TECHNICAL REPORT

Boundary Demarcation, Surveying & Mapping of Sustainable Forest Management (SFM) areas of Afforestation Division Sukkur.

Survey of Pakistan
Directorate of Southern Circle
No. 2 Survey Party Karachi
Tele: 021-99266381
Fax: 021-99266382

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Foreword

It gives me immense pleasure to write that Survey of Pakistan, SoP, have completed the boundary demarcation & survey of reverine forest of Sukkur Division under Sustainable Forest Management (SFM) Project (UNDP) funding for Sindh Forest Department, Government of Sindh. The whole project report has been divided into three parts Introduction, field result and recommendations.

We are highly thankful to Security agencies i.e Pakistan Rangers (Sindh), Shahbaz Rangers wing Sukkur and local Police providing full security cover and protection to Survey of Pakistan team during Survey Operation in notorious place “Kacha Area”. It is fact that without their support and assistance it was not possible to accomplish the task in stipulated time frame.

We are quite happy and satisfied that a national importance job has been accomplished in befitting manner, with desire support from all stakeholders at all stages of project executions.

Introduction

RIVERINE BELT

The riverine forest belt of Pakistan occurs on both side of the river Indus and its major tributaries. This belt contributes a lot when flood water spills over the river banks and is restricted on both sides of rivers by embankments. The riverine belt of Sindh initiating from Guddu Barrage continues till Indus Delta. This makes a strip along the sides of river Indus duly protected through embankments along river banks. The width of the riverine belt varies from 05 mile to 14 mile between embankments. Out of this huge area, the substantial riverine area of 140333.8 acres is legally declared as reserved Forest under section 20 of the Forest Act, 1927, which prohibits all acts except permitted under contract/agreement in the best Forestry interest.

Due to fluctuation in flood frequency, the prolonged droughts were observed which have badly affected the riverine Forests as a whole. Besides, the manifold population increment during last 2-3 decades, worst law and order regime from late 70s and weak governance were the core reasons which have paved way for peoples intrusion in reserved forests causing heavy encroachments, unauthorized cultivations and boundary alternations/defacing over the years.

SUSTAINABLE FOREST MANAGEMENT PROJECT

Sustainable forest management project is a joint project of Government of Pakistan, UNDP and GEF. Taking cognizance of heavy damages during 2010 super flood, honorable Supreme Court has ordered to remove all encroachments, to raze zamindaree bands and undertake massive Afforestation in riverine belt to avert/control flood damages in future. The federal flood commission is monitoring the compliance of court orders through a committee headed by one MNA. However, in compliance of court orders and under the provisions of GEF-UNDP assisted Sustainable Forest Management Project, the massive reforestation is to be carried out for which detail

INTRODUCTION

topographic survey of specific riverine forests is included as major project activity and Survey of Pakistan, Karachi was entrusted the Topographic Survey and Demarcation of BPs job, detailed as below.

DETAIL OF FOREST SURVEYED

DISTRICT	TALUKA	NAME	AREA PROPOSED (ACRES)	AREA SURVEYED (ACRRS)
Sukkur	New Sukkur	Qadrapur	2118.7	2120
Sukkur	New Sukkur	Ketishah	17925	17925
Sukkur	New Sukkur / Rohri / Pano Aqil	Bindi Dhareja	7264.5	7041
Shikarpur	Lakhi / Khanpur	Ketiabad	11325.2	17274
Sukkur	Pano Aqil	SK Shahu	10752	6852
Sukkur	Pano Aqil	Ketishahu	11144.8	16181

INTRODUCTION OF EXECUTING AGGENCY

Survey of Pakistan is an attached department of Ministry of Defense, Government of Pakistan. Its head office is located at Rawalpindi and regional offices at provincial capitals. The superintendence of Survey of Pakistan is vested with federal government and administration is vested and exercised by the Surveyor General of Pakistan. The task of this project was assigned and falls under the jurisdiction of Directorate of Southern Circle, Survey of Pakistan, Karachi

INTRODUCTION

RESPONSIBILITIES OF SURVEY OF PAKISTAN

Survey of Pakistan being sole national mapping organization is authorized to carry out survey work in view of SURVEY AND MAPPING ACT-2014. Survey of Pakistan is actively participating in the national development project and thus fulfilling the ever growing surveying and mapping demands of various government / semi-government and autonomous bodies. Over the years the department has gradually switched over from conventional to the digital production line by adopting modern surveying and mapping techniques methods and equipment. Some of the responsibilities of Survey of Pakistan are given as under.

- To provide Geodetic Control Points and Geographical Positions all over Pakistan
- To carry out topographic survey, updation and printing of topographic maps / sheets of National Map Series on scale 1:50000
- To delineate International Borders and demarcate and relocate Border Pillars
- To compile Derived Maps on scale 1:250000, 1: ½ M, 1:1M 1:2M and Aeronautical & ICAO Charts on scale 1:1M
- To generate maps on any scale through Aerial Photography and Remote Sensing through analytical and digital methods
- To develop GIS for Govt. / Semi Govt. departments, organizations and private sector according to their requirements on payment
- To survey & prepare Cantonment Maps
- To prepare and print Guide Maps, Atlas of Pakistan, District Maps and Road Maps

INTRODUCTION

- To train departmental employees and potential candidates from public / private sectors in various disciplines of surveying and mapping at Survey Training Institute in Certificate, Diploma and Short Courses
- To monitor the surveying and Mapping activities in Pakistan and to check the quality of data captured and to restrict / bound the unauthorized personnel's / organization / departments and individuals those who are not register with SoP and involved in spatial data collection

SEQUENCE OF THE REPORT

The report consist of three parts Introduction, Field results and recommendations. The first part Introduction consists of three sections, Introduction, Objectives and Methodologies. The section Introduction has brief introduction of Riverine Belt, Sustainable Forest Management (SFM) program. The section Objectives is describing the objectives of this specific project and deliverables that were agreed in ToR signed by both the departments. The section Methodologies is related to methods and procedures adopted to carry out this project.

The second part of the report is field results it consists of two sections Field Activities & Results and constraints and lessons learnt. The section Field activities and Results describe the type of usage of equipment / instruments and results obtained in the shape of provision of Ground Control Points (GCPs) and forest boundary delineated and demarcated. The section Constraints and lessons learnt is specifically about the learning and experience of our team. The third part of the report is Recommendations this chapter consists of some suggestions for betterment of SFM projects.

Objectives

In the beginning Terms of Reference (ToR) was signed for the project topographic survey and mapping of sustainable forest management (SFM) landscape forest areas of afforestation division sukkur. The ToR was sigined between the Conservator of Forests, Afforestation Circle, Sukkur and Directorate of Southern Circle, Survey of Pakistan, Karachi. In the ToR the scope of work, objectives deliverables, estimated time and cost was mentioned. The ToR is attached as Annex A at the end of the report. In accordance with ToR the demarcation and topographic survey of six riverine forest of afforestation circle sukkur, was carried out in April 2018. The objectives and deliverables as agreed in ToR are listed below.

OBJECTIVES

- To carry out topographic survey of above listed six riverine forests of Afforestation Division, Sukkur and demarcation of boundaries.
- To identify /demarcate the appropriate locations along boundaries for fixation of Geo referenced boundary pillars.
- To design, construct and fix 400 boundary pillars on geo referred locations.
- To provide Ground Control Point (GCPs) using Dual; Frequency GPs to establish Bench mark/ Reference Points for using to rectify satellite images on scale 1”=1Mile (1:63360), 1” = ½ Mile (1:31680) and 8”=1 Mile (1:7920).
- To digitize surveyed forest areas on scale 2”=1Mile (1:31680) 02 sheets and 8” = 1Mile (1:7920) 34 sheets with standard colours and Symbology of Survey of Pakistan.

OBJECTIVES

DELIVERABLES

The deliverables were also agreed upon in the ToR signed in the beginning of the project, deliverables are listed below.

- Five hard copies of each Map / Sheet to be provided to indenter.
- One soft copy in shape file / mixed format to be provided to indenter.
- Draft notification for each Forest with geo referenced boundaries / limits shall be prepared by vendor for issuing fresh notifications by the Government of Sindh in suppression of earlier notifications and valid to be used in litigations and re-surveying.
- Geo-Spatial data / technical document shall be prepared by Vendor for Indenter.
- Re-alignment of duly geo-referenced forest compartment (160 acre sized areas) lines shall be made on 1”=1 mile scale map for facilitating in locating the compartment line as and when needed.

Methodology

The execution of the project could be segregated into three parts establishing geodetic control, demarcating the forest boundaries and digitizing the topographic detail. The field activities started in mid of March 2018 and completed by the end of April 2018.

The geodetic control from RohriSBM and Pano Aqil SBM was shifted to fiveBenchmarks (BMs) established atGoth Lal Bux Mehar, Rohri Forest Nursery, Forest Rest House, Ketiabad and SK Shahuusing dual frequency GPS set. Rohri and Pano Aqil SBMs are connected with national geodetic network of high accuracy order. At planning stage more FBPs and less GCPs were worked out but during the execution phase it become vice versa and changed the previous plan in the best interest of accuracy and authentication of final product. Now there are 272 FBPs and 782 GCPs that have been provided on ground.

PROVIDING CONTROL POINTS IN THE FIELD

Bench Marks

The establishment of base points with reference to any high accuracy national grid point is very essential to have the high precision and accuracy in any survey work. In this regard 05 BMs were established in the area of work referenced to Rohri SBM and Pano Akil SBM, which are high order national geodetic network points in our country. These 05 BMs were established with 07 to 08 hours observation at Lal Bus Mehar, Rohri Forest Nursery and Forest Rest

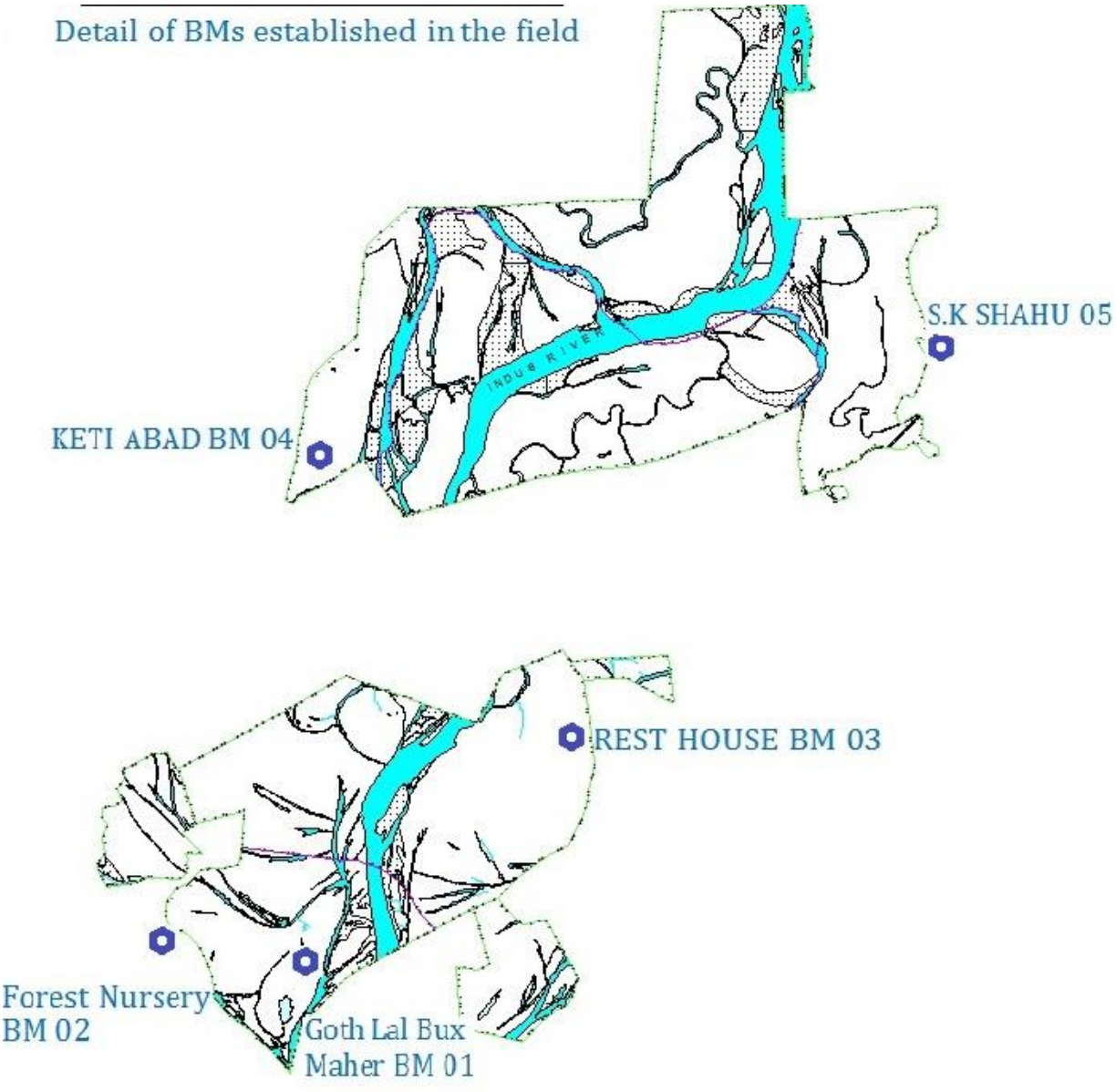
METHODOLOGY

House, Shah Bello. Three BMs are situated in sheet 1 and two BMs are situated in sheet 2. The detail of the BMs is provided in following table.

BENCH MARKS ESTABLISHED IN FIELD

SL. NO	FOREST	BM
1	Bindi Dhareja	BM 01
2	Keti Shah	BM 03
3	Ketiabad	BM 04
4	SK Shahu	BM 05
5	Qadarpur	BM 02

METHODOLOGY



These BMs were then used to provide the supplementary control and demarcation of forest boundary pillars. The points were observed using dual frequency GPS in WGS-84 system. The forest boundaries have been demarcated physically on the ground as per documents provided by DFO Forest Afforestation Division Sukkur, and further identified by the representatives of the forest department.

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Ground Control Point

Combined map of three forest Qadrapur, Bindhi Dhareja and KT Shah provided by the forest department was geo-referenced and control points were planned on that map. The control points were provided having BM as the base station and rover on the control points. A total of 782 Ground control points were observed in the field, for all the control points the duration of observation was around half an hour for each GCP. The GCPs are used to provide the geo referenced coordinate to Forest Boundary Pillars and to provide the control to the satellite imagery. The detail of GCPs is given in following table.

DETAIL OF GCP AND FOREST BOUNDARY PILLAR IN EACH FOREST

FOREST	AREA	GCPs	FBPs	COMPRTMENTS
Qadarapur	2120	39	37	19
Keti Shah	17925	142	78	136
Bindi Dhareja	7041	81	28	57
Ketiabad	17274	143	52	120
S.K Shahu	6852	68	58	48
Keti Shahu	16181	78	17	112
Out-side the Forest area	-	231	-	-

METHODOLOGY

DEMARCATION OF BOUNDARIES

Boundary Pillars

The boundary pillars are of length 3 feet, width and about 1.5 foot of which is buried in ground and half shown above, whereas the surface area of each pillar is one square foot, as shown in the image. The final GPS reading was observe after the erection of the Forest Boundary Pillars. A total of 272 boundary pillars have been erected on ground in six forest. The Qardarpur forest has the separate boundary pillar numbers whereas others have their outerlimit demarcated. The detail of forest wise pillars is given in above table.

IDENTIFICATION OF FOREST BOUNDARY PILLAR ON GROUND

The Forest boundaries were firstly identified on Deh Maps provided by the forest departments and then the proper Forest Boundary Pillar positions were marked on the deh maps with the assistance of representatives of forest departments. To locate/ relay the pointed position on the ground different soft wares were used, later the position on ground was physically identified by representatives of forest department.

DIGITIZATION OF DETAIL

The digitization of the forest area was carried out Stereo Satellite Imagery of 0.3 m resolution. The maps are projected in UTM projection on the scale 2”=1 mile (1:31680), 1”=1 mile (1: 63000) and 8”= 1 mile (1: 7920). The Forest Compartment having an area of 160 acres have been shown on the maps

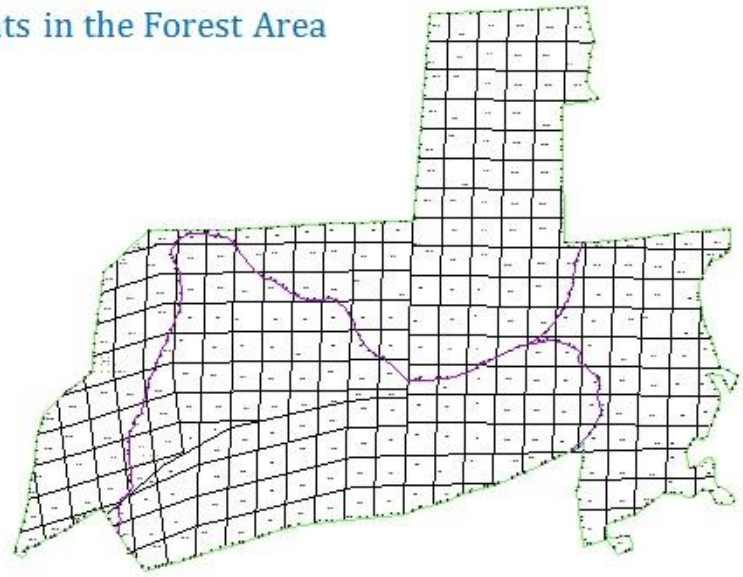
The forest boundary shown on the map is true to ground with respect to Forest Boundary Pillars, straight from one pillar to next pillar. The compartment lines are drawn keeping the area fixed as 160 acres in most of the compartments. The lines are drawn

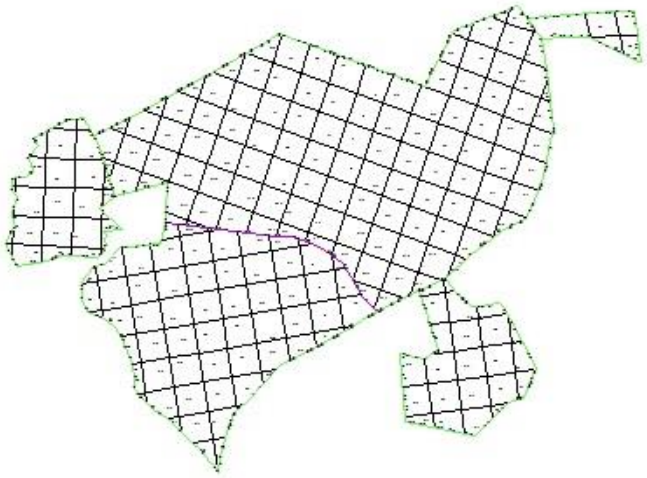
to be on an approximate position so that it appears to be at its old position as depicted in the old forest map. The sketch of the compartment in forest area are given as under.

0.3 meter resolution satellite imagery was obtained and DEM was generated through that imagery. The detail like dense forest, cultivation and other have been

digitized using 0.3m resolution satellite imagery and 34 sheets on scale 1:7920, 02 sheets on 1:31680, 01 sheet on 1:63360 have been prepared.

Sketch of Compartments in the Forest Area





METHODOLOGY

DETAIL OF LAYERS IN DIGITIZED MAP		
LAYERS	TYPE	DESCRIOTION
Bondary pillar	Point	This layer consists of Boundary pillar. It is a type of control point with ID 1
Boundary line	Line	This layer is connecting all the FBPs and is categorized as Forest Boundary and Internal Boundary
Control Point	Point	It consists of all the control points except FBPs. It includes Bench Mark and Control Points
Water feature poly	Polygon	It is categorized as Drain-non-perennial, Island, Lake, Pond-Perennial, River bed and River filling
Water feature line	Line	It describes the outer limits of all the water bodies. It also describes the perennial and non-perennial nalas
Road	Line	This layer contains all types of roads

Dense forest	Polygon	This layer describes the areas which have high density of trees
Cultivation	Polygon	It give cultivated area
Cultivation limit	Line	This layer is used to give the outer limit to cultivated areas
Contour	Line	It describes the contour lines falling in the area
Compartments	Polygon	This layer consist of almost equal sized compartments. Every compartment comprising of 160 acres
Embankment	Line	It describes embankment
Block	Polygon	It represents dense population, like cities
Block point	Point	Permanent huts and Mosques are shown in this layer
Tree	Point	It describes different types of trees

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EQUIPMENTS AND SOFTWARES USED

- Lieca Dual Frequency GPS set
- Arc GIS (9.3)
- Data processing Software (Skypro)
- Prolink

Field Activities and Summary

Field activities commenced on 15th March 2018, the Camp Head Quarter was established at forest nursery Sukkur. Mr. Nazir Ahmed, Survey Officer performed the duties as Camp Officer in supervision of Mr. Din Muhammad Mahar, Officer-in-Charge and Mr. Asad Ali Bhellar, Director Southern Circle. The field activities were span over two aud half months and completed on 31-05-2018. During the period the progress of field activities were regularly submitted to the all the concerned departments and the Surveyor General of Pakistan.

Detail of field activities as planned and executed are given in the following table with reasons for increase in the Quantum. The area to be surveyed was initially estimated as 60749.8 acres however during the field activities as per physical verification of ground features the area was accrued to be 67393 acres. As a result of field activities 6643 Acres Land of Forest Department was recovered/reclaimed. The number of FBPs planned were 400 whereas only 272 boundary pillars were erected on the ground. However 500 Ground Control Points (GCPs) were planned but the number of GCPs increased to 782 points. The agreed tasks and accomplished task comparison is drawn in the following table.

DETAIL FOR QUANTUM OF WORK

ITEM	AGREED	ACOMPLISHED	DIFFERENCE	REASONS
Area	60750	67393	6643	Increase in area is based on actual measurement.
GCPs	500	782	380	Because of increased area
FBPs	400	272	128	Internal limits between adjoining forests have not been identified demarcated

FIELD ACTIVITIES AND SUMMARY

TERRAIN TYPE

The terrain of the area is almost plain with height difference of 05meter to the maximum. Most of the area is covered with dense forest, and in some parts cultivation is also present. The weather in the area is hot and humid, tree shades are very dense and create obstacle in GPS observation. Movability in the area is difficult because of dense forest and not much tracks were there. The river Indus flows in between the forest area and only viable way to cross the Indus River is through boats.

Six forests that are demarcated and surveyed falls within the jurisdiction of District Sukkur whereas some part of Ketiabad forest falls in jurisdiction of District Shikarpur, the detail of each forest is mentioned in Table “Detail of Forest Surveyed”. The forests in the north, Ketiabad, Keti Shahu and Sk Shahu, are shown on Sheet 1 and the forest in the South, Qadrapur, Bindi Dhareja and Ketishah are shown on Sheet 2. In the extreme south city Sukkur is situated just adjacent to the forest Bindi Dhareja and city Pano Aqil is situated in the extreme east of the forest SK Shahu a little far from it. Where as city Chak is situated in the west of forest Ketiabad.

DEMARCATION OF FOREST BOUNDARY PILLARS

Total of 272 forest boundary pillars were erected on the ground. The pillar position was initially marked by the representatives of forest on the deh maps provided by revenue department and from there on the same were identified on ground and the coordinates were provided to it using dual frequency GPS. Initially as per ToR total number FBPs to be erected were 400, however the less number of boundary pillars were demarcated as the internal limits between the forests were not distinguishable on ground. At the initial stage it was proposed to be 400 FBPs but during the field only 272 FBPs were erected. However one can see in the Table “Detail for Quantum of Work” that in all other field activities the quantum of work has increased due to many other reasons.

FIELD ACTIVITIES AND SUMMARY

DETAIL OF GCPs

A total of 782 GCPs were provided on ground using dual frequency GPS every GCP sketch were prepared and the description of the point was mentioned. The GCPs were established using dual frequency GPS having base at one of the Bench Marks BM established in the forest area.There were total of five Bench Marks are established in the forest areal the detail is shown in Table “Bench Marks established in the field”.

Initially as per ToR 500 GCPs were planned however some 782 GCPs were established during the field activites. The number of GCPs increased mainly because of the increase in area and to provide better accuracy in the topographic survey. The detail of increase in Quantum of work is mentioned in Table “Detail of Quantum of Work”.

DISPUTES WITH VILLAGERS

During execution of forest boundary demarcation and embedding of boundary pillars number of khatedars of Deh Rahuja, Taluka New sukkur raised objection on measurement / encroachment in their land by Survey of Pakistan team. In response Director Southern Circle, Officer-in-Charge No. 2-Party, Camp Officer along with his team convened Khuli Katchery (Open Darbar) at CHQ Sukkur and listened their point of view and their genuine concern about limits of forest boundaries was resolved with their satisfaction, by this we became successful in completing the assigned task in befitting manner.

RESULTS

Ground Control Points

Five Bench Marks (BMs) of high accuracy were established in the area of field. All the BMs were established using dual frequency GPS and are referred to National Geodetic Grid. The detail of BMs is given in section “Methodolgy”. In the field area survey team

established 782 GCPs for establishment of control, demarcation of Forest Boundary Pillars, and drawing of contour lines. The detail of GCPs is provided in section “Methodology”.

Forest Boundary Pillars

272 Forest Boundary Pillars have been erected in the field for six forests. Qadarpur is the only forest that has its full limits delineated in the field. The other forests share the internal limits with each other and are not demarcated in the field. However the external limits of all the forests are delineated in the field. The detail of Forest Boundary Pillars with reference to respective forests is given in draft notification.

Area Surveyed and recovered

Initially the tentative area planned was 60750 Acres, however after the field activities it was found to be as 67393 Acres. The reason could be actual measurements on ground, that is to say that the initial plan was made on small scale maps, whereas on conclusion of Original survey / demarcation of limits of forest the substantive increase in the area was accrued.

Project Teams

The success and failure of project depends upon the employment of manpower for executing by having the right place, at the right time.

We are lucky having all the desired attributes with our project team. As a recognition of their valuable contribution and positive involvement in this project their names, designation & Organizations are mentioned fir future record & references.

PROJECT TEAM

SL. NO.	NAME	DESIGNATION	ORGANISATION
1.	Mr. Muhammad Ayaz Khan	National Country Manager SFM	UNDP/SFM
2.	Mr. Ghulam Qadir Shah	Project Manager	UNDP/SFM
3.	Mr. Abdul Haque Shaikh	Provincial Coordinator SFM	UNDP/SFM
4.	Mr. Muhammad Saleem Vistro	Conservator Forest Afforestation Circle	Forest Deptt. Govt. of Sindh
5.	Mr. Iftikhar Arain	DFO, Afforestation Division Sukkur	Forest Deptt. Govt. of Sindh
6.	Mr. Noor Ellahi	Deputy Surveyor General-II	Survey of Pakistan
7.	Mr. Asad Ali Bhellar	Director Southern Circle	Survey of Pakistan
8.	Mr. Haroon Majeed	Deputy Director / Officer-in-Charge No. 2 Party	Survey of Pakistan
9.	Mr. Din Muhammad	Assistant Director / Ex-Officer-in-Charge No. 2 Party	Survey of Pakistan
10.	Mr. Khalid Tufail	Assistant Director/Technical Officer to DSC	Survey of Pakistan

11.	Mr. Nazir Ahmed	Survey Officer/Camp Officer	Survey of Pakistan

Constraints and lessons learnt

INTERACTION WITH REVENUE DEPARTMENT

The Revenue Department Govt. of Sindh shared the desired revenue record but they left the field at very early stage of work. We felt some personal, organizational and capacities issues with Revenue Department officials. We also observed lack of dedication and determination with them. The main issue must be their traditional working practices and were not comfortable with our latest methods of using advance equipment.

The efforts shall be made to take them onboard with the use advanced methods of Land Measurements, so that a healthy participation of both the departments could be seen in future.

TRAVELING ON BOAT

The Indus river falls in between the forest, hence to cross the river was only way so we used the boat to cross the river very oftenly.

DISPUTES WITH VILLAGERS

During execution of forest boundary demarcation and embedding of boundary pillars number of khatedars of Deh Rahuja, Taluka New sukkur raised objection on measurement / encroachment in their land by Survey of Pakistan team. In response Director Southern Circle, Officer-in-Charge No. 2-Party, Camp Officer along with his team convened Khuli Katchery (Open Darbar) at CHQ Sukkur and listened their point of view and their genuine concern about limits of forest boundaries was resolved with their satisfaction, by this we became successful in completing the assigned task in befitting manner.

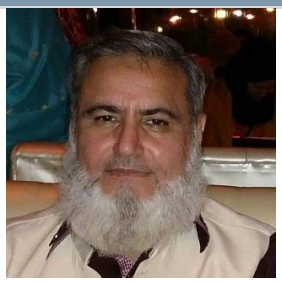
Recommendation and Suggestions

As this project has now been completed and all the deliverables have been delivered to the indentor, here are some recommendations and suggestions to be considered at appropriate level.

- Its better to have all the forest area got demarcated and notified.
- There should be an exercise as to ascertain the reasons for the increase in the area.
- There should be a routine exercise to check the boundary pillars, if they are damaged or destroyed then their repairs be carried out.
- Some of your Officials of SFD be trained for routine field activities. Survey Training Institute, Survey of Pakistan can arrange a suitable training sessions for your department.
- SFD should digitize historical records of reverence forest. These records must by well documented.
- Develop automated methods of companies of long term record using current computer based techniques.
- Utilization of emerging technologies like GIS Remote Sense & Satellite imageries quantitative analysis.

Contact Information

To replace a photo with your own, right-click it and then choose Change Picture.

ASAD ALI BEHLAR DIRECTOR	HAROON MAJEED VEESER DEPUTY DIRECTOR	KHALID TUFAIL ASSISTANT DIRECTOR
		
Tel02199266382 **Fax**02199266381 dwcquetta@gmail.com	**Tel**02199266388 **Fax**02199266381 haroonbahe@gmail.com	**Tel**02199266383 **Fax**02199266381 khalidtufail@gmail.com

Maps of the Forest