Data in Brief
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Article template

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Article title

BanglaShakNet: A Benchmark Multi-modal Dataset for Leafy Vegetable Classification in Bangladesh.

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Keywords

BanglaShakNet,Leafy Vegetable Classification,Shak Dataset,Image Classification,Agricultural AI

Abstract

Leafy vegetables, also known as 'shak' in Bangladesh, play an important role in nutrition and agriculture. However, organized digital investigations mostly neglect them. This study introduces BanglaShakNet, a new dataset created to identify and recognize the country's common leafy vegetables. The dataset includes 539 photos of 17 popular varieties, each labelled with Bengali and scientific names, as well as metadata about image quality and plant health. Photographs were taken from farms and local markets in Dhaka using generally available smartphones, keeping natural lighting and backgrounds to ensure that models trained on this resource function well in real-world agricultural situations. This dataset can aid future deep-learning algorithms in correctly classifying leafy vegetables and detecting illnesses. BanglaShakNet provides a practical and realistic baseline for agricultural image analysis in Bangladesh, setting the framework for future research into smart farming and food security. The dataset is publicly available at [insert URL].

SPECIFICATIONS TABLE

Subject	Computer Science, Artificial Intelligence
Specific subject area	Image Processing, Computer Vision, Deep Learning, Smart Agriculture.
Type of data	Image Dataset (jpg)
Data collection	Color image of Shaks were captured using smartphone cameras (Samsung Galaxy S10+, Xiaomi Poco X3, Redmi Note 7 Pro) in natural light(July - August, 2025)
Data source location	Images were captured from farms, village markets and gardens,Dhaka,Bangladesh
Data accessibility	Repository name: Mendeley Data Data identification number: (or DOI or persistent identifier) Direct URL to data: https://drive.google.com/drive/folders/1BeQD62GDBvQWBgGiSAwtgaeCW8D6dQ4t?usp=drive_link
Related research article	BDMediLeaves: A leaf images dataset for Bangladeshi medicinal plants identification

OBJECTIVE

- To establish a consistent image collection of 17 leafy vegetables commonly found in Bangladesh.
- To prepare labelled and preprocessed samples (512x512 pixels) for accurate classification of leafy vegetables
- To provide a benchmark dataset that supports research in machine learning, deep learning, and smart farming.

VALUE OF THE DATA

The BanglaShakNet dataset was created to digitally document and categorize 17 leafy vegetables grown and consumed in Bangladesh. Although these veggies are important components of local diets and cultural food traditions, there has been no systematic attempt to include them in digital research collections.

- It is the first organized dataset focused on Bangladeshi leafy greens and provides a solid foundation for recording indigenous crops.
- It provides a reliable resource for researchers to experiment with picture analysis, evaluate classification methods, and develop digital apps to help farmers identify various crop species.
- The collection can help to create mobile and automated applications for identifying and analyzing leafy crops' health and growth in real-world farming settings.
- This dataset, which combines traditional agricultural techniques with modern AI tools, assists researchers, engineers, and policymakers in developing sustainable farming and food-security programs in Bangladesh.

BACKGROUND

Leafy vegetables, known locally as "shak," are an important part of Bangladesh's nutrition, culture, and agricultural economy. Common kinds consumed daily across the country are Palong Shak (spinach), Kolmi Shak (water spinach), Pui Shak (Malabar spinach), and Lal Shak (red amaranth). Farmers and vendors frequently struggle to distinguish between these veggies because they all have similar appearances. Such superficial similarities can lead to mislabeling, incorrect cultivation, and uneven harvests, all of which undermine earnings and trust in local markets. Protecting the genetic and cultural diversity of these native greens is equally vital, as they have a direct impact on food security and sustainable farming techniques. Traditional recognition methods are based on human observation, which is time-consuming and frequently wrong. To address this constraint, there is an increasing interest in automatic recognition systems that employ image-based and AI-powered methodologies. The BanglaShakNet dataset was established to address this demand. It includes 539 high-quality photos of 17 different green vegetables, each labelled with both scientific and Bengali names. These are Alu Shak, Bilatidhone Pata, Chulai Shak, Data Shak, Dheki Shak, Helencha Shak, Kochu Shak, Kolmi Shak, Kumro Shak, Lal Shak, Lau Shak, Mula Shak, Palong Shak, Pat Shak, Pui Shak, Shapla Pata, and Thankuni Pata. Each entry also contains contextual information, such as brightness, contrast, and plant health indicators. These characteristics make the dataset appropriate for both visual classification and crop-condition analysis. Globally, computer vision has emerged as a crucial driver of agricultural research and automation. Several plant-leaf databases have been created to help with species identification, disease diagnosis, and crop monitoring [3],[4],[5],[6]. In Bangladesh, similar projects have evolved for vital crops. The BDMediLeaves collection focuses on medicinal plants [1], while SeasVeg collects photos of seasonal vegetables to help with automated categorization and quality rating [2]. These national-level projects show how locally created datasets can help improve digital agriculture in South Asia.On a larger scale, multinational datasets created by Hughes and Salathé (2015) [4] and Singh et al. (2020) [5] laid the groundwork for large-scale image repositories. More recent studies, such as those of Liu et al. (2024) and Wei et al. (2024) [3],[6], have merged images, text, and metadata to improve classification performance. Competitions such as the ICPR 2024 Leaf Inspect Challenge have also aided advancements in leaf segmentation and counting [8]. Several projects have focused on utilizing AI to recognize leafy vegetables. Islam et al. (2022) developed a deep-learning model for identifying local spinach varieties [9]; Kumar and Kumar (2023) used both classical and neural-network approaches to classify vegetable leaves [10]; and Liang et al. (2025) demonstrated that combining datasets can improve model generalization [7]. Despite these improvements, no comprehensive dataset has ever focused just on Bangladesh's indigenous leafy vegetables. BanglaShakNet bridges this gap by providing a benchmark resource that includes a wide range of photos, rich metadata, and authentic environmental circumstances. BanglaShakNet sets a new standard for agricultural informatics, smart-farming research, and deep-learning applications in South Asia by combining species-level identification with plant health assessment.

DATA DESCRIPTION

The BanglaShakNet dataset contains 539 color photos of 17 leafy vegetable types that are commonly grown and consumed in Bangladesh. To ensure uniformity and suitability for deep-learning procedures, all photos were downsized to 512×512 pixels. Between July and August 2025, we took images of tiny farms, local marketplaces, and household gardens in Dhaka. We selected widely available smartphones, such as the Samsung Galaxy S10+, Xiaomi Poco X3, and Redmi Note 7 Pro, to ensure a genuine representation of local farming conditions. This field-based strategy captured a variety of lighting and backdrop scenarios. It represents the way vegetables are exhibited in normal market settings. Pictures were taken immediately in farm and market settings, with no studio-style arrangements or false background editing. As a result, some photographs incorporate natural features such as hands, baskets, and earth surfaces. This depicts realistic agricultural scenarios in which real-world recognition systems are supposed to perform. Similar methods have been applied in recent "in-the-wild" datasets [6], which emphasize resistance to visual variance and noise. To capture varied environmental circumstances, photographs were taken indoors (controlled lighting) and outdoors (shaded daylight), an approach similarly employed in BDMediLeaves [1]. Each image is labelled with its Bengali and scientific name, similar to the SeasVeg dataset [2]. Alu Shak *(Solanum tuberosum),* Bilatidhone Pata *(Coriandrum sativum),* Chulai Shak *(Amaranthus viridis),* Data Shak *(Amaranthus tricolor),* Dheki Shak *(Diplazium esculentum),* Helencha Shak *(Enhydra fluctuans),* Kochu Shak *(Colocasia esculenta),* Kolmi Shak *(Ipomoea aquatica),* Kumro Shak *(Cucurbita maxima),* Lal Shak *(Amaranthus gangeticus),* Lau Shak *(Lagenaria siceraria),* Mula Shak *(Raphanus sativus),* Palong Shak *(Spinacia oleracea),* Pat Shak *(Corchorus olitorius),* Pui Shak *(Basella alba),* Shapla Pata *(Nymphaea nouchali), and* Thankuni Pata *(Centella asiatica).* Along with the photos, the collection contains metadata such as brightness, contrast, sharpness, colorfulness, and plant-health scores. Quantitative image-quality parameters were assessed using computer-vision techniques, while trained assessors manually annotated each leaf's visual health. This multimodal approach is consistent with developments in datasets like PlantDoc [5] and the multimodal work of Wei et al. [6].BanglaShakNet has a clear folder organization to help with reproducibility. Each vegetable category has its own directory, and the photographs are numbered sequentially (for example, shaknet_palonshak_00001.jpg and shaknet_palonshak_00002.jpg). This organization adheres to recommended practices outlined in datasets such as PlantVillage [4] and the ICPR Leaf Inspect Challenge [8]. Finally, the dataset supplements previous studies in this field. Islam et al. (2022) created a spinach-recognition model customized to Bangladeshi settings [9], and Kumar and Kumar (2023) investigated both machine-learning and deep-learning strategies for vegetable-leaf classification [10]. Similarly, Liang et al. (2025) emphasized the use of various datasets to increase generalization in plant disease detection [7]. Collectively, these works establish BanglaShakNet as a viable benchmark for computer vision and agricultural AI research.

Table 1: Number of images captured by which device

Image source	Number of original images
Samsung Galaxy S10+	200
Xiaomi Poco X3	174
Redmi Note 7 pro	165
Total	539

Table 2: Metadata file

	Original data	Preprocessed
File extension	*.jpg, *.jpeg	*.jpg
Dimension	Various	512x512 pixel

Figure 1: Representative samples from each vegetable class

a) Alu_shak

b) Bilatidhone_pata

c) Chulai_shak

d) Data_shak

e) Helencha_shak

f)Dheki_shak

g) Kochu_shak

h) Kolmi_shak

i) Kumro_shak

j) Lal_shak

k) Mula_shak

l) Lau_shak

m) Palong_shak

n) Pat_shak

o) Pui_shak

p) Shapla_pata q) Thankuni_pata

Figure 1. Example images from the BanglaShakNet dataset captured in natural farm and market environments. The photos show variations in lighting and background, along with occasional real-world elements such as vendor hands or market tables, illustrating the authentic conditions of agricultural image collection in Bangladesh.

EXPERIMENTAL DESIGN, MATERIALS AND METHODS

Data Collection

The BanglaShakNet dataset, which represents 17 leafy vegetable varieties that are frequently consumed in Bangladesh, was developed in July and August of 2025. In the Dhaka district, fresh samples were collected from neighborhood markets and small farms. Each variety was examined by agricultural specialists and checked against botanical reference materials to guarantee correct labeling. The dataset includes the following 17 leafy vegetables: Alu Shak (*Solanum tuberosum*), Bilatidhone Pata (*Coriandrum sativum*), Chulai Shak (*Amaranthus viridis*), Data Shak (*Amaranthus tricolor*), Dheki Shak (*Diplazium esculentum*), Helencha Shak (*Enhydra fluctuans*), Kochu Shak (*Colocasia esculenta*), Kolmi Shak (*Ipomoea aquatica*), Kumro Shak (*Cucurbita maxima*), Lal Shak (*Amaranthus gangeticus*), Lau Shak (*Lagenaria siceraria*), Mula Shak (*Raphanus sativus*), Palong Shak (*Spinacia oleracea*), Pat Shak (*Corchorus olitorius*), Pui Shak (*Basella alba*), Shapla Pata (*Nymphaea nouchali*), and Thankuni Pata (*Centella asiatica).* Instead of using lab setups, photos were taken both indoors (under controlled lighting) and outdoors (under natural shade) to capture true diversity. This made it easier to depict how vegetables actually looked in regional trading settings. High-resolution photos were captured using widely accessible smartphones and consumer cameras, including the Xiaomi Poco X3, Redmi Note 7 Pro, and Samsung Galaxy S10+. The class distribution is displayed in Figure 1, the class distribution of 17 leafy vegetable categories in the BanglaShakNet dataset.

In summary, BanglaShakNet provides an organized framework for computer-vision research in agriculture. It facilitates a variety of downstream activities, such as the classification of leafy vegetables, the assessment of plant health, and the development of AI-based smart farming solutions tailored to regional agricultural circumstances.

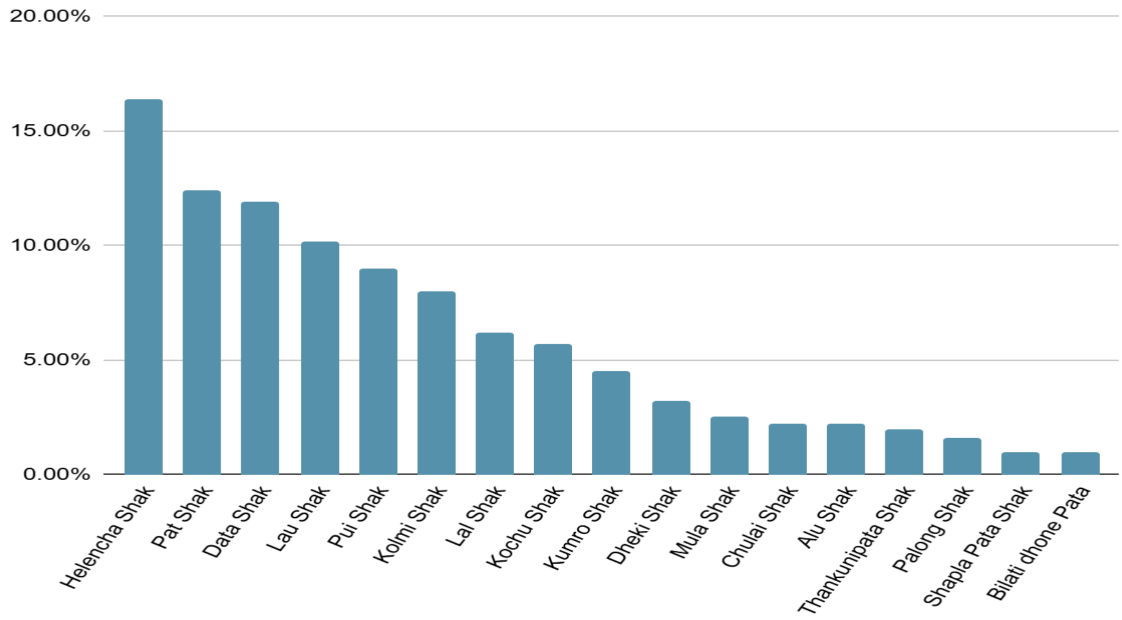


Figure 1. Class distribution of 17 leafy vegetable categories in the BanglaShakNet dataset.

Data Preprocessing

All images were first converted into JPEG format and resized to 512×512 pixels using bilinear interpolation. This standardization helped keep image sizes consistent and reduced differences caused by various cameras or devices.We used computer vision tools to automatically pull out details like sharpness, contrast, and brightness. After that, trained reviewers went through the images manually to double-check the information. They verified the Bengali and scientific names of each plant and confirmed the health status assigned to every sample.

Technical Validation

Data cleaning: Before releasing BanglaShakNet, we extensively examined all photos to eliminate duplicates and nearly identical samples. Many images appeared similar due to minor differences in angle or lighting. We identified these using the Structural Similarity Index (SSIM) and Perceptual Hashing (pHash). Images having a similarity score greater than 0.95 were carefully checked, and duplicates were deleted. This process ensured that only unique samples remained, resulting in a cleaner, more balanced, and reliable dataset for machine learning research.

Model Evaluation

To assess the dataset's reliability, two baseline classifiers were used: a Random Forest model and a feed-forward deep learning model. The Random Forest outperformed the deep learning baseline, with an accuracy of 0.954 and a macro-F1 score of 0.868. These findings show that the dataset enables excellent and consistent classification performance, even when visual diversity exists between samples.

Reproducibility

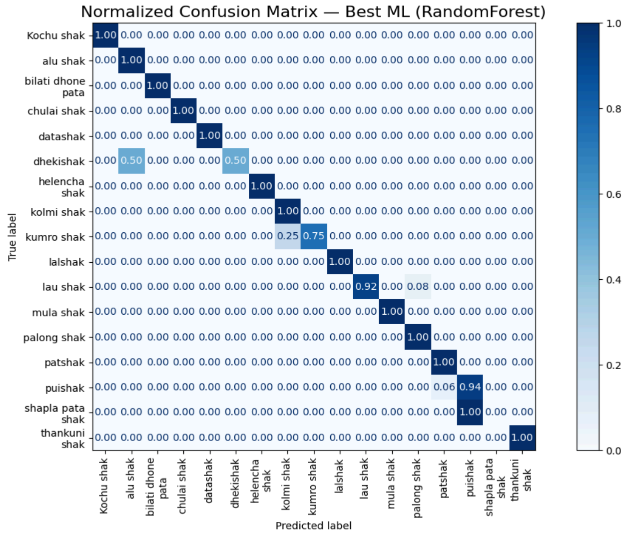
The models were trained for 50 epochs, attaining an average validation accuracy of approximately 0.73, with no evidence of overfitting.BanglaShakNet maintains a structured folder organization and standardized naming convention, making it easy for other researchers to replicate experiments, conduct comparative studies, and extend the dataset for a wide range of applications in agricultural computer vision.

RESULTS

Table 1—Overall results on the test set

Model	Accuracy	Macro-F1
Best ML (tuned)	0.954	0.868
Deep Learning	0.731	0.580

As seen in Table 1, the tuned ML model outperforms the Deep Learning model (accuracy: 0.954 vs 0.731; macro-F1: 0.868 vs 0.580). To visualize where these gains occur, Figure 2(a) and Figure 2(b) present the normalized confusion matrices.



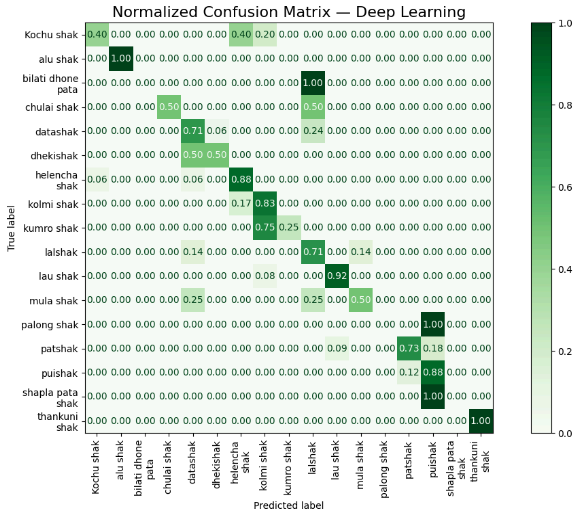


Figure 2(a): The tuned best ML model **Figure 2(b): The DL model**

The normalized (row-normalized, 0–1) confusion matrices for the tuned best ML model and the deep learning model are shown in Figure 2(a) and Figure 2(b), respectively. The ML matrix exhibits stronger diagonal structure across most classes, whereas the deep learning matrix shows greater off-diagonal mass—particularly for minority classes—consistent with the macro-F1 gap reported in Table 1. These visualizations make per-class recall explicit and complement the aggregate metrics.

Figure 3: Per-class F1-scores on the test set:

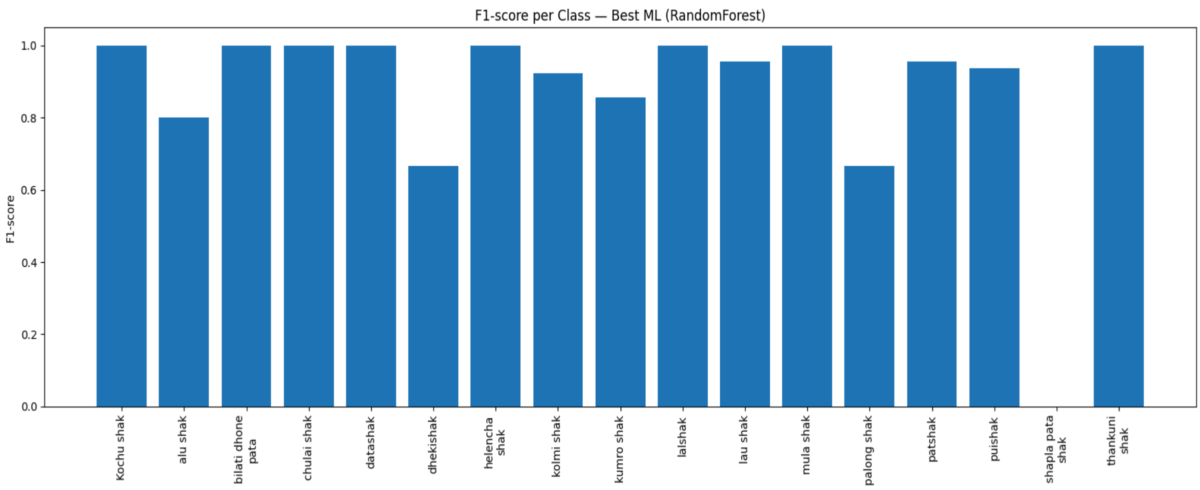


Figure 3(a): Tuned best ML (RandomForest)

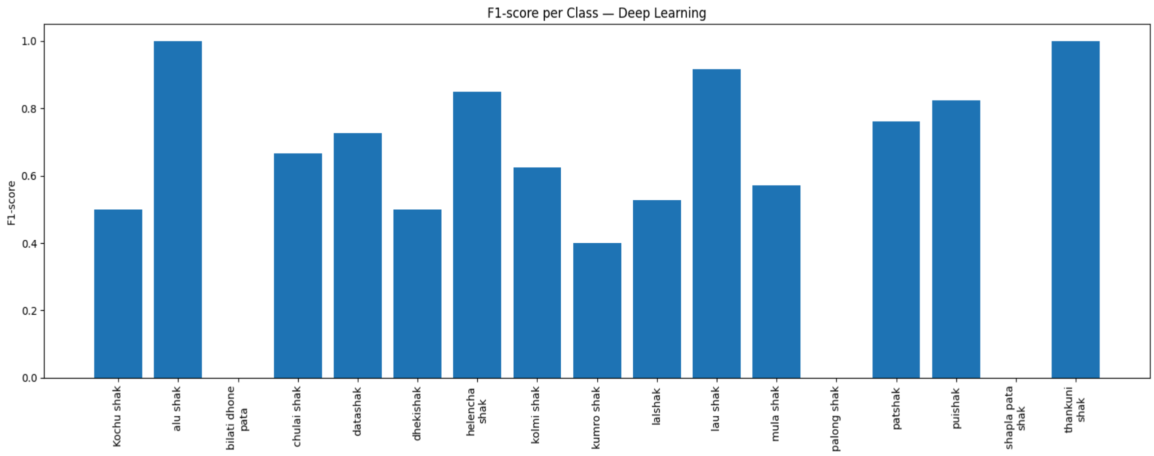


Figure 3(b): Deep Learning

Training dynamics: To inspect learning behavior, **Figure 4** plots the Deep Learning model's training and validation accuracy across 50 epochs.

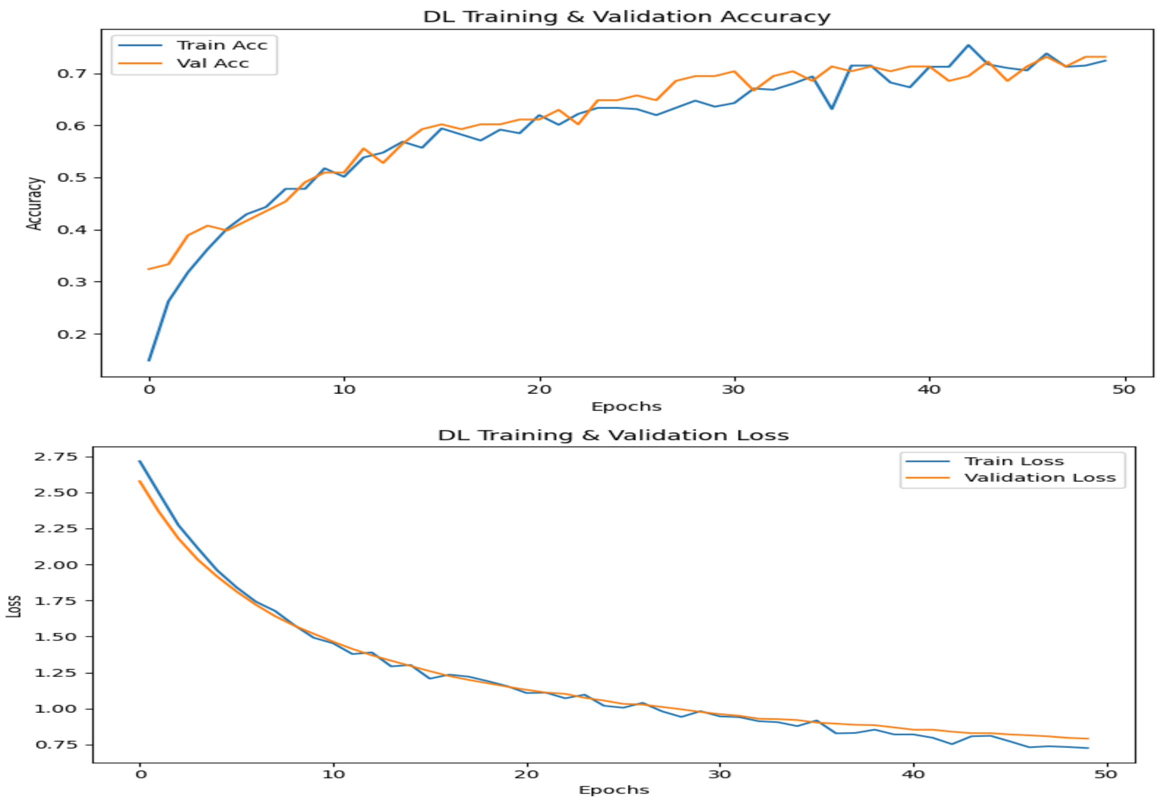


Figure 4. Deep learning training and validation accuracy over 50 epochs. The curves rise and plateau near 0.72–0.74 with a small generalization gap, indicating limited

overfitting and a performance ceiling—consistent with the lower test accuracy in Table 1.

Table 2. Per-class precision, recall, F1-score, and support for the tuned best ML model .Overall accuracy = 0.954.

Class	precision	Recall	F1-score	Support
Kochu shak	1.000	1.000	1.000	5
alu shak	0.667	1.000	0.800	2
bilatidhone pata	1.000	1.000	1.000	1
chulai shak	1.000	1.000	1.000	2
data shak	1.000	1.000	1.000	17
dheki shak	1.000	0.500	0.667	2
helencha shak	1.000	1.000	1.000	16
kolmi shak	0.857	1.000	0.923	6
kumro shak	1.000	0.750	0.857	4
lal shak	1.000	1.000	1.000	7
mula shak	1.000	1.000	1.000	4
lau shak	1.000	0.917	0.957	12
palong shak	0.500	1.000	0.667	1
Pat shak	0.917	1.000	0.957	11
pui shak	0.938	0.938	0.938	16
shapla pata	0.000	0.000	0.000	1
thankuni shak	1.000	1.000	1.000	1

Table 3. Per-class precision, recall, F1-score, and support for DL model .Overall accuracy =0.731.

Class	precision	recall	f1-score	support
kochu shak	0.667	0.400	0.500	5.000
alu shak	1.000	1.000	1.000	2.000
Bilatidhonepata shak	0.000	0.000	0.000	1.000
Chulai shak	1.000	0.500	0.667	2.000
data shak	0.750	0.706	0.727	17.000

dheki shak	0.500	0.500	0.500	2.000
helencha shak	0.824	0.875	0.848	16.000
Kolmi shak	0.500	0.833	0.625	6.000
Kumro shak	1.000	0.250	0.400	4.000
lal shak	0.417	0.714	0.526	7.000
lau shak	0.917	0.917	0.917	12.000
mula shak	0.667	0.500	0.571	4.000
palong shak	0.000	0.000	0.000	1.000
pat shak	0.800	0.727	0.762	11.000
pui shak	0.778	0.875	0.824	16.000
shapla pata	0.000	0.000	0.000	1.000
thankuni shak	1.000	1.000	1.000	1.000

LIMITATIONS

Although the dataset offers a valuable foundation for agricultural image processing and leafy vegetable recognition, several limitations should be noted.First, the collection is confined to 17 Bangladeshi leafy vegetable varieties, which restricts its applicability to crops beyond the local context. Second, the dataset shows class imbalance: varieties such as Bilatidhone Pata and Shapla Pata Shak are underrepresented compared to classes like Helencha Shak and Pat Shak, a reflection of seasonal availability and natural cultivation patterns.Third, a portion of the images contain incidental background elements, including hands, soil, or market surfaces. While these introduce minor noise for controlled experiments, they also add ecological validity by reflecting real-world farming and trading conditions.Finally, the dataset was compiled within a three-month window, meaning factors such as seasonal variation, soil differences, and cultivation practices are not fully captured. Expanding the dataset across multiple seasons and regions would help overcome this limitation in future versions.

ETHICS STATEMENT

This dataset comprises photographs of leafy vegetables obtained from publicly accessible markets and agricultural sites in Bangladesh. All images were acquired by the research team using personal photography equipment. The primary focus of all images is plant material; while some photographs may incidentally capture non-identifiable elements such as vendor hands during the natural process of handling produce, these do not represent human subjects research as no individual identification is possible. Data collection was conducted exclusively for academic and scientific purposes. The compilation process involved direct field photography without employing web scraping, hidden recording devices, or any methods that could potentially violate privacy expectations. Given that this research focuses entirely on botanical specimens without collecting, processing, or analyzing information pertaining to human participants, the institutional review board at Southeast University determined that formal ethical clearance and informed consent procedures were not applicable to this study.

CRediT AUTHOR STATEMENT

Rikha Akther: Formal analysis, Resources, Writing – original draft, Writing – review & editing.**Shahed Hossen Raihan:** Data curation. **Nusrat Jahan Ananna:**Data curation.**Syed Salman Rumon :** Data curation.

ACKNOWLEDGEMENTS

We sincerely thank the farmers and market vendors of Bangladesh for allowing us to collect different leafy vegetable samples. Our gratitude also goes to our colleagues and institutions for their encouragement and support during the creation of this dataset.

DECLARATION OF COMPETING INTERESTS

We confirm that we have no personal or financial conflicts connected to this work. The BanglaShakNet dataset was developed purely for academic study and research, without any commercial involvement or competing interests.

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