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Prevention and Reduction of Cadmium Contamination in Cacao Beans — Code of Practice

BUREAU OF AGRICULTURE AND FISHERIES STANDARDS
BPI Compound Visayas Avenue, Diliman, Quezon City 1101 Philippines
Trunkline: (632) 8928-8741 to 64 loc. 3301-3319
E-mail: info.dabafs@gmail.com
Website: www.bafs.da.gov.ph

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BAFS Building, BPI Compound, Visayas Avenue, Diliman, Quezon City
info.dabafs@gmail.com | bafs@da.gov.ph
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Foreword

In 2023, the Bureau of Agriculture and Fisheries Standards (BAFS)-Department of Agriculture (DA), through the Standards Development Division (SDD), conducted an inventory of Philippine National Standards (PNS) against Codex Standards to identify those that can be adopted as PNS. This initiative is aligned with the Philippines' commitment to the World Trade Organization (WTO) Sanitary and Phytosanitary (SPS) Agreement to base the country's SPS measures on international standards, guidelines, or recommendations, where they exist. With this, the Code of Practice for the Prevention and Reduction of Cadmium Contamination in Cocoa Beans (CXC 81-2022) was identified for adoption and included in the priority list for CY 2025. The development of PNS aims to establish recommended practices and guidelines that prevents and reduces Cd levels in cocoa beans during production and post-harvest processing, including fermentation, drying, storage, and transportation.

Furthermore, a research study entitled "Comparative Evaluation of Production Practices for the Prevention and Reduction of Cadmium in Cocoa Beans (*Theobroma cacao.* L.) of Cacao Bean Producers in Davao Region against Codex Standard" was conducted by the DA-BAFS-Standards Research Division (SRD) to support the development of PNS for Prevention and Reduction of Cadmium in Cocoa Beans in October 2024. The study aimed to compare the local practices of cocoa bean producers from Davao City with the relevant provisions in CXC 81-2022, on the following stages of the cacao value chain: before planting, production to harvesting, postharvest, and transport phase.

A Technical Working Group (TWG) was established through the Special Order No. 745, series of 2025 (Composition of the Technical Working Groups [TWG] and Project Management Team [PMT] for the Development of the PNS for Agricultural and Fishery Products and Machinery) and SO No. 1752, series of 2025 (Amendment to SO No. 745, series of 2025-Recomposition of the TWG and PMT for the Development of PNS for Agricultural and Fishery Products and Machinery). The TWG was composed of relevant stakeholders from the government sector, academe/research institutions, private sector organizations, and Civil Society Organizations (CSO). The draft PNS underwent a series of TWG meetings and stakeholder consultations conducted via an online platform before its endorsement to the DA Secretary for approval.

This document was drafted in accordance with the editorial rules of the DA-BAFS-SDD Standardization Guide No. 1: Writing the PNS.

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1 Scope

This Standard covers the recommended practices to prevent and reduce cadmium (Cd) contamination in cacao beans from the pre-planting, primary production, and post-harvest phases. The provisions of this Standard apply to both new and existing cacao plantations.

These guidelines were adopted from CXC 81-2022 (Code of practice for the prevention and reduction of cadmium contamination in cocoa beans) with some modification to consider the conditions in the Philippines. Any modifications from the original Codex document to consider the conditions in the Philippines are written in italicized text for distinction.

2 Normative References

The following documents are referred to in the text in such a way that some or all their contents constitute the requirements of this document. The latest edition of the referenced documents (including any amendments) applies:

Bureau of Agriculture and Fisheries Standards (BAFS)-Department of Agriculture (DA). (2017). Code of Practice (COP) for packaging and transport of fresh fruits and vegetables (PNS/BAFS 198:2017). https://bafs.da.gov.ph/index.php/approved-philippine-national-standards/

BAFS-DA. (2018). Code of Hygienic Practice (COHP) for fruits and vegetables. (PNS/BAFS 23:2018). https://bafs.da.gov.ph/index.php/approved-philippine-national-standards/

BAFS-DA. (2021). Good Agricultural Practices (GAP) for fruits and vegetables farming — Code of Practice (PNS/BAFS 49:2021). https://bafs.da.gov.ph/index.php/approved-philippine-national-standards/

Codex Alimentarius Commission (CAC). (2022). Code of Practice for the Prevention and Reduction of Cadmium Contamination in Cocoa Beans (CXC 81-2022). https://www.fao.org/fao-who-codexalimentarius/sh-proxy/ar/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXC%2B81-2022%252FCXC_081e.pdf

3 Terms and Definitions

For the purpose of this Standard, the following definitions below apply. The preferred terms are written in bold type after the Clause number while admitted terms are listed in italicized type after the definition, which could be interchangeably used in interpreting the provisions of this Standard.

3.1
biochar
stable carbonate byproduct derived from the pyrolysis of residual plant and/or animal biomass and applied in agriculture (CAC, 2022, *modified*)
admitted term: biocarbon

3.2
cane by-products
by-product of sugarcane through milling and pressing (CAC, 2022)

3.3
cation exchange capacity (CEC)
measure of the soil's ability to hold cations. The clay mineral and organic matter components of soil have negatively charged sites on their surfaces which adsorb and hold cations. This electrical charge is critical to the supply of nutrients to plants because many nutrients (e.g. Mg, K and Ca) exist as cations (CAC, 2022, *modified*)

3.4
cacao beans
seed of the cacao fruit, which is composed of the episperm (also called integument, testa or shell), embryo and cotyledon (CAC, 2022, *modified*)
admitted term: cocoa beans

3.5
dried cacao
commercial term designating cacao or cocoa beans which have been evenly dried throughout and which the moisture content shall not exceed 7.5% and not lower than 5.5% (DA-BAFS, 2019)

3.6
fermentation
process designed to degrade the pulp or mucilage and initiate biochemical changes in the cotyledon by enzymes and microorganisms in the farm environment (CAC, 2022)

3.7
humus
organic component of soil, formed by the decomposition of leaves and other plant materials by soil organisms (CAC, 2022)

3.8
pruning
regular removal of branches that are dry, diseased, or unbalanced from shade trees and cocoa plants (CAC, 2022, *modified*)

3.9
soil amendments
any material added to the soil to improve its physical and chemical properties. The application of amendments depends on the characteristics of the soils, and may be classified as organic and inorganic amendments (CAC, 2022, *modified*)

3.10
vinasse
by-product of the production of alcohol from sugar cane. It is obtained through the fermentation and distillation of molasses and serves as the primary organic residue in the process (CAC, 2022)

4 Recommended practices

4.1 Before planting (new plantations)

4.1.1 Recommended short- and medium-term practices

4.1.1.1 *Geospatial soil mapping or predictive modeling tools should be applied, where applicable, to provide technical guidance in determining land suitability for cacao cultivation pertaining to Cd levels.*

4.1.1.2 The prevention and reduction of Cd in cacao should begin with the physiochemical analysis of the soil.

4.1.1.3 Soil analysis shall not be limited to the determination of Cd concentration, but shall also include quantification of percent organic matter (OM), soil acidity (pH), total nitrogen (N) (%), available parts per million (ppm) of phosphorus (P), N, and potassium (K), cation exchange capacity (CEC), soluble zinc (Zn), electrical conductivity (EC), and other parameters deemed appropriate or necessary by the relevant competent authority/ies.

4.1.1.4 Physical analysis parameters shall include soil texture classification, determined by the relative percentage of sand, clay, and silt.

4.1.1.5 The soil, all applied agricultural inputs, and any irrigation water used in cacao production areas shall be monitored for Cd concentration.

4.1.1.6 It is recommended that a qualified professional shall be consulted for information and guidance on parameters influencing cadmium uptake by

plants, as well as for the interpretation of soil analysis results specified in Clauses 4.1.1.2 to 4.1.1.4.

4.1.1.7 The use of cover crops of perennial legumes should be considered.

4.1.1.8 *In case a cacao farm is to be established in open land areas, planting of permanent and some temporary shade trees should be established a year before new cacao trees are planted. The shade trees should be well arranged to provide shelter to the young plants.*

4.1.1.9 Planting cacao trees near to dumpsites in cities, mining areas, smelting areas, industrial wastes, sewage, and household wastewater shall be avoided.

4.1.1.10 Flood prone areas shall be avoided where water sources are contaminated with cadmium.

4.1.1.11 Recommended practices for suitability of the agricultural site for cacao production shall conform with the relevant provisions of Clause 4.1.1 Suitability of the Agricultural Site for Food Production and Primary Processing of the PNS/BAFS 49:2021 (GAP for fruits and vegetable farming — Code of practice) or their latest issuances.

4.1.2 Recommended long-term practices

4.1.2.1 It is recommended that cacao tree varieties that are less prone to cadmium uptake should be planted *when available*.

4.1.2.1 *Crop suitability maps should be used to plan crop rotation and production programs for cacao trees.*

4.2 From production to harvesting

4.2.1 Recommended short- and medium-term practices

4.2.1.1 Registered agricultural inputs shall be used to help minimize Cd contamination in cacao production.

4.2.1.2 At least one composite soil sample (consisting of at least 20 subsamples) per hectare should be collected at a depth of *0-30 cm*.

4.2.1.3 Soil analysis shall be conducted by accredited laboratories or by relevant national competent authority/ies using verified/validated methods or standard operating procedures.

4.2.1.4 When Cd levels in cacao beans are of concern and the soil is alkaline, the electrical conductivity of both soil and water should be less than 2 mS/cm.

4.2.2 Strategizing to immobilize cadmium in the soil (medium- and long-term practices)

4.2.2.1 In highly acidic soils with a pH *below 5.5*, the cultivation of cacao trees should involve the application of lime, which must be confirmed to be cadmium-free.

4.2.2.2 Lime should be applied in low doses (3 t/ha/year), preferably in the form of dolomite $CaMg(CO_3)_2$.

4.2.2.3 Organic fertilizers should be utilized such as treated animal manure, composted cacao pod husk, and other farm waste.

4.2.2.4 It is recommended that organic and/or inorganic soil amendments such as but not limited to magnesium sulphate [$MgSO_4$], dolomitic limestone, vinasse, zeolite, humus, biochar, carbonized rice hull, calcium sulphate [$CaSO_4$], cane by-products, and zinc sulphate [$ZnSO_4$] should be applied when necessary.

4.2.2.5 The heavy metal content of fertilizers and soil amendments shall be verified through analysis prior to application to soil to ensure that Cd content is low. *The maximum allowable level of Cd is 5 mg/kg for solid and liquid organic soil amendments.*

4.2.2.6 Apatite (or rock phosphate) should be avoided where possible.

4.2.2.7 Cacao plant genotypes with low Cd bioaccumulation if available should be cultivated and propagated by grafting onto rootstocks.

4.2.3 Avoiding further cadmium contamination of the soil (recommended practices in the short- and medium-term)

4.2.3.1 When soil analysis results showed high Cd concentration, pruning residues from cacao plants shall be removed from the area.

4.2.3.2 The application of sewage sludge shall be avoided.

4.2.3.3 The burial or incineration of household waste, which may contain metals, including Cd, shall be avoided.

4.3 Postharvest Phase (recommended practices in the short- and medium-term)

4.3.1 Mucilage draining shall be allowed during the fermentation process to help reduce both acidity and potential Cd accumulation in cacao beans. The drained mucilage shall not be used for consumption when there is confirmed high concentration of cadmium.

4.3.2 Cacao beans shall be fermented in an environment that is free from any contaminants such as smoke, gases emitted by dryers or vehicles, and industrial discharges.

4.3.3 Cacao beans shall be dried on clean solid surfaces and well-ventilated appropriate drying structures to avoid any contamination. When high Cd levels are detected, appropriate cleaning methods shall be performed.

4.3.4 During storage, cacao beans shall be protected from contamination caused by fuel spills, exhaust gases, or fumes.

4.3.5 It is recommended that the commodity covered by the provisions of this Standard should be prepared and handled in accordance with the relevant clauses of the PNS/BAFS 233:2018 (Code of Hygienic Practice for Fruits and Vegetables) and or their latest issuances.

4.4 Transport Phase

4.4.1 Loading/unloading areas shall be covered to protect the dried cacao beans from rain.

4.4.2 The transport vehicles shall be well maintained and thoroughly cleaned.

4.4.3 Covers shall be clean and free from damage during transport.

4.4.4 Bags and container vans that have never been used for chemicals or harmful substances shall be properly maintained and clean.

4.4.5 It shall be ensured that the humidity levels are as low as possible by using ventilated shipping container vans, when available, and cardboard/kraft paper lining.

4.4.6 For bagged *dried* cacao, bags shall be loaded carefully and covered with materials to absorb condensation.

4.4.7 For *dried* cacao in bulk, a sealable plastic liner shall be used when possible, and it shall be ensured that it does not come into contact with the container roof.

4.4.8 It is recommended that the commodity covered by the provisions of this Standard should be prepared and handled in accordance with the relevant clauses of the PNS/BAFS 198:2017 (COP for packaging and transport of fresh fruits and vegetables) and PNS/BAFS 233:2018 (COHP for fruits and vegetables) and/or their latest issuances.

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Department of Agriculture (DA)
Bureau of Agriculture and Fisheries Standards (BAFS)

Philippine National Standard (PNS) on Prevention and Reduction of Cadmium Contamination in Cacao Beans — Code of Practice

Technical Working Group (TWG)

Chairperson
Basay, Carlito, Jr.
Pascual, Lydia, PhD
University of Southern Mindanao (USM)

Vice-Chairperson
Manaig, Marcelo, Jr.
Daño, Aiseder Niño
Filipinas Oro De Cacao/Auro Chocolate

Members

1. Revesencio, Emily
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   Agricultural Training Institute (ATI)-DA

3. Loyola, Ivy Cassie
   Bureau of Plant Industry (BPI)-DA

4. Bautista, Karen, PhD
5. Dayap, Joseph
   Bureau of Soils and Water Management (BSWM)-DA

6. Lincallo, Don Moen
   Fertilizer and Pesticide Authority (FPA)-DA

7. Milanes, Maria Belen
8. Camba, Irene
   Philippine Council for Agriculture and Fisheries (PCAF)-DA

9 Valleser, Venses
10. Ang, Aileen May
    Central Mindanao University (CMU)

11. Felismino, Romel
12 Salazar, Bong
    College of Agriculture and Food Science (CAFS)-University of the Philippines (UPLB)

13. Sandique, Jo Ann
14. Banquerigo, Edwin
15. Cena, Luisito
    Cacao Pilipinas Sensory Resources (CacaoPilSense), Inc.

16. Ramos, Josephine
    Organization for Partnerships, Teamwork and Initiatives on opportunities for Nature Stewards (OPTIONS), Inc.

BAFS Management Team
Lanuza, Alpha, DVM
Aborido, Kristel Alarice, RND
Sison, Princess Shiella May, RAgr

Adviser
Mandigma, Mary Grace, PFT

BUREAU OF AGRICULTURE AND FISHERIES STANDARDS

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