.60	0.63 0.22- 1.83			0.90 0.40- 2.12	0.90 0.40- 2.02	2.70 1.12- 6.51	2.40 0.94- 5.90
	40 - 49 yrs	1.18 0.50- 2.92	1.38 0.53- 3.58			0.60 0.20- 1.51	0.50 0.20- 1.40	1.50 0.60- 4.10	1.30 0.50- 3.54
	≥ 50 yrs	3.03 1.34- 6.90	2.29 0.91- 5.71			2.30 1.04- 5.10	1.91 0.90- 4.30	2.90 1.13- 7.40	2.14 0.80- 5.70
Educational level	< Complete primary	1	1	1	1			1	1
	Complete primary to incomplete secondary	0.29 0.14- 0.60	0.38 0.17- 0.86	0.31 0.12- 0.80	0.31 0.10- 0.90			0.91 0.50- 1.82	1.12 0.52- 2.40
	≥Complete secondary	0.54 0.25- 1.16	0.81 0.33- 2.00	0.50 0.16- 1.30	0.51 0.16- 1.70			0.33 0.12- 0.90	0.50 0.20- 1.40
Number of paid jobs	0-1	1	1						
	2-9	0.30 0.08- 0.93	0.28 0.10- 1.00						
Weekly working hours	< 40 hours			1	1				
	40 hours			2.0 0.40- 9.54	2.20 0.43- 10.8				
	41 - 48 hours			1.14 0.18- 7.03	1.20 0.20- 7.54				
	49 - 80 hours			4.21 0.90- 20.3	5.10 1.02- 24.9				
Manipulation of toxic substances	No							1	1
	Yes							1.70 0.90- 3.10	1.40 0.71- 2.60

References

- Benavides, F. G., Zimmermann Verdejo, M., Campos Serna, J., Carmenate, J. A., Carmenate, L., Báez, I., Pinilla García, F. J. (2010). Conjunto mínimo básico de ítems para el diseño de cuestionarios sobre condiciones de trabajo y salud. *Archivos de prevención de riesgos laborales*, 13(1), 13-22.
- Brisbois, B. W., Harris, L., & Spiegel, J. M. (2018). Political Ecologies of Global Health: Pesticide Exposure in Southwestern Ecuador's Banana Industry. *Antipode*, 50(1), 61-81. doi:10.1111/anti.12340
- Burney, P. G., Luczynska, C., Chinn, S., & Jarvis, D. (1994). The European Community Respiratory Health Survey. *Eur Respir J*, 7(5), 954-960.
- Deknock, A., De Troyer, N., Houbraken, M., Dominguez-Granda, L., Nolivos, I., Van Echelpoel, W., . . . Goethals, P. (2019). Distribution of agricultural pesticides in the freshwater environment of the Guayas river basin (Ecuador). *Sci Total Environ*, 646, 996-1008. doi:10.1016/j.scitotenv.2018.07.185
- Doust, E., Ayres, J. G., Devereux, G., Dick, F., Crawford, J. O., Cowie, H., & Dixon, K. (2014). Is pesticide exposure a cause of obstructive airways disease? *Eur Respir Rev*, 23(132), 180-192. doi:10.1183/09059180.00005113
- Fieten, K. B., Kromhout, H., Heederik, D., & van Wendel de Joode, B. (2009). Pesticide exposure and respiratory health of indigenous women in Costa Rica. *Am J Epidemiol*, 169(12), 1500-1506. doi:10.1093/aje/kwp060
- Mamane, A., Baldi, I., Tessier, J. F., Raheison, C., & Bouvier, G. (2015). Occupational exposure to pesticides and respiratory health. *Eur Respir Rev*, 24(136), 306-319. doi:10.1183/16000617.00006014
- Mamane, A., Raheison, C., Tessier, J. F., Baldi, I., & Bouvier, G. (2015). Environmental exposure to pesticides and respiratory health. *Eur Respir Rev*, 24(137), 462-473. doi:10.1183/16000617.00006114
- Mostafalou, S., & Abdollahi, M. (2017). Pesticides: an update of human exposure and toxicity. *Arch Toxicol*, 91(2), 549-599. doi:10.1007/s00204-016-1849-x
- Negatu, B., Kromhout, H., Mekonnen, Y., & Vermeulen, R. (2017). Occupational pesticide exposure and respiratory health: a large-scale cross-sectional study in three commercial farming systems in Ethiopia. *Thorax*, 72(6), 498-499. doi:10.1136/thoraxjnl-2016-208924
- Nordgren, T. M., & Bailey, K. L. (2016). Pulmonary health effects of agriculture. *Curr Opin Pulm Med*, 22(2), 144-149. doi:10.1097/MCP.0000000000000247
- Quansah, R., Bend, J. R., Abdul-Rahaman, A., Armah, F. A., Luginaah, I., Essumang, D. K., Afful, S. (2016). Associations between pesticide use and respiratory symptoms: A cross-sectional study in Southern Ghana. *Environ Res*, 150, 245-254. doi:10.1016/j.envres.2016.06.013
- Schenker, M. B., Stoecklin, M., Lee, K., Lupercio, R., Zeballos, R. J., Enright, P., . . . Beckett, L. A. (2004). Pulmonary function and exercise-associated changes with chronic low-level paraquat exposure. *Am J Respir Crit Care Med*, 170(7), 773-779. doi:10.1164/rccm.200403-266OC
- To, T., Stanojevic, S., Moores, G., Gershon, A. S., Bateman, E. D., Cruz, A. A., & Boulet, L. P. (2012). Global asthma prevalence in adults: findings from the cross-sectional world health survey. *BMC Public Health*, 12, 204. doi:10.1186/1471-2458-12-204
- World Health Organization. Chronic respiratory diseases. Retrieved from <http://www.who.int/respiratory/en/>
- Wunschel, J., & Poole, J. A. (2016). Occupational agriculture organic dust exposure and its relationship to asthma and airway inflammation in adults. *J Asthma*, 53(5), 471-477. doi:10.3109/02770903.2015.1116089

6. Export-led Development and its Impact on the Health and Labour Conditions of Workers: the Apparel Industry in El Salvador and the Palm Oil Industry in Colombia

Daniel Hawkins and Oscar Gallo-Velez

The project of “developing” the so-called Third World, whilst successful in spreading the norms and values associated with Western consumerism and halting fertility rates around the world (Portes, 1997), failed remarkably in fomenting wealth creation and its distribution across the Global South. In its initial phase, the development project of the South sought to modernize and reorient institutions, cultural values, and economic paths to development (see Rostow, 1960). The supposed backwardness of many agrarian societies, dependent on agricultural commodities such as coffee and sugar and overly susceptible to authoritarian and populist political leaders, entailed a need to “reset” state priorities and foment capitalist development as a way of converting the rural peasant population into urban industrial workers. The World Bank’s 1949 Mission to Colombia typifies such a worldview. Headed by Lachlin Currie, this mission criticized the country’s vicious cycle of under-development and implored the Colombian government to expand the domestic and international capital market and reform macroeconomic policy as a means of overcoming the volatility of its coffee-dependent economy (Sandilands, 2015). This new path to development prioritized the advice of development economists and planners and recommended a concerted move towards capital accumulation and industrialization (Escobar, 1998). As a means of winning the ideological battle within the political sphere, the US state, initially during the Kennedy administration, set out in foreign policy its Alliance for Progress across Latin America which, alongside economic aid and military intervention, offered scholarships to young diplomats as a means of winning both their hearts and minds and thereafter redirecting state policy in a concerted manner (see Campbell, 1998).

External pressure and the power of Western discourse were, no doubt, significant push factors in shaping the political economy of many “undeveloped” countries. However, historical factors and emerging economic models within the region were also forceful in delineating paths for development, none more so than the Import Substitution Policies (ISPs), theoretically supported by distinct versions of the Dependency Schools (see Gereffi, 1989) and institutionally ingrained in the Chilean based, United Nations’ organism, ECLAC, the Economic Commission for Latin America and the Caribbean, and its Argentinian-born Director, Raúl Prebisch. Indeed, Prebisch foresaw the industrialization of the region not as part of a demonstration of blind faith in US-based policy experts but rather as a necessary path following the two World Wars and the Great Crisis of the

Depression (Prebisch, 1948/2016). Industrialization of peripheral countries, a track previously excluded to them due to the rigidities of the International Division of Labour (IDOL), had been unexpectedly opened due to the protectionist policies enacted by core countries following these cataclysmic events. Notwithstanding, such a development path was not possible for great swaths of Latin America and the Caribbean, indeed, without a sufficiently large domestic market and urban centres, the Latino industrial revolution only took firm hold in the Southern Cone (Brazil, Argentina, Chile, and Uruguay), Mexico and, more partially, Colombia (Portes & Hoffman, 2003). Nonetheless, despite the manifest problems associated with chaotic urban sprawl and the growth of the marginal mass of the reserve industrial army (Hawkins, 2011; Quijano, 1983; Nún, 1969), ISPs and a more internal-focused development programme did bring about both more economic stability and a tepid growth in social welfare provision and labour rights across the region in the three decades following WWII (see Portes & Hoffman, 2003).

Leading into the 1980s the discourse and practices of development took an animated turn, prioritizing external revenue, foreign direct investment (FDI), trade liberalization, privatization, independent monetary policy, and labour market flexibility. In Latin America, the debt crisis, initially honing in on Mexico with its 1982 threat of debt default (Bruner & Simms, 1987), and later enveloping further countries, set down the changing contours of structural dependency and opened up the way for a third phase of the new neoliberal, Washington Consensus-Led-Development model. Herein, the external market was the key, and Latino nations, riddled with crippling levels of public debt, were cajoled into fomenting external revenue by bolstering their export markets. From Mexico through to Central America, the path was gradually laid for the emergence and spread of the industrial *maquiladora* model.

Devised as a new path forward for the spread of global capital in its perpetual logic of reducing costs as a means of growing profits, from the 1980s onwards (and especially post NAFTA), the integration of Mexico and Central America into the demands and flows of the US market, especially in the maquiladora model, which is structured on low value-added exports with a high content of imported inputs, became one of the three key regional patterns of export-led development in Latin America and the Caribbean (Ocampo, 2009; Prochnik, 2010). Further South, especially from the 1990s onwards there was a concerted move back to the productive model of colonial times as primary commodity exports, especially for global energy demands, re-emerged as the driving force for economic growth in diverse countries (Ocampo, 2009), a trend well defined as the reprimarization of these economies (see Bonilla, 2011).

Fierce debate has surfaced regarding the pros and cons of these new models of development for the Global South (see: Bronstein, 2000; Kaufmann, 2007;

Mosley, 2011). Yet, there has been much less academic interest in examining how such shifting development models have impacted on the millions of workers who are cyclically pushed into their “engines of production”. If the integration of global production along vast and ever-more complex supply chains has been fomented as a means of temporarily overcoming the time-space compressions of capitalism, the associated changes in work organization have taken place as a means of increasing productivity, improving quality, and firm profitability (Barrientos, et al., 2011; Landsbergis, et al., 1999; Lee, et al., 2011); but all of this at what cost to the health, well-being and rights of workers in the Global South? The market-friendly reforms of the 1980s and 1990s and their impacts on labour unions across the region has been a theme of significant academic interest in the region (see: Collier & Collier, 2002; Murillo, 2000; Murillo & Schrank, 2005; Patroni, 2008; Anner, 2008), not least due to the remarkably quick manner in which significant union and worker gains were swept away during what is popularly known as the “long neoliberal night” (Escobar, 2015). Fewer scholars have examined how labour market reform in this period and thereafter has been linked to changing forms of worker control and work organization and the effects, not just on wages, but working conditions (for exceptions, see Anner, 2011, 2015; Landsbergis, et al., 1999).

Redirecting an examination of the impacts on workers, particularly their health, of the export-enclave development model, focusing on the maquiladora sector in El Salvador and the agro-industrial palm oil industry in Colombia, the chapter will examine how the periodic reorganization of work systems has led to the intensification of work (more tasks in less time), heightened pressure, less stability, increasingly faster worker “burn-out”, and the associated wear-and-tear on workers’ bodies and minds. The chapter ends with some brief reflections on how development cooperation could be refocused to permit workers in such industries to press for concerted social upgrading not just incremental and precarious wage increases.

El Salvador and the Rise of the Maquiladora Industry: Export Growth and Worker Strain

The 12-year war that engulfed El Salvador wreaked havoc, not only on the country’s economy, with negative growth for eight years in the 1980s (Alvarenga, 2001), but also on the broader population, as thousands of civilians were murdered and hundreds tortured and disappeared. The signing of the Peace Accords, in 1992, between the government formed by the Nationalist Republic Alliance (Arena) and the guerrilla group *Farabundo Martí para la Liberación Nacional* (FMLN) brought to an end a 60-year-old dictatorship and the dominance of an agrarian-based economy, where sugarcane and cotton were the mainstays of production. In its place, similar to trends across much of Central

America, two new channels of growth gradually emerged: the maquiladora apparel industry and the remittance economy, as hundreds of thousands of Latinos from the region fled to the US to escape war, with many forcibly leaving family behind. By the end of the 1990s remittances had grown to make up 10% of Salvadoran GDP. The maquiladora apparel sector, almost non-existent before the 1980s, quickly became the principal source of foreign revenue and FDI, generating more formal employment than any other industry in the country.

El Salvador, geographically bound to its neighbours—Honduras and Guatemala—together forming the Northern Triangle of Central America, reconfigured its newly democratized economy towards the needs of the US apparel market. Laws promoting and facilitating the construction and expansion of export-processing zones (EPZs), which offered special incentives to attract FDI, via tax deductions and exemptions for goods that are assembled and then exported, were fast tracked (OIT, 2014: 1). The Reserve Bank, via loans from the Inter-American Development Bank (IDB), assumed almost 75% of all the costs involved in developing and expanding the EPZs (Preiswerk, 1998). By the mid-1990s close to 90% of all FDI was centred in EPZs and the maquiladora-apparel industry (Ibid.). As of today, this sector is the country's leading exporter, contributing 45% of all exports in 2014. But not only has the industry grown exponentially in terms of its export revenues, it has also increased its specialization, gradually moving from the assemblage of imported textiles and fabric into finished clothes towards a more integrated process termed the “full packet” (*el paquete completo*). Indeed, while during the 1990s the sector was almost completely geared towards the piecing together of imported, pre-delivered fabric, by 2016, according to the Industrial Association of El Salvador (ASI), over 63% of all apparel exports were part of full packet processes (ASI, 2017: 59). These incremental steps undertaken to promote more value-added processes, while fundamentally linked to global supply chain dynamics, are also directly influenced by the quality and productivity of the predominantly female Salvadoran apparel-sector workers. Indeed, the lead export firm in this industry, the US-based sportswear giant, Hanes-Brands Inc., has made El Salvador its centre of global operations, with six factories and more than 10,000 employees. According to this firm's national manager, one of the advantages of establishing operations in El Salvador is “*the capacity to learn and the dedication of the Salvadoran workforce*”, which “*facilitates the country's adaption to the changes demanded by the global market, where today orders are more varied, the production flows are shorter, and due to this there must be great flexibility and adaptation to new cuts, weaving and styles even while operating with the same machinery*” (ASI, 2017: 55); in other words, these workers have become very adept at doing more, more quickly with no technological improvements.

Productivity, in this context, becomes much more a human-based factor than a capital one.

Labour Relations in the Salvadoran Apparel Industry

The apparel sector in El Salvador was originally promoted as the perfect way to generate external revenue and thousands of much-needed jobs in a country emerging from a highly destructive civil war. Nonetheless, the quality of work in this sector appeared to be a factor of little concern to the entrepreneurs and political backers who dreamed up and promoted the industry's emergence. As occurred in other countries of the region, the 1990s labour reforms prioritized the flexibilization of labour relations without simultaneously strengthening enforcement mechanisms in a context of significant economic restructuring (Anner, 2008). What was important to the US brands looking to outsource production in El Salvador was the ability to meet strict time and quality standards. With thousands of labourers working in huge factories across the multiple EPZs around the capital city, San Salvador, a labour regime of strict control and hierarchies was set in place.

Globally, the apparel industry is based on a division of labour in which fashion labels organise their supply chains functionally and geographically. Hence, logistics and transport play a fundamental role in ensuring fluidity and speed of connection between one link in the chain and another (Escalonada & Ramos, 2014). Increasingly, the geographical distribution of their supply chains depends on the duration of styles and fashion seasons in the biggest retail chains. For example, when a brand's collection does not vary for a whole season, the distribution of its fabrication is more dispersed, especially across countries with the lowest labour costs (Bangladesh, India, and China). However, when one shifts to clothes that have high components of fashion or a very unpredictable demand, the big clothing retailers require a more immediate resupply and as such, many buyers prefer to have the factories that make their clothes in closer proximity, even when this means marginally higher costs (Ibid., 115).

For El Salvador, the country's close proximity to the US and their commercial connection, via the FTA, CAFTA-DR (ratified in 2005), plays in its favour, especially for the fabrication of clothes with high fashion content and volatile demand. But this advantage has a cost for the Salvadoran apparel-sector workers. As one worker, who sews clothes for a variety of US-based brands, stated in an interview: "*Work intensity is higher these days than before because there are more styles, and therefore there is more pressure to make the daily*

quota; for some styles it's easier to make the quota and you can make more money, but for others, you can't even meet the quota".²

Another interviewed worker said that sewing children's clothing is extremely complicated and as such, it's more difficult to meet the production quota.³ Here, the concept of the production quota is key to understanding the dynamics of work in this industry. Upon examining the average wages of diverse occupations in the apparel sector of El Salvador compared to the legal minimum wage,⁴ it is clear that a considerable part of income comes from a combination of overtime and bonus rates for meeting quotas. These bonuses are paid either daily or weekly, depending on the firm in question and they are used to motivate productivity and increase worker yields. For many workers, the bonus rate for meeting quotas determines where workers prefer to work. As argued by one interviewed unionist who has worked for over 30 years in this sector: *"The bonus rate is very appealing, it works like a hook to attract workers (...) People work themselves to death to make the bonus rate, you work yourself to the bone because with this extra money you can pay for your transport and eat something and your wages can cover household necessities, in other words, in firms that don't pay a bonus you're much worse off".⁵*

Nevertheless, the possibility of earning a bonus and actually obtaining one are two different matters, especially in a working environment where the production quotas and quality controls are increasingly higher and where, simultaneously, the demands of foreign clients are ever more stringent. As another long-time apparel worker stated: *"For example, if I'm making a grey t-shirt and the order is this and the whole plant is making the same t-shirt, but suddenly, the client says: no, you need to change because in so and so store they're asking for blue t-shirts. Then we remove all the semi-assembled grey ones from the production modules and we change them for blue ones and then we have to complete production. Or there could be a change of style also. We're making short-sleeve shirts and a store asks for long-sleeve ones, so we must change..."⁶*

Without doubt, the specialisation of the global apparel industry in the last two decades has taken place, to a great degree, via new systems of work

²Interview N° 1: Carolina (a pseudonym selected by the author), of the firm Youngone de San Salvador. Interview done on 7 February 2018.

³Interview N° 2: Ana Maria (a pseudonym selected by the author), of the firm LB de El Salvador. Interview done on 7 February 2018.

⁴ In El Salvador the minimum wage is set by industry.

⁵ Interview N° 3: Emperatriz (a pseudonym selected by the author), union leader from Sintrasacosi. Interview done on 6 February 2018.

⁶ Interview N°4: Samantha (a pseudonym selected by the author), Union leader from Fenastras. Interview done on 6 February 2018.

organization and labour regimes where firms have ensured productivity increases through the continual intensification of work and related flexibility and multitasking of workers. Demanding that workers are ever more versatile in their sowing, cutting, weaving, and adorning of clothes (and threading and operation of diverse types of textile and dyeing machines) has been a tactic which ensures that operators face more difficulty in meeting their quotas. Another factor has been the transformation of the production process in the last step of sowing together the final item of clothing (the activity that requires most workers in the industry).⁷

Changing Ways of Squeezing More Profits from Workers

Following from the well-publicized transformations in the work process in the automotive industry, during the 1980s and 1990s, new slogan concepts for work organization were introduced (Toyotism, lean production, team concept, total quality management, cellular manufacturing, etc.). These were geared towards increasing worker productivity and firm profitability. However, they were often cloaked in discursive banter alluding to the related benefits of worker autonomy and group cohesion (for a critique, see Landsbergis, et al., 1999). The apparel sector also sought to transform production for the same ends of productivity–profit growth.

At the beginning of El Salvador’s insertion into the global apparel sector, most firms organized the work process in work lines where each sower undertook one specific task continuously (i.e., sowing a hem, sowing on sleeves, collars, adornments, etc.) on a bundle of a specific quantity of garment parts. The production quotas were individual and each worker made (or didn’t make) the bonus payment, depending on their own work rate. Such fragmented and repetitive work, known as *the bundle system*, especially when combined with piece-meal payments, has been shown to lead to high rates of work-related musculoskeletal disorders (WRMDs), especially ones such as carpal tunnel syndrome and tendinitis (Landsbergis et al., 1999: 10; see also, Brisson et al., 1989).

Around ten years ago, in El Salvador, this system was replaced by the modular system in which workers are placed in groups and the production quotas are collective ones (per team). Previous research in the US context has argued that the modular system, when compared to the bundle system, appears to improve quality while also reducing inventory and costs as well as allowing firms to

⁷ According to the ASI, for 2016, the apparel-textile industry in El Salvador generated 71,271 direct and formal jobs and 60,363 of these were sowing machine operators. Furthermore, the Chamber of Textile Employers, Camtex, stated that there were more than 200,000 indirect jobs created within this industry (ASI, 2017: 73).

respond more quickly to client's requests (Landsbergis, et al.,1999: 111). Notwithstanding, in other studies (García & García, 2016; Global Center for Workers' Rights & Workers' Rights Consortium, 2015), and in numerous interviews, two negative impacts on working conditions can be perceived when examining the effects of the modular system. First of all, this system was introduced on the back of significant job reductions as the sowing process in factories was downsized: less jobs but the quantity of work required was not reduced.⁸ Second, the reorganization of the work process was done with a slight change in control as the work teams assumed more control than previously. Without doubt one could argue that passing more control of the work process to workers is a net gain for them because it implies, at least theoretically, that the worker now has more autonomy to decide how she will undertake her tasks and responsibilities, but in the Salvadoran case, at least, this is not the case. In the words of the previously sighted long-term apparel worker-unionist (N°3): *“(W)hen the modular method won over it reduced costs because with less personnel workers are obliged to achieve the same production, but not only this, it also leaves workers to supervise themselves, you see, now the supervisor does not intervene, it's only the workers, the supervisor tells them that they must undertake self-monitoring. This creates conflicts between workers. As such, all these changes, which are well dressed up, as if they are part of modernization, in reality are perverse ones which only benefit the big companies”*.⁹

This new type of productive reorganization which is based on a form of discursive but not concrete worker autonomy is a subtle manner of transferring the competition between the capitals onto the shoulders of workers as they are now obliged to collectively press one another to produce more. It is part of the same process described by some scholars focusing on distinct industries and socio-labour geographies and termed “market despotism” (Webster, Lambert, & Bezuidenhout, 2009). Herein, the market mechanism, rather than the concrete figure of the supervisor, becomes key in controlling and squeezing workers. The desire to meet the daily, weekly, or monthly production quotas, while always ensuring that quality standards are met, for fear of deductions, drives workers to stress, anxiety, and frequently leads to illness and/or workplace accidents.

Work Intensity and Injury: the Cost of Speed and Stress

It appears inevitable that any attempt to augment production levels, particularly in industries that are extremely labour-intensive, such as the case for apparel, leads to added physical and psychological stress on workers, especially when the pay regime rests on stimulating workers to increase their production via

⁸ Interview N°5: Gilberto García, expert in labour and union relations and of the Salvadoran maquiladora apparel sector. Interview done on the 5 February 2018.

⁹ Interview with N°3; see footnote 4.

piece-rate systems (see: Mayhew & Quinlan, 1999). The response to such added stress factors, at least in the biggest and most profitable factories, is to improve their internal systems of industrial security and occupational health and ensure that employees wear the appropriate personal protection elements (PPE). Furthermore, the installation of a health service within the factory premises is generally required to offer immediate attention to injured or ill workers. Nonetheless, such efforts are often undertaken as a means of reducing workers' sick leave and grievous workplace accidents rather than focusing on prevention; injuries and illness become part of the daily grind and firms often adopt a cost-benefit analysis wherein they compare the costs of accidents/illnesses with productivity increases associated with the intensification of the work process. In this way, the health of workers becomes expendable and they are implicitly encouraged to prioritize money over their health.

Worker interviews with apparel workers in San Salvador uncovered numerous workplace health hazards and accidents. In a focal group with 15 female and male operators,¹⁰ workers stated that the main types of illnesses in the industry were respiratory infections and musculoskeletal problems and the most frequent accidents involved cuts and sewing-machine injuries. Respiratory illnesses were associated with the inhalation of dust and organic-synthetic materials, often due to workers not wearing their face masks owing to discomfort and scorching heat on the factory floor. Such health-related problems have been examined in occupational health literature, which has highlighted the relationship between hemp or cotton dust exposure to the development of the syndrome known as byssinosis, while other types of textile dust, such as silk, may contribute to reversible or irreversible chronic obstructive pulmonary disease (COPD) (Lai & Christiani, 2013). Musculoskeletal problems were related to workers sitting in the same position hours on end, often in poorly suited work benches and the already-mentioned repetitive strain disorders such as tunnel carpal syndrome. Such factors have, in the literature, been related to the textile industry where the intense manual labour and high repetition of tasks with a low variability in function are often deemed by workers to exacerbate musculoskeletal disorders and psychological stress (De Almeida, et al., 2017). Even in cases where employers provide more ergonomically suited work chairs, some workers continue to use their traditional chair or bench as they feel that it allows them to work faster. While these workers were unanimous in stating that industrial security had improved in recent years, they were also emphatic in arguing that such injuries/illnesses were almost intrinsic to work in the Salvadoran apparel industry (see also Rojas et al., 2015).

¹⁰ The focal group took place on 8 February 2018.

One important side effect emerging from both health-related stress factors and the continual search to increase worker productivity without affecting quality, is the implicit general rule in this industry whereby female operators become expendable and difficult to employ after they reach the age of 40. In the focal group discussion previously mentioned, the workers stated that the most popular age for apparel-sector employers was workers between 18-25 and one worker stipulated that *“a sowing machine operator that is 40 or 42 years old must make sure that she works diligently and that she protects herself because if she is fired she won’t find work in another firm”*.¹¹

One of the strategies post-40-year-old employees use to protect themselves from such a situation is to form or join a union and become an “elected” union representative as such workers are afforded special protection by the labour code. Unions, in this instance, become a formal mechanism for instrumental and individual employment protection rather than a medium to counter employer structural power and protect the working conditions of all workers. Indeed, both the massive use of contingent employment and the adverse effects of work organization and remuneration systems in the Salvadoran apparel industry have been so widespread precisely due to the systematic anti-union practices of employers and the overly weak legal mechanisms in place to protect unions and their members.

As is the case for the vast majority of countries that rely on the apparel industry as a key sector both for employment generation and export revenue, in El Salvador the union movement is extremely weak and fragmented. While there are 65 unions registered across the country’s industrial sector, making up 13% of all unions,¹² in the apparel sector, after more than 30 years of expansion there has not been one single collective bargaining agreement signed. Employers categorically refuse to negotiate with unions, even preferring to close down profitable factories over signing such an agreement. In such an environment, unions have become incredibly small and fractured and unable to build a concerted movement to pressurize to improve workers’ rights. Indeed, in various cases, there are multiple unions present in large-scale factories but apart from the eight union representatives required to formally set up a union local, none of them have any base members. While functioning to protect individual worker stability they have also become synonymous with corruption as employers pay-off false leaders as a way of ensuring that the union does not “spread” across the workplace. Workers yearn for better protection of their

¹¹ Focal group discussion, see footnote 9.

¹² Information taken from: Ministry of Work and Social Prevision: Registros Institucionales- Dirección General de Trabajo MTPS. 2016.

<http://www.mtps.gob.sv/wp-content/uploads/descargas/InformesEstadisticos/mtps-anuario-estadistico-2016.pdf>(accessed on 15 March 2018).

health and continue to attempt to counter the effects of the intensification of the work process and contingent, unstable employment. In the meantime, the vacuum of union collective bargaining agreement protections is filled by employers in their drive to increase profits come what may.

Palm Oil in Colombia: Plantation Price Squeeze and Worker Fatigue and Stress

The Colombian palm oil industry emerged in the 1930s but it was not until the 1960s that it began a gradual but notable geographical expansion, on the back of its institutional consolidation, with the founding of the palm oil employers' association, Fedepalma (in 1961), and state support, in line with the macroeconomic policy of Import Substitution (ISP) which accorded special preference for economic sectors that could give more dynamism to industrial processes. In line with both ISP dictates and the policy prescriptions of modernization theorists and their like-minded planners in developing country governments and in multilateral entities of the time, Colombia desperately needed to disentangle itself from its dependence on the coffee industry, especially due to its small-scale-producer structure, and develop industrial linkages between the rural and urban economies. Palm oil was perfect for such a proposition as the palm fruit can be processed for a variety of sub products (palm oil, palm kernel, palm kernel oil), which can then be further refined and used in diverse industrial processes (as biofuel, animal feed, the food industry, as well as for products in the chemical and cosmetic industries), and in this way, palm plantations, following in the footsteps of Colombia's sugarcane industry, could be deeply integrated into the industrial urban economy.

By the 1980s, the fruits of such objectives were beginning to ripen as the emerging industry benefitted from import controls, tax deductions, and significant state-backed loans as a means of protecting the local industry from foreign competition (Ospina and Ochoa, 2001: 149). Such incentives stimulated the expansion of African palm crops and by the end of the decade there were close to 110,000 hectares planted in four principal zones across the country. Nevertheless, expansion was stalled as the government of César Gaviria, in 1990, implemented trade liberalization, reducing tariffs and in the process squeezing agricultural production across the country. Simultaneously, palm plantations were being decimated by the spread of the disease, bud rot (*Elaeis guineensis*) which ruined thousands of hectares (Woittiez, et al., 2018), especially in the most established region of the Magdalena Medio.

The response of the main firms involved in the palm oil supply chain was to implement processes of economic integration as a means of protecting themselves from the volatilities of agricultural production (especially those associated with the spread of plagues and diseases) while simultaneously focusing on more value-added processes. This reorientation was given an added

push with the election of Álvaro Uribe as president in 2002 and later, in 2006, as his governments explicitly promoted and subsidized the palm oil industry. With petrol prices rising inexorably in the early 2000s and Colombia's oil reserves on the brink of depletion (see: Acosta, 2012), coupled with the existence of millions of hectares of unfarmed, arable land, the government decided that Colombia should bet on the biofuel industry, both via sugar-based ethanol and palm-oil-based biodiesel production. With numerous laws and presidential decrees promoting biofuel production and guaranteeing local demand, the biggest firms in the sector solidified their processes of vertical integration and began taking advantage of such strong state backing. By the end of Uribe's second presidential term, the 40 most important firms in the sector had organized themselves into ten conglomerates, together representing approximately 75% of all sales (Millán-Constaín & Posso-Vaca, 2014: 86).

As palm oil capital consolidated and the industrial process became increasingly more advanced, palm oil workers looked on in bemusement. For decades they had struggled to improve their precarious working conditions as their employers resisted anything more than incremental benefits, arguing that wage costs in Colombia were far higher than the world's leading producers, Indonesia and Malaysia. Instead of opening up to social dialogue as a means of negotiating improvements both in production and working conditions, employers of the biggest plantation-extraction firms sought to improve their international competitiveness by adopting more scientific methods of farming—led by high-level research undertaken by Fedepalma's research institute, Cenipalma—while also reducing labour costs by increasing outsourcing, on the one hand, and cutting back on expanding their own plantations in favour of purchasing palm fruit from independent producers who utilized informal and/or contingent labourers, on the other.

Palm Oil Workers: From Violence and Persecution to Work Instability and Intensification

The struggle for workers' rights in Colombia's palm oil industry has been a long and tragic journey. While the initial expansion of palm fruit plantations gave rural workers in the Magdalena Medio region the opportunity to form palm oil unions and attempt to improve the livelihoods of themselves and their families, immersed in an escalating pattern of rural warfare, unions and unionists were often associated with left-wing rebels and social upheaval and as such, union leaders became systematically targeted by paramilitary groups, which sought to protect palm oil employers from any form of democratic accountability and worker participation in the industry's development. In Colombia, after teachers, unionists from the agro-industrial sectors have suffered more anti-union violence than any other sectors; only in terms of

unionist murders, these two sectors together represent 68% of the total for the period between 1986 and 2010 (Comisión Colombiana de Juristas & Escuela Nacional Sindical, 2012: 57). And sadly, palm oil unionists are not exceptions to this pattern. Indeed, as can be seen from Table 1 in the almost forty years between 1980–2018, 66 palm oil union leaders have been murdered and many more have been persecuted in various ways.

Such violent acts are effective in deterring people from undertaking their normal daily activities and unionists are no different. The systematic persecution of unions and union members across the palm oil sector has dramatically hindered union attempts to deter growing labour outsourcing and employment contingency. Indeed, after ten years of the new millennium, practices such as labour outsourcing and the complete erosion, for some workers, of any legal semblance of a labour relation were so endemic in this sector that as part of the process of ratifying the FTA between Colombia and the USA, in April 2011, the two ex-presidents, Juan Manuel Santos and Barack Obama, signed the Labour Action Plan (LAP). This Agreement included 37 measures concerning 10 themes, all of which were focused on improving the protection of Colombian workers and guaranteeing many of their fundamental labour rights, which, up until then, had been ignored by many employers in the country. Indeed, this plan highlighted the precariousness of working conditions and unionism in the palm oil sector, as one of the five priority sectors that required more regulatory attention from the Labour Ministry, created as part of this Plan, especially in regards to the investigation into and elimination of illegal labour outsourcing, which was so widespread in this sector.

Table 1. Violations against the life, liberty. and integrity of palm oil unionists in Colombia (1988–2016)

Type of violation	N° Cases	%
Murders	66	52.8%
Death threats	18	14.4%
Forced disappearance	11	8.8%
Attempted murder (with or without injury)	10	8.0%
Forced displacement	7	5.6%
Kidnapping	7	5.6%
Torture	4	3.2%
Arbitrary detention	2	1.6%
Total	125	100.0%

Source: Sistema de Información en Derechos Humanos, SINDERH, ENS

In the following years, despite numerous legislative changes and a significant increase in the Ministry of Labour’s Budget (see: CUT, et al., 2014; ENS, 2015), both for hiring more inspectors and for reorganizing its institutional

structure and making it more transparent and systematic in its operations, state pressure on palm oil employers, to ensure that they comply with the law and stop discriminating against unionists, has not been sufficient. Beyond a few peripheral and partial labour formalization processes, particular in certain firms in the central zone of Colombia (Palmas del Cesar, Palmas de Monterrey, and more recently, Indupalma), contingent labour relations continue to be the norm for the majority of the thousands of workers who undertake agricultural and industrial productive processes in this sector. The inadequacies of legislative change and voluntary institutional upgrading in protecting core workers' rights are consistent with other occupational health research studies that have questioned the effectiveness of labour inspections and occupational health and safety systems in lowering work-related diseases and injuries, at least in the short term (Mischke, et al., 2013).

Low union density and fragmentation, phenomena that stand in contrast to the institutional strengthening and firm consolidation in this sector, have constrained the efforts of unions to protect the rights of their members and other workers and pressurize firms to transform their labour regimes from the archaic model that seeks to augment productivity via the forceful and unilateral intensification of the work process towards one where attempts to achieve economic upgrading are undertaken while thinking, simultaneously, of ways to promote social upgrading, as is proposed by numerous experts on economic development along global supply chains (Barrientos, et al., 2011). While the sustainability reports of palm oil firms and their heightened efforts to obtain certification for good environmental and social practices via RSPO, speak of the possibility of a new path for labour relations in this sector, their concrete human resource practices display a different trend. Up until now, many palm oil firms treat their workers as mere factors of production, through which the necessity of lowering marginal production costs to maintain or ensure competitiveness is primordial. In this perception, managers ignore the human condition of their workforce and the view that perceives work as a process bound by definitive social roots (Sen, 2000).

This vision, limited in any capitalist environment, is even more outdated in an industry that is ever-more connected to the needs of the world market and the global supply chain, in which straining oneself to reduce labour costs ignores that the production process should be based, not only on costs, but also quality standards, as well as ensuring compliance with socio-labour standards that highlight how workers are people with rights and dignity (Barrientos et al., 2011: 322; Trienekens, 2011). And beyond the significant limitation such practices place on collective actions to improve working conditions in Colombia's palm oil industry, they also leave workers at risk of serious health injuries and problems as unions, persecuted, fragmented and struggling for

survival, find it difficult to design and undertake collective action in the defence of worker health and security.

The Organization of Work and the Impacts on Workers' Health: a Gap in the Literature

There have been a plethora of studies examining the impacts on workers' health of the transformations of systems of work organization in the urban industrial setting, examining, as already noted, a variety of industries and service sectors (for example, autos, apparel and health). In Latin America, during the 1970s and 1980s, a growing school of scholars began examining the relationship between industrial production and worker fatigue (see, for example: Laurell & Noriega, 1989). In the agricultural and rural sectors, however, this social medical perspective has been generally absent and in its place, the biomedical view has been predominant (see: Gallo, et al., in peer review). Indeed, health studies in agriculture have generally focused on the effects on workers of pesticide use and exposure (see: Abreu, et al., 2014; Arias et al., 2014), although increasingly, studies have begun to examine the causes of musculoskeletal problems and their relationship with the work process (see: Aurora et al., 2011; Cardenas et al., 2016; Fathalla, 2010; Rossi-Rocha, et al., 2010).

For the Colombian palm oil industry there is a gaping hole in the literature concerning this topic. Indeed, in a literature review into the relationship between transformations in palm oil production and work modalities and their effects on worker health, only one Master's thesis and one scientific article were found.¹³ And even in these two articles there is no attempt to examine the problems of health from the perspective of the workers. In other words, at least in palm oil in Colombia, the voice of workers has been ignored as have their experiences of health/illness and the physical and psychological fatigue induced by new labour regimes.

As a means of advancing towards a gradual redirection towards this missing perspective a 2017/2018 study financed by the biggest Dutch union confederation, the FNV, and undertaken by the research area of the *Escuela Nacional Sindical* (ENS), in direct collaboration with four unions from the palm oil sector (Sintrapalmas, Sintraimagra, Sintrainagro, and Sintraproaceites), looked into the work-related health risks of palm oil production, in palm plantations and processing factories, in two of the main palm-oil-producing regions of Colombia. The study, using a methodology which we term, "felt

¹³ See Garzón-Castañeda and Luis Augusto, 2015; and Romero, 2000. "La salud ocupacional en las plantas de beneficio de palma de aceite". In a further literature search, an article examining worker perceptions of risks in palm-oil-processing plants in Malaysia was also found. See Shawal, Faten Noor Suhaida, Ng Yee, Guan, Dayana Hazwani, Mohd Suadi Nata, How, Vivien, & Tamrin, Shamsul Bahri Mohd., 2018.

morbidity”, organized eight workshops with 165 workers in which they mapped and described their perceptions of health and illness and related these symptoms to the work activities they undertake on a daily basis. In a complimentary fashion, the research team conducted 15 in-depth interviews with long-term palm oil workers which focused on how the work process had changed over time.

According to the workers who participated in this study, their working activities are associated with significant physical, chemical, physiological and psychological workloads. In the focal groups and in the individual “felt morbidity” sheets, workers spoke of the risks associated with high temperatures, especially in the processing plants in the chimney station (*caldera*) where temperatures generally exceed 100°C, or in the sterilization station where the boiling of the palm fruit produces dangerous water vapour. In plantations, the excessive heat of the tropics, combined with the rigorous physical activity, causes workers to sweat excessively, often leading to cramps and dizziness. According to one worker: “in the plantation the temperature is extremely high, you sweat a lot, the sweat drips into your eyes (...) the exposure to the sun is constant”. In all the work areas, workers perceive a lack of comfort related to the prolonged exposure to high temperatures.

In relation to chemical loads, workers highlight their direct contact with pesticides/herbicides that are applied to plantations, as well as the material particles that are present in the air. In the processing plants, caustic soda or benzene are used in various work stations. In terms of exposure to chemicals, workers suspect that firms underestimate the risks involved or they ignore their effects or attempt to manipulate the results. As one worker stated: “*In our collective bargaining agreement there’s a clause that includes tests for cholesterol, fat and other things, but these have become a two-sided sword because the company makes us take these tests but the results are not shared with us, especially those workers who are hired for fixed-term contracts. So, if a worker gets ill, the company reserves the information and when his contract ends, there’s no renewal and we start thinking, hey what happened to him, there’s no more work, and later we find out that this guy is suffering the effects of chemicals in his blood; my son-in-law... he ended up with I don’t know what in his bloodstream, it turned somehow poisonous, and he had to undertake a huge and complicated treatment...*”

Precarious ergonomic working conditions are also common, especially when related to: posture (prolonged, forced and anti-gravitational), excessive force related to repetitive movements or the manual manipulation of loads. Related to this factor, workers highlight the effects of fatigue associated with the corporal movements needed to cut down palm fruit and palm leaves with the *barretón* (tool used to harvest short palm trees) or the *guancho malayo* (tool used for the

tall palm trees),¹⁴ or the continuous bending down and twisting of one's hips required to pick up fruit and fruit peppers. In plantations, the weights lifted and the continuous walking in very uneven and muddy terrain cause fatigue, especially for harvesters, maintenance, pollinators, and workers who fertilize palm trees. One female pollinator (person responsible for the application of a powder which helps pollinate the palm trees' flowers) elaborates on such fatigue: "*Your arms, shoulders and legs are always tired and sore because you have to cover a lot of ground and the terrain is broken, there are pot holes, you have to pass over irrigation tubes*".

According to these workers, the psychological workloads are associated with long work shifts. In numerous interviews, workers highlight the arbitrariness of how firms measure productivity and the lack of clear technical and ergonomically sound parameters. Pollinators, generally female, express that they are occasionally exposed to sexual harassment and other workers speak of their excessive responsibilities, of union persecution and the way that company debts cause them unending stress, especially when it is increasingly difficult for workers to meet the daily production quotas.

In line with the work undertaken by Laurell and Noriega (1989), we contend that production in the palm oil industry leads to both an overload and an underload of psychological stress. In the first case, this is because the organization of the work process and the conditions of work produce a state of permanent psychological tension; second, the strict hierarchy of production obliges workers to obey supervisors and bosses for fear of the consequences. Although in plantations and in processing plants, workers often state that there is not too much direct pressure from supervisors, the pervasive employment instability, in regions that are synonymous with labour informality, unemployment, and poverty, allow firms the power to fire, suspend, or make working conditions even worse without workers being able to resist or express their discontent. Union freedom has been shown to act as an antidote to psychological underloads, however, in the interviews conducted, workers affirm that in palm oil-producing regions there is a strong antiunion climate.

To summarize, the interviewed workers highlight the existence of all the different workloads already mentioned. Moreover, in the workshops, workers' self-perceptions of the relation between their jobs and their health problems highlight how non-ergonomic working conditions lead to further complications as complex inter-corporal processes, such as the appearance and proliferation of fungi, a worsening of their hearing and other ailments, also become increasingly

¹⁴ According to one palm fruit harvester (*cosechador*) with 30 years' experience, one palm fruit *tallo* generally weighs between 15-25 kilos. Information given via telephone on 16 January 2018.

common. Indeed, an analysis of the “felt morbidity” sheets completed by all 165 workers shows the high prevalence of musculoskeletal and dermatological complaints which lead to work-limiting pain. Workers contend that muscular pain is persistent, for instance, palm fruit harvesters describe how they suffer persistent shoulder pain as well as cervical and back pain due to the continual use of the two different types of harvesting tools. Indeed, harvesters argue that nearly all of them suffer these problems, especially those related to the shoulders: “More than anything, around 90% of harvesters will speak of shoulder pain” related to the constant manipulation of these harvesting tools.

The gradual substitution of the African variety of palm tree for the hybrid specie (a cross between different American, African and Papua New Guinean varieties), while minimizing the spread of vegetal disease, has also required the creation of an activity that was previously unnecessary: pollination. However, this task, as in others, is complicated because young hybrid palms, although productive, are lower in height and as such, workers must bend down more and twist their body to pollinate, harvest, and perform maintenance work. In older palm trees, in contrast, muscular pain is more focused in the neck and upper-back regions of the body, because harvesters must always “look up”. All in all, the sensation of fatigue is predominant: *“Yes, related to harvesting, I’ve had accidents and yes, regarding physical force, you feel completely spent. Sometimes you get out of bed and get ready for work and at least I speak for myself, at times I feel like I can’t make it to work, because I am really tired, you get really fatigued from the physical force needed, your arms, legs, having to cover so much ground, you get tired and yes, because of this people get injured. It hasn’t happened to me, thank God, but comrades have damaged their spine, they’ve damaged their arms, their legs and they’ve suffered muscular tears in their back, it’s a permanent risk...”*

Of course, the symptoms vary depending on the activity undertaken. In plantations, according to workers, the most prevalent problems are musculoskeletal, dermatological, and psychological, while in processing plants these same problems occur as well as a higher incidence of respiratory problems. It’s also important to note that many of the participating workers who presently work in processing plants previously worked in plantations and as such, often their musculoskeletal pain is related to the tasks they undertook there in years past.

Work Organization and the Intensification of Activities: Worker Fatigue Born Out of the Quest for Competitiveness

Following the advice of practitioners of social medicine across Latin America, workers’ health should not be disconnected from concrete forms of work organization. When this occurs, medical diagnoses become plagued by a vision

that naturalizes risk and accords causality to environmental factors alone. As argued by Laurell and Noriega (1989: 9): “*dominant medicine has treated fatigue in two essential ways: as an expression of ageing and as an illness. In both cases they have been given a natural content; they are studied as biological phenomena. To establish, as a premise, the biological essence of ageing and illness, however, ignores that in each historical period each social class is characterized by specific forms of ageing, illness, and death*”.

To overcome such historical and antisocial diagnoses, one must examine how gradual changes in the productive process are expressed in workers’ health and well-being. For the specific case of Colombian palm oil, the task is one of illuminating, at least partially, how the above-mentioned factors of fatigue and work overload are related to systems of work organization, remuneration schemes, and employment modalities.

To do so, it is important to differentiate between work in palm oil and in other oleaginous-producing plants. Palm oil plantations are much more labour intensive than their vegetable-oil competitors (soya and sun flower especially), which are heavily mechanized. Of special importance here is the manual form of harvesting which still follows the same basic method as was used over 50 years ago, with only slight alterations in the two main tools used. Indeed, in many plantations across the country, harvesting is done by men accompanied by their trusted buffalo, which carries along a cart to load the harvested fruit. Many firms continue to prefer the buffalo (or mules) over tractors due to their lesser impact on the field’s terrain. In this way, manual work on farms, even those with extensions of thousands of hectares, is still viewed as being at odds with industrial production models. Nonetheless, despite the lack of technological progress at harvest, firms seek to increase their competitiveness by orienting and organizing harvest in a manner which ensures maximum productivity. Remuneration depends, not on hours worked but rather on kilos/tonnes of fruit harvested, and for other tasks the piecemeal rate is set according to different measurements: for pollinators wages are paid according to the number of flowers sprayed; with regard to maintenance workers, the number of palm trees de-weeded; with respect to fertilizers, the number of bags of fertilizer or the number of trees covered; and in the context of vegetable sanitation, the number of trees inspected, etc., All workers are set a basic rate which they must meet in order to receive the basic daily wage (which can vary depending on the workers’ contract from between \$25,000 to \$35,000 COP).¹⁵ When this target is met, whatever additional production they make, they are paid a bonus rate which depends both on their tasks, their contract, and the age of the palm tree (for harvesters).

¹⁵ In Euros, following the exchange rate for the 11 September 2018 (\$2,805,000 COP= 1 Euro): between 7-9.80 Euros.

The different piecemeal rates set, both for the basic daily rate and additional bonus rates are not arbitrary decisions but rather calculated in a manner that ensures that worker productivity, measured solely in worker yields, is maximized. Herein, calculations are made to improve yields relative to costs, as in the case of the apparel industry and rates are set alongside a strict process of vigilance and control of work, often not directly but rather through careful planning and supervision. Targets are set to ensure high standards of worker productivity and palm fruit-oil yields. Such a process is notoriously similar to the conventional understandings of the Taylorist model popularized in Ford factories at the beginning of the 20th century. In palm oil, the piecemeal system, although ever-more controversial in terms of its effectiveness in optimizing yields (see Guterman, 2014; Hinestroza, 2018), is promoted as a means of establishing cooperation between workers and management. In such reasoning, workers should be paid via a system of wage incentives which is justified by notions of justice and equality in that those that work hardest receive their fitting reward (see: Braverman, 1987; Silva, 1999). In the palm oil sector, in contrast to a daily rate paid to a worker based on his/her initiative, this wage scheme is set in the Taylorist logic whereby management first determines the optimum yield for each occupation in an “ideal day” of “fair work” (Aktouf, 2009).

Yet, beyond ambiguous notions of libertarian-type justice, the piecemeal system, when implemented in a context of global cutthroat competition, becomes a two-edged sword: on the one hand, workers can increase their income in local contexts of employment instability, unemployment and ever-expanding consumerism; on the other hand, considering the risks of physical and psychological stress and the fatigue their job entails, their quest to increase their bonus yield is often done in spite of the possible short, mid- and long-term side effects on their health and well-being. Concisely, workers, who offered a Faustian deal by management, often implicitly trade their health for a little extra money.

To summarize, the organization of work in Colombia’s palm oil industry appears to lead to risks for workers as they are directed by management to undertake a series of fast and repetitive movements continuously, day-after-day. Management, according to workers, is inflexible when workers complain of pain or fatigue. Indeed, workers often mentioned that unless they work with a trusted partner, it is almost impossible to change tasks during or even before their shifts commence. Supervisors and bosses are often described as being “never there when a problem or difficulty arises”. The pressure is such that in many firms, production suffers because so many workers are injured or ill and while contingent workers are generally “cast off” when their contract ends, full-time permanent workers who, through significant union struggle, have managed

to attain employment stability, reach a point where their bodies are no longer capable of performing the tasks to the level required to even make the basic day rate. When this occurs, when feasible, they are “relocated” to a different area, which generally implies that their average wage significantly declines at a time when their health and well-being are already overly compromised.

One should not perceive such effects as being the sum of simple fate, especially when all fifteen interviewed workers contended that the systems of work organization at their respective firms produce muscular pain and fatigue. Indeed, it is important to reiterate that during the workshops, focal groups, and interviews, it became evident that work-related pain has become naturalized and its location in time and context is often nebulous, as if no patholo-history existed. Indeed, following on from Andreas Zemleni (1988) one can affirm that illness has left its mark on the bodies and lives of palm oil workers. Upon analysing the interviews and the workers’ felt morbidity sheets, one can infer that many personal narratives have been erected around a paraphernalia of unsuccessful protective devices. Meanwhile, contingent and precarious employment grows alongside a productive model that is supported by an uninterrupted silence in the face of growing worker sickness and suffering.

Discussion: Rethinking Development Cooperation Outside the Box and in Benefit of Workers’ Health

The two cases of apparel workers in El Salvador and palm oil workers in Colombia, via worker testimony, allude to the negative health impacts of the export-enclave model of development so enthusiastically promoted by multilateral entity and wealthy nations’ development funds and cooperation. The basic assumption that any job is better than no job seems to prevail. The increased income and national expenditure associated with such development paradigms are implicitly implied as being more important than any adverse side effects regarding workers’ health and workers’ rights. Indeed, in all recent FTAs signed by the European Union, via the Commission, and the US Government, chapters are included that allude to the fundamental rights of workers.¹⁶ Nonetheless, such chapters, while calling for the respect for workers’ rights and obliging signatory governments to enhance and enforce their laws in line with such dictates, carry no hard-law mechanisms, a factor which is at odds with their stringent sanction mechanisms when the topic turns to commercial matters (see: Hawkins, 2016). As such, as has been seen in both case studies, workers are denied their fundamental right to union freedoms and they are also pressured into situations where the innate instability of employment and the precarious socio-economic context that surrounds them leads them to prioritize

¹⁶ In the case of the EU, this chapter is called Trade and Sustainable Development.

slight increases in wages whatever risk this may bring to their health and well-being.

Too often development cooperation seems to focus on ambiguous concepts that have been packaged and promoted by capital, more as a means to clean their corporate image and promote sales than as concrete mechanisms that can offer more freedom and better working conditions to workers. Corporate Social Responsibility (CSR) and Sustainable Development often “direct” development aid towards “Developing countries” but the terms of engagement regarding the protection and enhancement of workers’ rights and the prevention of illness and accidents at work are either notorious for their absence or too abstract to be measured. One of the core failures of the development by export model and, increasingly, the related integration into global supply chains, is that they fail to place importance on regulation. Particularly regarding labour inspection systems in developing countries, economic integration and the hollowing-out of the state has generally meant smaller and less effective labour inspection at a time when unionism has also seen both its associational and structural power significantly curtailed. Labour standards in global supply chains will never magically appear, despite the seemingly best intentions of third-party certification schemes. As Harpur (2011) notes, effective regulation entails three aspects: law must develop standards; there must be appropriate mechanisms for monitoring compliance and detecting non-compliance; and there must be methods of deterring non-compliance. Nevertheless, as already mentioned, heightened and more effective regulation may not necessarily improve the detection and prevention of work-related injuries and diseases, something which was discussed by the preliminary findings of the Cochran Collaboration, (see: Mischke, et al., 2013). However, in terms of fundamental workers’ rights and especially, the protection of workers’ freedom of association, improved enforcement mechanisms can enhance the power of worker organizations to undertake self-regulation, particularly as their capacity to collectively bargain increases, thereby enhancing employer compliance of national and international standards at the workplace.

Perhaps it is time for development cooperation to put effective regulation of work relations as a priority for developing countries before they can receive support. Furthermore, instead of resources being destined towards projects aimed at somehow promoting more sustainable development and more responsive CSR and/or social dialogue, they could be channelled into projects that are geared towards concretely enhancing workers’ rights, especially union freedoms and efforts to promote the importance of health at work and health as a basic human right and necessity.

Bibliography

- Abreu, P.H.B. de, and Alonzo, H.G.A. 2014. "Rural Work and Health Risks: a Review into de 'Safe Use' of Pesticides in Brazil", *Ciência & Saúde Coletiva*, 19(10): 4197–4208; <https://doi.org/10.1590/1413-812320141910.09342014>.
- Acosta, A. 2012. *Los biocombustibles: oportunidad o amenaza*. En: Los biocombustibles: oportunidad o amenaza. Edición virtual, pp. 21-86. Recuperado de: https://www.fedebiocombustibles.com/files/LOS%20BIOCOMBUSTIBLES_OPORTUNIDAD%20O%20AMENAZA.pdf
- Aktouf, O. 2009. *La administración entre tradición y renovación*. [s.l.] Universidad del Valle, Universidad Libre.
- Alvarenga, Ligia Elizabeth Jule. 2001. *La situación económico-laboral de la maquila en El Salvador: un análisis de género*. CEPAL. Unidad Mujer y Desarrollo. Santiago de Chile, May.
- Anner, Mark. 2008. "Meeting the Challenges of Industrial Restructuring: Labor Reform and Enforcement in Latin America", *Latin American Politics & Society*, 50(2): 33–65.
- Anner, Mark. 2011. "The Impact of Labor Outsourcing on Unionization and Wages: Evidence from the Apparel Export Sector in Central America", *Industrial and Labor Relations Review*, 64(2): 305–22.
- Anner, Mark. 2015. "Labor Control Regimes and Worker Resistance in Global Supply Chains", *LaborHistory*, 56(3): 292–307.
- Arias, L.A., C.R. Bojacá, D.A. Ahumada, & E. Schrevens. 2014. "Monitoring of Pesticide Residues in Tomato Marketed in Bogota, Colombia", *Food Control*, 35(1): 213–17. <https://doi.org/10.1016/j.foodcont.2013.06.046>
- Asociación Salvadoreña de Industriales (ASI). 2017. Ranking de Exportadores Industriales 2017. http://www.industriaelsalvador.com/wp-content/uploads/Ranking_2017.pdf
- Aurora, A., T. Partanen, S. Felknor, & M. Corriols. 2011. "Social Determinants of Workers' Health in Central America", *International Journal of Occupational and Environmental Health*, 17(3): 230–37.
- Barrientos, Stephanie, Gary Gereffi, & Rossi Arianna. 2011. "Economic and Social Upgrading in Global Production Networks: A New Paradigm for a Changing World", *International Labour Review*.
- Bonilla, Ricardo G. 2011. "Apertura y reprimarización de la economía Colombia: un paraíso a corto plazo", *Nueva Sociedad*, 231, January–February: 46–65.
- Braverman, H. 1987. *Trabajo y capital monopolista: la degradación del trabajo en el siglo XX*. Mexico: Nuestro Tiempo.
- Brisson, C., A. Vinet, M. Vezina, & S. Gingras. 1989. "Effect of Duration of Employment in Piecework on Sever Disability among Female Garment Workers", *Scandinavian Journal of Work Environment and Health*, 15: 329–34.
- Bronstein, Arturo. 2000. *International & Comparative Labour Law*. Red Globe Press.
- Bruner, Robert, & John Simms. 1987. "The International Debt Crisis and Bank Security Returns in 1982", *Journal of Money, Credit and Banking*, 19(1): 46–55; doi:10.2307/1992244
- Campbell, David. 1998. *Writing Security: United States Foreign Policy and the Politics of Identity*. Minneapolis: University of Minnesota Press.
- Cardena, B., C. Holguin, & E. Sandoval. 2016. *Absentismo laboral y prevalencia de síntomas musculoesqueléticos en área de desprese de empresa avícola del Valle del Cauca* (Especialización en Salud Ocupacional). Universidad Santiago de Cali, Santiago de Cali.
- Collier, Ruth B. & David Collier. 2002. *Shaping the Political Arena Critical Junctures, the Labor Movement, and Regime Dynamics in Latin America*. University of Notre Dame Press.

- Comisión Colombiana de Juristas (CCJ) & Escuela Nacional Sindical (ENS). 2012. *Imperceptiblemente nos encerraron. Exclusión del sindicalismo y lógicas de la violencia antisindical en Colombia, 1979-2010*. CCJ/ENS <http://www.ens.org.co/wp-content/uploads/2012/06/imperceptiblemente-nos-encerraron.pdf>
- CUT, CTC y AFL-CIO. 2014. Tres años de incumplimiento del Plan de Acción Laboral (PAL). Informe sobre los primeros tres años de la implementación del PAL (2011-2014). Ediciones Escuela Nacional Sindical (ENS), <http://www.ens.org.co/wp-content/uploads/2016/12/INFORME-PLAN-DE-ACCION-LABORAL-OBAMA-SANTOS-2014-COMPLETO.pdf>
- De Almeida, Larissa Brentini, Vieira, Edgar Ramos, Zaia, José Eduardo, de Oliveira Santos, Branca Maria, Lourenço, Américo Riccardi Vaccari, & Quemelo, Paolo Roberto Veiga. 2017. “Musculoskeletal Disorders and Stress among Footwear Industry Workers”, *Work*, 56(1): 67–73.
- ENS. 2015. Cuatro años de incumplimiento del Plan de Acción Laboral (PAL). Informe sobre los primeros cuatro años de la implementación del PAL (2011-2015). Ediciones Escuela Nacional Sindical (ENS), http://www.ens.org.co/wp-content/uploads/2016/12/INFORME-PLAN-DE-ACCION-LABORAL-OBAMA-SANTOS-2015_opt.pdf
- Escalona, Ana Isabel O., & David P. Ramos. 2014. “Global Production Chains in the Fast Fashion Sector, Transports and Logistics: the Case of the Spanish Retailer”, *Inditex. Investigaciones Geográficas, Boletín del Instituto de Geografía, UNAM*. N.85. 113–27.
- Escobar, Arturo. 1998. “Power and Visibility: Development and the Invention and Management of the Third World”, *Cultural Anthropology* 3: 428–43.
- Escobar, Arturo. 2015. “Latin America at a Crossroads: Alternative Modernizations, Post-liberalism or Post-development?” *Cultural Studies*, Vol. 24 (1) January 2010: 1–65.
- Fathallah, Fadi A. 2010. “Musculoskeletal Disorders in Labor-intensive Agriculture”, *Applied Ergonomics*, 41(6): 738–43.
- Fernández, Víctor Ramiro & Manuel Facundo Trevignani. 2015. "Cadenas Globales de Valor y Desarrollo: Perspectivas Críticas desde el Sur Global Dados”, *Revista de Ciências Sociais*, 58 (2): abril-junio, Universidade do Estado do Rio de Janeiro Rio de Janeiro, Brasil: 499–536.
- Gallo, Oscar, Daniel Hawkins, Jairo Ernesto Luna-García, & Mauricio Torres-Tovar. (Undergoing peer review). Trabajo saludable y sector rural. Una aproximación a partir de la literatura producida en América Latina.
- García, Gilberto & Andrea García, 2016. “Cadenas globales de suministro, trabajo decente y productividad”. Centro Internacional de Formación de la OIT: 22-27.
- Gereffi, Gary. 1989. “Rethinking Development Theory: Insights from East Asia and Latin America”, *Sociological Forum*, 4(4), Special Issue: Comparative National Development: Theory and Facts for the 1990s (Dec., 1989): 505–33.
- Garzón-Castañeda and Luis Augusto. 2015. Trastornos musculo-esqueléticos y la relación con la carga postural asociada a la labor de cosechero de palma aceitera en una plantación del Meta, Colombia
- Global Center for Workers’ Rights & Workers’ Rights Consortium. 2015. Alianzas Nefastas. 22 de enero. http://lser.la.psu.edu/gwr/documents/AlianzasNefastas_January2015.pdf
- Guterman, L. 2014. Costos de producción e indicadores de productividad laboral en la agroindustria de la palma de aceite en Colombia 2011- 2012. *Palmas*, 35(3): 23–40.
- Harpur, Paul. 2010-11- New governance and the role of public and private monitoring of labor conditions: sweatshops and China social compliance for the textile and apparel industry/CSC9000T. *Rutgers Law Record*. Vol.38: 49-73.
- Hawkins, Daniel. 2011. The Struggles over City Space: Informal Street Vending & Public Space Governance in Medellín, Colombia, Studien zu Lateinamerika, NOMOS Verlagsgesellschaft, Baden-Baden.

- Hawkins, Daniel. 2016. El tema laboral en las negociaciones de los TLC: Lecciones de las experiencias de Colombia frente a los TLC con los Estados Unidos y la Unión Europea. *Revista Controversia*. N°207. *El Mundo del Trabajo en el Posacuerdo*: 205–43.
- Hinestroza, A. 2018. Paso a paso en la producción de aceite de palma sostenible. *Palmas* 39 (1): 86-89.
- Kaufmann, Christine. 2007. *The Conflict between Core Labour Rights and International Economic Law*. Oxford: Hart Publishing.
- Lai, Peggy S. & David C. Christiani. 2013. “Long-term Respiratory Health Effects in Textile Workers”, *Current Opinion Pulmonary Medicine*, 19: 152–57.
- Landsbergis, P., J. Cahill, & P. Schnall. 1999. “The Impact of Lean Production and Related New Systems of Work Organization on Worker Health”, *Journal of Occupational Health Psychology*, Vol.4 (2): 108–30.
- Laurell, A.C. and M. Noriega. 1989. *La salud en la fábrica: estudio sobre la industria siderúrgica en México*. [s.l.] Ediciones Era.
- Lee, Joonkoo, Gary Gereffi & Stephanie Barrientos. 2011. “Global Value Chains, Upgrading and Poverty Reduction”, *Capturing the Gains. Briefing Note 3. Economic and Social Upgrading*. November.
- Levy, Marion. J. 1966. *Modernization & the Structure of Societies: The Organizational Contexts of Societies*, Vol. 2, HOEPLI.
- Mayhew, Claire & Michael Quinlan. 1999. “The Effects of Outsourcing on Occupational Health and Safety: A Comparative Study of Factory-Based Workers and Outworkers in the Australian Clothing Industry”, *International Journal of Health Services*, 29(1): 83–107.
- Millán-Constaín, Felipe & Mauricio Posso-Vaca. 2014. “Formación de clusters y competitividad en la agroindustria de la palma de aceite”, *Revista Palmas*, Bogotá, 35 (3), July–September: 81–8.
- Mischke, Christina, Jos H. Verbeek, Jenny Job, Thais. C. Morata, Anne Alvesalo-Kuusi, Kaisa Neuvonen, Simon Clarke, Robert I. Pedlow. 2013. “Occupational Safety and Health Enforcement Tools for Preventing Occupational Diseases and Injuries”, *Cochrane Database of Systematic Reviews*.
- Mosley, Layna. 2011. *Labor Rights & Multinational Production*. New York: Cambridge University Press.
- Murillo, Victoria & Andrew Schrank. 2005. “With a Little Help from My Friends: Partisan Politics, Transnational Alliances, and Labor Rights in Latin America”, *Comparative Political Studies*, 38(8): 971–99.
- Murillo, Victoria. 2000. “From Populism to Neoliberalism: Labour Unions and Market Reform in Latin America”, *World Politics* 52, January: 135–74.
- Nún, José. 1969. “Superpoblación Relativa, Ejército Industrial de Reserva y Masa Marginal.” *Revista Latinoamericana de Sociología* 5: 178–236.
- Ocampo, José A. 2009. “Foreword”, in Kevin, P. Gallagher & Daniel Chudnovsky (eds), *Rethinking Foreign Investment for Sustainable Investment: Lessons from Latin America*. Anthem Press.
- Ocampo, José A., Astrid-Romero, Carmen & María Angela Parra. 2007. *La búsqueda, larga e inconclusa de un nuevo modelo (1981-2006)*. Ocampo, José A. (Editor), *Historia Económica de Colombia*. Bogotá: Editorial Planeta/Fedesarrollo: 348-418.
- Ospina, M. & D. Ochoa. 2001. *La palma africana en Colombia. Apuntes y memorias*, 1. Bogotá: Fedepalma Editorial.
- Patroni, Viviana. 2008. “Economic Restructuring, Neoliberalism, and the Working Class”, in Harris, Richard & Jorge Nef (eds.), *Capital, Power and Inequality in Latin America and the Caribbean*. UK: Rowman & Littlefield: 96-117.
- Portes, Alejandro & Kelly Hoffman. 2003. “Latin American Class Structures: Their Composition and Change during the Neoliberal Era”, *Latin American Research Review*, 38(1): 41–82.

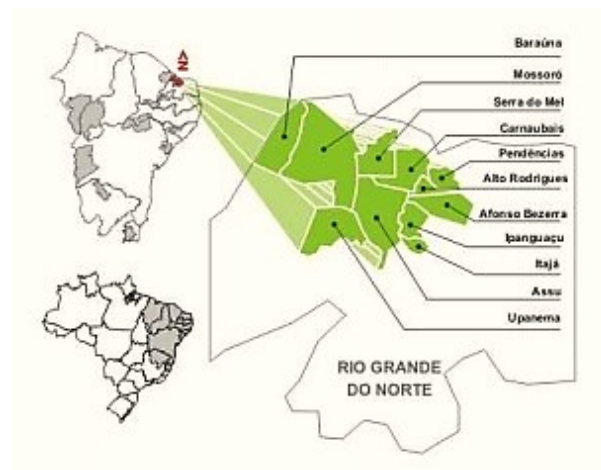
- Portes, Alejandro. 1997. "Neoliberalism and the Sociology of Development: Trends and Unanticipated Facts", *Population & Development Review*, 23(2), June.
- Prebisch, Raúl. 1948/2016. "The Economic Development of Latin America", in Ricardo Bielschowsky (compiled), *ECLAC Thinking: Selected Texts (1948-1998)*. United Nations, December, pp.45-84.
- Preiswerk, Yvonne. 1998. La maquila en El Salvador. *Les silences pudiques de l'économie: Économie et rapports sociaux entre hommes et femmes* [en línea]. Graduate Institute Publications: Ginebra, (generado el 13 octubre 2016). Disponible en Internet: <<http://books.openedition.org/iheid/6036>>. ISBN: 9782940503742. DOI: 10.4000/books.iheid.6036.
- Prochnik, Victor (Coordinator). 2010. La inserción de América Latina en las cadenas globales de valor"; João Alberto De Negri, Celso Garrido, Vinicius Rodrigues Peçanha, Leonardo E. Stanley; Red Mercosur de Investigaciones Económicas, Montevideo.
- Quijano, Anibal. 1983. "Imperialism and Marginality in Latin America", *Latin American Perspectives*, 10 (76): 76–85.
- Rojas, Marianela, David Gimeno, Sergio Vargas-Prada, & Fernando G. Benavides. 2015. "Musculoskeletal Pain in Central American Workers: Results of the First Survey on Working Conditions and Health in Central America", *Revista Panamericana de Salud Pública*, August, 38 (2): 120–28.
- Romero, Jaime. 2000. "La salud ocupacional en las plantas de beneficio de palma de aceite".
- Rossi-Rocha, Fernanda L., Maria H. Palucci Marzialo, & Oi-Saeng Hong. 2010. "Work and Health Conditions of Sugar Cane Workers in Brazil", *Revista da Escola de Enfermagem da U.S.P.* 44 (4): 978–83.
- Rostow, Walt. 1960. *Stages of Economic Growth: A Non-Communist Manifesto*. Cambridge: Cambridge University Press.
- Sandilands, Roger. 2015. La misión del Banco Mundial a Colombia de 1949, y las visiones opuestas de Lauchlin Currie y Albert Hirschman", *Revista de Economía Institucional* 17(32): 213–32.
- Sen, Amartya. 2000. "Work and Rights. International Labour Organization", *International Labour Review*, 139(2): 119–28.
- Shawal, Faten Noor Suhaida, Ng Yee Guan, Dayana Hazwani Mohd. Suadi Nata, Vivien How, & Shamsul Bahri Mohd. Tamrin. 2018. "Knowledge, Attitude, and Perception of Risk Management of Steam Boilers among Workers in Palm Oil Mills", *Work*, 60(1): 153–62.
- Silva, M.A. DE M. 1999. *Errantes do fim do século*. São Paulo, SP: Editora UNESP Fundação.
- Trienekens, 2011. "Agricultural Value Chains in Developing Countries: A Framework for Analysis", *International Food and Agribusiness Management Review*, 14(2): 51–82.
- Webster, Edward, Rob Lambert, & Andries Bezuidenhout. 2008. "The Return of Market Despotism", *Grounding Globalization: Labour in the Age of Insecurity*. Wiley-Blackwell, June.
- Woittiez, L.S., M.T. van Wijk, M. Slingerland, M. van Noordwijk, & K.E. Giller. 2018. Brechas de rendimiento en el cultivo de palma de aceite: una revisión cuantitativa de factores determinantes (Carlos Arenas, trad.). *Palmas*, 39(1): 16 68.

7. Occupational Health and Safety of Melon Workers in Brazil's Rio Grande do Norte

Valdênia Apolinário, João Matos Filho, Thales Augusto M. Penha, and Leticia Amaral

This chapter aims at analyzing the occupational health and safety conditions of agricultural workers in Brazil, particularly workers in the melon producing irrigated area of PoloAçu-Mossoró, located in the semi-arid region of the state of Rio Grande do Norte in Northeast Brazil (Map 1).

Map 1: Location of Polo Irrigado Açu-Mossoró



Source: Nunes and Schneider, 2008.

The history of agriculture in Rio Grande do Norte, as well as in the rest of the other states of north-east Brazil, was marked by cycles of productions that have been typical of the Brazilian economy, mainly exports, since the colonial period. The rise, peak, and fall of these cycles, and their respective demands, have created different types of labor relations. At first, in the early 18th century, there was sugar cane production based on slave labor; followed by cotton based on share-cropping arrangements; and finally, since the 1980s, irrigated fruit farming based on wage labor.

The production of melon in the irrigated lands of Rio Grande do Norte began in 1982, as an alternative to the production of cotton that fell into decay, due to competition from synthetic fibers and the beginning of cotton import. Unlike the cotton cycle, the melon cycle was based on modern techniques of production, harvest and post-harvest, all based on wage labor.

In the melon production process, working conditions and labor relations improved considerably since the beginning of the 1990s. Among several decisive factors for these improvements, better enforcement of international labor conventions and domestic labor laws as well as trade union activism stand out as significant developments. Melon workers benefited especially from the

activities of the Federation of Agricultural Workers of Rio Grande do Norte (FETARN). Despite these improvements, some significant decent work deficits still remain. The concept of decent work has been formulated by the International Labor Organization (ILO), to which Brazil is a signatory.

With regard to the present OS&H challenges in agriculture, we rely, on the one hand, on observations gained in the melon-producing area of Polo Açu-Mossoró and on the other hand on secondary literature as well as primary data from the Brazilian Institute of Geography and Statistics (IBGE), particularly the National Household Sample Survey (PNAD), from the Labor and Agricultural Ministries and from the Department of Statistics and Socioeconomic Studies of the Unions (DIESSE). Our field research included visits to fruit farms and interviews, seminars and meetings with representatives of companies, wage workers, farmers in agrarian reform settlements, as well as officials from workers' unions and the Federation of Agricultural Workers of Rio Grande do Norte. In total, we obtained information from 56 stakeholders of fruit production in Polo Açu-Mossoró in the years 2016 and 2017.

The chapter discusses OHS in a global and domestic context, stressing the concept sustained by the ILO. Along with an overview of OS&H in Brazil's agriculture, the conditions in melon production of Polo Açu-Mossoró are presented in depth. The chapter concludes with recommendations.

Occupational Health and Safety: Working Conditions in Perspective

A Brief History of Occupational Health and Safety Concerns

The industrial age was characterized by distressing work and health conditions. Regarding work conditions in 19th century-England, particularly of the miners and factory workers, Friedrich Engels had remarked:

[...] many young people die from rampant tuberculosis, and most people debase in their middle age, due to slow tuberculosis; they age prematurely, and become incapable of working between the ages of 35 and 45, and many transition abruptly from the hot air of the mineshaft (after having perspired abundantly while painfully climbing up the ladder), getting acute inflammations in the already diseased airways, which are often deadly.

[...] women working until childbirth, impossibility for them to take care of housework, the state of abandonment of the home and children. [...] Children are described as half-starved and ragged ... they would not eat anything from eight in the morning until seven at night. "The workers," says a physician in charge of examining the recruits, "are small, weak, and physically ill-formed. Many also present deformities in the rib cage or spine" (Engels, 1985: 274, 227).

The British Parliament's Factory Act of 1802 was a first in addressing these dire conditions. A few of the "improvements" stipulated by this Act are cited below:

All factory environments must be ventilated; The "slime" – dirt – should be removed twice a year; Children should receive two complete sets of clothes; The daily working

hours of children between the ages of 9 and 13 should be at most 8 (eight) hours, and in the case of adolescents between 14 and 18 years-old, it should not exceed 12 (twelve) hours; The labor of children under 9 years-old is prohibited, as they must attend school. These schools are to be maintained by the family's employers; Children should occupy bedrooms that are separated by sex, with each bed being used by a maximum of two children; Employers are responsible for the treatment of infectious diseases (Factory Act, 1802 Apud Camisassa, 2016: 1)

However, the law was mostly ignored as Karl Marx observed a couple of decades later: "for three decades, the concessions that had been won remained purely nominal. The Parliament had enacted, from 1802 to 1833, five different laws on labor – although they were sly enough not to fund the laws' mandatory implementation with a single penny". Marx then concludes that "these laws remained a dead letter"; "the truth is that until the year of 1833, children and adolescents had to work either all night, all day, or both" (Marx, 1988: 211).

In 1833, Great Britain finally enacted the Labor of Children Act, which determined among other details:

The obligation of granting children one hour for lunch – while keeping the previous limit of twelve hours in a working day for children between 14 and 18 years-old, and eight hours for children between 9 and 13 years-old; Children between the ages of 9 and 13 must have two hours of classes per day; Prohibition of night work for minors, under 18 (eighteen) years-old; Introduction of work inspection routines at the factories (Labor of Children, 1833 Apud Camisassa, 2016: 1).

In 1844, the British Factory Acts also included other requirements that support women's working conditions, the obligation to report and investigate fatal accidents, and the protection from machines, among others. At this time, several laws that dealt with accidents at work appeared in Germany, which also occurred in several other European countries in the subsequent decades. In 1878, the Factory Acts, which initially affected only women and children in the textile industries, were "extended" to other industries (Camisassa, 2016)

About the extension of these rights to other industries and countries, Marx (1988: 227–28) noted that each nation had its own struggle between capital and labor in establishing the limits to the consumption of labor power. As an example, Belgium, "Continental Liberalism's paradise, does not show any signs of having this movement either [...] workers of both sexes, and of any age, are consumed in complete 'liberty' for any length of time". Referring to the United States of America, a limitation to the achievements was that "the white-skinned worker cannot emancipate themselves, whilst the black-skinned worker is branded with iron and fire". As for France, he says that a revolution was necessary "for the introduction of the *Twelve Hours Law*", which went beyond the English legislation, and dictated the new laws for "all workshops and factories, with no difference", proclaiming "as a principle what in England has been accomplished only for the children and women".

In the 20th century, a number of organizations in the world were created aiming to, among other goals, protect labor; for example, the foundation of the ILO in 1919. In Brazil, it was only in 1891 that the Decree 1.313 was enacted, which was considered as one of the first instruments of labor protection, exclusively meant for minors. A milestone that brought significant changes in the matter was the promulgation of the Federal Constitution of 1988, which reckoned “the social value of labor as one of the foundations of the Republic, Article 1, IV”. It also defined in Article 7, the uniformity and equivalence of benefits and services to urban and rural workers (Lemos, 2015: 1).

However, as pointed out by Apolinário et al. (2016; 2017: 6), despite the fact that the Brazilian Constitution, since 1988, have been ensuring 34 different rights to workers, "the extension of these rights to rural workers, although it expresses a significant progress and effort, recurrently fails in its effective fulfilment”.

Brazil's Ratification of ILO Conventions on Occupational Health and Safety

Since 1992, Brazil has been a signatory of Convention number 155 of the ILO of 1981 that deals with Safety and Health of Workers. It established a field of action of public policy and private regulation that assures the protection of the health of workers, and mitigates risks that result in work accidents, represented as typical accidents, commuting accidents, occupational diseases, and death.

Typical Accidents are the accidents resulting from the nature of the professional activity performed by the injured person. Commuting Accidents are the accidents that occur on the way between the residence and the workplace - and vice versa - of the injured person. Accidents due to Occupational Illnesses are accidents caused by any sort of occupational disease, related to a certain type of activity listed in the social security table of activities (Ministry of Social Security, 2006: 1; emphasis authors’).

According to the DIEESE (2016), an initial reflection on the discussion of “Occupational Health and Safety” is about the limits of the subject. That is because scientific and official parameters generally only understand “occupational diseases” from the standpoint of the visible elements of an accident. As a result, they often emphasize workplace inadequacies (e.g. lighting, noise, ventilation, vibration, odors, temperature), or negligence on the part of the worker (e.g., not using Personal Protective Equipment, i.e., PPE), but disregard the impact of the usual practices that are currently applied in professional activity, which, not only just alter the management and organization characteristics of the activity, but also change the intensity of work, choices in technology, and exhaustive productivity goals.

Thus, a limitation stressed by Dieese (2016) is that an occupational disease, as a rule, refers to a "visible" manifestation of an "accident", expressed in a bodily

injury that causes the death, loss, or either permanent or temporary impairment of the ability to work. Therefore, statistics that deals with the health of the workers tend to emphasize on "the physical, biological, chemical risks that the nature of the labor could bring to the worker." "[L]ittle or no attention is given to the psychosocial risks that are strongly associated with the contemporary culture of work (stress, depression)." (Dieese 2016)

In the case of Brazil, another serious problem is the historical underreporting of occupational accidents. In 2013, the total number of official records reached 718,000 reports, using the Work Accident Report (CAT)—a document filled out by companies themselves. Of this total number, 452,000 were typical accidents (63%), 112,000 were commuting accidents (15.6%), 15,000 were occupational diseases (2%), and 2,800 resulted in deaths (0.4%) (Ministry of Social Security Statistics Annual—MPS apud Dieese, 2016: 2).

Nevertheless, these figures far from reflect the reality in Brazil, since official statistics do not cover informal market, which accounts for approximately 50% of the occupations in Brazil; as also it does not include the public servants and those self-employed. By aggravating the estimation from small to medium-sized companies, "less than 20% of work-related accidents are reported". Moreover, the "system for investigation in Brazil" does not track or is unresponsive to the various diseases listed in the legislation, and no reports are usually made by the company when the leave of absence is less than 15 days. Lastly, the expansion of outsourcing¹⁷ should "further aggravate the indicators of diseases at work" (Dieese, 2016: 3, 5).

Considering the above information and despite the official number of reports of 718,000 accidents, other sources account for much higher numbers. The National Health Survey (PNS), conducted by the IBGE in partnership with the Ministry of Health, for instance, registered 4.9 million occupational accidents in Brazil in 2013 (Diesat, 2017: 2).

Examining the matter in the light of the ILO, Convention 184 which focused on occupational health and safety in agriculture and was ratified by Brazil in 2001, a number of issues, such as those related to machine safety and ergonomics; chemicals; handling and transportation of materials; handling of animals; and protection against biological hazards were highlighted. The Convention covers:

¹⁷This article was written between July and September of 2017. During this period, the Chamber of Deputies in Brazil (National Congress) sanctioned profound changes in labor legislation, for instance, the outsourcing of core activities, also called total outsourcing; intermittent work (hourly employment/pay); the prominence of a negotiated agreement over a legislated one. Such legislation would come into force in November 2017.

Forestry and agricultural activities, including animal husbandry, and primary processing of agricultural and livestock products, as well as the use and maintenance of machinery, equipment, tools and facilities, and any process, operation, storage or transportation carried out in agricultural facilities, and directly related to agrarian production. **Exceptions: Subsistence agriculture, industrial exploitation of forests, and industrial processes that use agricultural products as raw materials.** (ILO Conventions, n/a: 1; emphasis authors')

In Article 4 of the aforementioned Convention, the ILO states that it is "an obligation of employers to ensure the safety and health of their workers in all aspects related to work". Articles 3 and 9 also see to it that employers:

Conduct appropriate risk assessments, and take preventive and protective measures for safety in agricultural activities, facilities, with machinery, equipment, chemicals, tools and processes; provide adequate training, instruction and supervision to agricultural workers; take immediate steps to evacuate and interrupt any operation in where there is a serious and imminent risk to safety and health (ILO Conventions, n/a: 1)

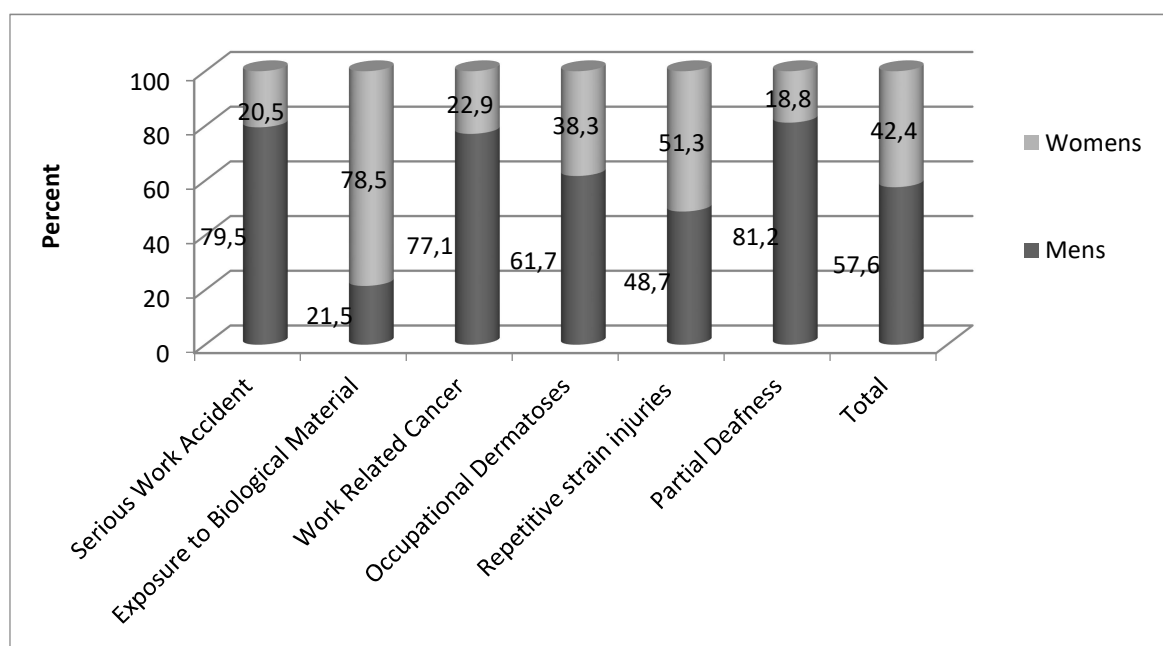
Convention 184 includes various types of workers. Article 9 of this Convention also provides that "temporary or seasonal workers shall receive the same safety and health protection as permanent workers", and that "the special needs of working women in relation to pregnancy, breastfeeding and reproductive health are to be considered" (ILO Conventions, n/a: 1).¹⁸

Occupational Health and Safety in the Brazilian Labor Market

Accidents and occupational diseases are distributed unevenly between sexes. In 2014, reports involving women totaled 42.4%, against 57.6% involving men. However, the percentage of women who suffered a "Work injury with exposure to biological material" (78.5%) and "Repetitive strain injuries (RSI)" (51.3%) is higher (see Chart 1).

¹⁸It should be noted that the recently approved Labor Reform in Brazil denies such a convention, stating that pregnant and breastfeeding women can work at unhealthy workplaces.

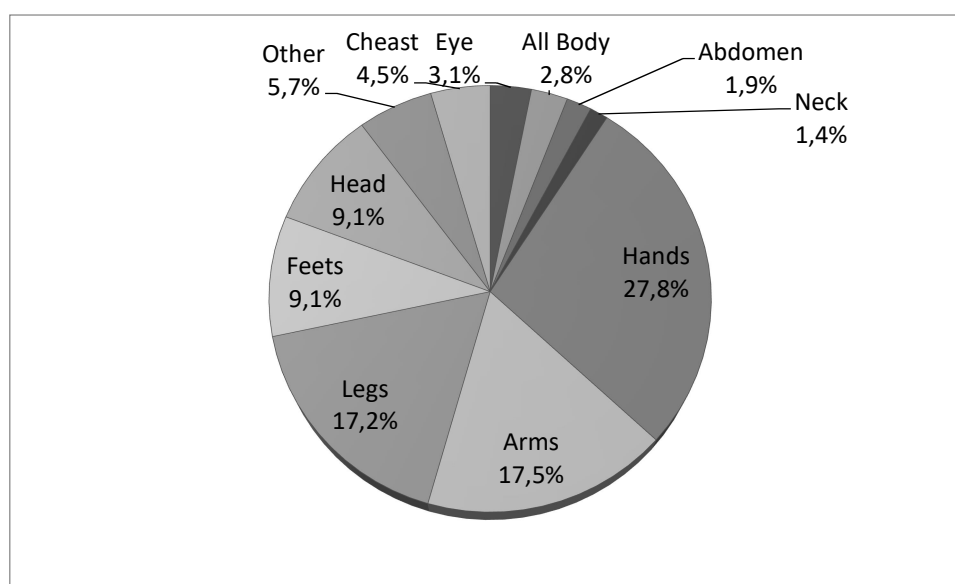
Chart 1 BRAZIL: Distribution of reports by sex, according to the type of work-related injury - Brazil, 2014 (percentage)



Source: Prepared by authors based on Anuário da Saúde do Trabalhador (2015).

Among the reports of serious accidents in 2014, the majority were “typical accidents” (77.1%) compared to “commuting accidents” (22.9%), varying according to region. In the north-east region, the percentages are 72.7% and 27.3%, respectively (Workers’ Health Annual Report, 2015: 200). In these serious accidents, the main parts of the body that are affected: hands (32.2%), upper limbs (20.3%), and lower limbs (20%; see Chart 2).

Chart 2 - BRAZIL: Reports of serious work accidents, according to affected body part - 2014 (percentage)



Source: Elaborated by the authors/ Anuário da Saúde do Trabalhador, 2015.

It is worth noting that in Brazil, the percentage of the population covered by private health insurance is 25.9%; 12.6% in the north-east, and 11.6% in the north (Workers' Anuário da Saúde do Trabalhador, 2015: 222). Therefore, it is reasonable to assume that the medical care responsible for dealing with such serious accidents, either in urban or rural areas, comes predominantly from public healthcare systems.

Even so, a significant part of the public and private healthcare infrastructure is concentrated in the capital cities and their surrounding areas (facilities, professionals, equipment), as claimed by Viana and Apolinário (2016). In non-severe cases, in 2013, 47.9% of the workers sought the closest Basic Health Units (UBS), or similar establishments, when they were ill or in need of healthcare; 20.2% attended private clinics; and 10.1% were aided at public hospitals. It is noteworthy that the access to “outpatient clinics affiliated with the company or union” is poor, indicating a difficulty of access to occupational physicians (see Table 1).

Table 1 - BRAZIL: Distribution of persons according to type of location attended when in need of medical assistance - 2013 (percentage)

Types of health care locations	%
Basic Health Unit (health centers or family health centers)	47,9
Private clinic	20,2
Public hospital	10,1
Emergency department of public hospital	6,2
Emergency department of private hospital	4,9
UPA (Urgent care unit)	4,1
Drugstore	2,9
Specialty center, polyclinic or PAM (Medical Assistance Center)	1,8
Other type of public urgent healthcare center (24 hours)	1,0
Outpatient clinic affiliated with company or union	0,4
Other service	0,3
At home, by private physician	0,2
At home, by professional from public healthcare family plan	0,0
TOTAL	100,0

Source: Our elaboration/Anuário da Saúde do Trabalhador, 2015.

On the other hand, the low coverage rate of private health insurance for the population in 2015, especially in the north-east region (12.6%), despite seeing significant growth between the years of 2005 and 2015, reinforces the importance of improving coverage of public healthcare systems.

Occupation Health and Safety in Brazil's Agricultural Sector

In 2014, the Brazilian agricultural sector accounted for 21.2%, the highest percentage of economic activities, followed by commerce and repair (17.3%), and manufacturing (14.6%), education, health, and social services (8.7%), among others. These estimates were made considering the distribution of employed persons over the age of 10 by the economic activity of their main occupation. It should be noted that the north-east region registered 36.1%, i.e., the highest percentage of employed persons in agriculture in 2014. Self-employed farmers (counted under “Worker producing for their consumption” constituted 4.5% of those employed in Brazil, and in the north-east region, such participation doubled (9.6%).

While numerous, the agricultural sector had the lowest wage workers' proportion among all activities in 2014, precisely only 27.4% of the workers receive wage, while the average of all the activities is 67.5%. It also had the lowest ratio of employees, with the formal contract to the total number of employees (43.2%), being only above domestic service (31.7%). This percentage ratio in the country is 71.7%.

The agricultural sector also registers the highest percentage of employed persons that earn only up to one minimum monthly wage (47.4%), and this sector stands above the percentage of those in domestic service (44.4%). The country's average persons earning only up to a minimum monthly wage, out of all the activities, is 17.6%.

In 2015, compiling data from 2004 to 2006, Dieese launched the 1st Workers' Health Annual Report, focusing on three topics: population and the workers' health (demographic); working conditions and health consequences; and public policy in healthcare. Although almost all the information relates to the non-rural labor market, there are important conclusions that can be drawn. The data was based on official sources such as the National Household Sample Survey (PNAD), National Health Survey (2013), Annual Social Information Report Data Bank (RAIS), Social Security Statistics Annual Data Bank (AEPS), National Register of Health Establishments (CNES), and ILO, among others. The following subsection is deeply grounded in the aforementioned Dieese report.

Regarding agricultural sector, specifically, in 2014, among the 20 occupations that registered the highest number of reports of “serious” work accidents in Brazil, which amounted to almost 50% of the total recorded (precisely 37,889 of 79,649 reports), “Agricultural workers in general” appear in second place (3,204 accidents, or 8.5%), and “Workers supporting agriculture” appear in the ninth place (1,608 accidents, or 4.2%).

In Brazil, in 2014, “Agriculture, forestry, hunting and fishing”, had the third highest “Mortality Rate by Sector” (9.3%) (death caused by typical accident, commuting accident, or occupational disease), preceded by “Mining” (10.5%) and “Civil construction” (9.4%). The period between 2004 and 2014 saw a decrease in the rate of mortality (from 6.7% to 3.8%), as per economic activity in the country (see Table 2).

Table 2 - BRAZIL: Mortality rate by sector of economic activity – 2004 and 2014 (per 100,000 workers)

Economic activity	2004	2014
Mining	14,2	10,5
Process manufacturing	7,2	3,8
Industrial services of public utility	7,3	4,4
Civil construction	19,5	9,4
Commerce	8,6	4,4
Services	6,7	3,5
Public administration	0,9	0,9
Agriculture, forestry, hunting and fishing	15,2	9,3
TOTAL	6,7	3,8

Source: Our elaboration/Anuário da Saúde do Trabalhador, 2015.

On a different note, in 2014, “Agriculture, forestry, hunting and fishing”, with 24.8% of the occurrences, also accounted for the third highest Incidence of Permanent Disability Retirement (by occupational accident or occupational disease), preceded only by “Mining” (48.5%) and “Industrial services of public utility” (35.5%) (see Table 3).

Table 3 - BRAZIL: Incidence of permanent disability retirement by sector of economic activity – 2004 and 2014 (per 100,000 workers)

Economic activity	2004	2014
Mining	35,5	48,5
Process manufacturing	11,1	10,1
Industrial services of public utility	20,4	30,5
Civil construction	32,0	12,3
Commerce	13,2	6,3
Services	12,6	9,7
Public administration	18,3	21,1
Agriculture, forestry, hunting, and fishing	20,3	24,8
TOTAL	14,9	12,3

Source: Our elaboration/ Anuário da Saúde do Trabalhador, 2015.

It is worth pointing out that, in 2014, almost 60% of the mortality occurrences and incidents of permanent disability retirement happened to workers of lower education, more precisely, amongst illiterate (36.4%), and those who have had

incomplete basic education (middle school) (23.2%). In the case of those with higher education, this rate dropped to 6.3% (see Table 4).

Table 4 - BRAZIL: Mortality rate and incidence of permanent disability retirement (work accident or occupational disease) by educational level – 2006 and 2014 (per 100,000 workers)

Educational level	2006	2014
Illiterate	53,5	36,4
Unfinished middle school	32,1	23,2
Unfinished high school	13,9	12,4
Finished high school / Undergraduate	8,5	6,1
Graduate (higher education)	11,3	6,3
TOTAL	15,4	9,4

Source: Our elaboration/ Anuário da Saúde do Trabalhador, 2015.

Occupational Health and Safety in Rio Grande do Norte

With respect to OHS specifically in the state of Rio Grande do Norte, by analyzing the micro data available in the Statistics Annual of Work Accidents (2015: 147),¹⁹ there have been 6,808 work accidents in 2015. Of all these incidents, 73% were reported through a Work Accident Report (CAT), while 27%, without a CAT.²⁰ Regarding their purpose, 66.5% were due to accidents at work, 25.1% for commuting accidents, and 8.3% for occupational diseases.

By comparing the data from such accidents in 2013 and 2015, it is noticeable that men are the predominant victims—67% and 64%, respectively, while women appear in 33% and 36% instances. It should be noted that more men have workplace accidents, albeit women outnumber them in instances of occupational diseases.

Concerning age statistics, most of the accidents in 2015 occurred among persons between the ages of 25 and 34 (36.5%), that is, at a relatively young age range. The percentage of accidents (14.2%) in the range of 35 to 39 years is also significant. Together, the 25–39 age range accounts for 51.8% of the accidents. Table 5 illustrates the data.

¹⁹This annual report was done by the Brazilian Ministry of Labor and Employment (MTE), the Social Security Technology & Information Agency (DATAPREV), the National Institute of Social Security (INSS).

²⁰The Work Accident Report (CAT) is a document filed to acknowledge the incident of either a work/commuting accident or an occupational disease. Under penalty of fine, “the company is obliged to inform the Department of Social Security of all the accidents at work suffered by its employees, even if there is no leave of absence required, by the first business day following the occurrence” (Social Security, n/a: 1). If the company does not report, others may do so: the workers themselves, the union, or the physician.

Table 5 - Rio Grande do Norte: Number of work accidents by sex and age groups (2013 and 2015)

	2013	%	2015	%
Male	4.615	67	4.334	64
Female	2.274	33	2.474	36
TOTAL	6.889		6.808,00	
AGE	2013	%	2015	%
19 and under	104	1,5	90	1,3
20 to 24	813	11,8	836	12,3
25 to 29	1.322	19,2	1.243	18,3
30 to 34	1242	18,0	1243	18,3
35 to 39	979	14,2	1038	15,2
40 to 44	759	11,0	814	12,0
45 to 49	683	9,9	612	9,0
50 to 54	979	14,2	1038	15,2
55 to 59	563	8,2	480	7,1
60 to 64	109	1,6	104	1,5
65 and older	11	0,2	22	0,3

Source: Our elaboration/ Anuário da Saúde do Trabalhador, 2015.

On a separate note, when isolating “*Agriculture and Related Services*” category from the National Classification of Economic Activity (CNAE 1), it can be observed that the most notable number of work accidents in Rio Grande do Norte in 2013 and 2015 occurred in two groups—CNAE 01.33 (cultivation of permanent fruit crops) and CNAE 01.19 (cultivation of temporary crops, which included the cultivation of melon).

Unlike other temporary crops, melon has the largest cultivated area (around 8,000 hectares), and is most scrutinized by consumers and importers with regard to its usage control of chemical pesticides, labor legislation, quality assurance, slave or child labor, and the living conditions of the crop workers. Consequently, melon production records the least number of occupational accidents.

No less important is the support on legal enforcement offered by the Ministry of Labor and Employment (MTE) and international organizations towards funding, technical cooperation, and certification of origin and quality of the exported fruits. In the case of other traditional products, such as cowpeas and cassava flour, there is no such rigorous inspection in the industrial production process.

Table 6 - Rio Grande do Norte – Number of work accidents in Agriculture and Related Services (2013 e 2015)

CNAE	Activity (Type)	2013	2015
1	AGRICULTURE AND RELATED SERVICES		
01.11	Cereal cultivation	0	15
01.12	Cultivation of cotton and other fibers in temporary crops	0	0
01.13	Sugarcane cultivation	16	12
01.14	Tobacco cultivation	0	1
01.19*	Cultivation of temporary crops not previously mentioned	21	19
01.21	Horticulture	1	0
01.32	Grape cultivation	4	1
01.33**	Cultivation of permanent fruit crops, except orange and grape	103	45
01.39	Cultivation of permanent crops not previously mentioned	0	2
01.41	Production of certified seeds	2	2
01.42	Production of certified seedlings and other propagating plants	3	0
01.51	Cattle raising	2	2
01.54	Pig farming	1	0
01.55	Poultry farming	17	11
01.61	Activities supporting crop cultivation	1	2
01.62	Activities supporting cattle raising	2	0

Source: Our elaboration/ Anuário da Saúde do Trabalhador, 2015.

(*) Pineapple, garlic, potato, onion, beans, cassava, melon, watermelon, tomato.

(**) Açaí berry, banana, cashew, citrus fruits except orange, coconut, guarana, apple, papaya, passion fruit, mango, peach (IBGE, 2006).

Among the municipalities that make up Polo Integrado Açu-Mossoró, the municipality of Mossoró—which, along with Baraúna, combine for almost 100% of the melon produced in the state of Rio Grande do Norte—has the highest number of work accidents. However, it is not possible to claim that such accidents are related to fruit production activities.

Occupational Health and Safety in the Melon Production Region of Rio Grande do Norte

As originally pointed out, this subsection is based on data and analysis derived from primary research—visits, interviews, and seminars, held in the years of 2016 and 2017, with key people and participants connected to Polo Açu-Mossoró, Rio Grande do Norte, namely, settlement farmers, workers, companies, and unions/associations of agricultural workers.

Occupational Health and Safety of Workers in Fruit Production in Polo Açú-Mossoró

Regarding accidents and/or diseases resulting from handling and exposure to chemicals used in agriculture, it is noted that even in companies who offered PPE, workers reported of harm and injury caused by exposure or handling.

Neurological illnesses have also been reported. The focus group mentioned a case about a female wage worker who suffered contamination due to exposure to agrochemicals. The circumstances had been aggravated, because even after confirming the illness by medical examination, the worker did not receive any compensation from the company. In fact, the occupational physician, who officially confirmed the illness of the worker, was persecuted by the company since she had confirmed that her patient's frequent fainting was due to exposure to pesticides, causing neurological problems. Even though the doctor was well known in the city of Açú, she felt the need to move due to the threats she suffered. The name of the company mentioned was Delmonte (Açú) and is one of the largest banana producers in the world. There are also occurrences of cancer due to work, the most common being of lung and eye nature.

In the focus group, workers mentioned about headaches, back and leg pain, and muscle ache as the most common health issues. There are reports of accidents with venomous animals as well. Regardless, it should be noted that the employees of the large company visited were using PPE throughout all stages of our visit.

While pesticides can affect workers mainly through the respiratory system and dermal contact, they may also be found in water, trees, crops and disposed objects—even if they are found at a quite distant place from their original location. An evident and negative issue in the agrarian reform settlements is that none had contemplated about the disposal of empty containers containing pesticide waste (e.g. insecticides, fungicides, herbicides). In addition, some of these packages do not seem to be disposed in environmentally safe location. For example, a hose used for irrigation of the melon crops was discarded over the field, and containers were reused. The labor union reported that in the past educational campaigns were promoted by auditors from the Ministry of Labor, aiming at teaching the workers about the safe use of pesticides and PPE. However, planning of new campaigns did not appear in their agenda.

Occupational Health and Safety of Female Workers in Fruit Production in Polo/Açú-Mossoró

Women working in fruit production in the melon-producing area can be categorized in two different groups of occupation.

The first group is the wage workers at companies (farms) of varied sizes, whose fruit production is exported and/or traded in the domestic/regional market. At these companies, as reported by Apolinário et al. (2017: 17–18), women work in many different types of cultivations. The ratio of women varies according to the type of fruit and work environment. In the case of melon production, on the crop fields, the ratio of men to women is 9:1. “In passion fruit production, 90% of the workforce is made up of women”. In melon production, women appear more often in areas like biological control and packaging (40%), and seedling preparation and laying out of trays (70%).

The second group of women is formed by those who work in agrarian reform land settlements or in small private properties. Some have other sources of income, combining agriculture with public administration. Some of them grow (i.e., beans, potato, pumpkin) for their own subsistence on their family’s land that was granted; others mix subsistence and commercial production in cultivation (e.g. melon, acerola, etc.) and animal raising (e.g. fish), for the local/regional market.

In all of these cases, women who take on these roles have a double burden, since they also undertake domestic activities, doing tasks that are traditionally attributed to women. Therefore, we can observe that there is pressure on the health and safety conditions of women who work in fruit production as a result of such a heavy routine. It's noted that these long hours, while necessary for the common development of the household, only remain to be the women’s full responsibility because of a prevailing sexist culture in such environment, in which men (adults or children) who perform “domestic” activities are considered “effeminate”.

Reports about cases of women being killed for futile reason, confirm that a sexist environment existed where women lacked dignity and safety. In the focus group, a female worker narrated: *“he killed her because she bought the groceries”* (buying groceries is considered as a man’s “privilege”). Besides women have difficulty in leaving their home for basic needs such as attending to public services; on such occasions husbands constrain them (“who would cook?”). Again women are discouraged to report about the violent behavior of their husbands; the chief of police who refused to file a report warned the woman: *“If I file this report, your husband will be arrested, and you will end up starving to death”*.

In addition, as emphasized by Apolinário et al. (2017), wage-working women in the fruit production, who work for fixed hours in a company (8 hours a day plus commuting time), feel even more pressurized by the little time they have for housework. To compensate their “absence” during the week, women work on domestic tasks late at nights and on Sundays. In addition, it has been reported

that unpaid female agricultural workers often work at times that do not jeopardize their household chores.

Regarding access to health, both female wage workers and women from land reform settlements complain about the low quality and insufficient coverage of public healthcare in rural areas, either for pregnancy care, gynecological exams for women, or for general appointments. According to them, the presence of specialized doctors is rare, while there are no nurses and products, even the most basic ones.

In the case of female wage workers, some findings in the focus group and through field research revealed that women who work at larger farms have access to the necessary PPEs (e.g., masks, hearing protectors, glasses, gloves)—as emphasized by Brazilian legislation and by international certifications that the companies need to adhere to—and are informed of the risks of their activities.

The workers' union says that some workers remove their PPE (e.g., glasses because they blur their vision), and end up cutting themselves (e.g., cutting their legs). It was also noted that some PPE are of poor quality, which hurt the workers (e.g., boots that cut the feet). They add that working in the sun, wind, and dust alone causes enough discomfort and sweating, which is often aggravated by the use of PPE. Men and women are subjected to these conditions.

As for female farmers in settlements, the existence of PPE seems to be rare. The same applies for all workers in settlements i.e., women, men, young people, the elderly, who deal with agriculture and are exposed to the use of chemical pesticides. Further, usually the equipment and pesticide suppliers were the only source of information about the materials and equipment delivered to farmers working with melon cultivation; however, large companies have their own technical assistance (offering guidance towards proper application, preparation, addition of the amount of chemicals needed, etc.).

Conclusion

The objective of this chapter was to analyze the occupational health and safety conditions of workers in agriculture in Brazil, and in the state of Rio Grande do Norte, by focusing on a globalized agri-food system—the melon production area of PoloAçu-Mossoró in the semi-arid region of Rio Grande do Norte (north-east Brazil).

Occupational health and safety have long been a topic of concern. Nevertheless, recent changes in the capitalist system related to the low growth of economies,

high rate of unemployment, and negligence regarding working conditions have altered the circumstances and perspectives.

The study showed that the working conditions in agriculture in Brazil are considerably poor: in 2014, it had the lowest wage rate, among all economic activities in the country. Also, the study revealed that though percentage of people involved in agriculture was the highest, they earned only a minimum wage, reporting second most work accidents, and the third most occupational fatalities.

In the agriculture sector in the state of Rio Grande do Norte, majority of the accidents are recorded in fruit production, though the occurrence of such mishaps is much more in sectors like clothing manufacturing and hospital activities. It is also clear that the accidents occur mainly in two municipalities—Natal and Mossoró.

Research conducted in PoloAçu-Mossoró revealed that while employees at large fruit farms have access to PPEs, an organized work environment and a regular schedule of working hours, workers and unions mention that these employees are also subjected to the effects of exposure to sun, rain, venomous animals, use of chemicals, handling of heavy tools and equipment, which make them vulnerable to accidents and illnesses. Moreover, female wage workers face extreme difficulties reconciling with their fixed working hours and domestic assignments that are traditionally imposed on them, and face problems in accessing occupational physicians.

In agrarian reform settlements, although workers enjoy relative flexibility, their long hours, misapplication of pesticides, careless disposal of chemical residues, and poorly assisted rural environment (regarding health, public safety, transportation) deeply compromise their OHS in these locations, particularly for women. With regard to the entire region, there were occurrences of several diseases related to work activities at fruit production companies and/or rural settlements, such as cancer, neurological diseases, musculoskeletal diseases, respiratory diseases, in addition to losses of limbs caused by handling of chemicals.

Therefore, despite important accomplishments and progress since the beginning of the activity in the region, OHS—considered as an indispensable requirement for ILO's notion of “decent work”—need to effectively materialize in the rural environments in Brazil, Rio Grande do Norte, especially, in PoloAçu-Mossoró.

These situations are all directly connected to the health conditions, occupational safety, and other characteristics related to decent work, which were not addressed in this study. Thereby, future researches need to contribute to the formation of a database and an analysis that would indicate solutions for rural

workers' organizations toward the progress of decent work in the global production of melon in the state of Rio Grande do Norte, and in other states of the Brazilian Federation.

To conclude we believe that some policies could mitigate the decent work deficits. Gaps in basic policies such as health, education, and security should be filled in. Poor access to education diminishes the possibility of youngsters to master better skills and improve income conditions. To initiate gender equality, it is essential to develop actions that can make women aware about domestic violence, referring to not only physical but also psychological aggression, thereby empowering them and informing them about public policies directed towards their welfare (for example, a specific credit line for women inside Brazilian Program for Family Farmers or Pronaf). Public actions and policies that already exists need to be enforced, hence inspection at workplaces should be undertaken by the Labor Ministry and their departments.

References

- Anuário Estatístico de Acidentes do Trabalho (AEAT) 2015 / Ministério da Fazenda ... [et al.]. – vol. 1 (2009) – . – Brasília : MF, 2015. 991 p. Accessed on 25 August 2017 at: <http://www.previdencia.gov.br/wp-content/uploads/2017/05/aeat15.pdf>.
- Anuário da saúde do trabalhador 2015. Departamento Intersindical de Estatística e Estudos Socioeconômicos. São Paulo: DIEESE, 2016. Accessed on 25 August 2017 at: : https://www.dieese.org.br/anuario/2016/Anuario_Saude_Trabalhador.pdf.
- Apolinário, Valdênia. Matos Filho, João. Penha, Thales Augusto M. Amaral, Letícia. 2017. Trabalho Decente em Sistemas Agroalimentares Globais: Reflexões sobre Condições de Trabalho e Gênero. In: XXII ENCONTRO NACIONAL DE ECONOMIA POLÍTICA. Campinas-SP: SEP, 30 de maio a 02 de junho de 2017. Accessed on 25 August 2017 at: <http://www.sep.org.br/downloads>.
- Apolinário, V., Penha, T., Matos Filho, J., and Amaral, L. 2018. “Organization of Production and Working Conditions in the Global Agrifood Systems: the Production of Melon in the Semi-arid Region of Rio Grande do Norte (Northeast/Brazil),”In: Christoph Scherrer and Santosh Verma (eds), Decent Work Deficits in Southern Agriculture: Measurements, Drivers and Strategies, Augsburg: Rainer Hampp Verlag pp. 34–58.
- Camissa, Mara. 2016. História da Segurança e Saúde no Trabalho no Brasil e no mundo. In: *Genjurídico*, 23March. São Paulo: Genjurídico. Accessed on 25 August 2017 at:<http://genjuridico.com.br/2016/03/23/historia-da-seguranca-e-saude-no-trabalho-no-brasil-e-no-mundo/>.
- Convenções Da Oit. Accessed on 25 August 2017 at: https://www.areaseg.com/download/oit/Resumo_das_Convencoes.pdf.
- Dieese. 2016. Departamento Intersindical de Estatística e Estudos Socioeconômicos. A saúde dos índices de saúde do trabalhador. São Paulo: DIEESE, Setembro de 2016. Número 162. Accessed on 25 August 2017 at: <https://www.dieese.org.br/notatecnica/2016/notaTec162Saude.pdf>.
- Diesat (Departamento Intersindical de Estudos e Pesquisas ee Saúde e Ambiente de Trabalho). 2017. 28 de abril – dia mundial em memória às vítimas de acidentes e doenças do trabalho. São Paulo: Diesat Accessed on 25 August 2017 at: <http://diesat.org.br/2017/06/07/28-de-abril-dia-mundial-em-memoria-das-vitimas-de-acidentes-e-doencas-do-trabalho/>.
- Engels, Friedrich. 1985. A situação da classe trabalhadora na Inglaterra. São Paulo: Global.

- IBGE. Conceitos e definições da PNAD. Accessed on 5 September 2017 at: https://www.ibge.gov.br/home/estatistica/populacao/mapa_mercado_trabalho/notastecnicas.shtm.
- IBGE. CNAE Subclasses – Versão 2.0. Brasília: IBGE, Nov/2006. Accessed on 5 September 2017 at: <http://www.fazenda.pbh.gov.br/iss/CNAE/Notas.pdf>.
- Lemos, Rafael Severo de. 2015. A valorização do trabalho humano: fundamento da república, da ordem econômica e da ordem social na constituição brasileira de 1988. In: Páginas de Direito, 25/06/2015. Accessed on 21 September 2017 at: <http://www.tex.pro.br/index.php/artigos/306-artigos-jun-2015/7243-a-valorizacao-do-trabalho-humano-fundamento-da-republica-da-ordem-economica-e-da-ordem-social-na-constituicao-brasileira-de-1988>.
- Marx, Karl. 1988. O capital: crítica da economia política. São Paulo: Nova Cultural, Volume I. (Os economistas)
- Ministère de L’agriculture, de L’alimentation, de la Pêche. 2012. Le monde agricole en tendances: un portrait social prospectif des agriculteurs. Paris: La documentation Française. Accessed on 25 August 2017 at: <http://agriculture.gouv.fr/le-monde-agricole-en-tendances-un-portrait-social-prospectif-des-agriculteurs-0>.
- Ministério da Previdência Social. 2006. **Seção IV - Acidentes do Trabalho. Brasília: MPS, 2006.** Accessed on 5 September 2017 at: http://www1.previdencia.gov.br/aeps2006/15_01_03_01.asp.
- Oit Brasil. 2017. Segurança e saúde dos trabalhadores. Accessed on 25 August 2017 at: <http://www.oitbrasil.org.br/node/504>.
- Previdência Social. 2017. Comunicação de Acidente de Trabalho – CAT. Brasília: Previdência Social, s/d. Accessed on 25 August 2017 at: <http://www.previdencia.gov.br/servicos-ao-cidadao/todos-os-servicos/comunicacao-de-acidente-de-trabalho/>.
- Revista Trabalho and Saúde. 2017. São Paulo: Diesat. Accessed on 5 September 2017 at: <http://diesat.org.br/revista-2/>.
- Viana, Joelmir Lisboa, and Apolinário, Valdênia. 2016. Saúde e desenvolvimento regional/local: estudo a partir da distribuição espacial dos serviços de saúde. In: Seminário de Pesquisa Do Ccsa. Anais... Natal: UFRN/CCSA, 2016. Accessed on 9 September 2017 at: <https://seminario2016.ccsa.ufrn.br/assets//upload/papers/7da33a43b8fa202f0d8d8b538377b4fa.pdf>.

8. The Impact of Quality Certifications on Working Conditions in the Context of Fresh Fruit Global Value Chain: The Case of Melon Production in Rio Grande do Norte, Brazil

Walter Belik and Thales A. M. Penha

International trade in the 21st century is marked by a new pattern—the inclusion of Global Value Chains (GVC). The GVC constitutes tasks associated with production processes which were dispersed around the world to instill more competitiveness, taking into account strategies that would facilitate cost reduction or enjoyment of market opportunities. This new paradigm of production transformed international trade and changed the trade web pattern amongst countries, who no longer traded with the final goods, but the tasks linked with the production process (Marcato & Baltar, 2017).

This new configuration of both production process and international trade opened a crucial discussion on its impact on countries involved in GVCs. This raised the need to investigate for upgrading inside value chains. The debate about upgrading as pointed out by Marcato and Baltar (2017) should involve a look from the top, emphasizing on the strength of upscaling along the chains. In fact, it needs to understand the impacts from the bottom, that is, to look how the gains from the insertion on these chains have been distributed among the agents involved, directly and indirectly. Literature has analyzed the impact in two ways—economic and social upgrading. Briefly, economic upgrading is understood as the increase in gains along the chain; while, social upgrading is the distribution of these gains among the actors who are part of the chain. But economic and social upgrading have no linear connections with each other; hence, an occurrence of economic upgrading not necessarily entails a social upgrading (Gereffi & Lee, 2016).

The measurement of social upgrading is a complex task as it encompasses many aspects and particularities of countries involved in a specific GVC. However, one of the main aspects that can be observed about social upgrading is the labor relations settled in the chain, especially in developing countries which in general suffer from poor labor conditions. For a deeper understanding about the impacts of GVCs in work conditions, Gereffi and Lee (2016) adopted the Decent Work concept. This concept allows a wide view in the work conditions covering four main aspects—jobs opportunity; social protection; social dialogue; and workers' rights. However, in rural areas, as pointed out by Oya (2015), it is important to look more carefully at specific indicators in the context of the intrinsic features of rural works and respective countries.

In less developed countries, working conditions are poor and incidences of accidents at work are frequent. Workers' rights and specifically health and

occupational safety have become an important topic about decent work agenda in rural areas. The situation is more puzzling in agricultural GVCs because of the presence of certifications and stamps. Certifications enforce good agricultural practices incorporating a range of quality signals addressed for the final consumers such as social responsibility, environmental issues, and labor aspects. However, those stamps and seals later are used as brands of large wholesalers and supermarket networks. This phenomenon has a massive impact on the coordination of the agricultural GVCs. The certifications represent the capacity of the actor at the head of the chains (industry, trader or retail chain) to set up a type of coordination that entails an asymmetrical relation among growers and buyers (Gereffi, Humphrey & Sturgeon, 2005).

Many of the certifications that act in the agricultural GVC's cover labor questions, such as GlobalG.A.P. which have guidelines about health and occupational safety. However, for Bain (2010), one of the consequences of this new pattern of coordination of global food production chains through seals and certifications is making the agricultural labor market intensely flexible, especially in developing countries. Certifications, in general, and Global Gap in particular, can only have a limited effect, despite strict requirements for labor protections (Bain, 2010).

In Brazilian Northeast, agricultural GVCs of fresh fruits had been playing an important role in rural dynamics since the early 90s. The region stands out in the international trade of melons, mangoes, and grapes, and is one of the top players in the international trade of these fruits. The labor market in this region suffers the effects of the less labor-intensive practices increase of production for exports and also some reflects the new pattern of governance imposed by certifications. This chapter aims to analyze the impact of certifications in health and occupational safety in the GVCs of fruits produced in the Brazilian Northeast.

This chapter is structured in four more sections. In the subsequent two sections, we will discuss briefly the new pattern of international trade of agrifood goods. In the first section, how trade is structured in value chains is explained. In the second one, the new form of governance of these chains and role of certifications in the coordination of value chain and its impact on the labor market is presented. In the fourth section, some data about the health and occupational safety in the melon production area in the Brazilian Northeast and its relation with the new institutional environment of certification brands is discussed. In the last section, concluding remarks about the new pattern of the agrifood trade and its impacts in the health and occupational safety, with reference to the case of melon production in the Brazilian Northeast, is presented.

Integration of Value Chains in Agriculture

The evolution of markets over recent decades has trended toward the insertion of primary products producers into commodity chains for the food, feed, or bioenergy industries, or, alternatively, toward their specialization as suppliers of natural consumer goods (processed or *in natura*) for high income, niche consumers.

In general, these two trends have led to market concentration and exclusion. On the one hand, the model of “commoditization” and agro-industrialization has led to increasing returns to scale and ever-increasing alienation from natural processes. On the other hand, the regularization of agricultural production has given rise to the “sanitization of rural life” (Marsden, 2001), with elevated costs arising from almost unreachable hygiene standards and high regulatory costs, which reinforce the dominance of agribusinesses. New investments (environmental, animal welfare, certifications, etc.) has led to new costs, and the price is paid by producers as they attempt to maintain small scales of production and achieve synergies between the heterogeneities of production and consumption (Marsden, 2001).

Many scholars draw upon the paradigm of “Distance and Durability” to explain the foundations of the current food system (Friedman, 1992). Be it in the production of commodities or specialty products, it is evident that markets tend towards global limits, and producers seek to increase durability of products to better serve consumers. Physical distance is constantly becoming less of a barrier to commercialization, while temporal delay between field and fork has increased in relevance. In terms of durability, the use of refrigeration and preservatives allows an increasingly wide array of “fresh” products to reach an ever-expanding range of consumers. In this sense, discussion of “short supply chains” may not always be referring to geographic distance, but rather the processes of movement and coordination exercised by agents involved in the process. The post-Fordist system of food production manifests itself through decentralized and flexible systems organized around achieving economies of scale and scope. The governance of food production chains is generally vertical, although it also makes use of the flexibility provided by new technologies to act over wide geographical spaces through systems of horizontal integration as well (Jha & Chakraborty, 2014).

Diversification of supply and the drive to improve quality are direct results of market saturation. Products’ quality is assessed by signals of quality, and social conventions that determine valuations of quality are themselves the result of coordination among actors within an institutional context. Quality is thus different from standards, which are objective rules. In the United States,

conventions and understandings of quality are weaker, since it is believed that the consumer can decide for himself or herself through market mechanisms (Sylvander, 1985). Considering the “Mad Cow Disease crisis” and other food contamination incidents in Europe in the 1990s, Valceschini and Nicolas (1995) call attention to the fact that sanitary and nutritional problems have always been present. The difference is that, today, with extensive market saturation and liberalization of trade, the question of quality has become one of greater urgency and import. Supply chains have grown in length and require greater efforts of coordination and control. Competition within the food system is leading to a generalization of rules based on quality standards, which in turn require transformations in industrial and commercial relations. Governments thus need to alter their public policies and practices as well, while, from the private perspective, consumers (lacking omniscience) require certifications to ensure quality and food safety.

In this context, it is important to differentiate between standards and grades, or classifications. The first are based on international sanitary regulations, specifically the Codex Alimentarius (from 1961), administered by the FAO and WHO, both organizations under the umbrella of the United Nations. This agreement is the primary source for the establishment of food standards and is used as a basis for international trade (Farina and Reardon, 2000).¹ In turn, Grades represent classifications based on qualitative attributes. Quality is a social convention resulting from coordination among actors, and may be based on four principal elements, which may or may not be complementary: objective rules agreed upon between parties, long-term ties between agents, “civic coordination” around a cause, and improved market functioning (Sylvander, 1995)².

As described by Barzel (1982), market transactions only occur if the buyer receives from the trade something perceived to be more valuable than that which she or he is sacrificing. In turn, the value of the item being considered for transaction reflects determined attributes of interest to the consumer, as long as the measurement of these attributes has a sufficiently low cost or no cost.

¹Guidelines of Codex were the reference to SPS (Sanitary and Phytosanitary Agreement) under World Trade Organization (WTO) mandate in 1995.

² In France, the *Appellation d'Origine Contrôlée* system (AOC) was formed for the wine industry in 1919, and expanded rapidly to include other products such as cheese, butter, honey, etc. The AOC is based on objective geographic attributes, but consumers' responses to quality signals establish preferences and buying habits. Other types of standards were established in France since the 1960s, which were linked not only to geography but to norms of “quality” specifically established and self-administered by producers. This is the case of the “label rouge” used for meats, “mountain” products, and “farm” products (Sylvander, 1995).

Nonetheless, if evaluation of product attributes is uncertain or costly, transaction costs may rise sharply, or the consumer may desist from the purchase altogether. Thus, the problem of measurement is fundamental to market relations: first, in terms of signaling of quality, and second, in terms of adverse selection. These elements may lead to possible error in the estimation of desired product qualities.

The establishment of norms of quality based on certifications may diminish asymmetries of information, which in agriculture may lead to opportunism on the part of agricultural producers and distributors. Opportunism is present in agriculture not only due to the limited rationality of economic agents, but also because of biological and environmental processes. With the objective of minimizing environmental and biological risk, agents invest heavily in sunk costs in the hope of adapting their systems of production to the specific new rules imposed by the certification, even though, in a world of imperfect information where knowledge is not distributed evenly, it is not possible for all adopters to have the same costs of production (Langlois, 1998).

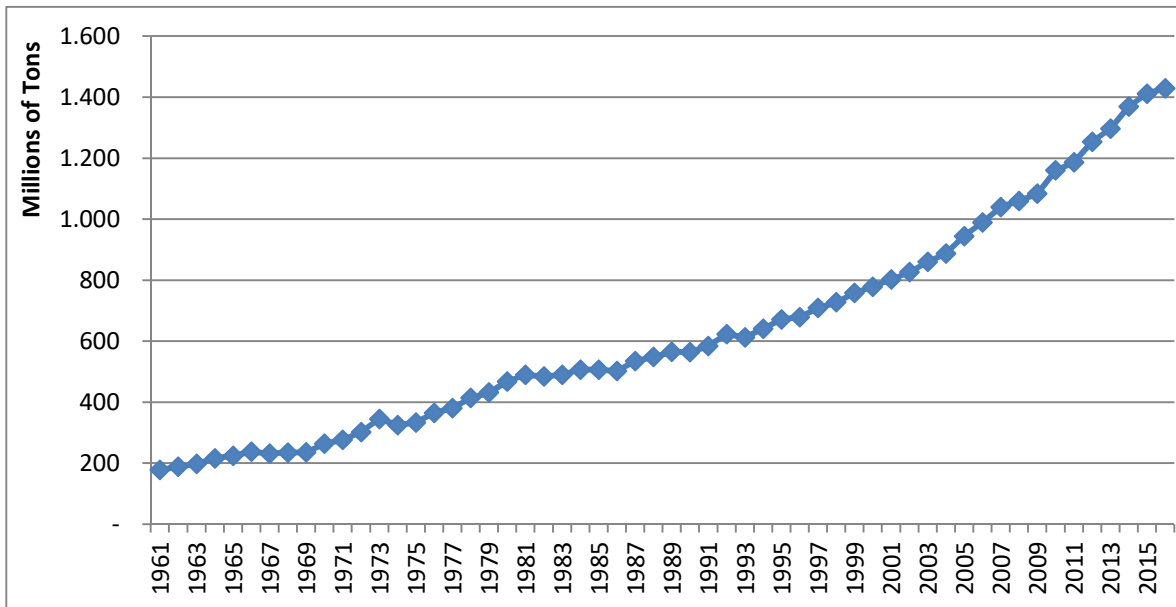
Therefore, certification seeks to reduce transaction and measurement costs, since they are focused not on the product in its specificity, but rather on the collection of attributes associated with the product. In this sense, commercialized fresh fruit carries with it not just its organic qualities, but cultural, social, and environmental attributes as well, which may be recognized or desired by the consuming public.

New Norms in Agricultural Markets: Certification, Labor Relations, and Coordination Mechanisms

Over recent decades, the market for agricultural products experienced expansion in scope, as illustrated in Figure 5. Between 1987 and 2016, international trade in agricultural products grew by 167%, almost to one billion and half tons sold.

Nonetheless, this expansion over recent decades was not limited to increases in quantity. There was also a structural transformation of food markets. In fact, during the final decades of the 20th century, it was possible to observe fundamental changes in consumption patterns of agricultural products. As highlighted by Milone (2009), environmental aspects, safety, and quality of foods came to occupy an important role in consumers' decision making. These evolving consumer preferences brought with them new demands for specific products, as well as concerns over quality and the environmental and social impacts of food production, including concern over labor relations and working conditions (Belik, 2007; Wilkinson, 2008; Raupp, 2010).

Figure 1 - Total Quantity of Agricultural Products Sold Worldwide (1961-2016)



Source: Created by author from FAOSTAT data

The possibility of attending to these new patterns of demand is intimately associated with another important development in the world food market: new processes of coordination of production and commercialization of agricultural products. Departing from the perception that consumers were increasingly valuing specific product attributes and even characteristics of the production process itself, agents mobilized to remodel modes of commercialization. As noted by Belik (2007), this process led to the ascension of a flexible supply system (demand pull), in which producers began to offer differentiated products with respect to the specificities of demand. The emergence of a system similar to the flexible production system in industry, able to adapt to increased demands for quality by consumers, opened the possibility for major wholesale networks to commercialize agricultural products on the global stage (Belik, 2007).

This change in market structure has had a large impact on the coordination of agro-food markets. Supermarket chains, wholesalers, and traders have consolidated their role as central agents within the global food market architecture. The new flexible production and supply model that has come to dominate the market reinforces the tendency of these central agents to utilize new forms of transaction coordination, such as distribution networks and flexible contracts with producers (Belik & Chaim, 1999; Ménard & Klein, 2004; Wilkinson, 2008). Burbach and Flynn (1980) describe the process by which, from the 1980s onwards, supermarket chains in the United States began to coordinate the production of Mexican produce to supply their stores. Similarly, Dolan and Humphrey (2000) highlight the central role played by European supermarket chains in the coordination of vegetable production in Africa, which grew by 150% between 1989 and 1997.

Within this restructuring of food markets, fruits, legumes, and vegetables (FLV) experienced significant gains in market protagonism. Dolan and Humphrey (2000) argue that this development was due to supermarkets' improved ability to appropriate larger profit margins from FLV products, which Penha et al. (2018) illustrate in their findings that supermarkets add significantly to the value of agricultural products, especially fresh, "ready to eat" products, by performing minimal processing, such as slicing melon instead of selling melons whole (a simple process conducted within the supermarket that adds more than 70% to supermarkets' gross margin).

Dolan and Humphrey (2000) argue that supermarkets' capacity to appropriate this value is due to an absence of participation by major traders within the FLV market, which allows supermarkets to link their own labels to these products and appropriate greater portions of the products' value. The authors affirm that FLV products, as well as meats, offer greater profitability for supermarkets insofar as supermarkets can develop their brands around the differentiation and identification of these items.

Valceschini and Berthet (2005) suggest that this process of differentiation allows for market segmentation, given that consumers are disposed to consume products with standout or peculiar attributes. Thus, these products come to command greater market value as a result of the quality attributed to them by the consumer, known in the literature as a quasi-rent, which is the additional value commanded by a product due to some peculiar characteristic it possesses.

The flexible, demand-pull model, as Belik (2007) describes it, is largely implemented by the new central agents: supermarket chains, major retailers, and distributors. This new paradigm is centered around the generation and appropriation of quasi-rents, which are obtained through investments in specific assets, standards, and modes of production (Klein et al., 1978)

In the face of these developments, some authors have focused on the possibility of creating or promoting recognition of quality by buyers in an area that has come to be called the Economics of Quality. Valceschini and Berthet (2005) point out that, in the face of new consumer attitudes, a large number of seals and certifications (grades) have emerged to inform consumers about desired product characteristics. Furthermore, since new consumer demands are often more personalized and segmented, agents have been obligated to reorganize supply chains that had previously been optimized to serve a homogenous mass market.

The dynamics described above exerted a significant impact on food production chains insofar as producers felt pressures to reorganize their productive routines and adapt to the requirements of new certifications (Wilkinson, 2008). In turn,

certifications established processes of monitoring agricultural producers' practices and products. These monitoring mechanisms and certifications were previously the domain of state or para-state organizations. However, these organizations have progressively lost ground to private organizations. At the international level, this trend may be observed at the level of large central distributors, supermarkets, and international wholesalers. These agents began to disseminate their own certifications (grades) with differing and sometimes divergent rules. This heterogeneity in norms led to the emergence of dozens of different seals and international quality certifications (Busch & Bain, 2004).

It is important to highlight that public certifications monitoring and regulating norms of commercialization (standards) have progressively lost their coordination capacity as a result of the emergence of new demands from buyers that are not strictly tied to legislation (grades). One additional difficulty comes from rapid technological changes and trade liberalization, which are altering the means of commercialization of fresh products and reshaping this commercialization around GVCs with simultaneous participation by diverse agents in different countries.

The trade liberalization that followed the Uruguay Round of trade negotiations in 1995 unleashed a process of reduction of tariff barriers for agricultural products. During this same period, Europe was experiencing a deep distrust of food health and safety norms in the fallout of the outbreak of Mad Cow Disease and Salmonella in eggs. Together, these events were decisive in provoking private initiatives to develop tripartite "third-party certifications (TPC)" (Hatanaka, Bain & Busch, 2005; Almeida, Pessali & de Paula, 2010). Differently from the directives included in standards such as the Codex Alimentarius, or the regulatory legislation of each country, these third-party certifications established norms agreed upon by major food product wholesalers, which built ties with both public and private organs to monitor products whose production and distribution chains were spread around the globe. TPCs were, in other words, institutional arrangements that permitted a broader and more impactful coordination of agents, without the costs of hierarchy.

It was in this context that in 1997, major European retailers formed a group in order to define a body of common rules for the production of FLVs. This group of 13 major retailers published a protocol known as EUREPGAP (Euro Retailer Produce Working Group for Good Agricultural Practices) in 1999. At the outset, the protocol only addressed issues related to fruits and vegetables, and only applied to countries where one or more of the participating retailers was active. Nonetheless, as time passed the protocol's standards came to encompass diverse products (coffee, flours, meats), and extended its reach to 120 countries.

Owing to the enormous breadth the protocol was able to reach, it is today referred to as GlobalG.A.P (GlobalG.A.P., 2017; Henson et al., 2011). The GlobalG.A.P. protocol encompasses four primary topics: food security, environmental preservation, workplace safety, and animal welfare (Asfaw et al., 2010).

GlobalG.A.P. consolidated a new standard for certifications and marked an inflection point in the coordination of global agricultural chains, where governance passed definitely from public to private hands and public sectors began losing relevance in decision-making processes across a range of countries (Hatanaka et al., 2005). The increased enforcement capacity of the private norms for fresh agricultural products has been even more apparent in developing countries, which have become important suppliers of global fresh food value chains, earning the acronym NACs (Newly Agricultural Countries). These countries have brought important new dynamism to agricultural value chains through their insertion into global markets.

A series of seals and certifications thus spread along global agricultural chains, bringing with them, among other aspects, an enormous variety of requirements, such as working conditions, social responsibility, and product traceability. Companies such as Carrefour, Tesco, and other retailers have their own seals and their own rules of certification, though all are underpinned by GlobalG.A.P.. Beyond aspects of product quality, these seals are employed by wholesalers to differentiate their fresh products. Upon instituting this complex tripartite relation involving diverse agents, the system described above depends on mechanisms capable of maintaining coordination, minimizing opportunism, and reducing associated transaction costs.

Certifications have exercised an important role in the organization of agricultural markets, especially within fresh food production chains. In the case of fresh foods, certifications enable lower transaction costs associated with the complexity of quality-evaluation during transactions. Nonetheless, Hatanaka et al. (2005) argue that TPC certifications have not facilitated impartial interventions in the market, since their widespread adoption had caused social and economic repercussions by organizing, reorganizing, and disciplining all agents inserted into global agricultural chains according to asymmetric power relations.

For Bain (2010), one of the consequences of this new pattern of coordination of global food production chains by seals and certifications has been an intensely flexible agricultural labor market, especially in developing countries. This process may be exacerbated by the seasonality of production and the pre-established production calendar these countries follow to maintain their

insertion into the consumer markets of the central economies. Thus, the labor market imposes a permanently low level of employment and significant oscillation in temporary employment (Bain, 2010). This volatility in turn leads to substantial instability of income, leaving workers dependent on the labor legislation and social policies of their respective countries and degradation of the condition of rural workers. Thus, for Bain (2010), despite GlobalG.A.P.'s claim to be a market strategy that strengthens relationships and mutual benefits by means of its regulations, it is in fact a mechanism structured to consolidate asymmetric power within the production chain.

For Bain (2010), certifications in general, and GlobalG.A.P. in particular, can have only a limited affect, despite strict requirements for labor protections. For instance, the majority of requirements related to working conditions are classified at the level of “minor must” (see Annex A), signifying that producers must satisfy up to 95% of the norms specified in the protocol.

Furthermore, the increased flexibilization of labor relations can conceal significant information related to working conditions, as is the case with subcontracting (Bain, 2010). Though GlobalG.A.P. insists that subcontracted labor also pass inspections, the tangle of contracts and subcontracts often makes such monitoring and enforcement difficult.

Even considering these deficiencies, GlobalG.A.P. may promote some positive changes in health and safety for workers. Ehlert et al. (2014), for example, suggest that some studies (while controversial) identify a significant reduction in exposure to pesticides upon adoption of GlobalG.A.P. norms. From field research in Kenya, these authors find evidence that producers who adopted GlobalG.A.P. suffered less pesticide exposure and even applied lower pesticide doses to their crops, resulting in positive impacts on health. It is important to mention that health and occupational safety for workers are considered a “major must,” and need to be completely obeyed by producers in compliance with GlobalG.A.P. norms regulating the use and application of pesticides.

Health and Occupational Safety in Rural Rio Grande do Norte

As highlighted by Penha et al. (2018), the labor market for the production of melon in Rio Grande do Norte, Brazil, exhibits intense volatility throughout the year, alternating between a period of intense hiring during the months of June through November, and a period of firings occurring between the months of December and May. Table 1 draws upon data from the General Registry of Employed and Unemployed (CAGED) to illustrate the dynamics of this cyclical employment phenomenon.

Table 1 illustrates that between 2008 and 2016 there was a reduction in the total number of workers employed in melon production in the Açú-Mossoró region of Rio Grande do Norte. In 2008 there were approximately 10,500 workers in this sector, while in 2016 the figure has declined to approximately 8,200. This decrease was already noted by Penha et al. (2018), who identified increasing yields per hectare and an increase in formal employment between the end of the 1990s and the beginning of the 2000s. The authors argued that the expressive growth in measured employment was due to labor formalization in a previous highly informal labor market, but that, upon closer inspection, there was a net decline in the total number of workers involved in melon production.

Furthermore, Table 1 illustrates that during this period, around 3,000 workers were fired each year without just cause, although an approximately equivalent number were rehired.³ Rehiring is substantial in the melon sector, especially in the two principal municipalities involved in the activity, Baraúna and Mossoró. Rehiring in the melon sector in Baraúna represents approximately 50% of the total number of re-hirings for all economic sectors in the municipality. In Mossoró, rehiring in melon production represent approximately 17% of the total municipal rehiring, according to data made available by CAGED (2017) for these two municipalities. These data indicate the dominance of melon production in the economies of the region, as well as the high levels of employment volatility associated with this activity. This volatility corroborates the argument introduced earlier by Bain (2010), in which global FLV value chains exhibit a tendency toward labor flexibilization, while certifications such as GlobalG.A.P., despite their attention to working conditions, do not consider workers' income stability and thus allow such volatility and disruptive behavior.

According to Apolinário et al. (2018), workers involved in melon production in Rio Grande do Norte have undertaken labor negotiations with regional firms since the middle of the 1990s, and since 2000, an agreement reached at the Collective Convention has been applied to all fruit-producing firms in the region. These authors also observe that workers in the region generally have the sense that their working conditions today are notably superior to what they were in the 1980s and early 1990s.

³ “Re-hiring” refers to those workers hired away from employment in another sector.

Table 1**Movements in Labor Market for Melon Production in Açú-Mossoró Region, 2008-2016**

Movement	2008	2009	2010	2011	2012	2013	2014	2015	2016
Admission to First Job	1,041	297	510	557	583	492	542	764	578
Admission by Re-hiring	3,829	3,017	3,598	3,692	3,588	2,868	3,141	3,463	3,715
Admission by Reintegration	0	0	0	0	1	0	0	1	0
Termination by Firing without Just Cause	2,818	2,968	2,771	2,956	2,929	2,859	2,487	2,605	2,960
Termination by Firing with Just Cause	152	20	4	7	6	3	4	7	8
Termination by Request	781	297	336	592	603	515	521	606	332
Termination by Death	6	4	5	7	4	6	4	5	10
Retirement	0	0	4	4	0	3	1	3	0
Termination by Termination of Contract	1,830	1,584	197	249	224	121	103	247	283
Short-Term Employment Contract	16	0	0	2	4	0	0	7	7
Expiration of Short-Term Employment Contract	48	45	43	97	177	144	124	198	318
Employment Stock	10,513	8,232	7,466	8,163	8,119	7,011	6,927	7,906	8,211

Source: Elaborated by the authors with data from CAGED MTE – Cadastro Geral de Empregados e Desempregados

Until the middle of the 1990s, workers suffered from restrictions imposed on their freedom to organize labor unions; salary campaigns led by rural workers' union occurred under a climate of significant tension. As an example, when the labor organizer and current president of FETARN⁴, Mr. Manoel Cândido, entered the largest fruit-producing property in the region to call a workers' meeting to discuss labor demands in the early 1990s, the police were called to expel him (Apolinário et al., 2018).⁵ Workers also had to suffer from unhealthy working conditions, such as exposure to chemicals, and were sometimes obliged to drink water from open tanks exposed to dust and debris. They were not provided with meals and were forced to bring their own food on to the farm, where they had no access to a kitchen or cafeteria. Furthermore, workers were not offered access to housing or adequate sleeping areas; those that came from

⁴ The Federation of Agricultural Workers of Rio Grande do Norte (FETARN) is the organization that brings together municipal rural workers' labor unions.

⁵ Information obtained from interview granted to the researchers during field research.

distant cities had to remain on the farm between shifts and even sleep in the open, exposed to the elements. Also, employment relationships were totally informal, with no guarantees of adequate salaries or social protections.

Towards the end of the 1990s, significant changes occurred in the institutional environment that led to changes in labor relations, and in some cases, there were substantial improvements. These new conditions were the result of a confluence of actions by three major institutions: the Ministry of Labor, international certifications, and labor unions. By the end of the 1990s, the Federal Government's Ministry of Labor had achieved legitimacy and authority in the area, and initiated a more rigorous application and enforcement of federal labor laws. Moreover, with expanded government oversight, pressure grew from importers, who feeling the exigencies of new patterns of commercialization, increasingly demanded for safe food products.

Finally, improvements in government oversight of working conditions and the new panorama of global agricultural value chains gave new scope of action to labor unions, which acquired new capacities to negotiate with agro-export firms (Matos Filho et al., 2016). Nonetheless, as pointed out by Apolinário et al. (2018), workers' bargaining power remains quite limited. To give a sense of these limitations, authors note that the list of workers' demands in collective negotiation processes tend to feature about 50 items, while final agreements tend to address only two to three of them. Normally, the primary focus of collective negotiations is workers' salaries, and such negotiation may end with an agreement to raise salaries to US\$4 above Brazil's federal minimum wage, leaving the remaining list of workers' demands unaddressed.

Even under these challenging conditions, there have been important advances, and there are strong indicators to suggest that workers continue to make gains with the backing of protective labor legislation (including local-level legislation) and the requirements imposed on fruit producers by directives established by international certifications. In this way, it is possible to affirm that producers' insertion into international export markets has had a major influence on the reorganization and improvement of working conditions in fruit production.

Nevertheless, as discussed in the previous section, the impact of international certifications has been controversial. From the point of view of health and occupational safety, some authors have identified positive results, as discussed by Ehlert et al. (2014). In order to better understand the impact of health and workplace safety certifications on working conditions in rural Rio Grande do Norte (RN), as well as along the global supply chain of melon produced in this region, we now undertake an analysis of secondary data. Data are drawn from

official statistics of the National Survey of Households (PNAD–*Pesquisa Nacional por Amostragem Domiciliar*) for the years 1998, 2003, and 2008⁶ in order to identify associations between health and occupations and activities in agriculture. The objective is to paint the entire picture encompassing all the changes that have occurred over the recent years.

It is notable that as illustrated in Table 2, interviewees' perceptions of health conditions worsened over the three years surveyed, for all categories of workers, and at the levels of Rio Grande do Norte, the Northeast region, and Brazil as a whole. However, it should also be noted that self-employed producers have an even worse perception of their health than do employed workers (Table 3). This may be explained by the tendency of self-employed workers to be family farmers utilizing primarily family labor, often over much longer working days than what would be allowed on the majority of agricultural firms or farms. In fact, family farmers often work over eight hours per day, and even on weekends and holidays. This hypothesis is strengthened by comparative analysis of Rio Grande do Norte, the Northeast region, and Brazil as a whole. A majority of the country's family producers suffer from low capitalization and high dependency on manual labor. Thus, for the three years surveyed, self-employed workers in the Northeast had poorer perceptions of workplace health conditions than the Brazilian average. However, it is also worth mentioning that the region's poor public health coverage fails to offer basic health infrastructure or efficient service to rural populations, worsening the populations' perceptions of health and well-being. The data indicate that workers in Rio Grande do Norte have an even poorer perception of their health than the Northeastern average, reflecting the low levels of dynamism in rural Rio Grande do Norte.

⁶The analyzed years are based on data extracted from the National Survey of Households that in these specific years have added a supplement on the health conditions of the population, which allowed the analysis of the health issues of the workforce. Unfortunately, the year 2008 was the last Household Survey that brought those kinds of information concerning health aspects. In 2013, the Ministry of Health elaborated a research on the health of the Brazilian population, but the questions have methodological differences that according to the view of the authors made the comparison with the previous data impossible.

Table 2. Workers' Perception of Health, by Occupation, 1998, 2003 & 2008

1998									
	Rio Grande do Norte			North East			Brazil		
Occupation	Good	Regular	Poor	Good	Regular	Poor	Good	Regular	Poor
Self-Employed Producers*	62	28	10	62	31	7	60	34	6
Agricultural Workers**	70	24	6	74	21	5	69	27	4
2003									
	Rio Grande do Norte			North East			Brazil		
Occupation	Good	Regular	Poor	Good	Regular	Poor	Good	Regular	Poor
Agricultural Producers	47.71	45	6	64	30	6	64	31	5
Ranchers	79	17	4	52	41	7	60	34	5
Agricultural Workers	68	28	4	74	22	4	70	26	4
Ranch Workers	71	20	7	66	29	5	67	28	5
2008									
	Rio Grande do Norte			North East			Brazil		
Occupation	Good	Regular	Poor	Good	Regular	Poor	Good	Regular	Poor
Agricultural Producers	52	32	16	61	33	6	62	32	6
Ranchers	50	34	16	60	33	7	59	34	7
Agricultural Workers	65	30	5	67	28	5	66	29	5
Ranch Workers	58	31	11	62	31	7	64	30	6

*Agricultural producers and ranchers were aggregated in the PNAD from 1998.

**Agricultural workers and ranch workers were aggregated in the PNAD from 1998.

Source: Elaborated by authors with data from PNAD (1998, 2003 and 2008).

Examining workers' perceptions of health by activity (Table 3), it appears that banana production in Rio Grande do Norte exhibits the highest proportion of workers rating their health situation as good. Banana production also features a higher proportion of agents reporting good health than the average for the Northeast region as a whole. Notably, the primary producer of bananas over the survey periods of 2003 and 2008 was Del Monte Fresh Products, a multinational company that began banana production in the Açú-Mossoró region in 1998, with almost all of its production destined for export. Together with melon, bananas came to be one of the dominant agricultural products of Rio Grande do Norte between 2000 and 2012. After this date, Del Monte dismantled its production in the state, leaving melon as the sole primary fruit product in the region.

Another measure of workers' health conditions is their reporting of their incapacity to complete tasks in the given time. This variable indicates whether the individual found themselves incapable of completing some typical task during any of the weeks referenced in the interview. Table 4 demonstrates that banana production presents the lowest rates of individuals reporting incapability of completing tasks in Rio Grande do Norte, with rates below even the regional average of the Northeast and Brazil as a whole. Data for cattle ranching and permanent crops are also notable for presenting lower rates of incapacitating conditions than those reported for grain production and horticulture in Rio Grande do Norte.

According to data made available by the Ministry of Pensions and Social Assistance, the number of work-related accidents in temporary crop production, after peaking in 2005 at 202 accidents, has presented a declining trend, as illustrated in Figure 2.

This variable measures the number of reported incidents, and is therefore likely to be an underestimate of the true incident rate. The period between 1999 and 2005 coincides with an important phase of institutional change, during which government regulators began implementing closer oversight of labor conditions and EurepGap began to implement its certifications along the FLV value chain. Nonetheless, as Penha et al. (2018) highlight in their study, this change in the institutional environment triggered a process of restructuring of production marked by exit from the market by older producer firms, notably the two historically largest melon-producing firms in the Açú-Mossoró region (Maisa & Frunorte). These exits were compensated for by the rapid entrance of new farms and companies. Together, these regional sectoral developments led to a process of reorganization of production and labor that resulted in a considerable decline in the quantity of workplace accidents by 2005.

The new configuration of melon production in the Açú-Mossoró producing area is marked by concentration of production in a few medium and big farms. Presently, almost less than two dozen companies/farms are responsible for melon production in the region. All of those companies/farms obtain the main certification stamps since they are necessary for accessing the retail sector of the world market, especially in Europe. The broad adoption of certifications creates a scale of economies in melon production. Producers have to pay for the stamps which raise the fixed costs of the melon production. These costs in some level are prohibitive for small-scale producers as they don't have a massive production to dilute the cost. So small-scale producers concentrate in the production of other fruits and sporadically produce melon, focusing on local markets (Field Research, 2017)

Table 3**Workers' Perceptions of Health, by Activity, 1998, 2003 & 2008**

1998									
	Rio Grande do Norte			North East			Brazil		
Activity	Good	Regular	Poor	Good	Regular	Poor	Good	Regular	Poor
Sugar Cane	78	20	2	74	22	4	73	23	4
Manioc	71	25	4	70	23	7	64	30	6
Maize	84	16	0	76	21	3	69	26	5
Horticulture	70	24	6	73	21	6	67	25	8
Other Crops	71	23	5	72	23	4	67	28	5
Ranching	71	21	8	73	23	4	70	26	4
2003									
	Rio Grande do Norte			North East			Brazil		
Activity	Good	Regular	Poor	Good	Regular	Poor	Good	Regular	Poor
Maize	36	40	24	66	28	6	66	29	5
Sugar Cane	25	75	0	75	21	4	74	22	4
Manioc	67	30	3	72	24	4	70	26	4
Temporary Crops	64	34	2	69	26	5	69	26	5
Horticulture	56	39	5	71	24	5	64	30	6
Banana	79	14	7	66	28	6	69	26	5
Permanent Crops	65	32	3	69	28	3	70	28	2
Cattle	87	9	4	70	27	3	71	25	4
2008									
	Rio Grande do Norte			North East			Brazil		
Activity	Good	Regular	Poor	Good	Regular	Poor	Good	Regular	Poor
Maize	69	21	10	66	28	5	65	30	5
Sugar Cane	67	33	0	77	19	4	79	18	3
Manioc	58	34	8	64	30	5	63	31	6
Temporary Crops	58	36	6	63	31	6	63	31	6
Horticulture	56	25	19	66	28	6	61	33	6
Banana	77	23	0	68	30	2	68	29	4
Permanent Crops	70	21	9	71	24	5	70	26	4
Cattle	72	18	10	74	22	4	70	26	4

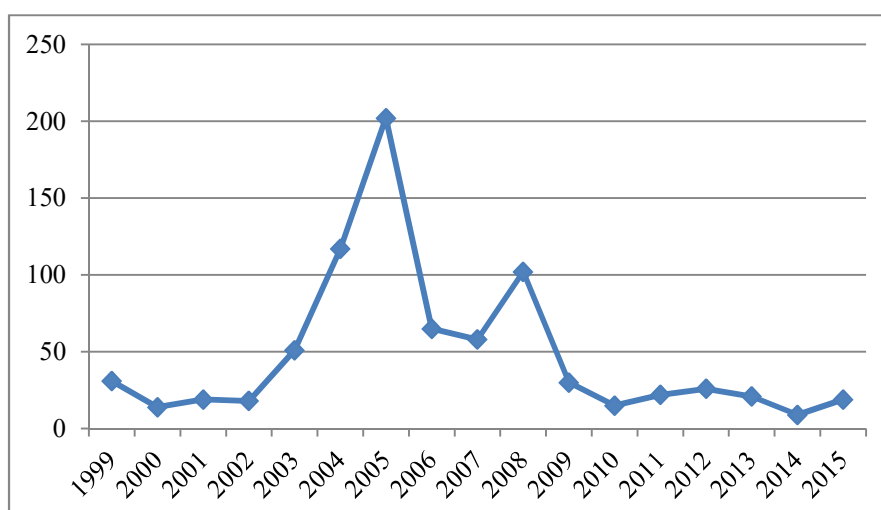
Source: Elaborated by authors with data from PNAD (1998, 2003, and 2008).

Table 4
Incapacity of Completing Some Task, 1998, 2003 & 2008

		Rio Grande do Norte		North East		Brazil	
		Yes	No	Yes	No	Yes	No
1998	Activity						
	Banana	0	100	8	92	8	92
	Sugar Cane	7	93	4	96	4	96
	Manioc	17	83	6	94	7	93
	Maize	0	100	6	94	7	93
	Horticulture	4	96	4	96	8	92
	Other Crops	6	94	5	95	6	94
	Ranching	3	97	5	95	6	94
2003	Maize	10	90	8	92	7	93
	Sugar Cane	0	100	5	95	6	94
	Manioc	9	91	6	94	6	94
	Temporary Crops	8	92	7	93	7	93
	Horticulture	10	90	7	93	9	91
	Banana	4	96	10	90	8	92
	Permanent Crops	9	91	7	93	7	93
	Cattle	5	95	8	92	7	93
2008	Maize	14	86	9	91	10	90
	Sugar Cane	0	100	6	94	7	93
	Manioc	16	84	9	91	10	90
	Temporary Crops	9	91	9	91	9	91
	Horticulture	19	81	11	89	11	89
	Banana	0	100	9	91	9	91
	Permanent Crops	14	86	9	91	8	92
	Cattle	7	93	5	95	8	92

Source: Elaborated by authors with data from PNAD (1998, 2003 and 2008)

Figure 2: Number of Work-Related Accidents Registered for Temporary Crop Activities in Rio Grande do Norte, 1999 - 2015



Source: Ministry of Pensions and Social Assistance, 2017

As pointed out earlier, producers emphasize that the buyers' main requirements about standards of certification is the amount of chemical residues on fruits. Despite the buyers' claims about other standards such as work safety and social aspects, the main concern for producers is quality of the fruit for consumption, as non-compliance would lead to a cancellation of the sale and can open a process of breach of contract and a notice of adjustment of conduct.

Thus, certifications appear to have controversial and mixed impacts on agricultural production in Rio Grande do Norte. On one hand, as argued by Bain (2010), there is a clear tendency for sectors with strong levels of certification to be linked to international commodity chains, with consequently higher levels of employment volatility, leaving workers more vulnerable to income instability. On the other hand, these same sectors have presented improved health conditions and workplace safety, primarily through the function of certifications as barriers to participation in agricultural markets, obliging producers to comply with safety and health norms (which should not be taken to suggest that the impact of certifications is necessarily so broad). In the case of fruit production in Rio Grande do Norte, health and occupational safety levels have improved to a greater extent than those of other economic activities in the region. This conclusion was derived both from interviews conducted with agents involved in fruit production in Rio Grande do Norte, as well as from aggregate data from the PNADs. Nonetheless, fieldwork involving direct interviews with workers would be a necessary and important contribution, given that these questions are specific and difficult to analyze using only aggregated data sources.

Final Considerations

This study sought to examine the role played by TPCs in the coordination of agricultural markets, as well as how these certifications have impacted labor relations and working conditions. Furthermore, the analysis drew upon a substantial body of secondary literature in order to better understand the origins of these certifications and their articulation along GVCs.

Agricultural markets have undergone a profound transformation, through which supermarket chains have come to play a central role in coordinating international markets and altering relations with producers. In this new market environment, producers of fresh fruits offer high value products for consumers, leading diverse agents along the fresh fruit value chain to coordinate actions in order to satisfy precise demands and specifications. Within this context, certifications have played a crucial role in guaranteeing intrinsic, hard-to-measure product quality, and guaranteeing the capture of quasi-rents. These certifications are private seals created by retail chains, but which depend on the participation of public organizations to assure their extension and applicability.

The impact of these certifications on agricultural value chains has been a topic of much discussion within the context of market liberalization, globalization, and flexibilization of working conditions. Some authors have argued that certifications reinforce employment precarization by inflating transaction costs and leading producers to pursue more flexible institutional arrangements, thus prejudicing workers and income stability. On the other hand, some authors have pointed to the benefits to health and occupational safety associated with adoption of certifications, including reductions in exposure to pesticides and unhealthy working conditions.

In the case of fresh fruit production in Brazil, and specifically in the Northeast and the Açú-Mossoró region of Rio Grande do Norte, this study identified some notable trends associated with the adoption of certifications introduced by supermarkets. Workplace safety and health conditions appear to have improved according to workers' reported perceptions. Despite important roles played by labor unions, it is evident that the reorganization of production chains was mostly the result of demands by powerful upstream agents, supported by federal labor legislation. This fact highlights the low level of bargaining power wielded by labor unions in strategic negotiations, where they have achieved little acknowledgement of their demands.

Even so, working conditions today are better than they were at the beginning of the 1990s, though it remains possible to identify major deficiencies that as Apolinário et al. (2018) demonstrate impede consideration of employment in fruit production in the region as decent work. Furthermore, the increased

flexibilization associated with linkages to international markets tends to conceal (often by means of subcontracting) situations that violate certification requirements. Finally, it is important to note that the current focus of the certifications is quite narrow, with most attention going to reduction in exposure to pesticides.

Observing the dynamics of the labor market as a whole, it is evident that it is characterized by high levels of volatility and a tendency toward declines in the number of workers employed. This in turn leads to a grave restriction on incomes in the Northeast, which is already a region characterized by low levels of economic dynamism and few opportunities for paid employment in the agricultural sector. In the context of the crisis through which Brazil is currently passing, these problems are only likely to get worse.

In sum, certifications have exerted a dual impact on the agricultural labor market. They have guided the consolidation of minimal levels of normalized employment relations between producers and agricultural laborers, but as of yet have proven unable to reach more significant levels of coverage or impact. In order to understand these dynamics more precisely, applied studies should be conducted to isolate the effects of certifications within the melon production supply chain and directly assess their impacts on working conditions.

References

- Almeida, F., Pessali, H. F., and de Paula, N. M. 2010. "Third-party Certification in Food Market Chains: Are You Being Served?," *Journal of Economic Issues*, 44(2): 479–86.
- Apolinário, V., Penha, T., Matos Filho, J., and Amaral, L. 2018. "Organization of Production and Working Conditions in the Global Agrifood Systems: the Production of Melon in the Semi-arid Region of Rio Grande do Norte (Northeast/Brazil)," *In: Christoph Scherrer and Santosh Verma (eds), Decent Work Deficits in Southern Agriculture: Measurements, Drivers and Strategies*, Augsburg: Rainer Hampp Verlag pp. 34–58.
- Asfaw, S., Mithöfer, D., and Waibel, H. 2010. "Agrifood Supply Chain, Private Sector Standards, and Farmers' Health: Evidence from Kenya," *Agricultural Economics*, Vol. 41(3&4): 251–63.
- Bain, C. 2010. "Structuring the Flexible and Feminized Labor Market: Global G.A.P. Standards for Agricultural Labor in Chile," *Signs: Journal of Women in Culture and Society*, 35(2): 343–70.
- Barzel, Y. 1982. "Measurement Cost and the Organization of Markets," *The Journal of Law and Economics*, 25(1): 27–48.
- Belik, W. & N.A. Chaim. 1999. "Formas híbridas de coordenação na distribuição de frutas, legumes e verduras no Brasil," *Revista Cadernos de Debate*, 7:1–9.
- Belik, W. 2007. "Agricultura, concentração no setor da comercialização e novos espaços para a distribuição de produtos frescos," *Revista Economia Ensaio*, 22(1).
- Burbach, R. & P. Flynn. 1980. *Agribusiness in the Americas [Latin America; USA]*. New York: Monthly Review Press.
- Busch, L., and C. Bain. 2004. "New! Improved? The Transformation of the Global Agrifood System," *Rural Sociology*, 69(3): 321–46.

- CAGED. Cadastro Geral de Empregados e Desempregados. Disponível em:
<http://bi.mte.gov.br/eec/pages/consultas/evolucaoEmprego/consultaEvolucaoEmprego.xhtml#relatorioSetor>. Accessed on 8 October 2017.
- Dolan, C., and J. Humphrey. 2000. "Governance and Trade in Fresh Vegetables: the Impact of UK Supermarkets on the African Horticulture Industry," *Journal of Development Studies*, 37(2): 147–76.
- Ehlert, C. R., D. Mithöfer, & H. Waibel. 2014. "Worker Welfare on Kenyan Export Vegetable Farms," *Food Policy*, 46, 66–73.
- Farina, E. M. M. Q. and T. Reardon. 2000. "Agrifood Grades and Standards in the extended Mercosur; Their Role in the Changing Agrofood System." Annual Meeting of AAEA Tampa Florida.
- Friedmann, H. 1992. "Distance and Durability: Shaky Foundations of the World Food Economy," *Third World Quarterly*, 13(2): 371–83.
- Gereffi, G., J. Humphrey, & T. Sturgeon, T. 2005. "The Governance of Global Value Chains," *Review of International Political Economy*, 12(1): 78–104.
- Gereffi, G., & J. Lee. 2016. "Economic and Social Upgrading in Global Value Chains and Industrial Clusters: Why Governance Matters," *Journal of Business Ethics*, 133(1): 25–38.
- GLOBALG.A.P.. 2017. Available at:
http://www.GlobalG.A.P..org/.content/.galleries/documents/160506_Fruit_and_Vegetables_Booklet_en.pdf. Accessed on October 2017.
- Hatanaka, M., C. Bain, & L. Busch. 2005. "Third-party Certification in the Global Agrifood System," *Food Policy*, 30(3): 354–69.
- Henson, S., O. Masakure, & J. Cranfield. 2011. "Do Fresh Produce Exporters in Sub-Saharan Africa Benefit from GlobalG.A.P. Certification?" *World Development*, 39(3): 375–86.
- Jha, P. & A. Chakraborty. 2014. "Post-fordism, Global Production Networks and Implications for Labor—Some Case Studies from National Capital Regime India." ISID Working Paper 172. New Delhi.
- Klein, B., R.G. Crawford, and A.A. Alchian. 1978. "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process," *Journal of Law and Economics*, 21(2): 297–326.
- Langlois, R.N. & Nicolai J. Fos. 1998. "Capabilities and Governance: The Rebirth of Production in the Theory of Economic Organizations." Working Paper, DRUID97(2).
- Marcato, M., & C. T. Baltar. 2017. "Economic and Social Upgrading in Global Value Chains: Concepts and Metrics." Available at:
<http://www.eco.unicamp.br/docprod/downarq.php?id=3557&tp=a>
- Marsden, T. et al. 2001. "The Road towards Sustainable Rural Development: Issues on Theory, Policy and Research Practice," *Journal of Environmental Policy & Planning*, 3: 75–83.
- Matos Filho, J., T. Penha, E.M. Nunes, F.S.S. Oliveira, J. G. Antunes. 2016. "Public Policy and Decent Work in Global Agrifood Systems: Melon Case Study in the State of Rio Grande do Norte/Brazil". Johannesburg: XI Global Labor University Conference.
- Ménard, C. and P. G. Klein. 2004. "Organizational Issues in the Agrifood Sector: toward a Comparative Approach," *American Journal of Agricultural Economics*, 86(3): 750–55.
- Milone, P. 2009. *Agriculture in Transition: a Neo-institutional Analysis*. Uitgeverij Van Gorcum.
- Ministério da Previdência e Assistência Social. 2017. Base de dados históricos de acidentes de trabalho. Available at: <http://www3.dataprev.gov.br/aeat/inicio.htm>. Accessed at October.
- Nicolas, F. and E. Valceschini 1995. *Agroalimentaire: une économie da la qualité*. Paris: INRA-Economica.

- Oya, C. 2015. “Decent Work Indicators for Agriculture and Rural Areas. Conceptual Issues, Data Collection Challenges and Possible Areas for Improvement”.FAO Statistics Division, Working Paper Series ESS/15-10.
- Penha, T., W.Belik, J. Matos Filho, and G. Oliveira. 2018. “Measuring Value Capture along the Brazilian Melon Value Chain,”in Christoph Scherrer & Santosh Verma(eds), *Decent Work Deficits in Southern Agriculture: Measurements, Drivers and Strategies*. In: Christoph Scherrer and Santosh Verma (eds), *Decent Work Deficits in Southern Agriculture: Measurements, Drivers and Strategies*, Augsburg: Rainer Hampp Verlag, 106-132.
- Raupp, A. 2010. “Transformações no sistema agroalimentar: novas e velhas possibilidades para a agricultura familiar,”Anais do IV Encontro da Rede de Estudos Rurais: Mundo rural, políticas públicas e atores em reconhecimento político.
- Sylvander, B. 1995. Conventions de qualité, marchés et institutions: le cas des produits de qualité spécifique. *Agro-alimentaire: une économie de la qualité*, 167–83.
- Valceschini, E. and E. Berthet. 2005. “Product Quality and Agrifood Markets: Scientific Knowledge and Research Perspectives,” *European Review of Agricultural Economics*, 32: 3.
- Valceschini, E., & F. Nicolas. 1995. La dynamique économique de la qualité agro-alimentaire. In: Nicolas, F. and E. Valceschini (eds.) *Agroalimentaire: une économie da la qualité*. Paris: INRA-Economica, 15–37.
- Wilkinson, J. 2008. Mercados, redes e valores: o novo mundo da agricultura familiar (No. 338.13). UFRGS.

Part III: Occupational Safety and Health on Smallholdings

9. Occupational Health, Risk and Vulnerability: Conditions of Farm Labour on Independent Tea Plantations in India

Debdulal Saha

Traditionally, tea is grown in large plantations across hundreds of hectares of land in rural areas in India. Tea workers on these plantations are covered by the Plantation Labour Act of 1951 and other Acts such as the Industrial Disputes Act of 1947. Besides stipulating provisions such as ensuring decent employment conditions, the Plantation Labour Act entails chapters on occupational health and safety (OHS) issues. The Act also made healthcare facilities mandatory. However, OHS obligations of employers are not concretely specified, often not applied in practice, or adequately enforced by labour inspectors (Saha et al., 2019). Therefore, tea plantation workers are suffering from acute decent work deficits in terms of health, wage, welfare benefits, and education for workers' children (Saha et al., 2019).

A trend in the making since a few decades has aggravated occupational health risks for tea plantation workers. While the area covered by large-scale tea plantations has shrunk, the area cultivated by self-employed tea cultivators has grown. These so-called small tea growers (STGs) account for almost 36% of the total tea production (2014) in India (CEC 2019). These peasant farmers, possessing a maximum of 10.12 ha of land for growing tea leaves, cultivate their own land either using family labour or employing wage labour. They sell leaves either to Bought Leaf Factory (BLF) or to tea estates through green leaf agents. While large plantations suffer from low prices set at auctions, small growers receive even lower prices for their tea leaves. The small growers respond with cutting down on labour costs to minimize costs of production. In general, the small tea planters fail to take any meaningful measures to protect their workforce against OHS risks. Their lack of attention is not only visible from the inhumane working conditions prevalent in the plantations but also the unhygienic living conditions in which workers toil. Tea plantation workers face a number of occupational hazards owing to physical, biological, chemical, and socio-psychological factors. Notably, the Plantation Labour Act is not applicable to farm labour engaged in small tea plantations. Against this backdrop, the present chapter focuses on occupational health, safety, and risks associated with the plantation workers who are working for the STGs in Assam and West Bengal, two of the major tea producing states of India, and their experiences to understand their vulnerable position.

A mixed methods research approach was adopted to carry out the study. A survey was conducted with 400 wage workers drawn purposefully at random from the important tea growing states Assam and West Bengal during 2017–18.

These states differ in the composition of the workforce between smallholders and plantation labourers (see below). A semi-structured schedule was used to conduct the interviews. Along with growers and casual workers, key informants from growers and workers from each district, government officials and leaders from different associations and societies from both the states were interviewed. A total of five group interviews each from Assam and West Bengal, and five focused group discussions each from Assam and West Bengal were performed with farm labour during primary data collection. This helped to understand the phenomenon and common issues among these casual workers.

The chapter is organized into seven sections and an introduction. The introduction section provides a context of the study and methodology adopted in the study. Governance of safety and health at the global, national and local levels of the tea plantation are discussed in the first section. The second section discusses on the existing employment structure and different labour market institutions within tea plantations. Social background based on primary data elaborated in the third section. The causes and symptoms of occupational hazards of farm labour in tea plantation are discussed in the fourth section while health issues of women and children are elaborated in the fifth section. The sixth section elucidates the availability and accessibility to health services in the tea plantation. The concluding section discusses how governance structure should be followed in the alternative model of plantation, implementing authorities and also what are the measures to be taken at various levels – global, national, and local – to address issues related to health, safety and occupational hazardsexperienced by farm labour under tea plantation economy.

Governance of Safety and Health at Global, National and Local Levels

The ILO has several conventions, recommendations and codes of practice to ensure OHS measures of workers across different sectors (see introduction to this volume). Out of the conventions and recommendations of ILO, India has not ratified any in the context ofOHSmeasures in agriculture in general, and specifically in plantation. There is a national framework to govern OHSmeasures in plantation sector; the Plantations Labour Act, 1951 puts forward several provisions regarding working conditions, sanitation facilities provided at workplace, maintaining safety provisions at work, taking preventive and protective measures for health at work, etc. The Act contains provisions for protective clothing and equipment like umbrellas, boots, aprons, goggles, masks, and others that protect the workers at work. The Act was further amended in 2010 to include provisions regarding health and safety of workers spraying pesticides and using other chemicals. Yet, these are seen to be glossed

over in most of the large tea plantations let alone practiced among small growers.

The Safety and Health in Agriculture Convention, 2001 (No. 184) specifies rights and duties of employers and workers with respect to OHS issues in agriculture and establish preventive and protective measures. Though these conventions and recommendations repeatedly highlight the importance of training and awareness programs targeted at workers, in reality, such programs are hardly available for the plantation workers. The tea plantation workers, trapped in their enclave economies, are debarred from such programs, hence, they remain even unaware about the issues confronting their safety and health (Saha et al., 2019). The management does not inform workers on safety and health matters.

The ILO's convention on Occupational Health Services Convention, 1985, lays out in Article 5 a range of functions as being integral to occupational health services, such as "a) identifying and assessing risks from health hazards in the workplace, (...) g) promoting the adaptation of work to the workers, h) contributing to measures of vocational rehabilitation, (...) and k) participation in analysis of occupational accidents and occupational diseases" (ILO, 1985). In the context of tea plantation workers, both academic and policy research is mostly stuck in the first stage. There is hardly any attempt to go further in the functions laid by the convention.

The Labour Inspection (Agriculture) Convention (No. 129) has provision for labour inspectors, "to secure the enforcement of the legal provisions relating to conditions of work and the protection of workers while engaged in their work, such as provisions relating to (...) safety, health and welfare, (...) " (ILO, 1969). Even the Plantation Labour Act, 1951, has guidelines for the labour inspector to look after the health and safety of workers but in most of the cases, these inspectors are usually seen to be absent or ineffective.

Employment Structure in Traditional Plantations

In tea large tea estates, there are broadly two types of non-standardized employment relations, one group directly employed by the tea estates, like that of temporary/*faltu*⁷ labourers, and the other of contract labourers who are hired through a contractor. Hence, there is heterogeneity in employment relations in tea estates not only in terms of standardized and non-standardized employment relationships but even within the non-standardized gamut. The temporary

⁷ It is popularly referred to as useless workers in the tea industry who are hired during peak session.

labourers are enrolled in the estates' payroll; hence, they are entitled to receive pay slips, wages, provident funds, rations, fuel, and benefits similar to those received by permanent workers, except a few additional benefits like annual pay, festival advances, and bonuses (Saha et al., 2019).

The contract workers, on the other hand, are either hired through a contractor or the locals from the same/nearby areas who approach the management directly. The estates only deal with the contractors, who often claim to be government-approved licensed contractors, and pay them a lump sum as wages for labourers. The contract explicitly prohibits the contractor from hiring an adolescent or a child as a labourer. These contract labourers are not entitled to any benefits that are obtained by the temporary/*faltu* labourers. While temporary workers, who usually belong to families of permanent labourers, are entitled to access basic facilities and provisions, contract labourers do not receive any such benefits. Both residential and non-residential labourers are entitled to receive health benefits for injuries of any sort during work, though it is mandatory for them to work for at least 90 days to be eligible for such benefits.

Tea workers on these plantations are covered by the Plantation Labour Act of 1951 and other Acts such as Industrial Disputes Act, 1947; Factories Act, 1948; Trade Unions Act, 1926; Payment of Wages Act, 1936; Minimum Wages Act, 1948; Maternity Benefit Act, 1961; Payment of Bonus Act, 1965; Equal Remuneration Act, 1976; Payment of Gratuity Act, 1972; Workmen's Compensation Act, 1923; and Employees Provident Fund and Miscellaneous Act, 1952. Besides stipulating provisions such as ensuring decent employment conditions, maintaining harmonious industrial relations, and providing economic as well as social security, Chapter III entitled 'provisions as to health'; Chapter IVA on 'provisions as to safety' and Chapter VIA on 'accidents' of the Plantation Labour, Act 1951 emphasized on mandatory healthcare facilities and safeguard workplace hazards. In Assam, the Assam Plantations Labour Rules, 1956 was brought separately to implement the Act effectively. Later, the Plantations Labour (Amendment) Act, 2010 was also introduced further to amend the Plantations Labour Act, 1951.

As mentioned earlier, despite being covered under national legislation, strict provisions for maintaining OSH are not specified, often not applied in practice, or adequately enforced by labour inspectors in the industry (Saha et al., 2019). Looking at health conditions, wage payment, access to welfare benefits, and workers' children education, it can be argued that there is an acute decent work deficit among the workforce in large plantations (*ibid.*). The occupational health risks are prevalent in plantations not only due to poor access to public health but also inferior quality of healthcare services (Saha et al. 2019; Columbia Law School 2014).

Social Background of Farm Labour in the Sample

There are no statistics related to farm labour involved in small tea plantations, not even with the tea board of India. From the NSSO data, we can see the trend at the macro level. Methodologically, the share of plantation growers is included in the category of ‘market gardeners and crop growers’ whereas plantation workers are enumerated⁸ within the category of ‘agricultural, fishery and related labour’. If we analyse the data on the share of planters/smallholders and plantation labourers in rural Assam and West Bengal, it shows an interesting contrast. While in Assam around 47% are planters/gardeners and about 13% are plantation workers, their shares in West Bengal are 18% and 37%, respectively (see Table 1). It can be assumed that a considerable portion of family labour as farm labour is engaged in plantations in Assam whereas a significant number of casual as well as regular wage workers is engaged in plantations in West Bengal.

Table 1: Share of Planters/Smallholders and Plantation Labourers and their Landholding across Districts in Rural Assam and West Bengal

District	Share of Planation worker (in %)	
Assam	46.7	12.7
West Bengal	18.0	37.0

Source: NSSO 2011–12.

We have presented a combined outcome of primary survey⁹ drawn from Assam and West Bengal in this section as the concerns and issues follow the similar pattern. Our sample of farm labour involved in independent tea plantation comprises 135 male workers (33.75%) and 265 female workers (66.25%). Around 83.3% workers have tea plucking as their primary occupation while 10% undertake tea cultivation. Only a small percentage of workers were found to have other occupations as their primary occupation; for example, 0.5% is engaged as petty commodity producers in a small shop at the village, 4% are contract labourers, and 2% tea factory workers. By religion, around 75.5% workers are Hindus, 16.5% are Muslims, 4.75% and 2.75% are Christians and Sikhs, respectively, combining both the states of Assam¹⁰ and West Bengal¹¹.

⁸ Table 1 is computed based on employment and unemployment data of National Sample Survey Office (NSSO) round of 2011-12 considering 3-digits of National Classification of Occupations (NCO).

⁹ A sample of 178 farm labour was considered from Assam and 222 were considered from West Bengal.

¹⁰ In Assam, as per Census 2011, Hindus make up the majority which constitute 61.47% of Assam population, and majority religion in 18 out of 27 districts of Assam state. Muslims form 34.22% of total population and Islam is followed with majority in

Share of Hindus in the sample shows above state-level average, both in Assam (61.47%) and West Bengal (70.54%) as per Census 2011. On the other hand, as per the Census 2011, Muslims in the sample of primary survey, shows below the state-level average considering both the states of Assam (34.22%) and West Bengal (27.01). Interesting, Christians constitute 4.75% of the total sample, which is higher than state-level average both in Assam (3.74% as per Census 2011) and West Bengal (0.72% as per Census 2011). The reason of domination of Hindus and Christians in our sample is that majority of farm labourers are Adivasis (original inhabitants). These Adivasi workers both in Assam and West Bengal are either Christians or Hindus.

The Adivasis often referred as ‘Tea Tribes’ in Assam, comprising 96 sub-groups, are largely of central India origin (mainly Chhotanagpur) who already have Schedule Tribe (ST) status in the states they came from. Nonetheless, in Assam, they are clubbed together as “Tea garden labourers, tea garden tribes, ex-tea garden labourers, and ex-tea garden tribes” (Zahan, 2016); and administratively, they are referred to as More Other Backward Classes (MOBCs). While Adivasis in West Bengal belong to ST, they are still struggling to get the status of ST in Assam. With regard to caste composition, in Assam and West Bengal together, around 87.6% of the total respondents belong to any of the categories of SC/ST/OBCs/MOBCs, about 26% of the sample respondents fall into SCs (Scheduled Castes). If we compare, the share of SC population in the sample is higher than the state-average levels in Assam (7% as per Census 2011) and West Bengal (23% as per Census 2011). The Scheduled Tribe (ST) population accounts 16% share of the total sample workforce (see Table 2) which is slightly higher than state-level average for selected states. As per Census 2011, in Assam, 12.4% of the total Assam population and 5.8% of the total population of West Bengal comprise Scheduled Tribes (ST). In the sample, around 45.8% workers have reported that they belong to OBCs (Other Backward Classes) or More OBCs (MOBCs) which is more than Assam and West Bengal state-level average¹². From the primary data, one can argue that

9 out of 27 districts in Assam. Christian, Sikh and Buddhist constitute of about 3.74%, 0.07%, and 0.18%, respectively.

¹¹ In West Bengal, religion Census 2011 shows that Hindus form the majority, constituting 70.54% of West Bengal population and majority of them are in 16 out of 19 districts of West Bengal state. Muslims constitute of 27.01% of total population and majority in 3 out of 19 districts. Christian, Sikh and Buddhist constitute of 0.72%, 0.07%, and 0.31% of state population, respectively.

¹² As per National Sample Survey Office (NSSO), 2011–12 41% of India’s total population belongs to Other Backward Classes (OBCs) whereas 25.3% of the total Assam state population belong to OBCs, and 8.7% belong to OBCs in West Bengal. Notably, the Government of India has not enumerated OBC population in Census as yet; it is declared that OBC population will be enumerated in 2021 Census.

farm labourers in tea plantations are at margin as far as social and demographic compositions are concerned comparing state-level averages in Assam and West Bengal (see Table 2).

Table 2: Social Profile of the Sample of Farm Labour in Independent Tea Grower's Plantations

Indicators		Sex		Total
		Female (%)	Male (%)	
Primary Occupation	Contract labour	1.5	9.6	4.2
	Kirana shopowner	0	1.5	0.5
	Tea cultivator	6.8	16.3	10
	Tea factory worker	1.9	2.2	2
	Tea Pluckers	89.8	70.4	83.3
Religion	Hindu	78.1	70.4	75.5
	Muslim	14.3	20.7	16.5
	Sikh	3.4	1.5	2.7
	Christian	3.4	7.4	4.7
Educational Qualification	Illiterate	57.7	31.8	49
	Can sign only	25.3	42.9	31.3
	Upto V	15.1	20.7	17
	Upto Secondary	1.5	4.4	2.5
	Graduate	0.4	0	0.2
Caste	General	13.1	9.6	12.5
	Scheduled Castes	28.7	20	25.8
	Scheduled Tribes	16.6	14.8	16
	Other Backward Classes (OBCs)/ More OBCs (MOBCs)	40.7	55.6	45.8
Age Distribution	Below 18	27.9	23.7	26.5
	18-25	39.2	40.7	39.8
	25-35	20.7	24.4	22.0
	35-45	8.7	7.4	8.3
	45-70	3.4	3.7	3.5

Source: Based on Fieldwork; N=400 (M=135, F=265)

On educational attainment, about 75% are functionally illiterate and 20% has completed primary education. In age distribution, about 26% is below 18 of which majority are below 14 and 2.5% is above 65 years of age. Since farm labour, constituting children and elderly persons as well, is constantly subjected to the direct exposure of sun rays, fertilizers, pesticides, and other chemicals during plantation throughout the year, this is a matter of concern (see Table 2).

Occupational Hazards on Tea Plantation: Causes and Symptoms

The most frequent hazards in agriculture relates to chemicals, use of machinery, toxic or allergic agents, carcinogenic substances or agents, transmissible animal diseases, confined spaces, ergonomic hazards, extreme weather conditions, contact with wild animals, and so on (ILO, 2000). The huge workforce engaged in agriculture in developing and least developed countries often face issues on account of heavy physical work combined with pesticide poisoning, organic dust, and occupational accidents. Agriculture has been claimed to be the most hazardous occupation worldwide where, as per ILO estimates, out of 335,000 fatal workplace accidents worldwide, around 170,000 deaths occur among agricultural workers (ibid.). In certain countries, occupational factors are further affected through other non-occupational factors like climate, level of education, training, parasitic diseases, poor hygiene and sanitation facilities, poor nutrition, and so on. Most cases, in the context of occupational accidents and diseases, are not reported owing to the scattered nature of agricultural practices and inadequate recordings and notifications system maintained.

Table3: Physical Hazards

Indicator	Physical Hazard	Percentage of Cases (%)
Physical stress	Back-pain	78.3
	Tiredness/fatigue	72.2
Averse climate	Dehydration	34.4
	Heat Cramps	20.0
	Heat Exhaustion	42.8
Pesticide related	Irritation of the eyes	33.3
	Breathing problem	23.9
	Allergic reactions	27.8
Workplace (Garden)	Insects	16.7
	Spiders	23.3
	Scorpions	3.3
	Snakes bite	2.2
	Injuries	15.0
	Cuts and bruises	32.8

Source: Computed by author based on fieldwork where N=400

On independent tea plantation, the present study shows major health problems which include headache owing to long working hours in scorching heat; body pain because of standing for long hours and carrying heavy loads of plucked leafs; injuries caused by bites from poisonous insects; anaemia, hypertension, respiratory diseases, cough, abdominal disorder, chest pain, and so on. Occupational hazards among small tea plantation workers are evaluated under

chemical hazards, biological hazards, physical hazards, and psychological hazards (see Table 3). The analysis is based on multiple responses from the labour.

Chemical hazard compounds are in the form of solid, liquid, gases, mists, dusts, fumes, and vapors which exert toxic effects through inhalation, absorption, or ingestion (WHO, 2002). Injuries resulting from exposure to agro-chemicals like pesticides and fertilizers depend on the type of crop cultivated, agro-chemical used, individual's susceptibility, mode of application, and so on. As Jeyaratnam (1990) depicts, on an average, 3% agricultural workers in developing countries suffer from pesticide poisoning a year and most of these cases are either not recorded or patients do not seek medical treatment.

Acute pesticide poisoning is seen among tea plantation workers as they are highly exposed to different pesticides. Chemicals are used on plantation mainly to kill red spiders and mosquitoes that in turn, makes these workers vulnerable to a series of pesticide-infected diseases. Most of the growers tend to provide cheaper, poor quality pesticides, which are not listed in the Plant Protection Code (PPC), to reduce cost of production. Further, STGs neither follow nor are aware about the quantities of pesticide to be used. The expenditure on pesticide is seen to be highest among STGs possessing land of 3 to 25 acres in both Assam (7.71%–8.3% of the total cost) and West Bengal (13.33%–18.75%). Workers are not provided any protective equipment like goggles, gloves, aprons, or masks that would protect them from coming in contact with pesticides and chemicals. Around 33% small tea plantation workers reported irritation in the eyes because of constant exposure to such chemicals and pesticides. The issues emerging through exposure to pesticides and chemicals also manifest in respiratory, neurological, gastrointestinal, and renal disorders. Amongst sample respondents, 24% workers experience breathing problems while 28% workers are claimed to be suffering from allergic reactions.

Physical hazards involve excessive levels of noise, vibration, illumination, temperature, and ionizing and non-ionizing electromagnetic radiation (WHO, 2002). Tea plantation workers also identified other reasons like exposure to excessive heat owing to lack of proper shelter close to their workplace, musculoskeletal disorders because of uncomfortable postures, and lifting of heavy bags for leaf collection, use of ergonomically inappropriate tools, and so on. Backpain is one such common problem across all plantations. Around 78.33% workers, engaged in small tea plantation, seem to be suffering from this issue, as evident from this study.

Tiredness/fatigue is another highly witnessed symptom among around 72% workers. The workers are seen to be working in the open thereby, exposing

them to wind, rain, heat and even ultraviolet radiations that have long-term implications. Some of the effects of exposure to these climatic conditions can lead to respiratory infections, sunstrokes, dehydration, fainting, and so on. Working under the sun for long hours and lack of proper drinking and sheltering facilities lead to dehydration among workers and it is seen among around 34% workers in small tea plantations, with 20% reporting to have suffered from heat cramps and 43% from heat exhaustion at work.

Biological hazards are caused by exposure to bacteria, fungi, viruses, and other living organisms, which might lead to fungal infections, malaria, tuberculosis, etc. Occupational accidents and injuries caused by use of equipments, attack of poisonous insects, snakes, spiders, and so on are common among tea plantation workers. Around 17% and 23% workers suffer from insects and spiders at their workplace, respectively. This is because they are not provided with boots and gloves at work which one can find among large tea plantation workers. Most workers, who work in other large plantations, often carry their own protective equipments to work. However, as seen in this study, not much is found to be working simultaneously on both plantations. In addition, workers also suffer from scorpion and snake bites at workplace, especially during summer. In context to the research, around 3% and 2% workers have reported of being attacked by scorpions and snakes. In addition, workplace injuries, and cuts and bruises are reported by 15% and 33% workers, respectively.

With regard to psychological hazards, many studies revealed high levels of stress, work frustration, and others among tea plantation workers. Harassment by supervisors and co-workers is common in tea gardens, also using verbal and physical abuse to pressurise workers to meet targets and compelling them to work overtime (Faisal and Hossain, 2016). Intoxication among plantation workers is considerably high. Having little level of literacy rate and awareness regarding the same, these workers consume high quantity local alcohol that in turn has an adverse impact on their health. The present study depict high levels of alcohol and tobacco consumption among male and female workers in tea plantations and these issues are usually not addressed through any awareness programs for the workers. At the time of the fieldwork, some of the female farm labour reported about miscarriage during their pregnancy but we failed to establish any connection with occupational health issues as the respondents could not recollect the actual causes.

Health Issues of Women and Children in Tea Plantation

Women account for almost half of the world's agricultural workforce, yet their role has been traditionally underestimated (ILO, 2005). Women and children, even in tea plantations, are among the most vulnerable groups in the context of

occupational hazards and diseases. Female workers are primarily engaged in plucking tea leaves, while male workers handle pruning, cleaning, and spraying. However, some female workers are also involved in heavy work during pruning and cleaning. Lack of mechanical means during irrigation or ridging renders such tasks for women more difficult. Improper working conditions and unavailability of safety equipment make them more vulnerable to injuries and diseases. As ILO (2005) study shows the risks of miscarriages, premature deliveries, and abortions are related to exposure to pesticides and greenhouse microclimates. However, the hazards involved in tea plantation not only refer to issues that are visible like working in scorching heat and carrying weights but also latent concerns that often go unattended. The consequences of such issues are visible in the long run. Parental occupation is also seen to have an impact on child health owing to parents' negligence to provide timely feeding of children or inability to attend them during their illness. One important cause can be the lack of institutional arrangement, as most plantations do not have proper child care facilities or crèches as laid in the Plantations Labour Act, 1951. There is high prevalence of underweight and under nutrition among the children of tea garden workers including deficiency disorders.

Child labour in tea plantations serve as another group of concern with several studies reporting the vulnerability of this group towards occupational hazards. In the sample, around 26.5% of the workforce comprises workers below 18 years (see Table 3) and this shows a high prevalence of child and adolescent labourers even within small tea plantations. However, adolescents are allowed to pluck. These children are doing more or less similar tasks to that of the adults where certain tasks like spraying of pesticides can have serious repercussions on their health. This is especially dangerous for the children working alongside their families in their small plantations where generally no protective measures are provided or used. This is leading to constant exposure of children to hazardous chemicals and pesticides which have severe impacts on the health of any adult individual, let alone children. Children are more vulnerable to toxic exposure as they are more susceptible to absorb toxic substances easily and retain them longer that in turn can severely affect their physical and neurological development (ILO, 2011). Though the Plantations Labour Act, 1951 of the country has strict guidelines regarding employment of child labour, these are not seen to be followed in most of the cases and at least not at all among the small tea growers.

Availability and Accessibility to Health Services in Tea Plantation

The availability of healthcare services for large plantations is generally on paper and less in practice. Both in terms of availability and accessibility of health

services, there is a problem in providing services. Despite having strict provisions regarding health and safety facilities in the general plantation act and state-specific acts, these are not followed (Saha et al., 2019). There is either no availability of such provisions or even where it is available the facilities are mostly defunct especially medicine and also services at the dispensary or hospital (ibid.).

As far as Small Tea Growers (STGs) and farm labour are concerned, the provision on health is far distant. As mentioned, STGs are not covered under any legislation to govern health and safety measures at workplace. Even Planation Labour Act, 1951 is not applicable to them. There is a very callous attitude towards this domain where workers are left to look for their own health and safety. This is despite the fact that they themselves are not educated or aware enough to take the responsibility. The unavailability of healthcare facilities at work is also combined with lack of safety provisions among the workforce. Their deplorable working and living conditions make them vulnerable to all sorts of occupational as well as other non-occupational diseases. Inadequate dietary supply is also another factor, where being engaged in high physical labour, they cannot afford rich diet. Hence, undernutrition among adults as well as child and adolescent workers is common in tea plantations. Even after having access to subsidised food, it is claimed that the same is often of poor quality (Saha et al., 2019; Columbia Law School, 2014).

The supply of safety kits and equipment are considered as essential to minimize health risks, in addition to provision of toilets or urinals at workplaces, clean drinking water during work, rest rooms, and so on and so forth. However, these are generally not seen in most of the small tea plantations. Even in respect to health centers run by tea plantations, it has been claimed that the people are not skilled enough. They are mostly capable of providing first-aid services and the same medicines are prescribed for all diseases (Faisal and Hossain, 2016). Though labour cost comprise a large share in the total cost of production among all STGs (author based on primary fieldwork during 2016–18), yet no additional provision is made for safety and health expenses. When farmers were asked the question of providing safety measures to the farm labour, all the growers reported that safety measure will further add to the total labour cost as they cannot negotiate the cost of pesticides and fertilizers.

Besides unavailability of adequate healthcare facilities as required by legislation, workers' unawareness to their basic entitlements and rights make situation worse. The educational qualification of workers is extremely poor with a significant section of the workforce being illiterate (see above). This has been cited as a major problem by several trade unions to organise the workforce besides other reasons like legal restrictions, geographical isolation, and cultural

attitude (ILO, 2011a). It is currently being further aggravated through increasing casualisation of work where illiteracy and ignorance of workers' rights among migrant workers renders the task of organising difficult.

Conclusion

Small tea plantations alongside traditional large tea estates are emerging as an alternative model of the tea sector in terms of production and employment generation across Northeast India and other major tea-producing states. However, the concern is around lack of producing quality green leaves thereby growers receive low price from the tea estates or independent bought leaf factory (BLF). If these growers receive low price from the processing units, they pay low wage to the workers. There is a high dependency of the estates on the small tea growers as the estates purchase about 40% green leaves from these growers. Therefore, the estates along with tea board of India organise several training workshops with these growers on how to use pesticides and fertilizers as per PPC. Further, estates conduct such workshops and training under their Corporate Social Responsibility (CSR) programs targeting small and marginal farmers (possessing upto 6 acres of land). However, there is no such program that is designed for the plantation workers who primarily pluck leaves and engage in spraying, pruning, and other work in the gardens. As discussed, the plantation workers face multiple vulnerabilities not only in terms of socio-economic securities but also for their socio-economic and demographic background such as gender, caste, religion, educational attainment, and age. This is also mainly because workers are neither aware of their rights nor is there anyone to cater towards their welfare benefits. Most importantly, due to the low level of educational attainment and in absence of accessibility to state, workers often do not know their basic rights including preventive measures which are related to health. In view of identity and entitlements of Adivasis, the situation is even worse in Assam as there is no clear administrative status of these workers, who are thereby denied of their access to basic rights.

Labour welfare division of the tea board of India should incorporate these plantation workers and introduce various welfare measures for them. Notably, tea growers are primary stakeholders to implement preventive and protective measures for the workers. A number of global governance initiatives in the tea sector, like that of multi-stakeholder roundtables and certification schemes, have been introduced as part of product and process upgradations. Nevertheless, there is no discussion on the upgrading of these farm labourers. Although the Plantation Labour Act, 1951 is not effective as far as labour in the traditional plantation estates are concerned, it has been able to safeguard workers in the estates to a certain extent. Hence, Tea Board and respective state's department

of labour and employment should identify some key indicators related to welfare benefits from the Chapters (I, III, IV, IVA, V, VI, VIA) of the existing Plantations Labour Act, 1951; Payment of Wages Act, 1936; Minimum Wages Act, 1948; Maternity Benefit Act, 1961; Payment of Bonus Act, 1965; Equal Remuneration Act, 1976; and others, and make it mandatory for the tea growers to implement them. Further, Tea Board, estates and BLFs should organise training workshops with the workers along with independent growers on the usage of pesticides and fertilizers. Blood test, eye and skin tests should be organised on a regular interval for the growers and workers by various stakeholders and external agencies. Though national and international non-governmental organisations, trade unions, and grassroots organisations are campaigning towards health concerns for plantation workers since very long, buyers (companies such as Unilever and Tata), traders, retailers, and brands may introduce ethical business clearance from the BLFs and estates which should include maintenance of labour standard along with quality of product. Tea Board, in collaboration with respective state government, should come forward in providing business ethics certificate to growers who follow fair business in terms of appropriate use of pesticides and fertilizers as per PPC guidelines, providing minimum wage, and not appointing children in plucking or in any other activities which will enable them to receive the higher price on the green leaves. This will not only encourage growers to become more competent entrepreneurs but also ensure labour standards.

References

- Centre for Education and Communication (CEC). 2019. 'Tea Plantation Workers', Retrieved from <http://www.cec-india.org/our-work.php?wid=9>, accessed on 27 September 2019.
- Columbia Law School. 2014. "'The More Things Change . . .': The World Bank, Tata and Enduring Abuses of India's Tea Plantations". Retrieved from: https://web.law.columbia.edu/sites/default/files/microsites/human-rights-institute/files/tea_report_final_draft-smallpdf.pdf (Accessed in September 2014).
- Faisal, A. and Md. I. 2016. "A Study Report on Working Conditions of Tea Plantation Workers in Bangladesh", International Labour Organisation.
- International Labour Office (ILO). 2000. "Safety and Health in Agriculture. Programme on Safety, Health and the Environment", *SafeWork*, Programme on safety, health and the environment, Labour Protection Department, Geneva: International Labour Office.
- International Labour Organisation. 1969. "C129-Labour Inspection (Agriculture) Convention", Convention Concerning Labour Inspection in Agriculture. Retrieved from https://www.ilo.org/dyn/normlex/en/f?p=1000:12100:0::NO::P12100_INSTRUMENT_ID,P12100_LANG_CODE:312274,en:NO
- International Labour Organisation. 1985. "C161-Occupational Health Services Convention", Convention Concerning Occupational Health Services. Retrieved from: https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312306

- International Labour Organisation. 2011. "The Impact of Pesticide Exposure on Child Labourers in Agriculture", Retrieved from: https://www.ilo.org/global/about-the-ilo/newsroom/features/WCMS_158425/lang--en/index.htm
- Jeyaratnam. J. 1990. "Acute Pesticide Poisoning: A Major Global Health Problem", *World Health Statist Quart.* 43.
- Saha, Debdulal, R. Singha and P. Sharma. 2019. "Beyond Standard Outcomes: State of Employment and Labour in Tea Industry of Assam", in Virginius Xaxa, Debdulal Saha, and Rajdeep Singha (eds), *Employment and Labour Market in Northeast India: Interrogating Structural Changes*. London & New York: Routledge.
- World Health Organisation (WHO). 2002. "Occupational Health: A Manual for Primary Health Care Workers". Retrieved from <http://applications.emro.who.int/dsaf/dsa191.pdf>, accessed on 27/01/2019..
- Zahan, Syeda Ambia. 2016. "The Story of Adivasis in Assam", Adivasi Resurgence, 21 November. Retrieved from <http://www.adivasiresurgence.com/story-adivasis-assam/>, accessed on 20/01/2019.

10. Social Upgrading and Occupational Safety and Health: a Case of Pakistan's Mango Industry

Mubashir Mehdi and Bilal Ahsan

Occupational injuries are most pronounced in Pakistan's agriculture. Most of the agricultural workers are socially deprived and work in poor Occupational Health and Safety (OHS) conditions. According to recent household surveys, the sector's share in total injuries (48%) is higher than its share in total employment (42%; see Table 1; Khan, 2016). While industrial workers are covered by OHS measures, though insufficiently, none is concerned directly about agricultural workers (GoP, 2016). Over and above, no direct labor law exists for them in Pakistan and OHS standards and the bylaws are still in the developing phase (Ahmad, 2009; Ghani, 2012).

While high injury rate is to be expected, given the governmental neglect, the question arises whether this is also true for the agricultural export sector which has to comply with international standards. In fact, some sectors such as the horticultural industry have made significant inroads in international markets because of support by the Government of Pakistan and international development agencies such as USAID, UNIDO and the Australian Centre for International Agricultural Research (ACIAR). The success with premium quality products can be considered as a marker of a thriving economic upgrading (Mehdi et al., 2016). However, does this economic upgrading also translated into social upgrading, i.e., better pay and working conditions, as well as more voice for workers and effective OHS measures at the farm level?

Previous studies on the implementation of OHS standards have pointed out that such upgrading will fall short if the target group, i.e., the workers, have no say in the monitoring of OHS measures. On average, it is seen that unionized workers are better protected from OHS risks (Freeman 1984; Freeman and Rogers, 2006).

In order to find out whether access to export markets translates into social upgrading and whether unionization as a key element of social upgrading leads to better compliance with OHS standards, we have carried out a case study on the mango industry. While most of this industry serves the domestic market, its export section has seen strong growth in the last decade (see Fig. 1).

The exporters have to meet the GLOBALG.A.P. standard which includes prescriptions for OHS measures. Therefore, we have identified 15 certified mango orchards for interviews with farm workers, supervisors, and owners. In our study, we intended to identify whether social upgrading (unionization) led to implementation of OHS measures at the farm level. All physical OHS factors,

as prescribed by GLOBALG.A.P. were found to be positively and significantly correlated with social upgrading (unionization), independent of the size of the farm.

The chapter starts with an overview of the agricultural sector with particular focus on OHS issues. It moves on to economic and social upgrading strategies that address OHS issues in Pakistan's mango industry, and then discusses the challenges of adopting better OHS practices. Finally, it offers some recommendations for addressing OHS deficits in agriculture.

An Overview of Pakistan's Agricultural Sector

Pakistan is an agriculture-based country having a population of more than 200 million, two-thirds of which live in rural areas. Agriculture is said to be an engine for industrial growth and, therefore, is given high priority in development policies (GoP, 2013). Nearly, 43.5% of the total workforce is directly or indirectly involved in the agriculture sector. Rural areas have more than double share in total employment. Agriculture, including farming, fishing, and forestry contributed 18.9% of the overall GDP of the country followed by the services sector (56%) and industry sector (13.6%) (GoP, 2017). The government is focusing on supporting small and marginalized farmers by extending innovative technologies to improve the overall productivity of the sector. Some initiatives are taken by the government such as crop diversification, efficient use of water, and promotion of high-value crops. The crop sector performed well and witnessed a growth rate of 3.8% against the last five year's (2012-16) average growth rate of 1.5%. Specifically, the growth rate of the major fruit and vegetables crop has increased by 3.3% as a result of value addition mainly in fruit crops such as citrus and mango (GoP 2017).

One of the important factors of growth in the crop sector is the promotion of input supply by private companies. They introduced new chemicals on a regular basis and tell farm workers that it is comparatively unharmed to humans and environment. However, many workers reported a variety of diseases; some even died due to pesticide poisoning. Diseases like cancer, gastrointestinal infection, and tuberculosis are common among the farm workers. Despite advances in medicine during the last two decades, the general health of farm workers has worsened (Ahsan et al. 2018).

Moreover, due to rising mechanization and lack of appropriate skills to handle machines most of the agricultural workers have got occupational injuries like skin cuts, damaged organs, etc. An International Labor Standards unit (ILS) under the Ministry of Overseas Pakistanis & Human Resource Development was established with the help of the International Labor Organization (ILO) to

report on the adherence to different conventions in a timely fashion (Khan, 2016). However, OHS provisions are being implemented in Pakistan mostly for industrial workers, hence, none are affecting agricultural workers directly. In fact, no direct labor law exists for the farm workers in Pakistan and OHS standard bylaws are still in the developing phase (Ahmad, 2009). Consequently, around 48% of the total occupational injuries are directly related to on-farm workers as indicated in Table 1.

Table 1: Employment, injuries and GDP distribution per sector in Pakistan

Sector	Sectoral share in GDP (%)	Share of sector in total employment (%)	Incidence of occupational injuries by sector (%)	Sectoral share in total injuries
Agriculture/Forestry & Fishing	20.88	42.28	4.54	47.95
Mining & Quarrying	2.92	0.16	6.84	0.27
Manufacturing	13.27	15.34	4.15	15.90
Electricity & Gas	1.67	0.40	3.14	0.32
Construction	2.44	7.31	8.90	16.27
Wholesale & Trade	18.26	14.64	1.93	7.07
Transport, Storage & Information & Communication	13.36	5.40	5.60	7.57
Financial & Insurance	3.14	0.59	0.64	0.09
Others	24.06	13.89	1.31	4.55

Source: PBS (Pakistan Bureau of Statistics), 2016.

Economic Upgrading of Pakistan's Mango Industry

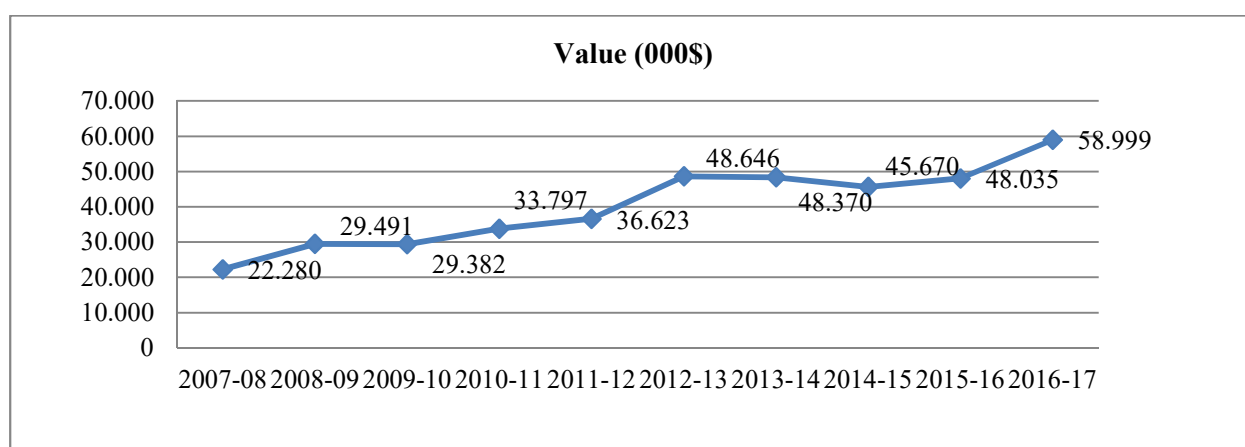
Pakistan's horticultural industry in general and its mango sector in particular showed a significant growth in the last one decade (as indicated in Fig. 1) due to various development projects undertaken by leading development organizations. An important mango program named "Australian-Pakistan Agriculture Sector Linkages Program (ASLP)" initiated in 2005 by the Australian Centre for international Agricultural Research (ACIAR) set out a great example of economic upgrading in mango value chain in Pakistan. Its objective was to provide market access to small and medium-size growers to high-value markets both in the local as well as international markets by building their capacity in adopting pre- and post-harvest best practices such as nursery management, disease management, harvesting, packaging, and logistics. These best practices inform the other development agencies' on-farm infrastructural support to mango growers so that they can adopt the best practices in more sophisticated manners. For example, USAID in association with the Agricultural Extension

Department and the Mango growers' union installed 15 state-of-the-art processing facilities in the key mango-producing areas of Sindh and Punjab.

The ASLP facilitated also the establishment of a high-tech mango post-harvest laboratory at the University of Agriculture Faisalabad. This lab has developed protocols for controlled atmosphere (CA) sea shipment for distant markets, for the first time in Pakistan. While using these facilities and technology, mango growers are able to build their direct linkages with high-end outlets both locally as well as in the international markets.

Mango exports are around 4% of the total production. The overall US \$ value increased steadily in the international market (as indicated in Fig. 1).

Figure 1: Export value of mango form Pakistan, 2007–17



Source: AMIS (Agriculture Marketing Information System), 2017.

The most important reason of Pakistani mangoes' popularity is its sweet taste and a beautiful golden color that has been consistently achieved under the mango value chain development initiatives, undertaken collectively by the International Development agencies with the collaboration of local government agencies.

Some of the growers-exporters who were supported by the development agencies as well as from the government agriculture department have been able to address the high-end markets such as TESCO, WALMAT, and METRO etc., in UK, the Netherlands, and UAE. They have successfully delivered premium quality mangoes on premium price and earned twice the profit than the traditional way of selling fruit in these markets (Mehdi et al., 2013). One of the main reasons behind the economic upgrading of their mango value chain is that they have upgraded their pre- and post-harvest management practices through skills upgrading and using state-of-the-art processing facilities on their farms. Some of them have been able to achieve certification such as GLOBALG.A.P.

OHS Requirements of GLOBALG.A.P. Certification System

Due to increasing pressure and market incentives for certified and standardized products, mango farms in Pakistan are acquiring international certification. International compliances like GLOBALG.A.P. certification emphasized on farm labor rights as well as OHS measures in terms of improved working conditions. Workers' health, safety, and welfare in the GLOBALG.A.P. certification system involve training for safe use of equipment, application of first aid, visual observation or identification of hazard signs, protection of clothing or uniforms, maintenance of proper sanitation facility and hygiene, worker's welfare, etc. The key characteristics of workers' safety and health, under GLOBALG.A.P. certifications are outlined here:

Health and safety training: The GLOBALG.A.P. farms are required to conduct health and safety training for their workers and there must be evidence of instructions and training record. It is essential to demonstrate competencies in responsibilities and tasks through visual observations. Some equipment is complex in its operations such as harvesters, processing machines, etc., which demand proper training to be operated.

Hygiene instructions: The written risk assessments for hygiene issues include production environment. The risk is associated with the product produced and supplied. The risk assessment is specific to each farm condition and must be reviewed annually and updated when changes occur in the farm. It is important to display hygiene instructions clearly with the help of clear signs and pictures and in the language which is commonly understood by workers. Hygiene instruction include hand cleaning; covering of skin cuts; limitation of smoking, eating, and drinking in designated areas; and notification of relevant infections where workers have chances of contact with chemicals.

Hazards and first aid: Permanent accident procedures must be clearly displayed in the predominant language at the workplace. Telephone numbers of hospitals, fire-brigade, and contact details for easy access to emergency healthcare by means of transport, electricity, water and gas suppliers, police and ambulance are important to be displayed prominently at the site.

Separate storage for chemicals: An independent and separate room for the storage of pesticides, fertilizers, and other necessary chemicals is essential at the farm level. Proper documentation is required to store these chemicals in order to assess the date of expiry and other necessary instructions.

First-aid kit: Complete and maintained first-aid kit according to the local recommendations must be available and accessible at all permanent sites and obtainable for transport (tractor, car, etc.) to the vicinity of work. There should

be trained personnel (may be a doctor) to handle accidents, providing first-aid care efficiently. It is recommended that there should be at least one worker who must be trained in handling first-aid care for workers.

Protection clothing: Protection clothing is not only recommended for workers but also for visitors on the farm. A complete set of protection clothing together with instructions on how and when to use these clothes must be available at the farm. Some of the clothing includes rubber boots, waterproof clothing, protective overalls, rubber gloves, face masks, appropriate respiratory equipment, ear and eye protective devices, life jackets, etc. The protective clothing must be clean and washed at regular intervals. If expired, it must be disposed off.

Workers' welfare: It is the responsibility of farm managers or owners to ensure compliance with the existing, current, and relevant national local regulations for the welfare of workers. It is recommended that concerns towards workers' health, safety, and welfare must be discussed at least once a year in a meeting with the management and workers.

Living facility: The on-farm living quarters for the workers need to be habitable and have strong roof, windows, and doors, and basic services like running water, toilets, and drains. In case of no drain, septic pits can be built in compliance with the local regulations. Handwashing facilities, portable drinking water, places to store food, and eat must be provided to the workers.

Challenges of Adoption of OHS Standards at Mango Farms in Pakistan

Many previous studies have established that social empowerment (social upgrading) of workers may lead to achieve better health and care facilities than those who remain socially deprived. Mishell and Walter (2003) posited that generous occupational health benefits are received more by unionized workers than the non-unionized ones. Occupational health and safety standards increase when labor unions are working at the farm level and safety conditions at work have been improved to standards of global value chain. Hence, social upgrading leads to OSH upgrading (Freeman 1984; Freeman and Rogers 2006).

However, Scherrer and Verma (2018) found that the most vulnerable and marginalized workers faced severity of decent work deficits (including OHS) in agriculture which required needful actions in comprehensive and context-specific form. This is true in the context of Pakistan's mango industry where the GLOBALG.A.P.OHS standards, as discussed above, have not been ensured in true letter and spirit except on mango farms where workers' group or union (informally) worked to ensure these facilities.

The employers or growers are reluctant to maintain these standards on a regular basis as it entail expenses. On the other hand, workers are well aware about their safety and health issues on the certified farm as auditors and inspectors used to visit these farms when the renewal of certifications was needed from authorized agencies. In order to assess the interdependency between workers' union (social upgrading) and the OHS measures, we conducted a study on certified mango orchards in Pakistan. Fifteen mango orchards, adopting best practices and having GLOBALG.A.P. certification, were identified purposively in Punjab and Sindh province in May 2017. Ten farm workers (including their supervisors) on each farm were interviewed. In-depth interviews with the farm owners were also conducted in order to triangulate the results' findings.

Pearson correlation analysis makes sense while dealing with binary variables (Gujarati, 1995). In our study, we intended to identify whether social upgrading (unionization) led to implementation of OHS measures at the farm level. All physical OHS factors, as described above, were found to have positive and significant Pearson correlation with social upgrading (unionization) in small, medium, or large farms. The coefficients of different OHS factors such as separate chemical rooms, first-aid and medical care, hazard signs and uniforms, sanitation facility, hygiene meals and accommodation generated a value of 0.48, 0.655, 0.267, 0.343, 0.670, and 0.321 respectively, as given in Table 2.

Table 2: Pearson Correlation Analysis among OHS Factors and Unionization

OHS Factors	R	Sig.
Hazard Signs	0.267*	0.007
Sanitation Facility	0.343**	0.000
Hygiene Meals	0.670***	0.000
First Aid and Medical Care	0.655***	0.000
Accommodation	0.321**	0.001
Safety Equipment	0.421**	0.000
Separate Chemical Rooms	0.483**	0.000

Source: Author's own calculations

* = Small Positive Relationship, ** = Medium, *** = Large

In these results, the Pearson correlation between labor unionization and existence of sanitation facility is about 0.343 which indicates that there is a small positive relationship between the variables as shown in the correlation table above. P-value was .000 which indicates significant effect at 5% level of confidence. It can be interpreted in a way that with the increase of unionization, labor got more facilities at the farm level. Correlation coefficient between unionization and hazard signs is about 0.267, which indicates that there is a small positive relationship between the variables as shown in correlation table.

P-value was .007 which indicates significant effect at 5% level confidence. It can be interpreted in a way that with the increase of unionization, workers' safety in terms of hazard signs increases.

Following the correlation table, the Pearson correlation between labor unionization and hygiene meals is about 0.670, which indicates that a large positive relationship exists between the variables. P-value is .000 which indicates significant effect at 5% level confidence. It can be interpreted in a way that with the increase of unionization, labor got more on-farm hygiene meals. Correlation coefficient between unionization and health factors like first-aid boxes and medical care are about 0.655, which indicates that there is a large positive relationship between the variables. P-value is .000 which indicates significant effect at 5% level confidence. It can be interpreted in a way that with the increase of unionization, workers' safety in terms of health benefits increases. Coefficient for protective accommodation showed a value of 0.322 with a p-value of 0.001.

Lack of usage of safety equipment is one of the main issues in on-farm industry of Pakistan. As shown in the correlation table, the Pearson correlation between labor unionization and availability of safety equipment is about 0.421, which indicates that a moderate positive relationship exists between the variables. P-value was .000 which indicates significant effect at 5% level confidence. It can be interpreted in a way that with the increase of unionization, labor got more safety equipment. Correlation coefficient between unionization and existence of separate chemical rooms is about 0.483, which indicates that there is a moderate positive relationship between the variables as shown in Table 2. P-value was .000 which indicates significant effect at 5% level confidence. It can be interpreted in a way that with the increase of unionization, workers' safety in terms of separate chemical rooms increases.

All the given findings indicated that social upgrading (unionization) of workers is critical to ensure OHS facilities at the farm level, particularly in a context where there is little evidence of existence of labor laws.

Conclusions

Agriculture is one of the greatest sources of employment in Pakistan and it is, in fact, one of the most hazardous of all sectors as many agricultural workers suffer occupational accidents and ill health every year. Mango industry is one of the fastest growing industries in the horticultural sector in Pakistan. Under the pressure of globalization, the mango industry has been focusing on more mechanized farming from the last couple of years. However, due to availability of greater number of labor force, majority of the mango farms adopt labor-

intensive production system rather than mechanized farming. Wide disparity in OHS of farm workers has been observed between certified and non-certified orchards. The workers on the certified orchards are more organized in form of association and therefore, more influential to acquire better OHS measures. On the other hand, majority of the non-certified orchards' workers are migrant or seasonal workers and bear high levels of risk towards on-farm injuries.

The task of improving OHS measures in agriculture faces a number of difficulties. First, agricultural workers are poorly protected by national labor law as the Government of Pakistan did not consider the agricultural sector for general labor legislation. Second, most of the farm workers are less trained or poor skilled in their respective jobs as there is no proper intuitional support from the government. Third, contractors mainly employed farm workers on the farm and their priority has been to get maximum work out of labor without investing money on their training. Last, but not the least, national systems for improving OHS measures in agriculture are also inadequate in Pakistan and competent OHS advice is often scarce. Consequently, many farmers and workers are unaware of their obligations, rights, and responsibilities, and fail to comply with OHS measures. And this is worse where the trade union or workers' union or associations are absent.

Way forward

There is a dire need of addressing OHS in agriculture on several fronts:

- There is need to develop a national policy on OHS in agriculture under the umbrella of ILO.
- It is required to give proper attention to develop the national OHS program for on-farm workers.
- The labor contractors, along with relevant authorities, should work on design and implementation procedures for workers' training needs in the agriculture sector.
- Growers and other parties should be more aware of their duties and rights in the area of OHS in agriculture, take specific action to manage and control OHS risks, and prevent occupational accidents and diseases in the sector.
- Workers should participate in skill-based training programs provided by the employer or contractors.
- The OHS program should be amended with the introduction of new technology.
- Training programs should be flexible with workers' family responsibilities.

- Workers and their contractors should participate in negotiation with their employers concerning all aspects of safety and health in agriculture.

References

- Ahmad, I. 2009. "Labor and Employment Law: A Profile on Pakistan", ILO Memo available on https://wageindicator.org/documents/Labour_and_Employment_Law-A_Profile_on_Pakistan.pdf.
- Ahsan, B. M., Mehdi, M., Ahmad, B., and Ahmad, U.S. 2018. Understanding the Interdependence Between Worker Livelihoods and Decent Work at Certified and Non-Certified Mango Orchards in Pakistan, *Earth Systems and Environment* <https://doi.org/10.1007/s41748-018-0075-5>
- AMIS (Agriculture Marketing Information System).2017. Agriculture Department, Government of Punjab, Davis Road Lahore. Pakistan.
- Freeman, R.B. 1984. *What Do Unions Do*. New York: Basic Books.
- Freeman, R.B., and Rogers, J. 2006. *What Workers Want?* Ithaca: Cornell University Press.
- Ghani M. 2012. "Labour Laws and Agriculture Workers". Newspaper article published in *Business Recorder*, 5 January.
- GoP (Government of Pakistan). 2013. "Pakistan Economic Survey 2013–14". Government of Pakistan, Finance Division, Economic Affairs Wing, Islamabad.
- GoP (Government of Punjab). 2016. Provision of the Law: An Act to Provide for Occupational Safety & Health at Workplace. The Punjab Occupational Safety and Health Law 2016, <file:///C:/Users/Admin/AppData/Local/Temp/Draft-Law-on-OSH-Final.pdf>.
- GoP (Government of Pakistan). 2017. Pakistan Economic Survey 2017–18. Government of Pakistan, Finance Division, Economic Affairs Wing, Islamabad.
- Gujarati, D.N. 1995. *Basic Econometrics* (Third edition). USA: McGraw-Hill.
- Khan, K.H. 2016. "OSH: Legal Framework and Statistical Trend Analysis". Ministry of Overseas Pakistanis and Human Resource Development, Islamabad, Pakistan.
- Mehdi, M., A.Adeel, Z. Ahmed, and F. Hussain. 2013. "The Effectiveness of a 'Whole of Chain' Approach in Linking Farmers to Market: a Case of the Pakistan Mango Market". International Agribusiness Marketing Conference 2013, 22–23 October. Kuala Lumpur, Selangor, Malaysia.
- Mehdi, M., A. Adeel, B. Ahmed, A. Yaseen, and N. Syed. 2016. A Comparative Study of Traditional Versus Best Practice Mango. *Pakistan Journal of Agricultural Sciences*. 53(3): 733–42.
- Mishel, L.R., and M. Walters.2003. *How Unions Help All Workers*. Washington, DC: Economic Policy Institute. Retrieved from http://www.epi.org/publication/briefingpapers_bp143/
- PBS (Pakistan Bureau of Statistics). 2016. Statistical Year book, <http://www.pbs.gov.pk/>.
- Scherrer, C. and S. Verma. 2018. *Decent Work Deficit in Southern Agriculture: Measurements, Drivers and Strategies*. Germany: ICDD, Rainer Hampp Verlag.

11. Waste Water Irrigation and Occupational Health and Safety of Agricultural Labor

Saira Akhtar, Shabbir Ahmad, and Abdul Ghafoor

Agriculture in Pakistan is not only an occupation but rather a way of life as the livelihood of two-thirds of the total population depends upon this sector. In spite of ample resources, four seasons, fertile land, and hardworking labor, this sector lags behind its potential. Many factors limit its potential which includes low quality inputs, obsolete production practices, weak markets, and shortage of irrigation water. Though Pakistan has one of the biggest irrigation systems in the world, yet its efficiency is questionable because a lot of water is being wasted, along with limited storage capacity facilities. As a result, farmers face shortage of irrigation water for crops and they are bound to explore some other sources like wastewater irrigation. Wastewater can be used for agricultural practices, if properly treated before use to avoid any injurious implications. However, most of the chemical industries are discharging their wastewater into fresh water channels without any treatment. Wastewater is even sold to the farmers of the peri-urban areas by their respective municipalities (DAWN, 2017). This issue is serious particularly in peri-urban areas of the industrial cities of Pakistan such as Karachi, Lahore, Faisalabad, Multan, Kasoor, and Sialkot where wastewater is being used without any treatment for the irrigation of the crops like vegetables. Farmers consider wastewater useful because it is cheap and, according to them, it is full of required nutrients which are helpful for the growth of the crops without realizing that it contains some insoluble elements such as chromium, lead, arsenic, and others which are not absorbed by the soil and are transferred to the vegetables during production process; hence, such vegetables are injurious for human consumption. The contamination of the food chain leads human beings to suffer from serious health implications such as hepatitis, skin diseases, cholera, eye problems, and many more.

This chapter reports on a study conducted in the district of Faisalabad of the Punjab province. In the first phase, wastewater was analyzed and in the second phase, stakeholders were surveyed to get an insight about the implications such usage had with regard to the crops and vegetables grown using it. Focus group discussions provided further awareness about the practices of the farmers.

Wastewater and Agriculture Sector

The Indus Basin Irrigation System in Pakistan is one of the biggest irrigation systems in the world. Yet, water accessibility in Pakistan has diminished from 1,299 m³ per capita in 1996–97 to 1,100 m³ per capita in 2006 (Alam et al., 2007). Apart from the wasteful usage practices of water, population growth has

further limited per capita water accessibility. The population of Pakistan has expanded from 141 million in 1997 to 172 million in 2006, and again to 207 million in 2017. Domestic and industrial wastewater is either released directly to a sewer system, a natural drain, or a water body, or into an internal septic tank. For the most part, this wastewater is not treated as none of the urban communities have any wastewater treatment facilities apart from Islamabad and Karachi; however, even these urban communities treat just a little extent (<8%) of their wastewater before disposal. There appears to be no national strategy for manageable utilization of wastewater in the country (Murtaza & Munir, 2012).

Persistent pressure on canal water has led to use of groundwater which has not only lowered aquifer but has also posed threats in terms of deteriorating quality of available underground water (Aslam et al., 2004). This situation motivated farmers to make use of untreated wastewater for urban, peri-urban, and even rural farming across Pakistan. In 2017, about 40% of the population lived in urban areas. Most of the vegetables consumed by urbanites such as cauliflower, cabbage, radish, carrots, coriander leaves, and spinach are grown with untreated wastewater in the peri-urban agricultural fields. Some 20 million hectares in 50 regions in Pakistan are watered with wastewater or semi-treated wastewater (Murtaza & Zia, 2012).

The Case Study of Faisalabad

The present study was conducted in the district of Faisalabad of the Punjab Province between September 2016 and July 2017. In the first phase, water samples were taken from the drains containing wastewater and flowing to the areas widely irrigated with wastewater such as Parokian Wala, Chak#219 (Gurhi and Dufrana), Merzi Pura, Uchkera, BawaChak, Islam Pura, Sidhu Pura, and ChoharMajra. The samples of wastewater were also collected from the drains situated near textile and chemical mills such as Kohinoor Textile Mills Ltd, Kalash Textile Mills Ltd, Rafhan Maize Product Company, Sadaqat Textile Mills (Pvt.) Ltd, and M.K. Sons (Pvt.) Ltd. Laboratories of the University of Agriculture, Faisalabad, analyzed the collected samples. In the second phase, a survey of 200 stakeholders working in the fields was conducted to collect information about the crops and vegetables grown in the study area using wastewater (see Table 2). In addition, focused group discussions were conducted to draw general inferences about farming practices and community members. The owners of textiles and chemical mills were also approached to discuss the results of the samples obtained from the drains situated near the mills.

A clear majority of the large industries in Faisalabad discharge their untreated industrial emissions into canals or drain. The open Paharang and Madduana

drains pose serious threat to the residents along the banks as they are exposed to polluted industrial and domestic wastewater laden with toxic chemicals. Besides being the source of odor and eye irritation due to prevailing anaerobic conditions, these drains also contaminate groundwater which is evident from increased TDS levels in groundwater (Kahlow et al., 2006). The governmental Water and Sanitation Agency (WASA) of Faisalabad has no authority to prevent pollution generated by the textile industry. There is a separate department under the district government for environment protection.

Table 1. List of Wastewater Irrigated Sites around Faisalabad, selected data

Site	Wastewater available (L/sec)	Wastewater Use (L/sec)	Area irrigated (ha)	Waste water Type	Crops irrigated
Narwala Road	850	400	250	Municipal	Rabi season cauliflower, spinach, wheat, sugar cane, fodder. Kharif season fodder (maize, millet, sorghum), rice
Chohar Majra	40-50	70-80	75	Municipal	-do-
Chak No. 279/RB	300	75	125	Industrial	
Sidhu Pura	70	70	50	Hospital waste	Wheat, fodder, rice
Islam pura	25	25	15	Municipal	Like Narwala Road site
Gao Shala Marzipura	25	28	15	Municipal	Like Narwala Road site
Satiana Road	1400	250	200	Industrial	Wheat, Rice, sugar cane, Fodder
Channel-4	1000	700	900	Industrial	Wheat, Rice, Spinach, Fodder (sorghum)

Source: Akhtar et al., 2018

Wastewater is being used for irrigating agricultural fields in the peri-urban areas of Faisalabad. Farmers in these areas are owners of small land holdings and wastewater is available to them usually at very cheap rates, at times even free of cost. Due to scarcity of canal irrigation water and any other reliable source of water, farmers generally rely on wastewater. The total area under wastewater irrigation is 2,139 hectares across different peri-urban areas of Faisalabad. Common crops grown include fodder, wheat, cotton, and vegetables (cauliflower, spinach, turnips, peas, carrots, radishes). Most sites have been using wastewater for the last 30 years (Baig et al., 2011). Typical crop rotations followed in Faisalabad include cotton-wheat, rice-wheat, sorghum-berseem (Table 1). In the city surveyed by International Water Management Institute (IWMI), vegetables, fodder, and cotton, and to a lesser extent rice are grown through wastewater irrigation. In our samples the main crops include sorghum,

cauliflower, spinach, cotton, wheat, and tomatoes. The vegetables, generally, receive wastewater irrigation twice a week, fodder once a week, and cotton once in three weeks. Farmers are reluctant to irrigate root crops such as carrots, radishes, onions, and potatoes with wastewater. This is because irrigation with wastewater can lead to foul smell, poor color, and as such they might not be sold in the local market at a reasonable price. No regulations existed for what could be grown with wastewater irrigation.

Some of the farmers used to directly divert the wastewater into their fields. Today, middlemen supply small farmers with wastewater. For example, the governmental Water and Sanitation Agency (WASA) of Faisalabad holds auctions for wastewater from municipal ponds. The highest bidder sells to small farmers on hourly basis. For instance, wastewater channels of 6 ($150.0 \text{ m}^3 \text{ h}^{-1}$) and 8 ($266.4 \text{ m}^3 \text{ h}^{-1}$) inches diameter were auctioned for a year and the highest bid was Rs 90,000 and 110,000, respectively. The bidder was selling out this wastewater to small farmers at the rate of Rs375 per hour for $150 \text{ m}^3 \text{ h}^{-1}$ wastewater (6 inches diameter pipe) and Rs500 per hour for $266.4 \text{ m}^3 \text{ h}^{-1}$ wastewater (8 inches diameter pipe).

The wastewater is of mixed type as there is no arrangement for separate disposal of industrial, domestic, and hospital sewage water. Wastewater contains constituents such as organic matter, nutrients (nitrogen phosphorus, potassium), inorganic matter (dissolved minerals), salts, toxic chemicals, and pathogens. Chemicals of potential health concerns were also identified in untreated water which includes the following:

- Heavy metals including cadmium, chromium, lead, mercury, and nickel
- Inorganic chemicals like cyanide, fluoride, hydrogen sulfide, and nitrate
- Nutrients such as nitrogen, phosphorus, and potassium
- Organic chemicals like benzene, phenol, toluene, and xylene
- Endocrine disruptors including pharmaceuticals (see Table 2).

The quantities of nitrogen (N) and potassium (K) in sewage irrigation are quite sufficient for any crop, but phosphorus (P) is low, hence supplementary supply from other fertilizer sources is needed for plants. P applied through sewage is almost completely soluble, that's why its availability is higher than the P applied through inorganic fertilizers. Murtaza et al., (2010) reported that nitrogen and phosphorus levels in sewage water application may exceed the amount needed by crops during the growing season.

Table 2: Composition of Wastewater Used for Irrigation at the Narwala and Channel 4 Sites in Faisalabad, Pakistan

Parameters	Unit	FAO and WHO guidelines	Narwala road	Channel 4
EC	dS m ⁻¹	<3	3.1	5.8
Faecal coliform	count 100ml ⁻¹	1000	>10	>10
Helminth eggs	number L ⁻¹	<1	763	
SAR		<9	6.3	16.9
N	mg L ⁻¹	s<30	41.6	35.7
P	mg L ⁻¹	8.6	5.7	
K	mg L ⁻¹	34.7	35.1	
Mn	mg L ⁻¹	0.2	0.14	
Cr	mg L ⁻¹	0.1	0.05	
Pb	mg L ⁻¹	5	0.24	
Ni	mg L ⁻¹	0.2	0.03	
Cu	mg L ⁻¹	0.2	0.09	
Co	mg L ⁻¹	0.05	0.08	
Cd	mg L ⁻¹	0.01	0	
Fe	mg L ⁻¹	5	0.16	
Zn	mg L ⁻¹	2	0.14	

Source: Akhtar et al., 2018

Why Farmers Prefer Untreated Wastewater

The absence of other water sources is the main reason for using untreated wastewater. While the scarcity of canal water has increased the use of groundwater, the latter has become expensive and unaffordable for small farmers due to increasing prices of petrol and electric shutdown. Sometimes the same piece of land must be irrigated twice (field research observation). Unfortunately, groundwater is also of inferior quality. Therefore, smallholders use wastewater. They prefer the untreated over the treated wastewater. The Uchkera site farmers in Faisalabad prized the untreated wastewater for its higher nitrogen content and lower salinity levels. The University of Agriculture Faisalabad owns 40 ha of agricultural land in Uchkera. It was observed when canal water irrigation was replaced with wastewater irrigation fertilizer application for wheat, the average wheat yield increased by 10% (Sadiq et al., 2005).

These economic advantages of using wastewater had already been pointed out by a study conducted by the Department of Agricultural Economics, University of Agriculture, Faisalabad, Pakistan, in 2009. It analyzed two situations, i.e., wastewater-used area and freshwater-used area, using multiple economic criteria. The data on production cost and output value for four major crops, i.e.,

wheat, berseem, sorghum, and maize were collected from Chak No. 570/JB as wastewater-used area and Chak No. 219/RB as freshwater-used region. The results revealed that wastewater use has higher benefit-cost ratio in study area irrespective of the negative externalities like health risks associated with it. Net benefit from crop production per rupee invested for wastewater irrigation returned Rs5.56 on an average as compared to Rs2.20 for freshwater irrigation. The average days of illness in wastewater area were 11.44 days per person per annum as compared to 8.04 days in freshwater area (Baig et al., 2011).

The major input cost for farmers was on the use of fertilizers, although this was a substantial cost; on an average, the total cost for canal water was less than those for wastewater. However, the average gross margin for a wastewater farmer (Rs 10,000/ha), was substantially higher than for a freshwater farmer using canal water (Rs 2,500/ha) because of its higher cropping intensities and the ability to cultivate crops with higher market values.

Farmers irrigating their crops with wastewater spend more money on insecticides, labor hiring cost, and land rent than those who use canal water. For example, land rent of wastewater irrigated land is about Rs150,000 ha⁻¹ compared to canal water-irrigated land, i.e., Rs 65,500 ha⁻¹. The higher land rent reflects the higher yield of wastewater-treated land.

In the eyes of most farmers these benefits justify the use of untreated wastewater. They have become used to the annoyance of wastewater odor and filthiness.

Implications for Farmers' and Consumers' Health

While short-term economic benefits cannot be denied, the use of wastewater has many negative externalities. Due to the contaminations and hazardous material, wastewater not only affects soil texture and its fertility, the sustained use of untreated wastewater makes land more compact, dense, and hard. It also has bad impacts on human health. Agriculturists and their families utilizing wastewater are exposed to health dangers like parasitic worms, protozoa, infections, and microbes. Numerous farmers cannot bear the cost of treatment for a portion of the medical issues caused by the exposure. For the most part, agriculturists inundating with wastewater have higher rates of helminth contaminations than farmers utilizing freshwater; however, there are special cases (Trang et al., 2007). Furthermore, skin and nail infections may occur among agriculturists utilizing wastewater (Van-der-Hoek et al., 2002; Trang et al., 2007).

Table 3: Different Kinds of Hazards Associated with Wastewater Use in Agriculture in Developing Countries

Hazard	Exposure route	Relative importance
Excreta-related pathogens		
Bacteria (for example E. coli, Vibrio cholerae, Salmonella spp. Shigella spp.)	Contact; Consumption	Low–high
Helminths (parasitic worms)		
Soil-transmitted (Ascaris, hookworms, Taenia spp.)	Contact; Consumption	Low–high
Schistosoma spp.	Contact	Nil–high
Protozoa (Giardia intestinalis, Cryptosporidium, Entamoeba spp.)	Contact; Consumption	Low–medium
Viruses (for example hepatitis A virus, hepatitis E virus, adenovirus, rotavirus, norovirus)	Contact; Consumption	Low–high
Skin irritants and infections	Contact	Medium–high
Vector-borne pathogens (Filaria spp., Japanese encephalitis virus, Plasmodium spp.)	Vector contact	Nil–medium
Chemicals		
Heavy metals (for example arsenic, cadmium, lead, mercury)	Consumption	Generally low
Halogenated hydrocarbons (dioxins, furans, PCBs)	Consumption	Low
Pesticides (aldrin, DDT)	Contact; Consumption	Low

Source: Adapted from WHO (2006)

The above-mentioned study by the University of Faisalabad in 2009 documented health risks from using wastewater. The average days of illness in wastewater area were 11.44 days per person per annum as compared to 8.04 days in freshwater area (Baig et al., 2011).

Conclusion and Recommendations

Wastewater irrigation, though economical for the farming community, is highly dangerous for the human health. The hazardous elements which are included in the wastewater by the industries using toxic chemicals pose serious consequences for human beings, aqua-culture, and environment. Wastewater irrigation should be avoided if its treatment is not possible. And if possible, some level of treatment should typically be given to crude metropolitan sewage before it tends to be utilized for irrigation purposes. We recommend the following measures:

- The Government of Pakistan should take strict measures against chemical industries discharging water into the freshwater channels without treatment. So chemical industries should be bound to establish water treatment plants to treat the wastewater before discharging into water

channels. The industries which violate the commandments must be heavily fined.

- An awareness campaign should be launched with the help of print and electronic media to make farmers and the general public aware about the hazardous effects of wastewater on human and aquatic life.
- Trees must be planted alongside water channels containing wastewater.
- There is need to change the cropping pattern in fields using wastewater. Rather than producing vegetables, grain crops like wheat, maize, sorghum may be preferred along with decorative plants and woody trees.

References

- Akhtar, S., S. Ahmad, W. Huifang, A. Shahbaz, A. Ghafoor, S. Imran, and A. Zafar. 2018. An Analysis of Wastewater Irrigation Practices and its Impacts on the Livelihood Generation and Food Chain Contamination in Faisalabad District, Pakistan. Vol. 5(4): 33–42, October. doi: 10.5897/ISAAB-JHE2018.0045.
- Alam, U., P. Sahota, and P. Jeffrey. 2007. "Irrigation in the Indus basin: A History of Unsustainability?", *Water Science and Technology: Water Supply*,7(1): 211–18.
- Aslam, M.M., M.A.Baig, I.Hassan, I.A.Qazi, M.Malik, and H. Saeed. 2004. "Textile Wastewater Characterization and Reduction of its COD and BOD by Oxidation", *EJEAF Che*, 3(6): 804–11.
- Ayub, C.M., M. Aslam Pervez, Waqas Ahmad, and Abdul Manan. 2014. "Threats of Untreated Wastewater Irrigation to Vegetable Crops in Pakistan", <http://www.pakissan.com/english/issues/threats.untreated.wastewater.irrigation.vegetable.crops.pakistan.shtml>
- Baig, I.A., M.Ashfaq, I.Hassan, M.I.Javed, W. Khurshid, and A.Ali. 2011. "Economic Impacts of Wastewater Irrigation in Punjab, Pakistan". *Economic Impacts of Wastewater Irrigation in Punjab*.
- DAWN. 2016. "Risks and Opportunities in Sewage Irrigation", www.dawn.com/news/196511
- DAWN. 2017. "Wastewater Use in Agriculture", <https://www.dawn.com/news/1311463>
- FAO, 2017. "Wastewater Use in Agriculture", <https://www.dawn.com/news/1311463>
- Kahlowan, M.A., M.Ashraf, M.Hussain, H.A.Salam, and A.Z. Bhatti. 2006. "Impact Assessment of Sewerage and Industrial Effluents on Water Resources, Soil, Crops and Human Health in Faisalabad". PCRWR, Islamabad.
- Murtaza, G., and Munir, H. Z. 2012. Wastewater production, treatment and use in Pakistan. In *Second Regional Workshop of the Project 'Safe Use of Wastewater in Agriculture* (pp.16-18). Retrieved from on 4th January, 2019 from http://www.ais.unwater.org/ais/pluginfile.php/232/mod_page/content/127/pakistan_murtaza_finalcountryreport2012.pdf
- Murtaza, G., A.Ghafoor, M.Qadir, G.Owens, M.A.Aziz, and M.H. Zia. 2010. "Disposal and Use of Sewage on Agricultural Lands in Pakistan", *Pedosphere*, 20(1): 23–34.
- Sadiq, B. M., Sharif, K., Bajwa, B. E., and Aziz, A. 2005. "Hazardous effects of sewage water on the environment: Focus on heavy metals and chemical composition of soil and vegetables", *Management of Environmental Quality: An International Journal*, Vol. 16 Issue: 4, pp.338-346, <https://doi.org/10.1108/14777830510601217>
- Trang, D.T., W. Van Der Hoek, N.D.Tuan, P.D. Cam, V.H. Viet, D.D. Luu, and A. Dalsgaard. 2007. "Skin Disease among Farmers Using Wastewater in Rice Cultivation in Nam Dinh, Vietnam", *Tropical Medicine & International Health*, 12(s2): 51–8.

Van-der-Hoek, W., M. Ul Hassan, J.H.J. Ensink, S.Feenstra, L.Rashid-Sally, S. Munir, M.R. Aslam, N. Ali, R. Hussain, and Y. Matsuno. 2002. "Urban Wastewater: a Valuable Resource for Agriculture", in Research Report 63. Sri Lanka: IWMI.

WHO. 2006. WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater – Policy and Regulatory Aspects, Vol. 1. Geneva: World Health Organization.

Occupational Safety and Health Challenges in Southern Agriculture

Labor and Globalization | Volume 15

Christoph Scherrer, Katja Radon (Eds.)

Occupational safety and health (OSH) is a core element of the ILO's Decent Work Agenda. Despite hazardous working conditions in agriculture, unfortunately, OSH issues in agriculture are frequently ignored. This volume's contributions from Brazil, Colombia, Costa Rica, Ecuador, Ghana, India, Nicaragua, and Pakistan as well as from various disciplines highlight

- the prevalent patriarchal norms and practices which expose women to more health risks;
- the lack of training and education which leave smallholders and farm workers frequently unaware of the health hazards involved in handling machinery and pesticides;
- the lack of protective gear and access to health services among smallholders;
- the undermining of OSH standards by the competitive pressures of global supply chains on their participants;
- the restriction of certifications' impact mostly to higher hygiene standards.

Key words: Occupational safety and health, agriculture, smallholders, farm workers, Global South

Christoph Scherrer, economist and political scientist, is Professor of Globalization & Politics at the University of Kassel, Executive Director of the International Center for Development and Decent Work, and chairperson of the steering committee of the Global Labour University.

Katja Radon, epidemiologist and environmental engineer, is Chairwoman, Center for International Health and Professor of Epidemiology at the Institute for Occupational, Social, and Environmental Medicine at the Hospital of the Ludwig-Maximilians-University, Munich.

Rainer Hampp Verlag
Augsburg, München
2019

ISBN 978-3-95710-247-8
ISSN 2196-5382
€ 24.80

