

Government of India
Ministry of Agriculture & Farmers' Welfare
Department of Agriculture, Cooperation & Farmers' Welfare

Mahalanobis National Crop Forecast Centre
Near Krishi Vistar Sadan
Pusa Campus, New Delhi-110012

Invitation for

Expression of Interest
For Gram Panchayat (GP) level Crop Yield Estimation Using
Technology for non-cereal crops

File No. 6/7(2)/PMFBY/2017-MNCFC
(November 2020)

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NOTICE INVITING EOI

Government of India Ministry of Agriculture & Farmers' Welfare Department of Agriculture, Cooperation & Farmers' Welfare MAHALANOBIS NATIONAL CROP FORECAST CENTRE Near Krishi Vistar Sadan, Pusa Campus, New Delhi-110012	
NOTICE INVITING EOI (For publishing in the Website)	
File No. 6/7(2)/PMFBY/2017-MNCFC	
Office of issue	Mahalanobis National Crop Forecast Centre (MNCFC), DAC&FW, Nr Krishi Vistar Sadan, Pusa Campus, New Delhi-110012
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Date of Presentation of EOI	First week of January (to be informed)
Place of Presentation of EOI	Committee Room, MNCFC, Nr. Krishi Vistar Sadan, Pusa Campus, New Delhi-110012.

On behalf of President of India, Expression of Interest is invited from experienced agencies for **Gram Panchayat (GP) level Crop Yield Estimation Using Technology for non-cereal crops**, for the Rabi 2020-21& Kharif 2021.

EOI Invitation document can be downloaded from MNCFC website www.ncfc.gov.in and DAC&FW website www.agricoop.nic.in

*The EOI can be uploaded online on www.ncfc.gov.in and copies can be sent through
email to ncfc@gov.in or "R. R. Banga" <rr.banga@nic.in>*

Sd/- (R R Banga)
HEAD OF OFFICE, MNCFC
☎ 011-25843224

GENERAL ASPECTS OF EOI INVITATION

1. NATURE OF EOI

This EOI is for obtaining services of reputed technical/research agencies for Gram Panchayat level Crop Yield Estimation Using Technology for non-cereal crops, for Pradhan Mantri Fasal Bima Yojana (PNFBY). The study should be carried out for non-cereal crops during Rabi 2020-21 and Kharif 2021, and may be extended depending upon the requirement of **Mahalanobis National Crop Forecast Centre (MNCFC)**/Department of Agriculture, Cooperation & Framers' Welfare (DAC&FW). Presently, services are required for Gram Panchayat (GP) level Yield Estimation using Technology in at least 6 districts (in each district 5 Blocks and in each block 10 GPs), well distributed in at least 3 states of different agro-climatic zones for *Rabi* and *Kharif* non-cereal crops. Each agency has to take at least 3 crops, i.e. each crop for 2 districts. The tentative list of crops along with special condition in selection of crops/area is presented in Annexure I.

2. ELIGIBLE AGENCIES

All service providing agencies must be having at least five years' service experience beside at least two years of experience related to yield estimation using technology (to be reckoned on the last date for submission of Eoi), for the Ministries/Departments, Central/State Autonomous Bodies, statutory bodies, public or private sector organizations and fulfilling the following conditions are eligible for submitting proposals:

- a) The Agency can be government/private/autonomous organisations from India or abroad. However, International Agencies should have technical units/collaborations in India.
- b) The Agency should have experience in working in at least 1-2 states of the country in different (2-3) crops.
- c) Agency should have experience of technology-based yield estimation
- d) The Agency should have facility of processing satellite & UAV of Remote Sensing data.
- e) The agency should have permanent/ on roll following Experts
 1. Remote Sensing Experts,
 2. Agriculture Experts,
 3. Crop Modellers,
 4. Data Analysts,
 5. Machine Learning and Artificial Intelligence experts, and
 6. Statistics Experts
- f) Agency should have experience of using modern tools like Artificial Intelligence/machine Learning, Crop Models, UAV Image Processing and Satellite data analysis (both optical and microwave).

The Private Agencies/Companies should fulfil following additional criteria.

- g) The Agency must not have been blacklisted by any Government/Ministry/Department/PSU, nor should they have been debarred from dealing with any public Department.
- h) The agency must be registered with all Government/statutory authorities such as Sales Tax Department, Income Tax Department, etc. as required in the normal course of business to render providing similar services.

3. BACKGROUND & SCOPE OF WORK

Pradhan Mantri Fasal Bima Yojana (PMFBY) is a yield-based crop insurance scheme that uses Crop Cutting Experiments (CCEs) to determine the yield loss suffered by the farmers due to natural catastrophes and adverse weather conditions. Owing to lowering of insurance unit level from block level to GP, number of CCEs to be conducted has increased manifold. Yield obtained from the CCEs is accurate but laborious and time-consuming which results into delay in settlement of claims. Further, in the current methodology of yield estimation, the allocation and selection of fields for conducting CCE is based on the information of crop of previous years due to non-availability of current year information at the time of planning of survey. As a result, the precision of estimates may get affected.

II. The Department (DAC&FW) is exploring various technology-based solutions for improving the crop yield estimates, which include Smart Sampling/CCE optimizations, 2-Step yield Estimations and Technology based Direct Yield Estimation.

III. In Kharif 2019, MNCFC/DAC&FW engaged thirteen Tech Agencies (government/private; national/international) for conducting Pilot studies for GP level yield estimation, using technology, in 64 Districts of 15 states for 9 crops. The yield estimation was validated during Rabi, 15 blocks of 4 states. Based on the encouraging results of the above Pilot studies, MNCFC/DAC&FW has engaged 8 Tech Agencies for conducting large-scale Pilot studies in 100 districts, each, during Kharif and Rabi of 2020-21 for Rice and Wheat crop.

IV. For crops, other than Rice and wheat, the Department, has decided to continue the Pilot studies, till the technology is duly validated and ready for implementation. Accordingly, this request for EoI is being released for identifying and engaging Tech Agencies to conduct these Pilot studies during Rabi, 2020-21 and Kharif, 2021.

V. In view of the above, DAC&FW/MNCFC have decided to carry out Pilot studies with the support of Government/private; national/international organisations to estimate crop yield at GP level using innovative technologies/data like High spatio-temporal resolution remote sensing data, Unmanned Aerial Vehicle (UAV), Advanced intelligent crop simulation models, Artificial intelligence/machine learning, IoTs, Soil, Weather & Crop data, Picture based Analysis, Advanced Statistics, etc. The outcome and finding of the pilot projects will be assessed for taking a decision/strategy for accurate yield estimation at GP level. Under this project Pilot study GP level

yield estimation for non-cereal (Rice & Wheat) crops, agencies have to provide yield estimates at GP level, using technology, for the selected GPs and selected crops during Rabi 2020-21 and Kharif 2021 season, in the major non cereal growing districts/states across India. The overall monitoring of entire process of implementation of pilot studies would be done by MNCFC with the support of a national level expert committee.

4. CRITERIA FOR WORK

The criteria for conducting the study is mentioned below:

- i. Agency should carry out the study in at least, 6 districts, 5 blocks in each district and at least 10 GP in each Block. The number may change depending upon the future requirement.
- ii. The districts should be well distributed in at least 3 states of different agro-climatic zones from different geographic regions (north, south, east, west and centre) of the country.
- iii. The study should be conducted for 3 crops, in each season. Each Agency should take three non-cereal (other than rice & wheat) crops, as per the Annexure I.
- iv. The Agency should give the list of crops, districts, blocks and GPs, in which it wants to carry out the study. However, MNCFC can change the districts and crops, in consultation with the agency, for a wider coverage.
- v. Minimum 10 GPs should be covered in each block of every district.
- vi. Yield Data of at least 6 properly distributed CCEs (Smart Sampling) in each GP, should be used for developing/ validating yield model.
- vii. Annexure-2 gives the guidelines of conducting CCEs, which can be used by the Agency (or its outsourcing partner) However, selected Agency should compulsorily monitor all the CCEs and also participate in at least 40% planned CCEs. Data of CCEs will be sent to MNCFC through App on real time basis.
- viii. Model should be developed based on data of 50% GPs and validated using the remaining 50% GPs.
- ix. Separate models should be developed separate districts and separate crops, also separately for irrigated and unirrigated.
- x. The Satellite based crop classification should use data of 20m or better spatial resolution. Both microwave (SAR) and optical remote sensing data be used, as per the requirement. Indian satellite data may be given preference.
- xi. Crop classification accuracy (overall accuracy) should be at least 80 per cent. At least 20 Ground truth points per block should be used for crop classification.
- xii. Technology proposed to be used should be an advanced technology, feasible and up-scalable.
- xiii. It should be attempted to have all the studies in diverse crops and regions.
- xiv. The final study report, for Rabi, needs to be submitted by Mid of June, 2021 and for Kharif needs to be submitted by Mid of February, 2022. The Report format is provided in Annexure III.

- xv. The Mid Term Report should be, for Rabi by 15th February and for Kharif by 15th October. However, the Agency should provide interim reports, as and when asked, and also provide regular updates, through a special portal designed for the purpose.
- xvi. The selection of the agency will be done by an expert committee, as per the selection criteria given in the Section 9.
- xvii. The expert committee may reject any proposal, if not found suitable.

5. SPECIFIC TERMS & CONDITIONS

- a. All the data collected (raw and processed) in the entire experiment will be the sole property of MNCFC/DAC&FW.
- b. All data, along with the metadata, should be stored on MeITY approved cloud and MNCFC/DAC&FW should be made a user of the account (with view, copy and edit permissions). However, at the end of the experiment the account should be handed over to MNCFC/DAC&FW, with MNCFC/DAC&FW being the sole owner of the account.
- c. There should not be any conflict of interest. The Agency should not take funding support from any other organisation for the same work, without prior formal approval of MNCFC/DAC&FW.
- d. The results of the study should not declared/published/ shared in any form, or with any organisation other than MNCFC/DAC&FW, till 2 years after the experiment is over. The Agency has to sign a Non-Disclosure Agreement with MNCFC/DAC&FW for this purpose
- e. The Agency has to work under a ceiling budget, as decided MNCFC /DAC&FW. The per district budget along with item/component wise, will be decided keeping in view of the workload for each study and available market rates for each component. The ceiling budget will include, agency charges and taxes.

6. TECHNOLOGY EXPECTED TO BE USED

The Agency should use at least 7 of these 11 technologies listed below with i, iii, iv, v, x, xi being mandatory.

- i. High Resolution Satellite data (Optical and microwave)
- ii. Unmanned Aerial Vehicle (UAV)
- iii. Advanced multi-parameter crop models
- iv. Mobile Applications for Field Data Collections
- v. Artificial intelligence/ Machine learning approach
- vi. Sensor Networks
- vii. Internet of Things
- viii. Field based digital photograph
- ix. Hand held instruments being mad
- x. Scientifically designed Study
- xi. Statistically sound Sampling Plans

7. FORMAT OF EOI TO BE SUBMITTED BY THE AGENCY

- i. Introduction
- ii. About the Organisation
- iii. Contact Details

- iv. List of Technical persons with their qualification
- v. Details of the previous study carried out- using satellite data, UAV, Crop Growth Simulation model, Machine Learning/Artificial Intelligence, Internet of Things, Smart Sampling,
- vi. Study Area, intended to be taken up.
- vii. Crops to be taken
- viii. Methodology/Technology to be used (in detail)
- ix. Experimental Setup
- x. Time line
- xi. Expected Results, Outputs, Deliverables
- xii. Lists of Patents/publications in the similar works

8. ADDITIONAL INFORMATION/DOCUMENT TO BE PROVIDED

The Private agencies should have to provide following additional documents.

- a) A brief profile of agency mentioning address of its registered head office, address of local office in Delhi, Contact no. (Mobile, landline, fax and email id), names of important persons who may be contacted etc.
- b) Certificate of Incorporation/ Registration of Agency/ Memorandum and Articles of Association/ Partnership Deed/ Proprietorship Deed/ Declaration of Proprietorship etc. as the case may be.
- c) Copy of PAN/TAN numbers.
- d) Copy of Income Tax Return for last two Financial Years i.e. FY 2018-19 & 2019-20.
- e) Audited accounts (Balance Sheet and Profit and Loss Account etc.) for the last two years.
- f) Copy of Service Tax Registration Certificate.
- g) Certificate by the Bidder to the effect that the agency is not blacklisted by any Govt. Organization/ DGS&D/ NCCF / PSU.
- h) Undertaking for the Study. A certificate of Undertaking that the Agency will carry out the study as specified in the Section 4 and 5.
- i) Certification. The Agency should provide certificates of the past experience of conducting similar kind of studies. Copies of experience certificates/order for award of contract for related services with other Ministries/Departments
- j) Non-Disclosure Agreement (NDA). The Agency should provide an NDA as per Section 5d.
- k) EoI Acceptance Letter on agency's letter head which should be filled, signed and stamped/certified properly.
- l) Bid security (EMD) of Rs.1,00,000/- or registration certificate of the Central Purchase Organization, or NISC.

Documents listed above must be properly scanned such that they are clearly readable/ legible as the poorly scanned documents may render the EoI unresponsive at technical stage. **The documents should be arranged, exactly, in the above order and page numbered, with an index, in the beginning, providing the page number of each document.**

9. SELECTION CRITERIA

The selection of Agency will be made, by an Expert Team, based on following criteria. The Agency has to provide supporting documents for all of these for proper evaluation. MNCFC will not be responsible, if an agency has not given any document, even though it might have that qualification.

- i. Number of years' **experience** of the Agency in similar work, i.e. crop yield estimation using satellite data (Max. **10 marks**: 2 marks for each year)
- ii. The **technologies proposed** to be used. The agency should provide detailed plans about this (Max. **20 Marks**, Max 2 marks for each unique technology, as mentioned in Section 5)
- iii. **Crops and Geographical distribution** of the proposed study (Max. **5 Marks**)
- iv. Details of the **Technical personnel** available with the Agency, for this study. The Agency should provide the names, contact details and qualifications of the proposed pilot study team members (Max. **20 marks**; 2 Marks for each PhD holder, 1 Mark for each MSc/MTech)
- v. **Technical facility** available with the Agency. Agency should provide the details. The facilities include, availability of IP/GIS Lab, Own UAVs, AI/ML Platform, Smart Apps for Field Survey, Crop Modelling tools, IoT/Sensor Networks, High end Servers or Cloud Processing Facility (Max. **10 Marks**: Max. 2 Marks for each facility)
- vi. **Planning** of the study. This will be decided by the Expert Committee, based on the rigour, advanced technology, scientific design, and scalability of the technology (Max. **10 Marks**)
- vii. **Presentation** Made by the Agency. This will be decided by the Expert Committee based on the presentation made, its clarity, orderliness and the capability of the presenter to reply to questions (Max. **10 marks**)
- viii. **Patents or reputed publications** of the Agency in the similar work (Max. **5 Marks**: 2 Marks for each Patent and 1 Mark for each peer reviewed journal publication with Impact Factor > 1.0)
- ix. **For Private Agencies: Annual Turnover** (average of last 2 years from Crop Yield Estimation Related Work): (Max: 10 marks, 2 marks for each crore)

Total: 100 (90 marks for government/autonomous agencies). Agencies scoring 60% or higher marks will be considered eligible. However, maximum 25 Agencies will be considered.

10. EMD/BID SECURITY (Only for Private Agencies)

- i. Agencies/Bidders, except those who are registered with the Central Purchase Organisation, National Small Industries Corporation (NSIC), shall have to furnish, as part of bid, an EMD/bid security for an amount of **1,00,000 /- (Rupees One lakh only)** in the form of an account payee Demand Draft, Fixed Deposit receipt, Banker's Cheque or Bank Guarantee from any Indian Commercial Bank in favour of "Pay & Accounts Officer (Extension), Shastri Bhawan, New Delhi", valid for a period of 45 days beyond the final EoI validity period and shall be delivered physically to Head of Office, Mahalanobis National Crop Forecast Centre (MNCFC), Nr Krishi Vistar Sadan, Pusa Campus, New Delhi-110012, on or before the last date and time fixed for EoI submission. An EoI not accompanied by EMD/EoI security shall be rejected being non-responsive at the bid opening stage and returned to the bidder unopened.

- ii. The bid security of the unsuccessful bidder will be discharged /returned to the bidder at the earliest after evaluation of the bid and latest on or before the 45th day after the award of the contract.
- iii. The successful bidder's bid security will be discharged upon the bidder's acceptance of the award of contract and furnishing the performance security.
- iv. The bid security may be forfeited:
 - a. If a bidder withdraws his bid during the period of bid validity specified above.
 - b. In the case of a successful bidder, if the bidder withdraws or amends the EoI or impairs or derogates from the EoI.

11. PERFORMANCE BANK GURANTEE (ONLY FOR PRIVATE AGENCIES)

The **PERFORMANCE BANK GURANTEE** is approximately 20% of the cost of the project. PBG will be taken in 2 instalments i.e. one instalment in Rabi season and one instalment in Kharif season. The amount shall be remitted through Account Payee DD/Fixed Deposit Receipt (FDR)/ Bank Gurantee in favour of "Pay & Accounts Officer (Extension), Shastri Bhawan, New Delhi" towards Performance Bank Guarantee (PBG). The PBG shall be valid for at least 90 (Ninety) days beyond the completion of contract period and shall be denominated in Indian rupees payable at New Delhi, issued by a scheduled bank in India through its branch in New Delhi, India. The proceeds of the performance security shall be payable to MNCFC as compensation for any loss resulting from the service provider's failure to complete its obligations under this EoI. MNCFC shall notify the service provider in writing of its invocation of its right to receive such compensation within 15 days, indicating the reasons for which the service provider is in default. The performance security shall be discharged by MNCFC and returned to the service provider within 30 days from the date of final certificate, certifying the fulfilment of the performance obligations under this EoI. The service provider shall furnish amendment to the performance security, if required, within 15 days of notification.

ANNEXURE-1 LIST OF CROPS**(The agency has to select one crop form each group)**

Group	Rabi 2020-21	Kharif 2021
1	Jowar, Maize, Barely	Jowar, Maize, Bajra, Ragi
2	Rapeseed & Mustard, Gram, Groundnut, Urad, Moong, Lentil	Groundnut, Soybean, Urad, Moong, Guar
3	Sunflower, Potato, Onion, Tomato	Cotton, Tur, Sugarcane, Jute/Mesta, Castor

Special Conditions in selection of Crops and districts:

1. (a) Agency selected earlier for the similar Pilot studies for estimation of Crop Yield at GP level using technology during 2019-20, will not select combination of same location, crop(s) and methodology during 2020-21.
- (b) Agency selected for validation of results/ large scale Pilot studies for estimation of Crop Yield at GP level for Rice & Wheat using technology during 2020-21, may select the same location, however, cost of inputs such as satellite data etc will be deducted proportionately.

ANNEXURE-2 GUIDELINES FOR CONDUCTING CCE

- i. At least 1800 (6 districts x 5 Blocks x 10 GPs x 6 CCEs) CCEs to be conducted in each season, out of which 900 should be used for yield model development and 900 for validation
- ii. The CCE sites should be located using smart sampling. A reliable yield proxy (preferably more than one parameter or a composite indicator), having good correlation with crop yield should be used for CCE planning.
- iii. The CCEs should be conducted following the procedure defined by NSSO/IASRI/state government.
- iv. Each CCE plot should be of minimum 5x5 sq m size or as defined by the Revenue Department of the concerned state.
 - v. The Field, where CCE will be conducted, should be at least of 1 acre area.
 - vi. The CCE plot within the field should be representative of the whole field, not affected by site specific external factors.
 - vii. The selected field should be sole-cropped (no mixed cropping) with the concerned crop.
 - viii. The CCE should be conducted in the field, which is ready for harvest.
 - ix. The CCE plot should be at least 3 m away from the field borders.
 - x. The CCE data will be collected through Smartphones using the MNCFC Android App (Bhuvan CCE). It should be checked that the GPS accuracy is better than 5 m.
 - xi. The smartphone should have Navigation App, for showing GPS reading and North Direction.
 - xii. Each CCE information should come along with latitude - longitude and 2 photographs (of crop cutting and grain weighing)
 - xiii. Additionally, 2 photographs i) of the field and ii) of the CCE plot (taken from 1 m above nadir viewing) should also be provided.
 - xiv. For Cotton crop CCE should be conducted for at least 3 pickings for rainfed crop and 4 pickings for irrigated crop.
 - xv. The accuracy of Biomass weighing should be 2 decimal levels in kg and grain yield in 3 decimal levels.
 - xvi. The Biomass and Grain yield should be weighed using high precision digital balance. Different digital balances should be used for weighing different items (Biomass, Grain Weight, 1000 Seed Weight)
 - xvii. Apart from the information coming through smart phones, the hardcopy form to be filled up and signed by the Observer, farmer and a third party not related to above two, along with their name and phone numbers should also be provided to the Centre.
 - xviii. The moisture percentage of Biomass should be obtained, at least in 5% cases, through drying method.
 - xix. The Grain moisture percentage should be obtained using portable grain moisture meter.
 - xx. A few CCE sites may be randomly selected for supervision (by MNCFC) and the Agency will facilitate (local logistics) for this supervision.
 - xxi. The online data should be sent real-time or maximum within 2 days of CCEs conducted and the hardcopies should be delivered within 15 days of conducting CCE.
 - xxii. In case of any deviation from standard CCE procedure, it must be reported to MNCFC.
 - xxiii. Agency should ensure compliance with prescribed procedure (for each crop) in each district.

ANNEXURE-3 REPORT FORMAT

- i. Executive Summary
- ii. Contents with Page Numbers
- iii. List of Tables
- iv. List of Figures
- v. List of Annexures
- vi. List of Contributors
1. Introduction (This should have review of literature, with references)
2. Study Area (Description with maps)
3. Data Used
 - Ground Data (Crop Survey, CCE, Soil, Weather Data, any other data) – Summary Tables should be provided for each
 - Satellite Data (Descriptions with number of scenes and dates of Data)
 - UAV Data (Type of UAV, Type of sensor, Map of UAV coverage, Total coverage, Dates)
 - Details of Any Other Data
4. Methodology
 - Field Data Collection
 - Satellite Data Processing for crop map and areas
 - Smart Sampling and CCE data Collection
 - Yield Modelling
 - Accuracy Evaluation (RMSE, NRMSE, t-test, MAPE, correlation coefficient, Index of Agreement)
5. Results and Discussion
 - Description of field data (summary tables with statistical analysis and any interpretation)
 - Crop Area Estimations (Statistics, Maps and accuracy)
 - Suitability of Smart Sampling (Stratification Efficiency)
 - CCE data description
 - Yield Estimation and its evaluation
6. Summary and Conclusions (including way forward)
7. Acknowledgment (DAC&FW, PMFBY and MNCFC should be acknowledged)
8. References (at least 20, please follow the reference format of Journal of Indian Society of Remote Sensing)
9. Annexures (Tables of all data details, which are being transferred to MNCFC)