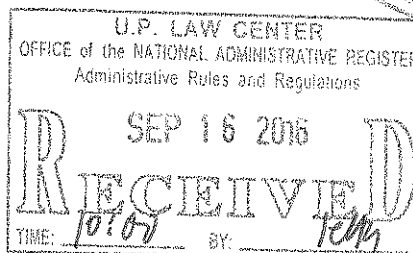


Republic of the Philippines
Office of the President
PHILIPPINE COCONUT AUTHORITY



ADMINISTRATIVE ORDER NO. 01

Series of 2016



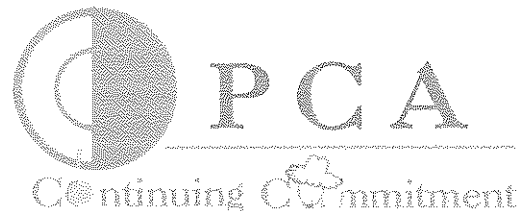
SUBJECT: PCA-NIA COCONET STANDARD GENERIC SPECIFICATION FOR IRRIGATION

I. TECHNICAL SPECIFICATIONS FOR COCONET AND VETIVER

101. SCOPE/DEFINITION

This generic specification covers the supply/furnishing of materials, delivery/handling, storage and installation of Coconet, Cocologs, Cocotwines and Cocopeat for minimizing soil erosion and slope stabilization in accordance with the detailed design and approved plans or as directed by the Engineer.

- a) **Supplier** is a Legitimate Firm Sole and/or Joint Venture and duly registered organization and Manufacturer with manufacturing plant, having complied with all the mandated legal requirements, with the PhilGEPS License/Registration ID Number in compliance with Republic Act No. 9184 "Government Procurement Reform Act".
- b) **Constructor** is a Legitimate Firm Sole and/or Joint venture with PCAB License and Legitimate Supplier and Manufacturer with manufacturing plant, having complied with all the mandated legal requirements, with the Department of Trade and Industry, Construction Industry Authority of the Philippines, Philippine Domestic Construction Board with Philippine Contractors Accreditation Board (PCAB) Registration ID Number in compliance with Republic Act No. 9184 "Government Procurement Reform Act" and Republic Act No. 4566, as amended by Presidential Decree No. 1746.
- c) **Implementing Office** refers to the unit(s) or department(s) within the agency assigned to supervise the implementation of the coconet and vetiver projects.
- d) **Coir** refers to fibers from coconut husks.



- e) **Coconets** refers to hand/mechanically spun coir twine woven into blankets of different density. It is used for minimizing soil erosion and stabilizing slopes when placed in sloping lands and embankments (top of concrete lined irrigation canal and irrigation drainage canal) to hold the vulnerable soil and permit vegetation such as vetiver grass, etc. to control surface erosion and conserve the productivity of the soil.
- f) **Cocolog** refers to a tubular structure of coir fiber blankets of different diameter filled with coir, and/or cocopeat.
- g) **Cocotwine** refers to a string made of coconut coir strands twisted together.
- h) **Cocopeat** refers to natural and residual materials or dust from coconut husk which serves as soil conditioner.

102. MATERIAL – QUALITY STANDARD SPECIFICATIONS

To ensure the quality standard of the materials utilized in the project, the following standards are hereby set to wit;

- a) **Coir fiber materials** for use in making of coconets and cocologs shall be of Grades CH-3 and/or CH-2 in accordance to PNS/BAFPS 21:2008 ICS 59.060.10

The hand/mechanically spun double twisted coir twine to be woven into coconet shall have a diameter of 5mm plus or minus 10% and shall have a tensile strength of not less than 150N or 15 kg (Force).

b) Coconet material

Table 1. Physical Properties of Coconet

PROPERTIES	COCONET 400	COCONET 700	COCONET 900
Thickness, mm	10.0 ± 1.0mm	10.0 ± 1.0mm	10.0 ± 1.0mm
Width, m	1.0	1.0	1.0
Length, m	25.0	25.00	25.0
Unit Weight, 1g/m ²	400 ± 20	700 ± 35	900 ± 45
Diameter of Twine, mm (mechanically or manually spun)	5.0mm ± 1.0mm	5.0mm ± 1.0mm	5.0mm ± 1.0mm
No. of Twines/m			
Crosswise Direction	40 min.	40 min.	70 min.
Lengthwise Direction	40 min.	70 min.	70 min.
	Woven Netting made from High Strength 100% Coconut Fiber Twine		
Color	Natural Earth Tone	Natural Earth Tone	Natural Earth Tone

Tensile Strength, N/twine	150 min.	150 min.	150 min.
Elongation			
(Machine Direction), %	26 min.	34 min.	42 min.
(Cross Machine Direction), %	32 min.	38 min.	32 min.
"C" Factor	0.002	0.002	0.002
Applicability in Terms of Water Velocity (Surface run off), m/sec	2.70 min	3.35 min	4.26 min
Water Absorption, %	163 min	146 min	132 min
Applicability in terms of slope inclination, H:V	Less than or equal to 1:1 ($\leq 45^\circ$ and below)	Greater than or equal to 1:1 to 1:1.5 (46° to 60°)	Greater than 1:1.5 (61° to 75°)

c) Cocolog materials

Table 2. Physical Properties of Cocolog

Type of Cocolog	Diameter (mm)	Weight (min.) (Kg/m)
Cocolog 100	100	2.00
Cocolog 200	200	4.50
Cocolog 300	300	10.00
Cocolog 400	400	20.00
Cocolog 500	500	30.00

103. EQUIPMENT AND TOOLS

Equipment and tools necessary for handling materials and performing all parts of the works shall be approved by the Engineer as to design, capacity and mechanical condition. The equipment shall be at the jobsite sufficiently ahead of the start of construction operations.

104. SITE PREPARATION

a) Clearing and Grubbing

a.1 Scope

The work under this Section shall include clearing, grubbing and disposal, in a manner approved by the Engineer, of all vegetation, trees, stumps, roots, brush, rubbish and all other objectionable matters within the entire right-of-way area to be put with coconet slope protection and elsewhere mutually agreed upon by the Engineer and the Constructor, all in accordance with the Drawings and these Specifications.

a.2 Method of Construction

i. Clearing on Light Vegetated Areas

The entire right-of-way for slope protection areas shall be cleared of all vegetation, trees and all other matters, except such trees or shrubs which the Engineer may order to preserve. All trees and shrubs ordered to be preserved including all existing adjacent facilities, properties and utilities, if any, shall be protected from injury or damage resulting from the Constructor's operations. All combustible materials from clearing operations shall be burned thoroughly or removed from the site of work or otherwise disposed to designated areas as directed by the Engineer.

All materials to be burned shall be piled neatly and when in a suitable condition shall be burned thoroughly. Piling for burning shall be done in such a manner and in such locations as to cause the least fire risk. The Constructor shall at all times take special precautions to prevent fire from spreading and shall have available at all times suitable equipment and supplies for use in preventing and fighting fires. In this connection, the Constructor shall be liable for all costs and damage resulting from such incident.

No clearing shall be done on any areas where there are standing crops until such crops have been harvested or unless the Constructor shall have secured written permission from NIA.

- ii. Grubbing shall consist of the removal of all trees, stumps, roots, brush and rubbish from the above mentioned work areas. It shall include necessary stripping of the natural ground surface to a depth not more than 10 centimeters by effective means to remove all objectionable materials or organic matters from the said work areas. Stripping beyond the 10-centimeter limit shall be subject to the approval of the Engineer.

b) **Embankment Formation/Trimming and Manual Compaction**

b.1 Scope

The work under this Section shall consist of spreading materials taken from canal excavation, side borrow and borrow haul, into canal embankments or roadways embankments or approaches to bridges and road crossing and into all other embankments indicated on the drawings; moisture conditioning and then manually compacting said materials into the desired degree of compaction, all in accordance with the Drawings and these Specifications or as directed by the Engineer.

b.2 Method of Construction

This paragraph covers the construction of all embankments designated on the Drawings as compacted manually including the placing of embankments shall be constructed to the lines, grades and dimensions shown on the Drawings, or established by the Engineer on proper foundations approved by the Engineer. No objectionable materials shall be placed on the embankments.

105. ANCHORING MATERIALS

a) For Coconet

The Anchoring Bamboo stakes shall be matured with head measuring at least 60 mm wide and 30mm long; notch, at least 20 mm; and body, at least 40mm wide and 300mm long tapered and sharpened at the end. The head shall coincide with the bamboo nodes to ensure strength. Stakes shall be embedded on ground so that only the notch sticks out from the top of the coconets to hold the coconets in place in accordance with the detailed design and approved plans or as directed by the Engineer.

b) For Cocolog

The Anchoring Bamboo Stakes shall be matured with head measuring at least 60 mm wide and 30mm long; notch, at least 20 mm; and body, at least 40mm wide and 300mm long plus One & One Half of the cocolog diameter tapered and sharpened at the end. The head shall coincide with the bamboo nodes to ensure strength. Stakes shall be embedded on ground so that only the notch sticks out from the top of the coconets to hold the coconets in place in accordance with the detailed design and approved plans or as directed by the Engineer.

106. PLACING BIO-ENGINEERING MATERIALS

- a) **Methodology and Concept in Installation/Placing of Coconets** as bio-engineering technology material for embankment protection and stabilization as follows to wit; 1) slope protection wherein the body of slope is inherently stable but the surface of the slope is prone to erosion from weathering and surface slip. Typically this might be on a sandstone rock face, or on slopes constructed from mixture of small rocks and fine sand where rainfall caused loss of fines which then destabilizes the slope causing rock-falls; 2) slope stabilization wherein the body of the slope is inherently unstable and is at risk of suffering from deep slip (where a large mass of the slope collapse). This may be caused by ground – water lubricating the soil or from other factors such as ground vibration.

b) Placing of the Cocopeat as Soil Conditioner or Growing Medium and CH-W Grade Coir as Cover

Site for coconet installation shall be graded and sloped to the approved design then flattened, compacted and smoothened, and any run-off such as diversions, dikes and berms shall be completed prior to installation. All depressions/gullies and eroded portions shall be backfilled and compacted for the coconets to snugly come in contact with the soil surface. Rocks, clods, vegetation and other obstructions shall be removed from tip to toe of the slope to ensure complete contact of the coconet with soil and/or in accordance with the detailed design and approved plans or as directed by the Engineer.

Prior to the installation of coconets, cocopeat shall be spread evenly on the slope to fill at least 5-mm thickness then raked and thumped in accordance with the detailed design and approved plans or as directed by the Engineer. Thereafter, fibers shall be spread evenly to cover the cocopeat applied to ensure appropriate soil moisture and nutrient supply to stabilize the root system of the vegetation. This is called the "Triple Armor" method of bio-engineering which is most appropriate for an effective slope stabilization and erosion control.

c) Installation/placing of Coconets

The **coconet 400** (for irrigation purposes) top edge (Berm) of the coconet shall consider an overlap accordingly and proper peg anchoring distance corresponding to the terrain slope as follows; for 75° slope, 1.00m coconet top edge overlap & must be folded thrice at 15cm peg distance; for 60° slope, 0.75m coconet top edge overlap & must be folded twice at 20cm peg distance; and 45° slope, 0.50m coconet top edge overlap & must be folded once at 25cm peg distance. The coconet then unrolled down the slope side-by-side to be sewn together using cocotwine. The coconets shall be laid loosely (not stretched) on the ground. Coconet shall then be fastened and secured firmly to the ground in accordance with the proper anchoring protocol. Bamboo stakes shall be installed perpendicularly and shall be fixed alternately at an interval of 30 cm across (horizontal) and 25 cm interval along the slope of the embankment (vertical) starting at the top berm which is approximately 12 bamboo stakes per square meter. The edge of the coconets is folded 10 cm underneath and lay towards the tip of the slope in accordance with the detailed design and approved plans or as directed by the Engineer.

d) Installation/Placing of Cocolog

The use of cocologs is optional, for slope more than 45° with a vertical height of more than 5 meters and/or the area is found to have massive water run-off velocity. At the top berm, the trench shall be deep enough to accommodate embedment of at least $\frac{1}{2}$ the diameter of the cocologs in order to effectively dissipate run-off energy. Contour interval shall be at

maximum of 7 meters depending on the steepness of the slope and the stabilization of the soil. The vertical cocolog shall be installed at a maximum of 5 meters interval as Collector Drain that will divert excessive water run-off downstream and shall be pegged accordingly. Cocologs shall be firmly secured to the ground using bamboo stakes fixed at the center crosswise and at the sides lengthwise. The center stakes shall be installed starting at a point 50 cm from the edge of the first cocolog and at an interval of 100 cm thereafter. Side stakes shall be installed in pairs starting at the edge of the cocologs at an interval of 25cm thereafter. The last of either center or side stakes are installed 10cm from the edge of the last cocolog in a row, the distance from the preceding stakes being a fraction of 100 cm. The pairs of side stakes shall be tied with cocotwine looped at least 5 times and locked closely through knots in accordance with the detailed design and approved plans or as directed by the Engineer.

e) **Vegetation**

Deep cut canal with concrete lining; cut & berm slope along the canal prism & service/access road; drainage canal embankment & auxiliary embankment for high lined canal shall be planted with vetiver grass (variety may depend on the requirement in the area in accordance with the detailed design and approved plans or as directed by the Engineer) slips "diamond lay-out" at an interval of 15cm across (horizontal) and 50 cm interval along the slope of the embankment (vertical) which is approximately 12 slips per square meter, and/or may vary depending on the soil stabilization, slope steepness and water run-off velocity, in accordance with the detailed design and approved plans or as directed by the Engineer.

f) **Constructor maintenance**

f.1 Post project monitoring shall include checking on any breaks of the installed coconets especially at the point of junctions, the growth of the vegetation and the manifestation of any failure of germination of plants and the sudden outburst of rain that might have inflicted damage to some sections. Repair works shall be done on damaged sections of the slope and replacement shall be done in case of plant mortality.

f.2 Constructor maintenance for watering, weeding and fertilization must be done within six (6) months from installation.

f.3 Proper training shall be extended to the farmer – Irrigators Association (I.A.) for the proper maintenance of the planted vegetation (vetiver) and handicraft training for the sustainable alternative source of income to the farmer–beneficiaries within the duration of six (6) months.

107. NOTICES

All notices, demands, and other communications required or permitted under this specifications/guidelines shall be in writing and addressed to the National Irrigation Administration (NIA), unless specified. Such notices and communications shall be deemed to have been duly given, upon receipt or confirmation.

108. METHOD OF MEASUREMENT

- a) The area to be measured for payment shall be within the limit of the entire right-of-way as shown on the Drawings or as staked by the Engineer during Construction Operations. All clearing and grubbing operations from area to be put with coconet slope protection and elsewhere are considered subsidiary works required for other pay items in the Bill of Quantities and will not be measured for payment under this Section. The costs of such work shall be included in the contract unit price for the various items in the Bill of Quantities where clearing and grubbing are required.
- b) Measurement for embankment shall be done by the cubic meter of embankment in its final accepted compacted position regardless of the origin of materials and the required degree of compaction. Computation shall be by the Average End Area Method for every 20m station or by the applicable method suitable for the work involved. The volume shall be the theoretical volume of the embankment as computed based on the neat lines or paylines shown in the Drawings.
- c) Measurement for soil conditioner shall be done by the cubic meter of triple-armor method of bio-engineering in its final. Computation shall be by the Average End Area Method for every 20m station or by the applicable method suitable for the work involved. The volume shall be the theoretical volume of the embankment as computed based on the neat lines or paylines shown on the Drawings.
- d) Coconet shall be measured in square meters, installed, completed and accepted. The area will be based on the surface covered including the overlapping top and bottom edges of the coconet.
- e) The cocologs in linear meter length of the top edge; and
- f) The effective vegetative growth of the vetiver grass is measured per square meter.

109. BASIS OF PAYMENT

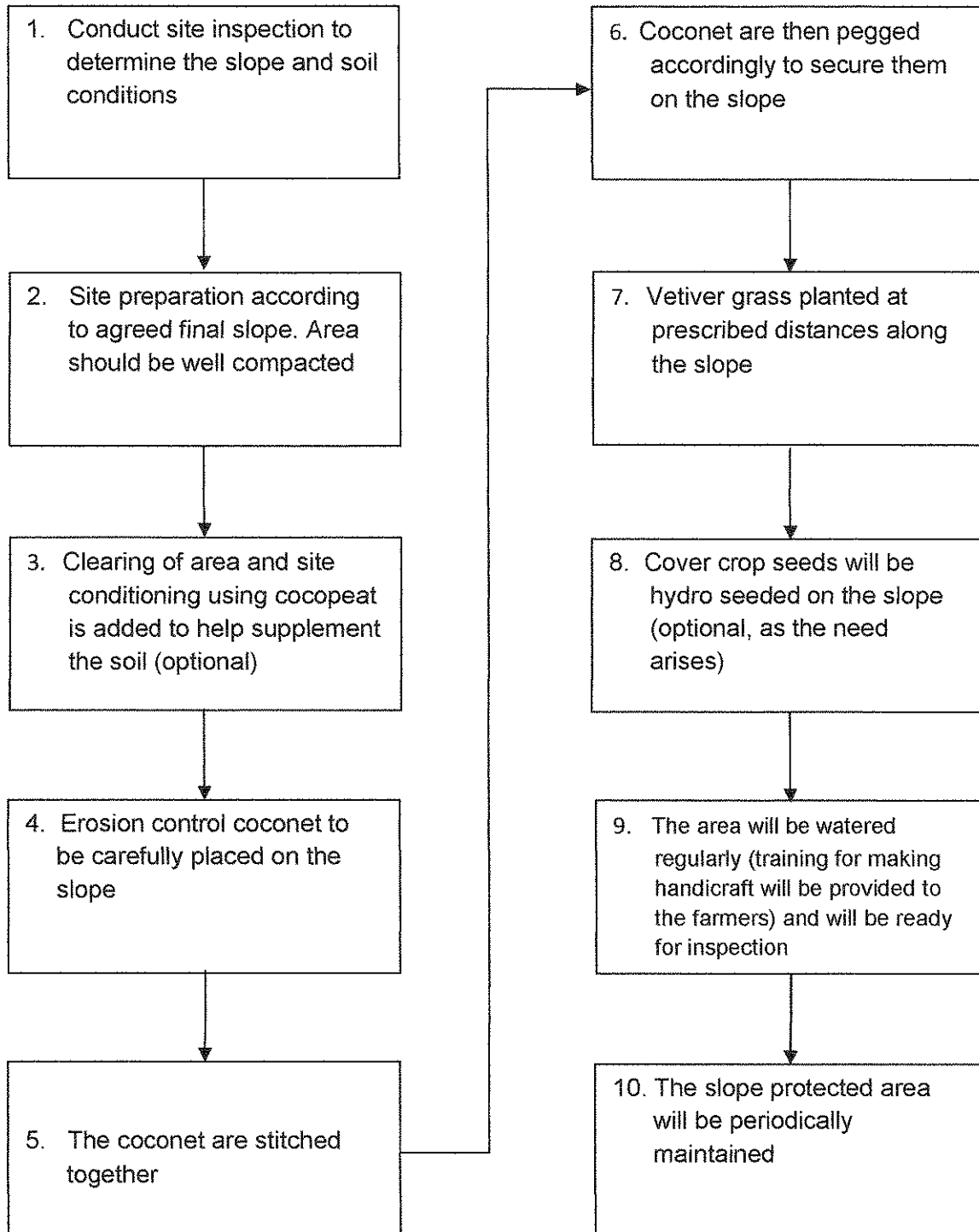
- a) Clearing and grubbing areas measured as provided above shall be paid at the Constructor unit price per square meter in the Bill of Quantities wherein price and payment shall constitute full compensation for furnishing all labors, tools, equipment, supplies and all incidentals or subsidiary works, (including stripping within the 10- centimeter limit) necessary for the successful completion of the work.
- b) The unit price shall constitute full compensation for any side borrow, borrow haul and overhaul operations made, acquisition of right-of-way (if necessary), clearing and grubbing of borrow area, excavation in borrow area, stripping of foundation (where necessary), hauling, loading, unloading, spreading, blending, moisture conditioning, stockpiling, compaction and trimming side slope (where necessary) including all labor, tools, equipment and all incidentals and subsidiary works, necessary for the successful completion of the work described under this Section. Provided, however, that payment shall only be made after presentation by the Constructor of a certification issued by the NIA Materials Testing Engineer to the effect that constructed embankment measured and covered by such progress payment has attained the required degree of compaction.
- c) The unit price shall constitute full compensation for cocopeat and coco fiber, stripping of foundation (where necessary), hauling, loading, unloading, spreading, blending, moisture conditioning, stockpiling, then raked and thumped of side slope (where necessary) including all labor, tools, equipment and all incidentals and subsidiary works, necessary for the successful completion of the work described under this Section. Provided, however, that payment shall only be made after presentation by the Constructor of a certification issued by the NIA Materials Testing Engineer to the effect that constructed triple-armor measured thickness and covered by such progress payment has attained the required proper/appropriate raked and thumped.
- d) The accepted quantity measured shall be paid for at the contract unit price for coconet, cocologs and vegetated with vetiver grass, wherein price and payment shall be in full compensation for supply/furnishing of materials, delivery/handling, storage and installation of coconets and for furnishing all labors, maintenance of plants, equipment, tools and incidentals necessary to complete the activities.

Payment shall be made on a per item basis according to the following:

Pay Item Number	Description	Unit of Measurement
1	Clearing and Grubbing	Square meter
2	Embankment Formation/Trimming and Manual Compaction	Cubic meter
3	Triple-armor (<i>cocopeat and CH-W coir</i>)	Cubic meter
4	Coconets	Square meter
5	Cocologs (Optional)	Lineal meter
6	Vegetation	Square Meter

II. PROCESS FLOW IN THE INSTALLATION/CONSTRUCTION METHOD OF THE SLOPE PROTECTION USING COCONET AND VETIVER

INSTALLATION / CONSTRUCTION METHOD



This Order shall take effect after five (5) days following its publication in a newspaper of general circulation.

Approved by the PCA Governing Board per Resolution No. 045-2016.

A handwritten signature in black ink, appearing to read "Glenn B. Santos", written over a horizontal line.

GLENN B. SANTOS, CESE
OIC - Administrator



Republic of the Philippines
Office of the President
PHILIPPINE COCONUT AUTHORITY

ADMINISTRATIVE ORDER NO. 01
Series of 2016

SUBJECT: PCA-NIA COCONET STANDARD GENERIC SPECIFICATION FOR IRRIGATION

I. TECHNICAL SPECIFICATIONS FOR COCONET AND VETIVER

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- a) Supplier is a Legitimate Firm Sole and/or Joint Venture and duly registered organization and Manufacturer with manufacturing plant, having complied with all the mandated legal requirements, with the PHICEP's License/Registration ID Number in compliance with Republic Act No. 9184 "Government Procurement Reform Act".
- b) Constructor is a Legitimate Firm Sole and/or Joint venture with PCAB License and Legitimate Supplier and Manufacturer with manufacturing plant, with the Department of Trade and Industry, Construction Industry Authority of the Philippines, Philippine Domestic Construction Board with Philippine Contractors Accreditation Board (PCAB) Registration ID Number in compliance with Republic Act No. 9184 "Government Procurement Reform Act" and Republic Act No. 4566, as amended by Presidential Decree No. 1748.
- c) Implementing Office refers to the unit(s) or department(s) within the agency assigned to supervise the implementation of the coconet and vetiver projects.
- d) Coir refers to fibers from coconut husks.
- e) Coconets refers to hand/mechanically spun coir twine woven into blankets of different density. It is used for minimizing soil erosion and stabilizing slopes when placed in sloping lands and embankments (top of concrete lined irrigation canal and irrigation drainage canal) to hold the vulnerable soil and permit vegetation such as vetiver grass, etc. to control surface erosion and conserve the productivity of the soil.
- f) Cocolog refers to a tubular structure of coir fiber blankets of different diameter filled with coir, and/or cocopeat.
- g) Cocowhine refers to a string made of coconut coir strands twisted together.
- h) Cocopeat refers to natural and residual materials or dust from coconut husk which serves as soil conditioner.

102. MATERIAL - QUALITY STANDARD SPECIFICATIONS

To ensure the quality standard of the materials utilized in the project, the following standards are hereby set to wit:

- a) Coir fiber materials for use in making of coconets and cocologs shall be of Grades CH-3 and/or CH-2 in accordance to PNS/BAPPS 21:2006 ICS 59.060.10.
- The hand/mechanically spun double twisted coir twine to be woven into coconet shall have a tensile strength of not less than 150N or 15 kg (Force).

b) Coconet material

Table 1. Physical Properties of Coconet

PROPERTIES	COCONET 400	COCONET 700	COCONET 900
Thickness, mm	10.0 ± 1.0mm	10.0 ± 1.0mm	10.0 ± 1.0mm
Width, m	1.0	1.0	1.0
Length, m	25.0	25.0	25.0
Unit Weight, kg/m ²	400 ± 20	700 ± 35	900 ± 45
Diameter of Twine, mm	3.0mm	± 15.0mm	± 5.0mm
(mechanically or manually spun)	1.0mm	1.0mm	1.0mm
No. of Twines			
Crosswise Direction	40 mm	40 mm	170 mm
Lengthwise Direction	40 mm	70 mm	170 mm
	Woven Notting made from High Strength 100% Coconut Fiber Twine		
Color	Natural Earth Tone	Natural Earth Tone	Natural Earth Tone
Tensile Strength, N/twine	150 min.	150 min.	150 min.
Elongation			
(Machine Direction), %	20 min.	34 min.	42 min.
(Cross Machine Direction), %	32 min.	38 min.	32 min.
C Factor	0.002	0.002	0.002
Applicability in Terms of Water Velocity (Surface run off), m/sec	2.70 min	3.35 min	4.26 min
Water Absorption, %	185 min	145 min	132 min
Applicability in terms of slope inclination, H:V	Less than or equal to 1:1 (< 45° and below)	Greater than or equal to 1:1	Greater than or equal to 1:1 (1:1.5 (61° to 75°)

Table 2. Physical Properties of Cocolog

Type of Cocolog	Diameter (mm)	Weight (mln)
Cocolog 100	100	7.00
Cocolog 200	200	4.50
Cocolog 300	300	11.00
Cocolog 400	400	22.00
Cocolog 500	500	33.00

103. EQUIPMENT AND TOOLS

Equipment and tools necessary for handling materials and performing all parts of the works shall be approved by the Engineer as to design, capacity and mechanical condition. The equipment shall be at the jobsite sufficiently ahead of the start of construction operations.

104. SITE PREPARATION

a) Clearing and Grubbing

a.1 Scope

The work under this Section shall include clearing, grubbing and disposal, in a manner approved by the Engineer, of all vegetation, trees, shrubs, roots, brush, rubbish and other obstructions to be removed within the entire right-of-way area to be put with coconet slope protection and elsewhere mutually agreed upon by the Engineer and the Constructor, all in accordance with the Drawings and these Specifications.

a.2 Method of Construction

1. Clearing on Light Vegetated Areas

The entire right-of-way for slope protection areas shall be cleared of all vegetation, trees and all other matters, except such trees or shrubs ordered to be preserved including all existing adjacent facilities, properties and utilities, if any, shall be protected from injury or damage resulting from the Constructor's operations. All combustible materials from clearing operations shall be burned thoroughly or removed from the site of work or otherwise disposed to designated areas as directed by the Engineer.

All materials to be burned shall be piled neatly and when in a suitable condition shall be burned thoroughly. Piling for burning shall be done in such a manner and in such locations as to cause the least fire risk. The Constructor shall at all times take special precautions to prevent fire from spreading and shall have available

at all times suitable equipment and supplies for use in preventing and fighting fires. In this connection, the Constructor shall be liable for all costs and damage resulting from such incident.

No clearing shall be done on any areas where there are standing crops until such crops have been harvested or unless the Constructor shall have secured written permission from NIA.

- ii. Grubbing shall consist of the removal of all trees, stumps, roots, brush and rubbish from the above mentioned work areas. It shall include necessary stripping of the natural ground surface to a depth not more than 10 centimeters by effective means to remove all objectionable materials or organic matters from the said work areas. Stripping beyond the 10-centimeter limit shall be subject to the approval of the Engineer.

b) Embankment Formation/Trimming and Manual Compaction

b.1 Scope

The work under this Section shall consist of spreading materials taken from canal excavation, side borrow and borrow haul, into canal embankments or roadways embankments or approaches to bridges and road crossing and into all other embankments indicated on the drawings, moisture conditioning and then manually compacting said materials into the desired degree of compaction, all in accordance with the Drawings and these Specifications or as directed by the Engineer.

b.2 Method of Construction

This paragraph covers the construction of all embankments designated on the Drawings as compacted, manually compacted work areas. Embankments shall be constructed to the lines, grades and dimensions shown on the Drawings, or established by the Engineer on proper foundations approved by the Engineer. No objectionable materials shall be placed on the embankments.

105. ANCHORING MATERIALS

a) For Coconet

The Anchoring Bamboo stakes shall be matured with head measuring at least 60 mm wide and 30mm long; notch, at least 20 mm, and body, at least 40mm wide and 300mm long tapered and sharpened at the end. The head shall coincide with the bamboo nodes to ensure strength. Stakes shall be embedded on ground so that only the notch sticks out from the top of the coconets to hold the coconets in place in accordance with the detailed design and approved plans or as directed by the Engineer.

b) For Cocolog

The Anchoring Bamboo Stakes shall be matured with head measuring at least 60 mm wide and 30mm long; notch, at least 20 mm, and body, at least 40mm wide and 300mm long plus One (1) One-half of the cocolog diameter tapered and sharpened at the end. The head shall coincide with the bamboo nodes to ensure strength. Stakes shall be embedded on ground so that only the notch sticks out from the top of the cocologs to hold the cocologs in place in accordance with the detailed design and approved plans or as directed by the Engineer.

106. PLACING BIO-ENGINEERING MATERIALS

- a) Methodology and Concept in Installation/Placing of Coconets as bio-engineering technology material for embankment protection and stabilization as follows to wit: 1) slope protection wherein the body of slope is inherently stable but the surface of the slope is prone to erosion from weathering and surface slip. Typically this might be on a sandstone rock face, or on slopes constructed from mixture of small rocks and fine sand where rainfall caused loss of fines which then destabilizes the slope causing rock-falls; 2) slope stabilization wherein the body of the slope is inherently unstable and is at risk of suffering from deep slip (where a large mass of the slope collapses). This may be caused by ground-water lubricating the soil or from other factors such as ground vibration.

b) Placing of the Cocopeat as Soil Conditioner or Growing Medium and CH-W Grade Coir as Cover

Site for coconet installation shall be graded and sloped to the approved design then fattened, compacted and smoothed, and any run-off such as diversions, dikes and berms shall be completed prior to installation. All depressions/gullies and eroded portions shall be backfilled and compacted for the coconets to snugly conform to the surface of the soil. Rocks, clods, vegetation and other obstructions shall be removed from top to toe of the slope to ensure complete contact of the coconet with soil and/or in accordance with the detailed design and approved plans or as directed by the Engineer.

Prior to the installation of coconets, cocopeat shall be spread evenly on the slope to fill at least 5-mm thickness then raked and thumped in the Engineer with the detailed design and approved plans or as directed by the Engineer. Thereafter, fibers shall be spread evenly to cover the cocopeat applied to ensure adequate soil moisture and nutrient supply to stabilize the root system of the vegetation. This is called the "Triple Armor" method of bio-engineering which is most appropriate for an effective slope stabilization and erosion control.

c) Installation/placing of Coconets

The coconet 400 (for irrigation purposes) top edge (80mm) of the coconet shall consider an overlap accordingly and proper peg anchoring distance corresponding to the terrain slope as follows: for 75° slope, 1.00m coconet top edge overlap & must be folded thrice at 15cm peg distance; for 60° slope, 0.75m coconet top edge overlap & must be folded twice at 20cm peg distance; and 45° slope, 0.50m coconet top edge overlap & must be folded once at 25cm peg distance. The coconet then unrolled down the slope side-by-side to be sown together using cocowhine. The coconets shall be laid loosely (not stretched) on the ground. Coconet shall then be fastened and secured firmly to the ground in accordance with the proper anchoring protocol. Bamboo stakes shall be installed at approximately 12 slips per meter. Side stakes shall be installed at an interval of 30 cm across (horizontal) and 25 cm interval along the slope of the embankment (vertical) starting at the top berm which is approximately 12 bamboo stakes per square meter. The edge of the coconets is folded 10 cm underneath and lay towards the tip of the slope in accordance with the detailed design and approved plans or as directed by the Engineer.

d) Installation/Placing of Cocolog

The use of cocologs is optional, for slope more than 45° with a vertical height of more than 5 meters and/or the area is found to have massive water run-off velocity. At the top berm, the notch shall be deep enough to accommodate embedment of at least 1/2 the diameter of the cocologs in order to effectively dissipate run-off energy. Contour interval shall be at maximum of 7 meters depending on the steepness of the slope and the stabilization of the soil. The vertical cocolog shall be installed at a maximum of 5 meters interval as Collector Drain that will divert excess water run-off downstream and shall be pegged accordingly. Cocologs shall be firmly secured to the ground using bamboo stakes. The cocolog shall be installed starting and at the sides lengthwise. The center stakes shall be installed starting at a point 50 cm from the edge of the cocolog end at an interval of 100 cm thereafter. Side stakes shall be installed in pairs starting at the edge of the cocologs at an interval of 25cm thereafter. The last of either center or side stakes are installed 10cm from the edge of the last cocolog in a row, the distance from the preceding stakes being a fraction of 100 cm. The pairs of side stakes shall be laid with cocowhine looped at least 5 times and locked closely through knots in accordance with the detailed design and approved plans or as directed by the Engineer.

e) Vegetation

Deep cut canal with concrete lining; cut & berm slope along the canal bank & service/access road; drainage canal embankment & auxiliary embankment for high lined canal shall be planted with vetiver grass (variety may depend on the requirement in the area in accordance with the detailed design and approved plans or as directed by the Engineer) slips "diamond lay-out" at an interval of 15cm across (horizontal) and 50 cm interval along the slope of the embankment (vertical) which is approximately 12 slips per square meter, and/or may vary depending on the soil stabilization, slope steepness and water run-off velocity, in accordance with the detailed design and approved plans or as directed by the Engineer.

f) Constructor maintenance

- 1.1 Post project monitoring shall include checking on any breaks of the installed coconets especially at the point of junctions, the growth of the vegetation and the manifestation of any failure of germination of plants and the sudden outbreak of rain that might have inflicted damage to some sections. Repair works shall be done on damaged sections of the slope and replacement shall be done in case of plant mortality.
- 1.2 Constructor maintenance for watering, weeding and fertilization must be done within six (6) months from installation.
- 1.3 Proper training shall be extended to the farmer - Irrigators Association (IA) for the proper maintenance of the planted vegetation (vetiver) and handicraft training for the sustainable alternative source of income to the farmer-beneficiaries within the duration of six (6) months.

107. NOTICES

All notices, demands, and other communications required or permitted under this specifications/guidelines shall be in writing and addressed to the National Irrigation Administration (NIA), unless specified. Such notices and communications shall be deemed to have been duly given, upon receipt or confirmation.

108. METHOD OF MEASUREMENT

- a) The area to be measured for payment shall be within the limit of the entire right-of-way as shown on the Drawings or as stated by the Engineer during Construction Operations. All clearing and grubbing operations from areas to be put with coconet slope protection and elsewhere are considered subsidiary works required for other pay items in the Bill of Quantities and will not be measured for payment under this Section. The costs of such work shall be included in the contract unit price for the various items in the Bill of Quantities where clearing and grubbing are required.
- b) Measurement for embankment shall be done by the cubic meter of embankment in its final accepted compacted position regardless of the origin of materials and the required degree of compaction. Computation shall be by the Average End Area Method for every 20m station or by the applicable method suitable for the work involved. The volume shall be the theoretical volume of the embankment as computed based on the neat lines or paylines shown in the Drawings.
- c) Measurement for soil conditioner shall be done by the cubic meter of triple-armor method of bio-engineering in its final. Computation shall be by the Average End Area Method for every 20m station or by the applicable method suitable for the work involved. The volume shall be the theoretical volume of the embankment as computed based on the neat lines or paylines shown on the Drawings.
- d) Coconet shall be measured in square meters, installed, completed and accepted. This will be based on the surface covered including the overlapping top and bottom edges of the coconet.
- e) The cocologs in linear meter length of the top edge; and
- f) The effective vegetative growth of the vetiver grass is measured per square meter.

109. BASIS OF PAYMENT

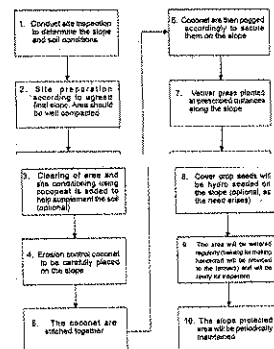
- a) Clearing and grubbing areas measured as provided above shall be paid at the Contractor unit price per square meter in the Bill of Quantities wherein price and payment shall constitute full compensation for furnishing all labor, tools, equipment, supplies and all incidentals or subsidiary works, including stripping within the 10-centimeter limit necessary for the successful completion of the work.
- b) The unit price shall constitute full compensation for any side borrow, borrow haul and overhaul operations made, acquisition of right-of-way (if necessary), clearing and grubbing of borrow area, excavation in borrow area, stripping of foundation (where necessary), hauling, loading, unloading, spreading, blending, moisture conditioning, stockpiling, compaction and trimming side slope (where necessary) including all labor, tools, equipment and all incidentals and subsidiary works, necessary for the successful completion of the work described under this Section. Provided, however, that payment shall only be made after presentation by the Constructor of a certification issued by the NIA Materials Testing Engineer to the effect that constructed embankment measured and covered by such progress payment has attained the required degree of compaction.
- c) The unit price shall constitute full compensation for cocopeat and coir fiber, stripping of foundation (where necessary), hauling, loading, unloading, spreading, blending, moisture conditioning, stockpiling, then raked and thumped side slope (where necessary) including all labor, tools, equipment and all incidentals and subsidiary works, necessary for the successful completion of the work described under this Section. Provided, however, that payment shall only be made after presentation by the Constructor of a certification issued by the NIA Materials Testing Engineer to the effect that constructed triple-armor measured thickness and covered by such progress payment has attained the required proper appropriate raked and thumped.
- d) The accepted quantity measured shall be paid for at the contract unit price for coconet, cocologs and vegetated with vetiver grass, wherein price and payment shall be in full compensation for supply/furnishing of materials, delivery/handling, storage and installation of coconets and for furnishing all labor, maintenance of plants, equipment, tools and incidentals necessary to complete the activities.

Payment shall be made on a per item basis according to the following:

Pay Item Number	Description	Unit of Measurement
1	Clearing and Grubbing	Square meter
2	Embankment Formation/Trimming and Manual Compaction	Cubic meter
3	Triple-armor (cocopeat and CH-W coir)	Cubic meter
4	Coconets	Square meter
5	Cocologs (Optional)	Linear meter
6	Vegetation	Square Meter

II. PROCESS FLOW IN THE INSTALLATION/CONSTRUCTION METHOD OF THE SLOPE PROTECTION USING COCONET AND VETIVER

INSTALLATION / CONSTRUCTION METHOD



This Order shall take effect after five (5) days following its publication in a newspaper of general circulation.

Approved by the PCA Governing Board per Resolution No. 045-2016.

GLENN B. SANTOS, CESE
OIC - Administrator