

## Bangladesh Agricultural Research Council

Project Title:	Development of Upazila Land Suitability Assessment and Crop Zoning System of Bangladesh
Implementing Organization:	Bangladesh Agricultural Research Council (BARC)
Component Organization:	1. Soil Resource Development Institute (SRDI) 2. Institute of Water Modeling (IWM)
Coordinator:	Member Director (Crops), BARC
Principal Investigator:	1. Hasan Md. Hamidur Rahman, Director (Computer and GIS), BARC 2. Md. Jalal Uddin, Chief Scientific Officer, SRDI 3. Dr. Mollah Md. Awlad Hossain, Director (ICT-GIS), IWM
Co-Principal Investigator:	1. Dr. Md. Rezwana Molla, Principal Scientific Officer (Crops), BARC 2. Md. Abdul Halim, Chief Scientific Officer, SRDI
Project Location(s):	All over Bangladesh (495 upazilas)
Project Duration:	June 2017 to December 2021 (1st Phase) February 2022 to May 2026 (2nd Phase)
Project Budget:	1st Phase: Taka 16,02,84,002.00 2nd Phase: Taka 12,93,27,250.00
Introduction:	<p>Against the backdrop of land scarcity of the country, the proposed investigation will be carried out to assess the land potential under different crops and cropping patterns at the upazila level. The purpose is to optimize land utilization through GIS-based technology, enabling location-specific decisions for agricultural planning.</p> <p>Given the country's pressing challenges in boosting productivity and sustaining growth to feed a rising population, this work carries significant importance. By identifying land with the highest agricultural potential, the approach will promote sustainable use of limited land and water resources.</p> <p>Moreover, in the National Agricultural Policy of Bangladesh, priority has been given to the development of crop zoning and to undertaking research activities for assessing and improving zone-based productivity through the application of modern technologies to increase crop production.</p>
Objective of the Project:	<p>The overall objective of the project is to support GOB's strategy in developing crop zoning to facilitate more efficient and sustainable agricultural production systems in the context of food and nutritional security. The objectives of the project are:</p> <ul style="list-style-type: none"> <li>• Provide crop zoning information to agricultural policy planners in creating a "farm friendly" policy framework to sustain an economically viable agriculture sector through conserving and protecting farmland for current and future generations;</li> </ul>

	<ul style="list-style-type: none"> <li>• Facilitate and strengthen farmers and other stakeholders’ access to information on suitable crop and fertilizer recommendation for increasing agricultural productivity and farm income;</li> <li>• Enhancement of existing online GIS based Crop Zoning Information System (CZIS) software, ‘Khamari’ Mobile app and agro-advisory portal;</li> <li>• Consolidation of information dissemination services provided through CZIS, ‘Khamari’ mobile app related to crop zoning system.</li> </ul>
Materials and Methods:	<p>The study adopts a methodological framework consisting of four distinct components: agro-edaphic suitability, agro-climatic suitability, agro-ecological suitability, and economic suitability.</p> <ul style="list-style-type: none"> <li>• <u>Agro-edaphic suitability</u>: Assessment of crop suitability based on land and soil properties, considering their relationship with maximum attainable yield (MAT).</li> <li>• <u>Agro-climatic suitability</u>: Evaluation of potential yield loss due to temperature and moisture stress, reflecting the crop’s response to climatic variability.</li> <li>• <u>Agro-ecological suitability</u>: Integration of agro-edaphic and agro-climatic factors, following the methodological guidelines outlined in the <i>Land Resources Appraisal of Bangladesh</i> (FAO/UNDP, 1988).</li> <li>• <u>Economic suitability</u>: Consideration of profitability and resource-use efficiency in determining feasible crop options.</li> </ul> <p>To implement this framework, geospatial technologies (GIS, remote sensing and GPS) were employed for crop suitability analysis and zoning at the upazila level.</p>
Expected output/result(s) and outcomes:	<p>(a) Outputs/results:</p> <p>The project will have several outputs. These are:</p> <ul style="list-style-type: none"> <li>• Updated Upazila land and soil properties information derived from upazila level soil survey;</li> <li>• Updated Upazila soil chemical/nutrient status information derived from analysis soil samples collected from each 200 hectare of land in a upazila;</li> <li>• Updated Upazila Nirdeshika and Soil and landform map;</li> <li>• Updated database of Upazila land and soil properties and agro-climatic information;</li> <li>• Updated Upazila land &amp; soil properties map and admin boundary map;</li> <li>• Updated agro-climatic maps;</li> </ul>

- Land parcel/Union based crop specific fertilizer recommendation;
- Online GIS-based software for data management, crop suitability analysis and zoning;
- Mobile app for dissemination of crop zoning information at field level;
- Agri-advisory portal for gathering and providing information related to agricultural development;
- Socioeconomic data management software and climatic data management software;
- Crop zoning outputs validation report, Awareness of field level extension officials and farmers' on 'Khamari' mobile app;
- Software documentation and usage manual;
- Strengthened technical capacity of ICT Unit of BARC.

(b) Outcomes:

The outcome of the project will be as follows:

- Crop suitability and zoning, fertilizer recommendation information will be made available through CZIS software and 'Khamari' mobile app for sustainable crop productivity;
- Benefit/income of farmers is expected to arise from: (i) increased productivity; (ii) maintaining soil health, (iii) preventing environmental damage; and (iv) reduction in production costs in some cases.
- Supporting policy planners/extension agent with information for land use planning based on crop zoning system;
- Improved livelihood of rural people, particularly, small, marginal and women farmers;
- Geospatial Agriculture Knowledge Repository (AKR) and Knowledge Platform will be built to disseminate knowledge for improved decision making in agriculture. It enables integrating spatial analysis tools into domain knowledge of agricultural systems and processes.

It is expected that, the findings of the project will benefit the agricultural scientists, planners, decision makers and farmers for optimizing the utilization of land resources thereby increasing the production and maximizing the benefits keeping the productivity of land at sustainable level. At national level, the self-sufficiency in food grain production will be sustained through the increase of land productivity. However, the farmers will be the ultimate beneficiaries from the findings of the project.

<p>Activities:</p>	<ul style="list-style-type: none"> <li>• Soil chemical analysis for the soil samples as collected will be conducted for determining nutrient status, organic matter, pH, salinity.</li> <li>• Updated soil and landform maps will be prepared and printed for 15 upazila.</li> <li>• Upazila Nirdeshika report will be compiled, edited and printed with updated soil and landform maps.</li> <li>• Upazila land and soil properties data will be compiled, analyzed, edited, coded and stored in a database for preparation of land and soil properties map layers.</li> <li>• Upazila soil chemical analyses data will be reviewed/checked and edited for addressing inconsistencies if exist.</li> <li>• Observed climate data of Bangladesh Meteorological Department (BMD) and gridded satellite climate data will be compiled, edited and processed for preparation of agro-climatic parameter and map layers.</li> <li>• Socio-economic data will be collected from upazila through Focus Group Discussion (FGD) and the data will be entered into the database.</li> <li>• Socio-economic data will be checked, edited and analyzed into the software for economic profitability analysis of crops/cropping patterns.</li> <li>• Scan, georeferencing, projection transformation and digitization of upazila soil and landform map.</li> <li>• Upazila Land use map will be prepared through digitization of different features from high resolution satellite imagery.</li> <li>• Edge matching of upazila map, soil and land properties, and preparation of seamless map layers for upazila.</li> <li>• GIS surface interpolation of soil nutrition status for preparing upazila map.</li> <li>• Updating of pourashava boundary/ward boundary will be carried out for 495 upazilas.</li> <li>• Carry out desk validation and field validation of crop zoning outputs for uncovering gaps, anomalies and other issues.</li> <li>• Conduct demonstration trial for validation of suitable crop and fertilizer recommendation at farmers' field.</li> <li>• Training on crop zoning system e.g. software/mobile app will be conducted at the upazila level for agriculture extension personnel/selected farmers and agri-input dealer.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Capacity building trainings will be arranged for the personnel related to development and maintenance of crop zoning system.</li> <li>• Awareness/ consultation workshops, meetings will be organized for the stakeholders' organizations.</li> <li>• Crop area estimation from high resolution satellite imagery will be carried out. For that all kinds of available existing agricultural, geographic and administrative information on crops (estimates of acreage of main crops in the area, ground data collected in the previous years in the area, cropping calendars, satellite data etc.) will be collected and validated.</li> <li>• Crop growing requirement information required for devising suitability limitation rating will be compiled/reviewed for formulation of crop rule for individual crop.</li> <li>• Crop suitability limitation ratings (edaphic and agro-climatic) needed for suitability assessment will be developed/ revised for individual crops.</li> <li>• Crop variety data, crop production technology, innovative/indigenous technology, etc. will be compiled, edited and organized in a database.</li> <li>• Building of Geospatial Agriculture Knowledge Repository (AKR) and a Knowledge Platform to disseminate knowledge for improve decision making.</li> <li>• Supervision of crop zoning software/mobile app/web portal development activities and provide necessary guidelines, ideas/suggestions and feedbacks for developing a robust/ improved system.</li> <li>• GIS based online crop zoning information system (CZIS) software, 'Khamari' mobile app and agri-advisory web portal will be developed/enhanced.</li> <li>• Land and soil characteristics, climate, crop resources inventories and others will be developed.</li> <li>• Present land use and updated land and soil information will be incorporated in crop zoning system.</li> <li>• Land type will be delineated using Digital Elevation Model (DEM) and land type wise soil series.</li> <li>• Agro-edaphic module and agro-climatic module will be reviewed/improved for assessment of agro-edaphic and agro-climatic suitability of crops.</li> <li>• Agro-ecological module will be reviewed/improved for combined assessment of agro-edaphic and agro-climatic suitability of crops.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Socio-economic module will be reviewed/improved for assessment of economic profitability of crops/cropping patterns.</li> <li>• Hazard, risk related information in agriculture will be integrated in crop zoning system.</li> <li>• Multi-criteria decision analysis to evaluate spatial and dynamic aspects of agriculture towards sustainable development will be developed/enhanced.</li> <li>• Information on crop, crop variety, crop production technology, pest and disease management, etc. will be incorporated in crop zoning system.</li> <li>• Mobile based agri-advisory service (planting time, seed, fertilizer, irrigation, insecticide, pesticide, etc.) will be developed/integrated.</li> </ul>
<p>Progress and Achievements:</p>	<p>An online crop zoning system (<a href="https://cropzoning.gov.bd">https://cropzoning.gov.bd</a>) has been developed comprises four integrated digital components:</p> <ol style="list-style-type: none"> <li>1. <b>Crop Zoning Information System (CZIS):</b> A software platform designed to manage and process agro-edaphic and agro-climatic data for crop suitability assessment and zoning.</li> <li>2. <b>Crop Zoning Dashboard:</b> A decision-support tool developed for planners and policymakers to guide strategic agricultural land use and production planning.</li> <li>3. <b>‘Khamari’ Mobile App:</b> A farmer-focused advisory tool, developed in Bangla, that delivers parcel-level information on suitable crops, recommended crop varieties (with expected yield and duration), fertilizer guidelines based on soil nutrient status, and land and soil characteristics. The app is available on the Google Play Store and Mac App Store.</li> <li>4. <b>Agri-Advisory Portal:</b> A comprehensive web platform for accessing and disseminating crop zoning and advisory information to a wide range of stakeholders.</li> </ol> <p>Together, these components form a unified system aimed at promoting data-driven, climate-resilient, and location-specific agricultural planning and decision-making in Bangladesh.</p> <p><b>Crop Suitability Assessment:</b> Suitability analysis was carried out for <b>76</b> crops across <b>464</b> upazilas out of 495, to identify location-specific crop potential.</p> <p><b>Crop and Technology Database Development:</b> A comprehensive database on crop varieties, management practices, and production technologies has been compiled and uploaded in both Bangla and English for wider accessibility.</p> <p><b>Socio-Economic and Profitability Analysis:</b> Cropping-pattern-wise profitability data—covering gross margin (GM) and benefit–cost ratio</p>

(BCR)—have been analyzed and uploaded into the Crop Zoning System for **476 upazilas**.

**Economic Indicators Estimation:** Gross margin (GM) and benefit–cost ratio (BCR) for **76 crops** have been estimated for **432 upazilas** and fully integrated into the system to guide evidence-based decision-making.

**Demonstration Trials and Validation:** A total of **150** field trials were conducted for **15** rice and non-rice crops at different locations to validate the fertilizer recommendations provided by Khamari app.

**Training and Capacity Building:** Conducted training workshops on the Crop Zoning System and the ‘Khamari’ Mobile App across 11 agricultural regions. A total of **758** extension personnel were trained to enhance field-level awareness, adoption, and application of these digital tools.

In addition, a total of **526** scientists, extension officials, and other stakeholders received specialized training at different times to strengthen their knowledge and skills in using the Khamari App and crop zoning system.

**Training at Upazila Level:** Upazila-level training programs were conducted for extension officials, farmers, and agricultural input providers to enhance the effective use of the Khamari Mobile App. A total of **5,614** participants actively took part in these sessions.

**Official Launch of Khamari App:** On February 26, 2025, the Khamari App was officially launched at the Horticulture Centre, DAE, Savar, Dhaka by the Hon’ble Advisor for Agriculture and Home Affairs, Lt. Gen. Md. Jahangir Alam Chowdhury (Retd.).

**Publication:** To strengthen awareness, knowledge-sharing, and dissemination of project outcomes, several publications were developed:

- **Booklet:** “*Khamari Mobile App: A Smart Technology for Balanced Fertilizer Use and Increased Crop Production*” – presenting field trial results and highlighting the app’s role in promoting balanced nutrient management and advancing smart agriculture.
- **Methodology Document:** A comprehensive document detailing the **crop zoning methodology**, serving as a technical reference for researchers, extension officials, and policymakers.
- **Project Leaflets:** Two informational leaflets prepared in **Bangla and English**, providing an overview of the project, its objectives, and key achievements for wider outreach.

**Video Documentary Development:** To promote awareness, demonstrate field applications, and encourage wider adoption of the Khamari Mobile App, video documentaries were developed highlighting its fertilizer recommendation practices and practical use.

	<p>Two key productions include:</p> <ul style="list-style-type: none"><li>• <b>Video Tutorial on Khamari App Usage</b> – prepared under the Crop Zoning Project budget, providing step-by-step guidance for farmers and extension officials.</li><li>• <b>Video Documentary on Fertilizer Recommendation Practices</b> – produced under the Revenue Budget, showcasing field applications and benefits for improved productivity and sustainability.</li></ul>
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