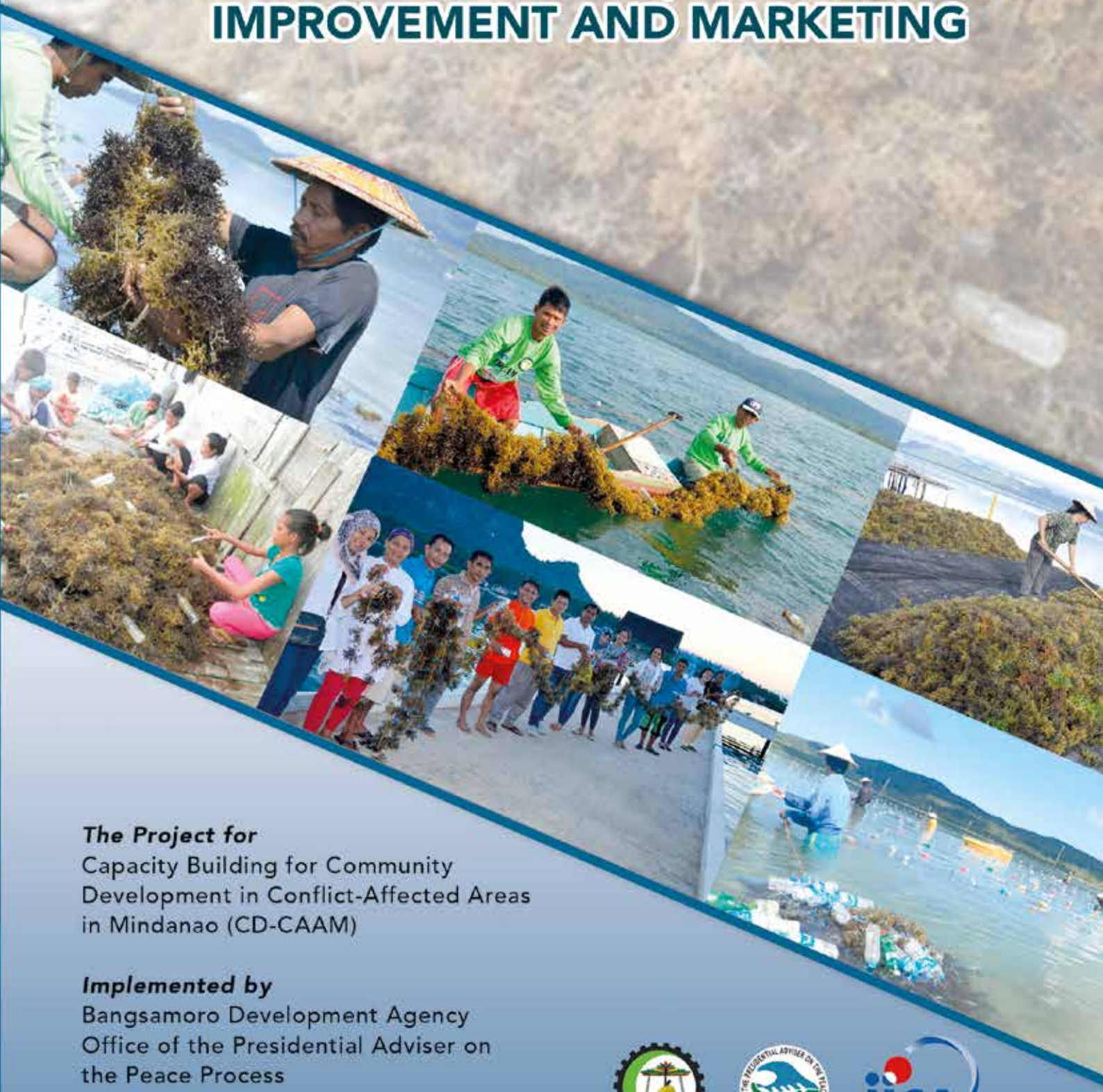
BASIC MANUAL

SEAWEED FARMING, POST-HARVEST IMPROVEMENT AND MARKETING



The Project for
Capacity Building for Community Development in Conflict-Affected Areas in Mindanao (CD-CAAM)

Implemented by
Bangsamoro Development Agency
Office of the Presidential Adviser on the Peace Process
Japan International Cooperation Agency

Foreword

This basic manual is written based on actual experiences of Ridjikih Fisherfolks Marketing Cooperative on seaweed culture, post-harvest improvement, and marketing under The Project for Capacity Building for Community Development in Conflict-Affected Areas in Mindanao (CD-CAAM) of the Japan International Cooperation Agency (JICA) in partnership with Bangsamoro Development Agency (BDA). The project was carried out in fifteen months from May 2015 to July 2016 at Brgy. Buan, Panglima Sugala, Tawi-Tawi, Philippines.

The purpose of this basic manual is to educate farmers in understanding the importance of good quality seaweed, the role they play, and the benefits they can achieve. The manual also provides guidance for buying agents, exporters and Fisheries officers in the roles they perform to improve and maintain the required quality of seaweed.

The project team is thankful for the technical assistance extended by the professors and researchers of Mindanao State University in Tawi-Tawi and in the Bureau of Fisheries and Aquatic Resources in Tawi-Tawi Province-ARMM. To Mr. Hasan Esmael, Provincial Project Operation Officer-Fishery of BDA Tawi-Tawi Provincial Management Office for his contribution and his strong desire to make this project study possible amidst challenges in monitoring due to the remoteness of the project site.

Likewise, to the Municipal Local Government Unit of Panglima Sugala for their full support in the field activities conducted and their guidance and motivation to the beneficiaries for the smooth implementation of the project.

July 2016
Fishery Sector
CD-CAAM Project

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1. Introduction

Seaweed *'Kappaphycus'* (originally called Eucheuma) have been commercially farmed in the Philippines since the 1970s in Sulu, Tawi-Tawi and Zamboanga[1], because of its extended shallow marine waters which is suitable for optimum growth of this commercially important marine plant.

Seaweed is an important material of "Carageenan"[2], which is widely used in the food and other industries as a thickening and stabilizing agent. Seaweed has shown increasing economic importance not only for its wide industrial uses but also for becoming one of the major contributors to growth of the fishery sector in the country. Seaweed farming is considered as the main income source among marginal fishers in ARMM particularly the Island Provinces of Sulu, Tawi-Tawi, Basilan and lately including Parang in Maguindanao with a 9.5% share in production volume (Table 1).

Table 1: Seaweed production in ARMM, 2005-2009. Bureau of Agriculture Statistics (BAS).

Provinces in ARMM	Annual Production (Metric Ton)					Annual Average	Share
	2005	2006	2007	2008	2009		
ARMM	510,137	560,684	617,624	657,159	683,084	605,738	
Maguindanao	14,450	55,800	64,007	74,116	80,222	57,719	9.5%
Lanao del Sur	0	0	0	0	0	0	0
Basilan	3,797	3,658	4,467	5,945	5,963	4,766	0.8%
Sulu	184,776	178,150	187,236	199,205	210,250	191,923	31.7%
Tawi-Tawi	307,114	323,076	361,912	377,892	386,648	351,328	58.0%

[1] *Hurtado, A.Q. and Agbayani, R.F. 2000. The farming of the seaweed Kappaphycus. Aquaculture Extension Manual. SEAFDEC. Tigbauan, Iloilo, Philippines.*

[2] *Carageenan is a natural product extracted from Kappaphycus. It has a wide range of use because of its suspending, thickening and gelling properties.*

The province of Tawi-Tawi has one of the largest shallow water areas suitable for seaweed farming in ARMM with 58% production share (Table 1) while Panglima Sugala municipality is one of the major seaweed producers in the province because of its large area for seaweed farming that are distributed in seven (7) island barangays including Buan (CD-CAAM target barangay) which have an aggregate total area of 1,094 hectares, with a total yield of 9.846 metric tons per hectare recorded in 2001 and has a value of 147.69 million pesos[3]. Aside from seaweed, it is recorded that gathering of shells and sea cucumber at night from natural stocks is another source to augment the income of the fishermen while waiting for seaweed to be harvested, therefore farmers can also diversify into sea cucumber culture in sea pens along with seaweed farming.

The contribution of seaweed farming to peace and development could be underscored especially in the conflict-affected areas because the technology is simple, adaptable, with available market, and a highly profitable investment. It has become a popular alternative livelihood in Southwestern Mindanao to uplift the socio-economic status of small-scale fishers and to reduce fishing pressure on overexploited fisheries. It has been incorporated into many community-based coastal resources management projects and fisheries management initiatives as an alternative livelihood for fishers.

Seaweeds farmers in this part of the region are more often victims of monopoly that are flourishing in domestic market both from foreign and domestic buyers. Middlemen and consolidators are slashing off the prices due to moisture content or foreign mixtures. With this in mind, this project is designed to promote good seaweed farming practices, improved post-harvest management, as well as the formation of an organization of seaweed farmers that will endeavor to build strong marketing linkages by establishing marketing tie-up/ covenant/ contract with local and export markets, so that farmers will reap the benefits on the advantage of better market prices.

[3] *CDP-ELA 2008-2010. Municipality of Paglima Sugala, Tawi-Tawi.*

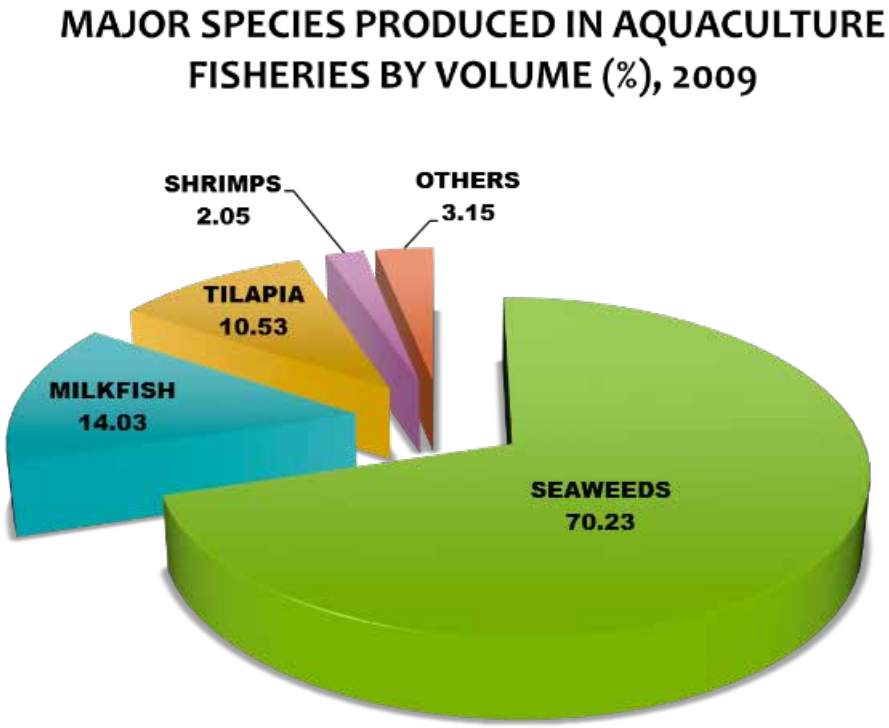


Figure 1. Major species produced in aquaculture in the Philippines. BFAR, 2011.

1.1. What is Seaweed 'Kappaphycus'

Kappaphycus is a red seaweed locally called 'agal-agal' or 'guso' in the Philippines.

Seaweed grows well in reef flats with coarse sandy coral substratum exposed to moderate water movement in the tropical intertidal and subtidal waters[4].

There are two genera of seaweeds as carrageenan materials namely *Eucheuma* and *Kappaphycus*. *Kappaphycus alvarezii* and *striatum* are the two most commonly cultured in Tawi-Tawi and in other areas in ARMM.

[4] *Hurtado, A.Q. and Agbayani, R.F. 2000. The farming of the seaweed Kappaphycus. Aquaculture Extension Manual. SEAFDEC. Tigbauan, Iloilo, Philippines.*

Figure 2. Commercially cultured seaweed 'Kappaphycus' in the Philippines. Kappaphycus alvarezii (a,b,c) and Kappaphycus denticulatum (d).

(a)

(b)

(c)

(d)

1.2. Importance of Seaweed 'Kappaphycus'

1.2.1. Seaweed farming is a family-based enterprise and considered one of the major sources of livelihood for coastal communities in Southwestern Mindanao (Sulu, Tawi-Tawi and Basilan) Philippines. As the seaweed industry grows and expands, so does the number of farmers and families involved in seaweed farming. Seaweed farming generates direct employment.

Figure 3. Beneficiary from Brgy. Buan assisted by members of her family in seaweed seedling preparation like cutting and tying to main cultivation line.

1.2.2. Seaweed is extracted for its "Carrageenan", which is widely used in the food and other industries as thickening and stabilizing agents.

Table 2. Industrial application of carrageenan extracted from seaweed 'Kappaphycus'[4]

USES	FUNCTION
(1) Meat preparation and processing	• Improves meat texture and sliceability, tenderizes meat products and retains flavor • Increase the shelf life, will not impart off-flavor • Prevent shriveling and shrinkage of processed poultry products
(2) Dairy products and desserts	• Boost the solubility and stability of coffee whiteners • Improve the creaminess, texture and consistency of ice cream and related products
(3) Beverages and juices	• Eliminates beer clouding resulting to sparkling, clear beer • Improves filterability, taste and chill stability

[4] *Hurtado, A.Q. and Agbayani, R.F. 2000. The farming of the seaweed Kappaphycus. Aquaculture Extension Manual. SEAFDEC. Tigbauan, Iloilo, Philippines.*

(4) Cosmetics and personal care products	• Ensure excellent stability of toothpaste under conditions of wide temperature variation; enhance shape retention, retains moisture and provides smooth and even consistency to toothpaste • Gives body to hair gels and reinforces its holding effect
(5) Pet foods	• Binds water, provides structure, and prevents fat separation during processing • Maintain uniform moisture throughout the can • Provide an excellent sheen to the product
(6) Air freshener gels	• Provides structure and controlled release of active ingredients such as perfumes and water gel base
(7) Sauces and salad dressings	• Prevent water separation • Soften harsh spice flavor • Provides consistency • Prevent sedimentation of solid particles in suspension
(8) Bread noodles and pasta	• Forms gel matrix during cooking cycle, thus binding moisture and providing additional structure • Improve resistance of noodles and pasta to breakdown during cooking • Increase water binding capacity of wet noodles, resulting in weight increase • Increase rates of extrusion • Gives products a superior polished surface

2. Culture techniques in seaweed 'Kappaphycus' farming

Multiple planting techniques have been applied by seaweed farmers in Tawi-Tawi, however, the choice of respective method is dependent on location of farm site and weather condition. Buan is located in a cove surrounded by mangrove area, sea grass beds, and patchy coral cover on shallow reef flats, therefore, the method discussed in the succeeding pages are applicable and have been adopted by local farmers.

2.1. Off-bottom stake method (Figure 4) – this technique is applied in shallow water areas, sometimes dried-up during lowest low tide. Seaweed lines are being tied to wooden stakes at both ends.

Figure 4.a. Seaweed exposed at lowest low tide applying off-bottom stake method in Brgy. Liyaburan, Panglima Sugala

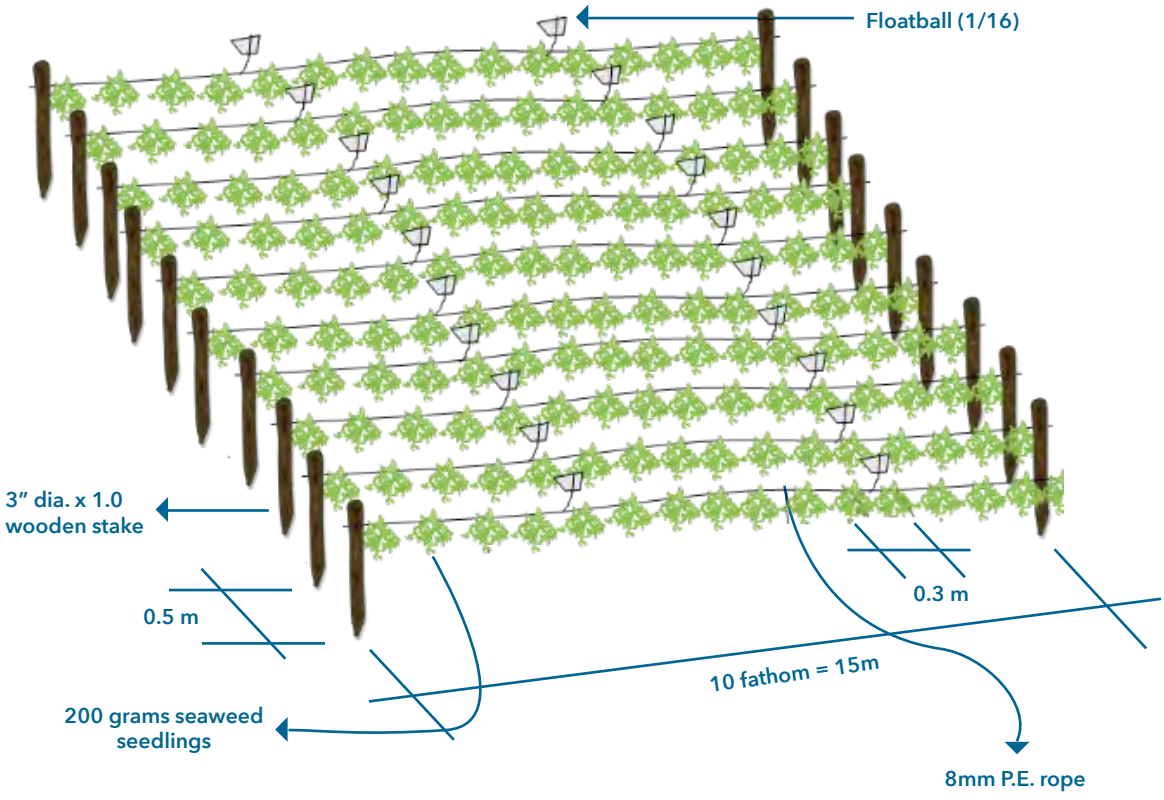


Figure 4.b. Diagram of off-bottom stake method

2.2. Floating method – It is applied in deeper water areas using floating materials like PET bottles, styrofoam, and bamboo poles. The seaweed lines are being tied into a raft constructed out of bamboos or polyethylene ropes.

There are many types of floating methods applied by seaweed farmers in Tawi-Tawi; it is just being modified according to the location, its adaptability, and the availability of local materials.

2.2.1. Mono-line Floating Method – is the technique where the main seaweed cultivation line is fixed at both ends using wooden stakes or iron rods. This method is usually applied in wider, exposed, and deeper water areas.

Figure 5.a. Monoline floating method in Brgy. Alu Layag-Layag, Parang, Sulu

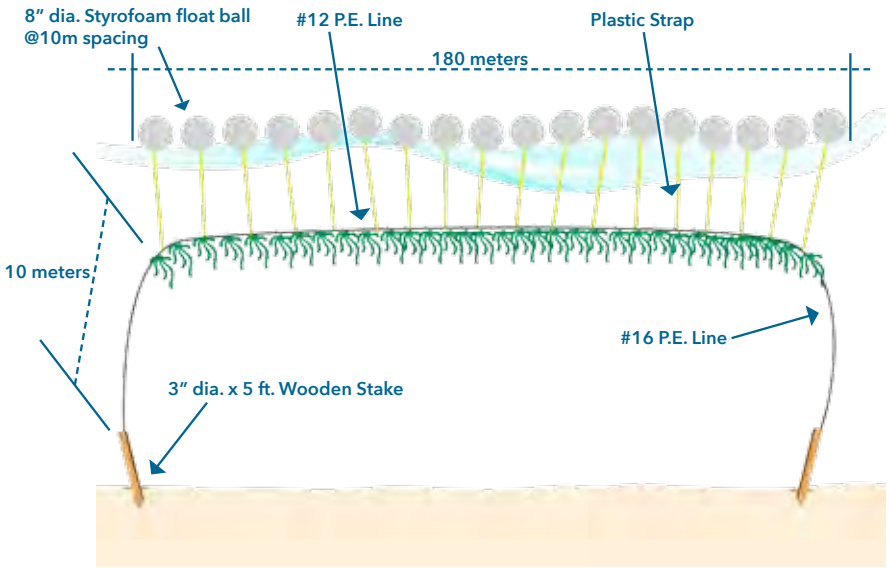


Figure 5.b. Diagram of mono-line floating method (Source: USAID LEAP Program)

2.2.2. Modified Floating Triangular Method (Pasengkang) – is the technique where the main line is fixed at both ends using wooden stakes or iron rods. A series of 1-meter seaweed cultivation lines are tied-up at both ends to the main line at a distance of 1 meter from each line to maintain an approximate 45° angle (Figure 6.b). This method is usually applied during northwest monsoon (saatan) in Buan, Panglima Sugala in Tawi-Tawi.

Figure 6.a. Modified Floating Triangular Method in Brgy. Kulape, Panglima Sugala

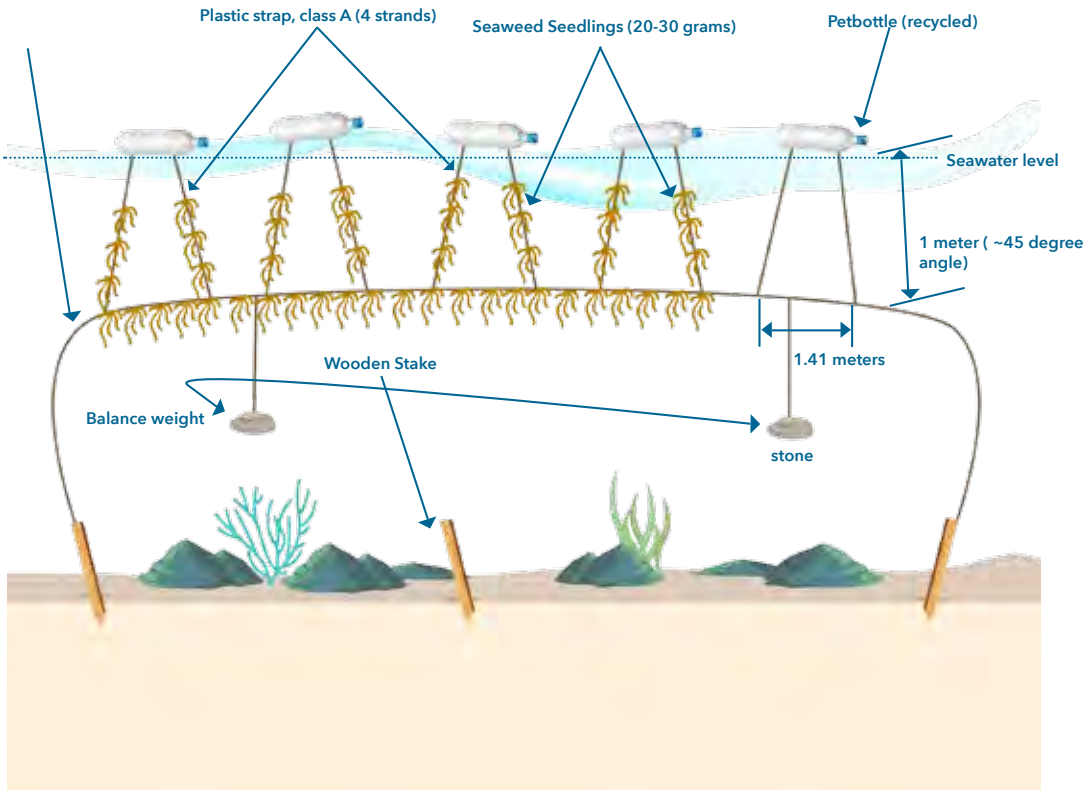


Figure 6.b. Diagram of Modified Floating Triangular Method "Pasengkang"

2.2.3. Modified Floating Joint Method (Patundan) – This method is a modification on the seaweed cultivation line which is quite simple, manageable even by women, at a low cost, and deemed more effective based on farmers' experience. Moreover, it is applicable on all seaweed farming techniques except in the seaweed line materials that may vary from site to site.

Figure 7.a. Modified Joint Floating method at Hamri Reef (CD-CAAM Project) in Brgy. Buan

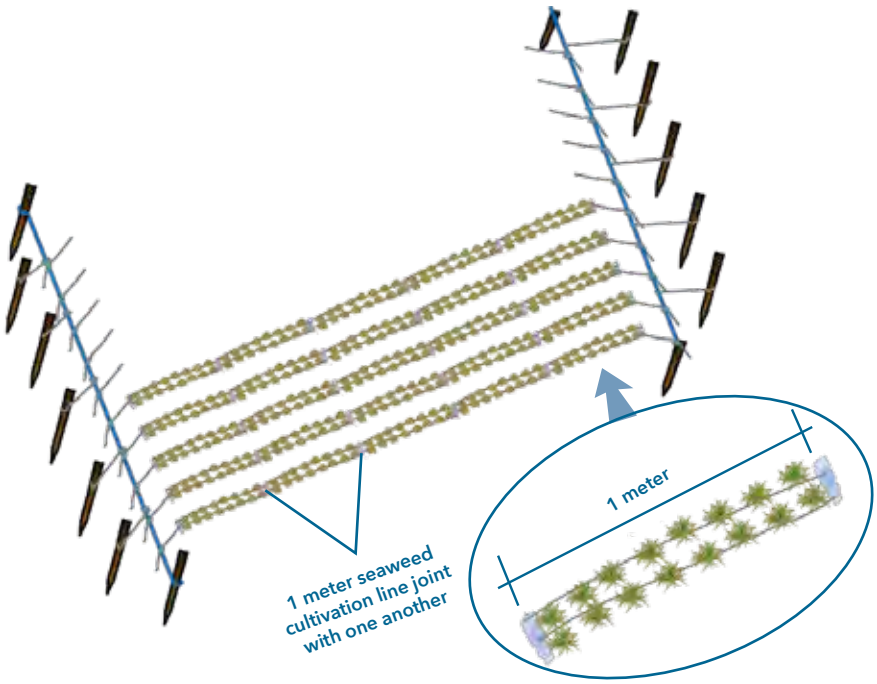


Figure 7.b. Diagram of Modified Floating Joint Method 'Patundan'

3. Stages in Seaweed 'Kappaphycus' Farming

3.1. Site selection

Like other aquaculture businesses, seaweed farming needs proper site for optimum plant growth, therefore the following should be considered:

- With moderate to strong water currents and wave action but not strong enough to damage the farm;
- Far from freshwater (e.g. river) sources as it affects seaweed growth;
- The water should be generally clean and away from industrial waste and pollution, therefore island barangays, like Buan, are practical sites.
- Substrate covered with vegetation (e.g. seagrass and algal beds). The site should have a water temperature of 24° celsius to 30° celsius and salinity of 27 to 35 parts per thousand;
- Away from water transport highway.

Figure 8. Site selection and water quality analysis by technical partner (MSU-Tawi-Tawi)

(a) Determining water salinity

(b) Determining the pH, Phosphate (PO_4), Nitrate (NO_3), and Ammonia (NH_3)

(c) Selected site at Hamri Reef

(d) Sites near households to strengthen security

Figure 9. Seaweed farm sites in Bgry. Buan established under CD-CAAM Project.

(a) Hamri Reef Seaweed Farm

(b) Biha Seaweed Farm

(c) Taytayan Seaweed Farm

(d) Tinambang Farm

(e) Capitol Seaweed Farm

(f) Tabba-Bato Seaweed Farm

3.2. Preparation of seaweed seedlings and planting materials

3.2.1. Use of Locally-Available Materials

It is recommended that the project utilizes only locally-available materials/inputs required in seaweed farming.

Figure 10. Locally-available materials/inputs required in seaweed farming

(a) Plastic straw, softie

(b) Plastic strap, double strand, class A

(c) Recycled PET bottles

(d) Polyethylene rope, #12

(e) Stainless knife

(f) Good quality seaweed seedlings

(g) Pointed iron bar

(h) Sledge hammer

(i) Wooden post

(j) Measuring tape

3.2.2. Preparation of 1-meter seaweed cultivation lines

- Prepare a 2.5 meter plastic strap double strand, tie both ends to fix to PET bottles (Figure 11.a)
- Tie softie strand to the prepared 1-meter seaweed with cultivation line at a distance of 6 to 8 inches between each tie (Figure 11.b and 11.c)
- Tie seaweed seedlings individually with average weight of 20 to 50g into 1-meter cultivation line (Figure 11.d)
- Maintain about 15 to 20 centimeter distance between seedlings in a 1-meter float line to prevent shading and for good growth of seaweed plants.
- Jointly tie 10-units of 1-meter seaweed cultivation lines for lighter loads in bringing to farm site (Figure 11.e)
- Before planting, seaweed cultivation lines should be immersed in the water to prevent desiccation (Figure 11.f)

Figure 11. Processes in the preparation of 1-meter seaweed cultivation lines

(a)

(b)

(c)

(d)

(e)

(f)

3.2.3. Selection of good seaweed seedlings

- Select seaweed with healthy and young branches (thalli) with no signs of diseases or infection from epiphytes
- Thalli must be smooth, slippery, and brittle [5] (Figure 12.a)
- When cutting, use sharp stainless steel knife (Figure 12.b)

Figure 12. Selection of good seaweed seedlings

(a)

(b)

[5] *Romero, J.B.A presentation on Seaweed Farming and Farm Management. College of Fisheries. MSU-TCTD, Sanga-Sanga, Bongao, Tawi-Tawi.*

4. Establishment of Seaweed Farm

- Prepare necessary materials (see Figure 10).
- Clean substrate of targeted farm sites from any debris, slow moving organisms/predators like sea star, crabs, sea urchins, etc. using rake or stake (Figure 13.a)
- Remove old and rotten stakes for sites that has been previously utilized.
- Establish prime corner stake at desired site, followed by 2nd, 3rd and the last stakes required to make it strong, and measure the areas using fiber glass measuring tape (Figure 13.b).
- Tie well the main seaweed line (PE rope # 12) from stake to stake (Figure 13.c).
- Tie 10-meter joint seaweed cultivation lines to main seaweed line from end to end using class "A" plastic binder (Figures 13.d and 13.e).
- Maintain a distance of 2 meters from each seaweed cultivation line (Figure 13.f).

Figure 13. Steps in establishment of seaweed farm in Brgy. Buan, Panglima Sugala

(a)

(b)

(c)

(d)

(e)

(f)

5. Seaweed Farm Management

- Visit seaweed farm daily if possible or at least 3 times a week and check for any damages in the seaweed farm such as ropes dismantling and others.
- Remove floating debris caught in the lines or in seedlings, place it in plastic basin and bring on land; do not throw back debris to the sea
- Remove slow moving grazers such as sea urchins, crabs, sea stars etc. (Figure 13.a)
- Immediately remove ice-ice disease infected seaweed to avoid contamination.
- If more than 10% of the seaweed plants are estimated to have been infected by ice-ice disease, it will be better to harvest immediately all the plants for good value recovery.

6. Establishment of Seaweed Seedling Bank/Nursery

- A seaweed seedling bank/nursery is important due to the following.
  - to ensure a sustainable supply of seaweed for successive farming cycles;
  - to maintain good quality variety of seaweed strains;
    to reduce expenses from constantly procuring seaweed seedlings
  - from other areas/municipalities which is costly and sometimes is unavailable

- Seaweed seedling bank/nurseries should be established in multiple sites utilizing multiple farming techniques.

7. Common Seaweed Diseases and its Remedy (based on Farm Experience)

1) Ice-ice – it is the whitening of seaweed branches usually in the basal parts of the thalli, it is a phenomenon caused by low salinity, temperature and light intensity [6]. Ice-ice will appear during southeast monsoon (locally termed 'uttara') and will disappear after 2-3 months[7].

Effects: loss of color and consequently, disintegration, and die-off.

Practical remedy: Remove the affected parts, harvest, or do seedling and transfer to other locations.

Figure 14. Seaweed disease "ice-ice" affects cultured seaweed in Brgy. Buan

Ice-ice as described by the experts as the whitening of the seaweed 'Kappaphycus' branches because of low salinity, changes in water temperature and sunlight intensity that causes stress to the marine plants. Drying of all the seaweed plants is the best remedy to avoid loss.

[6] *Hurtado A.Q., Agbayani R.F. 2000. The Farming of the Seaweed Kappaphycus. SEAFDEC AQD. Tigbauan, Iloilo, Philippines.*
[7] *Interview with Mr. Hamri Jupuri, 20 years seaweed farmers in Brgy. Buan, Panglima Sugala, Tawi-Tawi. March 28, 2016.*

2) Epiphytes – An aquatic marine plant attached to the cultured seaweeds. It is harmful to the infected plants because it penetrates to the outer layer of the host cell wall, invades it and then damages its tissue.

Effects: Competes for space, sunlight, nutrients and dissolved gases that lead to stunted seaweed growth.

Practical remedies:

1) For **endo epiphytes**

- Remove all the infected seedlings, harvest and sun-dry if already bigger
- Re-seedling bigger plants but make sure to tie it in new cultivation lines and also transfer locations

3) For **macro epiphytes**

- Submerge the plants by putting water half-full in the floats because macro algae is at the surface, however if it cannot be controlled, better to change sites.

Figure 15. Macro algae attached to cultured seaweed in Brgy. Buan

Macro algae, called by locals as 'lumot' is an epiphyte or non-parasitic algae attached to the seaweeds covering the photosynthetic area of the plant that inhibits sunlight which is necessary in the food-making capabilities of the plant. Seaweeds infested with epiphytes have stunted growth.

3) Contaminants – are drifted materials, either domestic or natural, that may be pollutants to the farm.

Domestic wastes are disposals being thrown to the sea which drift along to the seaweed farms and get contact with seaweed.

Natural contaminants usually results from seaweed bloom due to long term sunny days or an effect from El Niño phenomenon.

Effects:

- The direct contact of seaweed to domestic waste makes it prone to fungal infection.
- In natural contaminants, this will cover the seaweed branches (thalli) which will be smothered and lead to ice-ice disease and die-off if not taken cared of.

Practical remedy:

- Regular monitoring/visitation is a prime factor to determine the current condition of the seaweed farm.
- Cleaning of the seaweed farms in order to maintain seaweed branches' (thalli) growing condition.
- Transfer the seaweed to another farm site that is free from these types of contaminants.

Important notes:

- Seaweed farmers should have more than one farming site to sustain seaweed farming activities.
- Observe the condition of seaweed for about a week in a certain site by doing test plant of about 5 to10 cultivation lines before full blown planting of targeted volume.
- Southeast monsoon (uttara) is a good planting season for open seaweed farming areas due to its constant surface water movement. It is occasionally not good seaweed farming season to those sites near land mass or marginal farm areas due to its unstable wind directions.

8. Harvesting of Seaweed

- Harvest seaweed after 45/60 days culture period from re-seedling (Table 3)
- Remove seaweed from the lines and clean all impurities such as plastic straw, algae, sand, and shells, fishes which are not acceptable to buyers or processors.

Important notes:

- The seaweed may break its branches when we allow it to grow for more than 60 days.
- Observations revealed that seaweed will turn to smaller clumps when it passes the 60 days period.
- Impurities tend to lower the selling price of seaweed at a certain percentage.

Figure 16. Proper harvesting of seaweed

(a) Loading of seaweed to transport boat

(b) Transport of seaweed from farm sites to stilt-type solar dryer

(c) Place seaweed on top of stilt-solar dryer

Table 3 shows the growth increase of seaweed seedlings from 20.7g average weight to 124.2g/seedling average weight after 45 days of culture. Therefore, it is computed that the average daily growth increase of seaweed cultured in Brgy. Buan under CD-CAAM project is 2.3g/day. In terms of weight, 320g is the highest and 40g is the lowest.

Table 3. Weight increase of seaweed after 45 days of culture in Brgy. Buan, Panglima Sugala[8]

Initial weight at planting (ave.)	Final weight at harvest (ave.)	Weight gain after 45 days	Growth increase per day
20.7g	124.2g	103.5g	2.3g

[1]*End sampling conducted on May 3, 2016.*

9. Drying of Seaweed

a. Stilt-type solar dryer – above the ground drying is the best way to dry seaweed as it will keep away from contamination with dirt and other materials which could affect the quality of dried seaweed and reduce its selling price (Figure 17.a). On the ground drying is a bad practice (Figure 17.b).

Figure 17. Seaweed Solar Dryer

(a) Stilt-type Solar Dryer (Best practice)

(b) On-the-ground Solar Dryer (Bad practice)

b. Spread the seaweed (Figure 18) – during the drying process, spread harvest seaweed evenly using rake so that it can easily be turned upside down for quicker drying. Piled seaweed during drying will rot, lower its quality and will take longer drying time[9]. Do not cover seaweed directly during solar drying, it will cause condensation and will bleach seaweed. Likewise, it will cause heat up and cook the seaweed.

Figure 18. Spreading the seaweed during drying

(a) Removing seaweed from cultivation lines

(b) Spread seaweed evenly using rake

(c) Well spread seaweed for quick drying

[9] *Tiroba, Gideon. Seaweed Quality Control: a practical guide for seaweed farmers, seaweed extension officers, buying agents, and fisheries officers and exporters. Secretariat of Pacific Community Cataloguing-in-publication data. 2007.*

c. At night - The seaweed should be covered with plastic/ tarpaulin (Figure 19.a). The cover should be raised to protect seaweed from condensation. It also allows air movement over the seaweed, which helps in speeding up drying process.

d. During rainy days - Install raised plastic covers (Figure 19.b) to protect seaweed from contact with freshwater because it will lower the quality of seaweed and reduce the weight by washing its natural salt and will dissolve in freshwater.

Figure 19. Installation of plastic cover at night and during rainy days

(a) At night *(b) During rainy days*

Important notes:

- Seaweed will be dry in 3 days at full sunlight and 5 days when sky is overcast or there is occasional rain.

Table 4. Level of moisture content and corresponding quality of dried seaweed[10]

Moisture content (%)	Seaweed condition
35-39	Most stable
>40	Undergo degradation during storage
25-35	Relatively stable for periods in excess of 12 months (efficient for baling)
15-25	Extremely stable. But thalli maybe too brittle; resists pressure or snap bailing
<15	Stable, but can cause processing problems

[10] *Hurtado, A.Q. and Agbayani, R.F. 2000. The farming of the seaweed Kappaphycus. Aquaculture Extension Manual. SEAFDEC. Tigbauan, Iloilo, Philippines.*

10. Packaging and Storage

- Place the seaweed in the sack after drying. Never mix seaweed of different varieties in one sack.
- Weigh the sacked seaweed to keep record, and put marking on the sacks.
- Store seaweed in a dry well-ventilated storage area.

Figure 20. Processes of packaging and storage

(a) Well dried seaweed after 3-4 days of drying

(b) Removing debris (tie, rubbles etc.)

(c) Sacking dried seaweed

(d) Tying sack with seaweed properly

(e) Weighing at farmers sacks at farmers' site

(f) Proper warehousing while waiting for transport to market

11. Transport and Marketing

- Before delivery and selling, weigh the sacked seaweed and contact prospective buyers about current buying price. Look for a buyer who is trustworthy and dependable.
- Avoid contact of dried seaweed with water (rain or seawater) during transport as this reduces seaweed quality.
- Provide guidance to laborers to avoid seaweed falling-off to the sea during transport.
- Watch closely the weighing at buying station, keep a separate record if necessary.

Figure 21. Transport and Marketing of Dried Seaweed

(a) Transport dried seaweed with beneficiaries to Bongao town

(b) Weighing at buying station (Bongao Fish Trading)

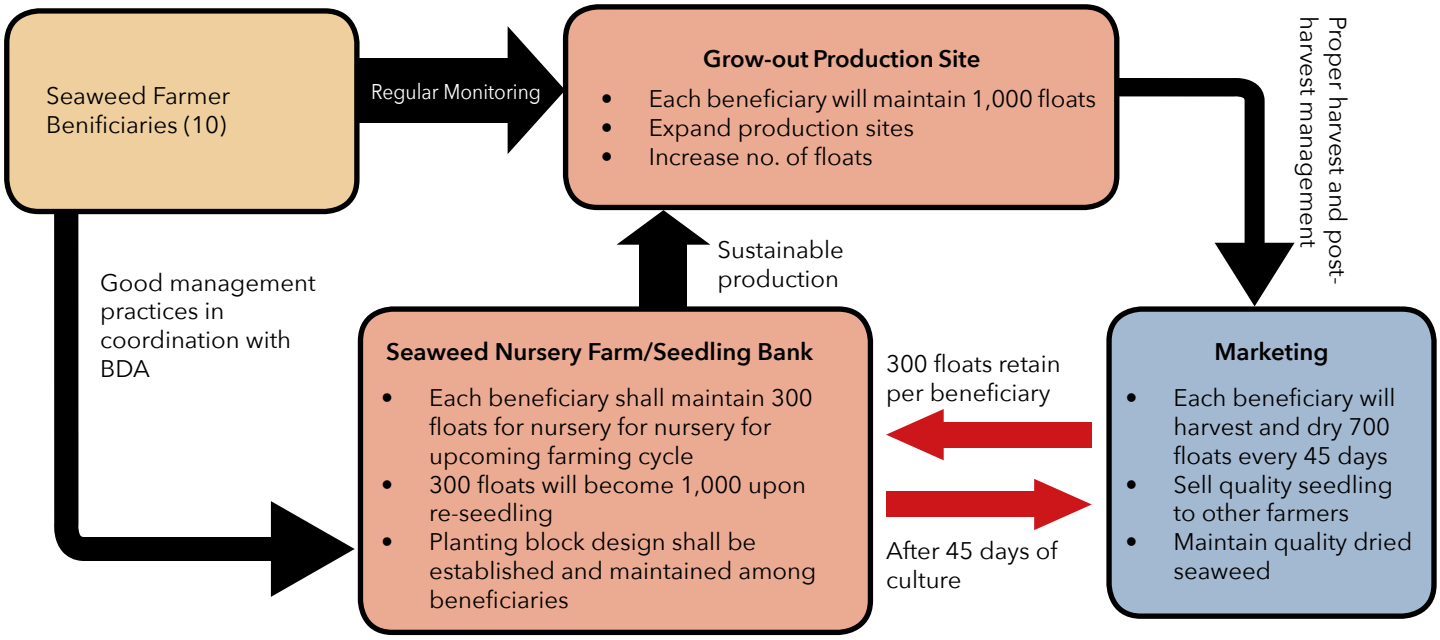
(c) 1st sale by CD-CAAM beneficiaries (PhP10,170)

12. Sustainable Approach of Seaweed Farming (Adopted by CD-CAAM in Brgy. Buan)

Seaweed farming can be more sustainable if the establishment of seaweed seedling bank/nursery to be managed separately by individual farmers near the grow-out farm is considered. The purpose of a seaweed seedling bank is to provide a sustainable supply of seaweed for successive farming cycle; to maintain and retain quality variety of a seaweed strains; and to reduce expenses from constantly procuring seaweed seedling every culture cycle from other areas/ municipalities which entail additional costs for the farmers and is sometimes unavailable.

Aside from the establishment of a seaweed seedling bank/nursery, farmers should also consider establishing multiple farm sites and adopting more than one farming techniques (see pages 6 to10 Culture techniques in seaweed farming).

Figure 22. Sustainable approach of seaweed farming (Adopted by CD-CAAM in Brgy. Buan)



13. Profitability of Seaweed 'Kappaphycus' Farming

The profitability of seaweed farming discussed in the succeeding page is based on the actual experience of Ridjikih Fisherfolks Marketing Cooperative under CD-CAAM Project in Brgy. Buan, Panglima Sugala, Tawi-Tawi.

The community beneficiaries in Brgy. Buan started their seaweed farming on January 2016 at Hamri Reef (Figure 9). After 45 days of culture period, they harvested or took out grown seaweed from the farm site (see Figure 10.a) and had their first re-seedling activity. There was no drying of seaweed being done in the first culture cycle intentionally to expand production from 3,000 floats to 10,000 floats at six (6) farm sites (Figure 9), and after 45 to 60 days thereafter, harvest will start.

Initial harvest and drying was conducted on May 27, 2016 while transport and marketing was done on June 16, 2016 at Bongao Fish Trading in Bongao town, Tawi-Tawi.

Table 5 shows the results of seaweed culture with 45-day culture in 1 (one) block that has an area of 600m^2. They had a net income of P2,081 by 45-day operation with return of investment (ROI) of 284%, a high enough rate for sustainable aquaculture business.

Table 5: Results of seaweed culture per block in Buan, TawiTawi (2016)

A.	**Total cost for facility per block (600m^2): PhP**	**4,012.00**
1	Cost of materials[11]	3,489.00
2	Cost of handling and transport :15% of material cost	523.00
B.	**Total production cost: PhP**	**2,138.00**
1	Seedling	1,920.00
2	Depreciation: 2-year life	218.00
C.	**Sales/Gross income per block with 45-day culture**	**8,232.00**
1	Harvest: Dried weight, 35% Moisture content (kg)	329
2	Selling price: PhP/kg	25.00
D.	**Net income per block**	**6,094.00**
E.	**ROI (%)**	**284**

Table 6. Material cost for establishment of 1-block 10m x 20m seaweed farm (2016)

Item/Description		Unit	Quantity	Unit Cost	Total Cost
A.	**Materials for establishment of 20x30m seaweed farm**				
1.	Plastic straw, softie, 1,000m/roll	Kg	0.48	160.00	77.00
2.	P.E. Rope #12, 200m/roll	roll	0.44	400.00	176.00
3.	Pet bottle, recycled	Pc	300	1.00	300.00
4.	Plastic binder, four strand class "A", 200m/roll	roll	4	150.00	572.00
5.	Wooden stake	Pc	20	20.00	400.00
6.	Sledge hammer	Pc	1	395.00	395.00
7.	Knife	Pc	10	35.00	350.00
8.	Measuring tape, 50m length	Pc	1	640.00	640.00
9.	Iron rod	pc	1	580.00	580.00
	Total material cost (PhP)				**3,489.00**
	Add: Handling and transport cost (15%)				523.40
	Total cost (PhP)				4,012.00

Potentially, farmers can have 6 to 7 culture cycles of seaweed per year with 45 days operation at optimum condition. Table 6 shows expected cost and profit per year in the project site, assuming that 100 blocks are in full

[11] *See Table 6*

operation by September 2016. It will be a great impact and will contribute to income generation in the project area if full-scale operation with 100 blocks is realized.

Table 7: Expected cost and profit of seaweed culture in full operation per year: PhP

A.	**Total production cost:**	**PhP 1,496,600.00**
B.	**Sales/Gross income per block with 45-day culture**	**5,792,400.00**
C.	**Net income per block**	**4,265,800.00**
D.	**ROI (%)**	**284**

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The Project for

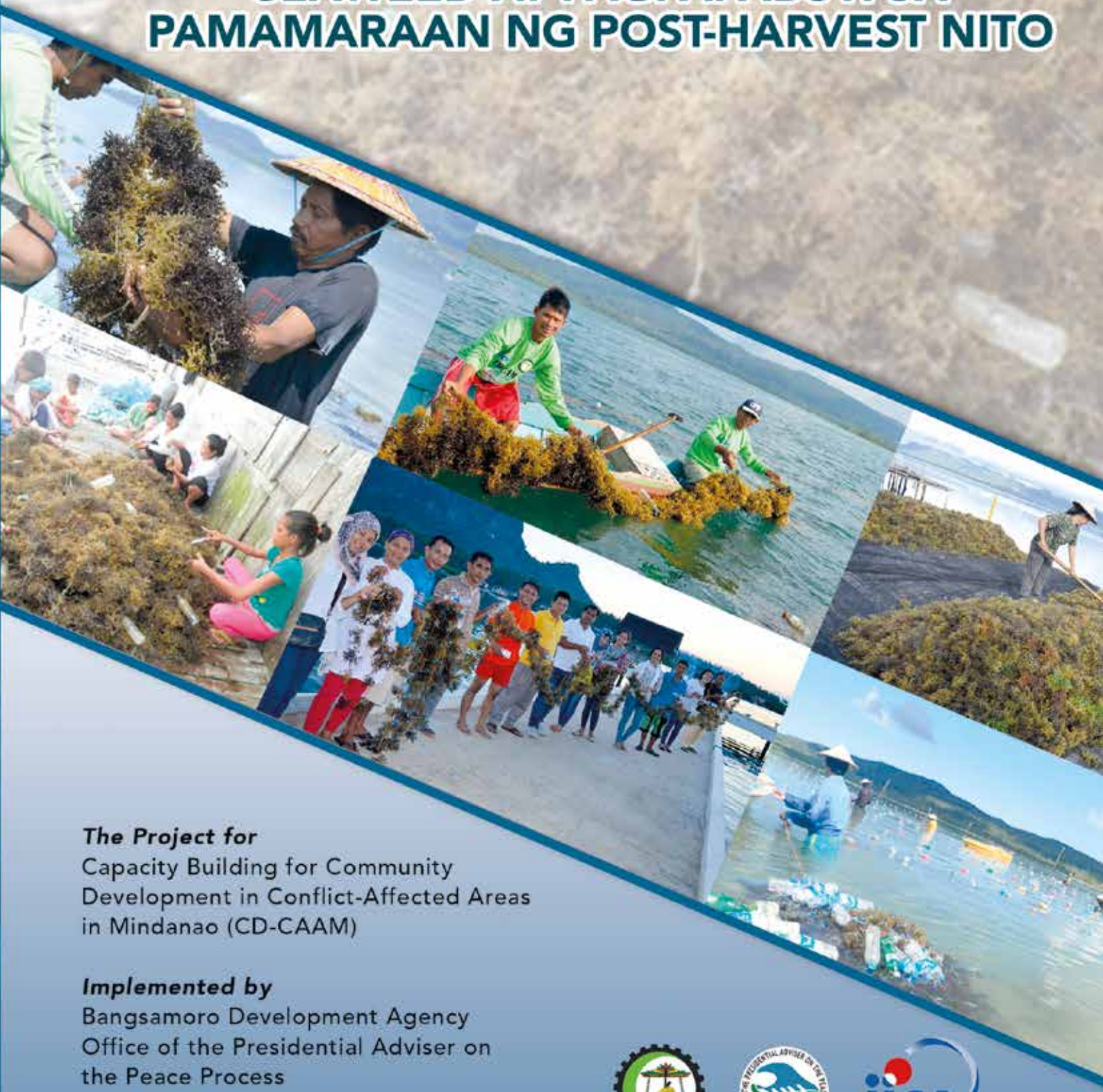
Capacity Building for Community Development in Conflict-Affected Areas in Mindanao (CD-CAAM)

Implemented by

Bangsamoro Development Agency (BDA)
Office of the Presidential Adviser on the Peace Process (OPAPP)
Japan International Cooperation Agency (JICA)

PANGUNAHING GABAY

SA PAGLILINANG AT PAGBEBENTA NG SEAWEED AT PAGPAPABUTI SA PAMAMARAAN NG POST-HARVEST NITO



The Project for
Capacity Building for Community Development in Conflict-Affected Areas in Mindanao (CD-CAAM)

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Bangsamoro Development Agency
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Japan International Cooperation Agency

Paunang Salita

Ang pangunahing gabay na ito ay isinulat base sa aktwal na karanasan ng Ridjikih Fisherfolks Marketing Cooperative sa paglilinang at pagbebenta ng seaweed at pagpapabuti sa pamamaraan ng post-harvest nito sa ilalim ng The Project for Capacity Building for Community Development in Conflict-Affected Areas in Mindanao (CD-CAAM) ng Japan International Cooperation Agency (JICA) katuwang ang Bangsamoro Development Agency (BDA). Ang proyektong ito ay naipatupad sa loob ng labinlimang (15) buwan mula noong Mayo 2015 hanggang Hulyo 2016 sa Barangay Buan, Panglima Sugala, Tawi-Tawi, Philippines.

Ang layunin ng pangunahing gabay na ito ay turuan ang mga mangingisda na maunawaan ang kahalagahan ng pagkakaroon ng magandang uri ng seaweed, ang kanilang papel sa paglilinang ng seaweed at ang makukuha nilang benepisyo mula dito. Ang gabay na ito ay nagbibigay patnubay rin sa mga mamimili, mga exporter at mga Fisheries Officers sa kanilang mga papel na gagampanan upang mapabuti at mapanatili ang magandang kalidad ng seaweed.

Nagpapasalamat ang project team sa mga tulong na teknikal na binigay ng mga professor at mga mananaliksik ng Mindanao State University ng Tawi-Tawi at ang Bureau of Fisheries at Aquatic Resources ng Tawi-Tawi Province-ARMM. Ganoon din kay Ginoong Hasan Esmael, Provincial Project Operation Officer-Fishery ng BDA Tawi-Tawi Provincial Management Office sa kanyang mga naiambag na tulong at ang pagnanais niyang magtagumpay ang proyektong ito sa kabila ng mga pagsubok sa pagsubaybay dahil sa layo ng lugar na isinagawa ito.

Kami ay nagpapasalamat din sa LGU ng Panglima Sugala para sa kanilang buong suporta sa mga ginanap na aktibidad at sa gabay at pagganyak sa mga benepisyaryo para sa maayos na pagsasakatuparan ng proyekto.

Hulyo 2016
Fishery Sector
CD-CAAM

Talaan ng mga Nilalaman

1. Panimula

Ang seaweed '*Kappaphycus*' (kilala din sa pangalang *Eucheuma*) ay sinimulang inaalagaan ng pangmalakihan noong 1970s sa Sulu, Tawi-Tawi at Zamboanga[1], dahil sa malawak at mababaw na karagatan na meron dito na naaangkop para sa paglago nitong mahalagang pagkomersyal na tanim dagat.

Ang seaweed ay pangunahing pinagkukunan ng "*Carageenan*"[2] na karaniwang ginagamit sa pagkain at sa ibang industriya bilang pampalapot at pampatatag na sangkap. Hindi lang sa dami ng pagagamitan ng seaweeds sa industriya makikita ang kahalagahan nito sa ekonomiya ngunit pati na rin sa malaking kontribusyon nito sa pagpapalaganap ng sektor ng pangingisda sa bansa. Ang pagpaparami ng seaweeds ang kinikonsidera na pangunahing kabuhayan ng mga mahihirap na mangingisda sa ARMM lalo na sa Island Provinces mg Sulu, Tawi-Tawi, Basilan at umabot na ngayon sa Parang sa Maguindanao na merong 9.5% bahagi ng produksyon

Talaan 1. Produksyon ng Seaweed sa ARMM, 2005-2009. Bureau of Agriculture Statistics (BAS).

Provinces in ARMM	Annual Production (Metric Ton)					Annual Average	Share
	2005	2006	2007	2008	2009		
ARMM	510,137	560,684	617,624	657,159	683,084	605,738	
Maguindanao	14,450	55,800	64,007	74,116	80,222	57,719	9.5%
Lanao del Sur	0	0	0	0	0	0	0
Basilan	3,797	3,658	4,467	5,945	5,963	4,766	0.8%
Sulu	184,776	178,150	187,236	199,205	210,250	191,923	31.7%
Tawi-Tawi	307,114	323,076	361,912	377,892	386,648	351,328	58.0%

[1] *Hurtado, A.Q. and Agbayani, R.F. 2000. The farming of the seaweed Kappaphycus. Aquaculture Extension Manual. SEAFDEC. Tigbauan, Iloilo, Philippines.*

[2] *Ang Carageenan ay isang natural na produkto galing sa Kappaphycus. Ginagamit ito sa iba't ibang paraan dahil sa kanyang kakayanang magsuspinde at magpalapot ng mga sangkap*

Ang probinsiya ng Tawi-Tawi ay isa sa may pinakamalawak na mababaw na parte ng karagatan na angkop sa pagpapalago ng seaweed sa ARMM at ito ay merong 58% na bahagi ng produksyon (Table 1) habang ang Munisipyo ng Panglima Sugala ay isa sa pangunahing may produksyon sa probinsiya dahil sa lawak ng karagatan na tinataniman ng seaweeds sa pitong (7) barangay nito kasali na ang Buan (target barangay ng CD-CAAM) na may pinagsamang kabuuang lugar na 1,094 ektarya at may ani na 9.846 tonelada kada ektarya na naitala noong 2001 na may halagang 147.69 million pesos[3]. Bukod sa seaweeds, naitala rin ang pagkalap ng mga kabibi at sea cucumber sa gabi bilang ibang pagkakakitaan habang inaantay ang pag-ani ng seaweed, kaya maari ring magparami ng sea cucumber sa loob ng sea pens sa tabi ng taniman ng seaweed.

Ang kontribusyon ng pagtatanim ng seaweed sa kapayapaan at kaunlaran ay hindi maaring maipagsawalangbahala lalo na sa mga magugulong lugar dahil ang teknolohiya ay simple, naangkop, may mapagbebentahan at maaring kumita ng malaki mula rito. Nagiging kilala na ito bilang isang alternatibong pangkabuhayan ng Timog-Kanlurang Mindanao upang maiangat ang katayuan sa ekonomiya ng mga maliliit na mangingisda at mabawasan ang sobrang pangingisda sa mga karagatan. Sinasama na rin ito sa maraming *community-based coastal resources management projects* at *fisheries management initiatives* bilang alternatibong pangkabuhayan ng mga mangingisda.

Ang mga nagtatanim ng seaweeds na kabilang ng rehiyon na ito ay kadalasang biktima ng *monopoly* na laganap sa local na pamilihan ng mga banyaga at lokal na mga buyer. Ang mga *middleman* at *consolidator* ay ibinababa ang presyo at sinasabing di gaanong tuyo ang seaweed o may mga duming nahahalo dito. Dahil sa ganitong klaseng sitwasyon ay dinesenyo ang proyektong ito na magtataguyod ng mabuting pamamaraan sa pagtatanim ng seaweeds, pag-igihin ang pamamahala ng post-harvest, at magtatag ng organisasyon ng mga nagtatanim ng seaweeds na magsisikap na magtatag ng strong marketing linkages sa pamamagitan ng pagtatag ng *marketing tie-up / covenant* o pakikipagkontrata sa mga lokal at pang-*export* na *market* upang makinabang ang mga nagtatanim sa benipisyo ng mas mataas na presyo ng seaweed.

[3] *CDP-ELA 2008-2010. Municipality of Panglima Sugala, Tawi-Tawi.*

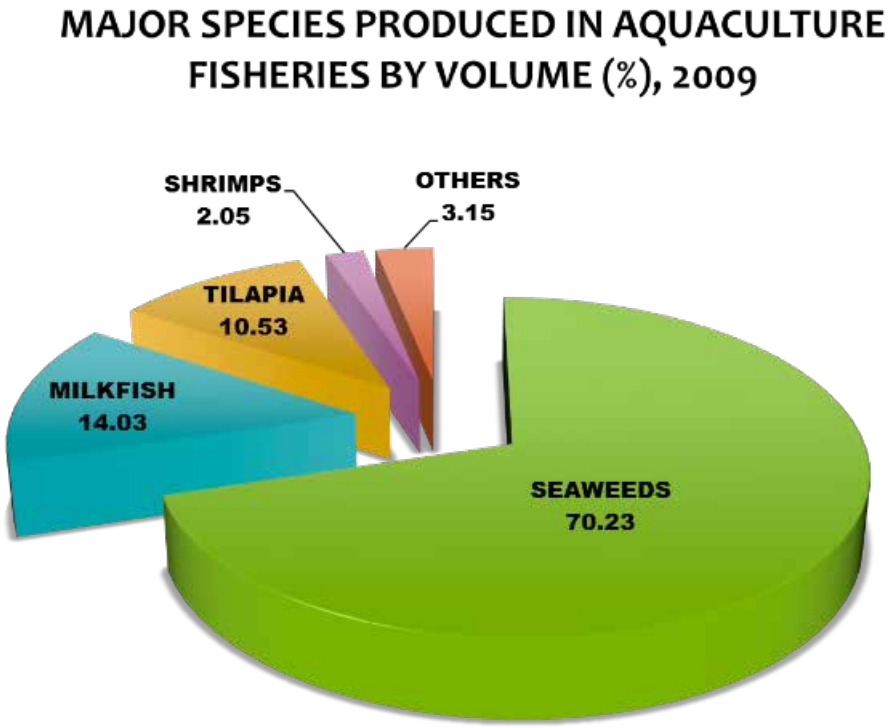


Figure 1. Pangunahing mga produkto sa aquaculture sa Pilipinas. BFAR, 2011.

1.1. Ano ang Seaweed '*Kappaphycus*'

Ang *Kappaphycus* ay ang pulang seaweed na tinatawag na 'agal-agal' o 'guso' dito sa Pilipinas.

Maganda ang tubo ng seaweed sa mga bahura (*reef*) na may magaspang na buhangin na koral, na di natatamaan ng malakas na alon, at may maayos na daloy ng tubig.

May dalawang uri ng seaweed na pinagkukunan ng carrageenan, ito ay ang *Eucheuma* at *Kappaphycus*. Ang *Kappaphycus alvarezii* at *striatum* ay ang dalawang karaniwang nililinang sa Tawi-Tawi at sa iba pang lugar sa ARMM.

Figure 2. Pangkomersyal na pagpaparami ng seaweed 'Kappaphycus' sa Pilipinas. Kappaphycus alvarezii (a,b,c) at Kappaphycus denticulatum (d).

(a)

(b)

(c)

(d)

1.2. Ang Kahalagahan ng Seaweed 'Kappaphycus'

1.2.1 Ang pagpaparami ng seaweed ay isang negosyong pangpamilya at itinuturing na malaking pinagkukuhaan ng pangkabuhayan ng mga naninirahan sa tabing dagat ng Timog-Kanlurang Mindanao (Sulu, Tawi-Tawi at Basilan), Philippines. Habang lumalawak at lumalaki ang industriya, ganun din ang bilang ng mga nagpaparami at mga pamilyang sumasali sa pagtatanim ng seaweed. Ang paglilinang ng seaweed ay naglilikha ng mga trabaho.

Figure 3. Isang benepisyaryo ng Barangay Buan na tinutulungan ng kanyang kapamilya sa paghahanda ng mga binhi ng seaweed gaya ng pagputol at pagtatali nito sa pangunahing cultivation line.

1.2.2. Ang seaweed ay ang pinagkukunan ng "*Carageenan*" na karaniwang ginagamit sa pagkain at sa ibang industriya bilang pampalapot at pampatatag na sangkap.

Table 2. Mga gamit ng Carrageenan na katas ng seaweed 'Kappaphycus' sa industriya.[4]

USES	FUNCTION
(1) Sa *meat preparation* at *processing*	• Mapabuti ang texture ng karne at madaling mahiwa, nagpapalambot ng mga produktong karne at mapapanatili ang lasa • Mas matagal masira at hindi nawawala ang lasa • Iniiwasang mangulubot at lumiit ang mga naprosesong karneng manok
(2) Mga *dairy* products at panghimagas (*desserts*)	• Tumutulong sa pagtunaw at estabilidad ng coffee whiteners • Nagpapabuti ng pagkakrema, texture at consistency kapanatilihan ng krema at mga produktong magkatulad
(3) Mga inumin	• Nagpapalinaw at nagpapakinang ng beer • Mas madaling salain, mas malasa at mas matagal mawala ang lamig

[4] *Hurtado, A.Q. and Agbayani, R.F. 2000. The farming of the seaweed Kappaphycus. Aquaculture Extension Manual. SEAFDEC. Tigbauan, Iloilo, Philippines.*

(4) *Cosmetics* at *personal care products*	• Pagsisiguro ng magandang kalidad ng *toothpaste* sa pabago-bagong temperatura, pinapanatili ang porma at ang moisture at nagbibigay ng pino at pantay na kalidad ng *toothpaste* • Mas pinapatibay at pinapatigas ang hair gel
(5) Pagkain ng mga alagang hayop	• Pinapanatili ang tubig, nagbibigay ng hugis, and pinapanatili ang taba habang pinoprosesso • Pinapanatili ang pantay na *moisture* sa buong lata • Pinapanatili ang magandang kintab ng produkto
(6) Gel ng *Air freshener*	• Binibigyang hugis at kinokontrol ang paglabas ng mga sangkap gaya ng pabango at water-based gel
(7) Sarsa at ensalada	• Pinipigalan ang paghiwalay ng tubig • Binabawasan ang maanghang na lasa • Pinapanatili ang kalidad • Iniiwasang magkalatak ang mga buong sahog sa tinimpla
(8) Tinapay, noodles at pasta	• Bumubuo ng *gel matrix* habang niluluto,kaya napapanatili ang tubig at binibigyan ito ng dagdag na hugis • Iniiwasang madurog ang noodles o pasta habang niluluto • Pinapalakas ang kakayahan ng basang noodles na sumipsip ng tubig kaya bumibigat ito • Pinapadali ang paraan ng extrusion sa pagkain gaya ng pasta • Binibigyan ang produkto ng makintab na panlabas

2. Mga Pamamaraan ng Paglilinang ng Seaweed 'Kappaphycus'

Maraming paraan ng pagtatanim ang ginagamit ng mga naglilinang ng seaweed sa Tawi-Tawi, subalit ang kanilang pamamaraan ay nakasalalay sa lokasyon ng taniman at ang kondisyon panahon. Ang Brgy. Buan ay matatagpuan sa may liko ng dagat na napapalibutan ng bakawan, maraming halamang dagat, may tagpi-tagping *corals* sa mababaw na mga bahura (reef), samakatuwid, ang mga paraan na tinatalakay sa susunod na pahina ay ang ginagamit ng mga lokal na mangingisda na naglilinang nito.

2.1. Off-bottom stake method (Figure 4) – ang paraang ito ay ginagamit sa mga mababaw na parte ng karagatan, na minsan natutuyo habang kati o low tide. Ang linya ng seaweed ay tinatali sa kahoy na tukod sa magkabilang dulo.

Figure 4.a. Lumilitaw ang seaweeds habang lowtide gamit ang off-bottom stake method sa Brgy. Liyaburan, Panglima Sugala

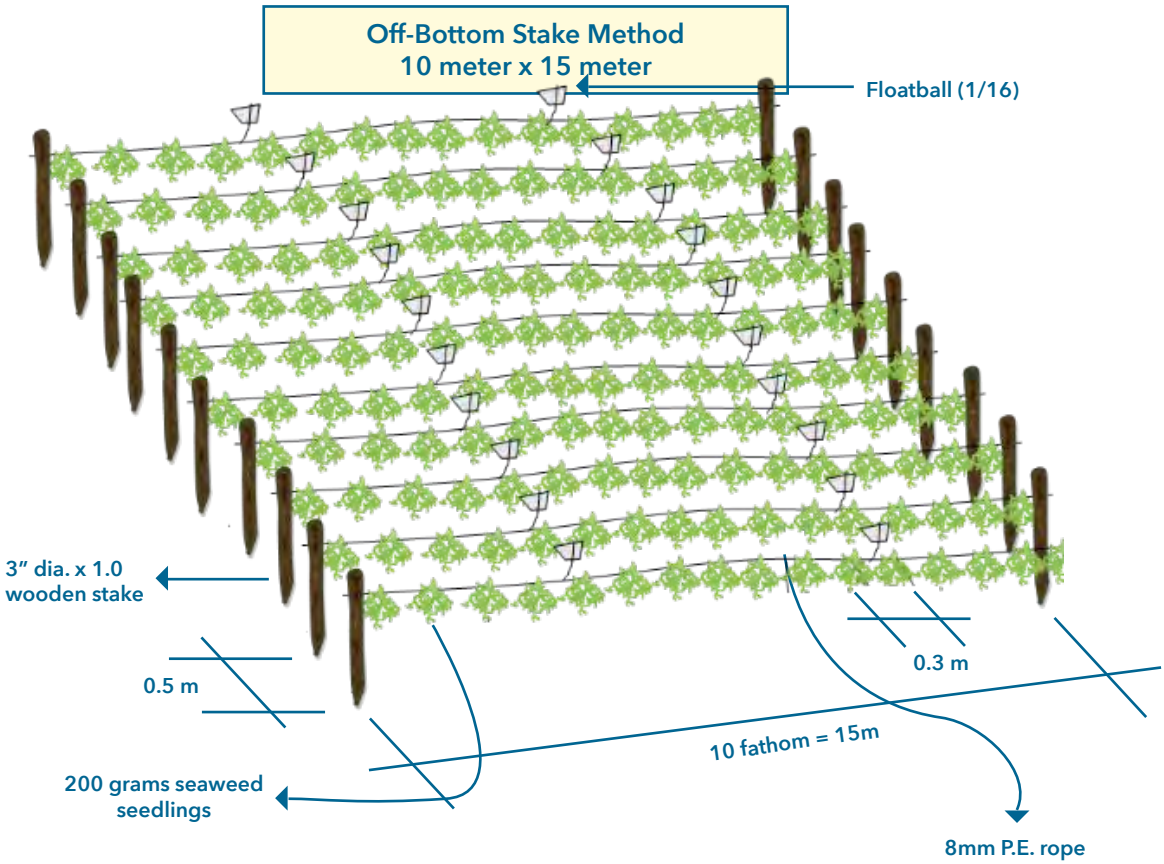


Figure 4.b. Anyo ng off-bottom stake method.

2.2. Floating method – ang paraan na ito ay ginagamit sa malalim na parte ng karagatan at gumagamit ng lumulutang na mga kagamitan gaya ng boteng plastik, styrofoam at bamboo poles. Ang *seaweed lines* ay tinatali sa balsa na gawa sa kawayan at plastik na tali.

Maraming paraan ng pampalutang ang ginagamit ng mga naglilinang seaweeds sa Tawi-Tawi at binabago ito depende sa lokasyon, pagiging angkop at ang pagkakaroon ng mga lokal na mga bagay na maaaring gamitin.

2.2.1. Mono-line Floating Method – Sa paraang ito, ang *main seaweed cultivation line* ay nakalagay sa magkabilang dulo gamit ang kahoy na tulos (*wooden stake*) o baras na bakal (*iron rod*). Ito ay ginagamit sa may malapad, lantad at mas malalim na parte ng karagatan.

Figure 5.a. Monoline floating method sa Brgy. Alu Layag-Layag, Parang, Sulu

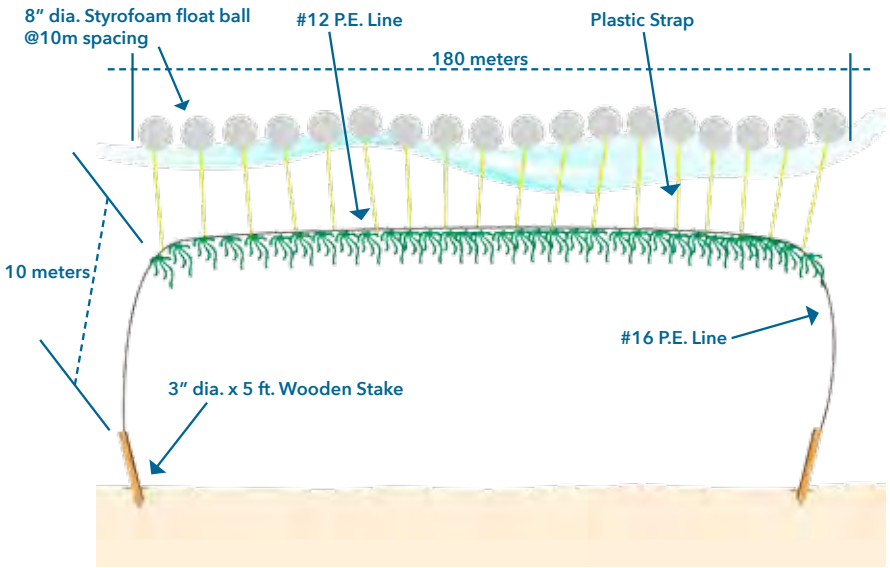


Figure 5.b. Anyo ng mono-line floating method (Source: USAID LEAP Program)

2.2.2. Modified Floating Triangular Method (Pasengkang) – Sa pamamaraang ito, ang *main line* ay mahigpit na naitali sa magkabilang dulo gamit ang kahoy na tulos (*wooden stake*) o baras na bakal (*iron rod*). Magkasunod-sunod na tig-iisang metro ng *seaweed cultivation line* ang nakatali sa magkabilang dulo papunta sa *main line* na may pagitan na 1 metro mula sa kabilang linya at may angulong 45° (Figure 6.b). Ang paraang ito ay karaniwang ginagamit kapag may hilagang-kanlurang habagat o *northwest monsoon* (saatan) sa Brgy. Buan sa Tawi-Tawi.

Figure 6.a. Modified floating triangular method sa Brgy. Kulape, Panglima Sugala

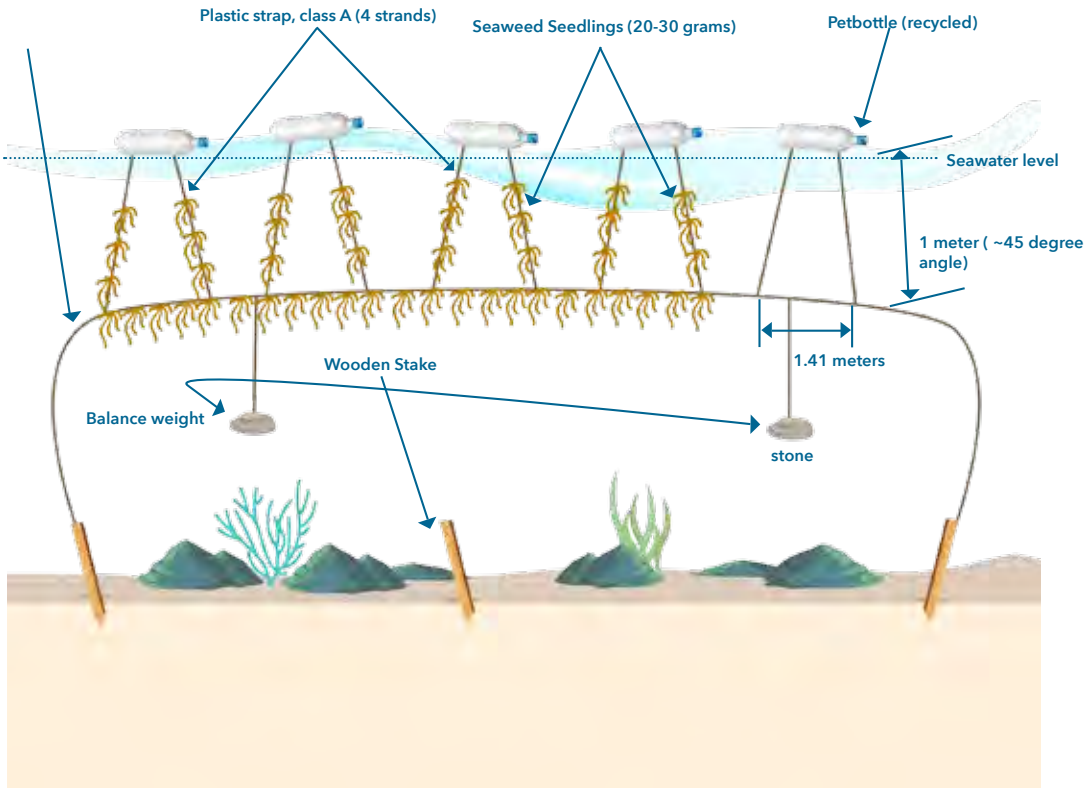


Figure 6.b. Anyo ng Modified Floating Triangular Method "Pasengkang".

2.2.3. Modified Floating Joint Method (Patundan) – Ang paraan na ito ng paglinang ng seaweed ay ay bahagyang binago at nagging mas simple, kayang isagawa ng mga kababaihan, mas mura, at mas epektibo ayon sa karanasan ng mga mangingisda. Higit pa rito, pwede itong gamitin sa lahat ng paraan ng paglilinang ng seaweed maliban sa mga kasangkapang gamit sa seaweed line na maaaring magkaiba sa bawat lugar.

Figure 7a. Modified joint floating method sa Hamri Reef of CD-CAAM Project sa Brgy. Buan

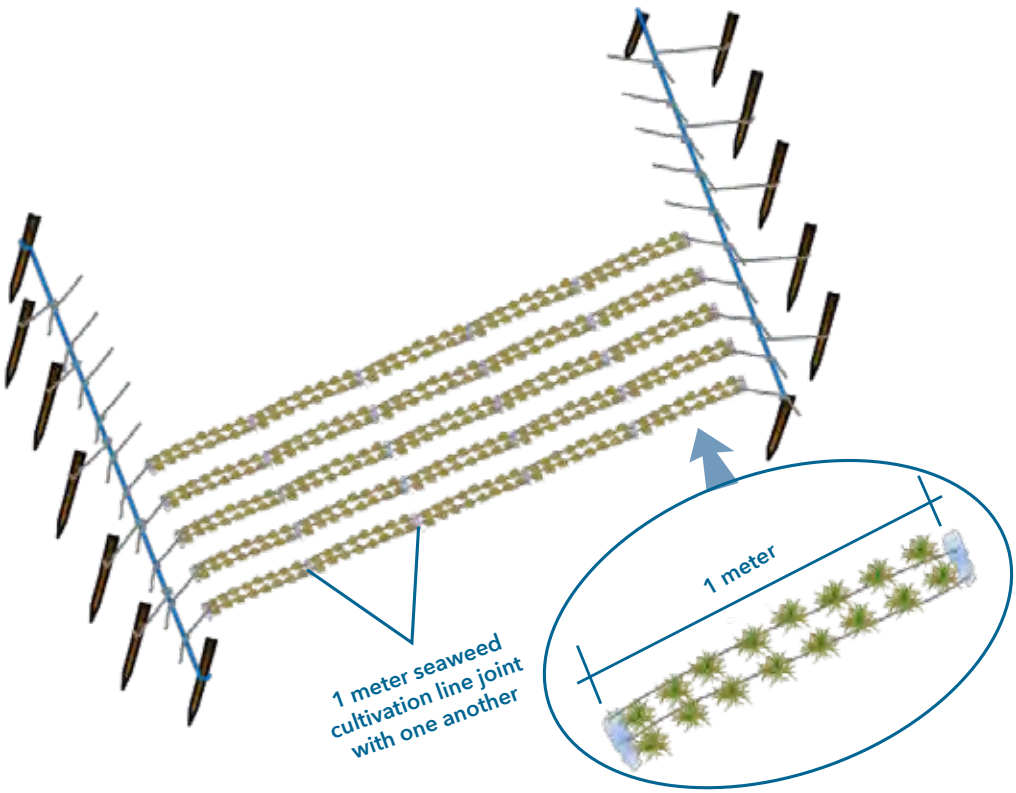


Figure 7.b. Anyo ng Modified Floating Joint Method "Patundan".

3. Mga Gawain sa Pagpaparami ng Seaweeds 'Kappaphycus'

3.1. Pagpili ng Lugar

Gaya ng ibang negosyong *aquaculture*, kailangan ng tamang lokasyon para sa magandang paglaki ng seaweed kaya kailangang isaalang-alang ang mga sumusunod:

a. May katamtaman hanggang malakas na agos at galaw ng alon ngunit hindi naman sobrang lakas na masisira ang taniman;
b. Malayo sa tubig-tabang gaya ng sapa dahil nakakaapekto ito sa paglaki ng seaweed;
c. Malinis na tubig at malayo sa mga pabrikang nagbubuga ng basura at polusyon, kaya ang islang barangay ng Buan ay praktikal na lokasyon.
d. Lugar na puno ng halamang dagat at lumot. Kinakailangang ang temperatura ng tubig ay nasa 24°C hanggang sa 30°C at ang salinity ay nasa 27 hanggang 35 parts per thousand;
e. Malayo sa daanan ng bangka o barkong pangkalakal

Figure 8. Pagpili ng lugar at pagsusuri ng kalidad ng tubig kasama ang technical partner (MSU-Tawi-Tawi)

(a) Pagdetermino ng alat ng tubig

(b) Pagdetermina ng pH, Phosphate(PO_4), Nitrate(NO_3), at Ammonia (NH_3)

(c) Piniling lugar sa Hamri reef

(d) Mga lugar na malapit sa kabahayan upang mapalakas ang seguridad

Figure 9. Mga taniman ng seaweed sa Bgry. Buan na naitatag sa tulong ng CD-CAAM Project.

(a) Hamri Reeef Seaweed Farm

(b) Biha Seaweed Farm

(c) Taytayan Seaweed Farm

(d) Tinambang Farm

(e) Capitol Seaweed Farm

(f) Tabba-Bato Seaweed Farm

3.2. Paghahanda ng mga binhi ng seaweed at mga gamit sa pagtatanim

3.2.1. Paggamit ng mga lokal na mga kagamitan

Nirerekomenda na ang gagamitin lamang ng proyekto ay mga kagamitan na nakukuha o nabibili sa lokalidad

Figure 10. Mga kagamitang lokal na kailangan sa pagpaparami ng seaweeds.

(a) Plastic straw, softie

(d) Plastic strap, double strand, class A

(c) Recycled na PET bottles

(d) Polyethylene rope, #12

(e) Stainless na kutsilyo

(f) Magandang kalidad na binhi ng seaweed

(g) Matulis na baras

(h) Sledge hammer

(i) Mga posteng kahoy

(j) Measuring tape

3.2.2 Paghahanda ng 1-metrong seaweed cultivation lines

- Maghanda ng 2.5 metro plastik na tali na *double strand*, itali ang magkabilang dulo nito upang hindi gagalaw ang boteng plastik. (Figure 11.a)
- Itali ang *softie strand* sa hinandang 1-metrong *seaweed cultivation line* na may distansiya na anim (6) hanggang walong (8) pulgada sa bawat tali (Figure 11.b at Figure 11.c)
- Isa-isang itali ng pantay-pantay ang mga binhi ng seaweed na may bigat na 20-50g sa bawat 1-metrong *seaweed cultivation line* (Figure 11.d)
- Siguraduhing may pagitan na 15 hanggang 20 sentimetro kada binhi sa bawat 1-metrong *float line* upang maiwasan na maliliman ang *seaweed* at mas mabilis at magandang tumubo ang binhi
- Sama-samang itali ang 10 piraso ng tig 1-metro *seaweed cultivation line* upang mas magaan itong dalhin sa taniman (Figure 11.e)
- Bago itanim, kailangang nakababad sa tubig ang mga *seaweed cultivation line* upang maiwasan ang pagkatuyo nito. (Figure 11.f)

Figure 11. Ang proseso ng paghahanda ng tig 1-metrong seaweed cultivation lines

(a)

(b)

(c)

(d)

(e)

(f)

3.2.3 Pagpili ng magagandang binhi ng seaweeds

- Pumili ng seaweed na may mga malulusog at batang sanga (*thalli*) na walang marka ng sakit o impeksiyong sanhi ng epiphytes
- Dapat makinis, madulas, at malutong ang *thalli*[5] (Figure 12.a)
- Gumamit ng matulis at stainless na kutsilyo kapag humihiwa ng binhi (Figure 12.b)

Figure 12. Pagpili ng magandang uri ng binhi ng seaweed

(a)

(b)

[5] *Romero J. B. A presentation on Seaweed Farming and Farm Management. College of Fisheries. MSU-TCTD, Sanga-Sanga, Bongao, Tawi-Tawi.*

4. Pagtatayo ng Taniman ng Seaweed

- Ihanda ang mga kailangang mga gamit (tingnan ang Figure 10).
- Linisan ang sahig ng nakalaang taniman ng binhi at tanggalin ang mga dumi at mga lamang dagat gaya ng *starfish*, alimango at tayom gamit ang *rake* o kahoy (Figure 13.a).
- Tanggalin ang mga luma o nabubulok na mga patpat o tulos na ginamit sa pataniman.
- Magtayo ng matatag na mga tulos sa bawat kanto ng napiling lugar, sundan ng pangalawa, pangatlo at panghuling mga tulos upang masiguro na matibay ito, at sukatin ang buong lugar gamit ang *measuring tape* na yari sa *fiber glass* (Figure 13.b).
- Itali ng maigi ang *main line* ng seaweed (PE rope # 12) sa lahat ng tulos para dito (Figure 13.c).
- Magtali ng pinagsamang 10-metrong *seaweed cultivation line* patungo sa *main line* gamit ang class "A" na *plastic binder* (Figure 13.d at 13.e).
- Panatalihin ang pagitang 2 metros sa bawat *seaweed cultivation line* (Figure 13.f).

Figure 13. Mga hakbang sa pagtatag ng pataniman ng seaweed sa Barangay Buan, Panglima Sugala

(a)

(b)

(c)

(d)

(e)

(f)

5. Pamamahala sa Taniman ng Seaweed

- Bisitahin ang taniman ng seaweed kung maaari ay araw –araw o kahit man lang tatlong beses sa isang lingo upang makita kung may mga nasira gaya ng natanggal o lumuwag na tali at iba pa.
- Tanggalin ang mga lumulutang na dumi na sumabit sa mga linya o sa mga binhi, ilagay ito sa palanggana at huwag itapong muli sa karagatan.
- Tanggalin ang mga lamang dagat gaya ng tayom, alimango at *starfish* at iba pa. (Figure 13.a)
- Agad na alisin ang mga nahawaan ng sakit na *ice-ice* upang maiwasan ang kontaminasyon
- Kung sumobra sa 10% ang nahawaan ng sakit na *ice-ice* sa mga pananim, mas mabuti pang anihin na ang lahat ng tanim upang makabawi sa gastos.

6. Pagtatag ng Seaweed Seedling Bank / Nursery

- Mahalaga ang *seaweed seedling bank/nursery* sa mga sumusunod na dahilan:
  - Upang masiguro ang tuloy-tuloy na supply ng seaweed para sa sunod-sunod na pagtanim
  - Upang mapanatili ang magandang kalidad ng klase-klaseng mga seaweed
  - Upang mabawasan ang gastusin sa parating pamimili ng binhi ng seaweed mula sa ibang lugar o munisipyo na sadyang magastos at kung minsan ay walang nabibiling binhi
- Nararapat na itayo ang seaweed *seedling bank/nursery* sa iba't-ibang lugar at gamit ang iba't-ibang pamamaraan.

7. Mga Karaniwang Sakit ng Seaweeds, at ang mga Lunas Dito (base sa aktwal na karanasan sa CD-CAAM)

1) Ice-ice – Ito ay ang pamumuti ng mga sanga at kadalasang nagsisimula sa katawan ng thalli; ito ay dahil sa kakulangan ng alat sa tubig, pabago-bagong temperatura at tindi ng sikat ng araw[6]. Ang ice-ice ay kadalasang lumilitaw habang may Southeast monsoon o 'Uttara' at nawawala naman pagkatapos ng 2-3 buwan[7].

Epekto: kawalan ng kulay at minsan natutunaw o namamatay na seaweed.

Praktikal na Lunas: Alisin ang apektadong bahagi, anihin o magtanim uli at lumipat sa ibang lokasyon.

Figure 14. Ang sakit na "ice-ice" ay nakaapekto sa mga seaweed ng Barangay Buan

Ang ice-ice ayon sa mga dalubhasa ay ang pamumuti ng tangkay ng seaweed 'Kappaphycus' dahil sa kakulangan sa alat at sa pabago-bago ng temperatura ng tubig at sa lakas ng sikat ng araw kaya nanghihina ang mga halamang dagat. Ang pagpapatuyo ng lahat ng tanim na seaweeds ang pinakamabuting lunas upang maiwasan ang pagkalugi.

[6] *Hurtado A.Q., Agbayani R.F. 2000. The Farming of the Seaweed Kappaphycus. SEAFDEC AQD. Tigbauan, Iloilo, Philippines.*
[7] *Interview kay Mr. Hamri Jupuri, 20 years seaweed farmers in Brgy. Buan, Panglima Sugala, Tawi-Tawi. March 28, 2016.*

2) Epiphytes – Isang halamang dagat na dumidikit sa nililinang na seaweeds. Nakasasama ito sa mga pananim dahil tumatagos ito sa balat ng seaweed, inaatake ang loob at sinisira ang laman nito.

Epekto: Inaagaw nito ang espasyo, sikat ng araw, mga nutrients at hangin kaya nababansot ang seaweed.

Praktikal na Lunas:

1) Para sa **endo epiphytes**

a) Tanggalin ang lahat ng apektadong binhi, anihin ito at ibilad sa araw kapag malaki na.
b) Itanim muli ang malalaking binhi ngunit siguraduhing magdagdag ng mga bagong linya at lumipat sa bagong lokasyon.

3) Para sa **macro epiphytes**

a) Ibabad ang mga tanim sa pamamagitan ng paglagay ng kalahating tubig ang mga seaweed dahil ang *macro algae* ay nasa ibabaw lang dumidikit subalit kung hindi kayang kontrolin ay mas maiging lumipat na lang sa mas mabuting lokasyon.

Figure 15. Macro algae na dumikit sa pananiman ng seaweed sa Barangay Buan

Ang macro algae ay ang tinatawag nating 'lumot'. Ito ay isang epiphyte o non-parasitic algae na dumidikit sa seaweeds kaya nahihirapan ang seaweed na makagawa ng sariling pagkain dahil hindi na ito direktang naaarawan. Ang mga seaweeds na apektado ng epiphytes ay nagiging bansot.

3) Contaminants – Mga bagay na sumasabay sa agos galing sa mga bahay-bahay o sa kapaligiran na nakakasira sa pananiman.

Domestic waste ay ang mga itinatapong basura sa karagatan na sumabay sa agos at napupunta sa mga seaweeds.

Natural contaminants ay kalimitang nagreresulta galing sa seaweed bloo dahil sa matagal na tag-araw o epekto ng El Niño

Mga Epekto nito:

a) Ang pagdikit ng mga domestic waste sa seaweed kung saan ay mas madali itong magka-fungal infection.

b) Sa natural na contaminants, tinatabunan nito ang sanga ng seaweed (thallus) kung saan ay magkakasakit ito ng "ice-ice" at kadalasang ay namamatay ito kung hindi maagapan.

Praktikal na Lunas:

a) Ang palagiang pagbisita at pagmomonitor ay napakahalaga upang malaman ang kasalukuyang lagay ng pananiman ng seaweed.

b) Ang paglinis ng pananiman ng seaweed upang mapanatili ang maayos na paglaki ng mga sanga ng seaweed (*thalli*).

c) Ilipat ang mga seaweeds sa ibang lugar na walang ganitong uri ng mga contaminants.

Dapat Tandaan:

- Kinakailangan na higit sa isa ang pananiman ng mga nagtatanim ng seaweeds upang mapanatili ang pagpapalago nito.
- Obserbahan ng isang linggo ang kalagayan ng seaweed sa mga napiling taniman sa pamamagitan ng pagtest plan ng mga 5 hanggang 10 *seaweed cultivation lines* bago ang malakihang pagtanim ng seaweeds.
- Ang Southeast monsoon (Uttara) ay magandang panahon sa pagtatanim ng seaweeds sa laot dahil sa pamalagiang paggalaw ng tubig. Hindi gaanong nakakabuti kapag ang taniman ay malapit sa lupa o nauukol sa gilid dahil sa palipat-lipat ang ihip ng hangin.

8. Pag-ani ng Seaweed

- Anihin ang seaweed pagkatapos ng 45/60 na araw mula ng paglipat galing sa nursery. (Table 3)
- Alisin ang seaweed galing sa linya at tagalin ang lahat ng dumi gaya ng straw, lumot, buhangin, *shells* at isda dahil hindi ito tinatangap ng mga mamimili.

Dapat Tandaan:
- Nababali ang tangkay ng seaweeds kapag hinahayaan natin itong lumaki sa loob ng higit 60 na araw.
- Napagobserbahan na nagkukumpol-kumpol ang seaweed kapag lumampas na ito ng 60 araw.
- Bumababa ang halaga ng benta ng seaweeds pag may nakahalong dumi ito

Figure 16. Maayos na Pag-ani ng Seaweed

(a) Loading ng seaweed sa transport boat

(b) Pagdala ng seaweed galing ng farmsites papunta sa stilt-type solar dryer

(c) Paglagay ng seaweed sa taas ng stilt-type solar dryer

Ipinapakita sa Table 3 ang paglaki ng binhi ng seaweed mula sa 20.7g na average na bigat hanggang sa 124.2g bawat seedling na average weight pagkatapos ang 45 na araw ng paglilinang. Dahil dito, nakalkula na ang average na paglaki ng seaweed sa bawat araw sa Brgy. Buan sa ilalim ng CD-CAAM project ay 2.3g bawat araw. Kung ang bigat ang pag-uusapan, 320g ang pinakataas na bigat at 40g ang pinakamababang bigat ng seaweed.

Table 3. Pagtaas ng timbang ng seaweed matapos ang 45 na araw ng paglilinang sa Brgy. Buan, Panglima Sugala[8]

Bigat sa panahon ng pagtanim (ave.)	Bigat sa panahon ng pag-ani (ave.)	Nadagdag na timbang matapos ang 45 na araw	Nadagdag na bigat bawat araw
20.7g	124.2g	103.5g	2.3g

[8]*End sampling conducted on May 3, 2016.*

9. Pagpapatuyo ng Seaweed

a. Stilt-type solar dryer – Ang pinakamainam na paraan ng pagpapatuyo ng seaweed ay nakapatong o nakasabit, dahil naiiwas ito sa kontaminasyon ng lupa at iba pang bagay na nakakasira na kalidad nito and nakapababa ng presyo (Figure 17.a.). Ang pagpapatuyo sa lupa ay hindi maganda para sa seaweed. (Figure 17.b.)

Figure 17. Seaweed Solar Dryer

(a) Stilt-type Solar Dryer (Best practice)

(b) On-the-ground Solar Dryer (Bad practice)

b. Paglalatag ng seaweed (Figure 18) – habang pinapatuyo, dapat pantay ang pagkakalatag nito sa pamamagitan ng *rake* upang mas madali itong mabaliktad at matuyo. Ang nakatambak na seaweed habang pinapatuyo ay nabubulok at mas matagal itong matuyo[9]. Huwag takpan ang seaweed habang pinapatuyo dahil nalalanta ito at nawawala ang kulay. Gayon din, maaring maluto ito dahil sa init.

Figure 18. Paglalatag ng seaweed habang nagpapatuyo nito

(a) Alisin ang seaweed mula sa cultivation lines

(b) Ilatag ng pantay-pantay ang seaweed gamit ang rake

(c) Maayos na pagkalatag ng seaweed para sa mabilisang pagkatuyo nito

[9] *Tiroba, Gideon. Seaweed Quality Control: a practical guide for seaweed farmers, seaweed extension officers, buying agents, and fisheries officers and exporters. Secretariat of Pacific Community Cataloguing-in-publication data. 2007.*

c. Kapag gabi (Figure 19.a.) – Mahalagang takpan ng plastic o tarpaulin ang seaweed kapag gabi. Dapat nakaangat ang pantakip upang di ito malanta. Nakakatulong din itong makapasok ang hangin at nakakatulong sa proseso ng pagpapatuyo.

d. Tuwing tag-ulan (Figure 19.b) – Maglagay ng nakaangat na *plastic cover* kung tag-ulan. Pinapababa ang kalidad ng seaweed kapag nauulanan o nababasa ito at pinapababa nito ang timbang dahil natatangay ang taglay nitong asin and natutunaw ito sa tubig.

Figure 19. Paglalagay ng plastic cover sa gabi at tuwing tag-ulan

(a) Kapag gabi

(b) Tuwing tag-ulan

Dapat Tandaan:

- Natutuyo ang seaweed ng 3 araw pag direktang nakabilad sa araw at 5 araw kung makulimkulim ang panahon o kapag umulan.

Table 4. Antas ng moisture kontent at ang katumbas na kondisyon ng seaweed[10]

Moisture content (%)	Kondisyon ng seaweed
35-39	Pinakamatibay
>40	Dadanas ng pagkababa ng kalidad habang nakaimbak
25-35	Medyo matibay sa ng panahon lampas 12 buwan (angkop para sa paggawa ng bale ng seaweed)
15-25	Lubhang matibay ngunit maaaring ang mga sanga (thalli) nito ay madaling maputol; Hindi susunod kung gagamitan ng puwersa o tatalian para gawing bale ng seaweed
<15	Matibay ngunit maaaring magkakaroon ng problema sa pagproseso

[10] *Hurtado, A.Q. and Agbayani, R.F. 2000. The farming of the seaweed Kappaphycus. Aquaculture Extension Manual. SEAFDEC. Tigbauan, Iloilo, Philippines.*

10. Pagbalot at Pag-imbak ng Seaweed

- Ilagay sa sako ang seaweed pagkatapos patuyuin. Iwasang magkahalo ang iba't ibang uri ng seaweed sa iisang sako.
- Timbangin, itala at lagyan ng marka.
- Ilagay ang mga sako ng seaweeds sa isang lugar na maganda ang bentilasyon

Figure 20. Ang proseso ng pagbabalot at pag-iimbak

(a) Maayos na pagkatuyo ng seaweed pagkatapos ng 3-4 days ng pagpapatuyo

(b) Pagtanggal ng dumi (tie, rubbles etc.)

(c) Paglalagay ng dried seaweed sa sako

(d) Maayos na pagtali ng sako ng seaweed

(e) Pagtitimbang ng seaweed

(f) Maayos na pag-iimbak ng sako habang hinihintay ang pagdala nito sa buyer

11. Pagdadala at Pagbebenta ng Seaweed

- Bago ihatid or ibenta ang sako ng seaweed, timbangin ito, kumontak ng mamimili tungkol sa kasalukuyang presyo sa merkado. Maghanap ng mapagkatiwalaan at maaasahang buyer.
- Iwasang mabasa sa ulan o tubig-dagat ang pinatuyong seaweed habang binabiyahe dahil mababawasan ang kalidad nito.

- Gabayan ang mga manggagawa upang maiwasang mahulog ang seaweed sa dagat habang binabiyahe.
- Bantayan ng maigi ang pagtitimbang sa pamilihan, magtala kung kinakailangan.

Figure 21. Ang Pagdadala at Pagebebenta ng Pinatuyong Seaweed

(a) Ang pagdala ng pinatuyong seaweed ng mga beneficiaries papunta sa Bongao, Tawi-Tawi

(b) Pagtitimbang ng mga sako ng seaweed sa buying station (Bongao Fish Trading)

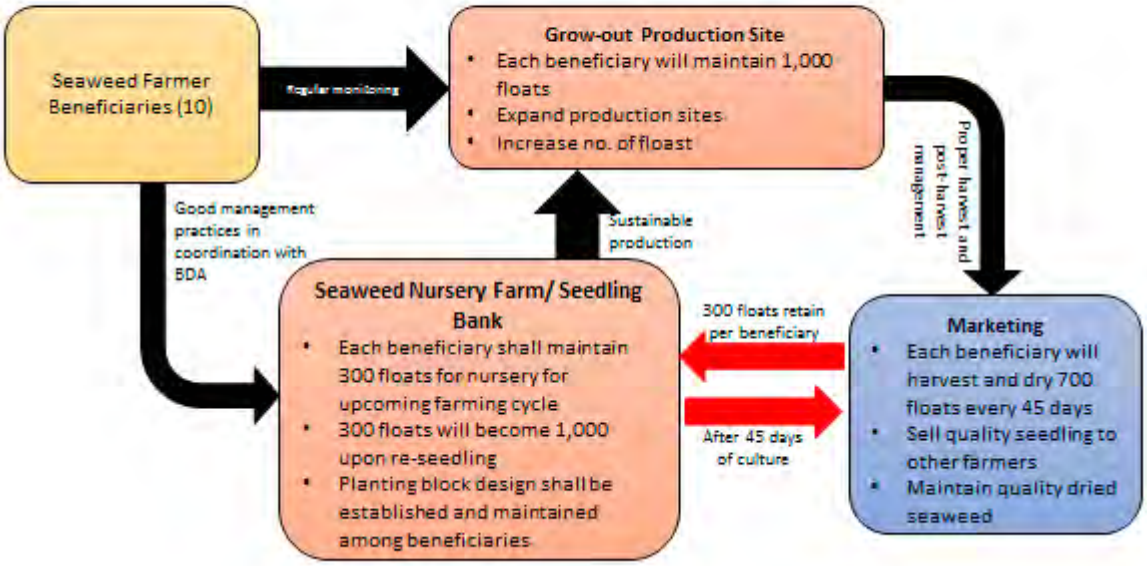
(c) Unang kita ng mga CD-CAAM beneficiaries mula sa seaweed (PhP10,170)

12. Pagsisiguro ng Tuloy-tuloy na Paglilinang ng Seaweed

Maaaring tuloy-tuloy ang paglilinang ng seaweed kung makapagpapatayo ng seaweed seedling bank/nursery kung pangangasiwaan ito ng mga indibidwal na mga mangingisda malapit sa *grow-out farm*. Ang layunin ng pagpapapatayo ng seaweed seedling bank ay para masiguro ang pagkakaroon ng supply ng seaweed para sa sunod-sunod na pagtatanim; para mapanatili ang magandang kalidad ng uri ng seaweed; at upang mapababa ang gastusin sa palagiang pamimili ng binhi ng seedling sa tuwing panahon ng pagtatanim mula sa ibang lugar o munisipyo na magdadagdag pa ng gastusin sa mga mangingisda at may panahon din na walang nabibiling binhi.

Maliban pa sa pagpapatayo ng seaweed seedling bank/ nursery, dapat din na magtayo ang mga mangingisda ng maraming taniman, at gagamit ng iba't-ibang pagtanim. *(tingnan ang pahina 6 hanggang 10 tungkol sa Mga Pamamaraan ng Paglilinang ng Seaweed)*.

Figure 22. Sustainable approach of seaweed farming (Adopted by CD-CAAM in Brgy. Buan)



13. Ang Kita sa Pagtatanim ng Seaweed 'Kappaphycus'

Ang kakayahang kumita mula sa paglilinang ng seaweed ay tinatalakay sa sumusunod na pahina batay sa karanasan ng Ridjikih Fisherfolks Marketing Cooperative sa ilalim ng CD-CAAM Project sa Brgy. Buan, Panglim Sugala, Tawi-Tawi.

Ang komunidad na benepisyaryo sa Barangay Buan ay nagsimulang magtamin ng seaweed noong Enero 2016 sa Hamri Reef (Figure 9), pagkatapos ng 45 na araw ng paglilinang ay umani sila o kumuha ng mga malalaking seaweed (tingnan ang Figure 10.a) at nagkaroon ng unang pagtatanim ulit. Walang pagpapatuyong naganap sa unang ani upang marami ang produksyon ng 3,000 floats at naging 10,000 floats sa apat (4) na pananiman (Figure 9), pagkatapos ng 45 hanggang 60 na araw ay magsisimula na silang umani.

Ang unang ani ay ginawa noong May 27, 2016 habang ang pagbebenta ay isinagawa noong June 16, 2016 sa Bongao Fish Trading sa bayan ng Bongao, Tawi-Tawi.

Ipinapakita sa Table 5 ang mga resulta ng paglilinang ng seaweed sa loob ng 45 na araw sa isang (1) block na may laki na 600m^2. Ang netong kita

ay PhP 2,081.00 sa loob ng 45 na araw ng operasyon at may Return of Investment (ROI) na 284%. Ito ay may sapat na taas na upang masabing maipagpapatuloy ang negosyong aquaculture na ito.

Table 5: Resulta ng paglilinang ng seaweed kada block sa Buan, TawiTawi (2016)

A.	**Total cost for facility per block (600m²): PhP**	**4,012.00**
1	Cost of materials[11]	3,489.00
2	Cost of handling and transport :15% of material cost	523.00
B.	**Ginastos sa produksyon: PhP**	**2,138.00**
1	Seedling	1,920.00
2	Depreciation: 2-year life	218.00
C.	**Sales/Gross income per block with 45-day culture**	**8,232.00**
1	Harvest: Dried weight, 35% Moisture content (kg)	329
2	Selling price: PhP/kg	25.00
D.	**Netong kita bawat block**	**6,094.00**
E	**ROI (%)**	**284**

Table 6. Gastos sa mga materyales sa pagtatanim sa isang block na taniman ng seaweed na may laki na 10m x 20m (2016)

Item/Description		**Unit**	**Quantity**	**Unit Cost**	**Total Cost**
A.	20x30m seaweed farm				
1.	Plastic straw, softie, 1,000m/roll	Kg	0.48	160.00	77.00
2.	P.E. Rope #12, 200m/roll	roll	0.44	400.00	176.00
3.	Pet bottle, recycled	Pc	300	1.00	300.00
4.	Plastic binder, four strand class "A", 200m/roll	roll	4	150.00	572.00
5.	Wooden stake	Pc	20	20.00	400.00
6.	Sledge hammer	Pc	1	395.00	395.00
7.	Knife	Pc	10	35.00	350.00
8.	Measuring tape, 50m length	Pc	1	640.00	640.00
9.	Iron rod	pc	1	580.00	580.00
	Kabuuang ginastos (PhP)				**3,489.00**
	Add: Handling and transport cost (15%)				523.40
	Total cost (PhP)				4,012.00

[11] *Tingnan sa Table 6*

Sa isang taon, maaaring makakatanim ng seaweed ang isang mangingisda ng anim or pitong beses na may 45 na araw lamang ng operasyon kung maganda ang kondisyon ng panahon. Ipinapakita sa Table 7 ang inaasahang gastos at kita bawat taon sa project site, kung ipagpalagay na tinaniman ang buong 100 na blocks pagdating ng September 2016. Napakalaki ng magandang epekto nito at ito ay malaking tulong sa pagkakaroon ng kita mula sa taniman ng seaweed.

Table 7: Inaasahang gastos at kita mula sa paglilinang ng seaweed kung gawing ganap ang operasyon bawat taon:

A.	**Total production cost:**	**PhP 1,496,600.00**
C.	**Sales/Gross income per block with 45-day culture**	**5,792,400.00**
D.	**Net income per block**	**4,265,800.00**
E	**ROI (%)**	**284**

14. Mga Reperensiya

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The Project for

Capacity Building for Community Development in Conflict-Affected Areas in Mindanao (CD-CAAM)

Implemented by

Bangsamoro Development Agency (BDA)
Office of the Presidential Adviser on the Peace Process (OPAPP)
Japan International Cooperation Agency (JICA)

BASIC MANUAL

FOR ROAD REHABILITATION AND MAINTENANCE BY LABOR-BASED TECHNOLOGY (LBT)

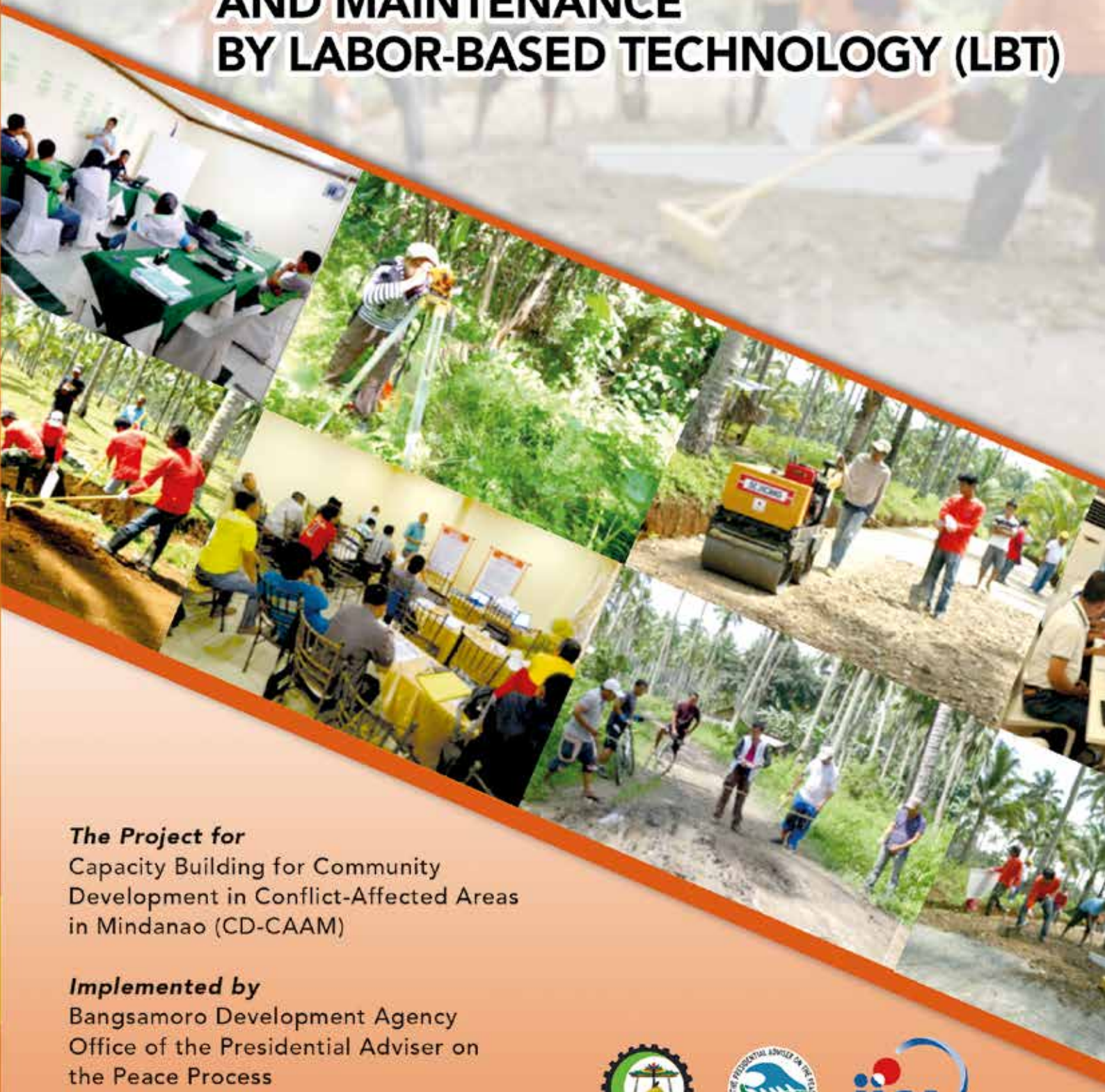

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Table of Contents

LIST of FIGURES, TABLES, and APPENDICES

Part A: ROAD CONSTRUCTION and REHABILITATION

LIST of ACRONYMS

ABC	-	Approved Budget for the Contract
AIP	-	Annual Investment Plan
ATNA	-	As The Need Arises
BDA	-	Bangsamoro Development Agency
BOQ	-	Bill Of Quantities
BRMT	-	Barangay Road Maintenance Team
CARI	-	Contractor's All Risk Insurance
CD-CAAM	-	Community Development-Conflict Affected Areas in Mindanao
cm	-	centimeter
cm^2	-	square centimeter
CORE	-	Community Road Empowerment
COW	-	Cut-Off Wall
DC	-	Direct Cost
DPWH	-	Department of Public Works and Highways
D/S	-	Downstream
EDC	-	Estimated Direct Cost
FMR	-	Farm to Market Road
G.I.	-	Galvanized Iron
ILO	-	International Labor Organization
IRA	-	Internal Revenue Allotment
JICA	-	Japan International Cooperation Agency
kg	-	kilogram
km	-	kilometer
km/hr	-	kilometer per hour
KN	-	Kilo-Newton
LB/ES	-	Labor Based/Equipment Supported
LBT	-	Labor-Based Technology
LGU	-	Local Government Unit
m	-	meter
m^2	-	square meter
m^3	-	cubic meter
M and E	-	Monitoring and Evaluation
MDD	-	Maximum Dry Density
ME	-	Municipal Engineer
MLGU	-	Municipal Local Government Unit
mm	-	millimeter
MPDC	-	Municipal Planning and Development Coordinator
MRMMT	-	Municipal Road Maintenance Monitoring Team
O and M	-	Operation and Maintenance
OCM	-	Overhead, Contingency, Miscellaneous
ODA	-	Official Development Assistance
OJT	-	On-the-Job Training
PCCP	-	Portland Cement Concrete Pavement
P.E.	-	Project Engineer
PE	-	Polyethylene
PERT/CPM	-	Program Evaluation and Review Technique/Critical Path Method
POW	-	Program Of Work
R.A.	-	Republic Act
RCPC	-	Reinforced Concrete Pipe Culvert
RPOO	-	Regional Project Operations Officer
SHEP	-	Smallholder Horticulture Empowerment Project
SWA	-	Statement of Work Accomplished
TOR	-	Terms Of Reference
TOT	-	Training Of Trainers
U/S	-	Upstream
WBS	-	Work Breakdown Structure

Acknowledgment

The **Bangsamoro Development Agency (BDA)** was established principally to determine, lead and manage the relief, rehabilitation and development projects in the **Conflict Affected Areas in Mindanao (CAAM).**

In support to this, the Office of the Presidential Adviser on the Peace Process (OPAPP) and Japan International Cooperation Agency (JICA) launched the Project for Capacity Building for Community Development in Conflict-Affected Areas in Mindanao (CD-CAAM) with the twin goal of establishing an effective and efficient implementation mechanism for community development projects in the CAAM and Capacity development of BDA as leading pubic institution for social and economic development of CAAM.

The role of rural infrastructure in the CAAM is primarily to support the sustainable livelihood and enterprise development in production areas. Roads in particular provide mobility to rural residents for better access to basic social services as well as enhance the productive capacity of the farming community and the fishermen. It is a fact that impassable roads are perennial issues and considered as one of the main factors that hinders economic development in rural areas. This consequently results to the high incidence of un-employment and under-employment especially in the CAAM. In addition, these areas are among the poorest of the municipalities in the country being a 5th or 6th class category hence the fiscal difficulty to undertake regular infrastructure development efforts.

It is in this context that labor-based technology in road construction, rehabilitation, and maintenance is promoted under CD-CAAM given its appropriateness with the availability of manpower and the budgetary constraints of local government units. Further, besides the absence or lack of rural roads in some areas, the declining condition of existing road networks in rural areas is highly observed. There were several issues identified that need to be addressed on the state of rural infrastructure facilities in support to agricultural productivity and these include lack of sustainable funding mechanisms and capacity for operation and maintenance.

Given these, the BDA as envisioned to manage the overall development efforts in CAAM and the LGUs being the primary institution mandated to develop these public facilities need to be capacitated on the aspects of rural infrastructure planning, implementation, and maintenance particularly local roads with the full involvement of communities and the rest of the stakeholders in these conflict affected areas.

To complement the capacity building effort, this technical manual on Labor-Based and "Do-Nou" technologies is developed to serve as reference in their pursuit to develop their skills further and ensure common understanding. This would also correct the interpretation of those charged with the responsibilities in the fields of rural infrastructure planning and maintenance.

The manual includes rural roads standard engineering prototypes and specifications, processes and procedures in the application of labor-based and "Do-Nou" technologies and the operation and maintenance (O and M) systems and procedures of completed facilities for sustainability.

The preparation of this technical manual could not have been possible without the availability of training materials, references and publications authored and compiled by various individuals and institutions working in the field of infrastructure development in the Philippines and abroad.

In deep appreciation of these sources, acknowledgement is accorded to the following authors and institutions:

- Labor-Based Technology Guidelines, Economic Infrastructure Department, Japan International Cooperation Agency (JICA), March 2012

- DPWH "Blue Book" Volume I, 2004 version on Standard Specifications for Highways, Bridges and Airports
- Contractors' Handbook for Labor-Based Road Works, Republic of Zambia, Ministry of Works and Supply, Roads Department Training School, Advisory Support Information Services and Training (ASIST), International Labour Organization (ILO), Norwegian Agency for Development Cooperation (NORAD), 2004
- Training Materials on Program Evaluation and Review Technique/Critical Path Method (PERT/CPM) – a compilation with source from Decision Research Corporation
- Manual on Effective Rural Infrastructure Planning and O and M, T.A. 7716-PHI: Decentralized Framework for Sustainable Natural Resources and Rural Infrastructure Management, Pacific Rim Innovations and Management Exponents (PRIMEX), Inc., Asian Development Bank (ADB), August 2013
- Labor-Based Routine/Preventive Road Maintenance, Upland Development Programme in Southern Mindanao (UDP), Department of Agriculture (DA), European Union (EU), November 2006
- Handbook written for TP3 on the routine maintenance of roads, PNPM, Mandiri, Perdesaan, International Labour Organization (ILO), April 2009
- Road Maintenance Using "Do-Nou" Technology, Simplified Field Training Material, Community Road Empowerment (CORE)
- Manual for Spot Improvement with "Do-Nou" Method for Ghana, Community Road Empowerment (CORE), September 2012
- Training Materials on Rural Infrastructure Operation and Maintenance Systems and Procedures, Northern Mindanao Community Initiatives and Resource Management Project (NMCIREMP), International Fund for Agricultural Development (IFAD), July 2007

INTRODUCTION

One of the means of achieving the objectives of CD-CAAM is to embark on capacity building initiatives in support to the development of the basically agricultural-based economy in conflict affected municipalities in Mindanao. This is in line with developing critical infrastructure projects in selected areas on a pilot scheme more particularly in rural roads with production areas. Initial studies made under CD-CAAM points to the appropriateness in the application of the Labor-Based Technology (LBT) in road construction and rehabilitation and "Do-Nou" technology in road maintenance. This is in consideration of the rural environment in the subject areas and availability of un-employed or under-employed communities engaged in intermittent and small-scale agricultural production activities.

In this context, and aligned with the national government's employment generation program, the Labor Based–Equipment Supported (LB/ES) methods of construction, rehabilitation, and maintenance of community development projects particularly rural infrastructure will be adopted for CD-CAAM. Further to this and pursuant to R.A. 5635 dated December 12, 1988 on government infrastructure projects, at least fifty (50%) percent of the unskilled and thirty (30%) percent of the skilled labor requirement shall be taken from the beneficiary community. Hence, beneficiaries within the community shall be the first priority in the selection of labor force.

Given these and in support to the initial capacity building initiatives for the BDA and LGUs, this Manual is hereby developed to be used in capacitating the target communities on the use of Labor-Based Technology (LBT) in road construction and rehabilitation and "Do-Nou" technology in road maintenance.

OBJECTIVES of the MANUAL

The general objective of this manual is to serve as source book for the BDA and LGU to capacitate and guide the community in adopting the salient features of the Labor-Based and "Do-Nou" Technologies applied to road construction, rehabilitation, and maintenance in municipalities covered under the Bangsamoro entity.

To further strengthen the capacity of BDA on community development through planning, implementation, monitoring, and evaluation of rural infrastructure projects, this manual includes the processes and procedures of implementing road construction, rehabilitation, and maintenance in using the above technologies.

Specifically, the BDA, LGUs and community will:

1. acquire the knowledge on rural road standard plans and technical specifications;
2. learn the basic procedures on labor-based rural road construction and rehabilitation works;
3. be aware of the road maintenance concepts and common distresses of rural roads;
4. learn the standard maintenance procedures and activities adopting the Labor-Based and "Do-Nou" Technologies; and
5. realize the importance of organizing communities for the sustainability of rural roads operation.

Proper maintenance of local road facilities is the main responsibility of LGUs under the Local Government Code of 1991. This is in cooperation with Community beneficiaries. Timely maintenance is critical to ensuring the usefulness of these facilities within its economic lifespan and this can only be provided by the LGUs and Communities themselves.

There are existing systems and procedures on Operation and Maintenance (O and M) of roads being adopted by different national line agencies particularly DPWH, provincial and municipal LGUs as well as past projects financed under the Official Development Assistance (ODA). The

development of this Manual is basically adopting applicable provisions that are currently practiced by these institutions but are slightly modified to fit the requirements of CD-CAAM Project.

Given the financial constraints of the LGUs, this manual has the following additional specific purposes:

1. to institute a labor-based community maintenance scheme;
2. enhance the partnership between the municipal LGUs and the Community in ensuring the sustainability of the road facilities;
3. promote cooperative spirit among the community members and enhance the development of a sense of commitment and ownership;
4. institute revenue generating measures to supplement funding for O and M purposes;
5. integrate maintenance activities in community organizational development; and
6. strengthen the Monitoring and Evaluation (M and E) of operation and maintenance activities of CD-CAAM assisted road projects and ensure compliance with agreement even beyond Project life.

This manual should not in any way encroach on the procedures prescribed by other institutions mandated to implement similar or related projects. However, applicable provisions on systems and procedures as developed by these institutions are highly recommended for adoption.

SCOPE and INTENDED USERS of the MANUAL

This technical Manual basically covers the systems and procedures in undertaking road construction and rehabilitation of rural or local roads using the Labor-Based Technology (LBT) and road maintenance adopting the "Do-Nou" method for major road distresses. The rest of the routine and periodic maintenance procedures are likewise included with additional features on O and M monitoring and evaluation system in an effort to institutionalize the sustainability mechanism of roads in support to social and economic development of Conflict Affected Areas in Mindanao (CAAM). Standard forms, labor-based hand tools and instruments, technical specifications and details are however provided for easy reference and uniformity.

The manual is intended for the use of BDA in the discharge of their roles and responsibilities in determining, leading, and managing the relief, rehabilitation, and development projects in the CAAM once the Bangsamoro Basic Law takes effect. This would serve as source document in undertaking community development projects by labor-base in partnership with participating LGUs as well as guide contractors engaged during its implementation. However, this Manual does not in any way limit the implementors to adopt innovative measures in improving the efficiency of ground implementation of community projects especially when it would require necessary modifications to fit actual field conditions. Hence, the Manual shall be modified and enhanced from time to time as implementation is being pursued.

Part A:
ROAD CONSTRUCTION and REHABILITATION

A-1. LABOR-BASED TECHNOLOGY in ROAD CONSTRUCTION and REHABILITATION

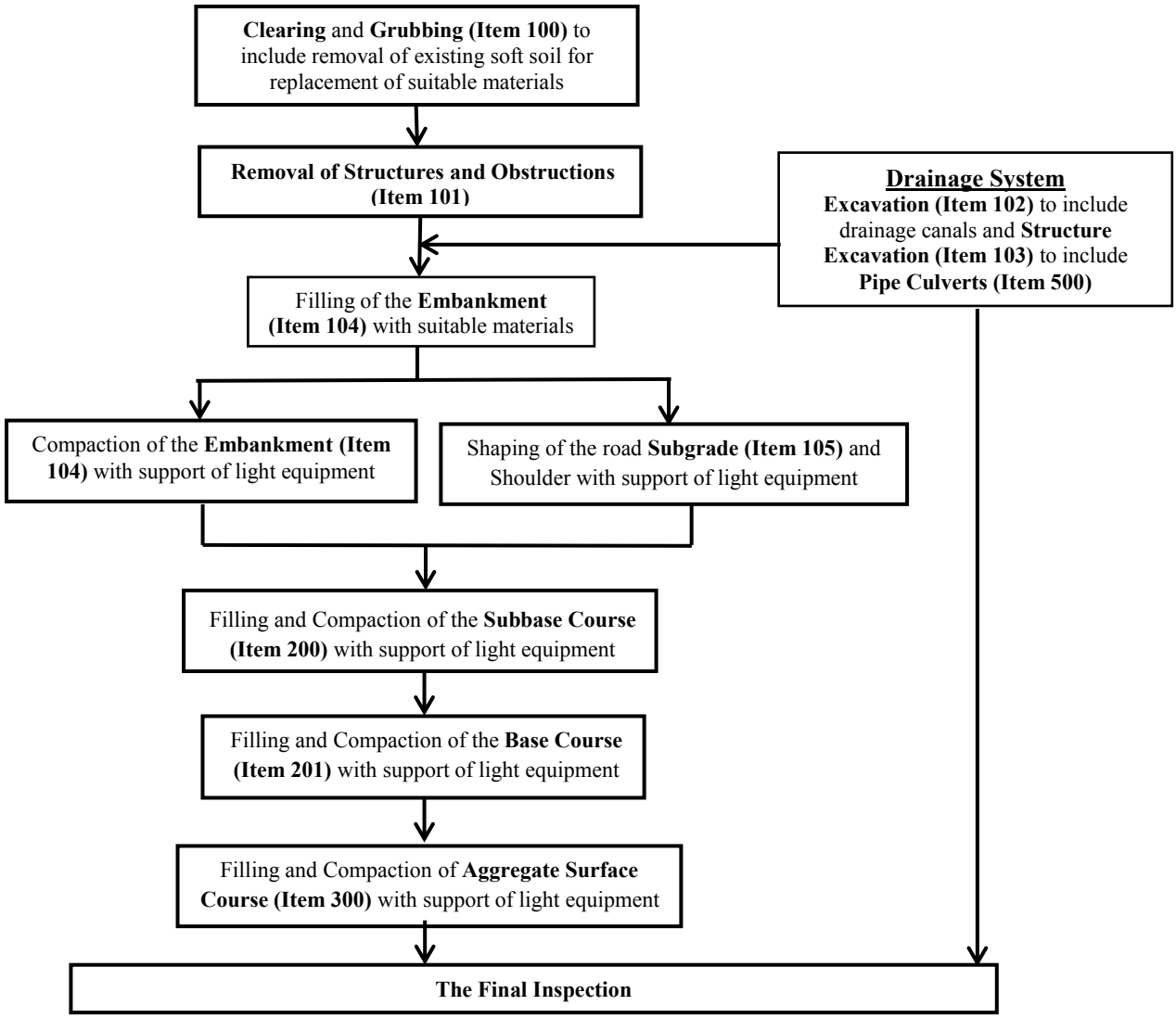
A1.1 Definition of the Labor-Based Technology (LBT)

Labor-Based Technology as defined in the JICA LBT Guideline is a "construction technology aimed at applying labor/equipment mix that gives priority to labor, but supplements it with light equipment where necessary for reasons of quality or cost". The CD-CAAM Project's thrust of capacity development of communities will optimize community participation on the labor-based works and will ensure concurrence to the JICA LBT Guideline of 2012.

LBT in CD-CAAM can be defined as "the construction technology utilizing the participation of the community as labor force supplemented with light equipment such as compactors to ensure the quality of the construction works."

It should be noted that the quality in this case, means the state to ensure smooth traffic for light vehicles and pedestrian. The basic design of CD-CAAM road rehabilitation project will be in accordance to the specification approved by JICA. The basic flow of road rehabilitation by LBT is as follows:

Figure 1* : *Basic Procedure for Road Construction and Rehabilitation by LBT



A1.2 Rural Road Standard Plans and Sections

Rural roads particularly barangay and farm to market roads (FMR) are generally termed as all-weather roads and composed of three (3) layers of base and surface courses If funds are available, the upper-most layer, Aggregate Surface Course (Item 300) is usually replaced with Portland Cement Concrete Pavement (PCCP-Item 311) to ensure durability and reduce regular maintenance cost.

Carriageway is 4.00 meters wide with 1.00 meter shoulders at each side. Drainage canals could either be triangular in shape for smaller surface run-off or trapezoidal for larger run-off discharges. Cross-fall (road surface transverse slope) ranges from 3% to 10% for gravel roads and 3% for PCCP. Figures below are typical sections of barangay and farm to market roads where road sections could be located in three common types of terrain and these are: *i) on "fill" section or embankment, ii) on "through – cut" section or, iii) on a combination of "cut" and "fill".*

Figure 2: Typical Road Section on "Fill"

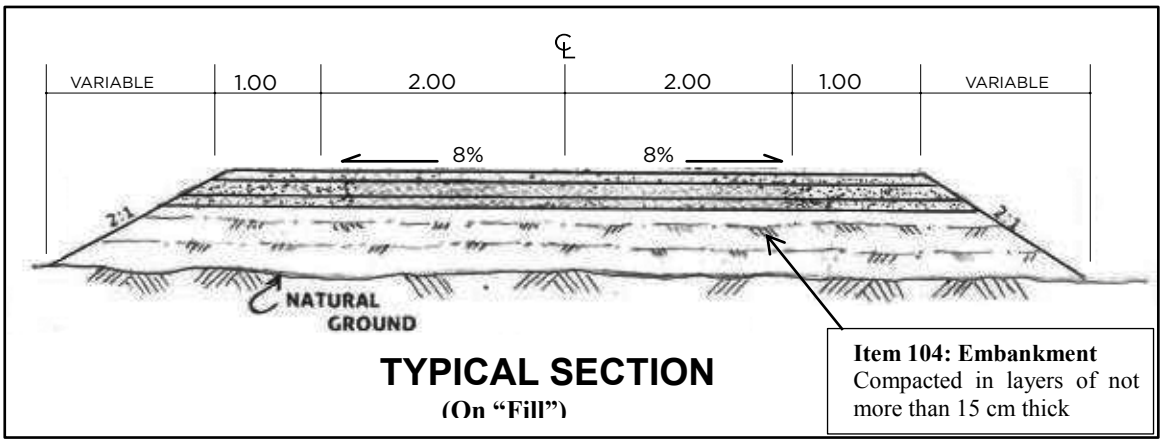


Figure 3: Typical Road Section on "Cut"

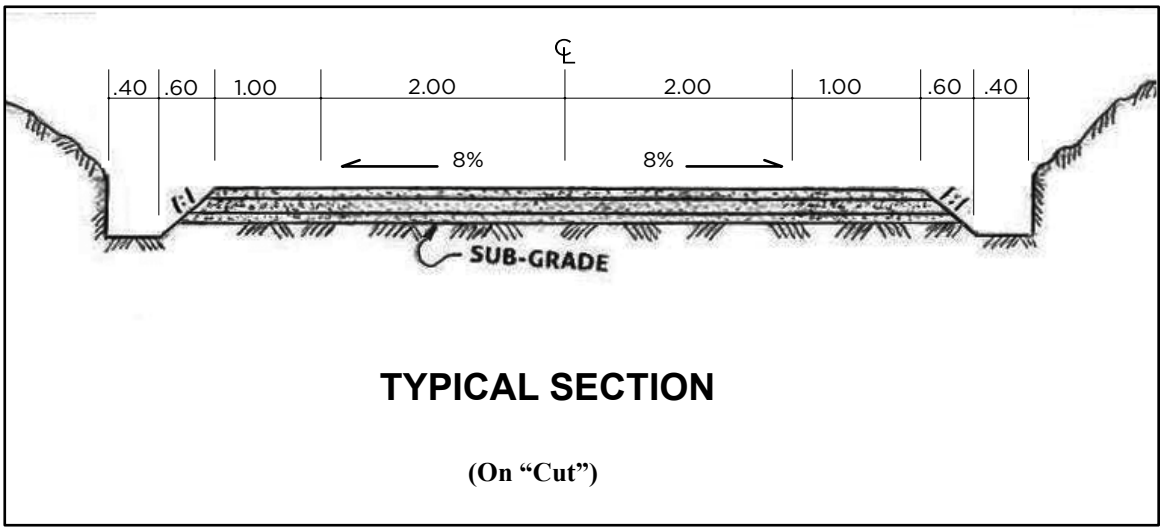
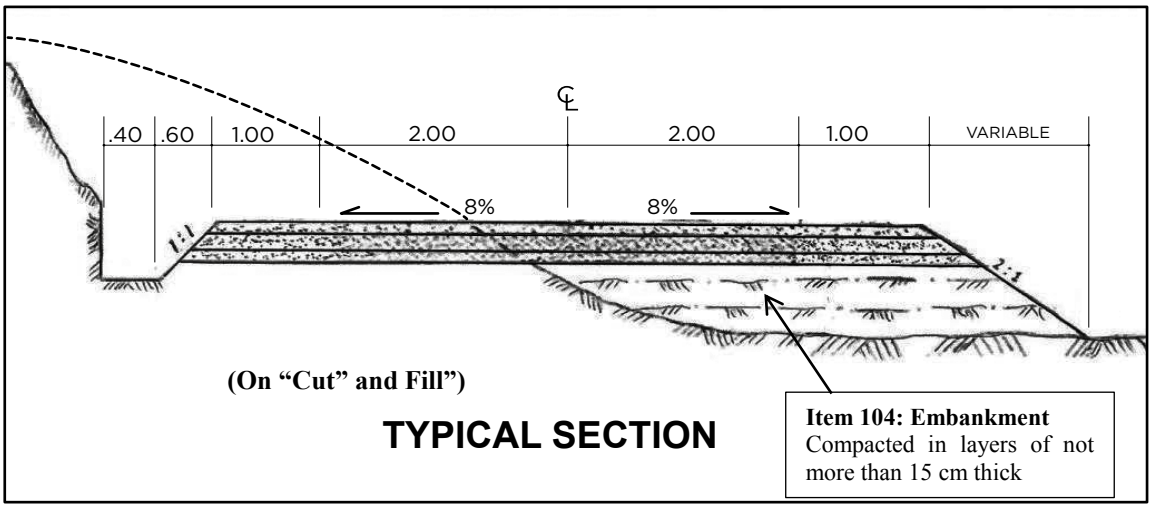


Figure 4: Typical Road Section on "Cut" and "Fill"



A1.3 General Standard Road Specifications

The following discussions are the General Standard Road Specifications. Specific details of these specifications have to refer back to the Philippines' DPWH "Blue Book" particularly Volume II on Standard Specifications.

Item 100: Clearing and Grubbing

This item shall consist of clearing, grubbing, removing and disposing all vegetation, trees, stumps, brush, roots, logs, rubbish and debris as designated in the Contract, except those objects that are designated to remain in place or are to be removed in consonance with other provisions of the specification. The work shall also include the preservation from injury or defacement of all objects designated to remain. Spoils should be deposited at the designated area.

Item 101: Removal of Structures and Obstructions

This Item shall consist of the removal wholly or in part, and satisfactory disposal of all buildings, fences, structures, old pavements, abandoned pipe lines, and any other obstructions which are not designated or permitted to remain, except for the obstructions to be removed and disposed of under other items in the Contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits.

Item 102: Excavation

This Item shall consist of roadway and drainage and borrow excavation and the disposal of material in accordance with the specification and in conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer. Roadway excavation will be classified as “unclassified excavation”, “rock excavation”, “common excavation”, or “muck excavation” as described in the Bill of Quantities.

Excavation operation shall be conducted so that materials outside the limits of slope stakes will not be disturbed. It shall start from the top down to sub-grade elevation and all fill section alongside cut should be benched before embankment materials are placed in layers not exceeding 15 cm.

All unsuitable materials shall be disposed off as shown on the plans and backfilled to the finished grade with approved materials. Suitable materials shall be spread to form as part of the compacted subgrade. The excavation of muck shall be handled in such a manner that will not permit the entrapment of muck within the backfill.

Item 103: Structure Excavation

This Item shall consist of the necessary excavation for foundation of bridges, culverts, under-drains, and other structures not otherwise provided for in the specifications. It shall also include the furnishing and placing of approved foundation fill material to replace unsuitable material encountered below the foundation elevation of structures.

Trenches or foundation pits for structures or structure footings shall be excavated to the lines and grades or elevations shown on the Plans or as staked by the Engineer. Batter Board shall be established.

Item 104: Embankment


This Item shall consist of the construction of embankment in accordance with the specification and in conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer. Embankments and backfills shall contain no muck, peat, sod, roots or other deleterious matter. Roadway embankment of earth material shall be placed in horizontal layers not exceeding 150 mm (6 inches), loose measurement, and shall be compacted as specified before the next layer is placed. Compaction of each layer shall continue until a field density of at least 95% of the Maximum Dry Density (MDD) has been achieved.

Item 105: Subgrade Preparation


This Item shall consist of the preparation of the subgrade for the support of overlying structural layers. It shall extend to full width of the roadway. Sub-grade preparation shall not be done unless the construction of the pavement structure is ready to start immediately. Prior to commencing preparation of the subgrade, all culverts, cross drains, ducts and the like (including their fully compacted backfill), ditches, drains and drainage outlets shall be completed. The compacted subgrade shall be free from any unsuitable materials especially unstable materials that cannot be compacted properly.

Item 200: Aggregate Subbase Course

This item shall consist of furnishing, placing and compacting of aggregate subbase course on a prepared subgrade in accordance with the specification and the lines, grades and cross-sections shown on the Plans. Aggregate for subbase shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural

gravel and filler of natural or crushed sand or other finely divided mineral matter and according to the specified grading requirements. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable subbase. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Compaction of each layer shall continue until a field density of at least 100% of the maximum dry density has been achieved. These rolling requirements shall be applicable to the succeeding courses on Items 201 and 300.

Item 200: Grading Requirements with Certificate from DPWH Accredited Laboratory

Sieve Designation		Mass Percent Passing
Standard, mm	Alternate US Standard	
50	2”	100
25	1”	55 – 85
9.5	3/8”	40 – 75
0.075	No. 200	0 – 12

Item 201: Aggregate Base Course

This Item shall consist of furnishing, placing and compacting of aggregate base course on a prepared subgrade/subbase in accordance with the specification and the lines, grades, thickness and typical cross-sections shown on the Plans. Aggregate for base course shall consist of hard, durable particles or fragments of crushed stone, crushed slag or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter and according to the specified grading requirements. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable base. The rolling requirement shall be the same as Item 200 above.

Item 201: Grading Requirements with Certificate from DPWH Accredited Laboratory

Sieve Designation		Mass Percent Passing	
Standard, mm	Alternate US Standard	Grading A	Grading B
50	2”	100	
37.5	1-1/2”	-	100
25.0	1”	60 – 85	-
19.0	¾”	-	60 – 85
12.5	½”	35 – 65	-
4.75	No. 4	20 – 50	30 – 55
0.425	No. 40	5 – 20	8 – 25
0.075	No. 200	0 – 12	2 – 14

Item 300: Aggregate Surface Course

This item shall consist of a wearing or top course composed of gravel or crushed aggregate and binder material, constructed on a prepared base in accordance with the specification and in conformity with the lines, grades and typical cross-sections shown on the Plans. The aggregate shall consist of hard, durable particles or fragments of stone or gravel and sand or other fine mineral particles according to the specified grading requirements and free from vegetable matter and lumps or balls of clay and of such nature that it can be compacted readily to form a firm, stable layer. The rolling requirement shall be the same as Item 200 above.

Item 300: Grading Requirements with Certificate from DPWH Accredited Laboratory

Sieve Designation		Mass Percent Passing			
Standard, mm	Alternate US Standard	Grading A	Grading B	Grading C	Grading D
25.0	1”	100	100	100	100
9.5	3/8	50 – 85	60 – 100	-	-
4.75	No. 4	35 – 65	50 – 85	55 – 100	70 – 100
2.00	No. 10	25 – 50	40 – 70	40 – 100	55 – 100
0.425	No. 40	15 – 30	25 – 45	20 - 50	30 – 70
0.075	No. 200	5 - 20	5 - 20	6 - 20	8 - 25

Item 311: Portland Cement Concrete Pavement (PCCP)

This Item shall consist of pavement of Portland Cement Concrete, with or without reinforcement, constructed on the prepared base in accordance with the specification and in conformity with lines, grades, thickness and typical cross-section shown on the Plans. Only ***Type I Portland Cement*** shall be used unless otherwise provided for in the Special Provisions. Different brands or the same brands from different mills shall not be mixed nor shall they be used alternately unless the mix is approved by the Engineer. Cement which for any reason, has become partially set or which contains lumps of caked cement must be rejected.

Fine Aggregate

It shall consist of natural sand, stone screenings or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles. Fine aggregate from different sources of supply shall not be mixed or stored in the same pile nor used alternately in the same class of concrete without the approval of the Engineer.

Coarse Aggregate

Coarse Aggregate

Shall consist of crushed stone, gravel, blast furnace slag, or other approved inert materials of similar characteristics, or combinations thereof, having hard, strong, durable pieces and free from any adherent coatings.

Water



Water used in mixing, curing or other designated application shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product. Water which is drinkable may be used without test.

Reinforcing Steel


Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale and loose or thick rust which could impair bond of the steel with the concrete. ***Dowels*** shall be *plain round* bars where one-half of the length of each dowel shall be painted with one coat of approved lead or tar paint. ***Tie Bars*** shall be *deformed bars* and should be 16 mm diameter installed on Longitudinal and Transverse Construction Joints.

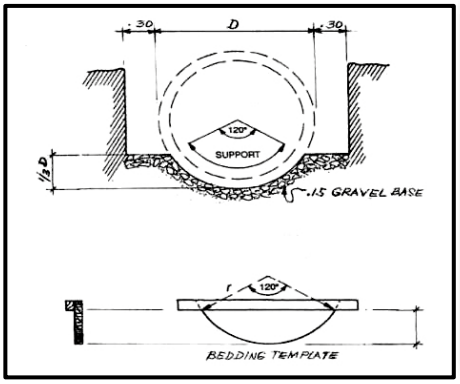
Joint Fillers

Poured joint fillers shall be mixed asphalt and mineral or rubber filler conforming to the applicable requirements of Item 705, Joint Materials.

Item 500: Pipe Culvert and Storm Drain


This Item shall consist of the construction or reconstruction of pipe culverts and storm drains, hereinafter referred to as "conduit" in accordance with the specification and in conformity with the lines and grades shown on the Plans or as established by the Engineer.

Trenches Excavation



Trenches shall be excavated in accordance with the requirement of Item 103, Structure Excavation, to a width sufficient to allow for proper jointing of the conduit and thorough compaction of the bedding and backfill materials under and around the conduit. Where feasible, trench wall shall be vertical.

The width of the pipe trench shall have sufficient allowance at both sides (at least 300mm at each side from the external side of the pipe) so that the pipe when installed, can be thoroughly compacted by tamping of the bedding material under and around the pipe and satisfactory collar jointing around the pipe can be placed.

Boulders, logs, and other objectionable materials encountered in excavation shall be removed.

When the foundation material is soft or mucky or otherwise unsuitable, as determined by the Engineer, the Contractor shall remove the unsuitable material and backfill with approved granular material.

After the excavation is complete, no foundation fill material or pipe culvert shall be placed until the Engineer shall have checked and approved the depth of excavation.

This foundation fill shall be placed and compacted in 150 mm (6 inches) layers up to the foundation elevation.

Bedding

The bedding shall conform to one of the classes specified below:

Class "A" bedding shall consist of continuous concrete cradle conforming to the plan details;

Class "B" bedding shall consist of bedding the conduit to a depth of not less than 30% of the vertical outside diameter of the conduit. The minimum thickness of bedding material beneath the pipe shall be 100 mm. The bedding material shall be sand or selected sandy soil;

Class "C" bedding shall consist of bedding the conduit to a depth of not less than 10% of its total height.

Jointing Conduit



Rigid conduits may either be of bell and spigot or tongue and groove design unless another type is specified. The method of joining conduit sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even.

Concrete collar – outside RCCP joint
Inner flushing – inside RCCP joint

Completed joints shall be protected against rapid drying by any suitable covering material

Portland Cement and Sand shall conform to the requirements of Item 405, Structural Concrete.

Joint Mortar

Joint mortar for concrete pipes shall consist of 1 part, by volume of Portland Cement and two (2) parts of approved sand with water as necessary to obtain the required consistency.

Backfilling


Materials for backfilling on each side of the conduit for the full trench width and to an elevation of 300 mm above the top of the conduit shall be fine, readily compactible soil or granular material selected from excavation or from a source of the Contractor's choice. All excavated materials considered suitable shall be utilized as backfill for embankment.

A1.4 Labor-Based Construction Tools and Equipment

The number and types of tools and equipment depends on the task and the number of workers employed. Proposed standard lists of tools and equipment are presented on the illustrations below. These lists can be used as a guide but need to be adjusted for each specific project hence additional tools may be needed as the need arises.

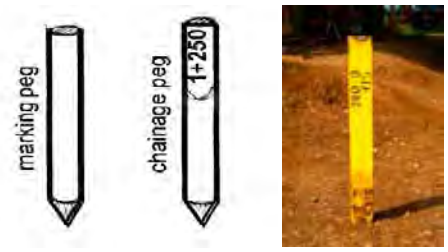
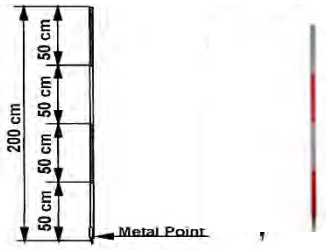
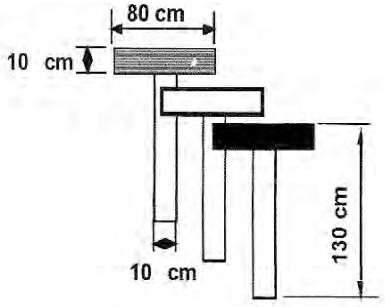
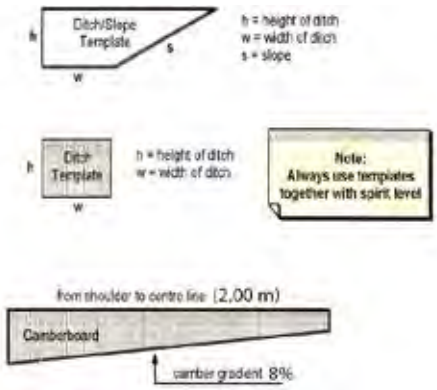
A1.4.1 Hand Tools

Figure 5: Common Labor-Based Hand Tools

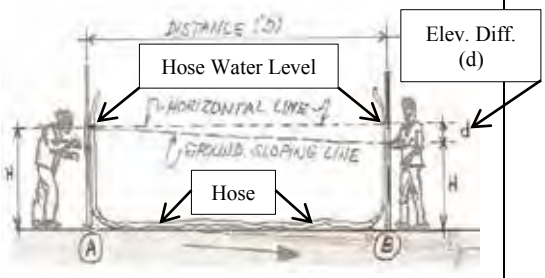
A1.4.2 Measuring Aids and Other Instruments

In addition to the hand tools shown in Fig 5, elementary simple measuring aids and instruments for site works under LBT will include the following:

Figure 6: Common Measuring Aids and Other Instruments

Pegs or Stakes Pegs are used for survey purposes and for setting out all the activities. On labor based sites, usually wooden sticks are used of approximately 50 cm length and strings. On one end they are pointed so that they can easily be hammered into the ground. Survey pegs such as chainage pegs are shaved at the edge so that clear marking can be made.	
Tape Measures The most common length of tape measure used for setting out is 30 or 50 meters. The tapes are made of steel or linen.	
Ranging Rods Ranging rods are round sticks usually 2 m long with a diameter of approximately 2.5 cm. They are made of various materials (metal, hard plastic, wood) and are usually provided with a pointed metal end. They are painted red and white with black marking at the 1 meter point. The length of the red/white sections is 50 cm.	
Boning Rods or Travellers Boning rods are T-shaped and of a uniform height. They can easily be manufactured by nailing a wooden plank of 80 cm length and 10 cm height on another plank of 130 cm length and 10 cm width so that the end result looks like a ¨T¨. The horizontal plank should be painted in clearly visible colors. Boning rods have to be used in a set of three.	
Templates Templates are used to control certain shapes of the road. For example, to control the correct shape for the slope and ditch, a template of the standard slope-ditch size can be used by the laborers to continuously check whether the correct shape is being dug. Templates are very useful control aids as any laborer can see the exact size and shape of the work she/he is required to carry out. They are usually made of wood and tailor-made for each particular project in accordance with the standard measurements (see specifications).	
Spirit Level Spirit levels are available in all different sizes. For construction work robust and long spirit levels are ideal. The longer the spirit level the more exact the measurement will be. Always ensure that the spirit level is properly adjusted before you buy it.	

<table>
<tr>
<td>Line Level
A line level is a small spirit level of about 80 - 120 mm length. It has a hook on each end of the level which is used for hooking the level onto a smooth line. The level is used together with a line, ranging rods (or profile boards) and a tape measure. The line level requires two people to operate.

The line level can be used to:
✓ transfer levels
✓ check existing gradien
✓ set out gradients
Always check:
✓ that the line is smooth or of nylon
✓ keep the line tight
✓ level is in the middle between the two ranging rods
✓ check the accuracy of the level regularly</td>
<td> 
Check accuracy of line level:
✓ Place two ranging rods 20 m apart
✓ Fix a line on the 1m-mark on one rod and transfer the level to the other rod mark this level. The line should be kept tight and the bubble on the line level should be in the middle
✓ Keep line in place, unhook the line level and turn it around
✓ Adjust the line again and make sure the bubble on the line level is in the middle
✓ Mark the new level on the rod and measure the difference between the two levels</td>
</tr>
<tr>
<td>Hose Level
Hose level is made of 6 mm diameter plastic transparent hose filled with water ensuring that no air bubbles are trapped within the whole length. The length depends on the farthest distance of transferring elevation or determining difference in elevation between two points.</td>
<td> 
</td>
</tr>
<tr>
<td>Plumb Bob
The plumb bob is usually used by masons to check the vertical alignment of walls. On road sites this is the case for structure work.</td>
<td>  </td>
</tr>
</table>

A1.4.3 Compaction Equipment

Even if LBT is adopted, it needs to be supported by compaction equipment to ensure works quality. It would be impractical to use manual compaction on roads due to the area of compaction coverage as well as the effectivity and efficiency factors.

Figure 7: Common Compaction Equipment with Specifications

Smooth Wheeled Rollers Suitability: for light clayey and well graded soils **Note:** self-propelled or tractor drawn ***Specification:*** Operational Weight: 2.5 to 4.5 tons Roller Width: 100 to 150 cm Working Speed: 1.5 to 3.0 km/hr Thickness Loose Layer: 10 cm Approximate Passes: 4 to 8 passes	
Towed Vibrating Roller Suitability: for light clayey and well graded soils **Note:** tractor drawn roller ***Specification:*** Operational Weight: 3 to 5 tons Roller Width: 140 to 190 cm Working Speed: 1.0 to 3.0 km/hr Thickness Loose Layer: 30 cm Approximate Passes: 2 to 4 passes	
Pedestrian Tandem Vibrating Roller Suitability: for light clayey and well graded soils **Note:** manual operated drawn roller ***Specification:*** Operational Weight: 1 to 1.5 tons Roller Width: 90 cm Working Speed: 1.0 to 2.0 km/hr Thickness Loose Layer: 15 to 20 cm Approximate Passes: 4 to 6 passes	
Vibro Tampers (Plate Compactors) Suitability: for light clayey and well graded soils **Note:** for compaction of backfill only (manual operated) ***Specification:*** Operational Weight: 100 kg Compacting Area: 1,000 to 1,600 cm^2 Blows per Minute: 500 Thickness Loose Layer: 20 to 30 cm Approximate Passes: 2 to 4 passes	
Dropping Weight Compactors (Jumping Jack) Suitability: for all types of soils **Note:** for compaction of backfill only (manual operated) ***Specification:*** Operational Weight: 50 to 100 kg Compacting Area: 530 to 890 cm^2 Blows per Minute: 60 to 80 Thickness Loose Layer: 20 cm Approximate Passes: 2 to 4 passes	

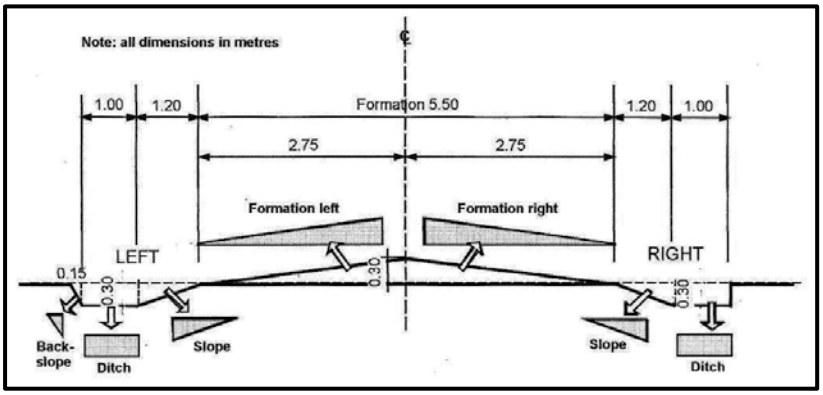
A1.5 Cost Estimates and Programming

A1.5.1 Road Measurements and Calculations (Length, Area, Volume)

The calculation of volumes is the most common calculation for road construction work. This is required to develop the Bill of Quantities (BOQ), to measure work for actual construction purposes (estimating resource requirements and time to complete the work, materials requirement, etc.), and finally to measure the completed work items.

To simplify the calculations, the technique is to dis-aggregate the road shapes into common geometrical figures with established formulas to calculate the surface areas. An illustrative example of a typical road section below is shown to demonstrate the simplified calculation of these areas and volumes. The road section is divided into common shapes of triangles and rectangles for easy computation.

Example: Given a Typical Road Section divided into Triangles and Rectangles



A. Calculate the volume of fill required for the formation over a road length of 100 meters

Steps:

1. divide the formation areas into common shapes that can be easily calculated into two (2) triangles;
2. calculate the area of each shape
3. calculate the total sum of all shapes or areas
4. to get the volume, multiply the total area with the length of the road (100 meters)

Calculation A

	Area of Formation	Formula	Calculation
FORMATION	Formation left (0.30m / 2.75m)	$\frac{a \times b}{2}$	$\frac{2.75m \times 0.30m}{2} = 0.4125m^2$
	Formation right (0.30m / 2.75m)	$\frac{a \times b}{2}$	$\frac{2.75m \times 0.30m}{2} = 0.4125m^2$
	Total Area of Formation		$0.4125m^2 + 0.4125m^2 = 0.825m^2$
Formation for 100m of Road	Total Area (m^2) x 100m	=	$0.825m^2 \times 100m = 82.5m^3$ Volume

Note: *For earth fill, a shrinkage factor of 30% is usually added on hence multiply the volume by a factor of 1.30 to get the* ***required total earth fill volume*** *equal to* ***82.5 x 1.3 = 107.25 m^3***

B. Calculation of the volume of excavation for side ditches over a road length of 100 meters

Steps:

1. divide the ditch-slope area into common shapes that can be easily calculated i.e. two (2) triangles and one (1) rectangle in each side;
2. calculate the area of each shape and multiply by two (if similar for both sides)
3. calculate the total sum of all shapes or areas
4. to get the volume, multiply the total area with the length of the road (100 meters)

Calculation B

	Part Area of Ditch	Formula	Calculation
DITCH AREA BOTH SIDES	Slope left and right (1.20m, 0.3m; 1.20m, 0.3m)	$\frac{a \times b}{2} \times 2$	$\frac{0.3m \times 1.2m}{2} \times 2 = 0.36m^2$
	Ditch left and right (1.00m, 0.3m; 1.00m, 0.3m)	$a \times b \times 2$	$0.3m \times 1.0m \times 2 = 0.6m^2$
	Backslope left (0.15m, 0.3m)	$\frac{h \times b}{2}$	$\frac{0.3m \times 0.15m}{2} = 0.0225m^2$
	Total Area of Ditch, Both Sides		$0.36m^2 + 0.6m^2 + 0.0225m^2 = 0.9825m^2$
Ditch Volume Both Sides for 100m Road	Total Area (m^2) x 100m	=	$0.9825m^2 \times 100m = 98.25m^3$ Volume

Note: *For excavation, no factor is necessary hence* ***required total excavation volume*** *is also equal to* ***98.25 m^3***

A1.5.2 Standard Manpower Capability

There are several available historical data on manpower capability compiled by different practitioners in the field of construction. However, one must be careful in using the data, as these are subject to variations due to actual field conditions and configurations. These include the road alignment terrain and elevation, soil characteristics, road location, and weather condition during construction among others. As a reference, the table below are the common road work activities with available historical data on manpower capability subject to actual verification and adjustment when necessary.

Table 1: Manpower Capability of Common Road Work Activities

Manual Work Activity	Manpower Capability	Remarks
• **Clearing and Grubbing**	150 sq. m. *per Man-Day*	Within the Road Right of Way (RROW)
• **Subgrade Preparation**	3.5 sq. m. *per Man-Day*	Levelling of road surface
• **Camber Formation**	150 sq. m. *per Man-Day*	Using camber board
• **Manual Excavation**		
✓*Canals*	2.5 cu. m. *per Man-Day*	Common Materials
(up to 1.5 m depth)	1.0 cu. m. *per Man-Day*	Slightly Hard Materials

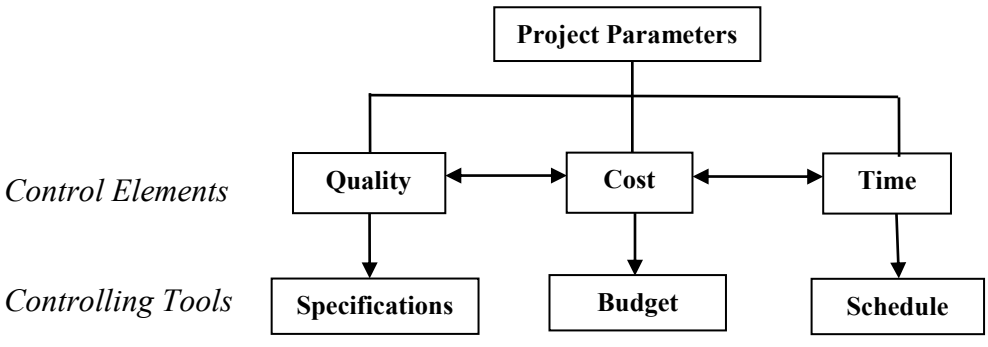
✓*Structures (up to 1.5 m depth)*	2.0 cu. m. *per Man-Day*	Common Materials
	0.75 cu. m. *per Man-Day*	Slightly Hard Materials
• **Manual Backfill**	3.0 cu. m. *per Man-Day*	Backfilling
	1.6 cu. m. *per Man-Day*	Backfill Compaction
• **Boulder Riprap**	1.5 cu. m. *per Man-Day*	Plain Riprap Laying
	0.5 cu. m. *per Man-Day*	Grouted Riprap Laying
• **Manual Spreading**		
✓*Earth*	15 cu. m. *per Man-Day*	Common soil embankment
✓*Aggregate Base Courses*	10 cu. m. *per Man-Day*	All types of courses (Items 200, 201, 300
• **Concreting Works**		
✓*Ditch Concrete Lining*	4.5 cu. m. *per Gang-Day*	*Gang: 1 leadman; 1 bagger mixer with operator; 10 laborers; 2 masons*
✓*Concrete Formworks*	3.5 cu. m. of 3,000psi concrete *per Gang-Day*	*Gang: 1 leadman; 2 carpenters; 4 laborers (fabrication, placing, dismantling)*
✓*Structure Concreting*		
- with mixer	3.5 cu. m. *per Gang-Day*	*Gang: 1 leadman; 2 masons; 8 laborers; 1 bagger mixer with operator*
- without mixer	2.5 cu. m. *per Gang-Day*	*Gang: 1 leadman; 2 masons; 10 laborers*
• **CHB Laying and Plastering**	12 sq. m. *per Gang-Day*	*Gang: 2 masons; 2 laborers*
RCPC Laying (24"Diameter)	12 pcs *per Gang-Day*	*Gang: 1 leadman; 1 mason; 1 carpenter; 12 laborers;1 bagger mixer with operator*

A1.5.3 Work Scheduling

Planning the Project

A project has three (3) basic parameters: *quality, cost, and time*. A successfully managed project is one that is completed at the specified level of quality, on or before the deadline, and operates within the budget. These parameters are specified in detail during the planning phase which will form the basis of control during the implementation phase. In controlling these parameters, each has specific tools or documents as basis for determining whether the project is going well or not. The project parameters are as follows:

Figure 8: Project Parameters



Planning means listing in detail what is required to successfully complete the project along the three (3) critical dimensions above. The basic planning steps are summarized as follows:

1. establish the project objective;
2. choose a basic strategy for achieving the objective;
3. break the project down into sub-units or steps (Work Breakdown Structure-WBS);
4. determine the performance standards for each sub-unit;
5. determine how much time is required to complete each sub-unit;
6. determine the proper sequence for completing the sub-units and aggregate this information into a schedule for the whole project;
7. estimate the cost of each sub-unit and aggregate costs into the project budget;
8. design the necessary staff organization, including the number and kind of positions, and the duties and responsibilities of each (TOR);
9. determine what training, if any, is required for project team members; and
10. develop the necessary policies and procedures.

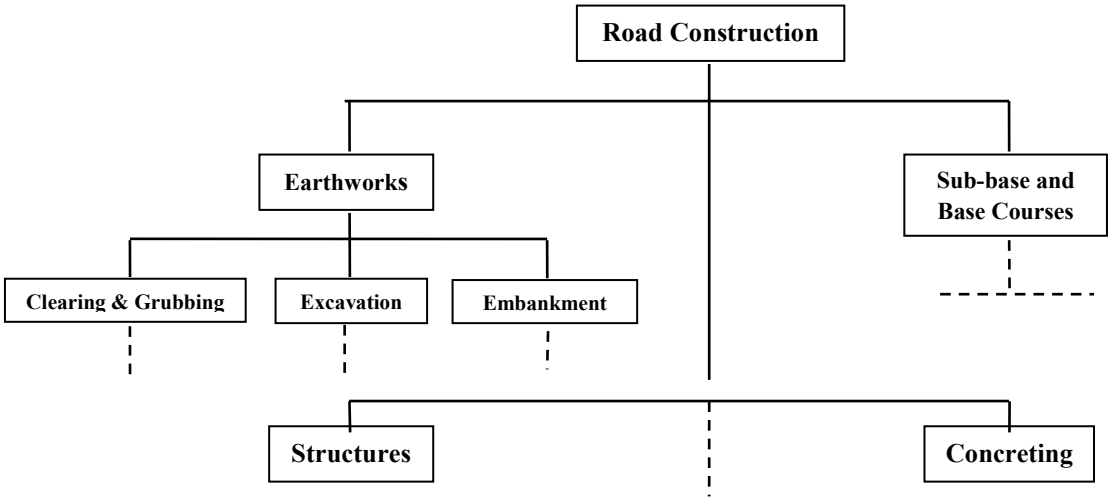
Planning the Quality Dimension

The quality plan establishes the criteria of performance by which the project output will be measured when completed. It includes specifications for quality and types of materials used, the performance standards to be met, and the means of verifying quality such as testing and inspection.

Techniques in quality planning:

1. **Work Breakdown Structure (WBS):** dividing the project into sub-units or work packages to reduce chances of neglecting or overlooking an essential step;

Figure 9: Typical Work Breakdown Structure (WBS)



2. **Project Specifications:** include all relevant requirements to meet the project's quality dimension like materials, workmanship, tests, and others. Examples would be the specifications in Section A1.3 to include details.

Planning the Time Dimension

The objective when planning the time dimension is to determine the shortest possible time to complete the project. Start with identifying the activities within the sub-units or work packages in the WBS and estimating the time that each activity will be completed. It is also during this time that the sequencing is established and identifying which of the sub-units and activities may be undertaken at the same time. The analysis would lead to determining the three (3)most significant time elements which are *i) the duration of each activity, ii) the earliest time that each may be started and iii) the latest time that each activity must be started*. Time estimates can be realistically done by experienced people like a foreman for civil works items hence one has to seek the assistance of field personnel unless historical records are already available.

There are two (2) common methods of project scheduling and these are as follows:

1. **Gantt Charts:** A horizontal bar chart that graphically displays the time relationship of the activities in a project developed by Henry Gantt, an industrial engineer who introduced the system in the early 1900s.

Figure 10: Typical Gantt Chart

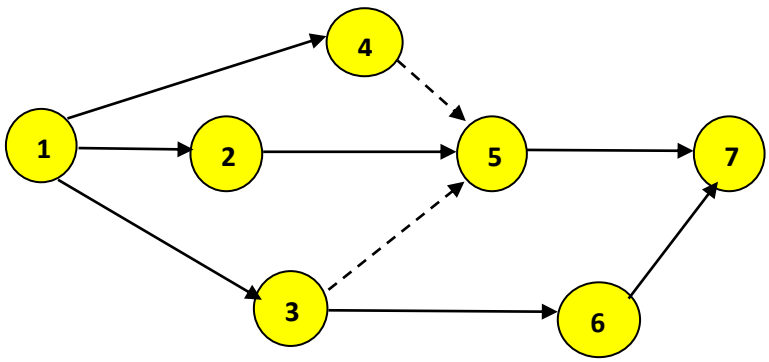
Sub-Units/ Activities	Planned/ Actual	Implementation Schedule								
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
A. Sub-Unit										
1. Activity 1	P	———	———	———						
	A									
2. Activity 2	P		———	———	———					
	A									
3. Activity 3	P					———	———			
	A									
4. Activity 4	P		———	———	- - -	- - -	- - -			
	A									
5. Activity 5	P							———	———	———
	A									

Activity Duration: ——— *Slack Time*: - - - -

Limitation: Difficult to show interdependence of activities for complex projects with several work packages

2. **PERT/CPM:** Program Evaluation and Review Technique / Critical Path Method – a more sophisticated planning technique than Gantt Chart and appropriate for projects with many interactive work packages and activities.

Figure 11: Typical PERT/CPM Network Diagram



Event: *(known as node) represents a milestone – points marking the start or end of an activity or group of activities*

Activity: *job or operation that requires resources*

Dummy: *artificial activity to maintain logic of network diagram*

Planning the Cost Dimension

Planning the cost dimension is synonymous to budgeting whose main function is to monitor the costs of the project while it is in progress and avoid cost overruns. Typical cost items in construction works are labor, materials, supplies and equipment commonly known as direct costs and the cost of overhead including general and administrative costs as well as taxes and profit margins (if by contract) known as indirect costs.

The basis for determining the project direct costs is from the WBS (basis for the Program of Work) and the project schedule and the indirect costs are from standard parameters used by an organization. The objective in preparing the budget is to be as realistic as possible hence careful research has to be done including identification of sources of supplies and materials and prevailing standard unit prices of all resources necessary to complete a project.

As a reference, the revised guidelines on the preparation of Approved Budget for Contract (ABC) by virtue of DPWH Department Order No. 29, Series of 2011, amending Department Order No. 57, Series of 2002, Indirect Cost items and factors will include the following:

1) Overhead Expenses which ranges from 5% - 8% of the estimated Direct Cost (DC), which includes:

a) Engineering & Administrative Supervision
b) Transportation Allowances
c) Office Expenses (office equipment, supplies, utilities)
d) Contractor's All Risk Insurance (CARI)
e) Financing Cost
   - Premium on Bid Security
   - Premium on Performance Security
   - Premium on Surety for Advance Payment
   - Premium on Warranty Bond (one year)

2) Contingencies which ranges from 0.5% - 3% of the estimated DC to include expenses for meetings, coordination works, billboards, ground breaking and inauguration ceremonies, and other unforeseen events;

3) Miscellaneous which ranges from 0.5% - 1% of the estimated DC includes laboratory tests for quality control and plan preparation; and

4) Contractor's Profit margin which ranges from 8% - 12% of the estimated DC for projects above P5 million and up to P5 million respectively

Table 2: Table of Percentage for Indirect Cost as % of Estimated DC

Estimated Direct Cost (EDC)	Indirect Cost % of EDC for OCM and Profit		Total Indirect Cost % of EDC for OCM and Profit
	OCM	PROFIT	
Up to P5 Million	12	12	24
Above P5M up to P50M	9	8	17
Above P50M up to P150M	7	8	15
Above P150M	6	8	14

A-2. LABOR-BASED WORK METHODS

A2.1 Work Sequencing

The Labor-Based Technology (LBT) operations are usually divided into single work activities each carried out by a separate team or gang. The teams or gangs have to be well balanced in size so that the activities follow each other at approximately the same speed. Usually there are distinct working teams for each work activity, the number of persons of which depends on the work volume. The technical staff of the Municipal Engineer's Office will provide support to these teams during implementation. Under CD-CAAM, the Bangsamoro Development Agency (BDA) will be involved during the piloting of road rehabilitation and maintenance.

At the average, the recommended team or gang compositions are as follows:

Table 3: Work Activities and recommended Work Force per Team

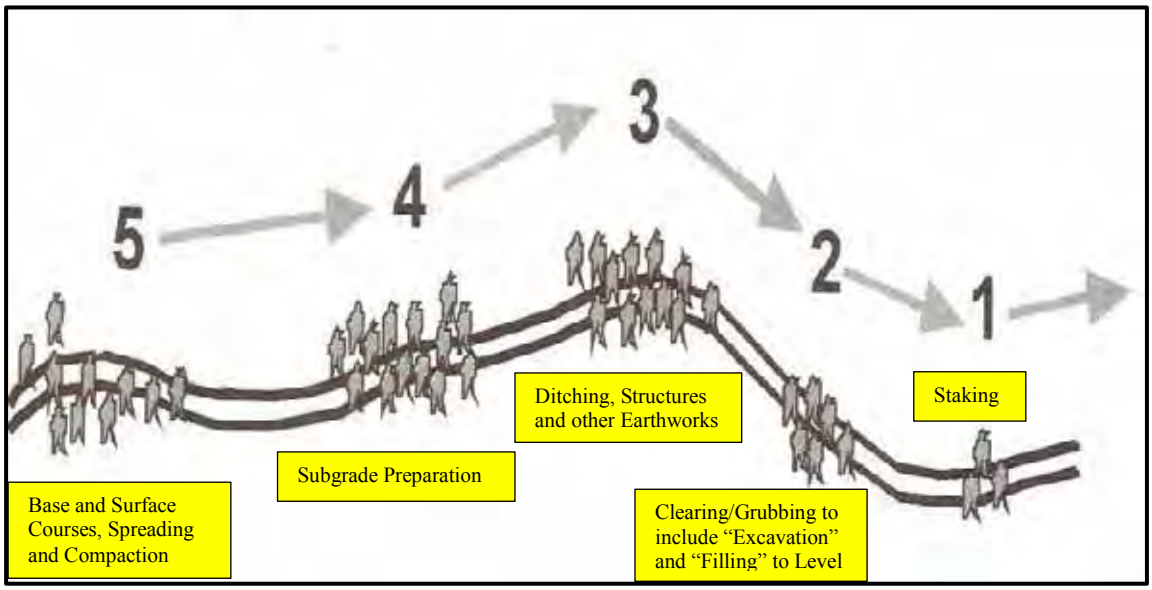
Team	Work Activity	Number of persons	Hand Tools	Materials
Team #1	Staking (Setting Out)	1 - Team Leader 3 - Laborers	✓ Ranging Poles ✓ Tape Measure (5m and 50m) ✓ Bolos ✓ Hammer	✓ Strings (nylon and Straw) ✓ Pegs
Team #2	Clearing and Grubbing to include "Excavation" and "Filling" to level	1 - Team Leader Laborers according to day task	✓ Bush knives ✓ Hoes ✓ Wheelbarrows ✓ Shovels ✓ Rakes	✓ Strings (nylon and Straw) ✓ Pegs
Team #3	Ditching and Camber Formation ***Note:*** *Structures and Earthworks may be done simultaneously with these activities by different team*	1 - Team Leader Laborers according to day task	✓ Pick-Mattocks ✓ Hoes ✓ Wheelbarrows ✓ Shovels ✓ Rakes ✓ Ditch Templates ✓ Camber Board ✓ Straight Edge (2 m.) ✓ Spirit Level ✓ Compaction Equipment	✓ Strings (nylon and Straw) ✓ Pegs

Team #4	Subgrade Preparation	1 - Team Leader Laborers according to day task	✓ Pick-Mattocks ✓ Hoes ✓ Wheelbarrows ✓ Shovels ✓ Rakes ✓ Straight Edge (2 m.) ✓ Spirit Level ✓ Boning Rod set ✓ Compaction Equipment	✓ Strings (nylon and Straw) ✓ Pegs
Team #5	Base and Surface Courses, Spreading and Compaction - Item 200 - Item 201 - Item 300	1 - Team Leader Laborers according to day task	✓ Hoes ✓ Wheelbarrows ✓ Shovels ✓ Rakes ✓ Ditch ✓ Camber Board ✓ Spirit Level ✓ Compaction Equipment	✓ Strings (nylon and Straw) ✓ Pegs
Team #6	Structures* Reinforced Concrete Pipe Culvert (RCPC)	1 - Team Leader 1 - Mason 1 - Carpenter 12 - Laborers 1 - Mixer Operator	✓ Pick-Mattocks ✓ Pipe Bars ✓ Shovels ✓ Wheelbarrows ✓ Carpenter's Tools ✓ Mason's Tools ✓ Bedding Templates ✓ Camber Board ✓ Tape Measure (5m and 50m) ✓ Spirit Level ✓ 1-bagger Concrete Mixer ✓ Buckets ✓ Hand Tampers ✓ Plate Compactor	✓ Strings (nylon and Straw) ✓ Pegs

**structures can commence anytime as long as it will be completed prior to Subgrade Preparation and consequently spreading and compaction of base and surface courses*

The common practice of work sequencing adopting the LBT is illustrated in *Figure 12* below.

Figure 12: Work Sequencing



A2.2 Staking

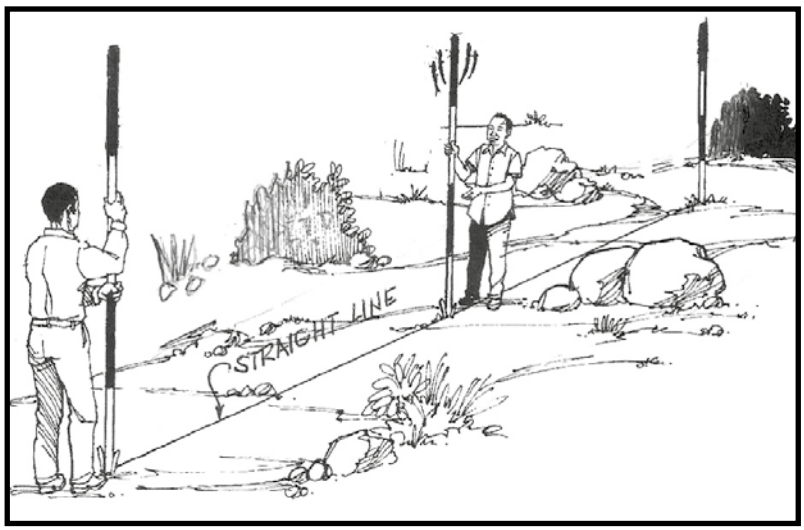
A2.2.1 Setting Out a Straight Line

For several activities, straight lines must be established, like the center line on straight sections of the road, establishment of structure lines, etc.

Procedure:

1. Establish two rods at both ends; and
2. Shift the rod in the middle until all 3 rods are in one straight line, then place pegs where needed, that is every 10 meters for the center line.

Figure 13: Establishing a Straight Line



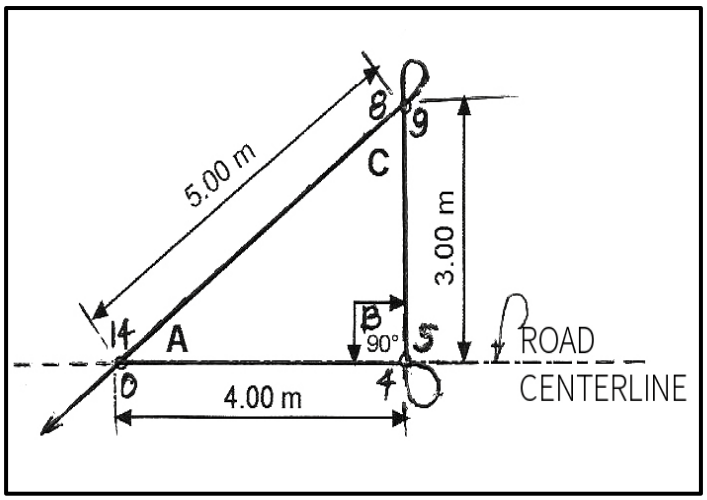
A2.2.2 Setting Out a Right Angle (90^{o})

This is mostly needed when setting out transversal guide perpendicular to the road centerline. The right angle is established by using the 3-4-5 triangle.

Procedure:

1. Mark the length of 4.00 meters along the road centerline (line AB) and drive a peg at Points A and B;
2. Loop 1.00 meter of the tape with the 5.00 meter mark overlapping the 4.00 meter mark and measure 3.00 meters hence that point will coincide with the 8.00 meter mark of the tape then drive a peg at Point C;
3. Loop 1.00 meter of the tape with the 9.00 meter mark overlapping the 8.00 meter mark and measure 5.00 meters hence that point will coincide with the 14.00 meter mark of the tape then connect it to Point A; and
4. Pull the triangle tightly and this should establish the 90 degree triangle.

Figure 14: Establishing a Right Angle



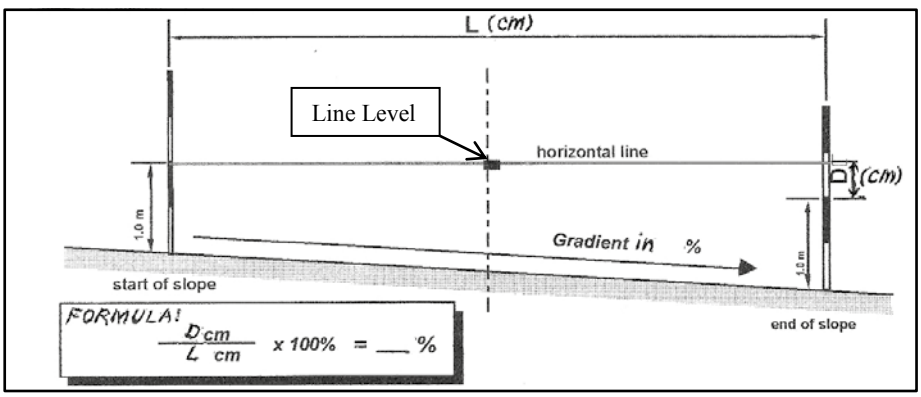
A2.2.3 Setting Out Gradients and Levels

In order to check existing gradients or to set out new ones over relatively short distances (up to 20m) the line and level method is simple and sufficiently accurate (± 0.5 cm).

Procedure for checking (finding) an existing gradient:

1. Fix ranging rods vertically at the two end points of the slope firmly into the ground;
2. Tie one end of the string line at the 1 meter mark of the ranging rod at the higher point of the slope;
3. Bring the other end of the string line at the lower ranging rod, hook the spirit line level at the middle point between the two ranging rods and move the string line at the lower point ranging rod up or down until the level bubble is exactly in the middle. Mark this level at the lower ranging rod, turn the line level around and mark the level again. The middle of the two marks is the exact horizontal level transferred from the higher to the lower ranging rod;
4. Measure the difference between your horizontal level mark and the one meter mark at the lower ranging rod "**D**";
5. Measure the exact distance (length) between the two ranging rods "**L**";
6. Calculate the percentage of the road slope or gradient. This is equal to "**D" divided by "L" multiplied by 100%.** Use centimeter for all measurements.

Figure 15: Measuring Actual Road Slope or Gradient



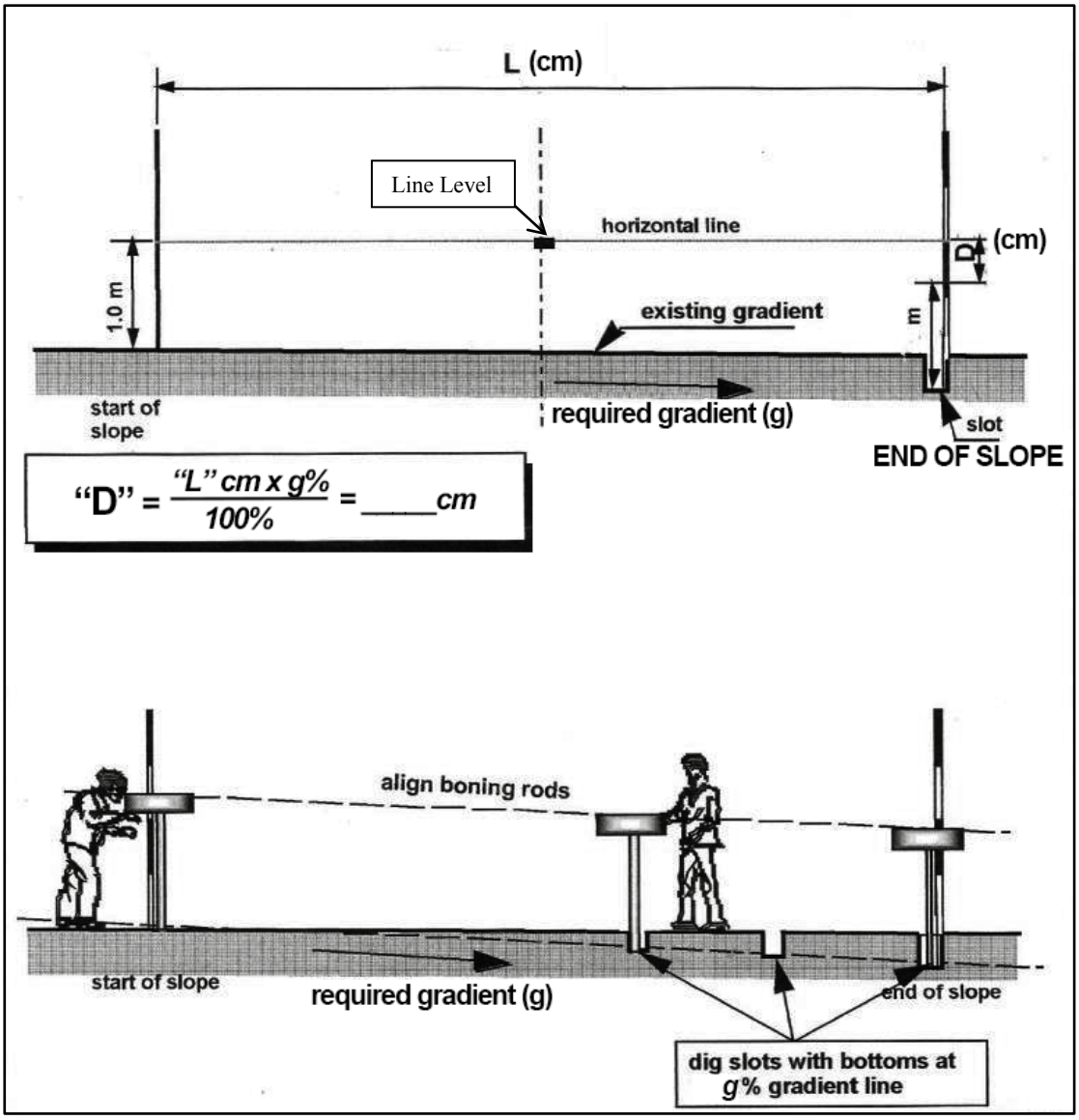
Note: This could also be done using water hose level at several intervals

Procedure for setting out a given gradient:

1. Determine the given gradient **"g"** or **"s"** and the distance **L** representing the start and end of slope;
2. Calculate "**D"** equal to "**L" multiplied by "g" divided by 100%**;
3. Tie the string line at the 1 meter mark of the ranging rod at the higher point of the slope;
4. Fix the line level to the lower ranging rod so that the line is horizontal and mark the point on the ranging rod;
5. Add **"D"** to the 1 meter mark of the lower ranging rod and measure the distance **"D + 1 meter"** from the level mark downwards; this will require you to dig a small slot at the base of the lower ranging rod until the **"D + 1 meter"** is measured with the horizontal line maintained;
6. In order to transfer the gradient uniformly, boning rods must be used, applying the method as follows: *i) set a boning rod at each end point; ii) every few metres, dig a small slot; iii) set the boning rod at the bottom of the intermediate slots and deepen the slot until all three boning rods are in line with one another.*

This procedure can also be done through the use of a water hose level but on several intervals unless the hose is long enough to reach both ends of the ranging rods. Illustration below demonstrates the initial two-step process of establishing the slots to guide the team in scraping off excess road surface to maintain the gradient or slope. It should be noted that the slot should be extended perpendicular to the road center line up to the shoulder edge of the road section on both sides.

Figure 16: Establishing a given gradient

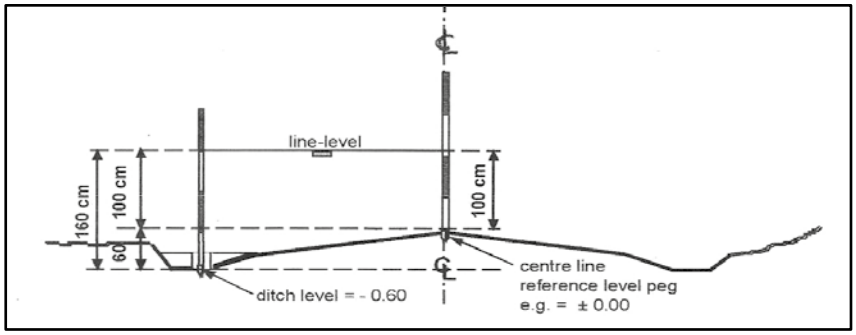


Note: This could also be done using water hose level at several intervals

Procedure for Establishing Levels

This method applies in principle also for the transfer of levels from an established reference level such as the center line level as illustrated below on establishing bottom level of ditches.

Figure 17: Establishing bottom level of Ditches



Note: this could also be done using hose level

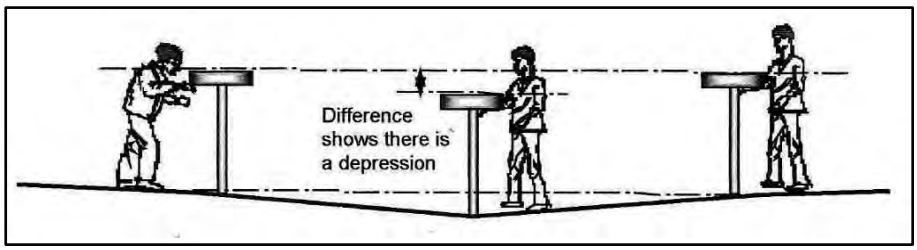
1. Place a ranging rod on the center line reference level peg (Elev. 0) and make a mark on the rod 100 cm above this level;
2. Dig a slot in the ditch to the approximate level and place another ranging rod in it;
3. Fix the line level on the 100 cm mark of the center line ranging rod and transfer this level to the ranging rod in the ditch. Mark this level on the rod; and
4. Measure the anticipated level-difference (in this case 60 cm) plus 100 cm (total 160cm) from the mark downwards and establish the correct level of the ditch bottom by either digging further down or adding some material.

Procedure in checking uniformity of gradient or slope along a road section

In order to achieve a reasonably smooth and aligned surface (horizontal or gradient) without unnecessary depressions or humps, it is necessary to control the levels. The simplest method is to use a set of boning rods or travellers.

1. Fix boning rods/profile boards at the two ends of the road section you want to check assuming that those two points have the level/gradient you need to maintain. If you use boning rods, make sure the two end rods are fixed at the same height from the ground; and
2. While sighting from one end to the other, let an assistant place the third boning rod at any point you want to check in-between the two end rods. Then sight from the first to the last rod and check whether the intermediate rod is in level with the two end boards. If not, you need to correct (lift or lower) until the intermediate rod is in level. Set a reference peg with the correct level.

Figure 18: Checking uniformity of slope or gradient



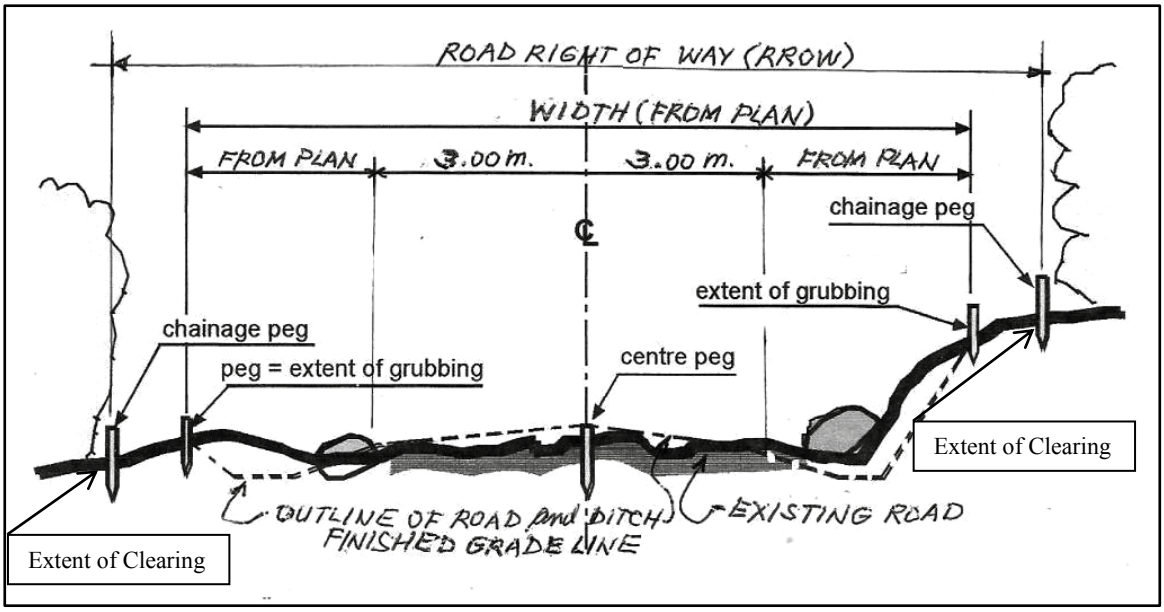
Note: This could also be done using water hose level at several intervals

A2.3 Clearing and Grubbing (Item 100)

Procedure:

1. Set out width of area to be cleared using pegs and strings;
2. Define quantity of work for the day and allocate laborers accordingly;
3. Remove all grasses and other vegetation (except trees) and all unsuitable topsoil and should be discarded outside of the grubbed width; and
4. Dispose of cut grasses properly bearing in mind that burning is against the Clean Air Act.

Figure 19: Clearing and Grubbing

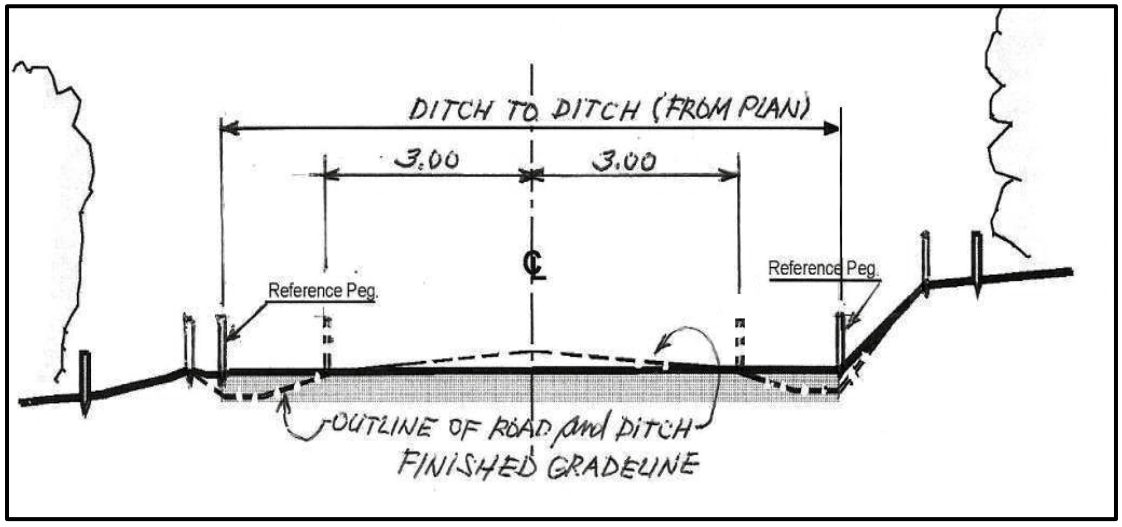


A2.4 Excavation and Filling to Level

Procedure:

1. Establish a guide for the excavation and filling of each 10-metre section of road to achieve a transversely level surface;
2. Define quantity of work for the day for excavation or fill and allocate laborers accordingly;
3. Spread the fill material in thin layers (about 0.15m) and compact to a density as specified in the plan. The operation continues until a smooth surface is achieved;
4. Check the level of the surface and correct where necessary; and
5. Compact surface to a density specified in the plan using pedestrian vibrating roller or standard self-propelled roller and ensure optimum moisture content (see Section 4.8) of the soil when compacting.

Figure 20: Excavation and Filling to Level



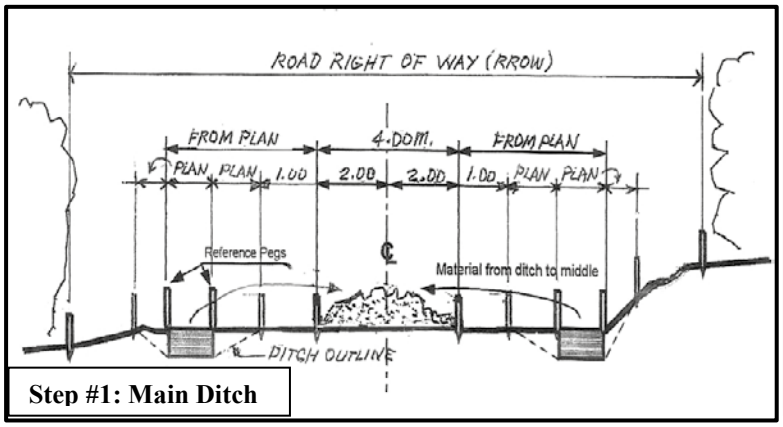
A2.5 Ditching (Item 102)

Procedure:

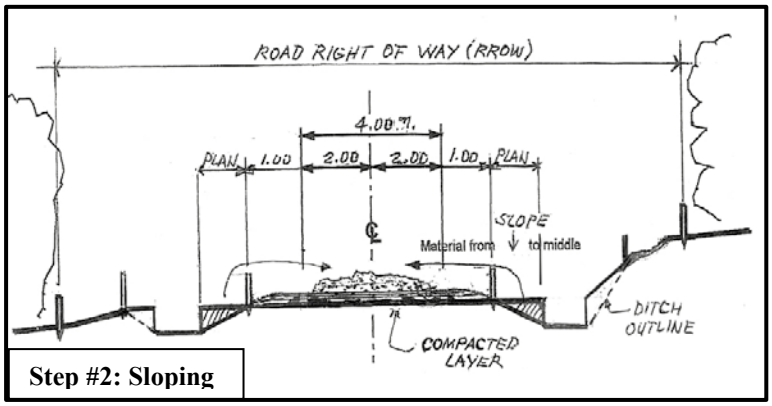
1. Set out the width of the ditches on both sides using pegs and strings. Establish the material and show edge of fill in the middle with strings (see dimensions below);
2. Define the quantity of work for the day and allocate laborers accordingly;
3. Excavate the ditches for the correct size. Use the ditch template to control width and depth. Throw the excavated material to the middle in between the material pegs;
4. Spread and level the materials in the middle part;
5. Compact middle layer with pedestrian vibrating roller or standard self-propelled roller and ensure optimum moisture content (see Section 4.8) of the soil when compacting.

Figure 21: Ditching Steps

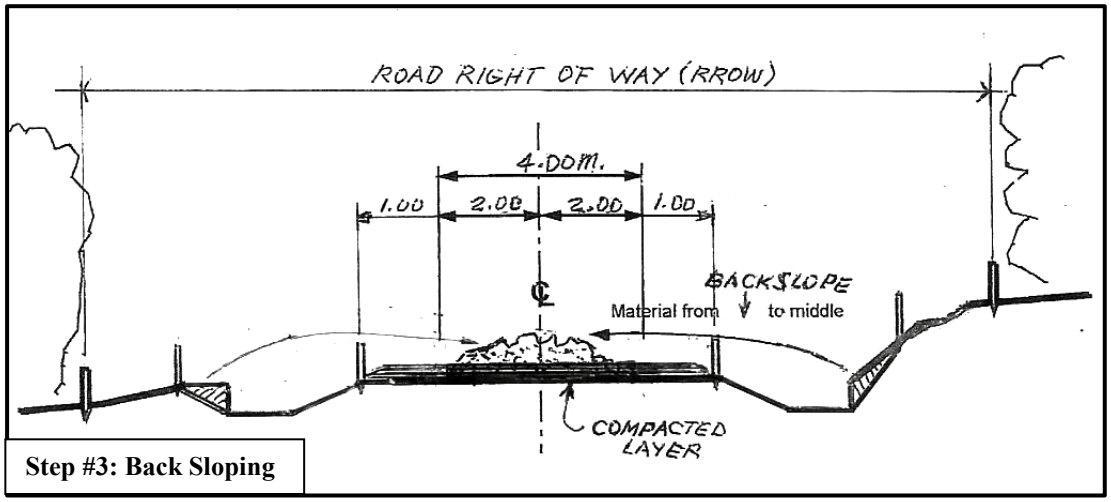
Ditching (Item 102)



Step #1: Main Ditch



Step #2: Sloping



Step #3: Back Sloping

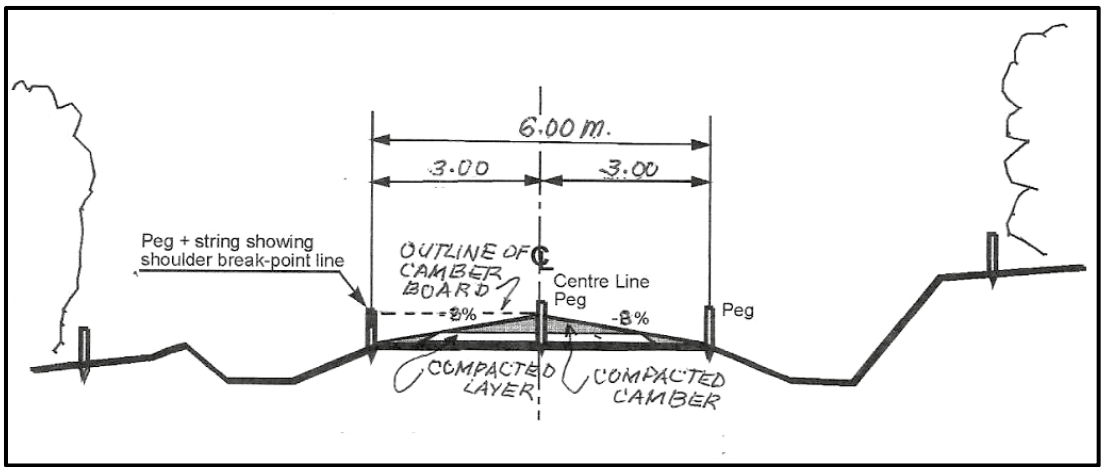
A2.6 Sub-grade Preparation (Item 105) and Camber Formation

Procedure:

1. Set out the shoulder break-point line using pegs and strings. Re-establish the road center line using pegs (see dimensions below);
2. Define quantity of work for the day and allocate laborers accordingly;
3. Spread the material that has been heaped in the middle towards the edge (shoulder break point);
4. Form the camber by ensuring that the crossfall from the middle to the edge is about 3% to 10%. Check with the camber board and spirit level. (The material will later settle during compaction and over time and the original "crown" shape will be rounded);

   Compact the spread material with a pedestrian vibrating roller or standard self-propelled roller ensuring an even surface and optimum moisture content (see Section 4.8) of the soil when compacting. Reshape where necessary or fill depressions with additional material from the backslope.

Figure 22: Camber Formation



A2.7 Subbase, Base and Aggregate Surface Course (Items 200, 201, 300)

Each activity, the Subbase Course, Base Course, and Aggregate Surface Course is carried out by one team or gang of laborers. It is important that materials are available and off-loaded at the nearest possible distance to the designated work section.

Procedure:

1. Spread the loose Subbase Course of Item 200 using hoes and heavy-duty rakes or spreaders;
2. Any coarse aggregate material larger than those required under the specifications shall be removed and thrown immediately;
3. Compact the spread material with a pedestrian vibrating roller or standard self-propelled roller ensuring an even surface and optimum moisture content (see Section 4.8) of the soil when compacting. Reshape where necessary or fill depressions with additional material and compact again until the desired compacted thickness of 10 cm. is attained.
4. Repeat procedure for the next layer of Base Course (Item 201) until the desired compacted thickness of 15 cm. is attained;
5. Repeat procedure for final layer of Aggregate Surface Course (Item 300) until the desired compacted thickness of 15 cm. is attained.

A2.8 Moisture Content and Compaction

A2.8.1 Moisture Content

The degree to which compaction can be achieved is governed by the moisture content. If the soil is too dry, friction between particles tends to resist close packing. If the soil is too wet, the water between particles prevents close packing. Therefore, there is an **optimum moisture content** at which a maximum density is achieved. As rule of thumb, the optimum moisture content of the soil can be checked in the field by squeezing a sample in the hand:

- ✓ if the material is too dry, it will not stick together and must be thoroughly mixed with water before compacting it;
- ✓ if water runs out of the material, it is too wet and should not be compacted but left to dry out until the moisture content has reduced;

✓ if the material is wet enough to stick (you can form a ball), it has the optimum moisture content and is suitable for compaction

Too Dry

Too Wet

Just Right

A2.8.2 Compaction Procedure *(Applicable to Embankment, Subgrade Preparation, Aggregate Subbase Course, Aggregate Base Course, and Aggregate Surface Course)*

1. Compaction shall be done at every 50.0 meter strip interval and along one side of the road section at a time with a maximum thickness of 20cms (8”);
2. Enclose the strip of 50.0m length x 3.0m wide strip with a string (tie box) to prevent vehicles from entering the compaction area;
3. Water the Course to achieve the optimum moisture content (see above) as required by the specification;
4. Wait sometime for the water to penetrate the course material. Watering during the spreading operation is an economic way of ensuring that the course is uniformly moist;
5. Compact using equipment, e.g. pedestrian vibrating roller or standard self-propelled roller maintaining a uniform speed of 1.50km/hr;
6. Rolling shall progress gradually from the canal sides to the center, parallel to the centerline of the road and shall continue until the whole surface (canal to centerline) has been rolled;
7. Ensure uniform rolling and number of passes. Also ensure that there is always a lateral overlap of at least 20cm (8”) from pass to pass;
8. Complete the “First Pass” from the canal side to the centerline then the next pass shall start again from the canal side where the first pass started;
9. The number of passes has to be determined through tests. Usually 6 to 8 passes are sufficient if the moisture content is optimal; and
10. Open the compacted strip to traffic and continue along the other side of the road following the same procedures above

Important Note:

DO NOT ALLOW HEAVY VEHICLES (4 WHEELS WITH CARGOES) TO PASS THROUGH THE ROAD DURING HEAVY RAINS TO PREVENT THE ROAD FROM FORMING RUTS; THE ROAD SURFACE BECOMES SOFT DURING THESE TIMES HENCE LET THE ROAD DRY FIRST BEFORE HEAVY TRAFFIC IS ALLOWED.

A2.8.3 Amount of Compaction

The degree of compaction that is achieved in a certain volume of material is a function of the compactive effort applied. Within practical limits, the higher the compactive effort, the higher is the density that will be achieved and therefore the more stable the soil will be. The compactive effort or amount of compaction applied to a soil can vary in two ways:

1. by varying the type of compaction equipment (the heavier the roller, the higher the compactive effort); and
2. by varying the number of passes.

Each equipment however, has an upper limit of compactive effort, beyond which additional passes have no further effect. As a general rule, this upper limit is reached after **about 6 to 8 passes**.

A2.9 Structures (Item 500) Reinforced Concrete Pipe Culvert (RCPC)

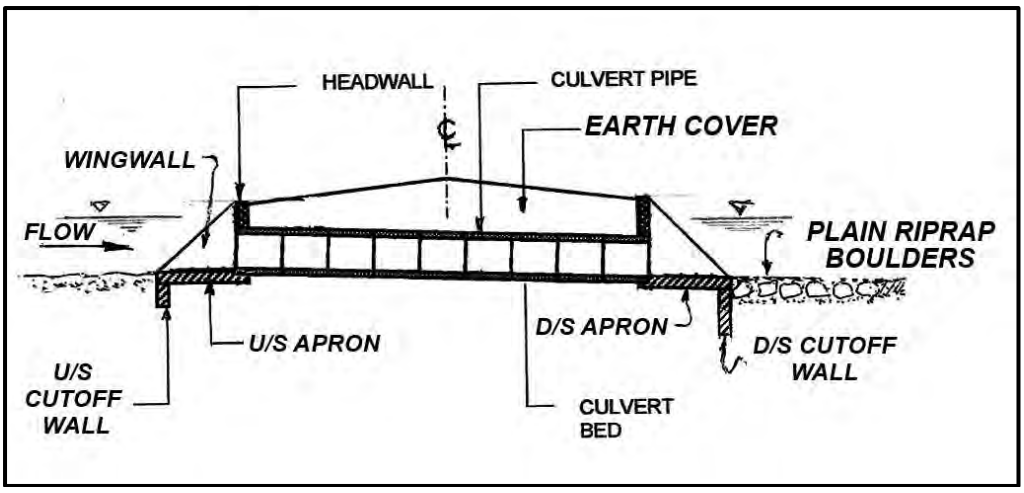
A2.9.1 Definition

Culverts or cross drainage structures are integral part of the road drainage system and conveys water across roads from the upstream to the downstream stretch of natural waterways or depressions. It also discharges runoff during and after rainfall from the road surface and adjacent roadside areas.

A2.9.2 Laying Standard Reinforced Concrete Pipe Culvert (RCPC)

1. Particular attention must be given to location and levels of culverts to prevent erosion and siltation;
2. Some locations require the road alignment to be raised to accommodate the culvert. The maximum ramp gradient should be five per cent (5%);
3. Culverts should be well seated on a shaped bed (check with template and boning rods), or concrete bedded;
4. Overfill or earth cover must be at least 2/3 barrel diameter of well compacted material (0.45 m for 0.60 m Ø culvert) over the top of the culvert;
5. Provision of haunching or full concrete surround is required if overfill is less than 2/3 barrel diameter;
6. Provision of cement stabilized bedding, haunching or full concrete surround is required in poor in-situ soil;
7. Always provide concrete wingwalls, headwalls, aprons and cut-off walls at both ends (inlet and outlet) of the pipe culverts.

Figure 23: Typical Longitudinal Section of RCPC



A2.9.3 Minimum Technical Specifications

1. Minimum "Freeboard" at Upstream (U/S) and Downstream (D/S) Headwalls shall be 30 cm;
2. Minimum depth of U/S Cut-Off Wall (COW) shall be 30 cm and D/S COW shall be 60 cm;
3. Minimum length of U/S Apron shall be 150 cm and D/S Apron shall be 200 cm;
4. Minimum length of D/S Riprap Boulders shall be 200 cm;
5. Minimum difference in Hydraulic Head between U/S and D/S water level shall be 30 cm;
6. Minimum slope of culvert shall be 2 percent;
7. Minimum earth cover (overfill) shall be 45 cm over the top of the culvert

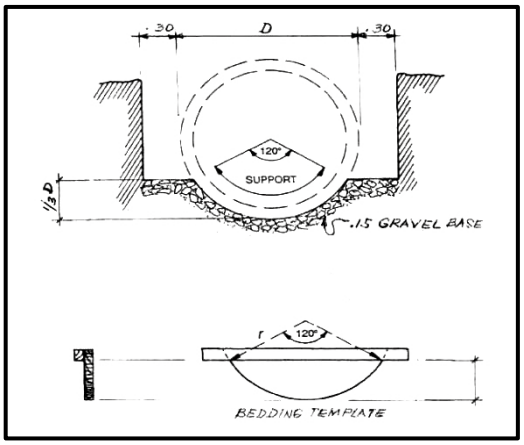
A2.9.4 Pipe Culvert Trenching and Bedding

1. The width of the pipe trench shall have sufficient allowance at both sides so that the pipe when installed can be thoroughly compacted by tamping of the bedding material under and around the pipe and to permit satisfactory collar jointing around the pipe and the width of the excavation shall be at least 30 cm (12 inches) greater than the horizontal outside diameter of the pipe at both sides;
2. Boulders, logs, and other objectionable materials encountered in excavation shall be removed;
3. When the foundation material is soft or mucky or otherwise unsuitable as determined by the Engineer, the Contractor shall remove the unsuitable material and backfill with approved granular material;
4. This foundation fill shall be placed and compacted in 15 cm (6 inches) layers up to the foundation level;
5. Culverts must be bedded on a stable material. Firm clay or sandy material is usually suitable. Large stones could damage the culvert rings under loading and must not be allowed in contact with the rings and should be removed, or covered

with suitable material. If necessary, gravel containing stones up to 20 mm or concrete may be used to bed the culvert rings;

6. The culvert bed should be excavated to give continuous support over the lower third (1/3) of the barrel outside diameter. The shape of the bed should be controlled using a culvert template.

Figure 24: Culvert Bedding (cross-section in between collars)



A-3. IMPLEMENTATION SUPERVISION and MONITORING

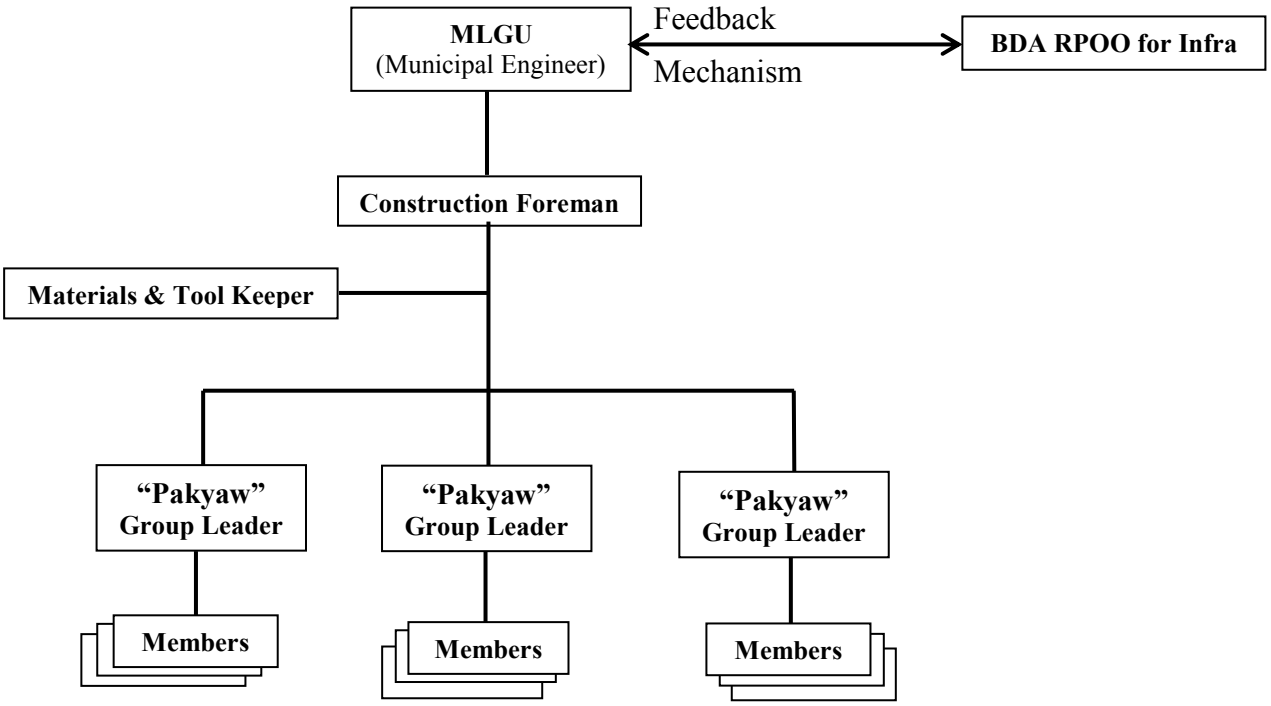
A3.1 Implementing Structure

The implementation arrangement for road construction and rehabilitation under the Labor-Based Technology depends largely on the source of funds and how the funds are managed.

Under the law, rural roads also known as local roads like barangay roads, farm to market roads, feeder roads, are among the devolved projects and programs to the local government by virtue of the Local Government Code of 1991. Hence development of the local road system is under the mandate of the local government units while the Bangsamoro Development Agency on the other hand is perceived to manage community development initiatives in Conflict Affected Areas in Mindanao (CAAM).

Under this premise, the recommended general implementing structure for LGU implemented labor-based road construction or rehabilitation may adopt the organizational structure below with the LGU implementing the project and the BDA providing the overall coordination and monitoring mechanism for projects within the CAAM.

Figure 25: Implementing Structure for Labor-Based Road Construction/Rehabilitation



In line with the national government's employment generation program, the "Pakyaw" system is by far the most appropriate method of implementing road construction and rehabilitation by labor-based technology. Further to this and pursuant to R.A. 5635 dated December 12, 1988 on government infrastructure projects, at least fifty (50%) percent of the unskilled and thirty (30%) percent of the skilled labor requirement shall

be taken from the beneficiary community. Hence, beneficiaries within the community shall be the first priority in the selection of labor force.

The advantage of the "Pakyaw" system is that workers are not paid on a daily basis but on "work package" agreed between the parties involved. Hence, institutional capacity building and transfer of technology during the process is most effective.

The general roles and responsibilities of the major implementing units above are as follows:

Municipal Local Government Unit (MLGU)

1. Prepares the schedule and packages of works by "Pakyaw" system
2. Selects and organizes the "Pakyaw" work force in coordination with the BDA
3. Procures and supplies the construction materials, hand tools, and light equipment (road roller)
4. Provides the field office and storage for materials and hand tools at the job site
5. Provides the Project Engineer and Construction Foremen
6. Implements the work by LBT according to directions and instructions from the BDA
7. Prepares and maintains actual daily work records through a construction logbook at the job site
8. Prepares a project weather chart on a daily basis
9. Prepares payment vouchers and releases payment of wages to "Pakyaw" Groups through the group leader
10. Prepares implementation progress reports as agreed for submission to BDA
11. Complies with BDA requirements to achieve LBT transfer of knowledge

Bangsamoro Development Agency (BDA)

1. Conducts periodic inspection and monitors the overall work by the MLGU
2. Prepares the "Pakyaw" Agreement and related documents for the use of the MLGU
3. Coordinates work implementation through the MLGU's Project Engineer and Construction Foremen
4. Conducts OJT on LBT to "Pakyaw" leaders and members in cooperation with the MLGU's Project Engineer and Construction Foremen
5. Validates and compiles all implementation progress reports submitted by the MLGU
6. Recommends policies and procedures to further improve project implementation

A3.2 Organizing the Work Force and "Pakyaw" Labor Contracts

Labor-based road construction and rehabilitation projects will be implemented through the engagement of community members organized into several "Pakyaw" groups. The number of "Pakyaw" groups shall be determined based on the number of work packages for each project to be constructed or rehabilitated.

The MLGU engineer in coordination with the BDA will determine the "Pakyaw" work packages based on work breakdown structure, identify the scope of work including duration of work for every work package, estimate the cost of each work package

including the number of "Pakyaw" groups and its members as well as the type and number of hand tools and light equipment to be used. Each work package shall not exceed the amount of PhP500,000.00 and shall be awarded to one single "Pakyaw" Group of about 10 - 15 members including the elected "Pakyaw" Team Leader.

The BDA shall assist the MLGU in organizing the work force into "Pakyaw" groups with the full cooperation of the barangay officials. The number of "Pakyaw" groups in each site shall be determined after work sequencing and work packaging shall have been prepared and agreed by the BDA, MLGU and the barangay officials. All "Pakyaw" documents to be used by the MLGU shall be initially prepared by the BDA. Once organized, the MLGU engineer shall sign the "Pakyaw" contract documents with the group leader, and must be witnessed by the BDA.

The guidelines and forms on the "Pakyaw System" is attached as *Appendix A1*.

A3.3 Reporting and Monitoring

Daily supervision of project implementation shall be under the responsibility of the MLGU's Project Engineer (P.E.) through the Construction Foreman. For transparency, the MLGU shall see to it that during mobilization, a signboard is installed at the starting point or any strategic place of the project site indicating the project name, the name of the executing agencies, physical target, duration, and other project details. The P.E. shall also ensure that all works are accomplished based on the approved plans and specifications. A construction logbook for each project shall be maintained at the jobsite at all times.

Regular monitoring shall be done by the BDA during the conduct of periodic review and planning session at the jobsite with the MLGU P.E. with support of the barangay officials who shall oversee the work on a daily basis. The frequency of field sessions shall be at least every 15 days (fortnight) with the session at each end of the month serving as the monthly review and planning session.

Preparation of periodic reports shall be the main responsibility of the MLGU's P.E. and shall include but not limited to the following:

a. Fortnight Physical Progress Summary Report (including problems, issues, and concerns)
b. Monthly Cumulative Physical Progress Report
c. Quality Control Tests Results
d. Monthly Weather Report
e. Pictorials of work sites before, during, and after work completion
f. Statement of Work Accomplished (SWA - if needed for billing purposes)

Sample forms for monitoring and periodic reports are attached as *Appendices A2 to A6*.

Part B: ROAD MAINTENANCE and DO-NOU TECHNOLOGY

B-1. LABOR-BASED TECHNOLOGY in ROAD MAINTENANCE

B1.1 General Concept of Operation and Maintenance

Rural roads or local roads like barangay roads, farm to market roads, feeder roads, whether foreign or locally assisted are implemented and completed within its Project life. But its completion would usually leave the participating LGUs and Communities attending to the Operation and Maintenance (O and M) of these completed facilities being a mandate of the concerned LGUs under the Local Government Code of 1991. Hence, to ensure sustainability of these facilities, there is a need to institutionalize the systems and procedures on Operation and Maintenance for the LGUs to adopt with the full involvement of the Community beneficiaries to bring about significant impact on the lives of the individual households in their pursuit to attaining an improved way of life.

To further ensure that O and M is carried out by the responsible units and entities, inclusion of O and M Monitoring and Evaluation (M and E) procedures to be undertaken on each completed facility is necessary.

Proper maintenance of completed local roads is the main responsibility of the LGUs and Community beneficiaries. As mentioned earlier, timely maintenance is critical to ensuring the usefulness of a facility within its economic lifespan. The LGUs and Communities themselves are the ones to provide its timely maintenance.

The rationale for regularly maintaining a road facility is to ensure that this is operational and in good condition and in order to address the following facts:

- ✓ any infrastructure facility will deteriorate due to constant use and wear and tear;
- ✓ a rural road will rapidly deteriorate as well due to heavy vehicles and equipment plying the road especially during rainy season;
- ✓ regular maintenance can prevent early deterioration of these roads;
- ✓ well maintained roads can reduce vehicle operating and maintenance costs; and
- ✓ a well maintained road enhances the delivery of basic services to the communities

B1.1.1 Basic Types of Maintenance

For roads, there are at least three (3) basic types of maintenance that are applicable and these are as follows:

A. Routine Maintenance

Routine maintenance is undertaken on a regular basis for a given year. The main purpose of which is to ensure that the road is kept in its original shape and is passable at all-weather condition. It is commonly labor intensive and does not usually require the use of heavy equipment, hence could be undertaken easily by the community themselves with proper guidance from the technical staff of the Local Government Units (LGUs). The frequency on which routine maintenance is undertaken depends on the specific maintenance activity based on established standard operating procedures. These are likewise validated through the conduct of regular routine inspection to identify specific sections and the extent of maintenance works that need to be done.

B. Periodic Maintenance

Periodic maintenance is the restoration of the original condition of a road after a given number of years of normal use and as a result of wear and tear even with regular routine maintenance procedures. Unlike routine maintenance, periodic maintenance would require the use of heavy equipment and the replacement of specific materials, hence more expensive than the former and would need the involvement of both the LGU and community. The frequency of periodic maintenance would depend on the extent of usage and exposure to weather condition. This would range from annual to about every five (5) years from the completion of the road.

C. Special Maintenance Works

These are unplanned works usually as a result of "force majeure" such as heavy rains and flash floods, landslides, embankment slips and the like. This would also involve the use of heavy equipment and substantial budget, hence have to be undertaken by the LGU, and with the support of labor requirement from the community.

B1.1.2 Responsible Entities and Support Mechanism

For rural or local roads including appurtenant structures like drainage crossings, the framework for the general O and M arrangement is to be carried out by the Municipal and Barangay LGU and community through the establishment of a Barangay Roads Maintenance Team (BRMT).

However, strategies and support mechanisms have to be in place to ensure sustainability. Recommendations are as follows:

- the Municipal LGU has to organize, train and operationalize the Barangay Roads Maintenance Team (BRMT);
- the Municipal LGU has to provide regular annual routine maintenance fund;
- the maintenance fund needs to be augmented thru the imposition of road users' fee if feasible thru a Barangay and Municipal ordinance as legal basis;
- the BRMT needs to formulate an annual maintenance program;
- the Municipal LGU has to involve the community thru commissioning of "Pakyaw" Groups to undertake maintenance adopting the "length man" system; and
- periodic maintenance needs to make use of the "Bayanihan System".

B1.1.3 Recommended Maintenance Implementation Schemes

There are basically three (3) schemes of undertaking maintenance activities of rural or local road facilities. While the "Lengthman System" is considered one of the most efficient way of maintaining road facilities by labor-based, other methods are also recommended for consideration. This would involve any of the following:

A. By "Force Account" or by Administration

The common scheme adopted by LGUs in undertaking maintenance works for roads is by "Force Account" or by administration. The maintenance unit of the municipality is charged with the maintenance of LGU operated facilities. This could be done by the municipal government through the barangay officials and commonly funded under the Internal Revenue Allotment (IRA). Maintenance workers (unskilled labor force) are usually hired from the community at the barangay level and this practice is encouraged to provide livelihood and source of income to jobless community members. However, there is a need for the LGU technical staff to provide closer supervision to ensure that maintenance works are done properly and according to accepted standards. The unskilled workers from the community are paid on a weekly basis while the skilled workers (foremen, carpenter, mason, etc.) may be regular employees of the municipal LGU who are paid on a monthly basis.

B. By Contract

This type of arrangement may be executed by an individual or through a community group established for the purpose. The common practice is to engage a maintenance crew composed of interested community members through a "Pakyaw Agreement". Payments are made on the basis of pre-determined work volume which may be claimed through progress billings or regular weekly schedule or as agreed upon by parties concerned. The "Pakyaw" group is represented by their "Pakyaw" leader and the LGU technical staff would be responsible for ensuring that works are done properly and accomplished based on the acceptable standards.

C. By Combination of "A" and "B"

In some cases, a combination of both schemes may prove to be more advantageous depending on the actual field circumstances.

D. By "Bayanihan" or "Pintakasi" (Community Voluntary Work)

This is a common practice in rural areas where the community agrees to conduct maintenance works on a specific period involving all or representatives from households that benefit from the use of the facility. Labor is usually free while some barangays provide free lunch and snacks as incentives to participating community members. Periodic maintenance is usually done under this scheme as it involves bigger work load and needs more unskilled workers to accomplish. However, this could also be appropriate in undertaking routine maintenance especially if funds are not available and the need to perform the work is urgent.

In Focus: The Lengthman System for Routine Maintenance

The **Lengthman System** is when an individual worker is assigned to carry out all routine maintenance activities over a specific length of the road and throughout the year. He/she is solely responsible for his/her section and carries out all work as instructed. The actual maintenance work is usually spread over a period of one year and during specific period of the year according to the agreed schedule hence, he/she will not be working on a regular daily basis. However, regular inspection works or "Walk Through" shall always be undertaken by the worker to determine if there is a need to repair some parts of the road section under his/her jurisdiction and undertake repair works immediately. Under average conditions, one worker should be able to cover the routine maintenance works each year of 1-2 km of a local gravel surfaced road. Payments could be done on a frequency agreed between the worker and the LGU the amount of which will depend on the overall configuration of the road section assigned in terms of the presence of drainage structures and other appurtenant facilities.

Another possibility is to have the lengthman contractor working only once or twice a year (for example before and after the rainy season) to carry out all necessary activities in one shot. After works have been completed his/her employment is terminated and must be re-employed before the next period.

The lengthman work is most effectively performed when workers are recruited from communities located in the vicinity of the roads. In addition, these community members will be under social pressure from their neighbors to do the job well, knowing that they are engaged by the LGU for the specific purpose. Those involved during the construction works of these roads are also ideal maintenance workers since they already have some training and experience in the works involved. Otherwise, the LGU needs to provide trainings to prospective road maintenance workers.

B1.2 Organizing the BRMT and the Roles of Barangay Council

While the Operation and Maintenance of rural or local roads and drainage facilities is a mandate of the Municipal and Barangay LGUs, there is a need to involve the community to ensure that

timely maintenance is undertaken being the direct users/beneficiaries. Since they are within the vicinity of the roads, they also develop a sense of ownership and responsibility as concerned citizens. In addition, it would be impractical to assume that the municipal engineering staff would always be around to maintain these facilities given the other pressing concerns that they have to attend to.

In this regard, the creation or establishment of a **Barangay Roads Maintenance Team (BRMT)** is recommended. This would be composed of one or more "Pakyaw" Group/s with section leaders and members. The BRMT will be headed by one (1) overall Team Leader. Periodic supervision shall be the main responsibility of the maintenance unit of the Municipal Engineer's Office.

Selection of team members shall be based on the following criteria:

1. must be a permanent resident of the barangay
2. must be physically fit
3. must be of good moral character
4. must have good relationship with the community
5. must have time and willing to work and become a member of the team
6. preferably residing along or within the vicinity of the road section assignment
7. has shown responsibility and diligence in working with other on-going or completed projects
8. has leadership capability
9. must be willing to disseminate acquired skills/experiences to other community members
10. preferably an active member of any existing organization in the barangay

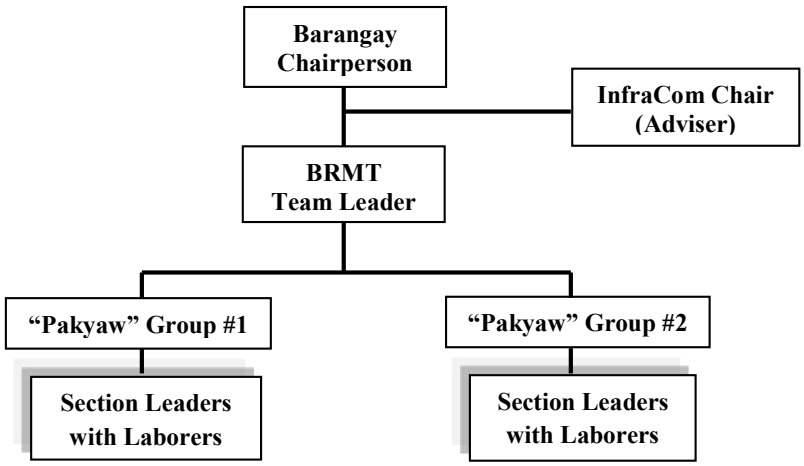
In addition, selected team leaders must preferably be able to read and write and capable of preparing O and M monthly inspection report. Membership may be rotated on a semi-annual basis to give opportunity to other members of the community to get involved in the maintenance activities.

The **BRMT** shall have the following duties and responsibilities:

1. with the assistance of the LGU technical staff, recommend policies as basis for drafting of a Barangay Ordinance on the proper use and safeguard of the roads;
2. prepare an annual Operation and Maintenance plan for recommendation by the BRM Team leader, concurrence by the Barangay Chairman, review by the Municipal Engineer and noted by the Municipal Mayor;
3. liaise with the Municipal and Barangay LGU to gain support in terms of budget allocation for O and M purposes;
4. conduct regular inspection ("walk through") on a monthly basis to determine the need to undertake routine maintenance work of the road section;
5. conduct special inspection after occurrence of heavy rains and other "force majeure" to determine damages if any and schedule and undertake special maintenance procedures immediately;
6. prepare and submit monthly inspection report to the community through the BRM Team leader and recommend measures to correct distresses, deficiencies and deteriorations;
7. schedule the conduct and undertake actual routine maintenance activities mobilizing other members of the community whenever necessary; and
8. recommend sanctions and penalties to erring community members.

The chairman of the infrastructure committee of the Barangay Council shall be designated as the overall adviser of the BRMT in every barangay. The typical organizational structure of the BRMT is shown in *Figure 26* below.

Figure 26: BRMT Organizational Structure



The Barangay Council

The Municipal LGU could not possibly attend to the frequent monitoring of O and M activities at the barangay level, aside from its role as a major stakeholder and the main responsible entity accountable in making sure that roads are kept in passable condition.

To protect the interest of the Municipal LGU, there is a need for the Barangay Council to ensure compliance of the community to the established O and M systems and procedures. This can be through the Infrastructure Committee of the Barangay Council and designated Purok Leaders. Hence, the council through the Infrastructure Committee and cooperation of the Purok Leaders will have the following roles and responsibilities:

1. ensure that the BRMT complies with the schedule and procedures of O and M;
2. regularly monitor and evaluate performance of the BRMT;
3. recommend supplemental funding support for O and M to the Barangay Council in case of default from the BRMT;
4. take over the O and M responsibility in case of failure of the BRMT;
5. act as first level for arbitration and resolution of O and M disputes amongst the BRMT leadership and members; and
6. elevate unresolved issues to the Municipal LGU for appropriate action

B1.3 O and M Systems and Procedures

B1.3.1 Training Requirements and Annual O and M Plan

Prior to establishing the O and M systems and procedures, there is a need to capacitate individuals and community members involved in maintenance and monitoring and evaluation activities of rural or local roads. For conflict affected areas (CAAM), the BDA and Municipal Engineers will compose the trainers' pool after the conduct of Training of Trainers (TOT). This partnership between the BDA and MLGU shall have the following roles and responsibilities:

1. attend the technical training and TOT on LBT road rehabilitation and maintenance systems and procedures;
2. conduct re-echo trainings on Labor-Based road rehabilitation and maintenance to selected barangay officials and community members who will compose the BRMT;

3. supervise the actual piloting on road rehabilitation and maintenance under the CD-CAAM under the guidance of a local consultant engaged under the Project;
4. monitor the O and M activities of the BRMT periodically and provide coaching while in the field;
5. provide technical assistance to BRMT at all times; and
6. recommend measures to the Municipal Mayor to further improve O and M systems and procedures to ensure sustainability of the road facilities.

One of the final outputs after the capacity building is an Operation and Maintenance plan that would be prepared on an annual basis by the BRMT. Standard form of an Operation and Maintenance plan is attached as *Appendix B1*.

For the guidance of Operation and Maintenance training participants during the planning exercise, the following are some of the specific routine maintenance activities for rural or local roads with corresponding recommended frequency to wit:

Table 4: Common Routine Maintenance Activities for Rural Roads

Act. #	Activity Description	Recommended Frequency
	For Barangay and Farm to Market Roads	
1	Vegetation Control	Quarterly
2	Manual Cleaning and Reshaping of Ditches	Quarterly and ATNA*
3	Patching of Potholes and other Depressions	Quarterly and ATNA
4	Restoring Road Surface and Manual Reshaping	Semi-Annually
5	Erosion Control and Slope Protection Repair	ATNA
6	Cleaning of Culverts and other structures	Quarterly
	For Appurtenant and Other Access Infrastructures	
7	Clearing of debris at bridge foundation and abutments	Semi-Annually
8	Repair of cracks on concrete works	ATNA
9	Bolts and Nuts tightening / check cable tension (hanging foot bridge)	Quarterly
10	Repainting and Rust Proofing works	ATNA
11	Replacing of dilapidated wooden parts (hanging foot bridge)	ATNA

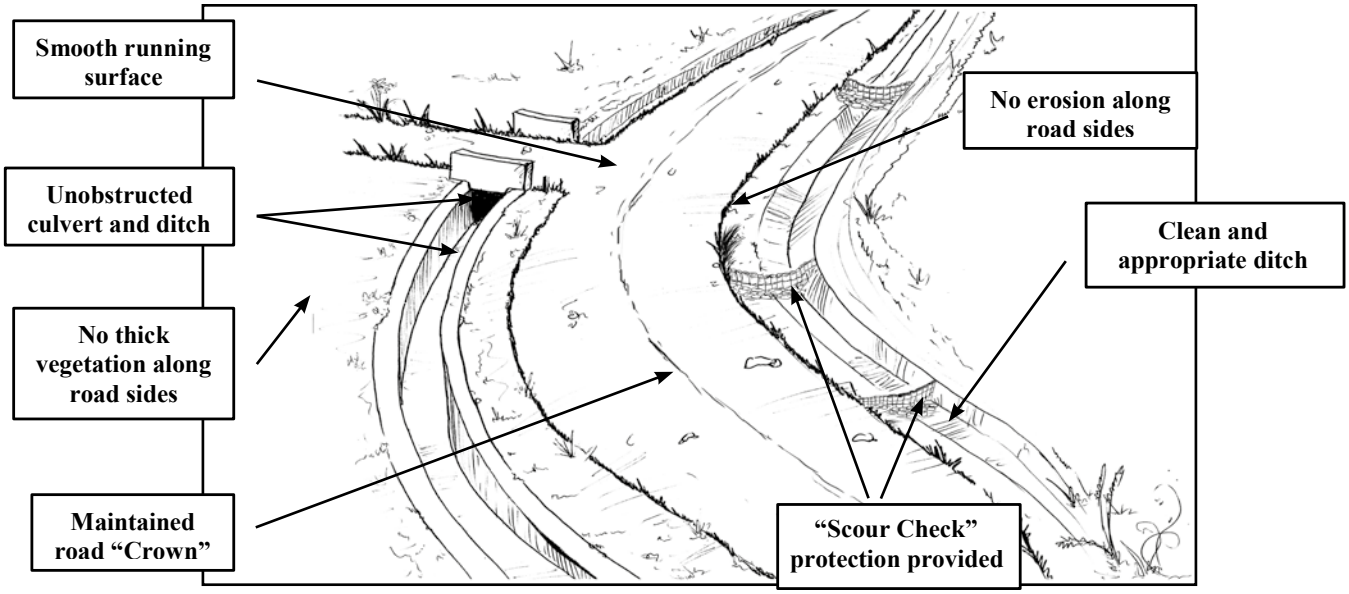
***ATNA** – *As The Need Arises*

For all these facilities, a regular inspection or a "walk through" on a monthly basis shall be conducted by the BRMT. A monthly O and M inspection report shall be prepared using the form in *Appendix B2* and submitted to relevant authorities.

B1.3.2 Visible Elements of Good and Operational Roads

As maintenance activities are undertaken to ensure that roads are operational and passable at all times, it should be kept in good shape according to the following visible properties and elements:

- ✓passable at all weather condition
- ✓good and stable sub-grade
- ✓stable and well compacted aggregate sub-base course
- ✓smooth, well crowned and well compacted aggregate base course and wearing surfaces
- ✓road right of way is free from any vegetation and rubbish materials
- ✓clean and adequate cross drainage structures constructed according to approved plans and specifications
- ✓clean and adequate side ditches and drainage interceptors
- ✓adequate and stable road slope protection works
- ✓concrete works are free from structural and thermal cracks
- ✓contraction joints are properly sealed
- ✓no settlement observed in any part of structures
- ✓bridge foundations and abutments are well protected and free from debris
- ✓exposed metal parts are well painted and free from rust and corrosions



Source: Handbook for TP3, PNPM, Mandiri, Perdesaan, ILO

Figure 27: Visible Elements of a Good and Passable Road

B1.3.4 Common Distresses, Deficiencies and Deteriorations in Roads

Signs of distresses, deficiencies and deteriorations in roads need to be addressed immediately to prevent further damage which may lead to serious and even more expensive rehabilitation works. For rural or local roads, these could be any of the following common distresses and deteriorations:

potholes – an isolated bowl-shaped depression in soft spots on the road surface due to repeated wheel loads and where water is allowed to pond. It develops rapidly if unattended.	
ruts – a surface depression in the wheel path parallel to the road centerline usually formed if the road is trafficked during wet season when the base of the road has weakened.	
rills – slight longitudinal depressions parallel to the road centerline created by surface run-off and usually due to marks caused by carabao sleds and dragging logs. These may turn into gullies when unattended.	
surface materials displacement – movement of loose aggregates away from the wheel path forming berms along the road centerline and shoulders	
clogged drainage facilities – presence of obstructions and silt due to erosion and uncontrolled weed growth diverting run-off flow into the road surface.	

improper cross section – loss of road centerline crowns and insufficient slopes from centerline to shoulder on both sides to drain surface run-off.	
uncontrolled growth of vegetation within road right of way	
surface corrugations – also known as washboarding, are closely spaced ridges and valleys or ripples at fairly regular intervals perpendicular to the traffic direction and usually form on hills and curves during heavy rains and in areas of acceleration or deceleration or in soft and potholed areas.	

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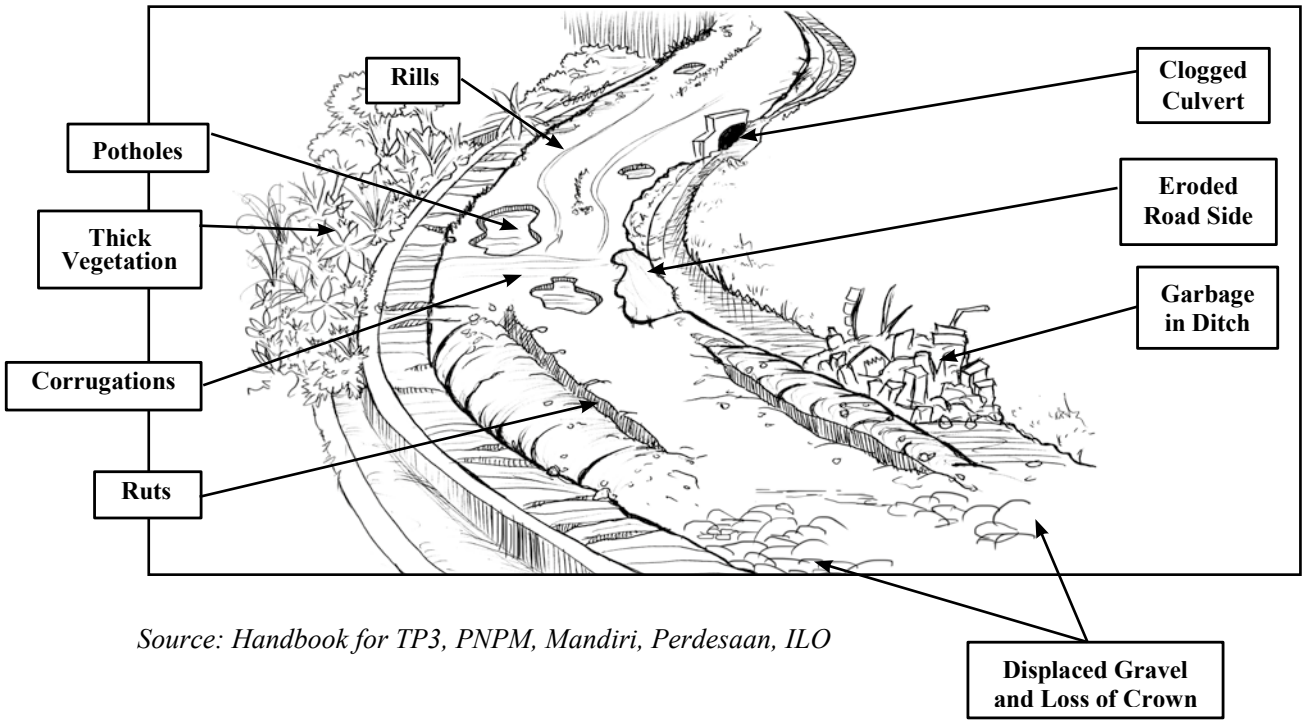
While majority of these deficiencies can be corrected through routine maintenance procedures, there would be instances that replacement of missing parts of facilities is necessary.



Source: Handbook for TP3, PNPM, Mandiri, Perdesaan, ILO

Figure 28: Visible Elements of a Dilapidated and Impassable Road

B1.3.5 Operation and Maintenance Hand Tools

To ensure availability of O and M hand tools, the preparation of Program of Work (POW) for each road project needs to integrate the cost of procurement of hand tools for use in the maintenance of the completed facility. Hand tools shall be of appropriate specifications and made of sturdy and heavy duty materials. The basic type of hand tools for rural road maintenance would include the following: wheelbarrow, shovel, bolo, scythe, axe, pick mattock, steel tamper, rake spreader, crowbar, pipe bar, rope/cable/cleaning rod, and adjustable wrench and turnbuckle for bolts, nuts and cable tightening of hanging foot bridge components. Other hand tools and measuring instruments may also be needed and these are illustrated in *Figures 5 and 6* under Part A.

B-2. BASIC MAINTENANCE WORK METHODS

Arresting distresses and correcting deficiencies and deteriorations at earlier stages for unpaved roads and its appurtenant structures have established procedures adopted by relevant agencies and institutions. As main source of reference, routine maintenance for rural roads shall adopt the work methods for specific distresses and the procedures are as follows:

B2.1 Vegetation Control

Description:

Mowing vegetation and cutting and clearing brush out of roadside areas and within road right of way with hand tools including proper disposal of cut materials by stacking or other approved method.

Purpose:

To maintain adequate sight distances and prevent obscuring of road signs, prevent clogging of drainage and beautification as well.

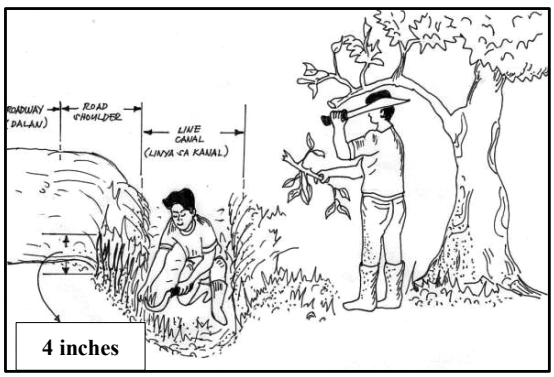
Timing:

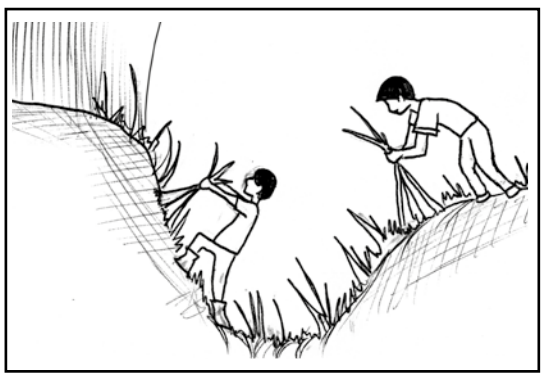
Quarterly and schedule when the vegetation within the mowing limits reaches an average height of one (1) meter or 0.50 meter depending on facility component.

Typical Work Method:

1. Split crew as needed on each side of the road;
2. With the use of hand tools, cut vegetation, grass and tree branches from the area to be cleaned;
3. Use scythe for grass cutting and bolo or axes for brush clearing; do not uproot grasses to avoid erosion of soil;

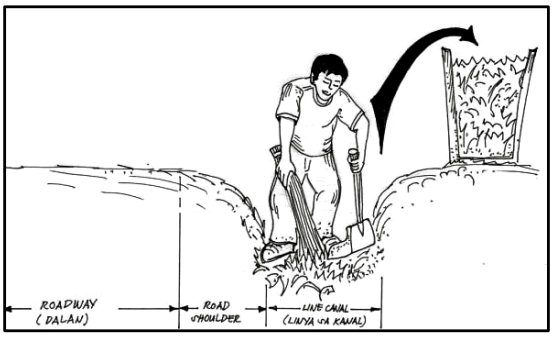
Correct Method ***Incorrect Method***





4. Put cut grasses in sacks and throw them away from the road sides to prevent obstruction to water flow in drainage canals;

Correct Method



5. Include shoulders, side slopes, ditches and the area within the right of way obscuring the road signs and bridge approaches;
6. Clearing area should be slightly wider at road intersections and on the inside of curves were sight distance is an important safety factor;
7. Cut vegetation to a height of 10 cms within mowing limits:
   - 2 meters from top edge of embankment slope in fill sections and 1 meter beyond ditch flow line in cut section
   - taper from cut to fill section

Productivity Rate: 200 - 500 pass meters* per crew-day for heavy vegetation		
Typical Crew: 1 - Team Leader 4 - Laborers	**Typical Tools:** Bolo, Axe, Scythe, Wheelbarrow, Rake	**Typical Materials:** None

** A pass meter is one mowing on one side of the road.*

B2.2 Cleaning and Reshaping of Ditch

Description:

Cleaning obstructed ditches (lined or unlined) and reshaping ditches that do not have adequate flow lines or cross sections with hand tools including proper disposal of debris and waste materials as well as digging of new ditches up to 100 meters.

Purpose:

To provide functional ditches and ensure efficient flow and draining of surface run-off.

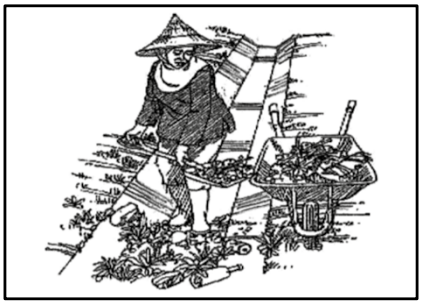
Timing:

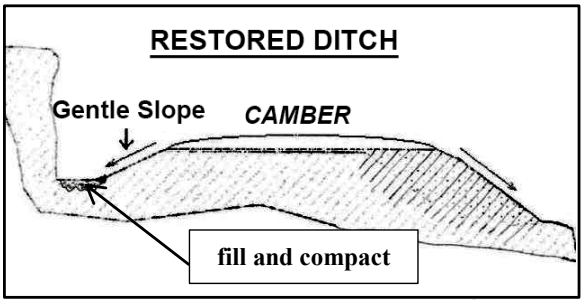
Quarterly and schedule when ditches are silted and obstructed. This should be done prior to the rainy season and when road surface defects are caused by inadequate drainage.

Typical Work Method:

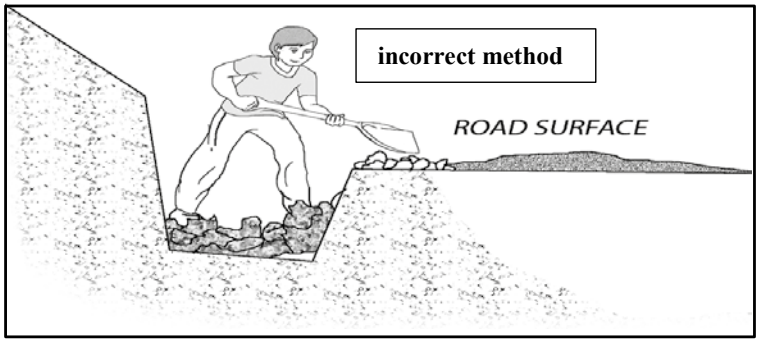
1. Start cleaning or digging from the downstream side or from the discharge point;
2. With hand tools, remove rocks, logs and other obstructions from the ditches;
3. Excavate silt or sand to make the bottom of the ditch flat or slightly rounded;
4. Reshape the sides of the ditches to an adequate flow line and cross section (as flat as possible) to provide better water flow and minimize erosion;
5. Final unlined ditch elevations should match culvert inlet and outlet elevations;

6. Dispose of excess materials by spreading out to fill low areas well clear of the ditch;

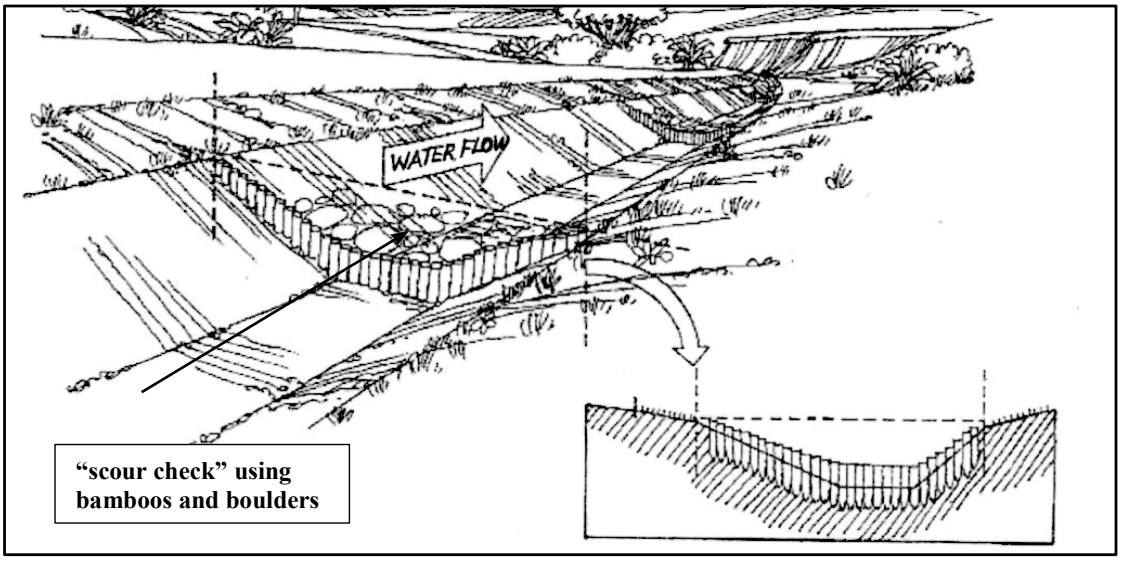




7. Do not pile the excess materials or make a ridge along the roadway that prevents water from flowing to the ditch;



8. Dig shoulder outlet channels if needed to allow water to drain;
9. Provide "Scour Checks" along canals with steep slopes to prevent erosion due to high water velocity.



Productivity Rate: 150 – 200 ditch meters per crew-day		
Typical Crew: 1 - Team Leader 4 - Laborers	**Typical Tools:** Pickmattock, Axe, Shovel Wheelbarrow, Tamper	**Typical Materials:** None

B2.3 Patching of Potholes, Rills, Ruts, and Other Depressions

Description:

Correcting minor surface erosions, ruts, corrugations, potholes and other depressions in unpaved roads by adding new materials and compacting the patches with hand tampers.

Purpose:

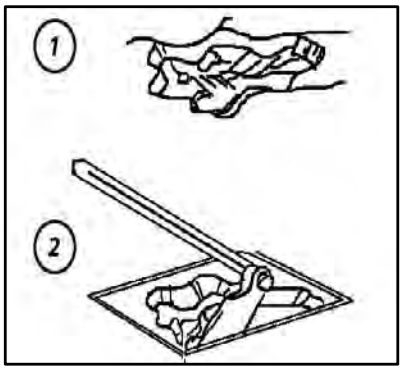
To eliminate hazardous conditions, improve surface smoothness and prevent ponding of water for a well-drained road surface.

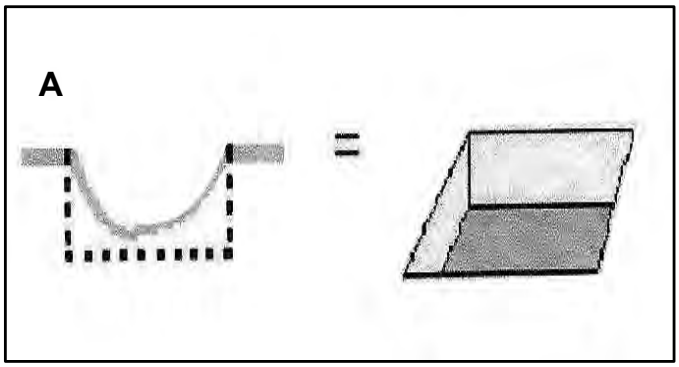
Timing:

Quarterly and schedule as the need arises.

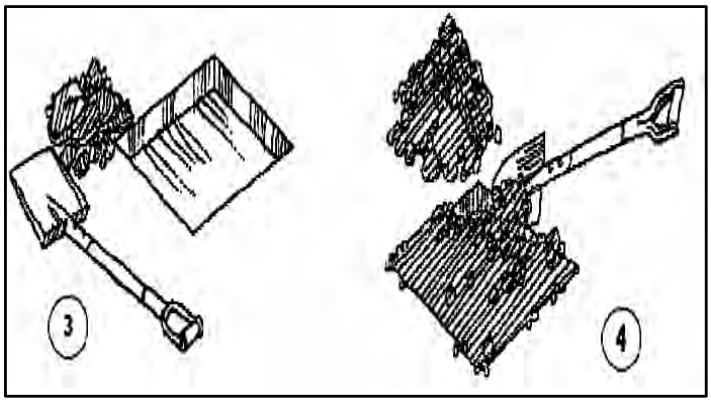
Typical Work Method:

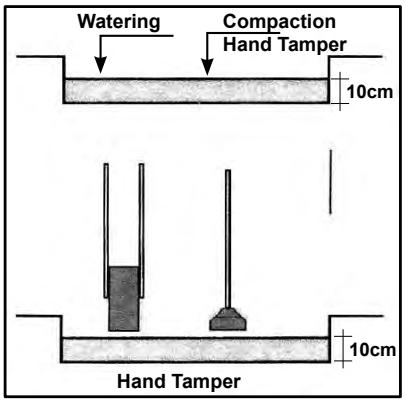
1. Remove water ponding and soft material from patch area;
2. Remove loose materials from edges of potholes, making sides of holes as vertical as possible;



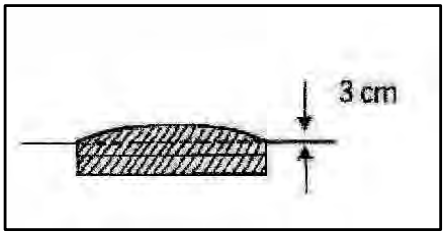


3. Place patching materials in layers of 10 cm and hand tamper each layer;





4. Rake final layer ensuring top of patch is slightly higher than the surrounding road surface by 3 cm;



5. Shape surrounding surface to allow water to drain to ditch.

Productivity Rate: 5.0 cubic meters of materials placed per crew-day		
Typical Crew: 1 - Team Leader 4 - Laborers	**Typical Tools:** Pickaxe or Hoe, Wheelbarrow Shovels, Rake Spreader Hand Tamper	**Typical Materials:** Borrow, Base Course Surface Course ***Note:*** *the type of materials shall be the same or better than the existing surface materials and may be taken along the roadside or from borrow pits. Oversized materials should be removed manually.*

B2.4 Restoring Road Surface and Manual Reshaping

Description:

Restoring road surface is done by returning surface materials displaced by traffic and reshaping road surface using camber boards and tampers and providing binders to compact loose surface materials.

Purpose:

To provide smooth and well drained road surface through proper crowning.

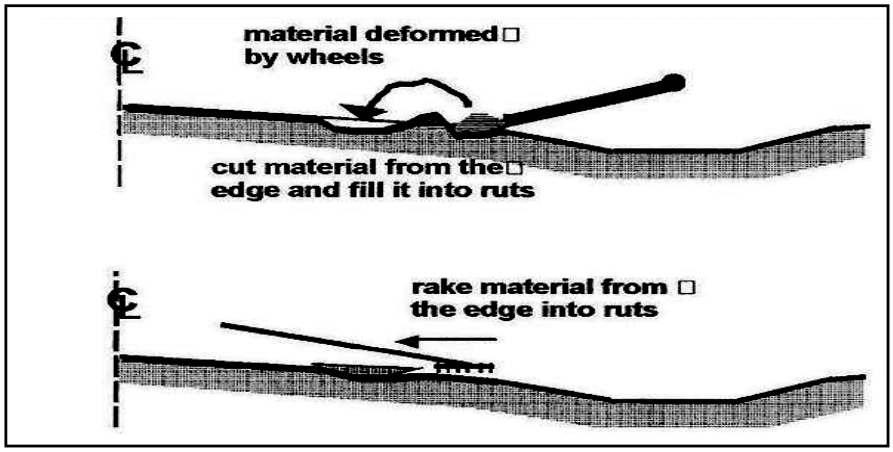
Timing:

Semi-annually and schedule as the need arises.

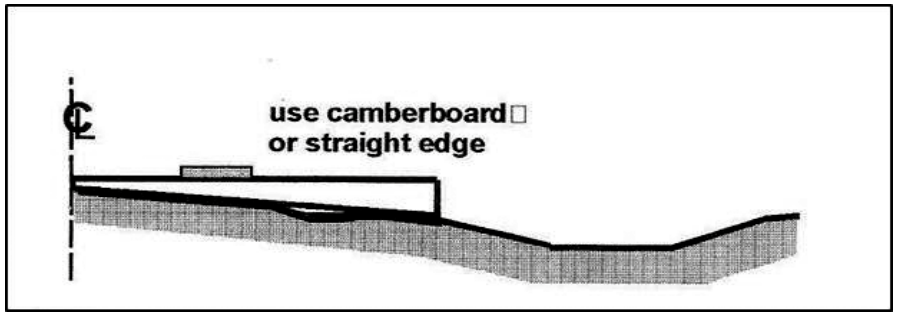
Typical Work Method:

1. Side drain all standing water;
2. Reclaim suitable materials from ditches and roadsides and waste unsuitable materials;

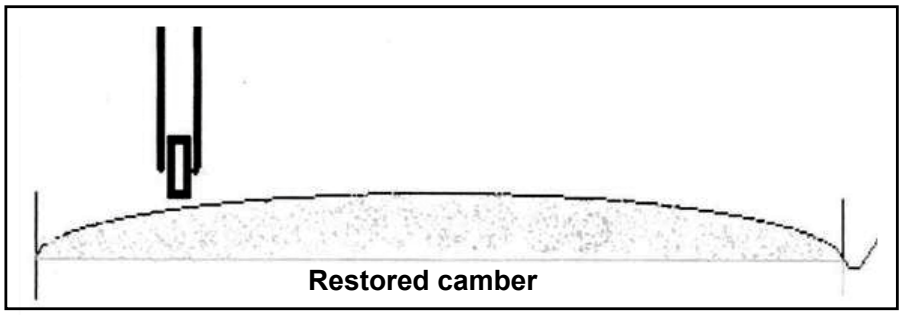
3. Cut high areas;
4. Blend materials from high areas with reclaimed materials adding aggregates and binders when necessary;
5. Return reclaimed blended materials to roadway surfaces where needed;
6. Spread materials with rakes or spreaders;



7. Reshape road surface using camber boards ensuring crown is restored;



8.Compact road surface with hand tampers.



Productivity Rate: 150 road centerline meters per crew-day		
Typical Crew: 1 - Team Leader 4 - Laborers	**Typical Tools:** Shovels, Wheelbarrow, Camber Boards, Rakes or Spreaders, Hand Tampers	**Typical Materials:** Aggregates, Binders

B2.5 Erosion Control

Description:

Repair of minor erosion of shoulders, slopes and ditches using hand tools and correcting conditions causing erosion. This includes installation and repair of riprap boulders, plain riprap ditch lining, ditch check structures, headwalls and other erosion control practices

Purpose:

To stabilize affected area and prevent further deterioration that may lead to serious damage on roadway.

Timing:

Schedule as the need arises.

Typical Work Method:

1. Repair eroded areas by filling with well compacted suitable materials with plain riprap armouring;
2. Correct conditions causing erosion adopting the following methods:
   - widening and downgrading of gradient of ditches
   - providing supplementary ditches to distribute flow
   - sodding of eroded areas
   - lining ditch with plain riprap
   - providing downstream riprap on culvert outlets
   - providing check and drop structures or "scour checks" along steep slopes of ditches

Productivity Rate: 3 – 5 cubic meters of materials placed per crew-day		
Typical Crew: 1 - Team Leader 4 - Laborers	**Typical Tools:** Mattock, Shovels, Axe, Wheelbarrow, Ropes	**Typical Materials:** Riprap boulders

Useful Plants for Erosion Control

Plants can help to slow down the movement of water and anchor the soil. Some available local plants which are very effective:

IPIL-IPIL: anchors the soil and prevents landslips, especially along the shoulders at outer edges of roads. However, it should be pruned regularly to avoid increased load on the slope.

MADRE DE CACAO (Kakawati): a good soil anchor, can form strong barriers and is useful to prevent erosion around the edges of structures. Easy to grow and establishes quickly.

BAMBOO (Kawayan): forms a strong, thick barrier and useful to prevent erosion around and below structures.

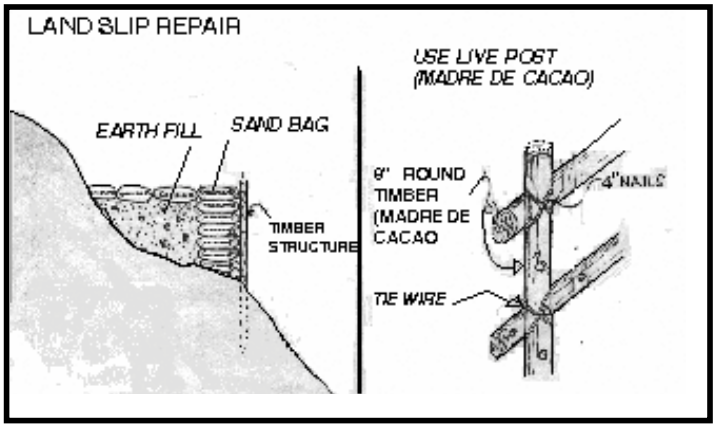
GROUND COVER LEGUMES (Pueraria, Centro, Vetiver): helps form a thick mass over the ground and is useful at the edges of turnouts.

CARABAO GRASS: provides an armour against surface erosion on slopes and around the edge of structures.

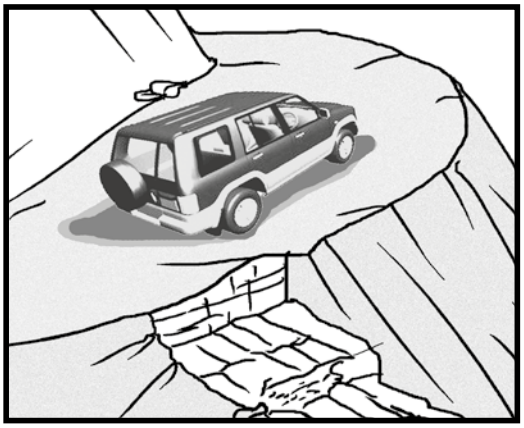
Note: *Fruit trees should not normally be used along road sides*

Common details on Erosion Control

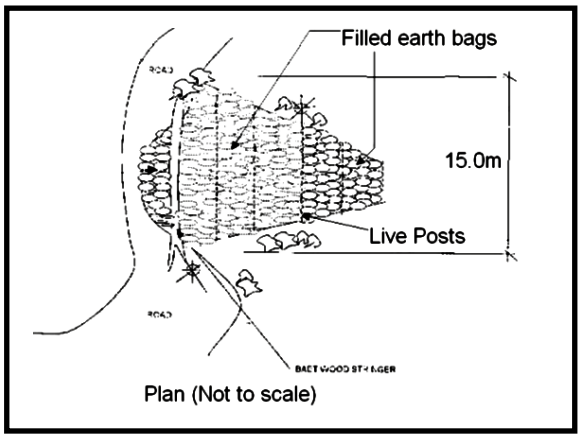
Typical Set of Landslip Repair



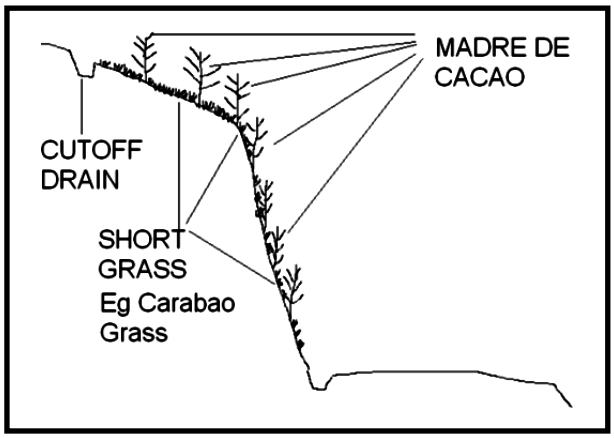
General Lay-out (Perspective)



General Lay-out (Plan)



Slope Sodding



CocoNet Roll

CocoNet Slope Protection

Vetiver Slope Protection

B2.6 Cleaning Culverts and Other Structures

Description:

Cleaning culverts can be done by removing silt, debris and other obstructions from ditches, culvert conduits, outlets and inlets, manholes, catch basins and in drop inlets.

Purpose:

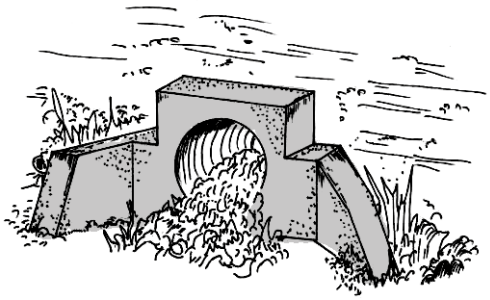
To provide functional drainage structures and ensure unobstructed flow of water.

Timing:

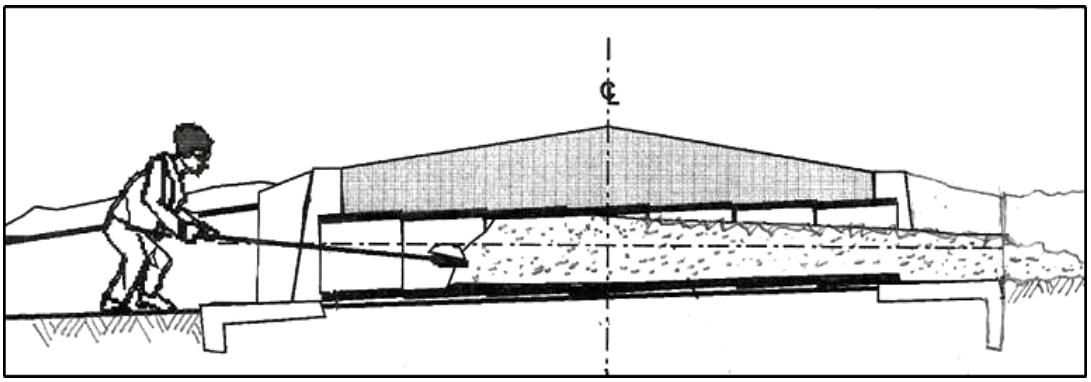
Quarterly and schedule when structures are silted and obstructed. This should be done prior to the rainy season and when road surface defects are caused by inadequate drainage.

Typical Work Method:

1. Remove debris from outlets and inlets;



2. Excavate silt and sand deposits with shovels if accessible, else use cables with buckets dragged through the conduit;



3. Flush out silt and sand by water at high pressure if possible;
4. Patch up minor damage on broken culverts and headwalls;
5. Dispose of all debris and waste materials properly;
6. Report major damage for repair or replacement.

Productivity Rate: Five (5) structures per crew-day for heavy siltation		
Typical Crew: 1 - Team Leader 4 - Laborers	**Typical Tools:** Shovels, Buckets, Wheelbarrow, Ropes or Cables, Cleaning Rods, Concrete Trowel	**Typical Materials:** Cement, Sand, Riprap Boulders

The other distresses not covered by the above procedures shall adopt the following methods:

In case of structural cracks in concrete structures, there is a need to re-evaluate the extent of damage and analyze the worthiness of the facility to withstand loads that it was designed for. In case of serious failure, remedial measures have to be undertaken to bring it back to its stable structural condition that would require re-designing procedures. However, thermal cracks can be corrected simply by providing concrete mortars to eliminate aesthetic deficiencies.

Rusted and corroded exposed metal parts (in case of hanging foot bridges and regular bridge metal parts) must be scraped and cleaned with steel brush and treated with rust converters prior to the application of fresh paints while tightening of loose bolts and nuts must be done with the use of wrenches. Sagging cables for hanging foot bridges must be tightened using turnbuckles in appropriate position.

B-3. DO-NOU TECHNOLOGY[1] for MAJOR DEPRESSIONS

B3.1 Introduction

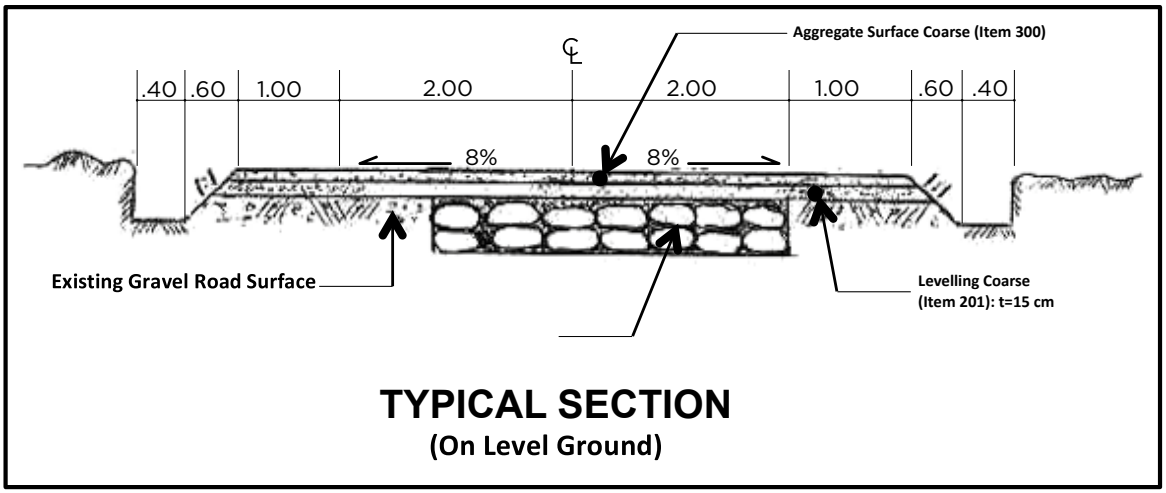
"Do-Nou" is a Japanese word that means wrapping soil in a gunny (jute) bag (45cm x 60cm) or sack. "Do-Nou" Technology is the application to road maintenance involving use of these bags to repair and maintain damaged sections of the road.

Spot Improvement using Do-Nou Method is ideal for large potholes (depressions) and ruts along unpaved rural or local roads since it improves the bearing capacity of muddy and soft soil that are subject to adverse conditions like rain and traffic with heavy loads throughout the year. Consequently, it provides accessibility to basic social services to communities in rural areas and enhances economic activities thereby improving their way of life.

The bags are filled appropriately with either sand or farm soil (earth fill) or gravel, thereafter properly securing the bag opening with an appropriate string. The bags are laid in a systematic way, compacted and covered with a wearing course of gravelly material (base course). Do-Nou bag has high bearing capacity of up to 250 KN and can carry an axle load of up to 25 tons. They are also commonly used to raise embankments to prevent floods, construct temporary structures in response to disasters, and reinforcing soft building foundations.

Figure 29: Do-Nou Method Actual Application

Figure 30: Typical Section of Do-Nou Application



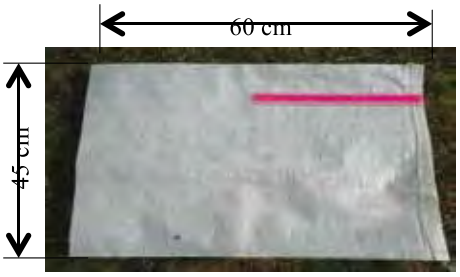
[1] Extracted from "Simplified Training Material" for the ILO Community Road Empowerment (CORE) by J._Kipyegon. ***Source:*** Road Maintenance Using "Do-Nou" Technology Training Material, Smallholder Horticultural Empowerment Project (SHEP), November 2009

B3.2 Specifications

1. In filling the bag, stones with size larger than the circle made by thumb and forefinger should be removed.

2. Do-Nou bags shall be made of Polyethylene (PE), Polyester, or Polypropylene materials of sufficient thickness. In case these materials are unavailable, rice or cement bags made of heavy duty straw with a capacity of 25kg or 40 kg respectively will suffice. These bags are approximately having the same dimensions asshown below.

Do-Noubag size



Empty

Filled

Alternative bag (using same amount of fillings)

Space in Do-Nou bag is maintained

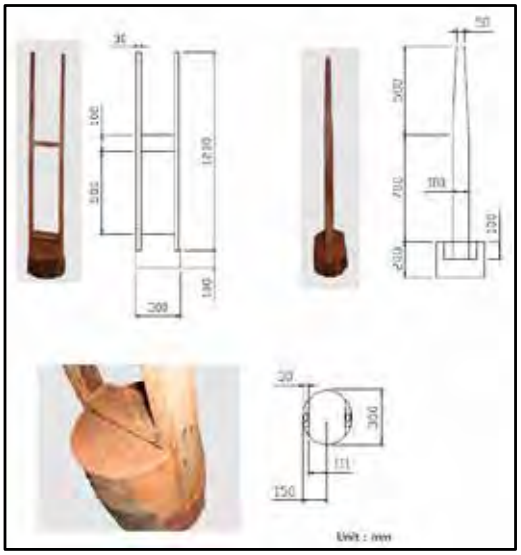
The same volume of filling is used

3. To achieve uniform volume of filling materials, any available plastic container having a capacity of 16 liters (4 gallons) may be used with the top cut-out and fully open.

4. Filling materials shall be any of the following materials under Category A or Item 201 (Base Course); pure clay or loam must not be used.

MAJOR DIVISION			GROUP SYMBOL	LETTER SYMBOL	GROUP NAME	
COARSE GRAINED SOILS CONTAINS MORE THAN 50% FINES	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVEL WITH ' 5% FINES		GW	Well-graded GRAVEL	
				GP	Poorly graded GRAVEL	
		GRAVEL WITH BETWEEN 5% AND 15% FINES		GW-GM	Well-graded GRAVEL with silt	
				GW-GC	Well-graded GRAVEL with clay	
				GP-GM	Poorly graded GRAVEL with silt	
				GP-GC	Poorly graded GRAVEL with clay	
		GRAVEL WITH ≥ 15% FINES		GM	Silty GRAVEL	
				GC	Clayey GRAVEL	Category A
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SAND WITH ' 5% FINES		SW	Well-graded SAND	
				SP	Poorly graded SAND	
		SAND WITH BETWEEN 5% AND 15% FINES		SW-SM	Well-graded SAND with silt	
				SW-SC	Well-graded SAND with clay	
				SP-SM	Poorly graded SAND with silt	
				SP-SC	Poorly graded SAND with clay	
		SAND WITH ≥ 15% FINES		SM	Silty SAND	
				SC	Clayey SAND	
FINE GRAINED SOILS CONTAINS MORE THAN 50% FINES	SILT AND CLAY	LIQUID LIMIT LESS THAN 50		ML	Inorganic SILT with low plasticity	
				CL	Lean inorganic CLAY with low plasticity	Category B
				OL	Organic SILT with low plasticity	
		LIQUID LIMIT GREATER THAN 50		MH	Elastic inorganic SILT with moderate to high plasticity	
				CH	Fat inorganic CLAY with moderate to high plasticity	
				OH	Organic SILT or CLAY with moderate to high plasticity	
HIGHLY ORGANIC SOILS				PT	PEAT soils with high organic contents	

5. Hand tampers/rammers may be made of hardwood (Yakal) the total weight of about 10kg or a fabricated steel plate with Galvanized Iron (G.I.) pipe handles.



Hardwood Material (Yakal)

Fabricated Steel Material

B3.3 Do-Nou Application Procedure

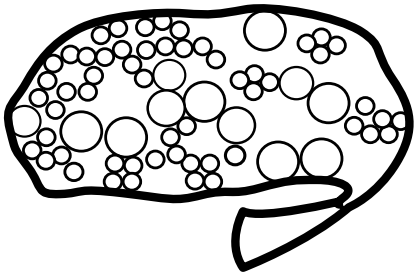
1. Identify damaged road section and mark out the damaged portion with a string;

2. Excavate the marked area and remove and dispose off the mud;

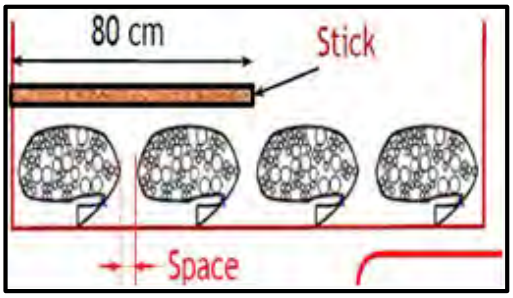
3. Remove loose materials from edges making sides of excavation as vertical as possible;

4. Fill the Do-Nou bags with the recommended amount of soil and tie tightly above the hand as it rests on the filling material;

Correct Placement of Bag

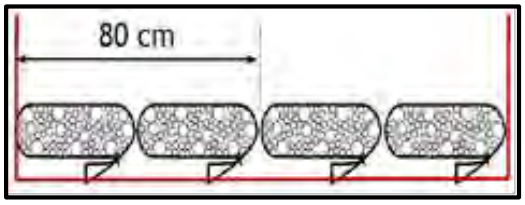


5. Lay Do-Nou bags appropriately and compact;

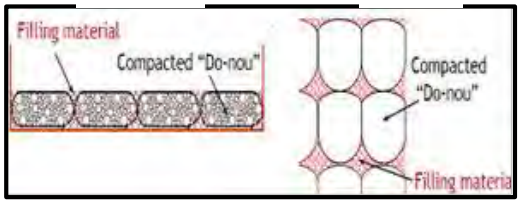


Space in the Do-Nou bags is maintained

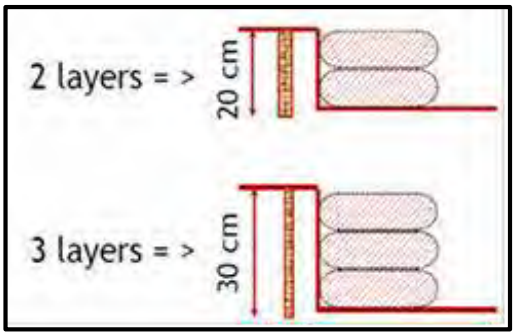
6. Spaces between Do-Nou bags disappear after compaction then fill the remaining spaces and compact the fill independently;

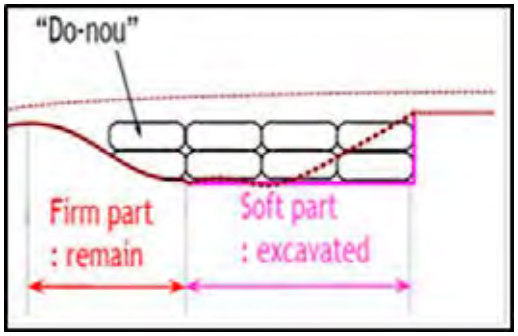


Section ***Plan***

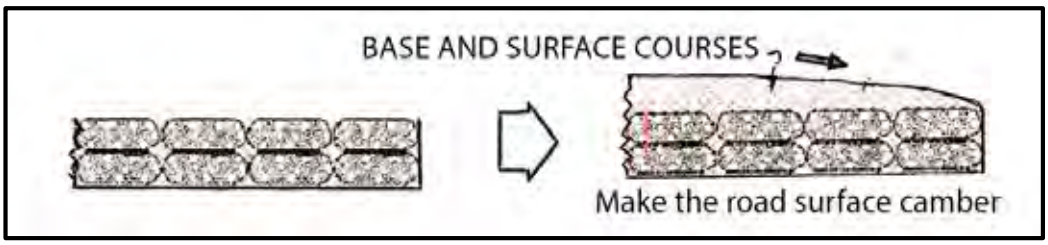


7. Number of layers depend on the depth of excavation;





8. Apply the required base and surface courses, form the camber and compact



B-4. MAINTENANCE WORK FORCE and FUNDING STRATEGIES

There are two (2) common options in engaging work force to undertake maintenance activities and these are either adopting the lengthman system which is hiring an individual worker for routine maintenance or contracting out works through a "Pakyaw" labor group for maintenance works. "Pakyaw" requires a number of workers to do the job on specific time period. While the former is ideal for common routinary works, the latter is more appropriate for those with substantial work items like the application of the Do-Nou method. The applicable documents for both these engagement may use the same guidelines and forms for the "Pakyaw" system as provided in *Appendix A1 of Part A*. However, some of the forms need to be modified to fit the particular features for individual hiring under the lengthman system and that for maintenance "Pakyaw" groups.

Funding constraints for regular maintenance works of rural or local roads is a perennial problem to almost all LGUs especially those categorized under the 4th to 6th class municipalities. Given this, there is a need to develop innovative measures in supplementing the scarce resources for the purpose. While the common source of funding O and M activities are from the municipal and barangay LGU IRA out of the 20% Development Fund, supplemental fund generation for rural or local roads may be attained through the following strategies:

1. collection of road users' fee where appropriate;
2. solicitation from the provincial government and other political leaders;
3. imposing penalties to erring users of the facilities; and
4. cash contribution from those who are unable to join "bayanihan" activities.

The first strategy however will need a local ordinance to be promulgated as legal basis for sanctions and imposing penalties.

B-5. ROAD MAINTENANCE MONITORING and EVALUATION

B5.1 Municipal Road Maintenance Monitoring Team (MRMMT)

To ensure the sustainability of rural or local roads through the organized BRMT, there is a need for the LGU to regularly allocate funds under its Annual Investment Plan (AIP) for Operation and Maintenance (O and M). However, the monitoring and evaluation (M and E) of the operational status of these facilities would continue hence the need to institutionalize the M and E procedure within the LGU structure. To achieve this, a **Municipal Road Maintenance Monitoring Team (MRMMT)** is recommended to be established and must be composed of the following:

1. Municipal Engineer (ME) as the Team Leader
2. Municipal Planning and Development Coordinator (MPDC) as Asst. Team Leader
3. Barangay Chairman as member for each Barangay
4. Other personalities deemed important by the ME and MPDC

The Team shall have the following responsibilities:

1. conduct regular site inspection of the roads within the barangay;
2. identify the extent of distresses, deficiencies and deteriorations;
3. assess the sustainability of the road facilities;
4. prepare reports on the observations during the conduct of site inspections using the road maintenance Monitoring and Evaluation (M and E) Forms in *Appendix B3*;
5. recommend measures to address the observed distresses, deficiencies and deteriorations;
6. prepare road maintenance instructions and directives for compliance by the BRMT using the form in *Appendix B4*;

7. recommend and approve measures for the improvement of the O and M systems and procedures; and
8. submit reports and recommendations to the Municipal Mayor for appropriate action.

The frequency of monitoring and evaluating road maintenance activities shall be on a semestral basis preferably during the months of January and July of each year. The MRMMT shall ensure that findings are initially discussed with the BRMT prior to final preparation of field reports and submission to the Municipal Mayor.

The MRMMT shall ensure that copies of reports be furnished to the concerned BRMT. Road maintenance instructions and directives shall likewise be posted on barangay bulletin boards for the information of the community members.

B5.2 Rating Guidelines and Monitoring and Evaluation Forms

The ratings for the evaluation of distresses, deficiencies and deteriorations shall be done on a qualitative and quantitative basis. The general characterization of the degree of distresses, defects and deterioration shall be as follows:

1. ***Good:*** when there are no significant distresses, defects and deteriorations largely visible in any part of the road facility. The road appears to be in a sound and well maintained condition with very few minor failures
2. ***Fair:*** when distresses, defects and deteriorations are visible in less than twenty five (25) percent of the entire configuration of the road facility or very rare failures and damages. The level of maintenance effort seems to be slightly average
3. ***Bad:*** when 25 – 50 percent of the entire road facility is affected and maintenance state is low
4. ***Severe:*** when more than 50% of the road facility shows distresses, defects and deteriorations and the quantities required to restore the facility to its original shape are largely exceeding the most cost effective solutions

The detailed physical description of road distresses, deficiencies and deteriorations are in *Appendix B5*.

The equivalent numerical rating for each observed distress, defect and deficiency for the above characterization shall be as follows:

Good = 1; Fair = 2; Bad = 3; and Severe = 4

The average numerical rating for the entire facility being evaluated shall be the total numerical rating divided by total number of type of distresses, defects and deficiencies. The resulting overall ratings shall have the following recommended actions to be undertaken:

- ***Average numerical rating between 1 – 2:*** advise BRMT to undertake corrective measures within 30 calendar days from receipt of O and M instruction letter from MRMMT;
- ***Average numerical rating between 2 – 3:*** advise BRMT to undertake corrective measures within three (3) months from receipt of O and M instruction letter from MRMMT;
- ***Average numerical rating between 3 – 4:*** advise BRMT to undertake corrective measures within three (3) months from receipt of O and M instruction letter from MRMMT after which a follow-up visit will be undertaken by MRMMT to verify compliance to instructions

Non-compliance to the O and M instructions for the first two categories shall constitute neglect of maintenance responsibility and shall warrant a warning from the MRMMT while those rated

between 3 - 4 shall warrant the imposition of sanctions and penalties that will be developed by the Municipal Engineer and approved by the Municipal Mayor.

B5.3 Monitoring and Evaluation Processes and Procedures

The Monitoring and Evaluation processes and procedures shall be disseminated to all concerned for proper information. The M and E of road facilities shall be undertaken according to the following processes and procedures:

1. **MRMMT** leader convenes the members to set the date of the initial site visit and inspection on the road facilities;
2. **MRMMT** conducts actual initial site visit and schedules visits thereafter on a regular basis twice a year during the first week of the months of January and July of each year;
3. **MRMMT** prepares inspection report *(Appendix B3)* and submits report to the **Municipal Mayor** on or before the 7th working day of January and July of each year;
4. **Municipal Mayor** reviews report and meets with **MRMMT** to discuss appropriate actions to be taken;
5. **MRMMT** prepares O and M instruction letter *(Appendix B4)* based on discussions with **Municipal Mayor** including adverse findings and forwards letter together with duly signed O and M Monitoring and Evaluation report *(Appendix B3)* to the BRMT for compliance;
6. **MRMMT** re-visits site 3 months after the instruction letter had been served to the BRMT to verify compliance;
7. **MRMMT** prepares report on compliance or non-compliance with recommendations and submits to **Municipal Mayor**;
8. **Municipal Mayor** reviews report and meets with **MRMMT** to discuss further actions to be taken if instruction letter was not complied.

As mentioned earlier, the MRMMT through the ME needs to develop sanctions and penalties, if necessary, to BRMT for non-compliance with the instruction letter. The conditions to warrant sanctions and penalties shall include but not necessarily be limited to the following:

1. facilities that have average numerical ratings between 3 – 4;
2. intentional neglect of the O and M organization to conduct regular maintenance of the completed facilities;
3. abandonment of damaged facilities as a result of misuse without exerting effort to restore its serviceability;
4. frequency of refusal to rectify defects as contained in the O and M instruction letters; and
5. other justifiable reasons as deemed fair and appropriate by the MRMMT.

The frequency on refusal to rectify defects to warrant sanctions and penalties shall be according to the following schedule:

Frequency	Indicator	Action to be taken
First Offense	❒ when **BRMT** fails to rectify defects of facilities with average numerical ratings between 3 – 4 within three (3) months after receipt of **first O and M instruction letter** from the **MRMMT**	➢ **MRMMT** to issue reminder letter to **BRMT**
Second Offense	❒ when **BRMT** fails to rectify defects of facilities with average numerical rating between 3 – 4 within three (3) months after receipt of **reminder letter** from the **MRMMT**	➢ To incorporate non-compliance in 2nd cycle report ➢ **MRMMT** to issue warning on sanction and penalty if not rectified in the next three (3) months noted by the **Municipal Mayor**
Third Offense	❒ when **BRMT** fails to rectify defects of facilities with average numerical rating between 3 – 4 within three (3) months after receipt of **warning letter** from the **MRMMT**	➢ **MRMMT** to recommend sanction to the **Municipal Mayor** cc: **BRMT**

XXXXX

Appendices

PART A

ROAD CONSTRUCTION and REHABILITATION

Appendix A1

GENERAL GUIDELINES and FORMS

on

"PAKYAW" SYSTEM

(For Local Road Construction, Rehabilitation, and Maintenance)

GENERAL GUIDELINES on the use of "PAKYAW" SYSTEM
(For Local Roads Construction, Rehabilitation, and Maintenance)

1. Introduction

"Pakyaw" system is used to undertake jobs in which manual labor is a major component. It eliminates the time consuming work of dealing with individual workers and preparing weekly payrolls as the procuring entity deals directly with the work group leader who is responsible for his group of workers. In addition, it gives opportunity to the community to organize themselves and enhance their capability in getting involved in the construction, rehabilitation, or operation and maintenance (O and M) of their rural infrastructure projects. The system should be readily acceptable to a rural workforce with little or no experience in implementing infrastructure projects. For labor-based construction, rehabilitation, or maintenance of local roads, the use of "Pakyaw" system seems to be ideal.

2. Organization of Pakyaw Groups

The "Pakyaw" concept is appropriately applicable to the construction, rehabilitation, and maintenance of local roads that are basically the responsibility of the Municipal LGUs.

In the case of road maintenance, while the "Lengthman System" is appropriate for simple routine works, the establishment of a Barangay Road Maintenance Team (BRMT) under one (1) overall team leader is also recommended for maintenance activities that require a certain number of workers to do the job. Hence, this concept presumes that the BRMT is also a conglomerate of several "Pakyaw" Groups for the road sections within a barangay. The group leader will represent the group and act as the "Pakyaw" leader.

In this regard, the organization of a "Pakyaw" Group shall adhere to the following procedures:

a. The formation of "Pakyaw" Groups should have the involvement of Barangay Leaders and the local community. This should likewise involve the tribal leaders in case of Certificate of Ancestral Domain Claim (CADC) areas.
b. The maintenance procedures should be scheduled so as not to conflict with agricultural peak season activities.
c. The Municipal Engineer (ME) and Municipal Planning and Development Coordinator (MPDC) and prior to the final completion of a road project (if on-going) shall convene a community meeting with assistance of the Barangay Chairman or Tribal Leaders and shall encourage attendance of unemployed and underemployed members of the community. The purpose is to provide accurate information about the proposed maintenance scheme.
d. The elected "Pakyaw" Leader shall be the signatory to the "Pakyaw" Contract and any other documents pertaining to the work on behalf of the "Pakyaw" Group. The "Pakyaw" Leader may be replaced at any time by the group but this should not invalidate any previous agreements.
e. The ME and MPDC may assist in the registration of "Pakyaw" Groups and in preparing their application for "Pakyaw" Agreements.

3. Workforce

a. Unskilled labor and "Pakyaw" Group members should be drawn from the immediate vicinity of the facility to be constructed, rehabilitated, or maintained.
b. When necessary, semi-skilled labor shall be recruited within the municipality preferably within the barangay while skilled labor shall be recruited within the province and preferably within the barangay/municipality.
c. The workforce should be formed into groups of workers, the number of which shall be based on the magnitude of work to be done but usually about ten (10) to fifteen (15) per "Pakyaw" Group including the group and section leaders.

d. The "Pakyaw" Group will elect a Group Leader who will also participate in the work.

4. Award of "Pakyaw" Agreement

a. The maximum value of individual "Pakyaw" contract shall be Php500,000.
b. The "Pakyaw" Group is expected to complete a contract within a specified period.
c. The Agreement would normally be for labor supply only. Tools, equipment and materials will be supplied by the LGU as acquired from the cost item in the sub-project POW.
d. No contract should be awarded without a certification of the Availability of Funds from the LGU.
e. All contract awards shall be made and signed by the "Pakyaw" Leader and the Municipal Mayor, certified by the LGU Accountant. Work will only commence after the award has been formalized.
f. Commencement of a new "Pakyaw" Contract will be subject to satisfactory completion of the previous contract.
g. The "Pakyaw" Group undertaking any work under the Agreement shall be exempted from the Contractor's Tax and other local taxes that are imposed on registered companies or profit oriented organization.

5. Supervision

a. The ME and MPDC will assist in the organization of the "Pakyaw" Groups and in the preparation of Pakyaw Agreements. It should also help resolve any disputes between the workforce and LGU. The ME and MPDC will also explain the standards and contract requirements to be achieved.
b. The ME and MPDC will oversee the selection of the "Pakyaw" Group members and be witnesses to the "Pakyaw" Agreement.
c. During maintenance works, the ME and MPDC will be responsible for overall implementation and ensuring compliance with the agreement. The ME or MEO representative will direct the site supervisions and be a party to the calculations of payments due to the workforce and a joint signatory to all documents relating to the accomplishment and payment for the work. He/She will closely supervise the work assuring that it is in accordance with instructions. He/She will also verify the daily attendance and will closely direct the "Pakyaw" Groups through their Group Leader (GL). He/She will give clear instructions to the GL, ensure that the handtools are adequate and the "Pakyaw" Group members are properly informed, and are actively participating in the work.
d. The GL will assist in setting out the task and in distributing the handtools and ensure that work is undertaken as directed. He must also check that workers are properly informed, present and working.

6. Tools

a. Hand tools (either acquired by LGU from the 20% DF or under the sub-project POW) will be supplied by the LGU through the barangay custodian or any authorized community member. They shall be to the specifications required and of sufficient quantity.
b. The barangay custodian through the GL will be responsible for keeping the tools in good working conditions by sharpening/repairing them.
c. Tools will be issued to the workforce and the issuance will be documented in the Pakyaw Contract Documents (See PC Form 5).
d. Worn out tools should be returned to the barangay custodian for replacement. These should then be returned to the Municipal property custodian for write off or replacement.
e. On completion of the "Pakyaw" Agreement, all tools and implements, whether serviceable or not, shall be returned to the barangay custodian. This shall be made a condition for payment of the "Pakyaw" Agreement. Any loss must be deducted at replacement value from the

contract sum and the amount recovered will be used for the purpose of replacement for tools lost.

f. No tools shall be offered or sold to the worker.

7. "Pakyaw" Payments

a. Before commencing the work, the Municipal Accountant has to certify the availability of funds to pay for the "Pakyaw" Agreement.

b. The "Pakyaw" Agreement should be designed to ensure completion of work segment within one (1) calendar month thus, the workers will be paid at least once a month.

c. In some cases, more frequent payments may be requested and, provided it is agreed with the LGU, a compromise payment halfway thru and on the completion of the contract may be made. However, with mid-contract payments some retention, say 10% should be withheld to ensure completion of work.

d. The "Pakyaw" Agreement estimate will assume normal productivity rates and prevailing local wage rate shall be as those adopted by the LGU. The "Pakyaw" Group should be given the incentive of working harder or longer in order to be paid early on completion of the work.

8. "Pakyaw" Contract Documents

a. Invitation to "Pakyaw" Groups (PC Form 1)

b. Application to undertake Work by "Pakyaw" System (PC Form 2)

c. "Pakyaw" Agreement (PC Form 3)

d. Schedule of Works (PC Form 4)

e. List of tools to be provided to the "Pakyaw Group" (PC Form 5)

f. General Conditions of "Pakyaw" Agreement for labor only (PC Form 6)

These annexes to the Agreement shall be prepared by the Municipal Engineer. The ME enters the quantity of tools to be issued to the "Pakyaw" Group Leader who signs the receipts and receive the tools from the barangay custodian for and in behalf of the "Pakyaw" Group.

Once the work has been completed and the tools returned, the barangay custodian certifies its return by signing on the appropriate space. The replacement value of any tools not returned on completion of work shall be deducted from the agreed payment.

PC Form 1

Republic of the Philippines
Municipality of _____
Province of _____

BIDS and AWARDS COMMITTEE (BAC)

INVITATION TO "PAKYAW" GROUP

The Municipal Government of _____, Province of _____ is inviting "Pakyaw" Groups (labor only) to apply for the various items of work involved in the *(construction, rehabilitation, maintenance)* of *(name of road section)*, located at, _____ to wit:

Scope of Work	Quantity	Estimated Cost
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
	Total	_____

Application forms are available at the Office of the Bids and Awards Committee (BAC), Municipal Hall, Municipality of _____ Province of _____.

The deadline for the submission of application forms will be on _____. Qualified "Pakyaw" Groups will be notified of their employment on or before _____.

The Municipal Government reserves the right not to accept and/or process application forms received after the above deadline.

_____
BAC Chairman

Date of Publication:

PC Form 2

Republic of the Philippines
Municipality of _____
Province of _____

BIDS and AWARDS COMMITTEE (BAC)

APPLICATION TO UNDERTAKE WORK BY "PAKYAW" SYSTEM

Date: _____

The BAC Chairman
_____
_____

Work Involved : *(Construction, Rehabilitation, Maintenance of name of road section)*
Location : _____

Sir/Madame:

We the undersigned, all of legal age, Filipino and Residents of Barangay _____ hereby apply to provide labor only and undertake the work described in the "Invitation to "Pakyaw" Groups.

We are a team of workers willing to undertake the work jointly under the direction of the Municipal Engineer (ME) or his duly authorized representative.

This will also authorize _____, who has been elected as "Pakyaw" Group Leader to make representations, sign documents and receive payments for and on behalf of the group.

Name of Worker	Address of Residence	Signature
1. (Leader)		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

PC Form 3

Republic of the Philippines
OFFICE of the Municipal Mayor
Municipality of _____
Province of _____

"PAKYAW" AGREEMENT
(Labor Only)

This AGREEMENT, made this ___ day of _____ 201__ by and between the Municipality of _____, Province of _____, represented herein by Hon. Mayor _____, hereinafter referred to as the Local Government Unit (LGU) and Barangay "Pakyaw" Group No. ___ hereinafter referred to as the "Pakyaw" Group and represented by their "Pakyaw" Group Leader, _____.

WITNESSETH, that for and in consideration of the rates in the Schedule of Work, attached as PC Form 4 to this Agreement and made an integral part hereof, the Parties hereto covenant and agree as follows:

(1) That the "Pakyaw" Group shall provide labor only necessary for the proper and faithful performance of the work described below at the total contract amount of _____ (Php _____).

(2) That the "Pakyaw" Group shall complete the work in accordance with the corresponding Agreement, under the supervision of the Municipal Engineer (ME) or his duly authorized representative appointed for the purpose by the Municipal Mayor.

(3) That the "Pakyaw" Group shall comply with all the terms and conditions of this Agreement more specifically those contained in the following documents:

Annex "A" – General Conditions of "Pakyaw" Agreement (PC Form 6)
Annex "B" – Application to undertake work by "Pakyaw" System (PC Form 2)
Annex "C" – List of Tools to be provided by the LGU (PC Form 5)

(4) That the "Pakyaw" Group agrees to commence work within ten (10) calendar days upon signing of this Agreement and to complete the same within ____ calendar days, Sundays and Legal holidays included.

(5) That the "Pakyaw" Group shall submit to the Municipal Engineer (ME) a periodic report on the time records of the workers, the group accomplishment and corresponding payments made thereof.

(6) That the slippage shall not go beyond 15%. If it exceeds 15%, the Municipal Engineer shall immediately tender a written report for appropriate action to the party of the "Pakyaw" Group.

Target Date of Completion: _____

Work Involved : *(Construction, Rehabilitation, Maintenance of name of road section)*
Location : _____

ITEMS OF WORK	QTY.	UNIT PRICE	AMOUNT
TOTAL			

a) IN WITNESS HEREOF, THE PARTIES HERETO SIGNED THIS AGREEMENT ON THE DATE INDICATED ABOVE.

FUNDS AVAILABLE: AS TO PROGRAM: BY:

_____ _____ _____
Municipal Accountant Municipal Engineer Municipal Mayor

CONFORMED:

_____
"PAKYAW" GROUP LEADER

ACKNOWLEDGEMENT

REPUBLIC OF THE PHILIPPINES)
PROVINCE OF _____)
MUNICIPALITY OF _____)

BEFORE ME, a Notary Public for and in the Municipality of _____, Province of _____, Philippines, personally appeared Mr. _____, with CTC No. _____, issued on _____, at _____, and Mr. _____, with CTC No. _____, issued on _____, at _____, all known to me to be the same persons who executed the foregoing instruments and acknowledged that the same is their free act and deed. This instrument consisting of ___ pages, including this page where the acknowledgement is written, pertains to a "Pakyaw" Agreement for the *(work involved)*, located at _____, and has been signed by the parties herein at the left hand margin of the first to its last page.

WITNESS MY HAND AND SEAL OF MY OFFICE on the day, month, year and place first written above.

_____
Notary Public

Doc. No. ____
Page No. ____
Book No. ____
Series of ____

Until December _____, 201__
PTR No. _____
Issued on _____
At _____

PC Form 4

Republic of the Philippines
Office of the Municipal Mayor
Municipality of _____
Province of _____

SCHEDULE OF WORKS

Work Involved : _____
Location : _____

Activity No.	Description	Quantity	Unit Cost	Estimated Cost

Note: *In case of substantial overruns/underruns, the corresponding additive/deductive amounts shall be proportional to the above quantities and estimate.*

PC Form 5

Republic of the Philippines
Office of the Municipal Mayor
Municipality of _____
Province of _____

LIST OF TOOLS TO BE PROVIDED TO THE "PAKYAW" GROUP BY THE LGU
(check tools to be provided)

Item	✓	Quantity
Axe*		
Bolo (Multi-purpose)*		
Brush Hook*		
Grass Cutting Bolo*		
Grass Cutter*		
Crowbar*		
Pipebar		
Shovel*		
Hoe*		
Forked Hoe*		
Pick Mattock*		
Pickaxe*		
Sledge Hammer*		
Rake Spreader*		
Hand Hammer*		
Wheel Borrow*		
Cold Chisel (Bladed)*		
Cold Chisel (Pointed)*		
Steel Scraper (animal drawn)		
Cart (animal drawn)		
Others (specify)		

* including handles

I certify that the above tools have been received by me on behalf of the "Pakyaw" Group.

Received by: Noted:

_____ _____
Pakyaw Group Leader Team Leader
Date: Date:

Upon Completion of Work

I certify that the above tools have been returned by the "Pakyaw" Group in acceptable condition.

Noted:

_____ _____
Barangay Custodian Team Leader
Date: Date:

PC Form 6

GENERAL CONDITIONS UNDER WHICH THE WORK SHALL BE UNDERTAKEN

(1) All works contemplated under the contract shall be performed in accordance with the "Pakyaw" Agreement. Any deviation shall not be accepted and considered invalid unless the same has prior written approval by the Municipal Engineer (ME).

(2) The work shall be carried out using labor-based methods under the direction of the Municipal Engineer or his duly authorized representative.

(3) The time of completion of work is _____ calendar days reckoned from the 10th day upon signing of "Pakyaw" Agreement. All works must be finished before _____.

(4) The Pakyaw Group shall employ, where available, unskilled workers within the immediate vicinity where the facility is located and when necessary, semi-skilled workers from the municipality where the facility is situated and skilled workers from the province which has jurisdiction over the facility.

(5) The ME may stop or suspend the work at any time he/she deems it to be necessary by informing the "Pakyaw" Group in writing. In such cases, payment shall be made based on the amount of work completed.

(6) The quantities and amounts entered in the Schedule of Work are estimates only. Payments will be based on the measured actual accomplishment upon completion of the works and acceptance by the ME.

(7) Interim payments may be allowed at the discretion of the ME, and shall be based on partial accomplishment. Ten (10) percent of any amount shall be retained by the LGU as retention money pending completion of the works and acceptance by the ME.

(8) If in the opinion of the ME, the work is not performed in accordance with the agreement and was unreasonably delayed, then the contract may be terminated and claims for partial payments shall be based on completed works acceptable to the ME.

(9) The "Pakyaw" Group shall work at least six (6) days a week excluding Public Holidays until such time as the works are completed and accepted by the ME.

(10) The "Pakyaw" Group shall take all reasonable precautions to prevent any disorderly conduct by or among members. The ME or his duly authorized representative may require the "Pakyaw Group" Leader to remove from the work any group member who in the opinion of the ME misconducts himself or is incompetent.

(11) Upon completion of works, the ME or his authorized representative shall proceed promptly to measure the works and prepare the estimate and the certificate of acceptance. He shall prepare the necessary voucher for payment to the "Pakyaw" Group Leader, deducting from there such sums as maybe lawfully retained.

(12) The LGU shall provide the "Pakyaw" Group with the necessary hand tools, wheelbarrows and steel scrapers, etc. for the duration of the works. The replacement cost of any items misplaced by the "Pakyaw" Group shall be deducted from the contract payment.

(13) Under this "Pakyaw" Contract, the contractor shall ensure that at least 80% of the required laborers and working tools and equipment specified for this activity are available at site at any stage of work.

(14) The LGU shall not be held liable for any obligation arising from injury, sickness, disability or death of the group members.

Appendix A2

Project Construction Logbook Entries

(one for each sub-project)

A. Logbook Cover

Project Title: _____

Location : _____

Physical Target: _____

Scope of Work:

1. _____
2. _____
3. _____
4. _____
5. _____

Contract Amount: _____ Duration: _____ **Calendar Days**

Date Started : _____ Date of Completion: _____

Contractor : *(if by Contract)* Project Engineer: _____

Address : _____

B. Logbook Entries *(on each page)*

Date:	Day:	Weather:

Resource Inventory:

A. Equipment and Tools

No.	Type	Model	Condition	Remarks

B. Manpower

Skill	No.	Remarks

C. Materials on site

No.	Description	Qty	Source	Remarks

D. Work Activities

-
-
-
-
-

E. Visitors on site					
Name	Office	Purpose	Signature	In	Out
F. General and Other Observations					

Note: *if entries in Items A, B, and C are the same as previous day, just put a note that these are the same and use the space for entries in Items D, E, and F and others as deemed necessary.*

Signature of Project Engineer: _____

Appendix A3

Fortnight (every 15 days) Physical Progress Summary Report

Project : _____ **Fortnight Progress No.:**

Location: _____

Physical Target: _____ **Date Started:** _____ **Target Completion Date:** _____

Item #	Scope of Work	Qty	Descriptive Summary *(in bullets)*		Problems, Issues, Concerns	Actions Taken / Recommendations
			Cumulative Accomplishments as of *(date)*	***Plans for*** *(date of next 15 days)*		
1.0			•	•	•	•
2.0			•	•	•	•
3.0			•	•	•	•
4.0			•	•	•	•
5.0			•	•	•	•

Use two sheets if necessary

Prepared By:	**Reviewed By:**	**Concurred By:**	**Noted:**
_____	_____	_____	_____
Project Engineer	Municipal Engineer	BDA RMO RPOO	BDA CMO

Date: _____

Attachment: At least one photo on work progress per scope of work taken at agreed "Photo" Point

Appendix A4

MONTHLY and CUMULATIVE PHYSICAL PROGRESS REPORT

as of _____

Project : _____
Location : _____
Physical Target: _____

Actual Date Started:
Target Date of Completion:
Time Elapsed to Date (%):

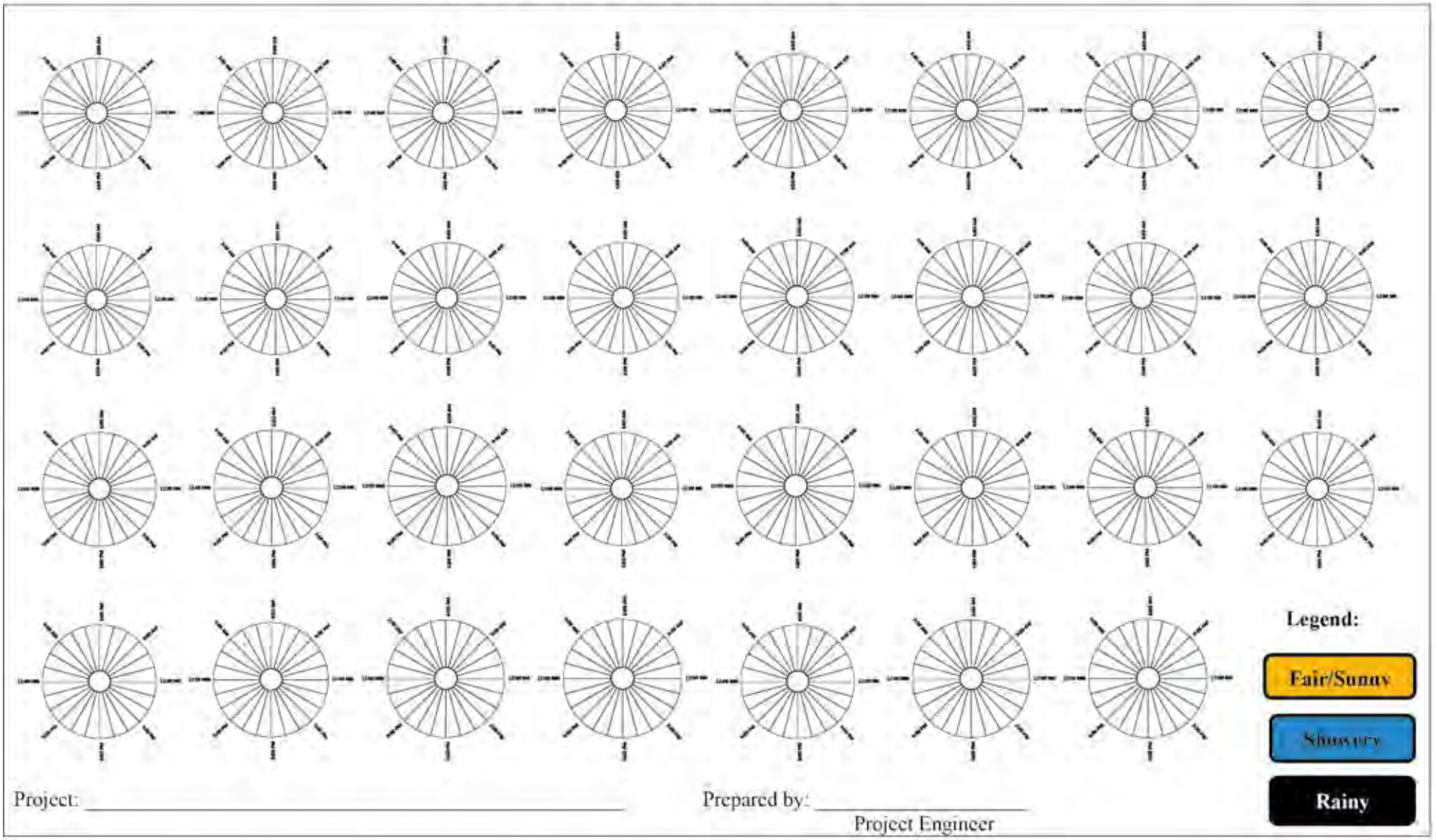
Item No.	Major Work Items (Direct Cost Only)	Contract Cost *(PhP)*	% Wt.	Qty.	Prog.	Monthly Implementation Schedule *(%)*				Total *(%)*	Remarks
					Act.	***Month 1***	***Month 2***	***Month 3***	***Month 4***		
1.0					P					*100*	
					A						
2.0					P					*100*	
					A						
3.0					P					*100*	
					A						
4.0					P					*100*	
					A						
5.0					P					*100*	
					A						
Monthly Total Accomplishment (%)		Programmed								*100*	
		Actual									
		Monthly Slippage (+/-)									
Cumulative Total Accomplishment (%)		Programmed							100		
		Actual									
		Cumulative Slippage (+/-)									

Slippage = (Actual – Programmed) %

Prepared by:	Reviewed by:	Concurred by:	Noted by:
_____	_____	_____	_____
Project Engineer	Municipal Engineer	BDA RMO RPOO	BDA CMO

Appendix A5

DAILY WEATHER CHART (for the Month of _____)



Project: _____

Prepared by: _____
Project Engineer

Appendix A6

Statement of Work Accomplished
as of _____

Billing No: ____

Project : _____
Location : _____
Physical Target: _____

Actual Date Started:
Target Date of Completion:
Time Elapsed to Date (%):

Item No.	Major Work Items	Contract Cost* *(PhP)*	Accomplishment to Date		Previous Accomplishment		Net Accomplishment		Remarks
			%	Value *(PhP)*	%	Value *(PhP)*	%	Value *(PhP)*	
1.0									
2.0									
3.0									
4.0									
5.0									
	TOTAL								

inclusive of Indirect Cost

Certification:
I hereby certify that the work itemized above has been accomplished in accordance with plans and specifications and other requirements thereof .

Total Amount Accomplished to Date: PhP _____
Less: Accomplishment Paid to Date : PhP _____
Less: Advanced Payment Deduction: PhP _____
Less: 10% Retention for this billing: PhP _____
Net Amount Due this Billing: PhP _____

_____
Project Engineer

Submitted by:	Verified Correct:	Concurred by:	Noted by:	Recommended for Release of Payment:
_____	_____	_____	_____	_____
Contractor	Municipal Engineer	BDA RMO RPOO	BDA CMO	

Appendices

PART B

ROAD MAINTENANCE and "DO-NOU" TECHNOLOGY

Appendix B1: Form 1

Annual Operation and Maintenance (O and M) Plan
***Name of Road Section*: _____**
(for CY: _____)

Name of BRMT:
Barangay :
Municipality :

Province:
Region :

Act. #	O and M Activities	Frequency	Implementation Schedule												Estimated Cost	Responsible Unit	Funding Source
			J	F	M	A	M	J	J	A	S	O	N	D			
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
	Total Estimated Cost																

Prepared by:	Recommended by:	Concurred:	Reviewed by:	Noted by:
_____	_____	_____	_____	_____
Team Leader (BRMT)	**Chair, Infra Committee**	**Barangay Chairman**	**Municipal Engineer**	**Municipal Mayor**
Dates: _____	_____	_____	_____	_____

Operation and Maintenance Monthly Inspection Report
(straight line diagram)

Name of Road Section: ______________________
Total Length: ______ Paved: ____ Unpaved: ____
Location: ______________________________
Sta. _________ to Sta. ________
Status Date: as of _____________
Inspected by: _________________
O and M Org.: ______________________

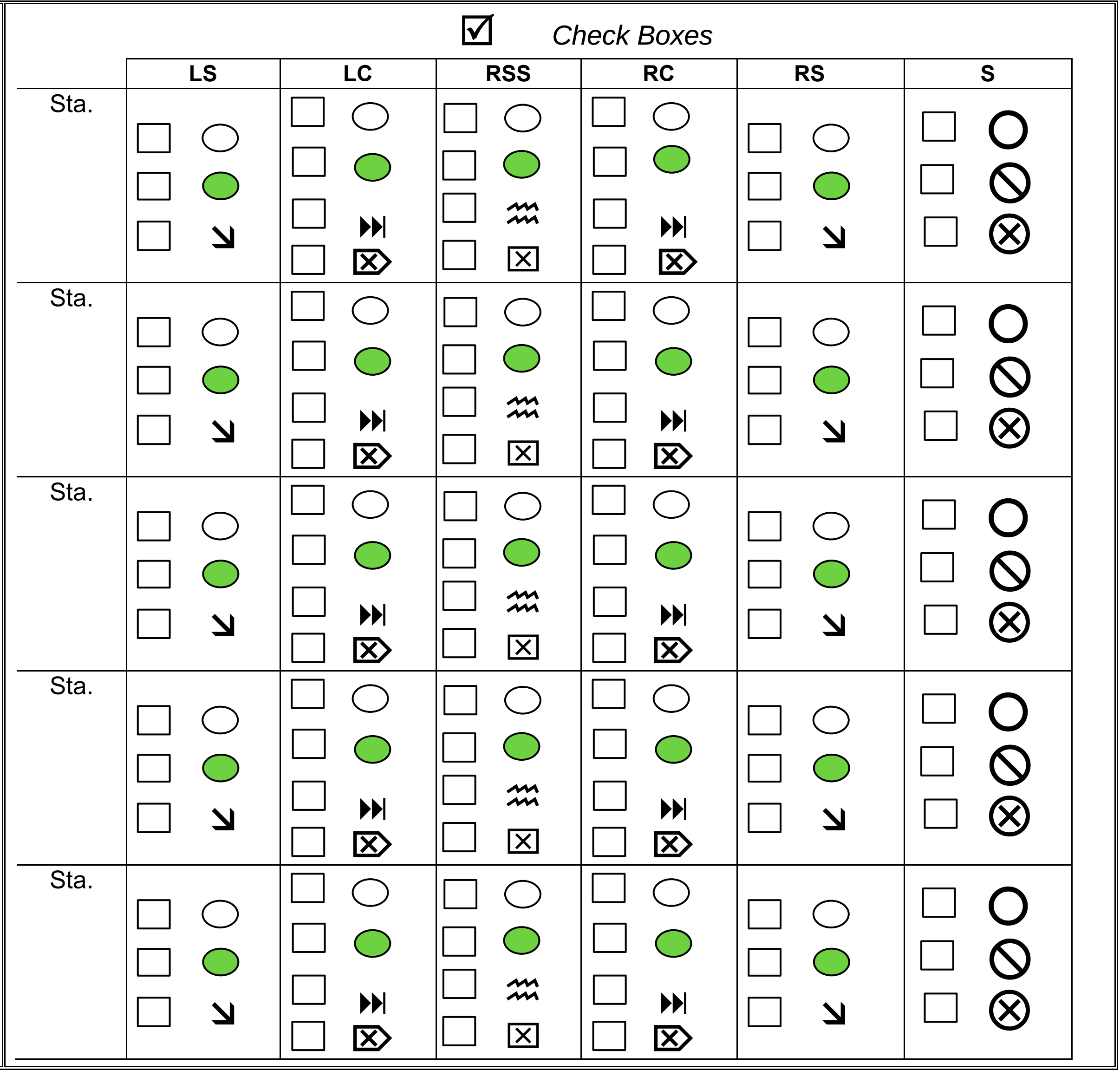
Legend:

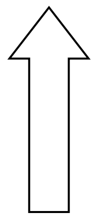
1. LS and RS – Left and Right Slopes
- in good condition
- thick vegetation growth
- erosion problem

2. LC and RC – Left and Right Canals
- in good condition
- thick vegetation
- partially silted ditches
- totally blocked ditches

3. RSS – Road Surface and Shoulders
- in good condition
- thick vegetation
- loose / displaced gravel surface
- potholes / ruts / rills / depressions

4. S – Structures (drainage, bridges, spillways)
- White – in good condition
- silted / clogged structure
- damaged structure





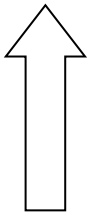
5. Other Observations:

6. Recommendations:

Submitted by: _____
(designation)

Cc: Brgy. Capt., ME

Sta.	LS	LC	RSS	RC	RS	S
0 + 000						
Sta.	LS	LC	RSS	RC	RS	S



General Notes:

_____

_____

_____

_____

_____

Appendix B2: Form 2b

OPERATION and MAINTENANCE MONTHLY INSPECTION REPORT

(complementary table)

Road Component	Station	Observed Distresses	Cause/s	Required Action/s
Road Surface and Base Courses				
Road Shoulders				
Side Slopes				
Canals/Ditches				
Bridges and Structures				

Appendix B3: Form 3

OPERATION and MAINTENANCE MONITORING and EVALUATION FORM

Date Inspected :
Name of Road Section:
Length :
Location :

Municipality:
Province :
Region :
Name of BRMT:

PHYSICAL STATUS

Road Component and Type of Distresses / Deficiencies	Physical Description				Numerical Rating
	Severe	Bad	Fair	Good	
	(4)	(3)	(2)	(1)	
A. Road Surface, Shoulders and Slopes					
1. Presence of Potholes, Ruts and Rills					
2. Presence of Corrugations					
3. Surface Materials Displacement					
4. Improper Cross Section					
5. Vegetation Growth					
6. Eroded Slopes					
B. Drainage Ditches					
1. Vegetation Growth					
2. Presence of Silt and Debris					
3. Eroded Sections					
C. Cross Drainage Structures, Bridges, Spillways*					
1. Vegetation Growth					
2. Presence of Silt and Debris					
3. Damage on Concrete Works					
4. Abutments, Inlet and Outlet Soil Erosion					
Total Numerical Rating					
Average Numerical Rating					

❒ **Other Observations**
1.
2.
3.

❒ **Recommendations**
1.
2.
3.

Notes:

1. *Add space for each structure if there are more than one*
2. *If there is no drainage ditch or cross drainage structure if needed, rating should be 4 (severe)*
3. *Average Numerical Rating is equal to the sum of all individual ratings divided by the number of distresses or deficiencies*

Evaluated by: Municipal Road Maintenance Monitoring Team (MRMMT)

Noted:

Barangay Chairman *(member)*	MPDC *(Asst. Team Leader)*	Municipal Engineer *(Team Leader)*	Municipal Mayor

Dates:

Appendix B4: Form 4

Municipal Road Maintenance Monitoring Team
(MRMMT)

Operation and Maintenance Instruction Letter No. ___
Date: _____

The Team Leader
(Name of BRMT)
Municipality of _____
Province of _____

In accordance to the routine O and M monitoring and evaluation inspection conducted by the Municipal Road Maintenance Monitoring Team (MRMMT), dated _____ on the *(name of road section)* located in Barangay _____, Municipality of _____, the following distresses, deficiencies and deteriorations were observed:

1.

2.

3.

4.

In this regard, you are hereby advised to undertake the following corrective measures within _____ days from receipt hereof:

1.

2.

3.

4.

The MRMMT shall conduct site re-visit on *(date of re-visit)* to verify compliance to the above instructions.

Failure to comply with the above instructions shall warrant a warning letter from the MRMMT and/or imposition of sanctions and penalties.

Please be guided accordingly.

_____
(Name of Municipal Engineer)
Team Leader, MRMMT

Noted:

_____
Municipal Mayor

Appendix B5

Physical Description of Distresses, Defects and Deficiencies

Component and Type of Distresses	Physical Description			
	Severe	**Bad**	**Fair**	**Good**
	(4)	***(3)***	***(2)***	***(1)***
A. Surface, Shoulders and Slopes				
❒ Presence of potholes, ruts, rills, corrugations, surface materials displacement, improper cross section and eroded slopes	when more than 50% of the entire road length shows any of these distresses	when 25% – 50% of the entire road length is affected	when any of these distresses are visible in less than 25% of the entire road length	when there are no significant presence of any of these distresses in the entire road length
❒ Vegetation Growth within Road Right of Way (mowing limits)	when average vegetation growth is above 100 cm high along the entire road length	when average vegetation growth is between 50 – 100 cm high along the entire road length	when average vegetation growth is between 30 – 50 cms high in the entire road length	when average vegetation growth is less than 30 cms high along the entire road length
B. Drainage Ditches				
❒ Vegetation Growth in ditches and berms	when average vegetation growth is above 50 cm high along the entire ditch length	when average vegetation growth is between 30 – 50 cm high along the entire ditch length	when average vegetation growth is between 10 – 30 cms high along the entire ditch length	when average vegetation growth is less than10 cms high along the entire ditch length
❒ Presence of Silt and Debris and eroded sections	when more than 50% of the entire ditch length is silted, obstructed or eroded	when 25% - 50% of the entire ditch length is silted, obstructed or eroded	when less than 25% of the entire ditch length is silted, obstructed or eroded	when entire ditch length is free of silt, debris and erosion
C. Drainage Structures, Bridges, Spillways	***distresses observed in more than 25% of the total number of drainage structures***			
❒ Vegetation Growth within immediate surroundings	when average vegetation growth is above 100 cm high within immediate surroundings	when average vegetation growth is between 50 – 100 cm high within immediate surroundings	when average vegetation growth is between 30 – 50 cms high within immediate surroundings	when average vegetation growth is less than 30 cms high within immediate surroundings
❒ Presence of Silt and Debris	when 50% - 100% of entire water flow is obstructed by silt and debris	when 25% - 50% of entire water flow is obstructed by silt and debris	when less than 25% of entire water flow is obstructed by silt and debris	when structure is free of any silt and debris obstruction
❒ Damage on Concrete Works	when replacement of any damaged concrete work is necessary	when cracks of ¼ " wide and above are observed	presence of hairline cracks on concrete surfaces	no significant cracks and damages observed
❒ Abutments, Inlet and Outlet Erosion	when immediate repair is urgent	when repair is necessary prior to rainy season	when only minor repair works is necessary	no significant erosion is observed

The Project for

Capacity Building for Community Development in Conflict-Affected Areas in Mindanao (CD-CAAM)

Implemented by

Bangsamoro Development Agency (BDA)
Office of the Presidential Adviser on the Peace Process (OPAPP)
Japan International Cooperation Agency (JICA)