PIR MEHR ALI SHAH
ARID AGRICULTURE UNIVERSITY RAWALPINDI (PMAS-AAUR)

Tender Inquiry No.2025-26/012-P

REQUEST FOR PROPOSAL (RFP)
for

PROCUREMENT OF MISCELLANEOUS ITEMS (MOBILE APPLICATIONS AND SYSTEM DESIGN, HARDWARE/SOFTWARE)

Pilot Project for Data Driven Smart Decision Platform for Increased Agriculture Productivity (DDSDP)

PMAS-AAUR,
SHAMSABAD, MURREE ROAD, RAWALPINDI.
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Summary Description

Summary

Invitation for Bids

PART 1 – BIDDING PROCEDURES

Section I. Instructions to Bidders (ITB)

This Section provides information to help Bidders prepare their bids. Information is also provided on the submission, opening, and evaluation of bids and on the award of Contracts. **Section-I contains provisions that are to be used without modification.**

Section II. Bid Data Sheet (BDS)

This Section includes provisions that are specific to each procurement and that supplement Section I, Instructions to Bidders.

Section III. Evaluation and Qualification Criteria

This Section specifies the criteria to determine the lowest evaluated bid and the qualifications of the Bidder to perform the contract.

Section IV. Bidding Forms

This Section includes the forms for the Bid Submission, Price Schedules, and Bid Security to be submitted completed by the Bidder and submitted as part of his Bid.

Section V. Eligible Countries

This Section contains information regarding eligible countries.

PART 2 – SCHEDULE OF REQUIREMENTS

Section VI. Schedule of Requirements

This Section includes the List of Services, the Delivery and Completion Schedules and the Technical Requirements that describe the Related Services to be procured.

Project: Pilot Project for Data Driven Smart Decision Platform for Increased Agriculture Productivity (DDSDP)

Procuring Agency: PMAS-Arid Agriculture University Rawalpindi (PMAS-AAUR)

Country: PAKISTAN

Issued on 11th December, 2025

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Pilot Project for Data Driven Smart Decision Platform for Increased Agriculture Productivity (DDSDP)

INVITATION FOR E-BID - TENDER NOTICE

Pir Mehr Ali Shah Arid Agriculture University Rawalpindi (PMAS-AAUR) invites electronic bids under the Project titled **"Pilot Project for Data Driven Smart Decision Platform for Increased Agriculture Productivity (DDSDP)"** from well reputed & registered eligible information technology/ software development firms registered with Income Tax and Sales Tax Department and who are on Active Tax Payer on List of FBR for the following work:

Procurement of Miscellaneous items (Mobile Application and System Design, Hardware/Software)
(Detailed Bidding Documents are available online on EPADS)

(a) E-bidding documents as per regulations, containing detailed terms and conditions, specifications and requirements etc. are available for the registered bidders on EPADS at (**www.eprocure.gov.pk**).
(b) The electronic bids, must be submitted by using EPADS (lot wise) by 26th December, 2025 before 1100 hours in the office of the Directorate of Procurement & Inventory Control (DPIC) of the University. The tender will be opened on the same day at 11:30 hours in the same office, in the presence of those bidders who may wish to participate. Besides the electronic bid, one manual COPY of bid should also be submitted. Bids which are submitted only in Manual form shall not be accepted. Bids will be opened on the same day half hour after the bid closing time.
(c) The interested bidders shall submit their bids according to PPRA rule 38 (2a) in single stage two envelop bidding procedure.
(d) Bid security money equivalent to 2% (lot wise) of the estimated price is to be deposited in shape of bank draft/call deposit from any scheduled bank in favour of **Treasurer, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi**, in the office of the Directorate of Procurement & Inventory Control of the University before the bid closing time.

(e) The rates must be quoted strictly in accordance with the scope of work specified in the Bidding Documents valid for 90 days.
(f) A conditional tender will not be accepted.
(g) **The firm has to submit along with tender bid an affidavit that the company is an active tax payer and not involved in litigation or black listed.**
(h) The University may reject all bids/proposals at any time prior to the acceptance of a bid or proposal as per PPRA Punjab rule 35, however upon bidder request the ground of rejection will be communicated to the concerned but no justification will be given as per PPRA rule 35 (2).

Chairman, Purchase Committee
PMAS-Arid Agriculture University,
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PART 1 – Bidding Procedures

Section I. Instructions to Bidders

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Section I. Instructions to Bidders

A. General

1. Scope of Bid

1.1 The Procuring Agency, as indicated in the Bid Data Sheet (BDS) invites Bids for the Works and Services **as specified in the BDS** and Section VI - Schedule of Requirements. The successful Bidders will be expected to provide services within the specified period and timeline(s).

1.2 Throughout these Bidding Documents:

(a) "Authority" means PMAS-Arid Agriculture University Rawalpindi.

(b) "Bidder" means a Firm/Company fulfilling the eligibility criteria and participating in the bidding for provision of work and/ or services as per provision of bid document/ contract.

(c) "EPADS" means e-Pak Acquisition and Disposal System. The system is used for online public sector procurements process.

(d) "Contractor" means the firm/company who's Tender has been accepted and awarded letter of intent followed by the Contract by the Procuring Agency.

(e) "Procuring Agency" or "Purchaser" means PMAS-Arid Agriculture University Rawalpindi, for the purposes of the Contract.

(f) "Contract" means the agreement entered into between the Procuring Agency and the Contractor, as recorded in the Contract Form signed by the parties, including all Schedules and Attachments thereto and all documents incorporated by reference therein.

(g) "Force Majeure" means an event beyond the control of the Contractor and not involving the Contractor's fault or negligence and not foreseeable. Such events may include, but are not restricted to, wars, revolutions, fires, floods, epidemics, quarantine restrictions, and freight embargoes.

(h) "Origin" shall be considered to be the place where the Goods are produced or from where the Works or Services are provided. Goods are produced when, through manufacturing, processing or assembling of components, a commercially recognized product results that is

	substantially different in basic characteristics or in purpose or utility from its components. The origin of Goods. Equipment and Services is distinct from the nationality of the Contractor. (i) "Delivery Acceptance Certificate" means the certificate to be issued by the Client to the Contractor, in accordance with the Contract. (j) "Works" and/or "Services" means work and/ or services to be performed by the Contractor under the Contract. (k) "Supplier" or "Service Provider" the firm/ company/ organization whose Bid to perform the contract has been accepted by the Procuring Agency and is named as such in the Contract Agreement. (l) the term "in writing" means communicated in written form (e.g. by mail, email, etc.) with proof of receipt; (m) if the context so requires, "singular" means "plural" and vice versa; and (n) "day" means calendar day.
2. Eligible Bidders	2.1. A Bidder may be a firm or company that is a locally registered entity, working in the domain of Information Technology/ Software Development. No Joint Venture (JV) or consortium is allowed. 2.2. A Bidder shall not have a conflict of interest. Any Bidder found to have a conflict of interest shall be disqualified. A Bidder may be considered to have a conflict of interest for the purpose of this bidding process, if the Bidder: (a) directly or indirectly controls, is controlled by or is under common control with another Bidder; or (b) receives or has received any direct or indirect subsidy from another Bidder; or (c) has the same legal representative as another Bidder; or (d) participates in more than one bid in this bidding process. Participation by a bidder in more than one bid will result in the disqualification of all bids in which such bidder is involved; or (e) any of its affiliates has been hired (or is proposed to be hired) by the Procuring Agency for the contract implementation.

	2.3. A Bidder shall not be eligible to participate if under suspension from bidding by the Procuring Agency as a result of previous contract or blacklisted by organizations **specified in the BDS**. 2.4. A bidder shall provide such evidence of eligibility satisfactory to the Procuring Agency, as the Procuring Agency shall reasonably request.
3. Eligible Works and Related Services	3.1 All the Works and Services to be delivered under the contract and financed by the Procuring Agency may have their origin in Pakistan. 3.2 For purposes of this Clause, the term "works", "services" and "solution" includes acts as specified in the Schedule of Requirements. 3.3 The term "origin" means the country where the works, services and solution have been produced, performed, prepared, assembled, integrated, processed or supplied.
B. Contents of Bidding Document	
4. Contents of the Bidding Document	4.1. The Bidding Documents consist of Parts 1 and 2, which include all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 6. **PART 1 Bidding Procedures** • Section I. Instructions to Bidders (ITB) • Section II. Bidding Data Sheet (BDS) • Section III. Evaluation and Qualification Criteria • Section IV. Bidding Forms • Section V. Eligible Countries **PART 2 Schedule of Requirements** • Section VI. Schedule of Requirements 4.2. The Invitation for Bids/ Tender Notice issued by the Procuring Agency is not part of the Bidding Document. 4.3. Unless obtained directly **as specified in BDS**, the Procuring Agency is not responsible for the completeness of the bidding document, responses to requests for clarification, the Minutes of the pre-Bid meeting (if any), or Addenda to the Bidding Document in accordance with ITB 6. In case of any contradiction, documents obtained **as specified in BDS** shall prevail. 4.4. The bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Documents and to furnish with

		its Bid all information or documentation as is required by the Bidding Documents.
5. Clarification of Bidding Documents	5.1	A bidder requiring any clarification of the Bidding Document shall contact the Procuring Agency in electronic form as **specified in the BDS** within a period **specified in the BDS.**
	5.2	The Procuring Agency shall forward its response to all identified Bidders who have acquired the Bidding Documents in accordance with ITB 4.3, including a description of the inquiry but without identifying its source in a manner as **specified in the BDS**.
	5.3	Should the clarification result in changes to the essential elements of the Bidding Documents, the Procuring Agency shall amend the Bidding Documents following the procedure under ITB 6 and ITB 20.2.
6. Amendment of Bidding Document	6.1	At any time prior to the deadline for submission of bids, the Procuring Agency may for any reason, whether at its own initiative or in response to a clarification requested by bidders, amend the Bidding Documents by issuing addenda.
	6.2	Any addendum issued including the notice of any extension of the deadline shall be part of the Bidding Documents and shall be available to all bidders on EPADS in accordance with ITB 4.3. Provided that the Bidder who had either already submitted their bid on EPADS prior to the issuance of any such addendum shall have the right to withdraw his already uploaded bid and submit the revised bid prior to the original or extended bid submission deadline as published on the EPADS.
	6.3	To give prospective Bidders reasonable time in which to take an addendum into account in preparing their bids, the Procuring Agency may, at its discretion, extend the deadline for the submission of bids, pursuant to ITB 20.2.
C. Preparation of Bids		
7. Cost of Bidding	7.1	The Bidder shall bear all costs associated with the preparation and submission of its bid, and the Procuring Agency shall not be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.
8. Language of Bid	8.1	The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Procuring Agency, shall be written in the language **specified in the BDS.** Supporting documents and printed literature, if any, that are part of the Bid may be in another language provided they are accompanied by

	an accurate translation of the relevant passages into the language **specified in the BDS,** in which case, for purposes of interpretation of the bid, such translation shall govern.
9. Documents Comprising the Bid	9.1 The bid shall comprise the following: (a) Letter of Bid in accordance with ITB 10; (b) Completed schedules, in accordance with ITB 10 and 12 (c) Bid Security, in accordance with ITB 17.1; (d) written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 18.2; (e) documentary evidence in accordance with ITB 15 establishing the Bidder's qualifications to perform the contract if its bid is accepted; (f) documentary evidence in accordance with ITB 15 establishing the Bidder's eligibility to bid; (g) documentary evidence in accordance with ITB 14, that the Works and Services to be provided by the bidder are of eligible origin; (h) documentary evidence in accordance with ITB 14 and 28, that the Work and Services to be performed for the Procuring Agency conform to the Bidding Documents; (i) any other document **required in the BDS.** 9.2 The Bidder shall furnish in the Letter of Bid information on commissions and gratuities, if any, paid or to be paid to agents or any other party relating to this Bid.
10. Letter of Bid and Price Schedules	10.1 The Letter of Bid and Price Schedules shall be prepared using the relevant forms furnished in Section IV, Bidding Forms. The forms must be completed without any alterations to the text, and no substitutes shall be accepted except as provided under ITB 18.2. All blank spaces shall be filled in with the information requested.
11. Alternative Bids	11.1 Unless otherwise **specified in the BDS,** alternative bids shall not be considered.
12. Bid Prices and Discounts	12.1 The prices and discounts quoted by the Bidder in the Letter of Bid and in the Price Schedules shall conform to the requirements specified below. 12.2 All Works and Services must be listed and priced as per Price Schedules given in Section IV-Bidding Forms.

	12.3 The price to be quoted in the Letter of Bid in accordance with ITB 10.1 shall be the total price of the bid, excluding any discounts offered. 12.4 The Bidder shall quote any discounts and indicate the methodology for their application in the Letter of Bid, in accordance with ITB 10.1. 12.5 Prices quoted by the Bidder shall be fixed during the Bidder's performance of the Contract and not subject to variation on any account, **unless otherwise specified in the BDS.** 12.6 Bids are invited for complete Works and Services mentioned in the Bidding Document. Prices shall be quoted as specified in Price Schedule included in Section IV, Bidding Forms. The dis-aggregation of price components is required solely for the purpose of facilitating the comparison of bids by the Procuring Agency. This shall not in any way limit the Procuring Agency's right to contract on any of the terms offered. (i) the price of the Works & Services shall be quoted including GST/PST on the provision of such Works and Services. (ii) the price for inland transportation, insurance, and other local services required to convey the works to their final destination as **specified in the BDS.**
13. Currencies of Bid and Payment	13.1 The currency of the bid and the currency of payments shall be as **specified in the BDS**.
14. Documents Establishing the Eligibility and Conformity of the Services & Products	14.1 To establish the conformity of the Works and Services to the Bidding Documents, the Bidder shall furnish as part of its Bid the documentary evidence **as specified in the BDS** that the Works and Services conform to the standards specified in Section VI: Schedule of Requirements.
15. Documents Establishing the Eligibility and Qualifications of the Bidder	15.1 To establish Bidder's eligibility in accordance with ITB 2, Bidders shall complete the Letter of Bid, included in Section IV, Bidding Forms. 15.2 The documentary evidence of the Bidder's qualifications to perform the contract if its bid is accepted shall establish to the Procuring Agency's satisfaction: (a) that the Bidder meets each of the qualification criterion specified in Section III, Evaluation and Qualification Criteria.

16. Period of Validity of Bids	16.1 Bids shall remain valid for the period **specified in the BDS** after the bid submission deadline date prescribed by the Procuring Agency in accordance with ITB 20.1. A bid valid for a shorter period shall be rejected by the Procuring Agency as non-responsive. 16.2 In exceptional circumstances, prior to the expiration of the bid validity period, the Procuring Agency may request bidders to extend the period of validity of their bids. The request and the responses shall be made in writing. If a Bid Security is requested in accordance with ITB Clause 17, it shall also be extended for a corresponding period. A Bidder may refuse the request without forfeiting its Bid Security. A Bidder granting the request shall not be required or permitted to modify its bid, except as provided in ITB 16.3. 16.3 If the award is delayed by a period exceeding 30 days beyond the expiry of the initial bid validity, the Contract price shall be determined as follows: (a) In the case of fixed price contracts, the contract price shall be the bid price adjusted by the factor **specified in the BDS**. (b) In the case of adjustable price contracts, no adjustment shall be made. (c) In any case, bid evaluation shall be based on the bid price without taking into consideration the applicable correction from those indicated above.
17. Bid Security	17.1 The Bidder shall furnish as part of its bid, a bid security, as **specified in the BDS,** in original form in the amount and currency **specified in the BDS.** 17.2 If a bid security is specified pursuant to ITB 17.1, the bid security shall be a demand guarantee in any of the following forms at the Bidder's option: (a) CDR/ Pay Order in the name of Treasurer, PMAS-AAUR; 17.3 If a Bid Security is specified pursuant to ITB 17.1, any bid not accompanied by a substantially responsive Bid Security shall be rejected by the Procuring Agency as non-responsive. 17.4 If a Bid Security is specified pursuant to ITB 17.1, the Bid Security of unsuccessful Bidders shall be returned as promptly as possible upon the successful Bidder's signing the contract and furnishing the Performance Security pursuant to ITB 39.

	17.5 The Bid Security of the successful Bidder shall be returned as promptly as possible once the successful Bidder has signed the contract and furnished the required performance security. 17.6 The Bid Security may be forfeited: (a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letter of Bid, or any extension thereto provided by the Bidder; or (b) if the successful Bidder fails to: (i) sign the Contract in accordance with ITB 38; or (ii) furnish a performance security in accordance with ITB 39.
18. Format and Signing of Bid	18.1 The Bidder shall prepare one original of the documents comprising the bid as described in ITB 9 and clearly mark it "ORIGINAL.". In addition, the Bidder shall submit copies of the bid, in the number **specified in the BDS** and clearly mark them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail. 18.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation **as specified in the BDS** and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid where entries or amendments have been made shall be signed or initialed by the person signing the bid. 18.3 Any inter-lineation, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.
D. Submission and Opening of Bids	
19. Sealing and Marking of Bids	19.1 The Bidder shall enclose the original and all copies of the bid, in separate sealed envelopes, duly marking the envelopes as "ORIGINAL", and "COPY." These envelopes containing the original and the copies shall then be enclosed in one single envelope/ package. 19.2 The inner and outer envelopes/ packages shall: (a) bear the name and address of the Bidder; (b) be addressed to the Procuring Agency in accordance with ITB 22.1;

	(c) bear the specific identification of this bidding process indicated in ITB 1.1**;** and (d) bear a warning not to open before the time and date for bid opening. 19.3 If all envelopes are not sealed and marked as required, the Procuring Agency will assume no responsibility for the misplacement or premature opening of the bid.
20. Deadline for Submission of Bids	20.1 Bids must be received by the Procuring Agency no later than the date, time and the manner **as specified in the BDS**. It is the responsibility of the Bidder to assure timely delivery of bid. Any bid received by the Procuring Agency after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder. 20.2 The Procuring Agency may, as per Punjab PPRA Rules, extend the deadline for the submission of bids by amending the Bidding Documents in accordance with ITB 6, in which case all rights and obligations of the Procuring Agency and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.
21. Late Bids	21.1 The Procuring Agency shall not consider any bid that arrives after the deadline for submission of bids, in accordance with ITB 20. Any bid received by the Procuring Agency after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.
22. Withdrawal, Substitution, and Modification of Bids	22.1 A Bidder may withdraw, substitute, or modify its Bid after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization (the power of attorney) in accordance with ITB 18.2, (except that withdrawal notices do not require copies). The corresponding substitution or modification of the bid must accompany the respective written notice. All notices must be: (a) prepared and submitted in accordance with ITB 18 and 19 (except that withdrawal notices do not require copies), and in addition, the respective envelopes shall be clearly marked "WITHDRAWAL," "SUBSTITUTION," or "MODIFICATION;" and (b) received by the Procuring Agency prior to the deadline prescribed for submission of bids, in accordance with ITB 20.

	22.2 Bids requested to be withdrawn in accordance with ITB 22.1 shall be returned unopened to the Bidders. 22.3 No bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Bid or any extension thereof.
23. Bid Opening	23.1 The Procuring Agency will open all Bids, in public, in the presence of Bidders' or their representatives who choose to attend, in the Bid proceedings at the place, on the date and at the time, **specified in the BDS**. The Bidders' representatives present shall sign a register as proof of their attendance. 23.2 First, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding bid shall not be opened, but returned to the Bidder. If the withdrawal envelope does not contain a copy of the "power of attorney" confirming the signature as a person duly authorized to sign on behalf of the Bidder, the corresponding bid will be opened. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening. Next, envelopes marked "SUBSTITUTION" shall be opened and read out and exchanged with the corresponding Bid being substituted, and the substituted Bid shall not be opened, but returned to the Bidder. No Bid substitution shall be permitted unless the corresponding substitution notice contains a valid authorization to request the substitution and is read out at bid opening. Envelopes marked "MODIFICATION" shall be opened and read out with the corresponding Bid. No Bid modification shall be permitted unless the corresponding modification notice contains a valid authorization to request the modification and is read out at Bid opening. Only bids that are opened and read out at Bid opening shall be considered further. 23.3 The Procuring Agency shall prepare a record of the bid opening that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, substitution, or modification. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record.

E. Evaluation and Comparison of Bids	
24. Confidentiality	24.1 Any effort by a Bidder to influence the Procuring Agency in the evaluation or contract award decisions may result in the rejection of its Bid. 24.2 Notwithstanding ITB 24.1, from the time of bid opening to the time of Contract Award, if any Bidder wishes to contact the Procuring Agency on any matter related to the bidding process, it should do so in writing or in electronic form that provides record of the content of communication. 24.3 Information relating to the examination, clarification, evaluation and comparison of Bids and recommendation of contract award shall not be disclosed to Bidders or any other persons not officially concerned with such process, except which is made public essentially under the PPRA rules.
25. Clarification of Bids	25.1 To assist in the examination, evaluation, comparison of the bids, and qualification of the Bidders, the Procuring Agency may, at its discretion, ask any Bidder for a clarification of its Bid. Any clarification submitted by a Bidder in respect to its Bid and that is not in response to a request by the Procuring Agency shall not be considered. The Procuring Agency's request for clarification and the response shall be in writing. No change, including any voluntary increase or decrease, in the prices or substance of the Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Procuring Agency in the Evaluation of the bids, in accordance with ITB 29. 25.2 If a Bidder does not provide clarifications of its bid by the date and time set in the Procuring Agency's request for clarification, its bid may be rejected.
26. Deviations, Reservations, and Omissions	26.1 During the evaluation of bids, the following definitions apply: (a) "Deviation" is a departure from the requirements specified in the Bidding Documents; (b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Documents; and (c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Documents.

27. Determination of Responsiveness	27.1 The Procuring Agency's determination of a bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB 9. 27.2 A substantially responsive Bid is one that meets the requirements of the Bidding Documents without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that: (a) if accepted, would (i) affect in any substantial way the scope, quality, or performance of the Works and Services specified in the Contract; or (ii) limit in any substantial way, inconsistent with the Bidding Documents, the Procuring Agency's rights or the Bidder's obligations under the Contract; or (b) if rectified, would unfairly affect the competitive position of other bidders presenting substantially responsive bids. 27.3 The Procuring Agency shall examine the technical aspects of the bid submitted in accordance with ITB 14 and ITB 15, in particular, to confirm that all requirements of Section VI, Schedule of Requirements have been met without any material deviation or reservation, or omission. 27.4 If a bid is not substantially responsive to the requirements of Bidding Documents, it shall be rejected by the Procuring Agency and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.
28. Non-conformities, Errors and Omissions	28.1 Provided that a bid is substantially responsive, the Procuring Agency may waive any non- conformities in the Bid. 28.2 Provided that a bid is substantially responsive, the Procuring Agency may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities or omissions in the bid related to documentation requirements. Such omission shall not be related to any aspect of the price of the Bid. Failure of the bidder to comply with the request may result in the rejection of its bid. 28.3 Provided that a bid is substantially responsive, the Procuring Agency shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for

	comparison purposes only, to reflect the price of a missing or non-conforming item or component. 28.4 If the bid is not substantially responsive, it will be rejected by the Procuring Agency and may not subsequently be evaluated for complete technical responsiveness.
29. Correction of Arithmetical Errors	29.1 Provided that the Bid is substantially responsive, the Procuring Agency shall correct arithmetical errors on the following basis: (a) if there is a discrepancy between the unit price and the line item total that is obtained by multiplying the unit price by the quantity, the unit price shall prevail and the line item total shall be corrected, unless in the opinion of the Procuring Agency there is an obvious misplacement of the decimal point in the unit price, in which case the line item total as quoted shall govern and the unit price shall be corrected; (b) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and (c) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a) and (b) above. 29.2 Bidders shall be requested to accept correction of arithmetical errors. Failure to accept the correction in accordance with ITB 29.1, shall result in the rejection of the Bid.
30. Margin of Preference	30.1 **Unless otherwise specified in the BDS,** a margin of preference shall not apply.
31. Evaluation of Bids	31.1 The Procuring Agency shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted. 31.2 To evaluate a bid, the Procuring Agency shall consider the following: (a) evaluation will be done for complete scope of works and services, as **specified in the BDS;** and the Bid Price as quoted in accordance with ITB 12; (b) price adjustment for correction of arithmetic errors in accordance with ITB 29.1;

	(c) evaluation factors as specified in Section III, Evaluation and Qualification Criteria;
32. Comparison of Bids	32.1 The Procuring Agency shall compare the evaluated prices of all substantially responsive bids established in accordance with ITB 33.2 to determine the highest scoring evaluated bid as the Most Advantageous Bid.
33. Qualification of the Bidder	33.1 The Procuring Agency shall determine to its satisfaction whether the Bidder that is selected as having submitted a technically qualified, financially compliant and substantially responsive bid meeting the qualifying criteria specified in Section III, Evaluation and Qualification Criteria. 33.2 The determination of Most Advantageous Bid shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 15 and ITB 34.2.
34. Procuring Agency's Right to Accept Any Bid, and to Reject Any or All Bids	34.1 The Procuring Agency reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to contract award, without thereby incurring any liability to Bidders according to PPRA Rule 35. In case of annulment, all bids submitted and specifically, bid securities, shall be promptly returned to the Bidders. 34.2 Where the Bid price is considered to be abnormally low, the Procuring Agency shall perform price analysis during determination of Most Advantageous Bid. If the Procuring Agency determines that the price in combination with other constituent elements of the bid is abnormally low in relation to the scope of the procurement or ancillary services, and raises concerns as to the capability and capacity of the respective bidder to perform the contract, the Procuring Agency may decide to reject such a bid as non-responsive. In order to identify the Abnormally Low Bid following approaches can be considered to minimize the scope of subjectivity: a) Comparing the bid prices with the cost estimates; b) Comparing the bid prices with the bids offered by other bidders submitting substantially responsive bids; and c) Comparing the bids with prices paid in similar contracts in the recent past either by a public sector entity or an international development partner funded project.

F. Award of Contract	
35. Award Criteria	35.1 Subject to ITB 34.1, the Procuring Agency shall award the contract to the bidder who's bid has been determined to be the Most Advantageous Bid, i.e., technically qualified, financially compliant lowest priced bid and is substantially responsive to the bidding documents, provided further that the bidder is determined to be qualified to perform the contract satisfactorily.
36. Procuring Agency's Right to Vary Quantities at Time of Award	36.1 At the time of contract is awarded, the Procuring Agency reserves the right to increase or decrease the quantity of Works and Services originally specified in Section VI, Schedule of Requirements, provided this does not exceed the percentages **specified in the BDS,** and without any change in the unit prices or other terms and conditions of the bid and the Bidding Documents.
37. Notification of Award	37.1 Prior to the expiration of the period of bid validity, the Procuring Agency shall notify the successful Bidder, in writing, that its Bid has been accepted. The notification letter called the "Letter of Acceptance" shall specify the sum that the Procuring Agency will pay the Supplier in consideration of providing the Works and Services. 37.2 Until a formal contract is prepared and executed, the notification of award shall constitute a binding contract.
38. Signing of Contract	38.1 Promptly after notification, the Procuring Agency shall send the successful Bidder the Contract Agreement. 38.2 Within fifteen (15) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Procuring Agency **as specified in the BDS**.
39. Performance Security/ Performance Guarantee	39.1 Within fifteen (15) days of the receipt of notification of award from the Procuring Agency, the successful Bidder, if required, shall furnish, **as specified in the BDS,** the Performance Security/ Performance Guarantee (as per Clause 2(w) and Clause 56 of Punjab PPRA Rules) using the Performance Security Form included in Section IV, Bidding Forms, **OR** in another form acceptable to the Procuring Agency as mentioned in ITB 39.3. 39.2 Failure of the successful Bidder to submit the above-mentioned Performance Security/ Performance Guarantee or sign the Contract shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security. In that event the Procuring Agency may award the contract to the next highest scoring evaluated Bidder, whose bid is substantially responsive

	and is determined by the Procuring Agency to be qualified to perform the contract satisfactorily. 39.3 In lieu of provision at ITB 39.1 above, the Procuring Agency can retain an amount as performance security/ performance guarantee from payment of every installment made to the contractor according to PPRA Rules and **as specified in BDS**.
40. Payment Terms	40.1 Subject to ITB 38 and ITB 39, the payments will be made in installments subsequent to fulfillment of codal formalities, as per the following tentative schedule: • First Installment (*on completion of Milestone 1 as specified in Schedule of Requirements*) = 10% of Total Contract Value • Second Installment (*on completion of Milestone 2 as specified in Schedule of Requirements*) = 40% of Total Contract Value. • Third Installment (*on completion of Milestone 3 as specified in Schedule of Requirements*) = 40% of Total Contract Value. • Final Installment (*on completion of Milestone 4 as specified in Schedule of Requirements*) = 10% of Total Contract Value. Payment Terms and Schedule will, however, be finalized at the time of signing the Contract Agreement.

Section II. Bid Data Sheet (BDS)

The following specific data for the works and services to be procured shall complement, supplement, or amend the provisions in the Instructions to Bidders (ITB). Whenever there is a conflict, the provisions herein shall prevail over those in ITB.

ITB Clause Reference	A. General
ITB 1.1	The Procuring Agency is PMAS-AAUR represented by: **Chairman Purchase Committee, PMAS-AAUR**.
ITB 1.1	**Preparation of RFP for:** **Procurement of Miscellaneous items (Mobile Application and System Design, Hardware/Software)**
ITB 2.3	Any firm/ company blacklisted by Federal or Provincial government or public sector enterprises are barred from participating in this Bid.
ITB 4.3	The Procuring Agency is not responsible for the completeness of the Bidding Documents and their addenda, if they were not obtained directly from the Procuring Agency's website or not downloaded from the EPADS. The electronic bids, must be submitted through EPADS. Besides the electronic bid, one manual COPY of bids should also be submitted. Bids which are submitted only in Manual form shall not be accepted. The bids submitted through EPADS will be treated as 'ORIGINAL", whereas as manual copy will be treated as "COPY" of the bid. The Bid Security must be submitted in ORIGINAL along with a manual COPY of the bid at the address mentioned below on or before the Bid Closing Date and Time, i.e., 26th December, 2025 by 1100 hrs. **Directorate of Procurement & Inventory Control,** **PMAS-Arid Agriculture University, Shamsabad, Murree Road, Rawalpindi, Pakistan**
B. Contents of Bidding Documents	
ITB 5.1	Clarifications regarding the Bidding Documents should be requested ONLY through EPADS or Email Address given below on or before 1500

	hrs, 24 December, 2025. Requests for clarifications shall NOT be entertained after this date. The Procuring Agency's address for clarifications only is: **Project Director (DDSDP),** **PMAS-Arid Agriculture University, Shamsabad, Murree Road, Rawalpindi, Pakistan** **Telephone: +92-051-9292163** **Facsimile number: +92-051-9292107** **Electronic mail address: naveed@uaar.edu.pk**
ITB 5.2	The consolidated responses will be uploaded by the Procuring Agency on EPADS within three (03) working days after the last date of submission of clarification requests as mentioned in ITB 5.1 above. No other means of communication (e.g. phone calls, SMS, Messaging, etc.) for clarification will be considered by the Procuring Agency.
C. Preparation of Bids	
ITB 8.1	The language of the bid is **English**. All correspondence exchange shall be in English language. Language for translation of supporting documents and printed literature, if any, is English.
ITB 9.1(i)	The Bidder shall submit the following additional documents with its bid: 1. Compliance Data Sheet/ Checklist.
ITB 11.1	Alternative Bids shall not be considered.
ITB 12.5	The prices quoted by the Bidder shall not be subject to adjustment during the performance of the Contract.
ITB 12.6	Prices quoted for contract shall correspond to 100 percent of the Scope mentioned in the Section VI: Schedule of Requirements.
ITB 12.6(ii)	This Sub-Clause is not applicable for the Works and Services mentioned in Section VI: Schedule of Requirements.
ITB 13.1	The prices shall be quoted by the bidder in: PKR.
ITB 14.1	The documentary evidence for conformity of the Works and Services shall be in the form of written description of the methodology,

	coordination approach, preliminary project plan including sequence of key activities and estimated duration, etc.
ITB 16.1	The bid validity period shall be 90 days.
ITB 16.3 (a)	The bid price adjustment factor shall not be applicable.
ITB 17.1	A Bid Security shall be required. The amount of the bid security shall be *2% of estimated price (lot wise*) in the form of deposit at call in favor of Treasurer, PMAS-AAUR and in currency specified in BDS for Clause ITB 13.1.
ITB 17.2 (b)	Pay Order or Call Deposit Receipt (CDR) in the name of Treasurer, PMAS-AAUR
ITB 18.1	In addition to the Bid submitted through EPADS, ONE additional copy of the Bid is required to be submitted **as specified in BDS, Clause** 4.3 and 19. Bids which are submitted only in Manual form shall not be accepted. The bids submitted through EPADS will be treated as 'ORIGINAL", whereas as the manual copy will be treated as "COPY" of the bid.
ITB 18.2	The written confirmation of authorization to sign on behalf of the bidder shall consist of written Power of Attorney attached to the Bid.
D. Submission and Opening of Bids	
ITB 19	The Clause 19 is substituted as follows: 19.1 The electronic Bid must consist of two separate documents: The 'Technical Proposal' and the 'Financial Proposal'. Each document should include the information specified in Sub-Clause 9.1, and both documents must be submitted online through EPADS. 19.2 The Bid Security must be submitted in ORIGINAL as specified in BDS Clause 4.3 and 20.1. 19.3 The Bidder shall enclose the Manual copies of the bid, in separate sealed envelopes, duly marking the envelopes as "COPY-TECHNICAL PROPOSAL", and "COPY-FINANCIAL PROPOSAL." These envelopes shall then be enclosed in one single envelope/ package. The inner and outer envelopes/ packages shall: (a) bear the name and address of the Bidder; (b) be addressed to the Procuring Agency in accordance with ITB 22.1;

	(c) bear the specific identification of this bidding process indicated in ITB 1.1**;** and (d) bear a warning not to open before the time and date for bid opening. 19.4 If all envelopes are not sealed and marked as required, the Procuring Agency will assume no responsibility for the misplacement or premature opening of the bid.
ITB 20.1	Bids shall be submitted through EPADS and ONE copy in Manual form. **The deadline for bid submission is mentioned, as follows:** Submission Date: 26th, December, 2025. Submission Time: On or Before **11:00 Hour**s. Opening Time: **11:30 Hours**
ITB 21.1	This Clause is substituted as under: The Bidder will not be able to upload any bid after the bid closing date and time. Therefore, the Bidder must ensure uploading their bid well in time before the bid closing time and date. Procuring Agency shall not be responsible for any issues related to uploading of bids in EPADS. However, the Procuring Agency may be informed by the potential bidder about the technical issues being faced in uploading the bid, by sending screenshots and the description of the issues before the closing time of bid submission mentioned in ITB 20.1, at the following email: Email: naveed@uaar.edu.pk
ITB 22.1	Sub-Clause is substituted as under: A Bidder may withdraw, substitute, or modify its bid on EPADS after submission but before Bid closing date and time.
ITB 22.2	Not Applicable
ITB 23.1	The technical bid opening shall take place at: : **Directorate of Procurement & Inventory Control,** **PMAS-Arid Agriculture University Rawalpindi, Shamsabad, Murree Road, Rawalpindi, Pakistan.** Date: 26th December, 2025 Time: **11:00 Hours**

	The financial bid opening shall take place for only those bidders who qualify technical evaluation. The Procuring Agency shall communicate the date, time and venue to the qualifying bidders at an appropriate time subsequent to completion of technical evaluation process.
ITB 23.2	Sub-Clauses is substituted as follows: The Technical Proposals shall be downloaded one at a time, and the following read out and recorded: (a) the name of the Bidder; (b) the presence of a Bid Security; and (c) Any other details as the Procuring Agency may consider appropriate.
ITB 23.3	Sub-Clauses is substituted as follows: The Bidders' representatives who are present shall be requested to sign on the attendance sheet. The omission of a Bidder's signature on the record shall not invalidate the contents and affect the record.
E. Evaluation and Comparison of Bids	
ITB 30.1	A margin of domestic preference shall not apply.
ITB 31.2(a)	Evaluation will be done for complete works and services *mentioned in the Schedule of Requirements*.
F. Award of Contract	
ITB 36.1	The maximum percentage by which contract works and services may be increased or decreased is _NIL_.
ITB 38.2	The successful bidder shall sign, date and return the Contract Agreement made on stamp paper having a stamp duty of an amount as per government rules. The stamp duty shall be paid by the successful bidder.
ITB 39.1	Provided ITB 39.3 is not invoked, a Performance Guarantee/ Performance Security in the form of Bank Guarantee shall be furnished by the successful bidder amounting to 10% of the Contract value.
ITB39.3	Instead of submission of Bank Guarantee as Performance Security/ Performance Guarantee by the successful Bidder, both parties (i.e., Procuring Agency and successful bidder) can mutually agree that the Procuring Agency can retain an amount of 10% as Performance Security/ Performance Guarantee from payment of every installment made to the Contractor as per Punjab PPRA Rules. The aggregate amount so deducted shall be paid to the Contractor after satisfactory completion of all obligations under the contract within 30 days of issuance of Letter of Completion of Contractual Obligations.

Section III. Evaluation and Qualification Criteria

Contents

1. Bidding Process

Single stage two envelopes bidding process will be adopted where bids will be selected under Quality and Cost Based Selection (QCBS) System and procedures described in this Bid Document, in accordance with the Punjab PPRA Rules.

The bidding process will involve the steps along with timelines as mentioned in Bid Data Sheet.

1. The electronic bids, must be submitted by using EPADS **as specified in the BDS**. Besides the electronic bid, one manual COPY of bids should also be submitted **as specified in the BDS**. Bids which are submitted only in Manual form shall not be accepted. Bids will be opened on the same day half hour after the closing time.
2. To enable bidders to prepare the proposal, a list of attached document formats have been provided in Section-IV-Bidding Forms.
3. Any request for clarification should be initiated in writing through electronic channels and addressed as mentioned in ITB and specified in BDS.
4. At any time before the submission of proposals, the Procuring Agency may, for any reason, whether at its own initiative or in response to a clarification requested by any bidder, modify the documents by amendment. The clarification on bids or any amendments of the bid will be intimated to all Bidders through EPADS. The Procuring Agency may as per Punjab PPRA Rules extend the deadline for the submission of proposals as mentioned in ITB.

2. Bidding Procedure for Evaluation of Bids

The bid submitted by the Bidder will be evaluated as per the following procedure:

1. The mandatory requirements will be checked before technical scoring is carried out for the submitted bids. Only those bidders who fulfill mandatory criteria will be scored and evaluated further.
2. Scoring of the Technical Bids will be carried out as per the Evaluation Scoring criteria given in this Section.
3. Bids that pass technical evaluation will be opened for financial evaluation.

Procedure for opening of Bids

Single stage two envelopes, procedure would be adopted for opening of bids. The detailed procedure and terms are as follows:

a) The bid shall consist of two separate documents, each marked as “Technical Proposal” and the “Financial Proposal”;

b) Initially, only the document marked as "TECHNICAL PROPOSAL" shall be opened in front of the Purchase Committee members and representatives of bidders, who wish to attend the opening of technical bids;
c) The Technical Proposals shall be evaluated for compliance to technical requirement of this document, without reference to the price and reject any proposal which does not conform to the specified requirements as listed in the said Sections of this Bid Document.
d) The envelope marked as "FINANCIAL PROPOSAL" shall be opened in front of Purchase Committee members and the representatives of qualified bidders after the technical evaluation who have scored at least 70% aggregate marks;
e) The Financial Proposal of bids found technically nonresponsive or unqualified shall not be opened;
f) The opened financial proposals will be evaluated and amount totals will be checked/ verified for correctness as well as other compliance requirements will be checked.
g) The technical and financial evaluation scores will be added with a weightage of 80% for technical score and 20% for financial score. The total evaluation score will be calculated as per the formula given under "Formula for Total Evaluation Score Calculation".
h) The bid scoring the highest total evaluation score and compliant in all respects will be considered as the Most Advantageous Bid for the award of procurement order.

3. Evaluation Procedure & Criteria

(i) Mandatory Documents for Eligibility

Technical Bids must have the following documents attached to be considered as eligible for further technical evaluation:

S #.	Item Description	Documents
1	Company/Firm must be in operation minimum for 10 years	Valid certificate from concerned regulator / authority / NTN with Federal Board of Revenue (FBR). Having Active Tax Payer status and registration with relevant revenue authority(ies) for GST / PST.
2	Registration of NTN with Federal Board of Revenue (FBR) and having Active Tax Payer status.	
3	Registration of General Sales Tax (GST)/ Provincial Sales Tax (PST) with relevant revenue authority(ies) and having Active Tax Payer status.	
4	Submit affidavit regarding bidders should not Blacklisted from PMAS-Arid Agriculture University and PPRA.	Affidavit on Judicial Stamp of Rs. 100/-

5	Compliance Data sheet/ Checklist shall be provided in the format specified in Section IV: Bidding Forms. Unless the submission of the same, bid shall be considered rejected straight away.	Compliance Data Sheet/ Checklist

Note: Any of the above documents NOT ATTACHED will result in declaring the Bid NON-RESPONSIVE and not qualified for further technical evaluation.

(ii) Technical Evaluation Scoring Criteria

Technical evaluation would be based on bidder's capability to undertake and complete the assignment. The detailed technical evaluation will be performed by the Technical Evaluation Committee and marks will be given as per the following scoring criteria:

Detailed Technical Evaluation Scoring Matrix

S.No.	Description of Technical Requirement	Marks
1.	General Experience: Company Experience in IT Solutions/ Software Development: • More than 05 years' experience = 10 marks • Between 2-3 years' experience = 5 marks • Less than 2 Years' experience = 0 marks *Attached the relevant Project Contracts/ Completion Certificates.*	10
2.	Technical Competency & Product Demonstration within one week after opening of bid Relevant the RFP: • Product demo for Mobile application as per RFP = 20 • Product Demo for System design, Hardware/software as per RFP = 20 *Attach relevant Project/Product Contracts/ Completion Certificates.*	40
3.	Financial Soundness: Avg. Annual Company Turnover for last 3 years • Above PKR 10 million = 10 marks • Less than PKR 10 million = 0 marks *Attach documents (e.g. audit reports) to substantiate numbers.*	10
4.	Local Presence: Company Office in Rawalpindi / Islamabad = 5 Other cities = Zero	5
5.	Team Composition: *CVs of Relevant domain experts to be attached*	5
6.	Technical Proposal/ Bid Response: • Understanding & Approach of the Project = Max 5 marks	30

	• IP Right = Max 5 marks • Source Code = 5 marks • Project Work Plan & Timelines = Max 5 marks • Presentation = Max 5 marks • Completeness of Required Forms/ Documents = 5 marks *Marks in this section will be given based on relevancy and completeness of the content/ write-up given in the proposal.*	
	TOTAL MARKS (*Firms securing 80% or above will be declared successful in technical evaluation*)	**100**

The Bidders whose Total Technical Evaluation Score is 80% or above will qualify for opening of financial bids.

(iii) Financial Evaluation

Financial bids of only those bidders who score at least 80% in the technical evaluation would be opened before the bidders' representatives who wish to attend the financial proposal opening. All amounts and total price calculations will be checked for correctness. In case of any discrepancy in calculations, the corrections in totals will be made as per mentioned in ITB 29. The financial bids will also be checked for conformity with ITB 33 and 34.

The Financial Evaluation Scoring will be made as per the following formula:

Lowest Priced Bid will get score of 100 and all other bids will get scores proportionate to the total bid price quoted by them. The formula for proportionate score is as follows:

Financial Evaluation Score of Bid n *= (Total Price of Lowest Bid / Total Price of Bid n) * 100*

(iv) Formula for Total Evaluation Score Calculation

The Technical and Financial Evaluation Scores will be based on the criteria mentioned in preceding section. The Total Score will be calculated as follows:

A = Technical Evaluation Score * 80%
B = Financial Evaluation Score * 20%
Total Score *= A + B*

The bid scoring the highest total score in evaluation and compliant in all respects will be considered as the Most Advantageous Bid for the award of procurement order.
Decision of the Procurement Committee will be binding on all concerned and in no case will be challengeable at any forum.

Section IV. Bidding Forms

Table of Forms

Letter of Bid

The Bidder must prepare the Letter of Bid on stationery with its letterhead clearly showing the Bidder's complete name and address.

Note: All italicized text is for use in preparing these forms and shall be deleted from the final products.

Date: **[insert date (as day, month and year) of Bid Submission]**

To: [***insert complete name of Procuring Agency***]

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB 6);

(b) We meet the eligibility requirements and have no conflict of interest in accordance with ITB 2;

(c) We have not been suspended nor declared ineligible by the Procuring Agency.

(d) We offer to supply in conformity with the Bidding Documents and in accordance with the Delivery Schedules specified in the Schedule of Requirements the following Works & Services: **[*insert a brief description of the* Works and Services*];**

(e) Our bid shall be valid for a period of **[*specify the number of calendar days*]** days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(f) If our bid is accepted, we commit to obtain a performance security/ performance guarantee in accordance with the Bidding Documents;

(g) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process in accordance with ITB 2.2(d);

(h) We, including any of our subcontractors for any part of the contract, have not been declared ineligible by the Procuring Agency, under the Procuring Agency's country laws;

(i) We are not a government owned entity.

(j) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

(k) We understand that you are not bound to accept the highest scoring evaluated bid or any other bid that you may receive.

(l) We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in any type of fraud and corruption.

(m) We also declare that the Government of Pakistan or Provincial Governments have not declared us ineligible on charges of engaging in corrupt, fraudulent, collusive, or coercive practices.

Name of the Bidder*** [insert complete name of person signing the Bid]**

Name of the person duly authorized to sign the Bid on behalf of the Bidder**** [insert complete name of person duly authorized to sign the Bid]**

Title of the person signing the Bid **[insert complete title of the person signing the Bid]**

Signature of the person named above [**insert signature of person whose name and capacity are shown above**]

Date signed **[insert date of signing]** day of **[insert month]**, **[insert year]**

**: Person signing the Bid shall have the power of attorney given by the Bidder to be attached with the Bid Schedules.

Affidavit

I/We, the undersigned solemnly state that:

1) We have read the contents of the Bidding Document and have fully understood it.
2) The Bid being submitted by the undersigned complies with the requirements enunciated in the bidding documents.
3) The Works and Services that we propose to provide under this contract are eligible Works and Services within the meaning of Clause 2 and Clause 3 of the ITB.
4) The undersigned are solvent and competent to undertake the subject contract under the Laws of Pakistan.
5) The undersigned have not paid nor have agreed to pay, any Commissions or Gratuities to any official or agent related to this bid or award or contract.
6) The undersigned are not blacklisted or facing debarment from any Government, or its organization or project.
7) The undersigned has no dispute anywhere in the country regarding supplies & services.

We affirm that the contents of this affidavit are correct to the best of our knowledge and belief.

Signed

Note: ***The affidavit must be on judicial stamp paper (Rs. =100/-) by the Executive of the Firm & attested by Oath Commissioner.***

Bidder Information Form

[The Bidder shall fill in this Form in accordance with the instructions indicated below. No alterations to its format shall be permitted and no substitutions shall be accepted.]

Date: *[insert date (as day, month and year) of Bid Submission*]

Page _____ of_ _____ pages

1. Bidder's Name *[insert Bidder's legal name]*
2. Bidder's year of registration: *[insert Bidder's year of registration]*
3. Bidder's Address: *[insert Bidder's legal address]*
4. Bidder's Authorized Representative Information Name: *[insert Authorized Representative's name]* Address: *[insert Authorized Representative's Address]* Telephone/Fax numbers: *[insert Authorized Representative's telephone/fax numbers]* Email Address: *[insert Authorized Representative's email address]*
5. Attached are documents in the Technical Proposal: *[check the box(es) of the attached original documents]* ☐ Incorporation Certificate of SECP ☐ NTN, GST Registration certificate ☐ ATL status printout/ slip ☐ Company Financial Statement (latest 3 year) ☐ Affidavit (Non-Blacklisted) on Rs. 100 Judicial Stamp Paper. ☐ Power of Attorney (on company letterhead).

Price Schedule Forms

*[The Bidder shall fill in these Price Schedule Forms in accordance with the instructions indicated. The list of line items in column 1 of the **Price Schedules** shall coincide with the List of Works and Services specified by the Procuring Agency in the Schedule of Requirements.]*

Price Schedule: Product/Item/Work

User Note: This form is to be filled by the Bidder and shall submit with the Financial Proposal.

Name of the Firm: _____
Bid. Ref.: _____ Date of opening of Bid. _____

S. No.	Name of the Product/ Item/work	Total Quoted Price (incl, applicable GST/PST)
1	**Lot 1. Mobile applications**	
	Separate Pricing for the following: a) Traceability Mobile Application (complete as per Schedule of Requirements of this RFP) b) Ground Disease Detection Mobile Application (complete as per Schedule of Requirements of this RFP) c) Corn Disease Detection Mobile Application (complete as per Schedule of Requirements of this RFP)	
2	**Lot 2. Complete Systems (System Design, Hardware/Software)**	
	a) Smart Variable rate fertilizer spreading system (Complete System Design hardware and Software as per schedule of Requirements of this RFP) b) Smart Irrigation Application System (Complete System Design, hardware and Software as per schedule of Requirements of this RFP)	
	GRAND TOTAL:	

The bidder/service provider may participate in any Lot and will submit price of each Lot separately

A) FINAL TOTAL QUOTED PRICE: ----------
(Both in figures and words)

Signature: ----------
Designation: ----------
Date: ----------
Official Stamp: ----------

Performance Security/ Performance Guarantee

Bank Guarantee

[This Form, when required, shall only be completed by the successful Bidder after contract award.]

[The bank, as requested by the successful Bidder, shall fill in this form in accordance with the instructions indicated]

[Guarantor letterhead or SWIFT identifier code]

Beneficiary: *[insert name and Address of Procuring Agency]*

Date: _ *[Insert date of issue]*

PERFORMANCE GUARANTEE No.: *[Insert guarantee reference number]*

Guarantor: *[Insert name and address of place of issue, unless indicated in the letterhead]*

We have been informed that _ *[insert name of Supplier, which in the case of a joint venture shall be the name of the joint venture]* (hereinafter called "the Applicant") has entered into Contract No. *[Insert reference number of the contract]* dated *[insert date]* with the Beneficiary, for the supply of _ *[insert name of contract and brief description of Works and Services]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Applicant, we as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of *[insert amount in figures]* ()*[insert amount in words]*,[1] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without the Beneficiary needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire, no later than the …. Day of ……, 2… [2], and any demand for payment under it must be received by us at this office indicated above on or before that date.

_____

[signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

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[1] *The Guarantor shall insert an amount representing the percentage of the Accepted Contract Amount specified in the Letter of Acceptance, and denominated in the currency of the Contract acceptable to the Beneficiary.*

[2] *Insert the date thirty days after the expected completion date as per the Contract. The Purchaser should note that in the event of an extension of this date for completion of the Contract, the Purchaser would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Purchaser might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to an extension of this guarantee for a period not to exceed [six months][one year], in response to the Beneficiary's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."*

Compliance Data Sheet / Checklist

S.No.	Description of Item/ Document Title	Compliance Status	Page No. in Bid/Proposal

Note: List all documents/ required information that are attached with both Technical & Financial Proposals. This Compliance Data Sheet/ Checklist should be attached with the Technical Proposal.

Section V. Eligible Countries

Eligibility for the Provision of Goods/ Equipment, Works and Services

As an exception, firms of a Country or goods/ equipment manufactured or works and services performed in a Country may be excluded if:

1) As a matter of law or official regulation, **the Procuring Agency's Country prohibits commercial relations with that Country**, provided that the Procuring Entity is satisfied that such exclusion does not preclude effective competition for the supply of the Goods/ Equipment or Services/ Works required, or

2) By an Act of Compliance with a Decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Procuring Agency's Country prohibits any import of goods from that Country or any payments to persons or entities in that Country.

3) For the information of Procuring Agency and bidders, at the present time firms, goods, equipment, works and services from the ***following countries are excluded*** from this bidding:

   - **Israel**
   - **India**

4) The bidder shall provide all the goods/ equipment/ deliverables/ services mentioned in Schedule of Requirements of made in the country of origin (Country of Manufacturer/ Principal) of the offered / quoted goods, works, services, equipment & all allied accessories/ deliverables. Goods, Equipment Services, Works or any of its unit components/ deliverables quoted by the bidders must not be rendered from or manufactured in Israel or India. Furthermore, the Bidder / Principal must not have any linkages with Israel or India regarding ownership, sponsoring and financing. In case any item/ deliverable may not confirms its country of origin, the bidder will provide the relevant documents to confirm the make and manufacturer. (if any item/ deliverable during course of execution may not confirm about its make then bidder shall provide an affidavit in this regard).

5) The bidder shall provide Undertaking of no business relations, manufacture, technical assistance etc. from Israel & India pertaining.

PART 2 – Schedule of Requirements

Section VI. Schedule of Requirements

Contents

TERMS OF REFERENCE/ PRODUCT DETAIL SPECIFICATION

Procurement of Miscellaneous Items (Mobile Application, System Design, Hardware/Software)

Pilot Project for Data-Driven Smart Decision Platform (DDSDP) for Increased Agriculture Productivity

1. Background

PMAS-AAUR, under its "Pilot Project for Data-Driven Smart Decision Platform (DDSDP) for Increased Agriculture Productivity", requires the Procurement of digital solutions as mentioned above:

2. Objectives

- Procurement of mobile applications given in the LOT 1.
- Procurement of systems design, Hardware/Software for Smart variable rate fertilizer spreading system and smart irrigation system meeting the requirement of both hardware and software mentioned in the LOT 2.

2.1 Training and Documentation

- Provide end-user manuals and training on both the hardware and software procured to the selected persons nominated by the client.
- Provide complete Technical Documentation that would support the client to manage and maintain the procured/ applications independently in the future.

3. Responsibilities

3.1 Supplier Responsibilities

- Provide Mobile Applications, System design, hardware /software in accordance with agreed specifications.
- Ensure secure, reliable, and scalable architecture of the procure items.
- Provide technical documentation, user manuals, and training for client staff.
- Deliver timely progress reports and maintain close coordination with the client throughout the assignment.
- Ensure both hardware and software are compatible for future upgrades and scaling.
- Provide Source code
- Provide Fully protected IP right to the Client

3.2 Client Responsibilities

- Facilitate coordination with stakeholders
- Review and provide timely feedback on deliverables and prototypes.
- Facilitate field validation and testing of the mobile application.

4. Expected Outcomes

- Fully functional Mobile applications, System design, hardware/software providing actionable insights for decision-makers.
- A robust Mobile App, System design, hardware/software complete product
- Enhanced client capacity to maintain, scale, and expand both systems in the future.
- Source code
- Fully protected IP right to the Client

5. Flexibility for Future Scaling

Both systems shall be developed with modular design and extensibility to allow:

- Integration of additional datasets and data sources.
- Expansion of mobile app to more crops and commodities.
- Customization/ Extension of dashboards based on evolving needs of the client.

6. Schedule of work and payment

S.No	Scope of Work	Timeline after the award of contract	Payment
1.	Delivery of Products/Items	4 Week	60%
2.	Testing and evaluation of product	6 week	30%
3.	Training	2 week	10%

LOT 1. (a)

Estimated Price Lot-01 Rs. 09.00 million

AgriTrace: MOBILE APPLCATION FOR CROP TRACEABILITY (End-to-End Agricultural Value Chain Track & Traceability Platform)

1. Introduction of the Product/Item

1.1. Product/Item Overview

The global agricultural sector is increasingly demanding transparency, food safety, and proof of sustainable/ethical practices. This project aims to develop a comprehensive, cloud-based track and traceability platform, "AgriTrace," that leverages QR codes to provide a digital passport for agricultural products. This system will track a product's journey from farm (seed/input) to fork (end consumer), enhancing supply chain visibility, ensuring compliance, building consumer trust, and adding value for all stakeholders.

1.2. Product Objectives

- Enhanced Transparency: Provide immutable, verifiable data at each stage of the value chain.
- Improved Food Safety: Enable rapid trace-back in case of contamination or recalls, minimizing risk and financial loss.
- Consumer Engagement: Offer end-consumers a direct window into the product's origin and journey via a simple QR code scan.
- Operational Efficiency: Digitize and automate record-keeping for farmers, processors, and distributors, reducing paperwork and errors.
- Market Access & Premiumization: Provide verifiable data to access markets requiring proof of origin, organic, or sustainable practices, allowing for premium pricing.
- Data-Driven Insights: Generate analytics for stakeholders to identify bottlenecks, optimize processes, and improve yields.

1.3. Feature of Product/Item

The features of the procurement Product/ item include;

1. A Web Portal/Dashboard for administrators and enterprise users (farmers, cooperatives, processors, retailers).
2. A Mobile Application (Android & iOS) for field data capture by farmers and inspectors.
3. A QR Code Generation & Management System with unique serialization.
4. A Public-facing Web Application/API that serves product journey information to consumers upon scanning the QR code.

5. A Secure Cloud Backend with database, application logic, and analytics engine.
6. System Integration APIs for potential future integration with ERP, IoT sensors, and certification bodies.

2. Overall Description

2.1. Stakeholders

Stakeholder	Description	Primary Needs
System Admin	Manages platform users, roles, and system health.	User management, analytics, system monitoring.
Farmer/Grower	Inputs data at the production stage.	Easy mobile data entry, input tracking, yield recording.
Processor/Packer	Processes raw goods, creates batches, prints labels.	Batch creation, QR code printing, process data entry.
Distributor/Logistics	Handles storage and transportation.	Shipping manifest integration, temperature/logging (future).
Retailer	Sells the final product to consumers.	Batch receiving, inventory management.
End Consumer	Scans QR code to view product history.	Simple, fast, and trustworthy information on origin, quality, and sustainability.
Certification Body	(External) Validates claims like Organic, Fair Trade.	Read-only access to verify specific data points.

2.2. User Stories & Functional Requirements

EPIC 1: User Management & Authentication

- FR1.1: The system shall allow users to register with email, phone number, and company details.
- FR1.2: The system shall implement role-based access control (RBAC) (Admin, Farmer, Processor, etc.) with granular permissions.
- FR1.3: The system shall support secure login and password recovery.

EPIC 2: Farm Management & Data Capture (Mobile App Focus)

- FR2.1: A farmer shall be able to create a digital record for a Plot/Land Parcel (geo-tagging supported).
- FR2.2: A farmer shall be able to log Inputs used (seed type, fertilizer, pesticide - including batch #, date, quantity).
- FR2.3: A farmer shall be able to record Harvest data (date, yield, estimated quality metrics).
- FR2.4: The system shall generate a Unique Harvest ID (which becomes the first digital asset) linked to the Plot and Input data.

EPIC 3: Product Processing & Batch Creation (Web Portal Focus)

- FR3.1: A processor shall be able to receive a harvest lot by scanning the farmer's Harvest ID QR code.
- FR3.2: A processor shall be able to create Batches by combining multiple harvest lots or processing a single lot.
- FR3.3: Upon batch creation, the system shall generate a Unique Batch ID and a corresponding QR code for printing on packaging.
- FR3.4: A processor shall be able to log processing data (washing, sorting, packaging date, processing techniques).

EPIC 4: Logistics & Distribution Tracking

- FR4.1: A distributor shall be able to create a Shipment Manifest by scanning the Batch ID QR codes of products to be shipped.
- FR4.2: The system shall update the status of batches to "In Transit" and record the destination (Receiver ID).
- FR4.3: Upon receipt, the retailer shall be able to scan the Batch IDs to confirm delivery, updating the status to "Delivered".

EPIC 5: Consumer Engagement & Traceability

- FR5.1: A consumer scanning the product's QR code shall be directed to a public, branded landing page.
- FR5.2: This page shall display a visual journey map of the product's path from farm to shelf.

- FR5.3: The page shall show key data points: Farm location (map), farmer story/photos, harvest date, processing date, certifications, and sustainability metrics.
- FR5.4: The page shall be optimized for mobile devices and load instantly.

EPIC 6: Reporting & Analytics (Admin/Web Portal)

- FR6.1: The system shall provide dashboards showing key metrics: traceability scans, product journey times, user activity.
- FR6.2: The system shall generate reports for trace-back exercises (e.g., "List all batches that used input X from supplier Y").
- FR6.3: The system shall provide data export functionality (CSV, PDF).

3. Non-Functional Requirements

- 3.1. Performance:
  - The consumer scan-to-info page must load in under 2 seconds.
  - The system must support concurrent data entry from 10,000+ users (scalable architecture).
- 3.2. Security:
  - All data in transit must be encrypted using TLS 1.3.
  - Personal and sensitive farm data must be encrypted at rest.
  - The system must be compliant with general data protection guidelines (e.g., GDPR, CCPA).
  - Robust input validation to prevent SQL injection and XSS attacks.
- 3.3. Reliability & Availability:
  - The system must achieve 99.9% uptime.
  - The database must have a disaster recovery plan with a Recovery Time Objective (RTO) of < 1 hour.
- 3.4. Usability:
  - The mobile app must be intuitive for users with low digital literacy. Use icons, simple forms, and voice-to-text support.
  - The consumer-facing page must be available in multiple languages.
- 3.5. Compatibility:
  - The mobile app must support Android 10+ and iOS 14+.
  - The web portal must be compatible with Chrome, Firefox, Safari, and Edge (latest versions).

4. Technical Specifications & External Interfaces

4.1. QR Code Standards

- Type: Static QR Code directing to a dynamic URL (e.g., https://websiteurl.com/product/{unique-id}).
- Data: The QR code will only contain a unique identifier. All product data will be fetched dynamically from the database upon scan.
- Printing Standards: Must be scalable to support various packaging types. Must comply with GS1 standards if needed for retail integration (e.g., using GTINs).

4.2. Technology Stack (Vendor to Propose)

- Backend: Preferred: Node.js, Python (Django/Flask), or Java (Spring Boot). Must be RESTful API architecture.
- Frontend (Web): React.js or Angular.
- Mobile: Native (Kotlin/Swift) or Cross-Platform (Flutter/React Native). Justify the choice.
- Database: PostgreSQL or MySQL with TimescaleDB extension for time-series data (e.g., sensor logs in future).
- Cloud Infrastructure: Proposal must include architecture diagram (VPC, load balancers, database replication).

4.3. APIs for Integration
The system must be designed with APIs for future integration:

- Weather Data API (e.g., WeatherStack) to auto-log weather conditions on harvest dates.
- IoT API to ingest data from soil sensors or temperature loggers in transit.
- ERP Integration via a secure API gateway.

5. Glossary

- GTIN: Global Trade Item Number. A unique identifier for trade items.
- Batch: A quantity of produce processed together under identical conditions.
- Traceability: The ability to track the movement of a food product one step back and one step forward at any point in the supply chain.
- QR Code: Quick Response code, a 2D barcode.
- API: Application Programming Interface.

LOT 1. (b)

NutScan: Groundnut Disease Detection Mobile App

1. Introduction of the Product/Item

1.1 Purpose

This document describes the functional and non-functional requirements for the Product of "NutScan," a mobile application designed to empower farmers and agronomists by accurately detecting diseases in groundnut plants using smartphone camera imagery and machine learning. The purpose of this Mobile Application product will help to track the disease in real time and will help to suggest recommendation to the farming communities to save the crop from the disease timely and effectively.

1.2 Document Conventions

- Features are categorized as Functional (FR) and Non-Functional (NFR).
- Features are uniquely identified (e.g., FR-1.1, NFR-5.2).
- Technical terms are defined in context.

1.3 Intended Audience and Reading Suggestions

- Project Managers: For planning and tracking.
- Developers & Architects: For system design and implementation.
- QA/Testers: For creating test plans and cases.
- Stakeholders & Clients: To understand project capabilities and scope.

1.4 Product Features

The NutScan app will allow users to photograph groundnut leaves and pods. The image will be processed by an on-device and cloud-based ML/DL model to identify common diseases (e.g., Early Leaf Spot, Late Leaf Spot, Rust, Aphid damage). The app will then provide immediate diagnostic results, detailed information about the disease, and science-backed treatment and prevention advice. Features include user profiles, detection history, an offline mode, and an informational library.

2. Overall Description of the Product/Items

2.1 Product Perspective

NutScan is a standalone mobile app that interacts with a cloud-based backend for complex ML&DL inference, user data synchronization, and content management. It is self-contained but may integrate with third-party services for weather data or agricultural databases.

2.2 Product Functions (High-Level Features)

1. User account creation and management.
2. Capture and upload images via phone camera.
3. AI-powered disease detection and confidence scoring.
4. Display of detailed disease information and treatment plans.
5. Save and manage detection history.
6. Access a learning library of diseases.
7. Participate in a community forum.
8. Function with limited internet connectivity.

2.3 User Classes and Characteristics

- Farmers (Primary): Low to medium tech literacy; needs simple, fast, and reliable results in local language.
- Agronomists (Secondary): High tech literacy; needs detailed data, history tracking, and accuracy metrics.
- Researchers: Interested in data trends and model performance; may provide feedback.

2.4 Operating Environment

- Platforms: iOS (v18.0 and above), Android (API level 24, Android 7.0 Nougat and above).
- Devices: Smartphones with rear-facing camera (8MP or higher recommended).
- Network: Functionality in both online and limited offline modes.

2.5 Design and Implementation Constraints

- The ML/DL models must be optimized for mobile deployment (e.g., TensorFlow Lite, Core ML) to ensure speed and reduce data costs.
- The app must support major local languages in target regions (e.g., English, Urdu).
- Must comply with Google Play Store and Apple App Store guidelines.

2.6 User Documentation

- In-app tutorials and tooltips.
- A dedicated "Help & Support" section within the app.
- Online knowledge base and FAQ on a dedicated website.

2.7 Assumptions and Dependencies

- Assumes users have a smartphone with a functioning camera.
- The accuracy of the ML/DL models are dependent on the quality and quantity of the training dataset.
- Dependencies on third-party services: ML/DL hosting platform (e.g., Google Cloud AI, AWS SageMaker), weather API.

3. External Interface Requirements

3.1 User Interfaces

- UI Framework: Native (Swift/Kotlin) or Cross-Platform (Flutter/React Native) for a premium feel.
- Design Language: Material Design 3 (Android) & Human Interface Guidelines (iOS) with a consistent, adaptive theme.
- Key Screens: Login/Signup, Camera View, Results Screen, History List, Disease Library, Forum Feed.

3.2 Hardware Interfaces

- The app shall interface with the device's camera to capture images.
- The app may use GPS (with user permission) to tag detection locations.

3.3 Software Interfaces

- Backend API: RESTful API for user authentication, image processing requests, syncing history, and fetching forum data. (e.g., `POST /api/v1/predict`).
- ML/DL Model: Interface with a TensorFlow Lite (`.tflite`) model hosted on-device or a cloud endpoint.
- Database: Cloud Firestore or PostgreSQL for user data and history.

3.4 Communications Interfaces

- HTTPS/SSL for all network communications to ensure data encryption.
- Push Notifications (Firebase Cloud Messaging / Apple Push Notification service) for community updates and model improvement news.

4. System Features

4.1 Feature 1: User Onboarding & Profile Management

- FR-1.1: The app shall allow users to register using an email address or phone number.
- FR-1.2: Users shall be able to create a profile indicating their role (Farmer/Agronomist) and region.
- FR-1.3: Users shall be able to edit their profile information and change app settings (e.g., language, notification preferences).

4.2 Feature 2: Camera-Based Disease Detection

- FR-2.1: The app shall provide a UI to capture an image of a groundnut leaf/pod using the device's camera.
- FR-2.2: The app shall allow users to select an image from their gallery for analysis.
- FR-2.3: The app shall display a preview of the image with guidance to ensure the leaf/pod is in frame.
- FR-2.4: Upon processing, the app shall display the top disease prediction(s) with a confidence percentage (e.g., "Late Leaf Spot - 92% confidence").
- FR-2.5: The app shall indicate if no disease is detected or if the image is unclear.

4.3 Feature 3: Disease Library & Information Center

- FR-3.1: The app shall provide a searchable, offline-accessible library of all supported groundnut diseases.
- FR-3.2: Each disease entry shall include high-quality images, symptoms, causes, and lifecycle information.
- FR-3.3: The system shall include a curated image collection of groundnut diseases, categorized by type and severity, to support both user education and AI applications.
- FR-3.4: The app shall support disease detection through an AI model trained on the collected image dataset. The model shall be capable of identifying diseases from user-submitted images and providing relevant disease information from the library.

4.4 Feature 4: Treatment & Prevention Recommendations

- FR-4.1: Based on the detection result, the app shall display a list of recommended organic and chemical treatment options.
- FR-4.2: The app shall provide cultural prevention practices (e.g., crop rotation, resistant varieties).
- FR-4.3: Recommendations shall be localized based on the user's region and available products.

4.5 Feature 5: History & Field Management

- FR-5.1: The app shall automatically save every scan with its image, result, timestamp, and location (if permitted).
- FR-5.2: Users shall be able to view, search, filter, and delete history entries.
- FR-5.3: Users shall be able to label entries with custom field names for organization.

4.6 Feature 6: Community & Expert Forum

- FR-6.1: Users shall be able to post questions, images, and findings to a public forum.
- FR-6.2: Users shall be able to comment on and react to posts.
- FR-6.3: Verified agronomists and experts shall have a special badge.

4.7 Feature 7: Offline Functionality & Data Sync

- FR-7.1: The core ML/DL models and disease library shall be downloadable for full offline detection.
- FR-7.2: Scans performed offline shall be queued and synced with the user's account when connectivity is restored.

5. Non-Functional Requirements

5.1 Performance Requirements

- NFR-1 (Speed): The app must launch in under 30 seconds. Disease detection analysis must provide results in under 45 seconds (on-device) or under 10 seconds (cloud-based, including upload/download).
- NFR-2 (Size): The initial app download size shall not exceed 500MB. Offline model downloads shall not exceed 500MB.

5.2 Security Requirements

- NFR-3 (Data): All user data and images must be encrypted in transit (TLS 1.2+) and at rest.
- NFR-4 (Privacy): The app must request explicit user consent for data collection (GDPR/CCPA compliant). A privacy policy must be accessible.

5.3 Software Quality Attributes

- Usability: The UI must be intuitive enough for a non-technical user to perform a scan within 45 seconds of opening the app. Text must be clear and icons recognizable.
- Accuracy: The ML/DL model must achieve a minimum of 85% accuracy on a held-out test set for major diseases.

- Accessibility: The app must support screen readers (VoiceOver/TalkBack), dynamic text sizing, and have sufficient color contrast.

5.4 Reliability, Availability, and Maintainability

- Reliability: The app shall have a crash-free rate of >90.5%.
- Availability: The backend API shall aim for 90.9% uptime.
- Maintainability: The code shall be well-documented and modular to allow for easy addition of new diseases or model versions.

5.5 Portability

- The app must perform consistently across all supported OS versions and device screen sizes.

6. Other Requirements

6.1 App Store Deployment

- The app shall be deployed on the Google Play Store and Apple App Store.
- App store listings shall include screenshots, feature descriptions, a video demo, and a privacy policy link.

6.2 Legal, Copyright, and Licensing

- All training data must be legally sourced and licensed for this purpose.
- The app must not provide agricultural advice that violates local regulations.

6.3 Applicable Standards

- Agricultural Standards: Recommendations should align with guidelines from recognized bodies (e.g., FAO, local agricultural universities).
- Data Standards: Use of JSON API standards for all REST communications.

Appendix A: Glossary

- ML/DL Model: A machine learning OR Deep Learning model trained to classify images of plants into disease categories.
- TensorFlow Lite (TFLite): A lightweight, open-source framework for deploying ML/DL models on mobile and embedded devices.
- RESTful API: An architectural style for designing networked applications.

LOT 1. (c)

MaizeShield: Multi-Disease Detection Mobile App for Maize

1. Introduction of the Product/Item

1.1 Product Purpose

This document specifies the product feature of "MaizeShield," a mobile application designed to detect, identify, and manage multiple diseases affecting maize (corn) plants. Utilizing advanced machine learning, the app provides farmers and agronomists with instant diagnostics, science-backed treatment options, and historical tracking of field health, aiming to reduce crop loss and improve yield.

1.2 Document Conventions

- Requirements are categorized as Functional (FR) and Non-Functional (NFR).
- Requirements are uniquely identified (e.g., FR-1.1, NFR-5.2).
- Technical terms are defined in the glossary or in context.

1.3 Intended Audience and Reading Suggestions

- Project Managers & Stakeholders: For overview, scope, and features (Sections 1, 2, 4).
- Developers & System Architects: For technical specifications (Sections 3, 4, 5).
- QA Engineers & Testers: For creating validation plans (All Sections, especially 4 & 5).
- UI/UX Designers: For interface guidelines (Section 3.1).

1.4 Product Feature

MaizeShield will allow users to photograph maize leaves, stalks, ears, and roots. The image will be processed by an on-device DL model to identify a wide range of diseases (e.g., Northern Corn Leaf Blight, Gray Leaf Spot, Common Rust). The app provides diagnostic results, localized treatment recommendations, historical field health analytics, and preventive alerts based on weather data.

2. Overall Description of the Product

2.1 Product Perspective

MaizeShield is a standalone mobile app that interacts with a cloud-based backend for user management, complex analytics, syncing, and integrating external data sources (e.g., weather APIs). The core DL inference is designed to be on-device for speed and accessibility.

2.2 Product Functions (High-Level Features)

1. Multi-farm and multi-field management.
2. Capture and analyze images of different maize plant parts.
3. AI-powered detection of multiple diseases with confidence scores.
4. Detailed information on diseases and their lifecycles.
5. Location and weather-based Integrated Disease Management (IDM) recommendations.
6. Track field health history and view trends over time.
7. Receive push notifications for disease outbreak alerts in the region.
8. Full functionality in offline mode.

2.3 User Classes and Characteristics

- Subsistence/Smallholder Farmers: Need simplicity, low data usage, and clear, actionable advice in local languages.
- Commercial Farmers & Farm Managers: Need precision, historical data, analytics for decision-making, and multi-user field management.
- Agronomists & Extension Officers: Need high accuracy, detailed information, and tools to advise multiple farmers.

2.4 Operating Environment

- Platforms: iOS (v14.0 and above), Android (API level 23, Android 6.0 Marshmallow and above).
- Devices: Smartphones with a rear-facing camera (12MP or higher recommended for better detail capture).
- Network: Optimized for offline-first use, with sync functionality when online.

2.5 Design and Implementation Constraints

- The multi-disease DL model must be highly optimized for mobile deployment (e.g., TensorFlow Lite, PyTorch Mobile) to handle multiple classes without performance degradation.
- Must support major languages in key maize-producing regions (e.g., English, Urdu).
- UI must be usable in bright sunlight conditions common in fields.

2.6 User Documentation

- Interactive in-app walkthrough upon first launch.
- Contextual help icons throughout the app.
- A video tutorial library accessible from the profile section.

2.7 Assumptions and Dependencies

- Assumes users can take a moderately clear, focused picture of the plant.
- Accuracy is dependent on continuous updates and retraining of the DL model with new data.
- Dependencies on third-party services: Weather data API (e.g., OpenWeatherMap), cloud storage (AWS S3, Google Cloud Storage).

3. External Interface Requirements

3.1 User Interfaces

- UI Framework: Native development (SwiftUI/Kotlin) is preferred for superior camera performance and access to native DL cores (Apple's Neural Engine, Android's NNAPI).
- Design Language: Adaptive design complying with both Material Design and HIG. Use of high-contrast colors and large buttons for field use.
- Key Screens: Farm Dashboard, Camera Capture View, Multi-Result Screen, Disease Detail Screen, Analytics Dashboard, Alerts Inbox.

3.2 Hardware Interfaces

- The app shall interface with the device's camera for image capture.
- The app shall use GPS (with explicit user permission per scan) to geotag detections for accurate field history and regional alerts.
- The app may use the device's accelerometer/gyroscope to provide capture guidance (e.g., "Keep phone steady").

3.3 Software Interfaces

- Backend API: RESTful API with JSON for all communications.

- DL Model: Primary interface with a TensorFlow Lite model bundled with the app. A secondary fallback to a more powerful cloud-based model API may be used for ambiguous cases.
- Database: Realm Database or SQLite for offline storage on device; PostgreSQL/MongoDB on the backend.

3.4 Communications Interfaces

- HTTPS/SSL (TLS 1.3) for all data in transit.
- Firebase Cloud Messaging (FCM) / Apple Push Notification service (APNs) for sending disease outbreak alerts and advisory notifications.

4. System Features

4.1 Feature 1: User Onboarding & Multi-Farm Management

- FR-1.1: Users shall register/login via email, phone, or social media account.
- FR-1.2: Users shall be able to create and manage multiple farms and, within them, multiple fields, specifying details like area, maize variety, and planting date.
- FR-1.3: Agronomists shall have a dashboard to view and manage scans from multiple farmers (client management).

4.2 Feature 2: Intelligent Camera Capture & Multi-Disease Detection

- FR-2.1: The camera UI shall have a mode selector (Leaf, Stalk, Ear, Root) to optimize the DL model for the specific plant part.
- FR-2.2: The app shall provide real-time capture guidance (e.g., framing hints, focus assist).
- FR-2.3: The DL model shall return a list of possible diseases, each with a confidence score, for a single image.
- FR-2.4: The results screen shall show side-by-side comparisons of the user's image and a canonical example of the identified disease.

4.3 Feature 3: Comprehensive Disease Library

- FR-3.1: The app shall include a searchable, categorized library of diseases.
- FR-3.2: Each entry shall include images, symptoms, favorable conditions, lifecycle information, and common misdiagnoses.

4.4 Feature 4: Integrated Disease Management (IDM) Recommendations

- FR-4.1: Recommendations shall be categorized by IDM principle: Cultural, Biological, Mechanical, and Chemical controls.

- FR-4.2: Chemical recommendations, if provided, must list common product names and active ingredients, with a clear disclaimer to check local regulations.
- FR-4.3: Recommendations shall be influenced by the user's location and current local weather data (if available).

4.5 Feature 5: Field Health History & Analytics

- FR-5.1: All scans shall be automatically saved to the respective field's history, creating a health log.
- FR-5.2: Users shall be able to view a timeline of detections and a chart showing the prevalence of different diseases over a selected period.
- FR-5.3: The app shall generate a simple season report summarizing major issues and yield impact estimates.

4.6 Feature 6: Alert System & Preventive Advisory

- FR-6.1: The app shall subscribe users to push notifications for public health alerts based on confirmed disease outbreaks in their geographic region (anonymous, aggregated data).
- FR-6.2: The app shall provide preventive advice for diseases whose risk is high based on current weather conditions (e.g., "High humidity forecasted - risk for Gray Leaf Spot is elevated").

4.7 Feature 7: Offline-First Functionality & Data Sync

- FR-7.1: The entire disease library and DL model shall be downloadable for offline use.
- FR-7.2: All scans, field creations, and edits shall work offline and sync seamlessly when connectivity is restored, resolving any conflicts automatically.

5. Non-Functional Requirements

5.1 Performance Requirements

- NFR-1 (Speed): The app must launch in under 1.5 seconds. On-device disease detection must provide results in under 3 seconds on mid-range devices.
- NFR-2 (Resource): The app shall not cause significant battery drain (>5% per continuous 10-minute usage period). Memory usage shall remain stable.

5.2 Security Requirements

- NFR-3 (Data): All personally identifiable information (PII) and farm data must be encrypted at rest and in transit. User images may be anonymized before being used for model re-training (opt-in required).

- NFR-4 (Privacy): User location data for alerts shall be aggregated and anonymized. A clear privacy policy must detail data usage.

5.3 Software Quality Attributes

- Usability: A first-time user should successfully complete a scan and understand the result without prior training.
- Accuracy: The DL model must achieve a minimum mean Average Precision (mAP) of 0.85 on a curated validation set for the top 10 diseases.
- Accessibility: Full compatibility with screen readers, support for voice commands for key actions (e.g., "Take picture"), and customizable text size.

5.4 Reliability, Availability, and Maintainability

- Reliability: The app shall target a crash-free rate of >99.8% as measured by analytics platforms (e.g., Firebase Crashlytics).
- Maintainability: The codebase shall be modular, with clear separation between UI, business logic, and DL components. The backend API shall be versioned (`/api/v1/`, `/api/v2/`).

5.5 Portability

- The app experience shall be consistent across different device manufacturers (Samsung, Xiaomi, etc.) and OS versions within the supported range.

6. Other Requirements

6.1 App Store Deployment

- The app shall be listed on major app stores with localized descriptions and keywords (e.g., "maize doctor," "corn disease").
- Regular updates shall be released to update the disease model and add new features.

6.2 Legal, Copyright, and Licensing

- All advice, especially chemical recommendations, must be accompanied by a disclaimer stating that the user must follow local laws and manufacturer instructions.
- The model training dataset must have appropriate licenses for commercial use.

6.3 Applicable Standards

- Agricultural Standards: Recommendations should align with Agriculture standards set by the FAO and local agricultural extension services.

- AI Ethics: The model must be tested for bias against different maize varieties and lighting conditions.

7. Appendix A: Supported Diseases (Initial List)

- Fungal Diseases: Northern Corn Leaf Blight, Southern Corn Leaf Blight, Common Rust, Gray Leaf Spot, Anthracnose, Head Smut.
- Bacterial Diseases: Bacterial Leaf Streak, Goss's Wilt.
- Nutritional Deficiencies: Nitrogen, Phosphorus, Potassium deficiency symptoms.

LOT 2. (a)

Estimated Price Lot-02 Rs. 14.00 million

Smart Variable Rate Spreading (SVRS) System

(System design, Hardware/Software)

1. Introduction of the System/Product/Item

1.1 Purpose

This document describes the functional and non-functional requirements for the Smart Variable Rate Spreader (SVRS) System. This system integrates with a tractor to precisely apply granular fertilizer based on a geospatial prescription map, optimizing input usage, improving crop yields, and reducing environmental impact. The intended audience includes project managers, developers, testers, and stakeholders.

1.2 Document Conventions

- Requirements IDs: Follow the format `SVRS-FR-[Feature#]-[Req#]` for Functional Requirements and `SVRS-NFR-[Category]-[Req#]` for Non-Functional Requirements.
- Priority: H (High), M (Medium), L (Low).

1.3 Intended Audience and Reading Suggestions

- Project Managers: Focus on Section 1 (Introduction) and Section 2 (Overall Description).
- Developers & Architects: Focus on Section 3 (Interfaces), Section 4 (System Features), and Section 5 (Non-Functional Requirements).
- Testers (QA): Focus on all sections to derive test cases.
- Stakeholders/Client: Focus on Section 2 and Section 4 to understand system capabilities.

1.4 Product/System Features

The SVRS system comprises:

1. A mobile application for map selection, basic monitoring, and manual control.

2. An on-controller software running on a dedicated hardware unit mounted on the tractor. This is the core system responsible for reading GPS data, interpreting the prescription map, and controlling the spreader mechanism.
3. A cloud service for storing prescription maps, application records, and generating reports.

2. Overall Description of the System Design, Hardware/Software

2.1 Product Perspective

The SVRS is a self-contained system that integrates into a larger agricultural operation ecosystem.

- Inputs: Prescription Map (from App/Cloud), GPS Signal, Tractor/Speeder Sensor Data (Speed, PTO RPM, Gate Position).
- Outputs: Control signals to hydraulic/electric actuators, User interface updates, Log files.
- External Systems: GNSS Receiver, Mobile Device (App), Cloud Server, Tractor ECU (optional via ISOBUS).

2.2 Product Functions (High-Level Features)

1. Import and validate digital prescription maps.
2. Determine vehicle position in real-time using GNSS.
3. Calculate required application rate based on vehicle position and speed.
4. Control spreader mechanism (gate opening, conveyor speed) to achieve the target rate.
5. Provide a real-time display of application status, errors, and performance metrics.
6. Record as-applied data with high accuracy for traceability and reporting.
7. Operate in both automated (map-based) and manual (user-defined rate) modes.

2.3 User Classes and Characteristics

- Operator: Primary user. Drives the tractor. Needs a simple, clear interface for starting/stopping jobs and viewing alerts. Medium technical proficiency.
- Farm Manager: Secondary user. Reviews reports and as-applied data. Uses the mobile app and web portal. High agronomic knowledge, variable technical proficiency.
- Service Technician: Configures and calibrates the system. Requires access to advanced diagnostic menus and calibration routines. High technical proficiency.

2.4 Operating Environment

- Hardware: Ruggedized industrial PC/Controller, GPS receiver, Hydraulic/Electric valves & actuators, Flow/Area sensors.
- Software (Controller): Real-Time Operating System (RTOS) or Embedded Linux.
- Software (Mobile App): Android and iOS.
- Physical Environment: Harsh agricultural conditions (dust, moisture, vibration, temperature extremes, unreliable cellular connectivity).

2.5 Design and Implementation Constraints

- Must comply with relevant portions of ISO 11783 (ISOBUS) for interoperability.
- System response time (from GPS input to actuator output) must be < 100ms.
- Must use industry-standard geospatial data formats (e.g., Shapefile, ISO-XML, GeoTIFF).

2.6 Assumptions and Dependencies

- A reliable, high-accuracy (GPS or PPP) GNSS signal is available.
- The physical spreader mechanism is correctly installed and calibrated.
- Prescription maps provided are accurate and in a supported format.
- The tractor's PTO RPM and ground speed can be accurately measured.

3. External Interface Requirements

3.1 User Interfaces

- Mobile App UI: Touchscreen interface with maps, job status, start/stop buttons, and settings.
- Controller UI: Physical buttons and a small LCD screen for basic status and diagnostics without the mobile app.

3.2 Hardware Interfaces

- SVRS-INT-HW-01 (H): The controller shall interface with a GNSS receiver via NMEA 0183 or NMEA 2000 protocol.
- SVRS-INT-HW-02 (H): The controller shall interface with ground speed radar or receive speed from the tractor's CAN bus (ISOBUS).
- SVRS-INT-HW-03 (H): The controller shall output control signals (PWM 0-5V or CAN messages) to hydraulic valves controlling the gate and conveyor.

3.3 Software Interfaces

- SVRS-INT-SW-01 (H): The mobile app shall transfer prescription map files to the controller via a Wi-Fi Direct or Bluetooth connection.

- SVRS-INT-SW-02 (M): The controller shall upload as-applied data logs to a cloud service via a cellular modem (e.g., using MQTT/HTTPs protocol).

3.4 Communication Interfaces

- Wi-Fi Direct/Bluetooth: For app-to-controller communication.
- CAN Bus (J1939/ISOBUS): For vehicle data acquisition.
- Cellular (4G/5G): For cloud communication.

4. System Features

4.1 Feature 1: Prescription Map Processing & Management

- SVRS-FR-1-01 (H): The system shall accept prescription map files in Shapefile (.shp) and ISO-XML format.
- SVRS-FR-1-02 (H): The system shall validate the coordinate reference system (CRS) of the map and project it to the CRS of the GNSS receiver if necessary.
- SVRS-FR-1-03 (H): The system shall allow the user (via the app) to select an active prescription map from a list of available maps.

4.2 Feature 2: Real-Time Geospatial Control

- SVRS-FR-2-01 (H): The system shall read the current position, speed, and heading from the GNSS receiver at a minimum rate of 10Hz.
- SVRS-FR-2-02 (H): The system shall determine the target application rate for the current vehicle position by querying the active prescription map.
- SVRS-FR-2-03 (H): The system shall calculate the required actuator position (e.g., gate opening %) based on the target rate, current ground speed, and known material characteristics (from calibration data).
- SVRS-FR-2-04 (H): The system shall implement a control algorithm (e.g., PID) to adjust the actuator to achieve the target rate.

4.3 Feature 3: Manual & Automated Operation Modes

- SVRS-FR-3-01 (H): The system shall have an "AUTO" mode where application rates are controlled by the prescription map.
- SVRS-FR-3-02 (H): The system shall have a "MANUAL" mode where the operator sets a uniform application rate across the entire field.
- SVRS-FR-3-03 (M): The system shall provide a physical "E-STOP" button that immediately closes the spreader gate.

4.4 Feature 4: System Monitoring & Diagnostics

- SVRS-FR-4-01 (H): The system shall display real-time data: current rate, target rate, applied area, total product used, vehicle speed, and GNSS quality.
- SVRS-FR-4-02 (H): The system shall generate audible and visual alerts for critical faults: GNSS signal loss, low product level, spreader blockage, control system fault.
- SVRS-FR-4-03 (M): The system shall provide a diagnostic menu for service technicians to test individual components (e.g., open/close gate, run conveyor).

4.5 Feature 5: Data Logging & Reporting

- SVRS-FR-5-01 (H): The system shall create an "as-applied" log file recording at minimum: timestamp, position, target rate, actual rate, vehicle speed, and area covered.
- SVRS-FR-5-02 (M): The system shall generate a summary report at the end of a job including: total area covered, total product used, average application rate, and job duration.
- SVRS-FR-5-03 (M): The system shall export report data in a common format (e.g., .PDF, .CSV) for use in other farm management software.

5. Non-Functional Requirements

5.1 Performance Requirements

- SVRS-NFR-PER-01 (H): The control loop (read position -> calculate rate -> adjust actuator) shall have a latency of less than 100 milliseconds.
- SVRS-NFR-PER-02 (H): The system shall achieve a spatial accuracy of within 1 meter of the intended path when using a high-accuracy GNSS source.
- SVRS-NFR-PER-03 (M): The application rate accuracy shall be within ±5% of the target rate across the recommended operating speed range.

5.2 Safety Requirements

- SVRS-NFR-SAF-01 (H): The system shall default to a "safe state" (gate closed) on startup, shutdown, or upon detection of any critical system fault.
- SVRS-NFR-SAF-02 (H): Manual override must always be available to the operator.
- SVRS-NFR-SAF-03 (H): All software components shall be developed following IEC 61508 or ISO 25119 standards for Safety Integrity Level (SIL) 1.

5.3 Security Requirements

- SVRS-NFR-SEC-01 (M): All data transmitted to the cloud shall be encrypted in transit (TLS 1.2+).
- SVRS-NFR-SEC-02 (L): Prescription map files on the controller should be digitally signed to prevent tampering.

5.4 Software Quality Attributes

- Reliability: The system shall have a mean time between failures (MTBF) of >1000 operating hours.
- Availability: The system shall be operational 99.5% of time during a planned job, accounting for GNSS dropouts.
- Maintainability: The software shall be modular with comprehensive logging to facilitate debugging.

5.5 Business Rules

- The system shall use metric units (kg/ha, m, km/h) as the primary unit system, with imperial units as a user-selectable option.

6. Other Requirements

6.1 Apportioning of Requirements

Requirements marked with a (H) high priority must be implemented in the first release. Medium and Low priority requirements may be deferred to future versions.

6.2 Acceptance Criteria

Formal acceptance will require successful completion of Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT) protocols, which will be based on the requirements outlined in this document.

7. Appendix A: Glossary

- GNSS: Global Navigation Satellite System (e.g., GPS, GLONASS, Galileo).
- Prescription Map: A digital map that defines the application rate of a material for different zones within a field.
- GPS: Global Positioning System
- ISOBUS: An international standard (ISO 11783) for communication between agricultural machinery and implements.
- PTO: Power Take-Off, a driveshaft supplying power from the tractor to the implement.
- As-Applied Data: A record of what material was actually applied, where, and at what rate.

LOT 2. (b)

Smart Irrigation System (System Design, Hardware/Software)

1. Introduction of the System/Product/Item

1.1 Purpose

This document provides a detailed description of the product for the AquaSmart mobile and web application. The system is designed to monitor and control drip and rain gun irrigation systems remotely, leveraging real-time sensor data and automated rules to optimize water usage, improve crop yield, and reduce operational costs.

1.2 Document Conventions

- Requirements IDs: Follow the format `FR[Section]-[ID]` for Functional Requirements and `NFR-[Section]-[ID]` for Non-Functional Requirements.
- Priority:
    - High (H): Must be implemented for the first release.
    - Medium (M): Should be implemented if possible.
    - Low (L): Nice to have, can be deferred.

1.3 Intended Audience

- Project Managers: For planning and tracking project scope.
- Developers & QA Engineers: For designing, building, and testing the system.
- Stakeholders & Clients: For understanding the system's capabilities and providing sign-off.
- Technical Writers: For creating user manuals and administration guides.

1.4 Product Feature

The AquaSmart system will consist of:

1. A cloud-based backend server for data processing and storage.
2. A cross-platform mobile application (iOS & Android) for primary user interaction.
3. A responsive web application for desktop management.
4. Interfaces for various hardware components: soil moisture sensors, weather stations, solenoid valves, pump controllers, and rain gun controllers.

2. Overall Description of System Design, Hardware/Software

2.1 Product Perspective

AquaSmart is a self-contained product that acts as the central brain for a farm's irrigation infrastructure. It interfaces with existing off-the-shelf sensors and controllers via industry-standard protocols.

2.2 Product Functions (High-Level)

- Remotely monitor soil moisture, temperature, humidity, and valve status.
- Manually start/stop irrigation valves and rain guns.
- Create automated irrigation schedules based on time, sensor thresholds, or weather data.
- View historical data and generate water usage reports.
- Manage multiple farms, zones, and users with different permission levels.
- Receive push notifications for system alerts and critical events.

2.3 User Classes and Characteristics

User Class	Characteristics	Key Goals
Farm Owner	Owns multiple farms, less technical.	View overall water usage, costs, and reports. Manage users.
Farm Manager	Manages daily operations, technically adept.	Schedule irrigation, respond to alerts, monitor all zones.
Field Technician	On-ground staff, uses mobile app primarily.	Manually override systems, perform maintenance checks.
System Admin	IT support for the application.	Manage system settings, user roles, and API keys.

2.4 Operating Environment

- Mobile App: iOS 14+ and Android 10+.
- Web App: Chrome, Firefox, Safari, and Edge (last two versions).
- Backend Server: Ubuntu Linux 20.04 LTS, running on a cloud provider (AWS/Azure/GCP).
- Database: A time-series database (e.g., InfluxDB) for sensor data and a relational database (e.g., PostgreSQL) for other data.

2.5 Design and Implementation Constraints

- The system must use MQTT for real-time communication with field devices due to its low bandwidth and bi-directional capabilities.
- The mobile app must function with limited internet connectivity (e.g., caching critical control commands).
- All data must be encrypted in transit (TLS 1.2+) and at rest (AES-256).

2.6 Assumptions and Dependencies

- Assumption: Field devices (sensors, controllers) are installed, powered, and have a reliable cellular/Wi-Fi/LoRaWAN connection to the internet.
- Dependency: Availability of third-party weather data APIs (e.g., OpenWeatherMap).
- Dependency: Mobile devices used by technicians have GPS capabilities.

3. External Interface Requirements

3.1 User Interfaces

- UI/UX: A clean, intuitive interface with a color-coded dashboard (green for good, red for alerts).
- Dashboard: Map view of the farm with overlays of zones and their status.
- Navigation: Bottom navigation bar on mobile (Home, Zones, Schedules, Alerts, Profile). Sidebar navigation on web.

3.2 Hardware Interfaces

- Soil Moisture Sensors: Interface via Modbus RTU/TCP or analog-to-digital converters.
- Solenoid Valves (Drip): Controlled via digital outputs from a Programmable Logic Controller (PLC) or IoT controller (e.g., Arduino/Raspberry Pi with relays).
- Rain Gun Controllers: Interface via similar PLCs or specific industrial controllers supporting Modbus.
- Water Pump Controller: Interface via a relay or dry contact to start/stop the pump.
- Gateway Device: A gateway (e.g., Raspberry Pi) in the field will aggregate data from sensors and execute commands from the cloud via MQTT.

3.3 Software Interfaces

- Weather Service API: (e.g., OpenWeatherMap API) to retrieve forecasted precipitation and ET (evapotranspiration) values.
- Cloud MQTT Broker: (e.g., AWS IoT Core, HiveMQ, VerneMQ) to handle communication with all field devices.
- Push Notification Services: Apple Push Notification Service (APNS) and Firebase Cloud Messaging (FCM).

3.4 Communication Protocols

- MQTT: Primary protocol for device-to-cloud and cloud-to-device communication. Supports last will and testament for detecting device disconnections.
- HTTPS/REST: For all communication between the mobile/web app and the backend server.
- Modbus RTU/TCP: For communication between the field gateway and the sensors/controllers.

4. System Features

4.1 Feature 1: Real-Time Monitoring & Dashboard

Description: Users shall have a dashboard to view the real-time status of all irrigation zones and key metrics.

- FR1-1: The system shall display a map of the farm with geo-referenced irrigation zones. (H)
- FR1-2: Each zone shall be color-coded on the map based on its current soil moisture status (e.g., red for dry, green for optimal, blue for wet). (H)
- FR1-3: Tapping a zone shall show a detail panel with: current soil moisture, temperature, valve status (On/Off), and last updated time. (H)
- FR1-4: The dashboard shall display a summary widget for current weather conditions and forecast from the integrated weather service. (M)

4.2 Feature 2: Manual Irrigation Control

Description: Authorized users shall be able to manually control irrigation valves and rain guns.

- FR2-1: The user shall be able to select a zone and manually turn a valve or rain gun On or Off. (H)
- FR2-2: For manual activation, the user shall be able to set a timer (e.g., run for 30 minutes) or choose to run indefinitely until manually stopped. (H)

- FR2-3: The system shall prevent manual activation if the master water pump is off or if a fault is detected (e.g., low pressure). (H)
- FR2-4: All manual commands shall require a confirmation and be logged with user ID and timestamp. (H)

4.3 Feature 3: Automated Rule-Based Scheduling

Description: Users shall be able to create flexible automation rules for irrigation.

- FR3-1: The user shall be able to create a schedule based on time (e.g., "Start Zone B every Monday at 6 AM"). (H)
- FR3-2: The user shall be able to create a sensor-based rule (e.g., "Start Zone A if soil moisture < 25%"). (H)
- FR3-3: The user shall be able to create a weather-based rule (e.g., "Do not irrigate any zone if precipitation probability > 60%"). (M)
- FR3-4: The user shall be able to set a duration for the irrigation event triggered by an automated rule. (H)
- FR3-5: The user shall be able to enable/disable any rule without deleting it. (H)

4.4 Feature 4: Historical Data & Reporting

Description: The system shall store and present historical data for analysis and reporting.

- FR4-1: The user shall be able to view a time-series graph of soil moisture for any zone for a user-selectable period (e.g., last 24 hours, last week, last month). (H)
- FR4-2: The system shall generate a PDF report of total water usage per zone, per week/month. (M)
- FR4-3: The system shall calculate and display estimated water savings compared to a fixed-timer baseline. (L)

4.5 Feature 5: User & Farm Management

Description: The system shall support multiple users and farms with role-based access control (RBAC).

- FR5-1: A Farm Owner user shall be able to add, edit, or remove farms and zones within the system. (H)
- FR5-2: A Farm Owner/Manager shall be able to invite new users and assign them roles (Viewer, Technician, Manager, Owner). (H)
- FR5-3: A user with a 'Technician' role shall only be able to view zones and perform manual controls but not create or edit schedules. (H)

4.6 Feature 6: Alerts and Notifications

Description: The system shall proactively alert users of important events.

- FR6-1: The system shall send a push notification to users' mobile devices when a soil moisture level in a zone falls below or rises above user-defined thresholds. (H)
- FR6-2: The system shall send an alert if a valve fails to activate or deactivate upon command (e.g., based on continuous flow sensor reading or power draw). (M)
- FR6-3: The system shall send an alert if a field gateway device disconnects from the MQTT broker. (H)
- FR6-4: Users shall be able to configure which alerts they receive in their notification settings. (M)

5. Non-Functional Requirements

5.1 Performance Requirements

- NFR-PER-1: The mobile app dashboard shall load and display real-time data within 3 seconds over a 4G connection.
- NFR-PER-2: The backend shall process a sensor data update and trigger any necessary automation rules within 5 seconds of receipt.
- NFR-PER-3: The system shall support up to 10,000 connected field devices and 100 concurrent mobile/web users.

5.2 Safety Requirements

- NFR-SAF-1: The system shall include a software-based emergency stop function that immediately halts all irrigation across the entire farm.
- NFR-SAF-2: Critical commands (like pump start/stop) shall have a two-step verification process to prevent accidental activation.

5.3 Security Requirements

- NFR-SEC-1: All user authentication shall be performed using OAuth 2.0 and secure tokens (JWT).
- NFR-SEC-2: All communication between apps, servers, and devices shall be encrypted using TLS 1.2 or higher.
- NFR-SEC-3: User passwords shall be hashed and salted (using bcrypt or similar) before storage in the database.
- NFR-SEC-4: The system shall be audited for common OWASP Top 10 vulnerabilities (e.g., SQL injection, XSS).

5.4 Software Quality Attributes

- Availability: The cloud backend shall have 99.9% uptime.

- Reliability: The system shall correctly execute 99.5% of all commanded irrigation events.
- Maintainability: The codebase shall be well-documented with an aim to maintain a test coverage of >80%.
- Usability: A new user shall be able to add a zone and create a basic schedule with less than 15 minutes of training.

6. Other Requirements

6.1 App Store Deployment

- The mobile application shall be deployed to the Apple App Store and Google Play Store.

6.2 Licensing and Legal

- The software will be licensed under a proprietary subscription model (SaaS).
- The application must comply with data privacy regulations like GDPR and CCPA.

6.3 Hardware Compatibility List

- A certified list of compatible sensors, controllers, and gateways will be provided to customers to ensure interoperability.

Appendices:

- Appendix A: Data Flow Diagrams (DFD)
- Appendix B: Entity-Relationship Diagram (ERD)
- Appendix C: Wireframes/Mockups