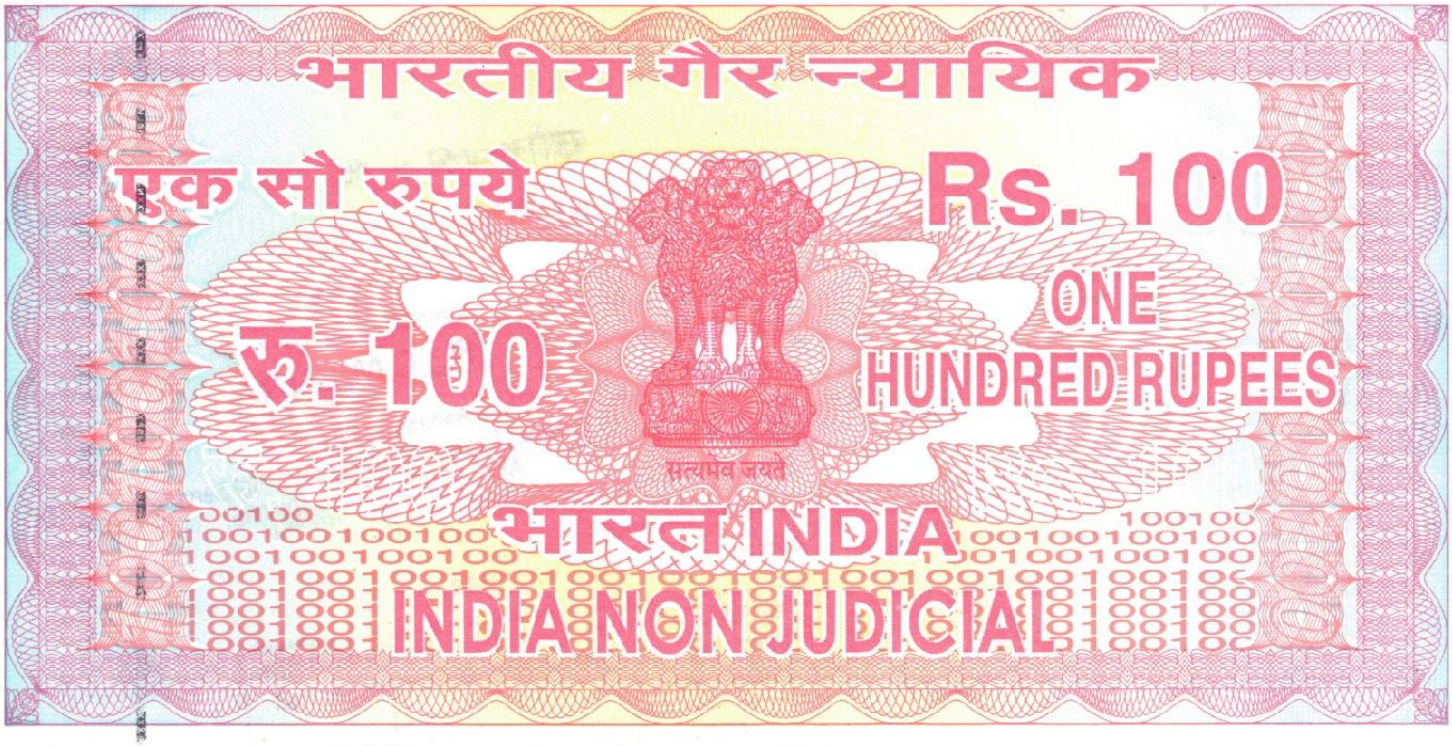

महाराष्ट्र MAHARASHTRA ◐ 2020 ◐ YR 854567

जिल्हा कोषागार कार्यालय, ठाणे
7 JUN 2021
मुद्रांक प्रमुख लिपीक / लिपीक

MEMORANDUM OF UNDERSTANDING

BETWEEN

NANAJI DESHMUKH KRUSHI SANJEEVANI PRAKALP, GOVERNMENT OF MAHARASHTRA

AND

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

For

WATER AND ENERGY MODELLING FOR IDENTIFICATION OF CONSTRAINTS, DEVELOPMENT OF SOLUTIONS AND EXTENSION PROGRAMS, FOR PROTECTING SMALL-HOLDER FARMERS

Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

IIT BOMBAY DEAN (R&D) Office MUMBAI - 400076

This Memorandum of Understanding is being entered into at Mumbai on 24th of August 2021 hereinafter called 'MoU'.

BETWEEN

Nanaji Deshmukh Krushi Sanjeevani Prakalp (NDKSP), Government of Maharashtra represented by Project Director (hereinafter referred to as **'First Party'**) having its office located at 30B, Arcade, World Trade Centre, Cuffe Parade, Mumbai- 400005 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 (hereinafter referred to as **'Second Party'**), represented by Dean, Research and Development, IIT Bombay, having its registered office at Powai, Mumbai 400076, Maharashtra, India, 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, the Second Party is willing to perform these services

2.0 Preamble:

The Government of Maharashtra (GoM) is implementing the World Bank aided project on climate resilient agriculture namely Nanaji Deshmukh Krushi Sanjeevani Prakalp (NDKSP). 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, Buldhana, Washim, Akola, Amravati, Yavatmal, and Wardha and approximately 1000 salinity affected villages in the basin of Purna river spread across Akola, Amravati, Buldhana and Jalgaon districts.

Since August 2018, IIT Bombay has been contributing as a technical partner to PoCRA through three MoUs. This is the fourth MoU between the Government of Maharashtra and IIT Bombay.

The collaborations have led to design and development of water balance models and tools and their incorporation into village plans. As more datasets were made available, these models and tools were further refined. An IT stack and database support was developed to enable advisories and to run a dashboard. Support was provided to PMU in various activities. In MoU III, special attention was given to extension of water balance concepts and resilience at the village and institution level. Access to energy for irrigation was studied and its impact on water security was outlined and proposals were made to improve energy access and reliability. A more detailed development of the work so far and what is planned for MoU IV appears below.

Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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Water

The project-development objective of PoCRA has been to enhance climate resilience and profitability of the smallholder farmer. Water forms a basic input for the farmer and is central to the problem of resilience. Frequent drought years, erratic and untimely rainfall, dry spells, wet spells along with low storage capacities of the basaltic aquifers are some of the climatic and geographic factors faced by the farmers, especially the smallholders in all the PoCRA districts. This often results in problems of lack of water availability, demand-supply gaps in water for agriculture, poor access to protective irrigation during crucial times, increased competition for limited groundwater, resulting uncertainty in access to water and so on. This further adversely affects the yields and hence the profitability of the farmers.

The core objective of the partnership between IIT Bombay and PoCRA has been to develop a GIS-based scientific planning framework based on water-balance in order to:

Increase aggregate water availability at village/cluster level → Ensure access to water at farm-level → Stabilize yields → Improve incomes and profitability

The framework has been developed through the design of a point level soil-water balance model, its implementation as a GIS-plugin usable in a spatio-temporal manner and its conversion to village-level water budgets. The model provides estimates of runoff, changes to soil moisture, groundwater recharge and crop water uptake and deficits.

All these outputs are published for every PoCRA village as a chart which is displayed in the village. These model outputs are crucial as far as planning and expenditure are concerned. The water budget is expected to be used by the local planners such as cluster assistants, Krushi Sahayaks (KS) to plan the NRM activities so as to reduce the deficits. At the same time efforts are undertaken so that the community understands and makes use of the water budget results in making crucial cropping decisions and investments.

Thus, the effectiveness of the water budget model depends on two key principles -
Soundness of the model – This has been achieved, to a large extent, and over the last two years, through continuous engagements and interactions with PMU, experts, external agencies and through preliminary validation of the model through on-field measurements and farmer experiences. Further improvements in the computation of groundwater recharge (resulting from the interactions with GSDA and World Bank experts) and incorporation of regional flows to compute inter-zone and inter-village water movements and cluster-level water balance is slated for MoU IV. These will further enhance the results of the model.

Utility of the model – At the same time, it is now required that extension activities move beyond the computation of the village water budget. In order to attain resilience, village cropping patterns must change. For this, the demand-side and supply-side, along with key concepts such as the stocks and flows, basic biophysical parameters, the notion of an area budget, etc. must be better understood by the community. This should be done by linking these water balance concepts to concrete problems faced by them which will further help in suggesting possible remediation measures. The key issues are profitability, risk management and sustainability. An important mechanism for extension will be to strengthen the platform of the Village Climate Risk Management Committee and its periodic meetings.

Thus, the proposed engagement with PoCRA will mainly focus on further improvements in the model along with their validation, and the utility of the model, and how the water budget

Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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results may be translated to simpler water management concepts which may help in achieving water security at farmer / village / cluster level.

Energy

The work done in MoU III resulted in:

- Demonstration of stress in the network and its contours.
- The proposal of optimization of infrastructure through restructuring of LT networks, loading of Distribution Transformers based on irrigation requirements
- Extension work, building farmers awareness of use of capacitors, pump selection and load management
- Water-energy correlations development through measurements of water and energy usage of about 40 farmers, and the implementation of a framework for crop-wise energy-water usage estimations at the feeder level
- Observation and measurement of irrigation practices including water transfers to understand water-energy correlations and water usage
- The status and reasons for the constraints in getting new agricultural connections

Access to a connection, and quality and schedule of power, for irrigation, is a major problem for farmers. Since access to reliable irrigation is an important aspect in strengthening farmers against unreliable rainfall, the energy component was included in MoU III. As crops and irrigation practices change, energy problems and issues in PoCRA villages have become prominent. These relate to increase in energy demand due to water-saving technologies and transfers, unreliable supply due to insufficiency in infrastructure, delay in new connections, and sub-optimal distribution system design practices which do not explicitly consider irrigation requirements. The correlations between water and energy usage were incorporated into a framework based on cropping, irrigation methods, and water source parameters. Feeder level and DT level energy consumption data was used to validate the framework. A first level model to base Distribution Transformer loading to cropping was presented. These problems were studied and quantified in MoU III and solutions were proposed.

Water and Energy in MoU IV

A conscious decision was taken to link energy and water in this MoU.

Water and energy are both key resources and their availability are key constraints which need to be managed together. This is especially so during the Rabi and summer season. As cropping patterns and irrigation practices change, especially with the adoption of water saving technologies or water transfers, the energy infrastructure may lag the corresponding energy demand. In addition, unreliable electricity supply leads to poor control over management and usage of water, even when farmers use sprinklers and drip irrigation. Villages must then be guided to undertake more sustainable irrigation practices, adopt appropriate pumps, use capacitors etc., and practice load management and scheduling. Estimation of energy consumption in PoCRA villages and extension of the above techniques is proposed in MoU IV. Moreover, at the farmer-level, indices for investments for irrigation infrastructure and matching estimates for public energy infrastructure will be developed. This

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Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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will help in guiding farmers and villages in choosing appropriate crop-plans which are economically sustainable.

Post-Harvest Processing

The project has a stated vision that Farmer Producer Companies (FPCs) will be strengthened and also benefit from the project, through climate□resilient investments in value chain development with the promotion of backward and forward linkages, and access to business development and incubation services. In line with this vision, it is proposed to assess and provide post-harvest and value addition technological solutions to the screened and selected FPCs. To take advantage of value-added agricultural potential, FPCs should be aware of value-added opportunities, as well as informed about the feasibility, planning and market development associated with a value-added business. There could be a possibility of additional revenue by adding a new enterprise around the commodities (which are being traded in a conventional manner), adopting new practices in cooperation with existing enterprises or by adding value to a commodity that is currently being produced.

3.0 Objective and Scope of the Assignment:

Water

The core objectives of the proposed engagement with PoCRA in MoU IV are:

- To strengthen the water-budget based planning framework through improvements and refinements to the water-budget model and its validation through mix of on-field measurements, farmer narratives and key field-observations
- To design and guide the development of smart interfaces and easy-to-use platforms to translate the water budget results into simple indices and thumb rules. These may then be used by the community and extension agents for sharper and targeted planning of interventions
- To support the PMU and the Department of Agriculture to strengthen extension mechanisms to reach the farmers and the community through information, comprehension and collective action-based framework to address key problems faced by the farmers. This will be done through design and preparation of simple protocols and their demonstration in selected clusters, which may be adopted by the PMU and the DoA into their extension programs. These may be:
- Documentation and reporting of feedback about use of information by the community as provided by the PMU (i.e., water budget charts, advisories, indices etc.) This will include reporting on (i) what is advised, (ii) how is it understood by the farmer/community, (iii) what actions are taken, and (iv) what are the outcomes.
- Development of framework for gathering relevant data and facts about problems and solutions at the local level, design of local surveys, formats etc.
- Inputs for conduct of community/village meetings, design of agenda for the meetings
- Development of directed and flow-chart-based extension plans based on the local needs

Energy

This proposal for MoU IV will build on the outcomes of MoU III. Community processes and technical solutions will be investigated for demand side management initiatives. The feeder

Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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level framework for energy-water correlations will be incorporated into an MLP based energy estimation tool which may be applied by PMU in all PoCRA villages. Cropping pattern-based Irrigation and Investment indices at the village level, will be developed for irrigated and non-irrigated farmers. Energy-water measurements will continue in the coming year to monitor irrigation practices in the second year.

Post-Harvest Processing

The objective is to reduce postharvest losses of selected agriculture produce through appropriate technological interventions such as appropriate storage structures and increase farmers' financial returns through value addition route which includes primary and secondary processing.

The proposed work of developing a detailed project report (DPR) will be useful for FPC in taking decisions prior to entering a new business and understanding the nature of the markets, the expected financial returns and the risks that surround the expected outcomes associated with new ventures.

This includes cost estimates of plants set up with different capacities, value chain proposition, opportunity, the operating plan, the marketing plan into anticipated financial results. It contains the status and the future projection of financial performance of the business with the selection, evaluation, and interpretation of financial data along with other relevant information in financial decision making. Perform risk analysis by building models of possible results considering variations in all important variables. This would help us understand all the possible outcomes of decisions and assess the impact of risk, allowing for better decision making under uncertainty.

The Feasibility analysis that is a part of this MoU will also eventually lead to a long-term handholding of the FPCs for the actual implementation of the DPRs developed by them in the course of time.

4.0 Implementation Arrangements: Methodology and Outputs

Methodology and Outputs:

I Water

A. Model validation and on-field measurements

The model validation will be done through on-field measurements as well as through farmer narratives and documentation of key field observations.

The on-field measurements will include - (i) runoff measurements at the catchment and sub-catchment outlets through water level sensors, (ii) runoff measurements at farm outlets through v-notches and water level sensors, (iii) soil moisture measurements through soil moisture sensors and (iv) rain gauges in the selected villages.

Tasks

1. Updation of validation methodology to incorporate base flows, surface water flows and post-monsoon water availability. Select clusters, villages and sites for setting up instruments, procurement and installation of instruments, initial readings, preliminary

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Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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report.

2. Analysis of data collected during the kharif season, documentation of observations, farmer narratives, new phenomena, insights for model improvements, initial results.
3. Analysis of collected data during the rabi season, farmer interviews, surveys for estimating groundwater extraction, measurement of base flows, and overall consolidation of activities and tasks.
4. Analytical comparison of water budget results for earlier years to understand year-to-year dependence if any. This will be done on the basis of the water-budget results, post-monsoon indices, the cropping data and the structures' data for the respective years.

B. Community extension

The key objective will be to demonstrate easy-to-understand village level exercises and develop protocols which will feed into the information, comprehension and collective action-based extension framework. The deliverables will be in the form of field-visits and actionable reports which will feed into PMU extension programs. These will be: (i) design and conduct of village-level surveys and formats for the same in selected clusters, which may be used by the Village Climate Resilience Management Committee (VCRMC) or the Krushi Sahayak (KS)/Cluster Assistant (CA), (ii) conduct of community meetings in the selected clusters as test exercises.

Tasks

1. Extension activities during Kharif season focusing on a selection of topics such as:
    a. Documentation of kharif yields, dry spells, coping mechanisms.
    b. Use of vulnerability maps for targeting interventions and documentation of access to protective irrigation in the village.
    c. Documentation of solutions-space analysis, cost-benefit of farmer investments and interventions.
2. Extension activities during Rabi season focusing on a selection of topics such as:
    a. Demonstration of concepts of entitlements and endowments, zonal water availability, and post monsoon indices to the villagers
    b. Documentation of rabi yields and rationing of water and presenting the same to the villagers.
    c. Demonstration of groundwater overexploitation, uncertainty associated with access to water.
    d. Design of a template for cost benefit analysis of investments by farmers and its demonstration.
    e. Testing, validation and demonstration in the pilot village for crop planning and crop diversification considering P1, P2, P3 crops and crop hierarchies (see section D on Rabi Planning Framework below).

C. Model improvements

Objectives:

(i) Improvements in point model for better estimation of groundwater recharge through incorporation of phenomena such as: baseflows, residual (previous year's) soil moisture in deep clay soils, ponding, aquifer properties etc. This is continuation of work from MoU III

Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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regarding IITB-GSDA interactions related to estimation of groundwater recharge and the improvements suggested by World Bank experts. Data available in the public domain on aquifer properties published by the GSDA and improved soil maps by NBSS-LUP will be used for the same.

(ii) Better estimation of inter-zone and inter-village flows of surface as well as ground water through implementation of regional geography and computation of regional flows.

Both the improvements will help in estimating and assessing the natural imbalance in post-monsoon water availability across zones and villages in the clusters due to geographical endowments. This will help in determination and classification of excessive groundwater extraction.

Tasks

1. Improvements in point-model
    a. GW recharge in clayey and sandy soils.
    b. Incorporation of aquifer properties.
    c. Incorporation of outcomes of A2 and A3
2. Implementing regional geography framework
    a. Integration of stream-network and differential watersheds to IT stack.
    b. Zone-ordering of all clusters and integration with the IT stack.
    c. Delineation of new zones of interest, if any, such as stream proximity zones. and addition to IT stack.
3. Computation of regional flows using regional geography
    a. Within- and across-zone water reallocation module. This will include computations for movements of surface as well as groundwater flows.
    b. Changes to current plugin and validation through results of A2 and A3.

D. <u>Rabi planning framework</u>

Objectives:

- To facilitate village-level crop planning and diversification based on the water, energy and other constraints
- To provide a regime for GW entitlements and endowments for better GW management.

The outcome of this will be a stand-alone module.

The planning tool may be used during village-level Rabi meetings by the community to aid in the crop planning exercise. This will be demonstrated through community meetings during Rabi season in the selected clusters as test exercises.

Tasks

1. Development of rabi planning framework at village level
    a. Design of rabi planning framework based on water, energy, economic, and other constraints for crop planning and diversification.
    b. Designing energy and irrigation practices as a joint constraint.
    c. Designing cropping scenarios through Linear Programming (LP) model.
    d. Addition of required datasets to IT stack (market rates, P1, P2, P3 definitions, crop hierarchies).

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Cuffe Parade, Mumbai - 400005.

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2. Incorporating feedback from field in overall framework and development of the module on Rabi planning

E. IT and PMU Support

Tasks

1. Changes to MLP script and plugin for incorporation of IMD forecast data and dynamic water budget computation in MLP app.
2. Support to the PMU for design and framework for improvements in existing MLP charts and new cluster-level charts.
3. IT support for fixing bugs, maintenance, and coordination with PMU.
4. Incorporation of new data sets such as aquifer thickness, specific yields, and other village or watershed parameters, to support components C for a selection of clusters. The parameters will be developed and supplied to PMU.

II Energy

F. Strengthening community action for demand side interventions

Objective:

- To demonstrate easy-to-understand DT-level load scheduling exercises, facilitate the implementation of demand-side measures including crop plans, irrigation practices and more efficient equipment.
- To develop protocols which will feed into the 'Information comprehension and Collective action' based extension framework.

This will be done for a selection of 4 distribution transformers in 1 to 2 clusters.

Tasks

1. Selection of 4 DTs in 1 to 2 different clusters
   - Introduction of community action approach to the DT users, benefits, and demand-side intervention possibilities
   - Get acceptance from DT users to test the community approach, i.e., agreement to install capacitors, test the load management approach, and prepare a report on the current status of demand.
2. Conduct awareness building programs on crop and irrigation practices, load management strategies, capacitor usage, pump selection.
   - Assist and facilitate implementing interventions
   - Use Load Management Application to develop schedules (See component J)
   - Survey/Get feedback on number of capacitors installed, incidence of implementation of load management
3. Documentation of existing infrastructure, developing guidelines for functioning and assistance to DT User Groups (DTUGs)
   - Tabulate status of pending connections, latent demand, DT network
   - To prepare a report on DTUGs demand side activities. Preparation of a template for functioning of DTUGs comprising rules and guidelines. The report will be shared with MSEDCL.

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Cuffe Parade, Mumbai - 400005.

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G. Monitoring energy and water usage on selected farmers

Objective: Continue to monitor energy and water usage in various crops of 33 farmers in 5 districts.

Tasks

1. Continue monitoring of water and energy meters with cropping and irrigation surveys in villages in 5 districts where energy and water meters have been installed in MoU III.

H. MLP based energy estimation tool prototype at the village level

Tasks

1. Selection of target clusters (3 villages/feeders); Feeder - village correlation from local MSEDCL offices
2. Collection of datasets - groundwater levels, transmission heads, water sources, water transfer practices, energy infrastructure (DT details, feeder energy data), irrigation practices; Develop framework for energy-water correlation further, incorporating data from other agencies such as irrigation department for irrigation tanks details, and GSDA for groundwater levels
3. Run the model for 3 villages/feeders, and validate at the end of rabi against feeder energy. Conduct Rabi surveys; Checks for DT overloading in village(s). Fine-tuning model based on validation
4. Final report

I. Cropping pattern-based Irrigation and Investment indices, village level, for irrigated and non-irrigated farmers

Tasks:

1. Review and restructuring of existing indices and proposal of new indices
2. Selection of villages (4), development of farmer sampling methodology (30 farmers per village), design of questionnaires and surveys
3. Survey of farmers in selected villages
4. Tabulation and preliminary findings
5. Review and final release.

J. Load Management Application Development and MLP tool IT Stack Integration

Objective: IT work for support of objectives F and H.

Tasks:

1. Development of Load Management Application to be used in upcoming rabi by IITB to support 4 pilot DTUGs in component F. The application will allow representation and evaluation of schedules for infrastructure performance. This application will be a tool that allows farmers to coordinate their DT network usage to reduce overloading.
2. Porting of the MLP based energy estimation tool into IT Stack. Incorporation of new

Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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data sets such as dug well depths, high-level parameters of irrigation tanks / dams in village, groundwater levels, energy infrastructure and other village parameters, to support component H for a selection of clusters.

III Post Harvest Processing

K. Technology Intervention to reduce post-harvest losses of onions

Tasks:

Development of a detailed project report for one existing Farmers Producer Company (FPC) in regard to technological intervention in large scale (500-1000 tonnes) onion storage structure.

a. Detailed mapping of onion production, processing and storage in selected PoCRA areas and current storage practices.

b. Screening of FPCs for technology intervention. This will be based on different parameters (given below) which will be used for screening.

Landscape and stakeholders' analysis: FPC portfolio, quantum and productivity of onion crop, detailed activities including production, trading and current value addition processes and products, interest and willingness to adopt technology for better price realizations.

c. Conduct a detailed study for potential technological interventions. This would include questionnaires, interviews, group discussion etc. and involve collection of relevant primary and secondary data.

d. Financial model: Projected income and expenditure, financial structure and sustainability, Cost-benefit and break-even analysis for the proposed intervention.

e. Implementation planning: Determination of human resources requirements, regulatory and legal approval, SWOT analysis, risk mitigation strategies, implementation schedule

Deliverable: Preparation of a Detailed Project Report (DPR).

L. Technology Intervention for value addition of agriculture produce via processing

Tasks:

Prepare a detailed project report for one FPCs in regard to value addition of agriculture produce via new processes & products developed at IIT Bombay and elsewhere. Commodities for value addition and proposed processes are as follows:

- Turmeric: Multiple products including Curcumin, essential oils, starch
- Ginger: Dry ginger powder, Essential Oil
- Soybean: Oil, Protein Isolate, Protein hydrolyzate, pellets
- Maize/Corn: Starch, glucose, oil, animal feed

a. Development of a matrix to screen crops in selected POCRA areas be used as a feedstock for value addition. This would also help assess the availability and

Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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accessibility of selected raw material throughout the year.

b. Screening of FPCs for technology intervention (as mentioned in K).

c. Conduct a detailed feasibility study for one or more potential technological interventions for the selected commodity/commodities. This would include questionnaires, interviews, group discussion etc. and involve collection of relevant primary and secondary data on the possible products profile and the factors influencing the supply chain.

d. Financial viability: Cost-benefit and break-even analysis for the proposed intervention.

e. Market viability: Identifying potential buyers (B2B) based on current demand of product and prepare a list of potential forward linkages.

f. Details of food safety measures and regulatory aspects

Deliverable: Development of Detailed Project Report (DPR) with interested FPC. This shall be done with the interested FPC who would like to implement the project further through the financial support of an external funding agency including the agribusiness component of the PoCRA project.

M. Commissioning of the storage project

Tasks:

a. Preparation of implementation planning note which includes determination of human resources requirements, risk mitigation strategies, implementation schedule and assist in selection of the suitable location and geographic features of the area.
b. Assist FPC in procurement of machinery and equipment, erection and building of said unit as per the blueprint and layout, and commissioning of the project

Deliverable: Subsequently commissioning of the project will be taken up by the FPC with the assistance of IITB. This could be done with the financial support of an external funding agency including the agribusiness component of the PoCRA project.

5.0 Reporting Obligations of the second party

COMPOSITION OF REVIEW COMMITTEE TO MONITOR CONSULTANT ACTIVITIES

The review committee from PoCRA PMU will consist as below -

1. Agronomist
2. Hydrologist
3. Agri Business Specialist
4. GIS Expert
5. Procurement Specialist
6. Agricultural Engineer
7. Finance specialist

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Project on Climate Resilient Agriculture
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Phase	Deliverables	Duration
I	Inception report	Within 15 days from commencement of work
II	Water: - Interim Report on field-work for Model Validation - Note on changes to MLP script and plugin for incorporating dynamic water budget computation and IMD forecast data *IT / Extension:* - Changes to the MLP script Energy: - A report on high-level description of 4 DTs selected and village context. - Installation of DT meters on selected DTs - Report with high level description of 3 villages/ feeders selected for MLP based estimation tool. Post-harvest processing: - A preliminary feasibility report in regard to storage technologies (onion storage structure) to improve financial gain of the selected farmers producers company. - A preliminary feasibility report for one/two FPCs in regard to value addition of agriculture produce via new processes & products.	Within 2 months from commencement of work
III	Water: - Interim Report on Model Validation (Kharif) - Report on Extension activities conducted in the selected cluster during Kharif - Interim report on implementation of Regional Geography and integration into PMU IT stack *IT / Extension:* - Scripts/API for zone ordering and delineation of stream proximity - Training material such as presentations on Community Extension Activities (Kharif) Energy: - A note on 4 DTs selected for DTUGs and characteristics of DTUGs. Network documentation of selected DTs. - Report on capacitor usage awareness building program and response to load management. - Sampling methodology, questionnaires and surveys developed for irrigation investment indices.	Within 5 months from commencement of work

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Project on Climate Resilient Agriculture
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	Post-Harvest Processing: Storage Structure - A detailed project report for a selected Farmer Producer Company in regard to storage technologies (onion storage possibilities to improve financial gain of farmers. - Uncertainty analysis report for storage interventions. Food Processing - A detailed project report for one/two FPCs in regard to value addition of agriculture produce via new processes & products. - Note on mapping of commodities for the assessment of the production, marketing, financial and personal attributes that should be considered for a new venture - Uncertainty analysis report for storage interventions.	
IV	Water: - Note on improvements in point model for groundwater recharge in clayey and sandy soils, incorporating aquifer properties and ponding - Report on computation of regional flows using regional geography and new zonal module - Report on conceptual framework for Rabi Planning *IT / Extension:* - New zonal module on reallocation of water within and across zones - Changes to MLP script/plugin incorporating improvements in point model, regional geography and zonal module - Preliminary module on LP model for cropping scenarios Energy: - Report on assistance to DTUGs, template for DTUGs' functioning, sample report on demand side activities and latent demand to be prepared by DTUGs. - Preliminary energy estimation model results from 3 villages/feeders. *IT:* - Load Management application Post-harvest Processing Implementation plan for onion storage structure* This includes: 1. Materials listing and procurement plan 2. Site selection plan 3. Preparation of training module 4. Development of Land 5. Building & Civil Works 6. Machinery requirement 7. Vendor list and placement of order 8. Details on Trial runs & Commissioning 9. Plans for electricity, and Water	Within 8 months from commencement of work

Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

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	*There will be a time gap between DPR completion and commencement of the implementation of the project. During this period, FPC will be ensuring timely processing of finances (including loan sanction) application to funding agencies and getting pre sanction etc.	
V	Water: - Closure (Final) Report on Model Validation - Report on Extension activities conducted in the selected cluster during Rabi - Note on improvements in MLP charts - Design and Framework *IT / Extension:* - Training material such as presentations on Community Extension Activities (Rabi) Energy: - Final report on MLP based energy estimation tool, and results from 3 villages/feeders - List of secondary level data required from villages, and final model - Support to PMU for implementation of MLP based energy estimation tool in all villages - Report on implementation of load management initiatives in Rabi season by the 4 DTUGs facilitated by IIT. - Interim report on preliminary findings from irrigation investment surveys. *IT:* - Load management Application - Incorporation of MLP based energy estimation tool into IT Stack Post-harvest Processing Commissioning of the onion storage structure project** **Schedule of project commissioning may change, depending upon unforeseen situations such as pandemic or delay in loan sanction etc.	Within 10 months from commencement of work

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VI	Water: - Closure note on Rabi Planning Framework and incorporation of feedback from the field for the same - Note on cluster level water budget charts *IT / Extension:* - Module on Rabi Planning Framework (stand-alone) - Prototype for cluster level charts (with incorporation of regional flows) Energy: - Final report on irrigation investment surveys. - Analysis and report on Kharif, Rabi and summer crops water usage from 5 districts. Post-harvest Processing - Technical support to the FPC during project commissioning	Within 12 months from commencement of work
IT Support to PMU Bug fixing, maintenance, coordination with PMU		Throughout the year (as and when required)

Table 5.1 Detailed Activities
I Water and Project Support

Components	Activity / Deliverable	Man Months	Research	Technical	Field*	Extension**	IT Design	Output
			(Man-Month)	(Man-Month)	(Man-Month)	(Man-Month)	(Man-Month)	
A. Model validation and on-field measurements								
A1	Preliminary report: Design, Cluster selection, site selection instrument set-up, initial readings	10		2	8			Report
A2	Interim report: Analysis of collected data during the kharif season, documentation of observations, new phenomena, insights for model improvements, initial results	12		2	10			Report
A3	Final report: Analysis of collected data during the rabi season, documentation of cropping pattern, groundwater extraction practices, water rationing, farmer interviews, Consolidation of the report	8		2	6			Report
A4	Analytical comparison of water budgets	2		2				

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B. Community Extension								
B1	Report on Extension activities in selected clusters during Kharif	3		1		2		Report, training material
B2	Report on Extension activities in selected clusters during Rabi	5		2		3		Report, training material
C. Model improvements								
C1	Report on improvements in the point model for improvement in GW recharge	4		2			2	Changes to existing plugin
C2	Report on implementation of Regional Geography	6	2	2			2	Integration with IT stack (scripts, APIs)
C3	Computation of regional flows and the zone-wise water reallocation module	4		2			2	Report, addon to existing plugin
D. Rabi-planning framework								
D1	Interim report on design on rabi-planning framework	3	1	1		1		Report
D2	Final report on rabi-planning framework	7	1	2		2	2	Report, stand-alone module
E. IT support and PMU coordination								
E1	Changes to MLP script and plugin for Farm Water App and MLP App	2		1			1	Note
E2	Changes to MLP Chart - Design and Framework	1		1				Internal support
E3	IT support for bug-fixes, maintenance of water budget model and dashboard	3					3	Support
	Total	70	4	22	24	8	12	

** Field includes field work for model validation and on-field measurements*

*** Extension includes a combination of deskwork and extension-related fieldwork.*

II Energy

Components	Activity	Man Months	Research	Technical	Field	Extension	IT Design	IT	Items	Output

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			(Man-Month)	(Man-Month)	(Man-Month)	(Man-Month)	(Man-Month)	(Man-Month)	(Quantity)	
F. Strengthening Community Action: DT User Groups:										
	Selection of 4 DTs in 2 clusters	1			1					Note
F1	Introduction of community action approach to the DT users, benefits and demand-side intervention possibilities. - Get acceptance from DT users to test the community approach, i.e., agreement to install capacitors, test the load management approach, and prepare a report on the current status of demand.	2			2					Note
F2	Conduct awareness building programs on crop and irrigation practices, load management strategies, capacitor usage, pump selection. - Assist and facilitate implementing interventions. - Use the Load Management Application to develop schedules.	4		1	1	2				Report
	Survey/ get feedback on number of capacitors installed, incidence of implementation of load management.	1			1					Report
F3	Documentation of existing infrastructure, developing guidelines for functioning and assistance to DT User Groups (DTUG). - Tabulate status of pending connections, latent demand, DT network. - To prepare a report on DTUGs demand side activities. Preparation of a template for functioning of DTUGs comprising rules and guidelines. The report will be shared with MSEDCL	4		1	2	1				Report, Template
G. Monitoring energy and water usage on selected farmers										
G1	Continuation of monitoring water-energy data in 5 villages, and installation of meters in 1 village.	6	1	4	1					Report, Framework model
H. MLP based energy estimation tool prototype at the village level										
H1	Selection of target clusters (3 villages/feeders) (Feeder - village correlations from local MSEDCL office)	1			1					Note
H2	Collection of datasets needed in the tool and develop the energy-water correlations model further.	2		1	1					Report, Template

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H3	Run the model for 3 villages/feeders, and validate at the end of rabi against feeder energy. Conduct Rabi surveys; Checks for DT overloading in selected village(s). Fine-tuning of the model based on validation.	4		2	2					Report
H4	Final report submission.	1		1						Report
I.	**Cropping pattern-based Irrigation and Investment indices, village level, for irrigated and non-irrigated farmers**									
I1	Review and restructuring of existing indices and proposal of new indices.	1	1							Note
I2	Selection of villages (4), development of farmer sampling methodology (30 farmers per village), design of questionnaires and surveys.	2		1	1					Template
I3	Survey of farmers in selected villages.	2			2					Report
I4	Tabulation of preliminary findings and documentation. Review and final report submission.	2	1	1						Report
J.	**Load Management Application Development and MLP tool IT Stack Integration**									
J1	Development of Load Management Application to be used in upcoming rabi by IIT to support 4 pilot DTUGs.	3					1	2		App
J2	Porting of MLP based energy estimation tool into IT Stack. Incorporation of new data sets such as dugwell depths, high-level parameters of irrigation tanks/ dams in village, groundwater levels, energy infrastructure and other village parameters, to support component H for a selection of clusters.	2						2		Note
	Total	38	3	12	15	3	1	4		

** Field includes field work for surveys and on-field measurements*

*** Extension includes the combination of deskwork and extension-related fieldwork.*

II Post Harvest Processing

Components	Activity	Man Months	Research	Technical	Field	Extension	IT Design	IT	Items	Output

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			(Man - Month)	(Man-Month)	(Man - Month)	(Man - Month)	(Man - Month)	(Man-Month)	(Quantity)	
K.	**Development of a detailed project report for onion storage structure**									
K1	Preliminary report: Stakeholders interviews, FPCs screening, mapping of crops and regions.	4	2		2					Report
K2	Interim report: Feasibility analysis report for selected FPC	3		1	2					Report
K3	Final report: Detailed project report including sensitivity and uncertainty analysis.	6	3	3						Report
L.	**Development of a detailed project report for one FPC in regard to value addition of agriculture produce via new processes & products**									
L1	Preliminary report: Stakeholders interviews, FPCs screening, mapping of crops and regions, screening of crops.	4		2	2					Report
L2	Interim report: Feasibility analysis report for selected FPCs. Assessment of the market demand/supply for different agricultural value chains to identify specific location and product-specific infrastructure and facilities gaps that can add value to the product through processing at different levels, increase efficiency, reduce wastage.	6	2	1	3					Report
L3.	Final report: Detailed project report including Cost and breakeven analysis, sensitivity and uncertainty analysis, quality control	6	3	3						Report
M.	**Commissioning of the storage project**									
M1	Assist in Selection of the suitable location and geographic features of the area. Implementation planning note: Determination of human resources requirements, risk mitigation strategies, implementation schedule.	6	2	2	2					Report
M2	Assist FPC in procurement of machinery and equipment, erection and building of said unit as per the blueprint and layout, and commissioning of the project	9	1	2	4	2				Training and support

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	Total	44	13	14	15	2			

6.0 Terms and Conditions:

6.1 Services:

(i) The Second Party shall perform the services specified in point 5.0 Reporting Obligations for the second Party.

(ii) The Second Party shall submit to the First Party, the reports listed in *5.0* Reporting Obligations of the Second Party and Review Mechanism within the time periods listed therein.

(iii) The Second Party shall provide the personnel listed in Annexure I, to perform the Services.

6.2 Term:

The Second Party shall perform the Services as agreed by the parties in writing and continuing through twelve 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. 2,19,06,000 (Excluding applicable taxes). This amount has been established based on the understanding that it includes all of the Second Party's costs and overheads.

B. Schedule of Payments:

The schedule of payments is specified below:

Phase	Duration	Payment#
Phase I	Within 15 days from commencement of work	10% of Agreement cost
Phase II	2 months from commencement of work	10% of Agreement cost
Phase III	5 Months from commencement of work	25 % of Agreement Cost
Phase IV	8 months from commencement of work	25 % of Agreement cost
Phase V	10 Months from commencement of work	20 % of Agreement cost
Phase VI	12 Months from commencement of work	10 % of Agreement cost

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Payment shall be made after acceptance by PMU, PoCRA of the deliverables mentioned in Phase I - VI.

C. Payment Conditions

Payment shall be made in Indian Rupees within 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 and Consultancy Account

Contact Details: Adishankaracharya Marg, Powai, Mumbai, 400076

Contact no. 91-22-25767020/ 7032/ 9769257032

Fax no.: 91-22-25764034

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

Bank Name: State Bank of India

Bank Branch: IIT Powai

Branch Address: Adishankaracharya Marg, Powai, Mumbai 400076

Contact no.: 91-22-25722894/ 1103 / 2900/ 5305

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

Account no.: 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

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The First Party designates the Agronomist of the 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.

The Second Party designates the Project Coordinators as the Project Investigator and the Co-Project Investigator from IIT Bombay as Second Party's Coordinators: the Coordinators shall be responsible for the submission of deliverables by the Second Party.

B. Reports

The reports listed in 'Table 5.0 Reporting Obligations of the Second Party and Review Mechanism' 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 highest standards of professional and ethical competence and integrity. The Second Party shall promptly replace any personnel assigned under this MoU as may be mutually agreed between the Parties.

6.6 Inspections and Auditing:

The Second Party shall permit, and shall cause its Sub-Consultants to permit, the First Party and/or persons or auditors appointed by the First Party to inspect and/or audit its accounts and records and other documents relating to the submission of the Proposal to provide the Services and execution of the MoU.

6.7 Confidentiality:

The Second Party shall not, during the term of this MoU and within two years after its expiration, disclose any proprietary or confidential information relating to the Services, this MoU or the First Party's business or operations without the prior written consent of the First Party.

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

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copy of such documents and software[1]. The Second party can use it for research and academic purposes with the prior approval from the first party. Any equipment procured by the second party for the purpose of this assignment will be handed over to the first party at the end of the assignment.

6.9 Left Blank:

6.10 Insurance:

The Second Party will be responsible for taking out any appropriate insurance as required.

6.11 Assignment:

The Second Party shall not assign this MoU or Subcontract any portion of it without the First Party's prior written consent.

6.12 Law Governing this MoU and Language:
The MoU shall be governed by the laws of India, and the language of all MoU related documents shall be English.

6.13 Dispute Resolution[2]:

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

6.14 Termination:

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

6.14.2. The First Party may terminate this MoU with at least ten (10) 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 seven (7) 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;

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[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.

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(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.

6.14.3. 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 or parts thereof, any other information and document gathered under this MoU prior to the date of termination.

7.0 Annexures:

Annexure – I: Second Party's Personnel and corresponding Unit Rates and Budget
Annexure - II: Key Staff and Professionals

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

FOR THE 'FIRST PARTY'

Signed by: Indra Mallo (IAS)
Title: Project Director, PoCRA
Date ....24.-.08.-.2021.....
Place: Mumbai
Seal: Project Director
Project on Climate Resilient Agriculture
Cuffe Parade, Mumbai - 400005.

FOR THE 'SECOND PARTY'

Signed by: Prof. A. M. Pradeep
Title: Associate Dean (R&D)
Date .....24.-.08.-.2021.....
Place: Mumbai
Seal: सह संकायाध्यक्ष, शोध एवं विकास
Associate Dean, Research and Development
कृते निदेशक, आय आय टी मुंबई
For Director, IIT Bombay

In the presence of the following witnesses:
1. (Dr. Meghana Kelkar)
2. (Vijay Kolekar)

In the presence of the following witnesses:
1. (AMIT ARORA)
2. (PRIYA JADHAV)

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Annexure I

Second Party's Personnel and corresponding Unit Rates

A. Water budget and Project Support				
Sr. No.	**Name of Personnel**	**Unit Rate (Rs. per month)**	**Number of Man - Months**	**Total (lakh)**
1	Prof. Milind Sohoni	30000 INR/Day	30 days	9.0
2	Team Manager and coordinator	120000	12	14.4
3	Senior IT consultant	140000	12	16.8
4	Team Lead (Field and Extension)	80000	12	9.6
5	Senior Project Engineer	70000	12	8.4
6	Field Engineer I	35000	10	3.5
7	Field Engineer II	35000	4	1.4
8	Field staff I	20000	3	0.6
9	Field staff II	20000	3	0.6
10	Students (3)	20000	5	3.0
Total Human Resource				**67.3**
Head-wise totals				
Human Resources				67.3
Travel + Logistics (for field stay)				12.0
Instruments	Water Level Sensors, soil moisture profile probes, v-notches with water level sensors, rain gauges + data-logging and IoT-based system for all the above instruments			15.0
Contingency				11.0

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Total (A)				**105.3**
B. Energy				
Sr. No.	**Name of Personnel**	**Unit Rate (per month)**	**Number of Months**	**Total (lakh)**
1	Prof. Priya Jadhav	30000 INR/Day	20 days	6.0
2	Prof. Anupama Kowli (Electrical networks, optimization expert)	30000 INR/Day	4 days	1.2
3	Project Research Engineer	70000	12	8.4
4	Project Research Assistant I	50000	12	6.0
5	Project Research Assistant II	50000	9	4.5
6	IT Assistant	60000	4	2.4
7	Senior IT consultant (External, part-time)	120000	1	1.2
8	Students (2)	20000	4.5	1.8
Total Human resource				**31.5**
Head-wise totals				
Human Resources				31.5
Travel + Logistics:				6.0
DT meters (6) and handheld single-phase power analysers for colleges				2.2
Contingency				6
Total (B)				**45.7**
C. Post-harvest processing				
Sr. No.	**Name of Personnel**	**Unit Rate (per month)**	**Number of Months**	**Total (lakh)**
1	Prof. Amit Arora	30000 INR/Day	5 days	1.5

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2	Project Research Engineer	50000	12	6.0
3	Project Research Assistant I	30000	12	3.6
4	Project Research Assistant II	30000	12	3.6
5	Students (4)	20000	6	4.8
6	Project Manager for Implementation work	100000	8	8.0
Total Human resource				**27.5**
Head-wise totals				
Human Resources				27.5
Travel + Logistics:				3.0
Contingency				4.0
Total (C)				**34.5**
Total (A + B + C), lakhs				**185.5**
Final Amount (lakhs, with 20% overhead) *				**219.06**

*** Exclusive of all taxes and 0% overheads for faculty fee**

*** Phase wise payment will be made as per 'B. Schedule of Payments' in point 6.3**

Note:

1. The manpower and salaries are indicative and allocation may be changed within the salary head for effective implementation.

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Annexure II

Key Staff / Professionals required

Sl No.	Positions	Qualification and Experience	Number
1	Project Coordinator: Water (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	Project Coordinator: Energy (CV indicating the qualifications and experience to be enclosed)	Faculty with experience in management of multi-disciplinary projects related to Agricultural water and energy consumption	1
3	Project Coordinator: Post-Harvest Technology (CV indicating the qualifications and experience to be enclosed)	Professor with experience in management of multi-disciplinary projects related to Post harvest management of Agricultural produce.	1
4	Team Manager and Coordinator (CV indicating the qualifications and experience to be enclosed)	Doctorate degree in the field relevant to natural resource management with experience in management of multi-disciplinary projects related to Natural Resource management, watershed Management, hydrological modelling and IT projects etc with government agencies	1
5	Senior IT Consultant: Water (CV indicating the qualifications and experience to be	Masters degree in Computer Science / IT Engineering and more than 7 years of experience in development and use of IT tools for multi-disciplinary projects	1

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	enclosed)		
6	Senior IT Consultant: Energy (CV indicating the qualifications and experience to be enclosed)	Masters degree in Computer Science / IT Engineering and more than 3 years of experience in development and use of IT tools for multi-disciplinary projects	1
7	Team Leader - Field and Extension: Water (CV indicating the qualifications and experience to be enclosed)	Masters degree in the field relevant to natural resource management / rural development and at least 3 years of work experience with government agencies in management of multi-disciplinary projects in the development sector for rural areas	1
8	Project Manager: Post Harvest Processing (For liasoning and implementation work)	Min. 5 years' experience with implementation projects in related domains of Food processing/Value chain/Storage Structures etc.	1
9	Senior Project Engineer: Water (CV indicating the qualifications and experience to be enclosed)	Masters degree in the field relevant to natural resource management / rural development and at least 3 years of work experience with government agencies in management of multi-disciplinary projects in the development sector such as watershed Management	1
10	Project Research Engineer: Energy (CV indicating the qualifications and experience to be enclosed)	Masters degree in the field relevant to natural resource management / rural development with at least one year experience in management of multi-disciplinary projects in the development sector such as agriculture, rural electrification, pumping systems, data analysis	1

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11	Project Research Assistant: Energy (CV indicating their qualifications and experience to be enclosed)	Bachelor's or higher degree with at least one year of experience in management of multi-disciplinary projects related to Natural Resource management/ agriculture / electrical engineering, stakeholder management, data analysis	2
12	Project research Engineer: Storage technologies	Bachelors or higher degree in the field relevant to post harvest management.	1
13	Project research assistant: Value addition through processing	Bachelors or higher degree with experience in value chain and food process engineering.	1
14	Field Engineer: Water (CV indicating their qualifications and experience to be enclosed)	Bachelor's or higher degree (preferred in Civil Engineering) with at least one year of field experience with required skills in field surveys, documentation, data analysis and basic knowledge of agriculture and hydrology.	2
15	Field staff: Water (CV indicating their qualifications and experience to be enclosed)	Bachelor's or Diploma degree in Engineering or BSc. degree in Agriculture with required skills in field surveys, documentation, data analysis and basic knowledge of agriculture hydrology.	2
16	IT Assistant: Energy (CV indicating the qualifications and experience to be enclosed)	Bachelors or higher degree with experience in development and management of IT Systems (Android apps, Java, Salesforce etc)	1
17	Electrical networks, optimization expert	Faculty with experience in electrical networks and optimization	1

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