

MEMORANDUM OF UNDERSTANDING

BETWEEN

PROJECT ON CLIMATE RESILIENT AGRICULTURE,
GOVERNMENT OF MAHARASHTRA

AND

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
For

WATER BALANCE FOR WATERSHED PLANS UNDER PoCRA

This Memorandum of Understanding is entered into at Mumbai on 16th August, 2017 hereinafter called 'MoU'.

BETWEEN

Project Management Unit of Project on Climate Resilient Agriculture (PoCRA), Government of Maharashtra represented by Project Director having its office located at 30, ARCADE World Trade Centre, Cuffe Parade, Mumbai- 400005 (herein after referred to as '**First Party**') which term and expression shall mean and include, unless repugnant to the context, its successors, assignees, administrators of the First Party

AND




Indian Institute of Technology Bombay, represented by Dean (Research and Development) having its office at Powai, Mumbai 400076 (hereinafter referred to as '**Second Party**') which term and expression shall mean and include, unless repugnant to the context, its successors, assignees, administrators of the Second Party

1.0 Source of Funding: The First Party will receive financing from the World Bank which will be used for this MoU and the First Party wishes to have the Second Party perform the services hereinafter referred to, and WHEREAS, based on the offer by the First Party, the Second Party is willing to perform these services.

2.0 Preamble:

Government of Maharashtra (GoM) has decided to implement the World Bank aided project on climate resilient agriculture namely Project on Climate Resilient (PoCRA). The project development objective is to enhance climate-resilience and profitability of smallholder farming systems in project districts of Maharashtra. The project aims to achieve the objective through promotion of climate resilient technologies and commodity value chain across approximately 4,000 drought-prone villages in 15 districts, namely, Jalgaon, Aurangabad, Jalna, Beed, Parbhani, Hingoli, Osmanabad, Latur, Nanded, Buldana, Washim, Akola, Amravati, Yavatmal, and Wardha and approximately 1000 salinity affected villages in the basin of Purna river spread across Akola, Amravati, Buldana and Jalgaon districts.

One of the important aspects of ensuring resilience is to assure availability of soil moisture at the critical stages of the crops. Since most of the project clusters are in rainfed areas, management of rainwater becomes critical. A host of factors like rainfall pattern, total rainfall, geomorphology of the watersheds, groundwater recharge potential, surface water & soil moisture management and cropping pattern have impact on the resilience of farmers against climate vulnerability and change. The long-term climate change projections indicate increased moisture stress on agriculture sector. Therefore, a scientific

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planning of this critical resource with stakeholder engagement is the key to ensure enhanced water and crop productivity.

3.0 Objective and Scope of the Assignment:

The project would be implemented in groups of villages (clusters) which are to be formed on the basis of hydrological boundaries (mini-watershed). The planning for the project activities in a cluster would be done through a participatory planning exercise called micro planning. In order to promote optimum cropping pattern as well as enhance the efficiency of available water, it is envisaged to carry out a water balance exercise at the village and the cluster level. This exercise would require a generic framework, i.e., a series of tools and analysis designed to help answer core questions of water availability assessment and water balance using both supply side analysis of surface and groundwater resources and demand side analysis of current water use.

The evolved framework will be used to assess water balance in the pilot watersheds and further refined based on the stakeholder feedback and will be up scaled. The output of the framework will feed into the watershed-level climate resilient plans development

The framework will also take into account specific issues in the salinity affected areas in the project districts and suitably accommodate the requirements.

4.0 Implementation Arrangement:

The overall development of the framework would be managed by IIT Bombay. In selecting the models for framework, the IITB team would take into account the data requirements to run the model compared with what is currently available. The model would run on desk-top PCs and eventually be freely available for wider use. It would have an easy-to-use interface usable by technically-skilled but non-specialist field level associates on a large scale.

The developed framework will be used to enable hydrological analysis for selected watersheds of POCRA clusters. IIT Bombay would test the developed model through pilots and ensure that the model seamlessly integrates with the process of micro planning.

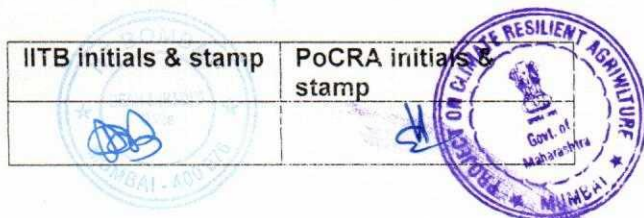
Deliverables

Framework/Model Finalization

- Develop and document a hydrological analysis framework for all of POCRA mini-watershed plans.
- Hydrological analysis framework will include:
 - Water Budgeting exercise at micro watershed level which will include the hydrological analysis and crop evapo-transpiration of prevailing village cropping pattern in addition to other sector water needs
 - The proposed framework would integrate the latest technological advances like remote sensing and climate studies etc.
 - Potential of ground water recharge considering the existing water harvesting structures and proposed watershed treatment works;
 - Possibility of utilizing the framework for management of cropping decisions and irrigation planning both for current and future scenarios at village as well as at the cluster level

Outputs include:

- O1. A document describing the process of evolution and development of the hydrological analysis framework with rationale and justification thereof. This would include information on the range of models considered, the application of the recommended models in India and elsewhere, availability of data to adequately test (validate) the models.



- O2. Delivery of an integrated set of models/tools and databases with consistent and simple interface suitable for use by technically skilled but non-specialist users, including the delivery of the software, necessary databases and appropriate documentation. The full package would run on desktop PCs and if feasible the same may be put on an on-line platform.
- O3. Integration of the above framework seamlessly into micro planning development exercise through collaboration with the larger team. Adaptation and refinement of the model and transfer of the full package to PMU.
- O4. Provide technical and handholding support to integrate this framework seamlessly into micro planning development exercise across the project areas.

Detailed Description of assignment

Technical details with Outcomes

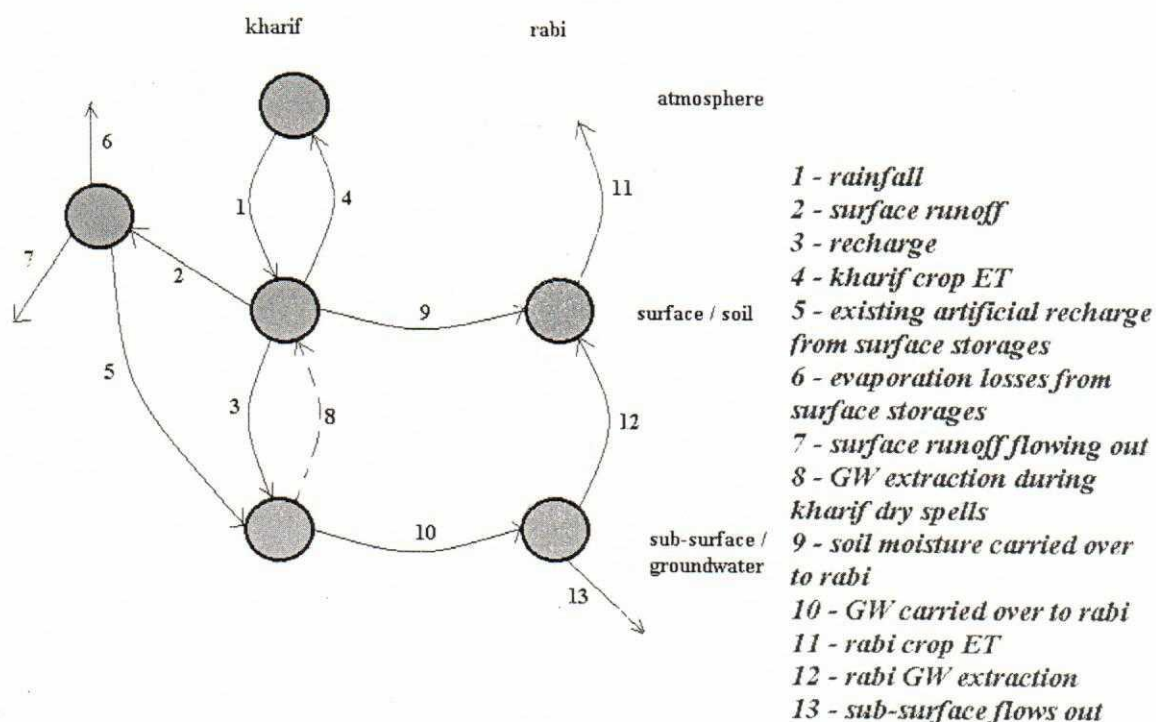
- Water Budgeting exercise at micro watershed level will include the hydrological analysis and crop evapo-transpiration of prevailing village cropping pattern in addition to other sector water needs
- The water balance will address spatial and seasonal aspects of water availability (surface water and groundwater) at village level based on current water use
- The output of the framework will include identification and marking of vulnerable zones/farmlands with respect to crop water availability along with recommendations to planners on nature and location of interventions required. This will be done with the help of land-use and soil maps provided by MRSAC.
- The output will also offer a suite of target cropping patterns for the villages based on different rainfall scenarios.
- The developed framework may be utilized for management of cropping decisions and irrigation planning both for current and future scenarios
- Components to be included (as discussed in the Technical consultation at PMU)

Methodology

A methodology will be developed for village level water budgeting based on protocols prepared in the past and on-going research. Such a water accounting will take into account seasonal water availability and extraction. The components of the water budget are as follows

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The advantages of this methodology are:

- Clarity on various sources of water, i.e., soil-moisture, extraction and surface and groundwater, and their contribution.
- A clear understanding of regional as well as local surplus/deficit in kharif, rabi and summer
- Clear and comprehensive framework to utilize agricultural, climatological and hydrological data as well as farmer practices
- A comprehensive framework to plug in expert inputs and yet easy to operate and compute by lay people
- Ease in validation of important sub-components.

Components

Water component	budget	Possible computation	Methodology	for	Data required
Surface runoff		Curve number			Rainfall, Land use, Soil maps
Groundwater recharge		Water level fluctuation method (GSDA)			specific yield, pre-monsoon to post monsoon well level fluctuation
Recharge from other structures		GEC 97 methodology			All surface storage structures (from WRD and MI local - ZP)
Crop ET		Standard norms from MPKV and WALMI			Village level crop sowing reports
GW extraction		Norms for irrigation requirement for different crops (with the help of MPKV)			From primary field visits (well surveys and farmer interactions) –
Sub-surface flows in and out		Thumb rules being developed at IITB using MODFLOW			well levels, slope maps, aquifer characteristics (conductivity data)



A methodology will also be developed for identifying vulnerable zones with the help of land-use and soil maps provided by Maharashtra Remote Sensing Application Centre, Nagpur (MRSAC).

Selected Pilot Mini-watersheds: Five (5) Clusters selected in Jalna(1), Hingoli (1), Yavatmal(1) and Buldana (2)

- Jalna- BajarVahegaon(Badnapur)
- Hingoli- Gondala (Sengaon)
- Yavatmal- Ratchandana (Yavatmal)
- Buldana- Yeulkhed (Shegaon)
- Buldana- Jalamb (Shegaon)

5.0 Reporting requirements and Review Mechanism:



Component	Area	Activities	Duration	Deliverable
Phase(I) Building prototype Cluster Water Balance (CWB-I) framework	2 pilot watersheds	Model Selection, field visit, primary data collection, preparing estimation protocols,	1 month	1.A document describing the process of evolution and development of the hydrological assessment framework
Phase (I) Testing and fine-tuning of CWB-I framework	remaining 3 pilot watersheds	Validation of protocols using above model	1 month	2.GIS based model with water balance computation
Phase (II) Adaptation and refinement of CWB-I into CWB-II.	Cross-section of watersheds	Validation of methodology on new watersheds. Integration. Observation of field practices, stress, etc.	1 month	Validated offline model (CWB-I framework)
Phase (II) Transfer of CWB-II to PMU		Preparing thumb rules and guidelines for micro-planners for CWB-II. Training of trainers -I	2 month	1.Integration of CWB framework in microplanning 2.Off line/ On line tool for water balance 3. Documentation & user manual
Phase (III) Support to PMU	All watersheds	Training of trainers -II, addressing field issues. Incorporating new learning's.	7 month	Revisions, if any, and technical support to PMU

The PMU will review the deliverables and outcomes. The feedback (if any) of the PMU as a result of these reviews shall be suitably addressed by IIT Bombay.

6.0 Terms and Conditions:

6.1 Services:

- The Second Party shall perform the services specified in Annexure I (annexed hereto), which is made an integral part of this MOU.

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- (ii) The Second Party shall submit to the First Party, the reports listed in Annexure II, within the time periods listed therein or as may be mutually agreed between the Parties.
- (iii) The Second Party shall provide the personnel listed in Annexure III, to perform the Services.

6.2 Term:

The Second Party shall perform the Services during the period commencing August 2017 and continuing through twelve (12) months or any other period as may be subsequently agreed by the parties in writing.

6.3 Payment:

A. Ceiling

For Services rendered pursuant to Annexure - I, the First Party shall pay the Second Party an amount not to exceed Rs.54,00,000/- (Rupees Fifty Four Lakhs Only) (Excluding applicable taxes). This amount has been established based on the understanding that it includes all of the Second Party's costs.

B. Schedule of Payments:

The schedule of payments is specified below:

Deliverables	Duration from the date of signing of MoU	Payment
A document describing the process of evolution and development of the hydrological analysis framework with rationale and justification thereof. This would include information on the range of models considered, the application of the recommended models in India and elsewhere, availability of data to adequately test (validate) the models.	Within 2 months	15% of the MOU cost
Delivery of an integrated set of models/tools and databases with consistent and simple interface suitable for use by technically skilled but non-specialist users, including the delivery of the software, necessary databases and appropriate documentation. The full package should run on desktop PCs but appreciate development on an on-line tool.	3 months	20% of the MOU cost
Adaptation, refinement, and transfer of the full package to PMU.	5 months	25% of the MOU cost
Handholding and technical support for upscaling the framework for all the mini watersheds.	From sixth month to twelfth months from the signing of MOU	40% of the MOU Cost equally divided in seven monthly instalments

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C. Payment Conditions

Payment shall be made in Indian Rupees within thirty (30) days following submission by the Second Party of invoices in duplicate to the Coordinator designated in Para 6.4.

Payments shall be made to Second Party's bank account.

Name of Account Holder: Registrar IIT Bombay, Project & Consultancy Account.

Contact Address: Adishankaracharya Marg, Powai, Mumbai 400076.

Contact Number: 91-22-25767020 / 7032 / 9769257032

Fax Number: 91-22-25764034

Email Address: registrar@iitb.ac.in / sivakami@iitb.ac.in

Bank Name: State Bank of India

Branch Name: IIT Powai

Branch Address: Adishankaracharya Marg, Powai, Mumbai 400076.

Contact Number: 91-22-25721103 / 2900 / 5305

Email Address: sbi.01109@sbi.co.in

Account Number: 10725729173

ECS / MICR Code: 400002034

Account Type: Current

SWIFT / BIC / IBAN: SBININBB519

NEFT / RTGS / IFSC: SBIN0001109

Branch Code: 1109

BSR Code: 0001109

6.4 **Administration:**

A. Coordinator

The First Party designates Mr. D D Wakure, Soil Science Expert, PMU, as First Party's Coordinator; the Coordinator shall be responsible for the coordination of activities under the MOU, for receiving invoices for payment, and for acceptance of the deliverables by the First Party.

B. Reports

The reports listed in 'Annexure - II, Reporting Obligations of the Second Party' shall be submitted in the course of the assignment, and will constitute the basis for the payments to be made under paragraph 6.3.



6.5 Performance Standards:

The Second Party undertakes to perform the Services with the existing highest standards of the industry. The Second Party shall replace any personnel assigned under this MOU as may be mutually agreed between the Parties.

6.6 Inspections and Auditing:

After the commencement of this assignment, the second party shall make available the accounts related to this assignment to the first party. The report of the internal/external audit done by the second party shall be made available to the first party.

6.7 Confidentiality:

Either Party shall not, during the term of this MOU and within two (2) years after its expiration/termination, disclose any proprietary or confidential information relating to the Services, this MOU or the other Party's business or operations without the prior written consent of the other Party hereto.

6.8 Ownership of Material:

Any studies, reports or other material, graphic, software or otherwise, prepared by the Second Party for the First Party under the MOU shall belong to and remain the property of the First Party. The Second Party may retain a copy of such documents and software¹. The Second party can use it for research and academic purposes. Any equipment procured by the First Party which is handed over to the Second Party for the purpose of this assignment will be handed over to the First Party at the end to the assignment.

6.9 Assignment:

No Party shall assign this MOU or Subcontract any portion of it without the the othe Party's prior written consent.

6.10 Law Governing this MOU and Language:

The MOU shall be governed by the laws of India, and the language of this MOU and all related documents shall be English.

6.11 Dispute Resolution²:

Any dispute arising out of this MOU, will be amicably settled between the parties.

6.12 Termination:

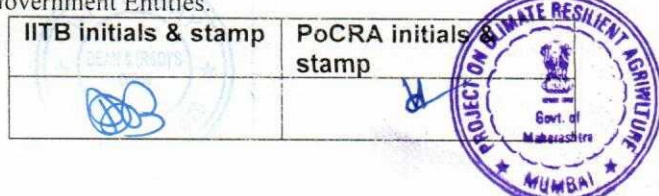
6.12.1. Either party hereto may terminate this MoU by provision of a thirty (30) days notice to the other party citing reasons.

6.12.2 Further, The First Party may terminate this MOU with at least thirty (30) working days prior written notice to the Second Party after the occurrence of any of the events specified in paragraphs (a) through (d) of this Clause:

- (a) If the Second Party does not remedy a failure in the performance of its obligations under the MOU within fifteen (15) working days after being notified, or within any further period as the First Party may have subsequently approved in writing;
- (b) If the Second Party finds it necessary to cancel the assignment and/ or shorten or extend its duration or becomes insolvent or bankrupt;

¹ Restrictions about the future use of these documents and software, if any, shall be specified at the end of Para 6.8

² The provision may be modified appropriately if both the First Party and the Second Party are Government Entities.



- (c) If the Second Party, in the judgment of the First Party or the Bank, has engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices (as defined in the prevailing Bank's sanctions procedures) in securing or in executing the MOU.
- (d) If the First Party, in its sole discretion and for any reason whatsoever, decides to terminate this MOU.

6.12.3. In the event of termination, the Second Party shall refund to the First Party, all payments made for providing remaining part of activities and the Second Party shall provide the First Party any reports, any other information and document gathered under this MoU prior to the date of termination.

7.0 Annexures:

Annexure - I: Terms of Reference and Scope of Services

Annexure - II: Reporting Obligations of the Second Party

Annexure - III: Second Party's Personnel and corresponding Unit Rates

In affirmation and witness whereof the parties hereto have caused this MoU and a copy thereof on their respective behalf by their duly authorized officials on the date and place herein above mentioned.

FOR THE 'FIRST PARTY'

FOR THE 'SECOND PARTY'

Signed by Vikaschandra Rastogi
 Title Project Director
 Date 16/08/2017
 Place Mumbai
 Seal:

Project Director

Project on Climate Resilient Agriculture

In the presence of the following witnesses:

1. Vijay S. Kolekar, Agronomist
2. Tulshidas Solanki
finance specialist.



Signed by Prof. P. V. Balyi
 Title Dean (R&D)
 Date 16/08/17
 Place Mumbai
 Seal: कृते निदेशक, आय आय टी मुंबई
Dean, Research and Development
For Director, IIT Bombay

In the presence of the following witnesses:

1. Prof. Milind Solanki
2. PARTH GUPTA

Terms of Reference and Scope of Services

Terms of Reference

WATER BALANCE FOR MINI-WATERSHED PLANS UNDER PoCRA

Background:

Government of Maharashtra (GoM) has decided to implement the World Bank aided Project on Climate Resilient Agriculture (PoCRA) with an objective to enhance climate-resilience and profitability of smallholder farming systems in project districts of Maharashtra. The project aims to achieve the objective through promotion of climate resilient technology and commodity value chain across approximately 4,000 drought-prone villages across districts and approximately 1000 salinity affected villages in the basin of Purna river spread across Akola, Amaravati, Buldana and Jalgaon districts.

One of the important aspects of ensuring resilience is to assure availability of soil moisture at the critical stages of the crops. Since most of the project clusters are in rainfed areas, management of rainwater becomes critical. Host of factors like rainfall pattern, total rainfall, geomorphology of the watersheds, groundwater recharge potential, surface water & soil moisture management and cropping pattern have impact on the resilience. The long term climate change projections indicate increased moisture stress on agriculture sector. Therefore a scientific planning of this critical resource with stakeholder participation engagement is the key to ensure enhanced water and crop productivity.

In this context PoCRA would like to partner with IIT Bombay with the view to gain from their institutional expertise and earlier experience with the water balance at the village level.

Scope of Work

- To build a framework, i.e., a series of tools and analyses designed to help answer core questions of water availability assessment and water budget using both supply side analysis of surface and groundwater resources and demand side analysis of current water use.
- The evolved framework will be used to assess water balance in the pilot watersheds and further refined based on the stakeholder feedback and will be up scaled. The output of the framework will feed into the micro watershed-level climate resilient plans development
- The framework will also take into account specific issues in the salinity affected areas in the project districts and suitably accommodate the requirements.

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Methodology

The overall development of the framework would be managed by IIT Bombay through a team of dedicated resource persons supervised by senior faculty. This team would ensure the stakeholder engagement and dialogue with the technical institutes/ organizations as and when necessary. The team would study the currently available models of computing the water balance in mini-watershed and assess their relevance and efficacy in the project area. The team would prepare a comprehensive model considering project requirements and test through a pilot. The evolved framework then would be refined based on the results. IIT Bombay will ensure that the framework seamlessly integrates with the process of micro planning. The developed framework will be used to enable hydrological analysis for all selected mini-watersheds under project

Deliverables and Time Frame:

Sl. No	Deliverables	Time Frame
1	A document describing the process of evolution and development of the hydrological analysis framework with rationale and justification thereof. This would include information on the range of models considered, the application of the recommended models in India and elsewhere, availability of data to adequately test (validate) the models.	Within two months from the signing of MOU
2	Delivery of an integrated set of models/tools and databases with consistent and simple interface suitable for use by technically skilled but non-specialist users, including the delivery of the software, necessary databases and appropriate documentation. The full package should run on desktop PCs but appreciate development on an on-line tool.	Within three months from the signing of MOU
3	Adaptation, refinement, and transfer of the full package to PMU	Within five months from the signing of MOU
4	Hand-holding and technical support for upscaling the framework for all the mini watersheds.	From sixth months to twelfth months from the signing of MOU



Key Staff/Professionals Required:

Sl No.	Positions	Qualification and Experience	No
1	Project Coordinator (CV indicating the qualifications and experience to be enclosed)	Professor or equivalent position with experience in management of multi-disciplinary projects related to Natural Resource management, watershed Management, hydrological modelling etc	1
2	Team Leader (CV indicating the qualifications and experience to be enclosed)	Masters or higher degree in natural resource management with experience in management of multi-disciplinary projects related to Natural Resource management, watershed Management, hydrological modelling etc	1
3	Middle level professionals (CV indicating their qualifications and experience to be enclosed)	Bachelor's or higher degree with experience in management of multi-disciplinary projects related to Natural Resource management, watershed Management, hydrological modelling etc	2



Reporting Obligations of the Second Party

Sl. No	Deliverables	Time Frame
1	A document describing the process of evolution and development of the hydrological analysis framework with rationale and justification thereof. This would include information on the range of models considered, the application of the recommended models in India and elsewhere, availability of data to adequately test (validate) the models.	Within two months from the signing of MOU
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Annexure - III

Second Party's Personnel and corresponding Unit Rates (for assignments where payments to the Second Party are made on Lump sum basis)

Resources required

Sl. No	Title	Name of the Personnel	Unit Rates (per month)	Phase 1 (No of man months)	Phase 2 (No of man months)	Phase 3 (No of man months)
1	Project Coordinator	Prof. Milind Sohoni	Rs 30000/day	10 man-days	13 man-days	26 man days
2	Researchers	Hemant Belsare + Pooja Prasad	Rs 1 lakh/month	2	0	0
2	Team Leader	Parth Gupta	Rs 70000/month	2	3	7
3	Middle level professional 1	Vishal Mishra	Rs 50000/month	2	3	3.5
4	Middle level professional 2	Shubhada Datri	Rs 50000/month	0	3	3.5
5	GIS Support	Ashish Karale	Rs 20000/month	2	3	7
Total phase-wise cost				7,80,000	9,60,000	17,60,000

Total Phase-wise budget

Sl. No.	Component	Phase 1	Phase 2	Phase 3
1	Human Resources	7,80,000	9,60,000	17,60,000
2	Travel+ Logistics: Survey and measurement costs + equipment such as GPS, Total station, computers) + Miscellaneous	4,00,000	2,00,000	4,00,000
Total phase-wise		11,80,000	11,60,000	21,60,000
After 20% IIT Overheads		14,16,000	13,92,000	25,92,000
Final Total				54,00,000*

* Excluding applicable taxes

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