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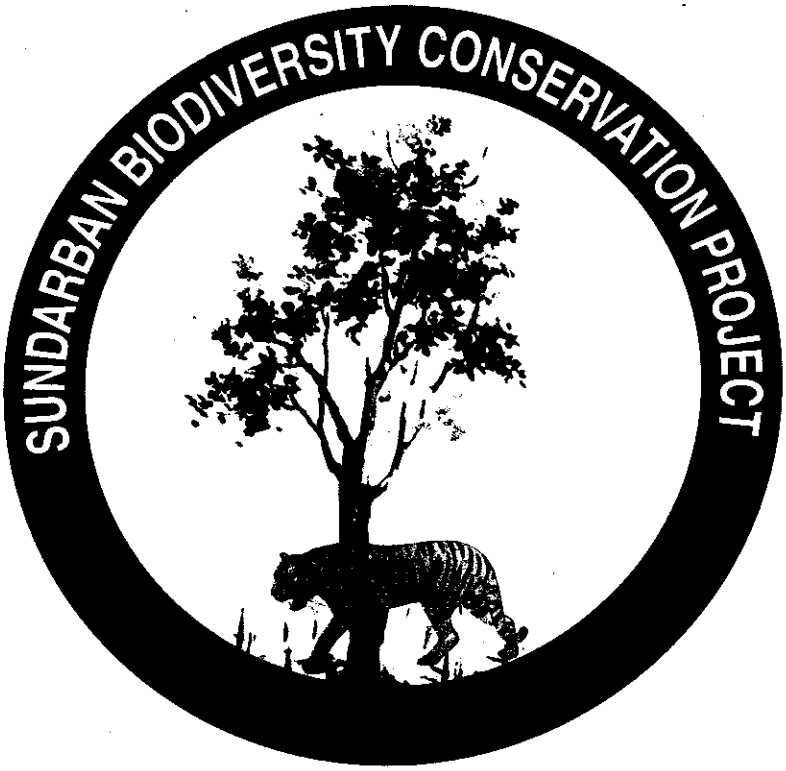

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INTERNAL NOTES- IN No. 14

Minor Forest Products

by Mr. R. A. Chowdhury

Minor Forestry Production Specialist

September 2000

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SUNDARBANS BIODIVERSITY CONSERVATION PROJECT

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Date : 17 September 2000

To : Project Director

From : Team Leader

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Subj : **Technical Note No. 3 – Minor Forest Products**

Attached please find copies of SBCP Technical Note No. 3 – Minor Forest Products in Sundarbans Reserved Forest by Mr. R.A. Chowdhury. Have circulated the document within the TAG and Khulna Circle as indicated on the Distribution List.

Respectfully submitted,

Robert C. Ellis
Team Leader

September 6, 2000

From,
Rowshan Ali Choudhury
Minor Forestry Production Specialist
Sundarban Biodiversity Conservation Project
Khulna.

To,

Mr. Robert C.. Ellis
Team Leader,
Sundarban Biodiversity Conservation Project
Khulna,

Subject : Submission of Technical Note - 1 on Minor Forest Products

Dear Sir,

I am enclosing herewith a Technical Note - 1 on Minor forest Products in Sundarbans Reserved Forest for favor of your kind perusal and taking necessary action.

Thanking you.

Sincerely Your's

(Rowshan Ali Choudhury).

SUNDARBANS BIODIVERSITY CONSERVATION PROJECT

DRAFT

TECHNICAL NOTE - 1 ON MINOR FOREST PRODUCTS

BY

ROWSHAN ALI CHOUDHURY

Minor Forestry Production Specialist

September , 2000

LIST OF ARCONYMS

AAC	:	Allowable Annual Cut
ACF	:	Assistant Conservation of Forest
BFRI	:	Bangladesh Forest Research Institute
CFT	:	Cubic Feet
DFO	:	Divisional Forest Officer
FD	:	Forest Department
FRMP	:	Forest Resources Management Plan
GOB	:	Government of Bangladesh
MOEF	:	Ministry of Environment and Forest
SRF	:	Sundarbans Reserved Forest
UNDP	:	United Nations Development Programm

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1. INTRODUCTION :

The most important Non-wood Forest Products (NWFPs) yielding plants in Sundarbans Reserved Forest (SRF) in terms of harvestings, revenue collections and employments of the rural people of the areas in and around the SRF (0-20km) are Golpatta (*Nypa fruiticans)*Hantal (*Phoenix paludosa*) and Grasses such as Malia grass *(Cyperus javanicus*), Nal grass (*Eriochloea brocera*), and Ulu grass (*Imperata cylindrica*).

In integrated management planning of SRF, all the resources found in the forest are now deemed to be of equal importance. It is more pertinent now in respect of non-wood forest products which are hoowested by about 85 percent of the people who access SRF. NWFPs are now more valuable in economic terms than wood products. Future management of the SRF must keep pace with this trend which has not been given adequate attention in the past and existing management systems.

The non-wood forest products profile has been heightened due to their high social and commercial values and also due to the increased dependences on these products by the rural people in and around the SRF of 0-20km. Proliferation in harvesting NWFPs bring with it a host of management problems related to harvesting methods, ecological and environmental factors, distribution of benefits, marketing, transportation, investment and social equity, many of which are directly associated with institutions, people and events outside the SRF. As such, it is highly essential that in future NWFP management the Forest Department (FD) must work with all the stakeholders, especially the traditional users whose interests must be safeguarded.

2. CURRENT SITUATION :

2.1. GOLPATTA (*Nypa fruiticans*):

2.1.1. SILVICS :

Golpatta (*Nypa fruiticans*) is a gregarious palm belouging to the family *palmae* with numerous large pinnate leaves, 4.6 - 9.1 meters long , growing in tufts from a stout creeping rhizome. The flowers are monoecious, on a spadix 1.22 - 2.13meters long. The fruit is a large head about 0.30 meter in diameter, with numerous crowded one-seeded drupes. The seed is as large as a hen's egg. Mature seeds of Golpatta are available during the periods from February to April of the year. But the seeds also occur sporadically throughout the year. The change of colour of the seeds from light brown to dark brown indicates their maturities. The seeds are collected by cutting the fruit bunch. A fruit bunch contains 50-100 seeds. One kilogram of fruit bunch contains 10-20 seeds.
The fruit bunches are stored for 3 days and subsequently the seeds are removed from the stalk by gentle pressures.

Golpatta regenerates by coppice and by seeds.Golpatta plantations can be raised by direct sowing of seeds at the planting sites by dibbling the seeds. But this method of raising golpatta plantations soldom becomes successful because the seeds are generally buried under sediment deposits and are also washed out by the tidal currents. As such, successful plantations cab be raised by planting out golpatta seedlings from the nurseries. Golpatta nurseries can be raised by the following two methods :

1. Golpatta seeds are sown in the nursery beds by dibbling the seeds 5cm apart. The beds are watered regularly for two months. Thereafter, the seedlings are planted out from the nursery beds to the planting sites.

2.Golpatta seeds are stored in a ditch periodically inundated by brackish water. Thereafter, the seedlings are transferred and planted at the planting sites when they are two months old.

Germination percentage of seeds under both these methods is 90. However, a common problem for the both methods is the enormous development of a root system which prohibits storing seedlings in the nursery for a longer period. Recently, raising seedlings on beds under laid by polythene sheet has been tried on an experimental basis, The seedlings attained a height of 80-90 cm in one year. More than 75 per cent survival was achieved after planting out these seedlings at the planting sites (Siddique et al, 1993). It takes about 5 years for seed - grown Golpatta to become harvestable.

A list of non-wood forest plants is given in Appendix - 1

2.1.2. DISTRIBUTIONS :

Golpatta is widely distributed through out the Sundarbans Reserved Forest. There are about 7,797 hectares of Golpatta strips along the river banks of the Sundarbans Reserved Forest (SRF). Golpata occurs in narrow strips in tidal channels, along river banks, low salinity estuaries, and occasionally in small patches in swampy areas within the forest. It grows better in moderately saline to fresh water zone. Golpatta Often occurs where no few tree preumatophores are found. If is of poorer quality in Satkhira Range and the leaves rarely reaches the size of leaves of golpatta growing in the Khulna and Sarankhola Ranges.

2.1.3 GROWING STOCK:

Golpatta growing stock in the entire Sundarbans was estimated through conducting additional surveys using special sampling procedures purposely to estimate Golpatta resources under the Forest Resource Management Plan (FRMP) Forest Inventory during

1997 - 98. The FRMP Forest Inventory estimated the available Golpatta in the entire Sundarbans at around 114,000 metric tons (green weight) of split fronds. Some 22, 500 metric tons found in the wildlife sanctuaries and 91,500 metric tons were spread all over the Sundarbans.

The Range - arise distributions of Golpatta are as follows :

Table- I
Rang-wise Distribution of Golpatta

Range	Wildlife Sanctuaries (metric tons)	Other Compartments (metric tons)	All Sundarbans (metric tons)
Sarankhola	7,680	22,675	30,355
Chandpai	0	17,804	17,804
Khulna	8,130	32,839	40,969
Satkhira	6,666	18,093	24,759
All Ranges	22,476	91,411	113,887

The results of the analysis of informations/data of the enumerated 31 Golpatta plot clusters for estimating the Golpatta resources in the SRF show that on the average, there are about 5,770 mature Golpatta, 2,180 immature stems and 650 seedlings per heactore of Golpatta stands along the river banks. The mature stems have about 18,900 leave/ha, about 9490 of which are considered utilizable. The utilizable leaves have an average length of 3.3 meters and are estimated to weigh about 14.6 tons/ha un green/split/harvested form. About 114,000 metric tons of utilizable Golpatta leaves (30 m wide shrips) are available along the banks of total river lengths of 12,874 km in the entire Sundarbans yielding 8.855 metric tona/kilometer river length. On area basis, about 114,000 matric tons of utilizable Golpatta leaves (30m wide strips) over a total area of 7,797.43 ha in the entire Sundarbans yield 14.62 metric tons of Golpatta/ha.

2.1.4 REVENUE SYSTEMS, PERMITS AND ROYALYT PAYMENTS :

Revenue Systems :

Forest charges have been collected from the Sundarbans Reserved Forest area from before the original reservation in 1876 (Heing, 1892). Historically forest charges have been collected by a system comprising royalty payments, permit fees and aution sales and this combination of methods still prevails.

Permits and Royalty Payments :

Forest charges for many different products are collected by charging either a royalty charged per unit of production or by charging for the issuance of a permit, for a specific quantity of the product prior to collection. **Generally, permits are issued for the lower value products and most of the non-wood forest products.** The rates are periodically revised by modest amounts, although the rates have tended to more or less keep pace with inflation. When the rates are revised there is generally a survey of prevailing market prices. The permit fees are set to approximate 10-50% of the market value.

There are a vast number of charges payable for many different products. The fees are also charged by many different units (such as cft., mds, 100 mds, pices, pon, etc) and in some instances by different size classes. This large number of charges and the many different units mean that the revenue has to be collected under numerous headings. This is both cumbersome and inaccurate as many of the smaller items are aggregated under one heading (miscellaneous). This means that important information's lost. The permit system also indicates incorrectly that many of the products are sold by the quantity produced.

There are fees collected by the Forest Department which are not mentioned in the approved schedule of rates (such as the collection of lees for "miscellaneous fish", "under size fish", and also fines when an offender is caught red handed and agrees to pay the fine_.

For the products which are sold by permit, the revenue is collected when the permits are issued, for a specific quantity of the product. As the schedule of rates is only revised periodically the actual value of the permits in relation to the market value of the product is generally very low . For most of the non-timber resources the volumes and value of the products are so low that the current system of permits should continue unchanged. However, there is notable exception to this such as Golpatta.

2.1.5 HARVESTING :

Golpatta is normally harvested during the months of October to March each year and the rest of the year is devoted as growing period. At the beginning of the harvesting season the main Golpatta areas are sample surveyed to estimate the approximate standing number of leaves which is then fixed as the target figure for harvesting. Golpatta collections permits are then issued up to this target figure.

The measurement of the amount of Golpatta harvested form the Sundarbans Reserved Forest is done by assessing the capacity of the boats used in hauling the produce out of the forest. The assessment is made annually when the boats are measured and are issued with **Boat Loading Capacity (BLC) Registration Certificates.**

When the boat owner wishes to collect some forest produce he must apply to Station Office after coming at the station office with his boat along with a certificate from the Chairman of union Parishad (lowest level of Local Government) stating that he is who says he is and that the boat belongs to him. BLCs for the country boats which haul the Golpatta out of the Sundarbans Reserved orest are issued at the station offices on specific days for the relevant permit . The BLC in maunds is measured according to the following formula :

$$BLC = 0.356 \ L \times B \times D$$

Where : 0.356 is a constant conversion factor;
L is the length of the boat along the water line wher under full load;
B is the average breadth measured in 3 places; and
D is the vertical distance between the waterline at full lead and the bottom of the boat.

When the boat is measured for its BLC it is empty. This means that the water line when under full load has to be estimated. This estimated line is defined by having a level mark painted on the side of the boat. A note is made in the records that it is so many inches below the gunwale or top edge of the boat. All the measurements, the maundage capacity and the BLC number are recorded in a ledger at the station office. The BLC number is also painted by the side of the boat.

The relevant royalty based on the capacity as estimated when the BLC was issued must be paid prior to extracting the produce. Once the permit is issued the permit holder can than go and cut and extract the produce .On leving the Sundarbans Reserved Forest the permit holder must report with the loaded boat to the issuing station office where the load is reassessed. If the water line is found to be higher than the original estimate made when the BLC was issued than the capacity is recalculated by adding the difference between the gunwale and the level mark and the gunwale and the actual water line to the **D** measurement in the formula above. The operator must then pay the extra royalty before departure form the Sundarbans Reserved Forest is permitted.

The system of measurement of boats was designed many years age and is based on a formula that was presumably derived simply by trial and error by weinghing loads and then measuring the boats that the loads were carried in. The formula presented about is the one currently used by the Forest Department.

It is conventional wisdom That the basic shape of the boats has changed since the formula was designed. Now a days it is taken that the boats have been redesigned to maximize the actual carrying capacity whilst at the same time minimizing the calculated loading capacity on which royalties are paid. This has been carried to the extent that boats are virtually unstable when they arrive at forest station for BLC assessment. These are subsequently made stable and have the carrying capacity increased by adding "mallam" boards on the sides of the boats, This has led the DFO to issue instructions that boats of given lengths must have certain minimum depths. It has also been reported that the boats form different localities have different shapes as well.

Analysis of a loaded Golpatta boat was undertaken by measuring the size of the stacked loads and then by weighing and measuring samples. This analysis revealed that the BLC underestimated the amount of Golpatta on one particular boat by 65% (Mitchell, 1995).

Part of the problem with this method is that it uses linear measures to make estimates weight. Golpatta leaves loose a considerable proportion of their weight as they dry. The sample weights for the Golpatta leaves used in the analysis described about for example were taken form freshly cut leaves. This weight would probably reduce to half that once the leaves have dried out.

With all management plans prepared using volumes, the recording of the removals of Golpatta by estimates of weight is not rational. The only argument for measuring the produce by weight would be if bulk purchases could weigh the produces by the use of cranes or weighbridges. **It is considered that the measurement of removals of Golpatta should in future be done entirely on a basis of stack measurement.** Conversion back to numbers of leaves for Golpatta is then easily undertaken by sample measurements, which could be taken each year in each coupe. Measuring the boats could be done as it is at present to simply istimate the volume of the stack that could not be measured once the boat is loaded. These figures could then be recorded in exactly the same way as the previous BLC maundages were.

The new BLC System :

The century - old BLC system of measuring boat capacity had been revised or updated to take int nconsideration boat shape. The results of the study carried out by J.A. Canonizado and DFO Akbar Hossain, under the FRMP, on measuring boat load by displacement indicate a vary high predictive power of the estimating equations generated of 33 boats of different sizes and shapes measured. In the study,96 sample data were generated representing boat measurements and varying loads .Ordinary least squares procedure was used to generate load estimating equations using ordinary boat measurements and water displacement as regressors (predictors). Boats were classified according to their cross section shape : Type A (Deltoid), Type B (Trapezoidal), and Type C (Rectamgular). More than 75% of the sample boats were of Type C. The final categories lumped Types A and B as one oroup and Type C as another group, yielding two different estimating equations. In both equations, the adjusted R -square is greater than 0.9, meaning that less than 10% of load variation is unexplained by the chosen predictors which are : length of waterline when boat is empty (Le), the average width of the boat (Bav) measured at 3 points, the distance from a fixed point (X- point) on the topside of the boat to the waterline when the boat is empty (De), and the distancer from the X - point to the waterline when the boat is loaded (Dx). Water displacement (Disx) is calculated as De - Dx. The natural form of the new BLC equation is :

$Wx = K(Le)^{c1} (Bav)^{c2} (Disx)^{c3}$,
Where Wx is the boat load, and K,C1, C2,C3 are the coefficients estimated.

The analysis was carried out ising natural logarithms and the resulting natural forms are given as :

A. For Type C Boats : $Wx = 17.12(Le)^{0.6066} (Bav)^{1.2525} (Disx)^{0.9871}$

B.For Type A and B Boats : $Wx = 15.52(Le)^{0.6339} (Bav)^{1.2732} (Disx)^{0.9695}$

Due to the complexity of these equations, a simplified procedure for field use was developed and provided in Appendix - II, complete with ready tables for easy applications.

The entire New BLC study - methodology , field use procedures, and raw data are included in one whole set of attachments given in Appendices III - VI.

The DFOs East and West Sundarbans shall initially implement the new BLC system on a trial basis in the same field stations that carried out the study and take note of the technical problems encountered so that they mab be resolved febore the system is finally adopted. Prior to implementing the new BLC system, the DFO, Management Plan Division, Khulna should, if necessary, modify the new BLC system by conducting studies of the methodology and field use procedures of the new BLC system by consucting studies of the methodology and field use procedures of the new BLC system used in the FRMP to simplify its applocation by the field staff and providing them training in practicing the new BLC system.

It is also suggested that if the new revenue system is introduced at the same time reasonable levels of honorarium / allowances are given to the forest staff due to the difficult conditions of their workings and also living away from their families .

GOLPATTA COUPES :

Seasonal Golpatta coupes were set up in 7 locations according to the names of the major rivers. Some coupes overlapped in terms of range territory. In the Integrated Forest Management plan for the Sundarbans Reserved Forest being implemented since 1988-99, the Golpatta coupes have been setup according to range territories. Estimated coup-wise distribution and estimated allowable annual cut are given in the following Table.

TABLE - II

Coupe-wise distributions and allowable Annual Cut of Golpatta

Range	Coupe	Compartments	Available Stock Metric Tons(MT)	AAC MT/YR
Sarankhola	Sarankhola	1-3,7,8,11,12b,24, 45	22,675	16,000
Chandpai	Chandpai	9,10,15,21,30,31	10,366	7,200
Chandpai	Sela	12A,13,14,22,23,25-29	7,438	5,400
Khulna	Arua-Sipsa	18-20,37,38,40	18,539	13,000
Khulna	Sipsa	16,17,32-36,39	14,300	10,000
Satkhira	Satkhira	41,42,46-52	18,039	12,700
(Mixed)	Sanctuaries		22,477	15,700

Source : Integrated Forest Management Plan for the Sundarbans Reserved Forest, 1998

GOLPATTA CUTTING RULES :

I. Exploitation should not be allowed in any area more than once in a year and cutting of Golpatta should not be allowed during the months of April-September which is the growing period.

II. The unopened frond i.e. the so called central leaf and the leaf next to it (side leaf) in each clump must be retained.

III. All dead and dry leaves will be cut at the time of cleaning the clumps.

IV. Flowers and fruits should in no way be disturbed at the time of cutting leaves.

V. Sample plots must not be disturbed.

VI. Purchasers must not be allowed to cut the leaves which they do not intend to utilize but leave them on the ground to rot.

VII. Young plants with only one utilizable leaf should not be cut.

GOLPATTA COUPE RULES :

I. Though Golpatta will be worked annually all over the forest, for facility of management, seven coupes have been prescribed above. In the territory of the wildlife sanctuaries one or more coupes may be formed at the discretion of the

II. DFO,Wildlife and Tourism. The main work of the coupe staff will be to ensure that felling rules are observed and that no Golpatta in the interor is left un worked before the coupes move on. Each purchaser will be allotted a khal or part of it to work in and should not be allowed to move on into a fresh area until the area already allotted to him is worked over completely. As for as possible, assignment of khals should be in reference to compartments to avoid overlapping.

III. Areas towards the seaface should be worked during the calm season.

IV. The coupe staff should be trained in the field by the concerned ACFs of the Sundarbans East and West Divisions or by the DFO, Management planning, Khulna on the sampling procedure of conducting Golpatta survey, if necessary by modifying the sampling procedure used in the FRMP Golpatta survey to simply its application by the coupe staff. Once trained, the coupe staff, as they travel over the forests, shall carry out the sampling procedure, noting down the length and width of Golpatta groves and collecting and measuring sample leaves at specified points. Coupe staff will prepare stock maps on a scale 1: 50.000 in each compartment. Sufficient number of copies should be prepared for maintaining records in the Divisional Office and Range Offices. Approximate outturs in inmetric lons will be noted against each khal on the map. The results of these Golpatta surveys will be analyzed annually to estimate available stock and to facilitate the assignment of cutting areas.

V. All jhools, tharias, dabbas, masts and mallums, etc. which were felled for use in Golpatta carrying boats should be hammer-marked before felling and outturn should be recorded against the outturn of the compartment from which timber is felled. Permit for felling for jhools, tharias, dabbas, etc. should be allowedfrom the annual copes as far as possible and permits from areas outside the coupes may only be allowed sparingly when the coupe is not within a reasonalde distance from the working area for Golpatta - when such permits are allowed, felling should be by way of thiningand should be under close supervision and the choice of spocies should rest with the coupe staff.

2.1.6 PRODUCTIONS AND REVENUES FROM GOLPATTA BY YEAR

Productions and Revenues from Golpatta for the Last 10 fiscal Years are given in the following table:

TABLE - III

Item	Unit	Fiscal Year									
		1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000 (Up to May)
Production	Metric Ton	72,483	72,769	66,824	68,409	64,580	64,513	61,833	52,464	38,741	30,465
Revenue	Taka	57,98,607	58,21,518	54,46,593	59,06,901	58,59,684	55,97,181	52,29,647	47,77,405	35,10,601	26,87,723
Price	Taka/ Metric Ton	80	80	82	86	91	87	85	91	91	88

Source : Forest Department; Sundarbans Division's Annual Report.

The above table shows that the production of Golpatta remained fairly constant during the perods from 1990-91 to 1996-97i.e. seven (7 years) and starting falling from 1997-1998 with the lowest in 1999-2000. The reasons for this drop of productions during the last three (3) years have bean stated by the Conservator of Forest , Khulna Circle, Mr. Osman Ghani are :

i) Decreased demand of Golpatta due to the fact that low quality thin corrugated iron sheets compare favourably with the price of Golpatta and these do not require replacing after 2 or 3 years.
ii) Time of extensions of Golpatta coupe workings have been totally stopped.
iii) Boats carrying more than 500 maunds capacities of Golpatta are not allowed at all.
iv) Less investments by the boat owners for hauling Golpatta from the forests.
v) Strict enforcements of Golpatta cutting rules, coupe rules, working periods, and taking disciplinary actions sgainst the staff violating the rules and regulation of Golpatta workings in the forests.

The market for Golpatta however, is not static, and it appears that currently, there is a decreased demand and that not all areas targeted for harvesting are cut. There are two possible solutions to increase the demand :

i) To lower the price of the Golpatta,
ii) To improve the quality of the product.

The first soluation could be achieved by arranging auctions of standing areas, as mentioned earlier, which would hopefully cut out the middle men and any windfall profits that can be made along the line. This would not necessarily mean that the revenue to the Forest Department would drop, infact, it may even rise.

The second solution to improve the quality of the product could be achieved, according to Shiva (1994), if the Golpatta leaves were processed into Shingles which could also be treated with preservatives to lengthen the life of the product. A substantial saving could also be made if the method of measuring the removals was changed (This of course would not be necessary if the system of sale was changed to one of standing auctions).

2.1.7 USE PATTERNS AND DEMANDS :

Use Patterns :

Golpatta (Nypa furiticans) is considered as the most important non-wood forest produce from Sundarbans. It is the main thatching material not only in the adjoining areas (Impact Zone) of Sundarbans but also in the fax flung areas in the country. Golpatta Inflorescence is also taped for the production of a kind of country wine locally consumed (Shiva, 1994).

Golpatta is a thatching material for light construction, boat use , weaving and walls. Golpatta leaf petioles are used as fish floats for fish nets and main axis is used for fish poles. Sometimes the leaflet midribs are soaked and twisted to make ropes. Brooms can also be made from midribs. Leaf petioles are commercially also chopped and boiled to make salt. Young leaflets can be used as cigarette wrappers, older ones may be used to weave hats, umbrellas and raincoats, baskets, mats and bags for local use. Leaves are useful for insulation boards. Outer layers of leaf stalk yields pulp for good quality boards of intermediate density, but leaves are unsuitable for paper pulp (Hamilton and Murphy, 1988).

Young seeds have gelatinous endosperm which are edible in raw form or preserved in syrup. Endosperm of young fruits is suitable for making edible jelly. The hardened endosperm of mature fruits is used as a vegetable ivory and for making buttons.

Sap is tapped for the production of country wine or toddy used by local people. There can not be an organized system for manufacturing wine as this product is prohibited by the Government of Bangladesh. Therefore, it may useful to utilize the tapped watery sap from the stalk of inflorescence for making Jaggery and sugar. Fresh Nypa sap contains 17% sucrose and only traces of reducing sugars. Sugar can be made on commercial scale at nearby centers provided sap is utilized readily in fresh condition to avoid fermentation. Nypa palm which generally flowers in July-August and fruits during November-December is ready for tapping after the second flowering season when about five (5) years old and tapping can be continued for 50 years or more. If one plant bears more than one inflorescence called spadix, onlyone should be tapped and other removed. Tapping starts sometimes after or just before fruit formation and sap collection is continued for about **three months**. The average yield of sap per plant during the season is about 43 litres. It is reported that about 30% plants produce sap in natural stands but production can be improved by wider spacing of nypa palm by planting 1.5-1.7m spacing (about 400 plants per ha.).

It is advisable to clear the vegetation around palm trees to allow free growth and access for tapping. Trees start fruiting as early as three (3) years and are full sized after five (5) years. Tapping may be started in the fifth year when plant becomes four (4) year old. Leaves from plants that may be exploited for tapping sap, should not be cut for thatching since loss of mature leaves reduces yield of sap. However, old leaves may be cut before allowing them to fall naturally.

Production of sugar from nypa sap is labour intensive as compared to sugar can as man power requirement is estimated to be 38 per 10 hectare plot for nypa sugar production--(30 men tapping/collecting; 5 for maintenance; 2 on syrup transport and 1 (one) technical personnel) .

After utilizing the fresh sap for making sugar, the stored sap may be utilized for making vinegar containing 2-3% acetic acid by allowing the fermented sap to stand for about two (2) weeks.

There is a good scope for manufacturing industrial ethanol or fuel alcohol from the fermented sap. Nypa alcohol can be blended with petrol up to a ratio of 1:4 without the need to redesign or adopt the carbuters of gasoline engines.

Young shoots, decayed wood, burnt roots or leaves are useful for treatment of herpes, toothache and headache. Herpes is treated both by drinking the juice from the young shoot mixed with coconut water and by applying the pulp of young shoots after extracting juice on the affected part. The ash obtained by burning roots and leaves relieves toothache. The use could be popularized within the indigenous system of medicine in Bangladesh by Hakims.

Demands :

It shows from the production figures of Golpatta from the Sundarbans Reserved Forest for the last seven (7) years (1990-91) to 1996-97) that the demands of Golpatta were fairly constant. Thereafter, the productions started dropping from 1997-98 with the lowest in 1999-2000 (upto May) at a level of 26,87,723 metric tons reflecting decreased demands of Golpatta. The decreased demands are attributed to the facts that low quality thin corrugated iron sheets compare fawourably with the price of Golpatta and these do not require replacing after 2 or 3 years, extensions of Golpatta coupe workings used to be granted earlier have been altogether stopped, boats having carrying capacities of more than 500 maunds are not allowed to enter Sundarbans to carry Golpatta, boat owners are inventing less for hauling Golpatta from the forests and Golpatta cutting rules, coupe rules, working periods are strictly enforced, by the Forest Department including taking disciplinary actions against the field staff for violating the rules and regulations of Golpatta working in the forests.

2.1.8 MARKET PRICING AND ROYALTIES :

Royalties are the chief means of extracting economic rent or society's rightful share of revenues from the sale of natural resources. Royalty rates for all Sundarban Reserved Forest products are set and periodically revised by the Forest Department. The most recent comprehensive review of royalty rates was conducted in 1989. The rates were set at 12.5% of prevailing market prices. The new established rates resulted in thefty increase for some products, such as 87.5% for Golpatta. Because of strong public opposition to these large increases, royalty rates for 11 products were rolled back to more "reasonable" levels in 1990.

Government can set royalty to favor the poorer sectors of society dependent on the Sundarbans for their livelihood. As long as the beneficiaries do not take undue advantage of lower royalties to generate excess profits, this instrument helps fulfill government's social responsibility to the poorer sectors of the economy. In contrast, commercial scale extraction of resources should be levied the maximum royalty rates while affording the extractor a comfortable margin for profit.

Government can also use royalty to influence user of a resource to act in ways consistent with government policy on resource use, conservation and development. This works by way of influencing demand for resources. high royalty rate will encourage users to seek substitute materials and thus help conserve the resource.

Setting royalty rates is administratively convenient, but not always beneficial to society. If set too infrequently, royalty rates can easily get out of line with market prices. The most efficient way to extract economic rent is to let the market decide.

The following actions are suggested for taking by the Forest Department :

I) Periodically survey market prices and prevailing costs of extraction and transport for all SRF products. These information will be used to evaluate the need to set new royalty rates.

II) Create an internal Royalty Review Committee to make appropriate recommendations when to make changes, by how much, and for which products. The committee shall prepare the analytic framework and procedures for setting new royalties rates. The committee shall prepare a revenue projection based on the proposed new royalty rates.

III) Royalty rates shall be revised every 5 years at the longest, but not more frequent than annually.

IV) Public hearings, will be conducted as necessary, or in accordance with existing government regulations on the subject.

V) The committee will elevate their recommendations to higher authorities for approval.

VI) The Forest Department shall disseminate the information on new approved royalties through its field offices.

The current market rates at Khulna for Golpatta are as follows:

i) Wholesale price of Golpatta on an average is Taka 837/ T.
ii) Retail price of Golpatta of Khulna on an average is Taka 1,256/ T.

2.1.9 RAPID RURAL APPRAISAL (RRA) FOR GOLPATTA :

A Rapid Rural Appraisal (RRA) was conducted in August, 2000 at Kalikapur village of Krishnanagar Union under Kaliganj Upzilla of Satkhira District with the harvesters, users and traders of Golpatta by Mr. Sailendra C. Saha, Community Development Specialist of the Sundarbans Biodiversity Conservation Project (SBCP) along with Mr. Ruhul Amin, ACF, Khulna Environment Management Division, Forest Department (FD), and counterparts of Community Development Specialist, Mr. Ajit Kumar Rudra, ACF, Jessore forest Extension Division, FD, Mr. Shahidul Alam, Forester, Kaliganj Upzilla Nursery Centre under Jessore Forest Extension Division, FD, Mr. Feroz Ahmed, Manab Sampad Unayan Kendro (NGO) and also other NGO officials.

A check list for collecting informations on Golpatta from The Resource Users Groups by holding Community workshop was developed by Mr. Rowshan Ali Chowdhury, Minor Forestry Production Specialist (Domestic) in collaboration with Mr. L. S. Saunders, Natural Resources Economist and Mr. Andrew Jenkins, Community Development Specialist (International). A copy of the check list is given is Appendix - VII.

Findings of the Community Workshop :

i) About 50 male villagers of Kalikapur village of Krishnagar Union under Kaligonj Union of Satkhira District attended the workshop.
ii) The populations of Kaligonj Upzilla is 2,25,596; Krishnanagar Union is 21,046 and Kalikapur Village is about 3,500.
iii) About 1000male villagers are involved in Golpatta collections and harvestings from Sundarbans, personal consumptions and tradings.
iv) The members of Golpatta extractors from Sundarbans have increased than these were in 5 or 10 years ago.
v) Those Golpatta extractions are hauling Golpatta from the Sundarbans traditionally from generations together.

vi) Each Golpatta extractor earns about TK. 3,000 - 5,000 per trip and three (3) such trips are made in one extrating season (October - March of the year). They spend about 12 -15 days per trip in Sundarbans. This being a seasonal occupation, the Golpatta extractors earn their livelihoods during rest part of the year by providing their labors for cultivating and harvesting paddy, workings in shrimp cultivations and processing's, daily laborers for earth cutting works, etc.

vii) Generally, the Golpatta collectors go to the same places. They collect the same quantities of Golpatta from the same place as they used to collect 5 or 10 year ago.

viii) The capacities of the boats used by the Golpatta collector varies between 0.04 MT - 187.5 MT.

ix) Availabilities of Golpatta are reported to be same as these were 5 or 10 years ago, but the uses of Golpatta have increased in the area mainly due to increase of populations.

x) Golpatta is used mainly for thatching and tradings by each household in the village. About 4,500 Mt of Golpatta are harvested from the forests in one season (October - March of the year).

xi) The Golpatta collectors use boats for collecting Golpatta from the owners of the boats.

xii) It is estimated that about TK. 120 - 130 is required for collecting 0.04 MT and about TK. 200 is the selling price per 0.04 MT at Bashkata (Kaliganj Upzilla), Noyabeki (Shymnagar Upzilla), Vetkhali (Shymnagar Upzilla), Binerpota (Satkhira Sadar), Ashashuni Upzilla, and Khulna.

xiii) Previously the royalties of Golpatta was TK.0.33 per MT but now the revised royalties is TK. 3 per Mt. Previously the duration of the permit was 45 days, but now it has been reduced to 28 days.

xiv) Prices of Golpatta have increased in the local markets in recent years. Previously 0.019 Mt of Golpatta costed TK. 25 - 30, but now it cost TK. 120 - 140 per 0.019 MT. The increase in price is due to the increase of populations and shortages of straws caused due to conversions of agricultural lands to shrimp farmings.

xv) The Golpatta collectors did not know the cutting rules, but now they know the rules and most of them follow the rules.

xvi) There are no cottage industries in the area based on Golpatta, but it is reported that if the Golpatta collectors provide credit, infrastructures are developed in the area, credit they can go for poultry farmings, vegetable productions, trading on paddy, etc.

xvii) Each Golpatta collector can collect about 0.6MT of Golpatta per day from good fronds .

xviii) In each trip the Golpatta collections have to spend about15 days.

xix) Dacoits and money lenders are the main problems for the Golpatta collectors in the area.

xx) Golpatta collectors require 5-7 days for preparations, 2-3 days for reaching the coupe, and 3-5 days to return after harvesting the Golpatta.

xxi) About 70-80% of 1000 people involved in Golpatta collections also collect other produces from the Sundarbans

xxii) About 700 - 800 persons are directly involved in Golpatta collections from Sundarbans.

xxiii) Generally the people in the area do not raise Golpatta plantations, but they can be motivated to raise plantations by providing them technical know by the Jessore Forest Extension Divisions Officers and staff.

Analysis:

The populations of 3,500 of Kalikapur village of Krishnanagar Union under Kaligonj Upzilla of satkhira District are dependent on Sundarbans Reserved Forest Resources for earnings their livelihood by collecting, using and trading Golpatta and other plant based non-wood plants . Of these rural populations, about 100 male populations, out of the total populations of 3,500 i.e. about 29% are directly involved in Golpatta collections from Sundarbans. The subsistence of this 29% rural population depends solely on Golpatta collections from Sundarbans during the periods from October-March of the year and by carrying out other jobs such as providing labors for cultivations of rice, Shrimp cultivations, earth cutting works, etc. during the rest part of the year. Such dependencies of the rural populations in and around the Sundarbans Reserved Forest on Sundarbans resources for earning their livelihoods are crucial for the management, conservation and development of Sundarbans Reserved Forest. In fact, it is because of this reason and to reduce pressure of the rural populations in and around Sunderbans Reserved Forest dependent on Sundarbans resources, the Sundarbans Biodiversity Conservation Project will be addressing the problems of sustainabilities of these rural populace through developments of infrastructures, creating job opportunities, providing credits to these populace, developing cottage industries, etc. in the Impact Zone (0-20km of Sundarbans).

The current level of extractions of Golpatta from Sundarbans appear to be within sustainable limits as the extractions are well below the Allowable Annual Cut (AAC) as prescribed in the current Integrated Forest Resource Management Plan of Sundarbons Reserved Forest being implemented since 1998-99.

The problems of dacoits in the Sundarbans will have to be addressed by strengthening the man power of the Forest Department along with supplying them adequate modern arms and ammunitions for facing the dacoits, providing adequate logistics to these staff (provisions exist in the SBCP), liasoning with coast Guards and local police and Civil Administrations, etc. The problem of exploiting the rural poor Golpatta collections by the traders (money lenders) will be addressed by providing micro-credits to these poor people by the Pally Karma Sahayak Foundation (PKSF) as envisaged in the SBCP.

2.2 HANTAL (*Phoenix paludosa*) :

2.2.1. SILVICS and Distributions:

Hantal (Phonix paludosa) is a subgregarious palm belonging to the family **palmae** which flowers during March an June. The seeds of Hantal ripen in July-August. A brown colour of the seeds indicates maturation.

Hantal is usually a slender, straight, small tree which can attain height of five to six meters. It sometimes forms nearly pure stands of impenetrable thicket which are often located along river banks. In other areas it can occur as undergrowth beneath a sparse over story.

The seeds are collected by cutting the bunch. After storing the bunch for 2 to 3 days, the seeds are detached from the bunch. It takes about 4 to 5 days for decay of the mesocarp. The seeds are then washed and sown in nursery beds or polybags by dibbling the seeds completely into the soil. One kilogram contains about 1200 - 1500 seeds. Germination starts from 10 weeks after sowing and continues for up to 20 weeks. A 80% germination success rate was obtained.

Hantal reproduces from dispersal of floating seeds and also vegetatively from root suckers (Karim, 1995). Up till now, no plantation of Hantal has been raised. For experimental purpose one year old seedlings, raised in poly bags, were planted in the field and a survival of 100% was found.

2.2.2 Growing stock, Harvesting:

There is little knowledge about either the growing or the growth rates of Hantal. The stems of Hantal are harvested by permit, for sale as rafters and purlins, and also as fence and house posts. The stems of Hantal are found to be both light, relatively strong and reasonably durable when kept off the ground.

2.2.3 PRODUCTIONS AND REVENUES FROM HANTAL BY YEAR :

Productions and revenues for the last 10 fiscal years are given in the following table :

TABLE - IV

PRODUCTION AND REVENUE FROM HANTAL BY YEAR

Item	Unit	Fiscal Year									
		1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000
Production	Metric Ton	6,778.46	9,074..14	6,081..08	6,756.19	1,419.15	4,358.93	1,458.04	583.20	449.66	726.04
Revenue	Taka	3,34,404	4,47,657	3,91,380	3,38,549	1,05,474	2,31,312	71,557	30,797	24,697	38,109
Price	Taka/ Metric Ton	49.33	49.33	64.36	50.11	74.32	53.7	49.08	52.81	54.92	52.49

Source: Forest Department; Sundarbans Division's Annual Report.

2.2.4 GRASSES:

In the Sundarbans Reserved Forest there are three (3) main types of grasses which are harvested each year, namely, Malia grass **(Cyperus javnicas)**. Nal grass **(Eriocholea procera)** and Ulu grass **(Imperata cylindrica)**. Forest Department consolidate all three grasses under one heading in the recording of removals.

The productions and revenues of all three grasses for the last 10 fiscal years are given in the following table :

TABLE - V
PRODUCTION AND REVENUE FROM GRASSES BY YEAR

Item	Unit	Fiscal Year									
		1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000
Production	Metric Ton	7,166.36	4,606.58	5,775.86	5,163.45	5,090.70	4,023.49	5,872.20	5,256.45	4,926.11	5,397.75
Revenue	Taka	57,330	36,852	72,532	78,015	86,235	64,578	95,801	80,277	79,393	83,366
Price	Taka/ Metric Ton	8.00	8.00	12.56	15.11	16.94	16.05	16.31	15.27	16.12	16.00

Source: forest Department; Sundarbans Division's Annual Report.

The above table shows that the production of grass from the Sundarbans Reserved forest has decreased considerably during the last ten years. The drop in production may in part due to the apparent increase in price .The royalty rate for Nal and Malia grass works out approximately TK 8 per tonne and all other grass Tk. 16 per tonne. These rates were last revised in 1990.

Malia Grass:

Malia grass grows along canal sides and in the low lying area in the interior of the Sundarbans and normally grows to 1-1.3 meter in height. It is possible to crop Malia grass on an annual cycle. Malia grass is used as the raw material for the manufacture of mate. Many of the poorest inhabitants of the surrounding area, particularly women are involved in the manufacture and marketing of this mats.

The production of malia grass is not restricted in the Sundarbans. Malia grass used in the locality also comes from outside the Sundarbans Reserved Forest and is harvested from the polder embankments.

Nal Grass :

Nal grass occurs along the river and khal banks and also on newly accreting char lands. It can also be found in association with some tree species. The production of Nal grass is reported to be increasing due to the increase in production of this grass on the new Chars. Nal grass can reach up to 2 meters in height and can be cut on an annual rotation basis.

Nal grass is used for the manufacture of baskets, rice containers (shajees) and contaniersfor paddy (dhamas) and other rice container (Dola). As with the malia grass the exploitations of Nal grass is associated with the poorest sector of the local communities. The products (the Dolas) are utilized by the low to moderate income farmers.

Ulu Grass:

Ulu grass is found growing throughout the Sundarbans on the higher and drier ground. It is used mainly as thatching material primarily to give shade for the cultivation of betel leaf, which in turn is an important cash crop grown for both export and domestic markets. This means that the Ulu grass produced from the Sundarbans has a ready market. Ulu grass can also be found growing outside the SRF but due to its less durable nature is not in such high demand.

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APPENDIX - I

LIST OF NON - WOOD FOREST PLANTS IN SUNDARBANS RESERVED FOREST

Scientific Names	Vernacular Names	Type of plant	Family
Acanthus ilicifolius	Hargoza	Serambling woody thorny herb	Acanthaceae
Aegiceras corniculatum	Khulsi	Shrub/small tree	Myrsinaceae
Blumea sp.	Bon ghash	Aromatic herb	Compositae
Brownlowia tersa (B.lanceolata)	Sundri lota	Scandant shrub	Tiliaceae
Caesalpinia crista	Kutum Kata	Shrub	Leguminosae
Clerodendron inerme	Sitka, sitki	Shrub/small tree	Verbanaceae
Cyperus javanicus	Kucha, Kusha, Malia	Grass - like herb (sedge)	Cyperaceae
Ipomeae pes - caprae	Chagal kuri	Succulent prostrate herb	Convulvulaceae
Leea acquata	Kaka jangha	Shrub	Leeaceae
Lepisanthes rubiginbsa	Ban lichu	Shrub	Sapindaceae
Mallotus repandus	Bon notoy	Scandent shrub	Euphorbiaceae
Pandanus foetidus	Kewa Kata	Succulent Screwpine	Pandanaceae
Premna corymbosa	Scropoli, Setpoli	Shrub/small tree	Verbanaceae
Palms: *Nypa fruiticans*	Golpatta	Palm	Palmac
Phoenix Paludosa	Hantal	Palm	Palmae
Grasses : *Eriochloa procera*	Nal Ghash	Grass	Gramineae
Imperata cylindrica	Ullu	Grass	Garmineae
Myriostechya wightiana	Dhansi	Grass	Gramineae
Myriostechya wightiana	Dhansi	Grass	Gramineae
Oryza coweeata	Uri	Swampy grass	Gramineae
Phragmitis karka	Nal/Khagra	Reed grass	Graminae
Saccharum spontaneum	sumgrass	Grass	Gramineae
Schumaniathus dichotoma	Murta	Grass	Gramineae
Typha elephantina	Hogla	Grass	Gramineae

New BLC System

APPENDIX II

NEW BLC SYSTEM

STATISTICAL RESULTS
FIELD APPLICATION PROCEDURES
ORIGINAL STUDY PROPOSAL
RAW AND PROCESSED DATA

STATISTICAL RESULTS

The statistical program **TSP 6.0** was used to analyze the BLC data in Appendix G.4. Table 1 presents the regression analysis for Type C Boats. The adjusted R-squared value is 0.9628 which has a very high predictive power, exceeding the 0.001 level of significance in a 2-tailed t-test. All the regressors are significant at the 0.05 level. This result means that only 3.72% of the variation in load is unexplained by the regressors.

TABLE 1 - TYPE C BOATS
LS // Dependent Variable is LWX
Date: 2-02-1998 / Time: 18:29
Number of observations: 70

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
LLE	0.6066237	0.2367272	2.5625432	0.013
LBAV	1.2524807	0.2415224	5.1857751	0.000
LDISX	0.9871424	0.0458458	21.531807	0.000
C	2.8400230	0.3269793	8.6856360	0.000

R-squared	0.964431	Mean of dependent var	8.710173
Adjusted R-squared	0.962814	S.D. of dependent var	0.942648
S.E. of regression	0.181777	Sum of squared resid	2.180838
Durbin-Watson stat	0.766470	F-statistic	596.5110
Log likelihood	22.08182		

Table 2 presents the regression analysis for Type A and B Boats. The adjusted R-squared value is 0.9312 which likewise has a very high predictive power, exceeding the 0.001 level of significance in a 2-tailed t-test. All the regressors are significant at the 0.05 level. This result means that only 6.88% of variation in load is unexplained by the regressors.

TABLE 2 - TYPE A and B BOATS
LS // Dependent Variable is LWX
Date: 2-02-1998 / Time: 18:32
Number of observations: 26

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
LLE	0.6338876	0.2488679	2.5470849	0.018
LBAV	1.2731544	0.3160513	4.0283158	0.001
LDISX	0.9694795	0.1016652	9.5359995	0.000
C	2.7420417	0.4449617	6.1624220	0.000

R-squared	0.939532	Mean of dependent var	8.184740
Adjusted R-squared	0.931286	S.D. of dependent var	0.868346
S.E. of regression	0.227623	Sum of squared resid	1.139864
Durbin-Watson stat	1.689705	F-statistic	113.9423
Log likelihood	3.761033		

APPENDIX
The New BLC System
Results of Regression Analysis

Appendix G.3 is the study proposal and methodology for conducting the BLC study. Please refer to this document for various illustrations and study procedures.

Following is the summary of the statistical analysis conducted on 33 boats representing 96 measurements of boat dimensions, loads and corresponding displacement readings reckoned from a fixed point (X-point) in Figure 2 in Appendix G.3.

Measurements taken are:

De = vertical distance from X-point to water level when boat is empty
Dx = vertical distance from X-point to water level when boat is loaded
Bm measured at ½ L (inner dimesion)
Bf measured at ¼ L from front (inner dimension)
Bb measured at ¼ L from back (inner dimension)
Type = Boat type (A, B, or C) See Figure 1 of Appendix G.3
W1 = initial load (300 or 200 maunds approx)
W2,W3,W4,W5= trial additional weights
D1,D2...D5 = vertical distance to water level from X point in cm for each successive load
L= the longest length of boat from end to end in meters (excluding protrusions)
Le= the length of the waterline when the boat is empty

The average width (**Bav**) of the boat is calculated using **Bf, Bm,** and **Bb**.
Displacement (**Disx**) when loaded is calculated as the difference between **De** and **Dx** for a given load.

After trying several least squares estimates, the most efficient estimators were provided by the logarithms of the following variables: **Le, Bav, Disx,** and **Wx**. The boat load, **Wx,**, is the predicted value given the boat measurements and the water displacement variable **Disx**. Their corresponding logarithmic variables are **LLE, LBAV, LDISX,** and **LWX**, respectively, and are used in Tables 1 and 2 below. **LWX** is the dependent variable and the rest are regressors in the following linear model used:

$$LWX = Co + C1.LLE + C2.LBAV + C3.LDISX \quad \text{... (Equation 1)}$$

...where: **Co,C1,C2,** and **C3** are the regression coefficients.

The natural form of this logarithmic equation is:

$$Wx = k(Le)^{C1}(Bav)^{C2}(Disx)^{C3} \quad \text{... (Equation 2)}$$

...where **k** is the natural form of the logarithmic constant, **Co**, that is, $k=e^{Co}$

ESTIMATING EQUATIONS

The estimated equations from the above regression analysis are given below. The value to be estimated is **Wx**, the boat load. **Le** and **Bav** are measured in meters. **Disx** is measured in cm and **Wx** is given in Kg. To convert **Wx** to maunds, divide the Kg value by 37.33. Both Kg and Maund units are tabulated in Appendix G.2, Part IV.

A. For Type C Boats:

LWX=2.84 + 0.6066 LLE + 1.2525 LBAV + 0.9871 LDISX ...Eqn. 3

B. For Type A & B Boats:

LWX=3.76 + 0.6339 LLE + 1.2732 LBAV + 0.9695 LDISX ...Eqn. 4

The natural forms of Equations 3 and 4 are:

A. For Type C Boats: $Wx = 17.12(Le)^{0.6066}(Bav)^{1.2525}(Disx)^{0.9871}$ ...Eqn. 5

B. For Type A & B Boats: $Wx = 15.52(Le)^{0.6339}(Bav)^{1.2732}(Disx)^{0.9695}$ ...Eqn. 6

PROCEDURE FOR FIELD OFFICES

Appendix G.2 shows the field tables to be used to remove the need for logarithmic calculations. The field personnel need only to gather boat dimensions (Le, Bav, De, and Dx) and look up the values from the given tables. Three examples are given for using the tables. Example 1 is for determining actual load. The second is for determining boat capacity by assigning a value to Dx. Example 2 approaches the current practice of painting a (loaded) waterline along the boat to determine the capacity and as a mark to indicate whether the boat's capacity has been exceeded or not.

The range of values for the BLC Measurement Tables in Appendix G.2 exceed the range of the data to ensure that most if not all possible boat measurements can be read from the tables. In the extremely rare case that there are boats that exceed these ranges, Example 3 is provided to calculate tabular values for the out-of-range boat measurements.

APPENDIX III

NEW BLC SYSTEM FIELD USE PROCEDURES

BLC MEASUREMENT TABLES AND WORKED-OUT EXAMPLES FOR USING THE NEW BLC METHOD

BLC MEASUREMENT TABLES

PART I – LENGTH OF WATERLINE (LE) in Meters

I.1 – TYPE C BOATS

Le	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
2	0.4205	0.4501	0.4783	0.5053	0.5311	0.5558	0.5796	0.6025	0.6246	0.6459
3	0.6664	0.6863	0.7056	0.7243	0.7424	0.7600	0.7770	0.7937	0.8098	0.8256
4	0.8410	0.8559	0.8706	0.8848	0.8988	0.9124	0.9257	0.9388	0.9516	0.9641
5	0.9763	0.9883	1.0001	1.0117	1.0230	1.0341	1.0451	1.0558	1.0664	1.0767
6	1.0869	1.0970	1.1068	1.1165	1.1261	1.1355	1.1447	1.1539	1.1629	1.1717
7	1.1804	1.1890	1.1975	1.2059	1.2141	1.2223	1.2303	1.2383	1.2461	1.2538
8	1.2614	1.2690	1.2764	1.2838	1.2910	1.2982	1.3053	1.3123	1.3193	1.3261
9	1.3329	1.3396	1.3462	1.3528	1.3593	1.3657	1.3720	1.3783	1.3845	1.3907
10	1.3968	1.4028	1.4088	1.4147	1.4206	1.4264	1.4321	1.4378	1.4435	1.4491
11	1.4546	1.4601	1.4656	1.4709	1.4763	1.4816	1.4868	1.4920	1.4972	1.5023
12	1.5074	1.5124	1.5174	1.5224	1.5273	1.5322	1.5370	1.5418	1.5466	1.5513

I.2 – TYPE A and B BOATS

Le	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
2	0.4394	0.4703	0.4998	0.5280	0.5549	0.5808	0.6057	0.6296	0.6527	0.6749
3	0.6964	0.7172	0.7373	0.7568	0.7757	0.7941	0.8120	0.8293	0.8462	0.8627
4	0.8788	0.8944	0.9097	0.9246	0.9392	0.9534	0.9673	0.9810	0.9943	1.0074
5	1.0202	1.0328	1.0451	1.0571	1.0690	1.0806	1.0920	1.1033	1.1145	1.1251
6	1.1358	1.1463	1.1566	1.1667	1.1767	1.1865	1.1962	1.2057	1.2151	1.2244
7	1.2335	1.2425	1.2513	1.2601	1.2687	1.2772	1.2856	1.2939	1.3021	1.3102
8	1.3181	1.3260	1.3338	1.3415	1.3491	1.3566	1.3640	1.3713	1.3785	1.3857
9	1.3928	1.3998	1.4067	1.4136	1.4204	1.4271	1.4337	1.4403	1.4468	1.4532
10	1.4596	1.4659	1.4721	1.4783	1.4844	1.4905	1.4965	1.5025	1.5084	1.5142
11	1.5200	1.5257	1.5314	1.5371	1.5426	1.5482	1.5537	1.5591	1.5645	1.5698
12	1.5752	1.5804	1.5856	1.5908	1.5959	1.6010	1.6061	1.6111	1.6161	1.6210

PART II – Average Boat Width (Bav) in meters

II.1 – TYPE C BOATS

Bav	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	0.0000	0.1194	0.2284	0.3286	0.4214	0.5078	0.5887	0.6646	0.7362	0.8039
2	0.8682	0.9293	0.9875	1.0432	1.0965	1.1476	1.1968	1.2440	1.2896	1.3335
3	1.3760	1.4171	1.4568	1.4954	1.5328	1.5691	1.6043	1.6387	1.6721	1.7046
4	1.7363	1.7672	1.7974	1.8269	1.8557	1.8838	1.9114	1.9383	1.9647	1.9905
5	2.0158	2.0406	2.0649	2.0888	2.1122	2.1352	2.1577	2.1799	2.2017	2.2231

II.2 – TYPE A and B BOATS

Bav	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	0.0000	0.1213	0.2321	0.3340	0.4284	0.5162	0.5984	0.6756	0.7483	0.8172
2	0.8825	0.9446	1.0038	1.0604	1.1146	1.1666	1.2165	1.2646	1.3109	1.3555
3	1.3987	1.4404	1.4809	1.5200	1.5581	1.5950	1.6308	1.6657	1.6997	1.7327
4	1.7650	1.7964	1.8271	1.8570	1.8863	1.9149	1.9429	1.9703	1.9971	2.0233
5	2.0491	2.0743	2.0990	2.1232	2.1470	2.1704	2.1933	2.2159	2.2380	2.2598
6	2.2812	2.3022	2.3229	2.3433	2.3634	2.3831	2.4025	2.4217	2.4405	2.4591

PART III – Water Displacement (De–DI) in cm.

III.1 – Type C Boats

Dis	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	2.8400	2.9341	3.0200	3.0990	3.1722	3.2403	3.3040	3.3638	3.4203	3.4736
2	3.5243	3.5724	3.6183	3.6622	3.7042	3.7445	3.7832	3.8205	3.8564	3.8910
3	3.9245	3.9569	3.9882	4.0186	4.0481	4.0767	4.1045	4.1315	4.1579	4.1835
4	4.2085	4.2329	4.2567	4.2799	4.3026	4.3248	4.3465	4.3677	4.3885	4.4088
5	4.4288	4.4483	4.4675	4.4863	4.5047	4.5229	4.5406	4.5581	4.5753	4.5922
6	4.6087	4.6251	4.6411	4.6569	4.6725	4.6878	4.7028	4.7177	4.7323	4.7467
7	4.7609	4.7749	4.7887	4.8023	4.8158	4.8290	4.8421	4.8550	4.8677	4.8803
8	4.8927	4.9050	4.9171	4.9291	4.9409	4.9526	4.9641	4.9755	4.9868	4.9980
9	5.0090	5.0199	5.0307	5.0414	5.0519	5.0624	5.0727	5.0829	5.0931	5.1031
10	5.1130	5.1228	5.1326	5.1422	5.1517	5.1612	5.1705	5.1798	5.1890	5.1981
11	5.2071	5.2160	5.2249	5.2336	5.2423	5.2510	5.2595	5.2680	5.2764	5.2847
12	5.2930	5.3012	5.3093	5.3174	5.3253	5.3333	5.3411	5.3489	5.3567	5.3644
13	5.3720	5.3796	5.3871	5.3945	5.4019	5.4092	5.4165	5.4238	5.4309	5.4381
14	5.4451	5.4522	5.4592	5.4661	5.4730	5.4798	5.4866	5.4933	5.5000	5.5067
15	5.5133	5.5198	5.5263	5.5328	5.5392	5.5456	5.5520	5.5583	5.5645	5.5708
16	5.5770	5.5831	5.5892	5.5953	5.6013	5.6073	5.6133	5.6192	5.6251	5.6310
17	5.6368	5.6426	5.6484	5.6541	5.6598	5.6654	5.6710	5.6766	5.6822	5.6877
18	5.6932	5.6987	5.7041	5.7095	5.7149	5.7203	5.7256	5.7309	5.7362	5.7414
19	5.7466	5.7518	5.7569	5.7621	5.7672	5.7722	5.7773	5.7823	5.7873	5.7923
20	5.7972	5.8022	5.8071	5.8119	5.8168	5.8216	5.8264	5.8312	5.8360	5.8407
21	5.8454	5.8501	5.8548	5.8594	5.8640	5.8686	5.8732	5.8778	5.8823	5.8868
22	5.8913	5.8958	5.9003	5.9047	5.9091	5.9135	5.9179	5.9222	5.9266	5.9309
23	5.9352	5.9395	5.9437	5.9480	5.9522	5.9564	5.9606	5.9648	5.9690	5.9731
24	5.9772	5.9813	5.9854	5.9895	5.9935	5.9976	6.0016	6.0056	6.0096	6.0136
25	6.0175	6.0215	6.0254	6.0293	6.0332	6.0371	6.0409	6.0448	6.0486	6.0524
26	6.0562	6.0600	6.0638	6.0676	6.0713	6.0750	6.0787	6.0825	6.0861	6.0898
27	6.0935	6.0971	6.1008	6.1044	6.1080	6.1116	6.1152	6.1187	6.1223	6.1259
28	6.1294	6.1329	6.1364	6.1399	6.1434	6.1469	6.1503	6.1538	6.1572	6.1606
29	6.1640	6.1674	6.1708	6.1742	6.1775	6.1809	6.1842	6.1876	6.1909	6.1942
30	6.1975	6.2008	6.2040	6.2073	6.2106	6.2138	6.2170	6.2203	6.2235	6.2267
31	6.2299	6.2330	6.2362	6.2394	6.2425	6.2457	6.2488	6.2519	6.2550	6.2581
32	6.2612	6.2643	6.2673	6.2704	6.2735	6.2765	6.2795	6.2826	6.2856	6.2886
33	6.2916	6.2946	6.2975	6.3005	6.3035	6.3064	6.3094	6.3123	6.3152	6.3181
34	6.3210	6.3239	6.3268	6.3297	6.3326	6.3355	6.3383	6.3412	6.3440	6.3468
35	6.3497	6.3525	6.3553	6.3581	6.3609	6.3637	6.3664	6.3692	6.3720	6.3747
36	6.3775	6.3802	6.3829	6.3857	6.3884	6.3911	6.3938	6.3965	6.3992	6.4018
37	6.4045	6.4072	6.4098	6.4125	6.4151	6.4178	6.4204	6.4230	6.4256	6.4282
38	6.4308	6.4334	6.4360	6.4386	6.4412	6.4437	6.4463	6.4489	6.4514	6.4539
39	6.4565	6.4590	6.4615	6.4640	6.4666	6.4691	6.4716	6.4740	6.4765	6.4790
40	6.4815	6.4839	6.4864	6.4888	6.4913	6.4937	6.4962	6.4986	6.5010	6.5034
41	6.5058	6.5083	6.5107	6.5130	6.5154	6.5178	6.5202	6.5226	6.5249	6.5273
42	6.5296	6.5320	6.5343	6.5367	6.5390	6.5413	6.5436	6.5460	6.5483	6.5506
43	6.5529	6.5552	6.5574	6.5597	6.5620	6.5643	6.5665	6.5688	6.5711	6.5733
44	6.5756	6.5778	6.5800	6.5823	6.5845	6.5867	6.5889	6.5911	6.5933	6.5955
45	6.5977	6.5999	6.6021	6.6043	6.6065	6.6086	6.6108	6.6130	6.6151	6.6173
46	6.6194	6.6216	6.6237	6.6259	6.6280	6.6301	6.6322	6.6343	6.6365	6.6386
47	6.6407	6.6428	6.6449	6.6469	6.6490	6.6511	6.6532	6.6553	6.6573	6.6594
48	6.6614	6.6635	6.6656	6.6676	6.6696	6.6717	6.6737	6.6757	6.6778	6.6798
49	6.6818	6.6838	6.6858	6.6878	6.6898	6.6918	6.6938	6.6958	6.6978	6.6998
50	6.7017	6.7037	6.7057	6.7077	6.7096	6.7116	6.7135	6.7155	6.7174	6.7194

PART III – Water Displacement (De–DI) in cm.

III.1 – Type C Boats

Dis	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
51	6.7213	6.7232	6.7252	6.7271	6.7290	6.7309	6.7328	6.7348	6.7367	6.7386
52	6.7405	6.7424	6.7443	6.7461	6.7480	6.7499	6.7518	6.7537	6.7555	6.7574
53	6.7593	6.7611	6.7630	6.7648	6.7667	6.7685	6.7704	6.7722	6.7741	6.7759
54	6.7777	6.7795	6.7814	6.7832	6.7850	6.7868	6.7886	6.7904	6.7922	6.7940
55	6.7958	6.7976	6.7994	6.8012	6.8030	6.8048	6.8065	6.8083	6.8101	6.8119
56	6.8136	6.8154	6.8171	6.8189	6.8206	6.8224	6.8241	6.8259	6.8276	6.8294
57	6.8311	6.8328	6.8345	6.8363	6.8380	6.8397	6.8414	6.8431	6.8448	6.8466
58	6.8483	6.8500	6.8517	6.8534	6.8550	6.8567	6.8584	6.8601	6.8618	6.8635
59	6.8651	6.8668	6.8685	6.8701	6.8718	6.8735	6.8751	6.8768	6.8784	6.8801
60	6.8817	6.8834	6.8850	6.8866	6.8883	6.8899	6.8915	6.8932	6.8948	6.8964
61	6.8980	6.8997	6.9013	6.9029	6.9045	6.9061	6.9077	6.9093	6.9109	6.9125
62	6.9141	6.9157	6.9173	6.9189	6.9204	6.9220	6.9236	6.9252	6.9267	6.9283
63	6.9299	6.9315	6.9330	6.9346	6.9361	6.9377	6.9392	6.9408	6.9423	6.9439
64	6.9454	6.9470	6.9485	6.9500	6.9516	6.9531	6.9546	6.9562	6.9577	6.9592
65	6.9607	6.9623	6.9638	6.9653	6.9668	6.9683	6.9698	6.9713	6.9728	6.9743
66	6.9758	6.9773	6.9788	6.9803	6.9818	6.9833	6.9847	6.9862	6.9877	6.9892
67	6.9907	6.9921	6.9936	6.9951	6.9965	6.9980	6.9995	7.0009	7.0024	7.0038
68	7.0053	7.0067	7.0082	7.0096	7.0111	7.0125	7.0139	7.0154	7.0168	7.0183
69	7.0197	7.0211	7.0225	7.0240	7.0254	7.0268	7.0282	7.0297	7.0311	7.0325
70	7.0339	7.0353	7.0367	7.0381	7.0395	7.0409	7.0423	7.0437	7.0451	7.0465
71	7.0479	7.0493	7.0507	7.0521	7.0534	7.0548	7.0562	7.0576	7.0590	7.0603
72	7.0617	7.0631	7.0644	7.0658	7.0672	7.0685	7.0699	7.0713	7.0726	7.0740
73	7.0753	7.0767	7.0780	7.0794	7.0807	7.0821	7.0834	7.0847	7.0861	7.0874
74	7.0887	7.0901	7.0914	7.0927	7.0941	7.0954	7.0967	7.0980	7.0994	7.1007
75	7.1020	7.1033	7.1046	7.1059	7.1072	7.1086	7.1099	7.1112	7.1125	7.1138
76	7.1151	7.1164	7.1177	7.1190	7.1203	7.1215	7.1228	7.1241	7.1254	7.1267
77	7.1280	7.1293	7.1305	7.1318	7.1331	7.1344	7.1356	7.1369	7.1382	7.1394
78	7.1407	7.1420	7.1432	7.1445	7.1458	7.1470	7.1483	7.1495	7.1508	7.1520
79	7.1533	7.1545	7.1558	7.1570	7.1583	7.1595	7.1608	7.1620	7.1632	7.1645
80	7.1657	7.1669	7.1682	7.1694	7.1706	7.1719	7.1731	7.1743	7.1755	7.1768
81	7.1780	7.1792	7.1804	7.1816	7.1828	7.1840	7.1853	7.1865	7.1877	7.1889
82	7.1901	7.1913	7.1925	7.1937	7.1949	7.1961	7.1973	7.1985	7.1997	7.2009
83	7.2020	7.2032	7.2044	7.2056	7.2068	7.2080	7.2092	7.2103	7.2115	7.2127
84	7.2139	7.2150	7.2162	7.2174	7.2186	7.2197	7.2209	7.2221	7.2232	7.2244
85	7.2256	7.2267	7.2279	7.2290	7.2302	7.2313	7.2325	7.2336	7.2348	7.2359
86	7.2371	7.2382	7.2394	7.2405	7.2417	7.2428	7.2440	7.2451	7.2462	7.2474
87	7.2485	7.2496	7.2508	7.2519	7.2530	7.2542	7.2553	7.2564	7.2575	7.2587
88	7.2598	7.2609	7.2620	7.2632	7.2643	7.2654	7.2665	7.2676	7.2687	7.2698
89	7.2709	7.2721	7.2732	7.2743	7.2754	7.2765	7.2776	7.2787	7.2798	7.2809
90	7.2820	7.2831	7.2842	7.2853	7.2864	7.2874	7.2885	7.2896	7.2907	7.2918
91	7.2929	7.2940	7.2951	7.2961	7.2972	7.2983	7.2994	7.3004	7.3015	7.3026
92	7.3037	7.3047	7.3058	7.3069	7.3080	7.3090	7.3101	7.3112	7.3122	7.3133
93	7.3143	7.3154	7.3165	7.3175	7.3186	7.3196	7.3207	7.3217	7.3228	7.3239
94	7.3249	7.3260	7.3270	7.3280	7.3291	7.3301	7.3312	7.3322	7.3333	7.3343
95	7.3353	7.3364	7.3374	7.3385	7.3395	7.3405	7.3416	7.3426	7.3436	7.3447
96	7.3457	7.3467	7.3477	7.3488	7.3498	7.3508	7.3518	7.3529	7.3539	7.3549
97	7.3559	7.3569	7.3579	7.3590	7.3600	7.3610	7.3620	7.3630	7.3640	7.3650
98	7.3660	7.3670	7.3681	7.3691	7.3701	7.3711	7.3721	7.3731	7.3741	7.3751
99	7.3761	7.3771	7.3781	7.3790	7.3800	7.3810	7.3820	7.3830	7.3840	7.3850
100	7.3860	7.3870	7.3880	7.3889	7.3899	7.3909	7.3919	7.3929	7.3938	7.3948

PART III – Water Displacement (De–Di) in cm.

III.2 – Type A and B Boats

Dis	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	3.7610	3.8534	3.9378	4.0154	4.0872	4.1541	4.2167	4.2755	4.3309	4.3833
2	4.4330	4.4803	4.5254	4.5685	4.6098	4.6494	4.6874	4.7240	4.7592	4.7932
3	4.8261	4.8579	4.8887	4.9185	4.9475	4.9756	5.0029	5.0294	5.0553	5.0805
4	5.1050	5.1290	5.1523	5.1751	5.1974	5.2192	5.2405	5.2614	5.2818	5.3018
5	5.3214	5.3405	5.3594	5.3778	5.3960	5.4138	5.4312	5.4484	5.4652	5.4818
6	5.4981	5.5141	5.5299	5.5454	5.5607	5.5757	5.5905	5.6051	5.6195	5.6336
7	5.6476	5.6613	5.6749	5.6882	5.7014	5.7144	5.7273	5.7400	5.7525	5.7648
8	5.7770	5.7891	5.8009	5.8127	5.8243	5.8358	5.8471	5.8583	5.8694	5.8804
9	5.8912	5.9019	5.9125	5.9230	5.9334	5.9436	5.9538	5.9638	5.9738	5.9836
10	5.9933	6.0030	6.0125	6.0220	6.0314	6.0406	6.0498	6.0589	6.0680	6.0769
11	6.0857	6.0945	6.1032	6.1118	6.1204	6.1288	6.1372	6.1456	6.1538	6.1620
12	6.1701	6.1781	6.1861	6.1940	6.2019	6.2097	6.2174	6.2251	6.2327	6.2402
13	6.2477	6.2551	6.2625	6.2698	6.2771	6.2843	6.2914	6.2985	6.3056	6.3126
14	6.3195	6.3264	6.3333	6.3401	6.3469	6.3536	6.3602	6.3668	6.3734	6.3799
15	6.3864	6.3929	6.3993	6.4056	6.4119	6.4182	6.4245	6.4307	6.4368	6.4429
16	6.4490	6.4550	6.4610	6.4670	6.4729	6.4788	6.4847	6.4905	6.4963	6.5021
17	6.5078	6.5135	6.5191	6.5247	6.5303	6.5359	6.5414	6.5469	6.5524	6.5578
18	6.5632	6.5686	6.5739	6.5792	6.5845	6.5898	6.5950	6.6002	6.6053	6.6105
19	6.6156	6.6207	6.6258	6.6308	6.6358	6.6408	6.6457	6.6507	6.6556	6.6605
20	6.6653	6.6702	6.6750	6.6798	6.6845	6.6893	6.6940	6.6987	6.7034	6.7080
21	6.7126	6.7172	6.7218	6.7264	6.7309	6.7354	6.7399	6.7444	6.7489	6.7533
22	6.7577	6.7621	6.7665	6.7709	6.7752	6.7795	6.7838	6.7881	6.7924	6.7966
23	6.8008	6.8050	6.8092	6.8134	6.8175	6.8217	6.8258	6.8299	6.8340	6.8380
24	6.8421	6.8461	6.8501	6.8541	6.8581	6.8621	6.8660	6.8700	6.8739	6.8778
25	6.8817	6.8855	6.8894	6.8932	6.8971	6.9009	6.9047	6.9084	6.9122	6.9160
26	6.9197	6.9234	6.9271	6.9308	6.9345	6.9382	6.9418	6.9454	6.9491	6.9527
27	6.9563	6.9599	6.9634	6.9670	6.9705	6.9741	6.9776	6.9811	6.9846	6.9881
28	6.9915	6.9950	6.9984	7.0019	7.0053	7.0087	7.0121	7.0155	7.0188	7.0222
29	7.0256	7.0289	7.0322	7.0355	7.0388	7.0421	7.0454	7.0487	7.0519	7.0552
30	7.0584	7.0617	7.0649	7.0681	7.0713	7.0744	7.0776	7.0808	7.0839	7.0871
31	7.0902	7.0933	7.0964	7.0996	7.1026	7.1057	7.1088	7.1119	7.1149	7.1180
32	7.1210	7.1240	7.1270	7.1300	7.1330	7.1360	7.1390	7.1420	7.1449	7.1479
33	7.1508	7.1538	7.1567	7.1596	7.1625	7.1654	7.1683	7.1712	7.1740	7.1769
34	7.1798	7.1826	7.1855	7.1883	7.1911	7.1939	7.1967	7.1995	7.2023	7.2051
35	7.2079	7.2106	7.2134	7.2161	7.2189	7.2216	7.2243	7.2271	7.2298	7.2325
36	7.2352	7.2379	7.2406	7.2432	7.2459	7.2486	7.2512	7.2539	7.2565	7.2591
37	7.2617	7.2644	7.2670	7.2696	7.2722	7.2748	7.2773	7.2799	7.2825	7.2850
38	7.2876	7.2901	7.2927	7.2952	7.2977	7.3003	7.3028	7.3053	7.3078	7.3103
39	7.3128	7.3153	7.3177	7.3202	7.3227	7.3251	7.3276	7.3300	7.3325	7.3349
40	7.3373	7.3397	7.3422	7.3446	7.3470	7.3494	7.3518	7.3541	7.3565	7.3589
41	7.3613	7.3636	7.3660	7.3683	7.3707	7.3730	7.3753	7.3777	7.3800	7.3823
42	7.3846	7.3869	7.3892	7.3915	7.3938	7.3961	7.3984	7.4007	7.4029	7.4052
43	7.4074	7.4097	7.4119	7.4142	7.4164	7.4186	7.4209	7.4231	7.4253	7.4275
44	7.4297	7.4319	7.4341	7.4363	7.4385	7.4407	7.4429	7.4450	7.4472	7.4494
45	7.4515	7.4537	7.4558	7.4580	7.4601	7.4622	7.4644	7.4665	7.4686	7.4707
46	7.4728	7.4749	7.4770	7.4791	7.4812	7.4833	7.4854	7.4875	7.4895	7.4916
47	7.4937	7.4957	7.4978	7.4998	7.5019	7.5039	7.5060	7.5080	7.5100	7.5121
48	7.5141	7.5161	7.5181	7.5201	7.5221	7.5241	7.5261	7.5281	7.5301	7.5321
49	7.5341	7.5360	7.5380	7.5400	7.5420	7.5439	7.5459	7.5478	7.5498	7.5517
50	7.5537	7.5556	7.5575	7.5595	7.5614	7.5633	7.5652	7.5671	7.5690	7.5710

PART III – Water Displacement (De–DI) in cm.

III.2 – Type A and B Boats

Dis	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
51	7.5729	7.5748	7.5767	7.5785	7.5804	7.5823	7.5842	7.5861	7.5879	7.5898
52	7.5917	7.5935	7.5954	7.5973	7.5991	7.6010	7.6028	7.6046	7.6065	7.6083
53	7.6101	7.6120	7.6138	7.6156	7.6174	7.6193	7.6211	7.6229	7.6247	7.6265
54	7.6283	7.6301	7.6319	7.6336	7.6354	7.6372	7.6390	7.6408	7.6425	7.6443
55	7.6461	7.6478	7.6496	7.6513	7.6531	7.6548	7.6566	7.6583	7.6601	7.6618
56	7.6635	7.6653	7.6670	7.6687	7.6704	7.6721	7.6739	7.6756	7.6773	7.6790
57	7.6807	7.6824	7.6841	7.6858	7.6875	7.6892	7.6908	7.6925	7.6942	7.6959
58	7.6975	7.6992	7.7009	7.7026	7.7042	7.7059	7.7075	7.7092	7.7108	7.7125
59	7.7141	7.7158	7.7174	7.7190	7.7207	7.7223	7.7239	7.7256	7.7272	7.7288
60	7.7304	7.7320	7.7336	7.7353	7.7369	7.7385	7.7401	7.7417	7.7433	7.7449
61	7.7464	7.7480	7.7496	7.7512	7.7528	7.7544	7.7559	7.7575	7.7591	7.7606
62	7.7622	7.7638	7.7653	7.7669	7.7684	7.7700	7.7715	7.7731	7.7746	7.7762
63	7.7777	7.7793	7.7808	7.7823	7.7839	7.7854	7.7869	7.7884	7.7900	7.7915
64	7.7930	7.7945	7.7960	7.7975	7.7990	7.8005	7.8020	7.8035	7.8050	7.8065
65	7.8080	7.8095	7.8110	7.8125	7.8140	7.8154	7.8169	7.8184	7.8199	7.8213
66	7.8228	7.8243	7.8258	7.8272	7.8287	7.8301	7.8316	7.8330	7.8345	7.8359
67	7.8374	7.8388	7.8403	7.8417	7.8432	7.8446	7.8460	7.8475	7.8489	7.8503
68	7.8518	7.8532	7.8546	7.8560	7.8574	7.8589	7.8603	7.8617	7.8631	7.8645
69	7.8659	7.8673	7.8687	7.8701	7.8715	7.8729	7.8743	7.8757	7.8771	7.8785
70	7.8799	7.8812	7.8826	7.8840	7.8854	7.8868	7.8881	7.8895	7.8909	7.8922
71	7.8936	7.8950	7.8963	7.8977	7.8991	7.9004	7.9018	7.9031	7.9045	7.9058
72	7.9072	7.9085	7.9099	7.9112	7.9125	7.9139	7.9152	7.9166	7.9179	7.9192
73	7.9205	7.9219	7.9232	7.9245	7.9258	7.9272	7.9285	7.9298	7.9311	7.9324
74	7.9337	7.9350	7.9364	7.9377	7.9390	7.9403	7.9416	7.9429	7.9442	7.9455
75	7.9467	7.9480	7.9493	7.9506	7.9519	7.9532	7.9545	7.9558	7.9570	7.9583
76	7.9596	7.9609	7.9621	7.9634	7.9647	7.9659	7.9672	7.9685	7.9697	7.9710
77	7.9723	7.9735	7.9748	7.9760	7.9773	7.9785	7.9798	7.9810	7.9823	7.9835
78	7.9848	7.9860	7.9873	7.9885	7.9897	7.9910	7.9922	7.9934	7.9947	7.9959
79	7.9971	7.9983	7.9996	8.0008	8.0020	8.0032	8.0045	8.0057	8.0069	8.0081
80	8.0093	8.0105	8.0117	8.0129	8.0142	8.0154	8.0166	8.0178	8.0190	8.0202
81	8.0214	8.0226	8.0238	8.0249	8.0261	8.0273	8.0285	8.0297	8.0309	8.0321
82	8.0333	8.0344	8.0356	8.0368	8.0380	8.0392	8.0403	8.0415	8.0427	8.0438
83	8.0450	8.0462	8.0473	8.0485	8.0497	8.0508	8.0520	8.0532	8.0543	8.0555
84	8.0566	8.0578	8.0589	8.0601	8.0612	8.0624	8.0635	8.0647	8.0658	8.0670
85	8.0681	8.0692	8.0704	8.0715	8.0726	8.0738	8.0749	8.0760	8.0772	8.0783
86	8.0794	8.0806	8.0817	8.0828	8.0839	8.0851	8.0862	8.0873	8.0884	8.0895
87	8.0906	8.0918	8.0929	8.0940	8.0951	8.0962	8.0973	8.0984	8.0995	8.1006
88	8.1017	8.1028	8.1039	8.1050	8.1061	8.1072	8.1083	8.1094	8.1105	8.1116
89	8.1127	8.1138	8.1149	8.1159	8.1170	8.1181	8.1192	8.1203	8.1213	8.1224
90	8.1235	8.1246	8.1257	8.1267	8.1278	8.1289	8.1299	8.1310	8.1321	8.1332
91	8.1342	8.1353	8.1363	8.1374	8.1385	8.1395	8.1406	8.1416	8.1427	8.1438
92	8.1448	8.1459	8.1469	8.1480	8.1490	8.1501	8.1511	8.1522	8.1532	8.1543
93	8.1553	8.1563	8.1574	8.1584	8.1595	8.1605	8.1615	8.1626	8.1636	8.1646
94	8.1657	8.1667	8.1677	8.1688	8.1698	8.1708	8.1718	8.1729	8.1739	8.1749
95	8.1759	8.1769	8.1780	8.1790	8.1800	8.1810	8.1820	8.1830	8.1841	8.1851
96	8.1861	8.1871	8.1881	8.1891	8.1901	8.1911	8.1921	8.1931	8.1941	8.1951
97	8.1961	8.1971	8.1981	8.1991	8.2001	8.2011	8.2021	8.2031	8.2041	8.2051
98	8.2061	8.2071	8.2080	8.2090	8.2100	8.2110	8.2120	8.2130	8.2139	8.2149
99	8.2159	8.2169	8.2179	8.2188	8.2198	8.2208	8.2218	8.2227	8.2237	8.2247
100	8.2257	8.2266	8.2276	8.2286	8.2295	8.2305	8.2315	8.2324	8.2334	8.2343

PART IV.1 – Antilog Values in Kg.

Total	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
6.00	403	407	412	416	420	424	428	433	437	441
6.10	446	450	455	459	464	469	473	478	483	488
6.20	493	498	503	508	513	518	523	528	534	539
6.30	545	550	556	561	567	572	578	584	590	596
6.40	602	608	614	620	626	633	639	645	652	659
6.50	665	672	679	685	692	699	706	713	721	728
6.60	735	742	750	757	765	773	781	788	796	804
6.70	812	821	829	837	846	854	863	871	880	889
6.80	898	907	916	925	934	944	953	963	973	982
6.90	992	1,002	1,012	1,022	1,033	1,043	1,054	1,064	1,075	1,086
7.00	1,097	1,108	1,119	1,130	1,141	1,153	1,164	1,176	1,188	1,200
7.10	1,212	1,224	1,236	1,249	1,261	1,274	1,287	1,300	1,313	1,326
7.20	1,339	1,353	1,366	1,380	1,394	1,408	1,422	1,437	1,451	1,466
7.30	1,480	1,495	1,510	1,525	1,541	1,556	1,572	1,588	1,604	1,620
7.40	1,636	1,652	1,669	1,686	1,703	1,720	1,737	1,755	1,772	1,790
7.50	1,808	1,826	1,845	1,863	1,882	1,901	1,920	1,939	1,959	1,978
7.60	1,998	2,018	2,039	2,059	2,080	2,101	2,122	2,143	2,165	2,186
7.70	2,208	2,231	2,253	2,276	2,298	2,322	2,345	2,368	2,392	2,416
7.80	2,441	2,465	2,490	2,515	2,540	2,566	2,592	2,618	2,644	2,670
7.90	2,697	2,724	2,752	2,779	2,807	2,836	2,864	2,893	2,922	2,951
8.00	2,981	3,011	3,041	3,072	3,103	3,134	3,165	3,197	3,229	3,262
8.10	3,294	3,328	3,361	3,395	3,429	3,463	3,498	3,533	3,569	3,605
8.20	3,641	3,678	3,715	3,752	3,790	3,828	3,866	3,905	3,944	3,984
8.30	4,024	4,064	4,105	4,146	4,188	4,230	4,273	4,316	4,359	4,403
8.40	4,447	4,492	4,537	4,583	4,629	4,675	4,722	4,770	4,817	4,866
8.50	4,915	4,964	5,014	5,064	5,115	5,167	5,219	5,271	5,324	5,378
8.60	5,432	5,486	5,541	5,597	5,653	5,710	5,768	5,825	5,884	5,943
8.70	6,003	6,063	6,124	6,186	6,248	6,311	6,374	6,438	6,503	6,568
8.80	6,634	6,701	6,768	6,836	6,905	6,974	7,044	7,115	7,187	7,259
8.90	7,332	7,406	7,480	7,555	7,631	7,708	7,785	7,864	7,943	8,022
9.00	8,103	8,185	8,267	8,350	8,434	8,519	8,604	8,691	8,778	8,866
9.10	8,955	9,045	9,136	9,228	9,321	9,414	9,509	9,605	9,701	9,799
9.20	9,897	9,997	10,097	10,199	10,301	10,405	10,509	10,615	10,721	10,829
9.30	10,938	11,048	11,159	11,271	11,384	11,499	11,614	11,731	11,849	11,968
9.40	12,088	12,210	12,333	12,457	12,582	12,708	12,836	12,965	13,095	13,227
9.50	13,360	13,494	13,630	13,767	13,905	14,045	14,186	14,328	14,472	14,618
9.60	14,765	14,913	15,063	15,214	15,367	15,522	15,678	15,835	15,994	16,155
9.70	16,318	16,482	16,647	16,815	16,984	17,154	17,327	17,501	17,677	17,854
9.80	18,034	18,215	18,398	18,583	18,770	18,958	19,149	19,341	19,536	19,732
9.90	19,930	20,131	20,333	20,537	20,744	20,952	21,163	21,375	21,590	21,807
10.00	22,026	22,248	22,471	22,697	22,925	23,156	23,389	23,624	23,861	24,101
10.10	24,343	24,588	24,835	25,084	25,336	25,591	25,848	26,108	26,370	26,635
10.20	26,903	27,174	27,447	27,723	28,001	28,283	28,567	28,854	29,144	29,437
10.30	29,733	30,031	30,333	30,638	30,946	31,257	31,571	31,888	32,209	32,533
10.40	32,860	33,190	33,523	33,860	34,201	34,544	34,892	35,242	35,596	35,954
10.50	36,316	36,680	37,049	37,421	37,798	38,177	38,561	38,949	39,340	39,735
10.60	40,135	40,538	40,946	41,357	41,773	42,193	42,617	43,045	43,478	43,915
10.70	44,356	44,802	45,252	45,707	46,166	46,630	47,099	47,572	48,050	48,533
10.80	49,021	49,513	50,011	50,514	51,021	51,534	52,052	52,575	53,104	53,637
10.90	54,176	54,721	55,271	55,826	56,387	56,954	57,526	58,105	58,689	59,278

PART IV.2 – Antilog Values in Maunds

Total	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
6.00	11	11	11	11	11	11	11	12	12	12
6.10	12	12	12	12	12	13	13	13	13	13
6.20	13	13	13	14	14	14	14	14	14	14
6.30	15	15	15	15	15	15	15	16	16	16
6.40	16	16	16	17	17	17	17	17	17	18
6.50	18	18	18	18	19	19	19	19	19	19
6.60	20	20	20	20	20	21	21	21	21	22
6.70	22	22	22	22	23	23	23	23	24	24
6.80	24	24	25	25	25	25	26	26	26	26
6.90	27	27	27	27	28	28	28	29	29	29
7.00	29	30	30	30	31	31	31	32	32	32
7.10	32	33	33	33	34	34	34	35	35	36
7.20	36	36	37	37	37	38	38	38	39	39
7.30	40	40	40	41	41	42	42	43	43	43
7.40	44	44	45	45	46	46	47	47	47	48
7.50	48	49	49	50	50	51	51	52	52	53
7.60	54	54	55	55	56	56	57	57	58	59
7.70	59	60	60	61	62	62	63	63	64	65
7.80	65	66	67	67	68	69	69	70	71	72
7.90	72	73	74	74	75	76	77	77	78	79
8.00	80	81	81	82	83	84	85	86	87	87
8.10	88	89	90	91	92	93	94	95	96	97
8.20	98	99	100	101	102	103	104	105	106	107
8.30	108	109	110	111	112	113	114	116	117	118
8.40	119	120	122	123	124	125	126	128	129	130
8.50	132	133	134	136	137	138	140	141	143	144
8.60	146	147	148	150	151	153	155	156	158	159
8.70	161	162	164	166	167	169	171	172	174	176
8.80	178	180	181	183	185	187	189	191	193	194
8.90	196	198	200	202	204	206	209	211	213	215
9.00	217	219	221	224	226	228	230	233	235	238
9.10	240	242	245	247	250	252	255	257	260	262
9.20	265	268	270	273	276	279	282	284	287	290
9.30	293	296	299	302	305	308	311	314	317	321
9.40	324	327	330	334	337	340	344	347	351	354
9.50	358	361	365	369	372	376	380	384	388	392
9.60	396	399	404	408	412	416	420	424	428	433
9.70	437	442	446	450	455	460	464	469	474	478
9.80	483	488	493	498	503	508	513	518	523	529
9.90	534	539	545	550	556	561	567	573	578	584
10.00	590	596	602	608	614	620	627	633	639	646
10.10	652	659	665	672	679	686	692	699	706	714
10.20	721	728	735	743	750	758	765	773	781	789
10.30	796	804	813	821	829	837	846	854	863	871
10.40	880	889	898	907	916	925	935	944	954	963
10.50	973	983	992	1,002	1,013	1,023	1,033	1,043	1,054	1,064
10.60	1,075	1,086	1,097	1,108	1,119	1,130	1,142	1,153	1,165	1,176
10.70	1,188	1,200	1,212	1,224	1,237	1,249	1,262	1,274	1,287	1,300
10.80	1,313	1,326	1,340	1,353	1,367	1,381	1,394	1,408	1,423	1,437
10.90	1,451	1,466	1,481	1,495	1,511	1,526	1,541	1,557	1,572	1,588

NEW BLC SYSTEM
Example TO CALCULATE ACTUAL LOAD

1. Type C Boat
2. Length of Waterline (Le) = 10.2 m
3. Width measurements (Bf,Bm,Bb) = 2.5, 3.8, 2.7
4. Distance (De) from X−point to waterline when boat is empty= 70 cm.
5. Distance (Dl) from X−point to waterline when boat is loaded = 30 cm.

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6. Calculate average Boat width (Bav) = (2.5+3.8+2.7)/3 = 3.0
7. Calculate displacement (De−D1) = 70−30= 40 cm
8. Look up log value for Le (use Part I.1 for Type C):

LE	Log LE
10.2	1.4088

9. Look up log value of Bav (Use Part II.1 for Type C)

Bav	Log Bav
3.0	1.3760

10. Look up log value of Displacement = 40 cm (Use Part III.1)

De−D1	Log Dis
40.0	6.4815

11. Sum up the 3 log values in No.8,9,10

Log LE	1.4088
Log Bav	1.3760
Log Dis	6.4815
Total	9.2663

12. Round up Total to 2 decimal places = 9.27
13. Look up this value (9.27) from Part IV.1 (for Kg) or Part IV.2 (for Maunds)

Total	9.27	
Load	10,615	Kg
Load	284	Maund

NEW BLC SYSTEM
Example 2: HOW TO SET BOAT CAPACITY

1. Type C Boat
2. Length of Waterline (Le) = 10.2 m
3. Width measurements (Bf,Bm,Bb) = 2.5, 3.8, 2.7
4. Distance (De) from X−point to waterline when boat is empty= 70 cm.
5. Set Boat Capacity Waterline (Dc) at 24 cm below X−point

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6. Calculate average Boat width (Bav) = (2.5+3.8+2.7)/3 = 3.0
7. Calculate displacement (De−Dc) = 70−24= 46 cm
8. Look up log value for Le (use Part I.1 for Type C):

LE	Log LE
10.2	1.4088

9. Look up log value of Bav (Use Part II.1 for Type C)

Bav	Log Bav
3.0	1.3760

10. Look up log value of Displacement = 46 cm (Use Part III.1)

De−Dc	Log Dis
46.0	6.6194

11. Sum up the 3 log values in No.8,9,10

Log LE	1.4088
Log Bav	1.3760
Log Dis	6.6194
Total	9.4042

12. Round up Total to 2 decimal places = 9.40
13. Look up this value (9.40) from Part IV.1 (for Kg) or Part IV.2 (for Maunds)

Total	9.40	
Load	12,088	Kg
Load	324	Maund

NEW BLC SYSTEM
Example 3: WHAT TO DO WHEN BOAT MEASUREMENTS EXCEED THE TABLE VALUES

1. Waterline (Le) is more than 12 meters long, say, 14.2, for a Type C boat.
2. Split Le into two multiplicands. (14.2 = 2 x 7.1). Now, both 2.0 and 7.1 can be read from Part I.1 Appendix G.2. Thus:

Table value of 14.2 = Table value of 2.0 + Table value of 7.1
= 0.4205 + 1.1890
= 1.6095

3. NOTE: The table values MUST BE ADDED, not multiplied.
4. You can apply the same procedure for Bav and Water displacement (De-Dx) measurements.
5. Proceed with the calculations in Example 1 or Example 2.

APPENDIX IV

NEW BLC SYSTEM ORIGINAL STUDY PROPOSAL AND METHODOLOGY

FRMP STUDY PROPOSAL
Title: **Boat Load Measurements of Forest Produce at SRF**
Duration: 15 days
Proposed Start Date: 5 September 1997
Study Leaders: Dr. Jerry Canonizado and DFO Akbar Hossain

Objective of Study: To develop an improved method of measuring boat loads of forest produce in order to correctly assess forest charges and more accurately determine actual quantity of forest produce extracted.

How Results of the Study will be Applied: The results of the study will evolve a new improved system of measuring boat loads of forest produce to replace the century-old BLC system in current use. The study will categorize different types of boats and generate an applicable load estimation formula for each type of boat with known dimensions. The new procedure will not significantly change the procedures in current use. It will only improve the estimation method so that fees are properly assessed and quantities extracted are accurately reported.

Background: The BLC system (Boat Loading Capacity) dates back to the Heinig Working Plan of 1892 (possibly earlier) and has not changed since then. It is not known exactly when and how this formula was derived, or who originated it. The BLC system is a system of issuing registration certificates to authorized collectors of Golpatta, firewood. timber and other forest produce measured in terms of weight. The BLC formula in maunds is determined as follows:

$$BLC = 0.356\ L_F B D$$

Where: L_F = length of the boat in feet along the waterline when in full load
B= average breadth of of the boat in feet measured in 3 places, and
D= vertical distance between the waterline at full load and the bottom of the boat in feet

In application, a boat to be measured under the BLC system undergoes a registration procedure for ownership and issuance of a collection permit by a field office. The BLC registration certificate number is painted on the boat. Since the boat is empty at registration, its BLC is estimated roughly. To do this, the waterline (L_F) at full load is normally set at 6 inches below the gunwale or top edge of the boat. This line is painted on the side of the boat and is called simply the "waterline". This and the other measurements are taken and then the BLC is calculated and recorded and the proper fees collected. When the boat reports back at the station loaded with forest produce, the station officer determines if the BLC is exceeded, i.e. the actual water level is above the 'waterline mark'. If so, the new waterline is measured and the BLC recalculated and additional charges are paid based on the new calculated BLC.

The system sets an initial capacity upon which fees are charged before actual collection takes place. This is a sound practice to ensure that fees are collected out front. The

reassessment at loaded condition is also a logical practice. However, this system encourages collectors to exceed their BLC rather than underload because then they would have paid more in fees than they should. It is to be expected that collectors would try to go around this system by changing the shape of their boats so that they can load more than their rated capacity. Clearly, the reason for this is that the system DOES NOT measure actual load. It only sets an initial capacity as a basis for assessing fees in advance and recalculates the capacity if the initial capacity is exceeded. Besides, the shape of boats through the years have changed so much that the BLC formula is no longer a reliable way of estimating boat loads.

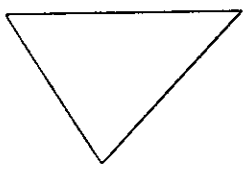
Theory: The measurement of boatloads may be appealed to Archimedes Laws of Buoyancy. A boat is a floating body and by Archimedes Principle, a floating body displaces its weight in water. A loaded boat thus displaces its weight and its load in water. The practical difficulty associated with measuring the weight of water displaced by a boat and its load is the actual shape of a boat which is generally not exactly following a regular geometric or solid shape. This negates the application of analytical solutions. However, using statistical procedures, it is possible to develop precise estimates of boatloads provided boats can be properly classified as to their shapes. This and the use of theoretical relationships can be used to generate estimating equations to determine actual weight of a load with acceptable accuracy and without entailing complicated measurements.

Methodology:

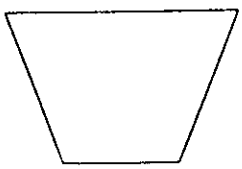
This study will attempt to develop a load estimation procedure that is easy to apply in actual field conditions. For the purpose of this study, boats will be classified according to their horizontal cross section, that is by looking at the boat horizontally from one end (not sides). There are expected to be three basic shapes:

1. Deltoid Shape: Inverted pyramid shape (See Figure 1A)
2. Trapezoidal Shape: (See Figure 1B)
3. Rectangular Shape: Flat-bottomed Approaching a square (See Figure 1C)

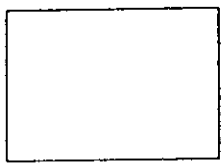
FIGURE 1 - Basic Horizontal Cross Section Shapes of Boats



A. Deltoid Boat

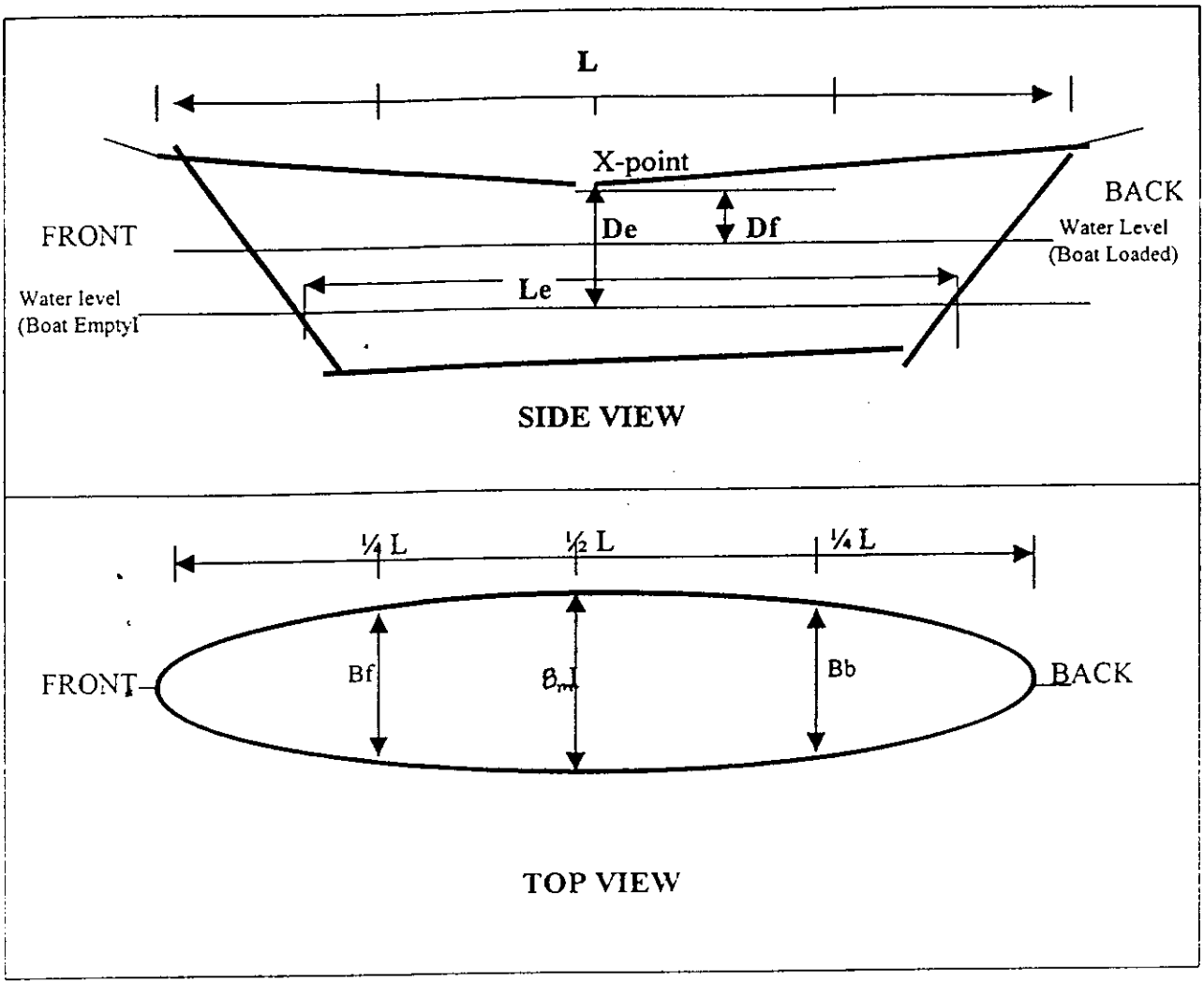


B. Trapezoidal Boat



C. Ractangular Boat

FIGURE 2 – POINTS OF BOAT MEASUREMENT



De = vertical distance from X-point to water level when boat is empty
Df = vertical distance from X-point to water level when boat is loaded
Bm measured at ½ L (inner dimesion)
Bf measured at ¼ L from front (inner dimension)
Bb measured at ¼ L from back (inner dimension)
L measured from front to back using inner dimension (excluding protrusions)

For this study, a target of 12 boats per category will be sampled. The boats to be used will come from nearby owners. Owners of boats selected for the study will receive an honorarium from the Project in the form of a day's rental at prevailing rates.

Preparatory Steps:

At the selected station/s where the study will be conducted, a load of sandbags, people, and/or other materials whose weight can be established (e.g. Sundri logs) will be prepared. A large weighing scale such as the one used in ricemills will be brought in. Each log, sandbag or person to be used in the study will be tagged and weighed accordingly. Sundri logs will be numbered and their individual weights recorded. Same is true with sandbags. Preferably, individual sandbags will be of a uniform weight, e.g. 50 or 75 kg, so that loading/unloading and recording can be facilitated. Persons who volunteer to participate will be tagged and weighed in kg. The six laborers to be hired, the crew of the boat, and station personnel will be used as additional weights.

Measurement Procedure:

1. An empty boat is brought in. Its shape category is determined. (A,B, or C)
2. Boat measurements are taken (See Figure 2 for illustration):

   L = the longest length of the boat in meters measured at the inside top from one end to the other, excluding protrusions
   Le = the length of the boat at the waterline when it is empty
   Bm = width (breadth) at the middle section in meters
   Bf = width (breadth) at ¼ L from the front in meters
   Bb = width (breadth) at ¼L from the back in meters
   De = vertical distance from the water level to the top edge in cm. (where Bm is measured). This point, the **X-point**, to be marked on the boat (see Fig. 2)

3. After taking boat measurements, the logs and or sandbags will then be loaded.

   a. First, approximately 300 maunds are loaded. Record actual weight, W1.
   b. Measure D1 (distance from the X point to the water level) in cm.
   c. Next, load an additional 100 maunds (approximately). Record actual weight, W2=W1+additional weight.
   d. Measure D2 (distance from the X point to the water level) in cm.
   e. Next, load an additional approximate 100 maunds of sandbags and/or people. Record actual weight, W3=W2+additional weight
   f. Measure D3 (distance from the X point to the water level) in cm.
   g. Next load an additional approximate 100 maunds of sandbags and/or people if the boat capacity still allows it. Record the actual weight, W4=W3+additional weight.
   h. Measure D4 (distance from the X point to the water level) in cm.
   i. If the boat can still carry an extra load, put in an additional 100 maunds (approx). Record actual weight, W5=W4+additional weight.
   j. Measure D5 (distance from X point to the water level) in cm.

k. **Fully unload the boat and bring in another boat.**
l. **Repeat the measurements (3a to 3k).**

3. **Limit weight measurements to a maximum of 5, but at least 3 weights per boat. Depending upon the boat's capacity, loading can start from 200 maunds (approx).**

4. The tabulation should be recorded according to Form 1.

Analysis of Results:

Logically, the greater the weight of the load, the deeper the boat goes under water. The difference between De and the successive D1,D2,...,D5 measurements will capture the actual submerged section of the boat representing the displaced volume of water equivalent to the weight of the load. The series of D measurements will capture the incremental weights as the boat takes in additional load. For each boat type, assuming that 12 samples can be obtained will produce a minimum of 36 and a maximum of 60 data points.

A regression analysis will be conducted to determine the following (details of the regression analysis are presented in Appendix 1):

- The relationship of Actual Weight as a function of ΔD (the difference between the loaded D and De) and boat dimensions.
- The rate of change in ΔD as the load is augmented above a minimum weight.
- The Average Boat Capacity (ABC) providing a safe distance above water level.

The regression equations as detailed in Appendix 1 are expected to produce R-squared values above 0.90 to be usable for prediction purposes.

New Procedures to be Evolved by the Study:

In application, assuming that the study will be successful, the following new procedural options for calculating actual loads and fees are contemplated:

Option 1: Very little change compared to old procedure

1. Boats will be registered the usual way, with the usual documentation as to ownership.
2. They will be marked as before for identification.
3. Measurements of **L, Le, Bm, Bf, Bb**, and **De** will be obtained if the measurements are made for the first time.
4. Instead of an initial BLC calculated using the old BLC formula, an Average Boat Capacity or **ABC** will be calculated using the results of the study for the particular boat shape category.
5. Fees will be charged according to the **ABC.**
6. When the boat reports back to the station fully loaded, the actual load will be estimated by measuring the final distance above water **(Df)** and subtract this from the

De value recorded. The actual boat load (ABL) is then calculated and compared to ABC. The difference will be charged additional fees correspondingly. If the ABL is less than the ABC, then FD should make a decision on whether to refund the overpaid fees to the permittee (boat owner) or to credit him for the next shipment ot to totally forfeit the amount.

Option 2: Pre-determined Actual Load

This option provides for the case when a boat owner applies for a known amount of produce, for example, 600 maunds. Thus, the correct amount of fees can be calculated rightaway. The officer then determines the waterline from the results of this study and paints it on the side of the boat. The complete procedure will be as follows:

1. Boats will be registered the usual way, with the usual documentation as to ownership.
2. They will be marked as before for identification.
3. Measurements of **L, Le, Bm, Bf, Bb,** and **De** will be obtained if the measurements are made for the first time.
4. The applicant informs the officer how many maunds he wants to collect. The fees are calculated and paid for the maundage indicated.
5. The officer now consults a table of figures derived from this study and determines the number of centimeters (ΔD) above the water level. This will be the waterline for the known maundage. He then paints the waterline on the side of the boat. (From the X-point, this is the vertical distance of **(De-ΔD)**.
6. When the boat reports back to the station fully loaded, the officer checks if the waterline has been exceeded. If so, he measures the actual distance (Df) from the water level to the X-point. Consulting a table derived from this study, he determines the actual weight of the load and determines the additional fees to be paid.

Either option has the advantage of assuring the boat owner that correct fees are assessed based on actual weight. Likewise, the FD for revenue purposes will not be cheated. Moreover, the new system will provide a more accurate reporting of actual extraction rates of forest produce.

Estimated Cost of the Study (in Taka):

Cost of purchasing 1 heavy duty weighing Scale =	5,000
Cost of transporting crew members (fuel cost) =	7,000
Honorarium (rental) for boats to be used @Tk500/boat (approx) =	20,000
Wages for 6 laborers to load/unload boats @Tk100/person/day for 15 days =	9,000
Cost of paint, 700 jute sacks for sandbagging =	4,000.
Allowance for contingency	5,000
Total Cost of Study =	**50,000**

FORM 1- Raw Data Form for Recording Boat Measurements and Loads

N	Type	L	Le	Bm	Bf	Bb	De	W1	D1	W2	D2	W3	D3	W4	D4	W5

N = Boat identification Number
Type = Boat type (A, B, or C) See Figure 1.
W1= initial load (300 or 200 maunds approx)
W2,W3,W4,W5= trial additional weights
De = vertical distance to water line from X point in cm.
D1,D2...D5 = vertical distance to water level from X point in cm.
L= the longest length of boat from end to end in meters (excluding protrusions)
Le= the length of the waterline when the boat is empty
Bm.Bf,Bb = Breadth of boat at the middle, at ¼ L from front and from back, in meters.

APPENDIX V

NEW BLC SYSTEM
RAW DATA
AND
PROCESSED DATA

APPENDIX - Details of Regression Analysis to be Conducted

Part A1 – To determine load weight based on Le

(1) $W_L = c_0 + c_1 \Delta D.B_a.Le$ ...combined variable form

(1a) $\Delta D = C_0 + C_1 W_L / B_a.Le$ ... ΔD dependent C-V form

(2) $\log W_L = d_1 + d_2 \log \Delta D + d_3 \log B_a + d_4 \log Le$ ... logarithmic form

(2a) $\log \Delta D = D_1 + D_2 \log W_L + D_3 \log B_a + D_4 \log Le$ ... ΔD dependendent log form

where: W_L = Weight of Load
ΔD = Difference between De and D reading for given weight
B_a = Average of the three width readings Bm,Bf, and Bb
Le = length of boat at the waterline when empty
The c, C, d, and D's are regression coefficients to be estimated

PART A2 - To determine load weight based on L rather than Le

(1.1) $W_L = c_0 + c_1 \Delta D.B_a.L$ ...combined variable form

(1.1a) $\Delta D = C_0 + C_1 W_L / B_a.L$ ... ΔD dependent C-V form

(2.1) $\log W_L = d_1 + d_2 \log \Delta D + d_3 \log B_a + d_4 \log L$ ... logarithmic form

(2.1a) $\log \Delta D = D_1 + D_2 \log W_L + D_3 \log B_a + D_4 \log L$ ... ΔD dependendent log form

where: W_L = Weight of Load
ΔD = Difference between De and D reading for given weight
B_a = Average of the three width readings Bm,Bf, and Bb
L = longest length of boat (except protrusions)
The c, C, d, and D's are

Any loss in efficiency of estimates arising from the use of L only will be evaluated. Further, an average L such as Lav=½ (L+Le) will also be tried.

PART B1 – Rate of Change in Weight per unit change in D based on Le

(3) $\Delta W/\Delta D = g_0 + g_1 De.Le.B_a$ ... as a function of boat volume

(4) $\Delta W/\Delta D = h_0 + h_1 Le.B_a$ ... to test independence of (3) from De

(5) $\log(\Delta W/\Delta D) = m_0 + m_1 \log Le + m_2 \log B_a + m_3 \log De$

(6) $\log(\Delta W/\Delta D) = n_0 + n_1 \log Le + n_2 \log B_a$

... with g,h,m.and n's as regression coefficients to be estimated. Equations 5 and 6 are alternative logarithmic forms for (3) and (4).

PART B2 – Rate of Change in Weight per unit change in D based on L

(3.1) $\Delta W/\Delta D = g_0 + g_1 De.L.B_a$ ... as a function of boat volume

(4.1) $\Delta W/\Delta D = h_0 + h_1 L.B_a$ ... to test independence of (3) from De

(5.1) $\log(\Delta W/\Delta D) = m_0 + m_1 \log L + m_2 \log B_a + m_3 \log De$

(6.1) $\log(\Delta W/\Delta D) = n_0 + n_1 \log L + n_2 \log B_a$

... with g,h,m.and n's as regression coefficients to be estimated. Equations 5 and 6 are alternative logarithmic forms for (3) and (4).

In Parts B1 and B2, any losses in efficiency of estimates from the use of L rather than Le will be evaluated. Further, an average L such as Lav=½ (L+Le) will also be tried.

PART C – Average Boat Capacity (ABC)

Using Equation 1, ABC can be calculated as:

(7) $ABC = c_0 + c_1 D_a.B_a.Le$

Where: ABC = weight in maunds of allowable produce to be collected
Where: $D_a = p(De - k)/100$ with k as an arbitrary safe vertical distance from the X-point to the water level in cm and p is a percentage between 50 and 100

APPENDIX - VI

NEW BLC SYSTEM
RAW DATA
AND
PROCESSED DATA

PART I
NEW BLC SYSTEM
RAW DATA

No.	TYPE	L	LB	BM	BF	BB	Bav	De	W1	D1	W2	D2	W3	D3	W4	D4	W5	D5
1	3	6.8	5.2	1.51	1.39	1.33	1.41	38	540	30	1,080	23	0	0	0	0	0	0
2	3	7.1	5.3	1.63	1.48	1.46	1.52	35	540	28	1,080	21	0	0	0	0	0	0
3	3	7.2	5.5	1.76	1.64	1.60	1.67	56	1,692	35	3,350	17	0	0	0	0	0	0
4	3	7.7	5.4	1.92	1.78	1.80	1.83	45	1,176	30	2,016	20	2,632	15	0	0	0	0
5	3	7.8	6.6	1.88	1.75	1.73	1.79	44	2,050	22	3,485	9	0	0	0	0	0	0
6	3	8.0	6.1	2.04	1.74	2.06	1.95	40	800	34	1,600	29	2,000	24	2,810	16	0	0
7	3	8.6	7.1	2.52	2.50	2.46	2.49	35	3,000	15	5,035	6	0	0	0	0	0	0
8	3	9.3	7.3	2.40	2.30	2.30	2.33	66	2,050	47	4,200	30	0	0	0	0	0	0
9	3	10.6	8.9	2.99	2.90	2.96	2.95	55	3,000	45	5,000	38	9,000	25	13,000	13	0	0
10	3	10.8	10.1	3.56	3.57	3.56	3.56	70	8,000	52	12,100	40	16,600	28	20,103	17	0	0
11	3	11.1	8.3	2.60	2.50	2.50	2.53	58	4,100	36	8,450	16	0	0	0	0	0	0
12	3	11.4	9.5	2.56	2.40	2.70	2.53	81	4,100	62	8,305	44	0	0	0	0	0	0
13	3	11.7	11.0	3.80	3.60	3.20	3.53	71	9,400	41	13,700	23	17,800	19	0	0	0	0
14	3	11.7	10.8	3.52	3.11	2.15	2.93	69	3,000	58	12,000	33	16,000	31	20,050	25	0	0
15	3	11.8	11.2	3.50	3.50	3.47	3.49	78	9,500	44	13,800	28	18,900	26	20,400	21	21,200	0
16	3	11.9	10.1	3.30	3.23	3.08	3.20	52	4,000	39	8,600	21	10,830	15	0	0	0	0
17	3	12.1	11.6	3.12	3.14	3.08	3.11	62	4,000	46	8,600	29	12,446	12	0	0	0	0
18	3	12.4	10.9	3.94	3.89	3.90	3.91	68	8,800	38	12,150	31	0	0	0	0	0	0
19	3	12.4	11.0	3.51	3.28	3.40	3.40	56	4,000	39	8,600	24	12,200	13	0	0	0	0
20	3	12.6	11.5	3.67	3.50	3.36	3.51	75	6,000	55	10,500	49	14,500	36	18,600	24	22,755	0
21	3	12.8	11.8	3.21	3.20	3.18	3.20	61	4,000	49	8,600	35	13,200	17	14,280	13	0	0
22	3	13.2	11.4	3.01	3.56	3.41	3.33	57	4,000	44	8,000	32	12,050	22	0	0	0	0
23	3	14.2	12.8	3.17	3.70	3.53	3.47	60	4,200	46	8,400	33	11,090	24	15,090	15	0	0
24	2	6.1	4.5	1.60	1.34	1.37	1.44	41	1,025	19	2,005	9	0	0	0	0	0	0
25	2	6.8	2.8	2.03	1.60	1.62	1.75	53	2,340	27	0	0	0	0	0	0	0	0
26	2	7.3	5.5	2.00	1.72	1.82	1.85	40	2,000	16	2,800	6	0	0	0	0	0	0
27	2	7.3	5.4	2.00	1.71	1.83	1.85	39	1,155	21	1,700	19	2,300	14	3,100	6	0	0
28	2	7.7	5.9	2.25	1.99	2.13	2.12	43	2,000	13	3,650	7	0	0	0	0	0	0
29	2	8.6	5.1	2.08	1.86	1.77	1.90	41	1,300	27	1,800	24	3,900	8	0	0	0	0
30	2	9.9	5.3	1.80	1.38	1.48	1.55	43	1,500	23	2,800	10	0	0	0	0	0	0
31	2	10.5	8.1	2.74	2.27	2.50	2.50	77	4,100	50	8,510	26	10,440	14	0	0	0	0
32	2	16.3	13.6	4.40	2.95	3.80	3.72	132	3,393	124	12,285	101	16,751	96	25,623	87	0	0
33	1	9.5	7.2	3.55	3.12	2.65	3.11	79	4,212	52	8,505	27	10,675	15	0	0	0	0
	ALL	10.1	8.3	2.71	2.53	2.52	2.59	58.2	3,484	39.6	6,446	26.1						
	C	10.6	9.1	2.83	2.77	2.71	2.77	57.9	3,998	40.7	7,333	27.4						
	A,B	9.0	6.3	2.45	1.99	2.10	2.18	58.8	2,303	37.2	4,406	22.9						

PART II
PROCESSED DATA
BLC MEASUREMENTS

No	TYPE	L	LE	Bav	De	Disx	Wx
1	3.0	6.8	5.2	1.4	38.0	8.0	540
2	3.0	6.8	5.2	1.4	38.0	15.0	1,080
3	3.0	7.1	5.3	1.5	35.0	7.0	540
4	3.0	7.1	5.3	1.5	35.0	14.0	1,080
5	3.0	7.2	5.5	1.7	56.0	21.0	1,692
6	3.0	7.2	5.5	1.7	56.0	39.0	3,350
7	3.0	7.7	5.4	1.8	45.0	15.0	1,176
8	3.0	7.7	5.4	1.8	45.0	25.0	2,016
9	3.0	7.7	5.4	1.8	45.0	30.0	2,632
10	3.0	7.8	6.6	1.8	44.0	22.0	2,050
11	3.0	7.8	6.6	1.8	44.0	35.0	3,485
12	3.0	8.0	6.1	1.9	40.0	6.0	800
13	3.0	8.0	6.1	1.9	40.0	11.0	1,600
14	3.0	8.0	6.1	1.9	40.0	16.0	2,000
15	3.0	8.0	6.1	1.9	40.0	24.0	2,810
16	3.0	8.6	7.1	2.5	35.0	20.0	3,000
17	3.0	8.6	7.1	2.5	35.0	29.0	5,035
18	3.0	9.3	7.3	2.3	66.0	19.0	2,050
19	3.0	9.3	7.3	2.3	66.0	36.0	4,200
20	3.0	10.6	8.9	3.0	55.0	10.0	3,000
21	3.0	10.6	8.9	3.0	55.0	17.0	5,000
22	3.0	10.6	8.9	3.0	55.0	30.0	9,000
23	3.0	10.6	8.9	3.0	55.0	42.0	13,000
24	3.0	10.8	10.1	3.6	70.0	18.0	8,000
25	3.0	10.8	10.1	3.6	70.0	30.0	12,100
26	3.0	10.8	10.1	3.6	70.0	42.0	16,600
27	3.0	10.8	10.1	3.6	70.0	53.0	20,103
28	3.0	11.1	8.3	2.5	58.0	22.0	4,100
29	3.0	11.1	8.3	2.5	58.0	42.0	8,450
30	3.0	11.4	9.5	2.5	81.0	19.0	4,100
31	3.0	11.4	9.5	2.5	81.0	37.0	8,305
32	3.0	11.7	11.0	3.5	71.0	30.0	9,400
33	3.0	11.7	11.0	3.5	71.0	48.0	13,700
34	3.0	11.7	11.0	3.5	71.0	52.0	17,800
35	3.0	11.7	10.8	2.9	69.0	11.0	3,000
36	3.0	11.7	10.8	2.9	69.0	31.0	12,000
37	3.0	11.7	10.8	2.9	69.0	38.0	16,000
38	3.0	11.7	10.8	2.9	69.0	44.0	20,050
39	3.0	11.8	11.2	3.5	78.0	34.0	9,500
40	3.0	11.8	11.2	3.5	78.0	50.0	13,800
41	3.0	11.8	11.2	3.5	78.0	52.0	18,900
42	3.0	11.8	11.2	3.5	78.0	57.0	20,400
43	3.0	11.8	11.2	3.5	78.0	62.0	21,200
44	3.0	11.9	10.1	3.2	52.0	13.0	4,000
45	3.0	11.9	10.1	3.2	52.0	31.0	8,600
46	3.0	11.9	10.1	3.2	52.0	37.0	10,830
47	3.0	12.1	11.6	3.1	62.0	16.0	4,000
48	3.0	12.1	11.6	3.1	62.0	33.0	8,600
49	3.0	12.1	11.6	3.1	62.0	50.0	12,446
50	3.0	12.4	10.9	3.9	68.0	30.0	8,800

PART II
PROCESSED DATA
BLC MEASUREMENTS

No	TYPE	L	LE	Bav	De	Disx	Wx
51	3.0	12.4	10.9	3.9	68.0	37.0	12,150
52	3.0	12.4	11.0	3.4	56.0	17.0	4,000
53	3.0	12.4	11.0	3.4	56.0	32.0	8,600
54	3.0	12.4	11.0	3.4	56.0	43.0	12,200
55	3.0	12.6	11.5	3.5	75.0	20.0	6,000
56	3.0	12.6	11.5	3.5	75.0	26.0	10,500
57	3.0	12.6	11.5	3.5	75.0	39.0	14,500
58	3.0	12.6	11.5	3.5	75.0	51.0	18,600
59	3.0	12.6	11.5	3.5	75.0	62.0	22,755
60	3.0	12.8	11.8	3.2	61.0	12.0	4,000
61	3.0	12.8	11.8	3.2	61.0	26.0	8,600
62	3.0	12.8	11.8	3.2	61.0	44.0	13,200
63	3.0	12.8	11.8	3.2	61.0	48.0	14,280
64	3.0	13.2	11.4	3.3	57.0	13.0	4,000
65	3.0	13.2	11.4	3.3	57.0	25.0	8,000
66	3.0	13.2	11.4	3.3	57.0	35.0	12,050
67	3.0	14.2	12.8	3.5	60.0	14.0	4,200
68	3.0	14.2	12.8	3.5	60.0	27.0	8,400
69	3.0	14.2	12.8	3.5	60.0	36.0	11,090
70	3.0	14.2	12.8	3.5	60.0	45.0	15,090
71	2.0	6.1	4.5	1.4	41.0	22.0	1,025
72	2.0	6.1	4.5	1.4	41.0	32.0	2,005
73	2.0	6.8	2.8	1.8	53.0	26.0	2,340
74	2.0	7.3	5.5	1.8	40.0	24.0	2,000
75	2.0	7.3	5.5	1.8	40.0	34.0	2,800
76	2.0	7.3	5.4	1.8	39.0	18.0	1,155
77	2.0	7.3	5.4	1.8	39.0	20.0	1,700
78	2.0	7.3	5.4	1.8	39.0	25.0	2,300
79	2.0	7.3	5.4	1.8	39.0	33.0	3,100
80	2.0	7.7	5.9	2.1	43.0	30.0	2,000
81	2.0	7.7	5.9	2.1	43.0	36.0	3,650
82	2.0	8.6	5.1	1.9	41.0	14.0	1,300
83	2.0	8.6	5.1	1.9	41.0	17.0	1,800
84	2.0	8.6	5.1	1.9	41.0	33.0	3,900
85	2.0	9.9	5.3	1.6	43.0	20.0	1,500
86	2.0	9.9	5.3	1.6	43.0	33.0	2,800
87	2.0	10.5	8.1	2.5	77.0	27.0	4,100
88	2.0	10.5	8.1	2.5	77.0	51.0	8,510
89	2.0	10.5	8.1	2.5	77.0	63.0	10,440
90	2.0	16.3	13.6	3.7	132.0	8.0	3,393
91	2.0	16.3	13.6	3.7	132.0	31.0	12,285
92	2.0	16.3	13.6	3.7	132.0	36.0	16,731
93	2.0	16.3	13.6	3.7	132.0	45.0	25,623
94	1.0	9.5	7.2	3.1	79.0	27.0	4,212
95	1.0	9.5	7.2	3.1	79.0	52.0	8,505
96	1.0	9.5	7.2	3.1	79.0	64.0	10,675
	Avg	10.6	8.9	2.7	60.8	30.7	7.687
	Max	16.3	13.6	3.9	132.0	64.0	25.623
	Min	6.1	2.8	1.4	35.0	6.0	540

APPENDIX - VII

CHECK LIST FOR GOLPATA INFORMATIONS COLLECTIONS THROUGH VILLAGE COMMUNITY WORKSHOP

District.....
Thana.....
Union.....
Village.....

Populations.....
District.....
Thana.....
Union.....
Villages.....

- Nos. of Golpata collectors (male and female separately) attended the workshop
- Nos. of persons (male and female separately) involved in Golpata collections
- Nos. of persons:
  -- Who provide labors; has these nos increased or decreased over last
  -- Last 5 years / 2 years; how much TK/day do they get (should be self assessed - may be Casual labor rates
- How these persons get involved in Golpata collections
- How many persons use Golpata:

What for	How much	Month	Time Input	Whose labor-	Where n.a.
Own use Sale					

- How much time is spent for harvesting Golpata

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- How these persons get involved in Golpata collections
- How many persons use Golpata:

What for	How much	Month	Time Input	Whose labor-	Where n.a.
Own use Sale					

- How much time is spent for harvesting Golpata

- What categories (Capacities) of boats are used for collecting Golpata and how many members of each catagory
- How much it costs for collecting 1md. Of Golpata and at what rate (in Tk.) it is sold in market per mound (Market rate of Golpata)
- Where the Golpata collectors sell their Golpata? Which are the markets? What percentage of Golpata is harvested? Who are the middle men?
- How much Golpata do you find in the forests and markets? Was it more or less 5 years ago or 10 years ago.
- Are Golpata permits holder get now more permit than 5 years or 10 years ago? Are they more expensive now than 5 years ago or 10 year ago?
- How many people grow Golpata in the locality (village) and why they grow it and for what purpose? Are the Golpata plantations raised by the people themselves successfully or have these plantations been failed. How much time is spent for raising such Golpata plantation? How much Golpata have been produced from such plantations? Do the people want to raise more Golpata plantations?
- Has the price of Golpata been raised in market now than previous years. (5 or 10 years)?If so, what is the reason?
- Are there more opportunities for using Golpata now than previous years (5 or 10 years)?
- Are there any cottage industries in the area based on Golpata? If not, is there any scope of establishing such cottage industries by the people in the area?
- Do the Golpata collectors Know the Cutting rules of Golpata of the FD? How do they learn the rules? Do they cut according to rules.
- Do the Golpata collectors go to the same places in Sundarbans every year for collecting Golpata?

- How long the Golpata collectors have been coming to the sundarban? Did their parents and grand parents also used to go to Sundarbans for collecting Golpata? Do the people get the same amount of Golpata every year in the same place? Did they used to get such amount earlier, say 5 or 10 years age?
- After cutting do they soak the fronds in water?
- How many trips are made to the sundarbans per month/year/season for collecting golpata?
- How many people are involved in each of such trip? Are there any conflicts by the golpata collectors with the FD or others in Collecting Golpata from the Sundarbans?
- Are these people dependable on Sundarbans for their livelihood? Do they have any other sources of earning livelihood? If so, what are these?
- Are there any opportunities of developing any other sources of income generations for these people in this area? If so, name such opportunities. Can these opportunities be developed by the people of this area themselves or do they need support of the Govt. In this respect? If so, what type of support do they want from, the Govt.
- Have they get any problems/constraints in workings in Sundarbons for collecting Golpata. If so, name these problems /constraints and what do they suggest for solving these problems/constraints
- How may trips per year for cutting Golpata?
- How many days for starting/ transport /departure.
- How many days cutting /trip.
- How much cut per person:
- 1 day - in good stands fronds
- --In poor stands; how much to pay for knife , etc.
- Do they harvest other resources from SRF.

Document Name : Technical Note: 3 - Minor Forest Products
Date : 17 Sept '2000

SUNDARBAN BIODIVERSITY CONSERVATION PROEJCT

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CONSULTANTS

- ☐ Mr. Robert C. Ellis, Team Leader, SBCP
- ☑ Mr. Wandert Benthem, Mangrove Specialist
- ☑ Mr. Garry Bernacsek, Fisheries Management Specialist
- ☑ Mr. Hans van Zon, Fisheries Management Specialist
- ☑ Mr. Luis Chaves, Eco-tourism Specialist
- ☑ Ms. Maureen de Coursey, Non – Wood Forest Product Specialist

- ☐ Mr. Andrew Jenkins, Community Dev. Specialist
- ☐ Mr. Anthony Latham, Media Commun. Specialist
- ☐ Mr. Jean Louis Leterme, Common Property Dev. Specialist
- ☐ Mr. Clarence Maloney, Management Advisor
- ☑ Mr. Lindsay S. Saunders, Natural Resources Economist
- ☑ Mr. Walther Warnaar, MIS Specialist
- ☑ Mr. M. A. Malek, Coordination Specialist
- ☐ Mr. Mouddur Rahman, Info/ Edu. & Commu. Specialist
- ☑ Mr. R. A. Chowdhury, Minor Forestry Prod. Specialist
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