



Article

Designing the UI/UX of Pangan Zone to Improve Accessibility to Food Education Content

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Abstract—Access to understandable food-related information can be limited by interface complexity, differences in digital literacy, and accessibility needs. This study presents the UI/UX design and evaluation of Pangan Zone, a web-based food-education prototype developed using a User-Centered Design (UCD) orientation. User requirements were obtained from a five-point questionnaire completed by 127 potential users and summarized using frequencies, percentages, and weighted mean scores. The resulting requirements informed the information architecture, card-based content presentation, typography, color selection, and navigation structure. The prototype was evaluated by 30 participants completing five usability tasks. Across 150 task attempts, 146 were successful, giving an overall task-completion rate of 97.3%. The mean of the five task-level average times was 17.7 seconds, the mean recorded error value was 0.2, and the mean task-difficulty rating was 1.3 on a 1 to 5 scale. Using the standard System Usability Scale (SUS) transformation on the rounded item means reported in Table 7 gives an approximate SUS score of 86.8. WCAG 2.1 Level AA was used as a design target, and selected text-background color pairs were checked quantitatively, but a complete criterion-by-criterion WCAG conformance audit was not performed. The results support high usability for the tested tasks and show how stated user requirements were translated into interface decisions within the evaluated prototype.

Keywords—UI/UX; digital accessibility; food education; interface design; user experience; inclusivity.

1. Introduction

Access to accurate and understandable food-related information remains a challenge, particularly when digital interfaces must serve users with different abilities, ages, and levels of digital literacy. Recent accessibility and UX studies show that interface structure, adaptable presentation, and direct user evaluation are necessary because guideline compliance alone does not guarantee that users can complete real tasks (Ara et al., 2024; Atata & Odedeyi, 2025; Gomez-Hernandez et al., 2023; Power et al., 2012). Similar concerns apply to online learning environments, where interface usability can affect how easily users reach and interpret educational content (Miya & Govender, 2022). These findings motivate an accessibility-oriented approach for food education interfaces rather than treating accessibility as a final visual adjustment.

This study is grounded in three related concepts: UCD, accessibility in UX, and food literacy. UCD requires an explicit understanding of users, tasks, and context of use and an iterative evaluation of design solutions (International Organization for Standardization [ISO], 2019). Usability is treated as an outcome of use that includes effectiveness,

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Table 1. Comparative Analysis: Pangan Zone vs. Reference Platforms

Feature / Criteria	Pangan Zone (This Study)	FoodData Central	Crop Trust App	AgriLearning	NutritionFacts
CONTENT FOCUS					
Specialization in Food Crops	✓ Primary Focus	● Database-centric	✓ Yes	● Broad agriculture	✗ Nutrition only
Global Variety Coverage	✓ 18 varieties from multiple countries	✓ Extensive database	● Limited varieties	● Regional focus	✗ No variety info
Cultural Context Integration	✓ Cultural facts included	✗ Scientific only	● Minimal	✗ Not included	✗ Not included
Educational Content Depth	✓ Comprehensive (origin, nutrition, uses)	● Technical data	✓ Good	● Practical focus	✓ Evidence-based
ACCESSIBILITY FEATURES					
WCAG 2.1 Compliance	● Selected AA	● Partial compliance	✗ Not tested	✗ Not documented	● Basic compliance
Screen Reader Support	● Alt text/semantics	● Limited support	✗ Not supported	✗ Minimal	✓ Supported
Keyboard Navigation	● Partial	✓ Yes	✗ No	● Partial	✓ Yes
High Contrast Mode	● ≥4.5:1 pairs	● Some sections	✗ No	✗ No	● Text only
Adjustable Text Size	✓ Responsive typography	✓ Browser default	✗ Fixed size	● Limited	✓ Yes
UI/UX DESIGN APPROACH					
User-Centered Design Process	✓ UCD methodology documented	✗ Not documented	● Basic UX	✗ Not documented	● Iterative design
Visual-First Design	✓ Card-based, image-heavy	✗ Table-based data	● Some images	● Mixed approach	✓ Video-centric
Clear Information Hierarchy	✓ Category → List → Detail	● Search-focused	✓ Module-based	● Topic-based	✓ Topic-based
Mobile Responsive Design	✓ Fully responsive	● Limited	✓ Mobile app	● Basic responsive	✓ Fully responsive
EDUCATIONAL APPROACH					
Beginner-Friendly Content	✓ Simple language, clear explanations	✗ Technical jargon	✓ Yes	● Some complexity	✓ Clear language
Interactive Learning Elements	● Browse & explore	✗ Static database	✓ Quizzes, games	✓ Videos, courses	✓ Videos

Legend:

✓ = Fully Supported

● = Partially Supported

✗ = Not Supported

efficiency, and satisfaction in a specified context (ISO, 2018). UX extends this view by considering the broader experience produced through interaction with a system (Hassenzahl & Tractinsky, 2006). Accessibility requirements were informed by WCAG 2.1, while WCAG 2.2 is acknowledged as the newer extension of the same standard family (World Wide Web Consortium [W3C], 2018, 2023). Accessibility is treated as both a design and evaluation concern because technical guidance should be combined with user testing and organizational process (Lazar et al., 2015; Power et al., 2012). The content strategy follows food-literacy research, which defines food literacy as more than factual knowledge and includes the ability to understand, select, prepare, manage, and use food-related information in context (Poelman et al., 2018; Truman et al., 2017; Vidgen & Gallegos, 2014).

Digital agriculture research has expanded the use of online services, data platforms, and digital decision support, but these systems are often designed around production, transactions, or

technical information rather than accessible public education (Abiri et al., 2023; Klerkx et al., 2019; Saprida et al., 2024; Warahmah et al., 2025). Pangan Zone addresses a narrower problem: how food-crop educational content can be organized in an interface that is understandable to general users while explicitly considering accessibility and usability requirements. The intended contribution is therefore not a new agricultural algorithm, but a traceable UI/UX design process linking user requirements, accessibility-oriented design decisions, and usability evaluation.

The study is organized around the following research questions:

RQ1. What information-presentation, navigation, digital-literacy, and accessibility needs are reported by the target users?

RQ2. How can the identified needs be translated into an information architecture and interface design using UCD and WCAG-oriented criteria?

RQ3. What level of usability does the resulting prototype demonstrate in task-based testing and SUS evaluation?

To position the prototype, Table 1 compares Pangan Zone with four reference platforms: FoodData Central, Crop Trust App, AgriLearning, and NutritionFacts.org. The comparison covers content focus, accessibility features, UI/UX approach, and educational presentation. The symbols indicate the feature status used in this study: ✓ denotes supported, ● denotes partially supported, and X denotes not supported or not identified. Because the external platforms were not evaluated with an identical criterion-by-criterion WCAG procedure, Table 1 is used for contextual feature comparison rather than formal accessibility ranking.

Table 1 identifies the design dimensions considered in Pangan Zone, including food-crop content, information hierarchy, accessibility-oriented features, and educational presentation. The subsequent evaluation focuses on the questionnaire findings, the implemented interface, and the usability test reported in Sections 2 and 3.

2. Methods

2.1. Research Approach

This study uses a UCD-based design and evaluation approach with descriptive quantitative analysis of questionnaire and usability data. UCD provides the governing principle that design decisions should be based on an explicit understanding of users and evaluated iteratively (ISO, 2019). The five operational stages shown in Figure 1, Empathize, Define, Ideate, Prototype, and Test, are used as a practical design cycle within that UCD orientation rather than being presented as the formal stage names of ISO 9241-210. Iterative prototyping and early usability evaluation are also consistent with established HCI practice (Nielsen, 1994; Norman, 2013).

The stages are linked to specific study outputs. Empathize collects user characteristics, digital-literacy information, accessibility needs, and presentation preferences. Define converts these observations into design requirements, including simple navigation, categorized content, readable text, and sufficient contrast. Ideate develops the information architecture and candidate page structures. Prototype converts these decisions from low-fidelity wireframes into a high-fidelity interactive interface. Test evaluates whether participants can complete representative tasks and how they perceive overall usability. This mapping makes the relationship between user evidence and interface decisions explicit rather than treating the five stages as independent activities.

2.2. Data Collection

User requirements were collected through a structured Google Form questionnaire completed by 127 potential users, including students, educators, agricultural users, office workers, and members of the general public. Section A recorded demographic characteristics, digital-literacy level, and accessibility needs. Section B measured preferences for information presentation and navigation using five ordered categories: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree. The questionnaire was used for requirements elicitation rather than population-level hypothesis testing. Consent for participation in the questionnaire and usability



Fig. 1. Research Flow Diagram of Pangan Zone Development

evaluation was obtained through Google Form before data collection. Participant records were anonymized for analysis, and the manuscript reports only aggregate counts, percentages, means, and standard deviations. Because no probability sampling frame is specified, the questionnaire results are interpreted descriptively and are not generalized statistically to

a wider population.

2.3. Data Analysis and Metrics

Questionnaire responses were summarized with frequencies, percentages, and weighted means. Let N denote the number of respondents, n_i the frequency in response category i , and P_i the corresponding percentage. For a five-point preference item, $i = 1, \dots, 5$ also represents the assigned score from Strongly Disagree to Strongly Agree, and M denotes the weighted mean. Category percentages and weighted means were calculated using Eqs. (1) and (2), respectively.

$$P_i = \frac{n_i}{N} \times 100\% \quad (1)$$

$$M = \frac{\sum_{i=1}^5 i n_i}{N} \quad (2)$$

For usability testing, let A denote the total number of task attempts, S the number of successful attempts, and K the number of tasks. Equation (3) gives the overall task-completion rate R . For task i , t_i , e_i , and d_i denote the task-level mean completion time, observed errors, and difficulty rating, respectively. Equation (4) gives an overall mean by substituting x_i with t_i , e_i , or d_i .

$$R = \frac{S}{A} \times 100\% \quad (3)$$

$$\bar{x} = \frac{\sum_{i=1}^K x_i}{K} \quad (4)$$

Perceived usability was measured with the ten-item System Usability Scale (SUS). For one participant, q_i is the 1-to-5 response to item i and c_i is its adjusted score. Equation (5) applies the standard positive-item and reverse-scored transformations, and Eq. (6) converts the sum of the ten adjusted values to the 0-to-100 SUS scale (Brooke, 1996; Lewis, 2018).

$$c_i = \begin{cases} q_i - 1 & i \in \{1, 3, 5, 7, 9\} \\ 5 - q_i & i \in \{2, 4, 6, 8, 10\} \end{cases} \quad (5)$$

$$SUS = 2.5 \sum_{i=1}^{10} c_i \quad (6)$$

The standard procedure calculates SUS for each participant and then averages the participant scores. Because Eqs. (5) and (6) are linear, the same mean can also be reconstructed from unrounded item means. When the item means have already been rounded, as in Table 7, the reconstructed value is approximate (Bangor et al., 2009; Sauro & Lewis, 2016).

$$s = \frac{v}{255} \quad (7)$$

$$f(s) = \begin{cases} \frac{s}{12.92} & s \leq 0.04045 \\ \frac{s + 0.055^{2.4}}{1.055} & s > 0.04045 \end{cases} \quad (8)$$

$$L = 0.2126 f(r) + 0.7152 f(g) + 0.0722 f(b) \quad (9)$$

$$CR = \frac{L_1 + 0.05}{L_2 + 0.05}, \quad L_1 \geq L_2 \quad (10)$$

Color contrast was evaluated with the WCAG relative-luminance method. An 8-bit RGB channel value is first normalized with Eq. (7), then linearized with Eq. (8). Equation (9) combines the linearized red, green, and blue channels into relative luminance, and Eq. (10) gives the contrast ratio between the lighter and darker colors (W3C, 2018, 2023).

For normal text, WCAG Level AA requires a contrast ratio of at least 4.5:1. These equations evaluate individual foreground-background color pairs; they do not establish complete WCAG conformance for an interface.

2.4. Design and Testing Procedure

The design process moved from low-fidelity wireframes to a high-fidelity prototype. WCAG 2.1 Level AA was used as a design target for relevant interface decisions, including text contrast, resize-friendly typography, keyboard-oriented navigation, alternative text and semantic structure, and clear page hierarchy (W3C, 2018). The final usability evaluation involved 30 participants, including three participants classified as having accessibility needs. Each participant attempted the five tasks listed in Table 6. The following measures were recorded during the evaluation:

1. Task completion: whether the participant completed the assigned target action.
2. Task completion time: elapsed time for the task, reported in seconds.
3. Task errors: the number of observed errors recorded during task performance.
4. Task difficulty: the participant rating on the 1-to-5 scale reported in Table 6.
5. System Usability Scale (SUS): the ten standard item responses scored with Eqs. (5) and (6) (Brooke, 1996; Lewis, 2018).

Table 5 describes the usability-test sample, Table 6 reports task-level outcomes, and Table 7 reports SUS item means and standard deviations. The study uses these measures descriptively; no baseline interface or control condition was tested.

3. Results

3.1. User Research Findings

The respondent profile ($N = 127$) is summarized in Table 2. Percentages were calculated with Eq. (1) and rounded to one decimal place. For example, the student category contains 52 respondents, so the corresponding percentage is:

$$P_i = \frac{52}{127} \times 100\% = 40.9\% \quad (11)$$

Students were the largest occupation group, accounting for 52 respondents (40.9%), while intermediate digital literacy was reported by 76 respondents (59.8%). Twenty-four respondents (18.9%) reported visual impairment, motor limitations, or a need for cognitive support, while 103 respondents (81.1%) reported no special accessibility need. These characteristics describe the tested sample and provide context for the interface requirements.

Table 3 summarizes the six information-presentation

Table 2. Respondent Demographics

Characteristic	Category	Frequency (n)	Percentage (%)
Age Group	18-25 years	48	37.8%
	26-35 years	42	33.1%
	36-45 years	23	18.1%
	46-60 years	14	11.0%
Education Level	High School	28	22.0%
	Undergraduate	61	48.0%
	Graduate	32	25.2%
	Others	6	4.7%
Occupation	Student	52	40.9%
	Educator/Teacher	23	18.1%
	Office Worker	31	24.4%
	Farmer/Agriculture	12	9.4%
	Others	9	7.1%
Digital Literacy	Beginner	18	14.2%
	Intermediate	76	59.8%
	Advanced	33	26.0%
Accessibility Needs	No special needs	103	81.1%
	Visual impairment	12	9.4%
	Motor limitations	7	5.5%
	Cognitive support needed	5	3.9%

Table 3. User Preferences for Information Presentation (n=127)

Preference	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean Score
Prefer visual content (images, icons) over text-heavy pages	2 (1.6%)	5 (3.9%)	12(9.4%)	58(45.7%)	50(39.4%)	4.17
Need simple and consistent navigation	1 (0.8%)	3 (2.4%)	8 (6.3%)	47(37.0%)	68(53.5%)	4.40
Require adjustable text size for readability	3 (2.4%)	7 (5.5%)	23(18.1%)	52(40.9%)	42(33.1%)	3.97
Prefer categorized information over single-page layout	2 (1.6%)	4 (3.1%)	15(11.8%)	61(48.0%)	45(35.5%)	4.13
Need clear breadcrumb navigation	4 (3.1%)	9 (7.1%)	28(22.0%)	54(42.5%)	32(25.2%)	3.80
Require high contrast colors for accessibility	3 (2.4%)	11(8.7%)	34(26.8%)	48(37.8%)	31(24.4%)	3.73

preferences. The weighted means were calculated with Eq. (2). Simple and consistent navigation received the highest mean (4.40), followed by visual content rather than text-heavy pages (4.17), categorized information (4.13), adjustable text size (3.97), breadcrumb navigation (3.80), and high-contrast colors (3.73).

For the simple-navigation item, the response counts from Strongly Disagree to Strongly Agree are 1, 3, 8, 47, and 68. Substitution into Eq. (2) gives:

$$M = \frac{(1 \times 1) + (2 \times 3) + (3 \times 8) + (4 \times 47) + (5 \times 68)}{127} \quad (11)$$

$$= 4.40$$

These results were translated into interface requirements: simple navigation informed the shallow page hierarchy, visual preference informed the card-based list design, categorization informed the Home > Category > List > Detail structure, and readability preferences informed typography and contrast decisions.

3.2. User Interface Design

Based on the wireframes and user feedback, the final high-fidelity interface was developed with an emphasis on clear information structure and accessibility-oriented presentation. The platform structure follows a hierarchical organization to ensure ease of navigation, as illustrated in Fig. 2.

Color System and Accessibility. Readability and contrast were identified as design considerations in the questionnaire (Table 3). The prototype therefore uses a limited palette with stable roles for brand elements, accents, backgrounds, and text, as listed in Table 4. WCAG contrast is a property of a specific foreground-background pair, so selected text-background pairs were checked using Eqs. (7)-(10).

As a worked example, the Charcoal body-text color (#333333) is paired with the Cream White background (#FAF7F2). Their RGB values are (51, 51, 51) and (250, 247, 242). Applying Eqs. (7)-(9) gives relative luminances of 0.0331 for the

Pangan Zone - Website Sitemap

Information Architecture & Navigation Structure

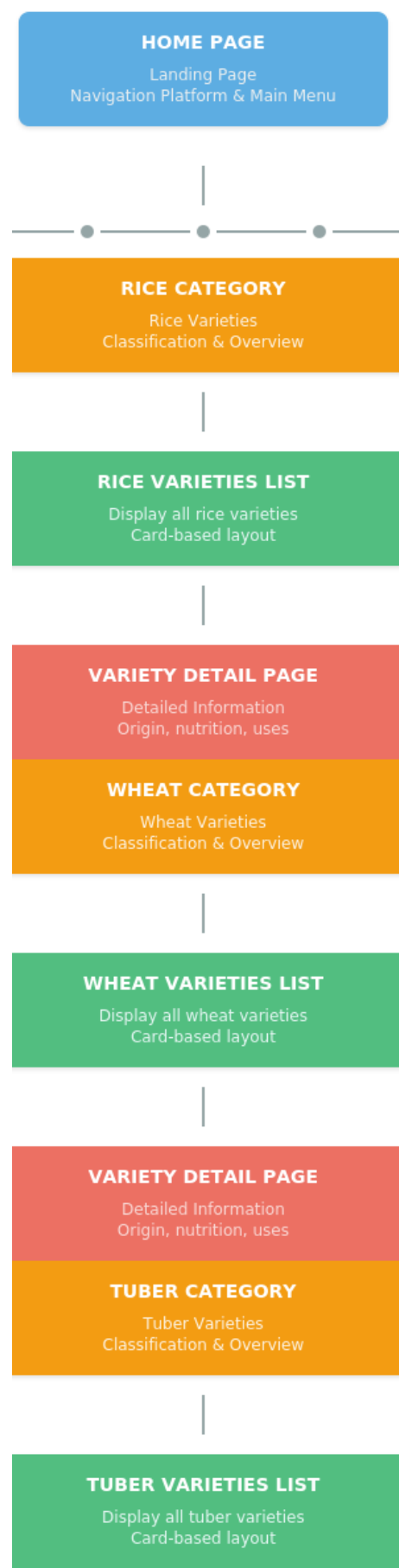


Table 4. Primary Color Palette

Color Name	Hex Code	RGB Values	Usage
Primary Brand - Earth Brown	#8B4513	RGB(139, 69, 19)	Header, primary buttons, emphasis elements
Secondary - Harvest Gold	#F5A623	RGB(245, 166, 35)	Accent elements, category highlights, CTA buttons
Tertiary - Forest Green	#2D5016	RGB(45, 80, 22)	Success messages, agricultural icons
Background - Cream White	#FAF7F2	RGB(250, 247, 242)	Main background, card backgrounds
Text Primary - Charcoal	#333333	RGB(51, 51, 51)	Body text, headings, primary content
Text Secondary - Slate Gray	#666666	RGB(102, 102, 102)	Secondary text, captions, metadata

text and 0.9326 for the background. Then (10) gives results as follows:

$$CR = \frac{0.9326 + 0.05}{0.0331 + 0.05} = 11.82 : 1 \tag{12}$$

The 11.82:1 ratio exceeds the WCAG 2.1 Level AA minimum of 4.5:1 for normal text. White text (#FFFFFF) against Harvest Gold (#F5A623), by contrast, produces 2.03:1 and does not meet the same threshold. These calculations verify only the stated color pairs and do not constitute a complete WCAG conformance audit.

Homepage and Categorization. The homepage serves as the central hub and provides distinct entry points for the three main crop categories: Rice, Wheat, and Tubers (Fig. 3). This structure implements the questionnaire preference for simple and consistent navigation (mean 4.40). The same hierarchy is then used across categories so that the navigation path remains predictable.

Variety List Interface. The variety-list page uses a responsive card grid. Each card combines a crop image, origin cue, and short description. This choice implements the questionnaire preference for visual content over text-heavy presentation (mean 4.17). Figures 4 to 6 show the same layout pattern for rice, wheat, and tubers. Reusing the same component structure reduces variation between categories and supports recognition of where the same types of information are located (Norman, 2013).

Detail Page and Accessibility Features. The variety-detail page separates nutrition, usage, and other information into repeated content blocks and retains breadcrumb navigation at the top of the page. This design corresponds to the questionnaire preferences for categorized information (mean 4.13) and breadcrumb navigation (mean 3.80). Figures 7 to 9 show the same structure across crop types. Headings, spatial grouping, color, and text labels are used together so that meaning does not depend on color alone. The breadcrumb provides an explicit location cue within the Home > Category > List > Detail hierarchy, while the repeated block structure keeps the information location consistent across varieties (W3C, 2018).

Fig. 2. Information Architecture (Sitemap) of Pangan Zone

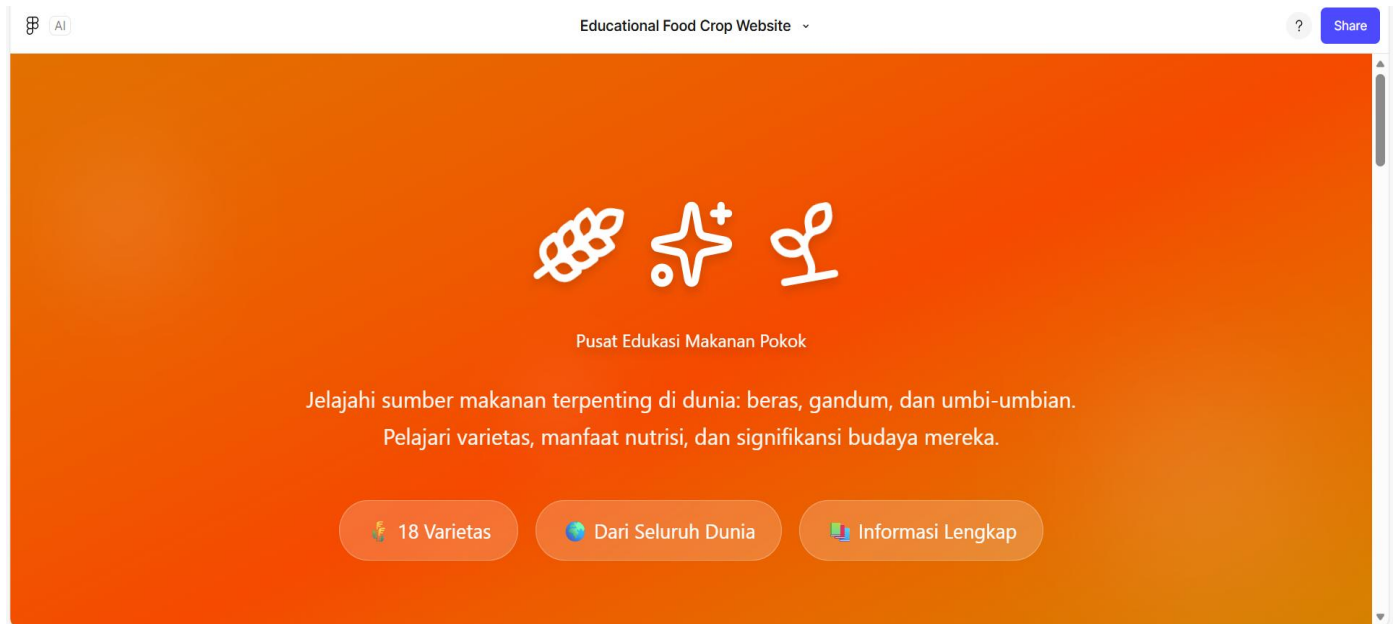


Fig. 3. Home Page UI

Table 5. Usability Testing Participants (n=30)

User Group	Number of Participants	Percentage
Students (18-25 years)	12	40.0%
General public (26-45 years)	10	33.3%
Educators/Agricultural professionals	5	16.7%
Users with accessibility needs	3	10.0%
Total	30	100.0%

3.3. Usability Testing Results

The usability test involved 30 participants, whose distribution is shown in Table 5. Each participant attempted the five tasks listed in Table 6, which reports success rate, completion time, observed errors, and difficulty for each task.

Across 30 participants and five tasks, the test contains 150 task attempts. The success counts in Table 6 sum to 146. Using Eq. (3), the overall task-completion rate is:

$$R = \frac{146}{150} \times 100\% = 97.3\%$$

Task-level success ranges from 93.3% for the search task to 100% for browsing the Tuber category and returning to the home page. Applying Eq. (4) separately to the five task-level means gives an overall mean completion time of 17.7 seconds, 0.2 observed errors, and a difficulty rating of 1.3 on the 1-to-5 scale.

Table 7 reports the mean response and standard deviation for each of the ten SUS items across the 30 participants. These item means allow the aggregate score to be reconstructed with Eqs. (5) and (6).

Applying Eq. (5) to the ten displayed item means gives adjusted values of 3.2, 3.5, 3.5, 3.4, 3.3, 3.6, 3.6, 3.7, 3.4, and 3.5. Their sum is 34.7. Substitution into Eq. (6) gives:

$$SUS \approx 2.5 \times 34.7 = 86.75 \approx 86.8$$

The reconstructed SUS score is approximately 86.8. It is approximate because Table 7 reports item means rounded to one decimal place; participant-level scoring from the unrounded responses is the preferred procedure. Positively worded items have mean responses from 4.2 to 4.6, while negatively worded items have means from 1.3 to 1.6.

4. Discussion

4.1. Usability of the UCD-Based Prototype

The usability results show that participants completed the tested tasks with high success and low reported difficulty. Task success ranged from 93.3% to 100%, overall completion was 146 of 150 attempts (97.3%), and the mean difficulty rating across the five tasks was 1.3. The SUS value reconstructed from the Table 7 item means was approximately 86.8. These findings support the usability of the prototype for the tested scenarios. Because the study did not include a pre-design baseline or control interface, they do not establish that UCD or any single design feature caused the observed performance (ISO, 2018; Nielsen, 1994).

The SWOT analysis in Table 8 is used as an interpretive summary of design-stage observations and user feedback. It is not an independent statistical analysis. Strengths and weaknesses therefore describe the prototype and its current evaluation scope, while opportunities and threats describe plausible implementation conditions that would need separate investigation in future work.

Table 8 identifies the clear content structure and accessibility-oriented design as current strengths, while low digital literacy and the need for continuing content maintenance remain practical constraints. The usability data

Table 6. Task Completion Analysis

Task	Success Rate	Average Time (seconds)	Average Errors	Difficulty Rating (1-5)
Task 1: Navigate to Basmati Rice	96.7% (29/30)	24.3	0.3	1.4
Task 2: Use search feature	93.3% (28/30)	18.7	0.5	1.6
Task 3: Browse Tuber category	100% (30/30)	21.5	0.1	1.2
Task 4: Return to home page	100% (30/30)	8.2	0.0	1.1
Task 5: Access nutritional info	96.7% (29/30)	15.8	0.2	1.3
Overall Average	97.3%	17.7	0.2	1.3

Table 7. SUS Item Response Summary (n=30)

SUS Item	Mean Score	Std. Dev
1. I think I would like to use this system frequently	4.2	0.7
2. I found the system unnecessarily complex (R)	1.5	0.6
3. I thought the system was easy to use	4.5	0.6
4. I would need support to use this system (R)	1.6	0.7
5. The functions in this system were well integrated	4.3	0.6
6. There was too much inconsistency in this system (R)	1.4	0.5
7. Most people would learn this system very quickly	4.6	0.5
8. I found the system very cumbersome to use (R)	1.3	0.5
9. I felt very confident using the system	4.4	0.6
10. I needed to learn a lot before using this system (R)	1.5	0.6

partly address the navigation concern because the tested tasks had high completion rates, but the present evaluation does not establish long-term adoption, learning outcomes, or content-retention effects.

4.2. Accessibility interpretation

Accessibility was treated as a general quality requirement rather than a feature intended only for a disability subgroup. WCAG guidance notes that accessible content can also improve usability for older users and users operating under different situational constraints (W3C, 2018). At the same time, empirical accessibility cannot be inferred from guideline-oriented design alone. Studies of blind web users show that guideline coverage and real user problems do not always match, which supports combining standards with task-

Table 8. SWOT Analysis of Pangan Zone Platform

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> Clear content structure with three distinct categories Strong focus on accessibility from the design phase Visual-heavy approach aligns with user preferences Simple navigation structure reduces cognitive load 	<ul style="list-style-type: none"> Limited awareness of food crop diversity among target users Potential technical challenges for users with low digital literacy (14.2%) Content depth may vary across different crop varieties Requires continuous content updates to maintain relevance
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> Growing interest in food security and nutrition education Lack of integrated food education platforms in Indonesian context Potential for integration with agricultural curricula Expansion possibilities to include more crop categories Collaboration opportunities with agricultural institutions 	<ul style="list-style-type: none"> Competition from general educational platforms User retention challenges if content is not regularly updated Potential accessibility barriers if design principles are not consistently maintained Language barriers for non-Indonesian speakers

based evaluation (Power et al., 2012). In this study, only three usability participants were classified as having accessibility needs, so the results are not sufficient for disability-specific generalization. The stronger claim supported here is that accessibility requirements were integrated into the design process and evaluated within a mixed user sample (Lazar et al., 2015).

4.3. Visual-first information presentation

The questionnaire showed a preference for visual content

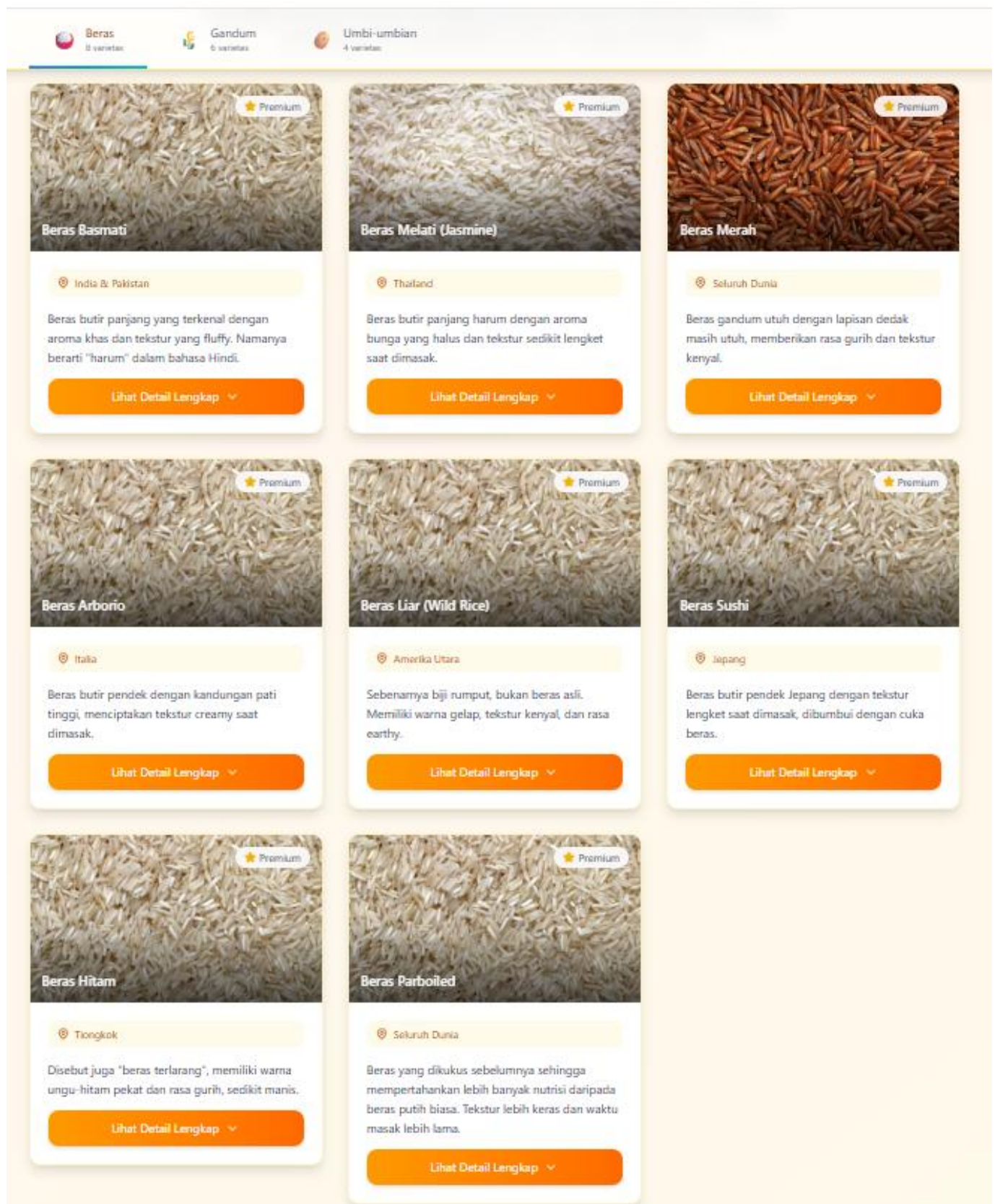


Fig. 4. Rice Variety List Page

over text-heavy pages (mean 4.17), which provided an empirical basis for the card-based interface. Dual-coding and picture-superiority research provides a theoretical rationale for combining images and verbal labels (Paivio, 1986), but the present study did not conduct a controlled memory,

recognition, or learning-retention experiment. The result therefore supports user preference for the visual-first presentation and successful task use of that interface, not a causal claim that the cards improve learning retention.

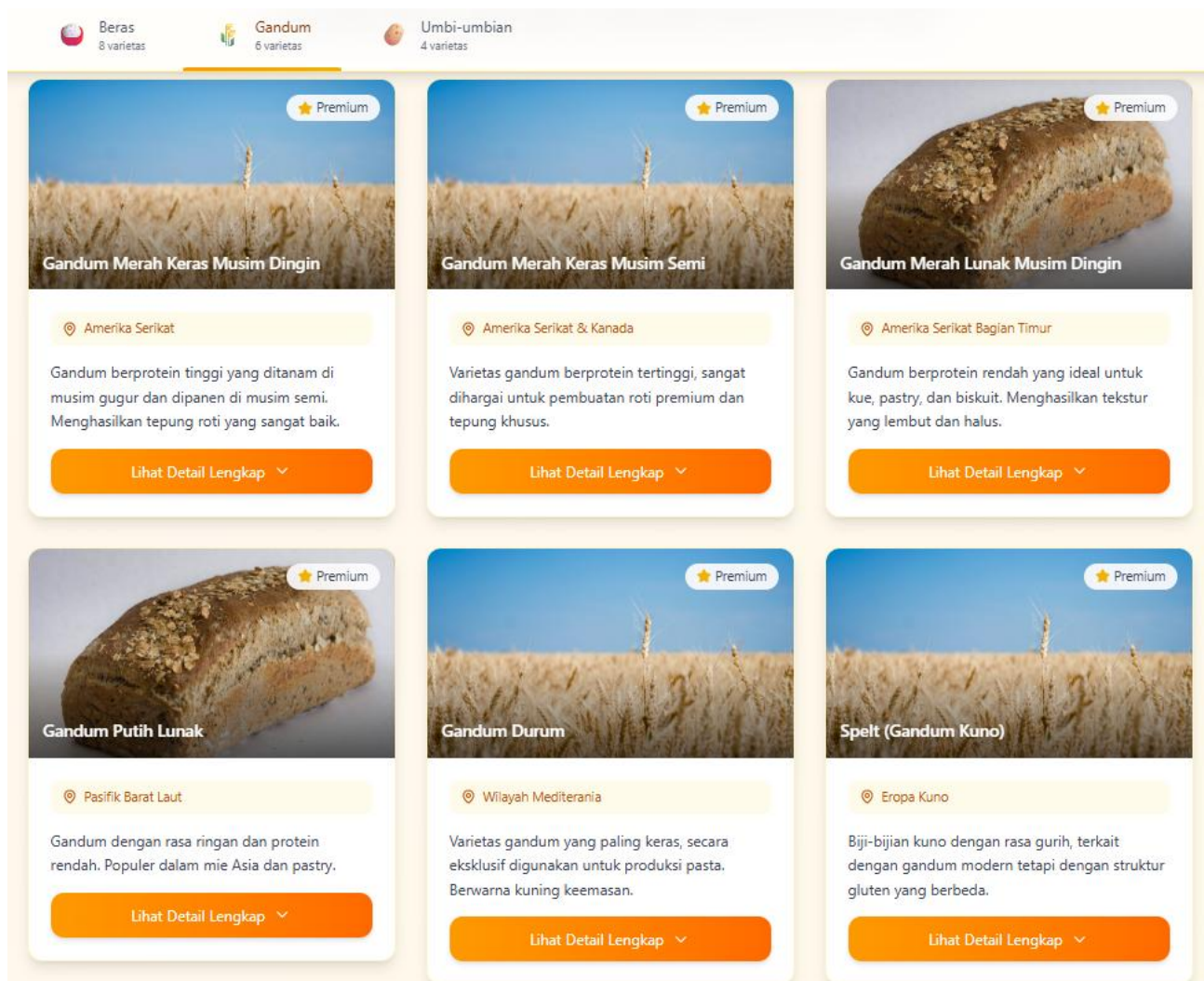


Fig. 5. Wheat Variety List Page

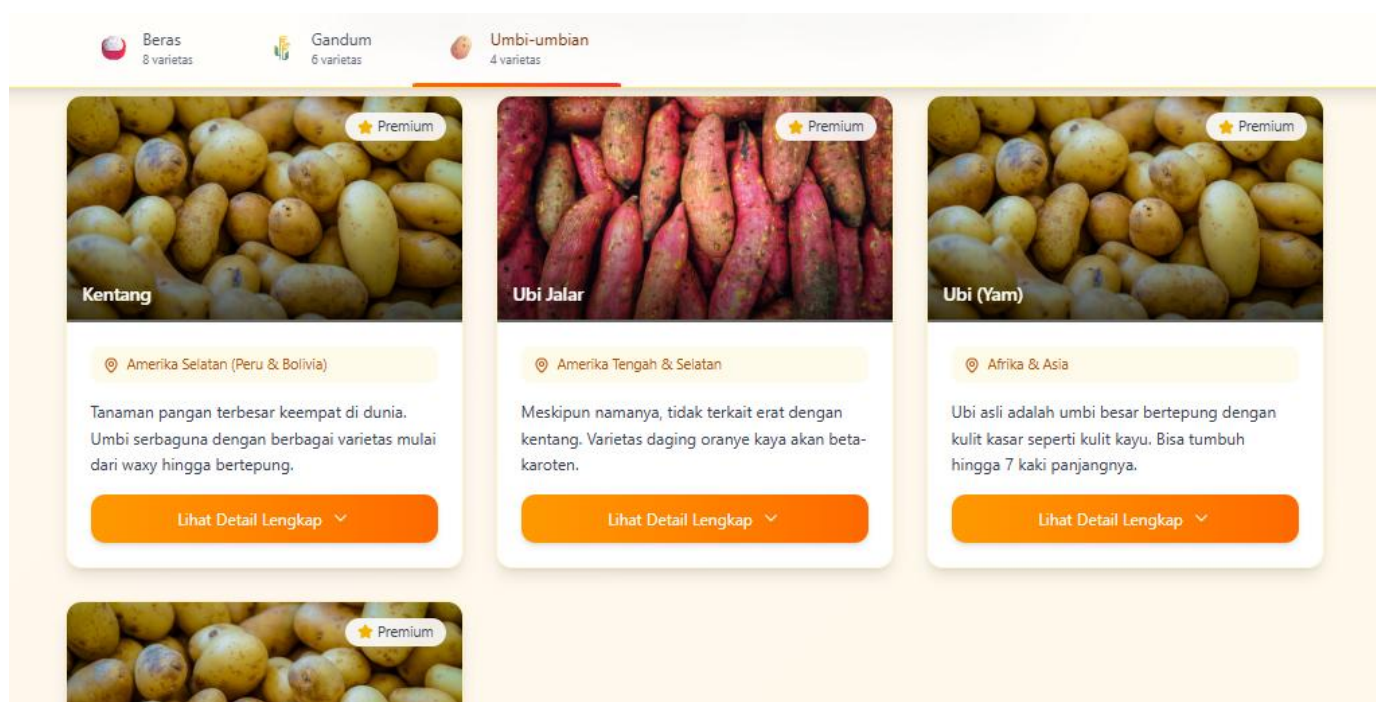


Fig. 6. Tuber Variety List Page

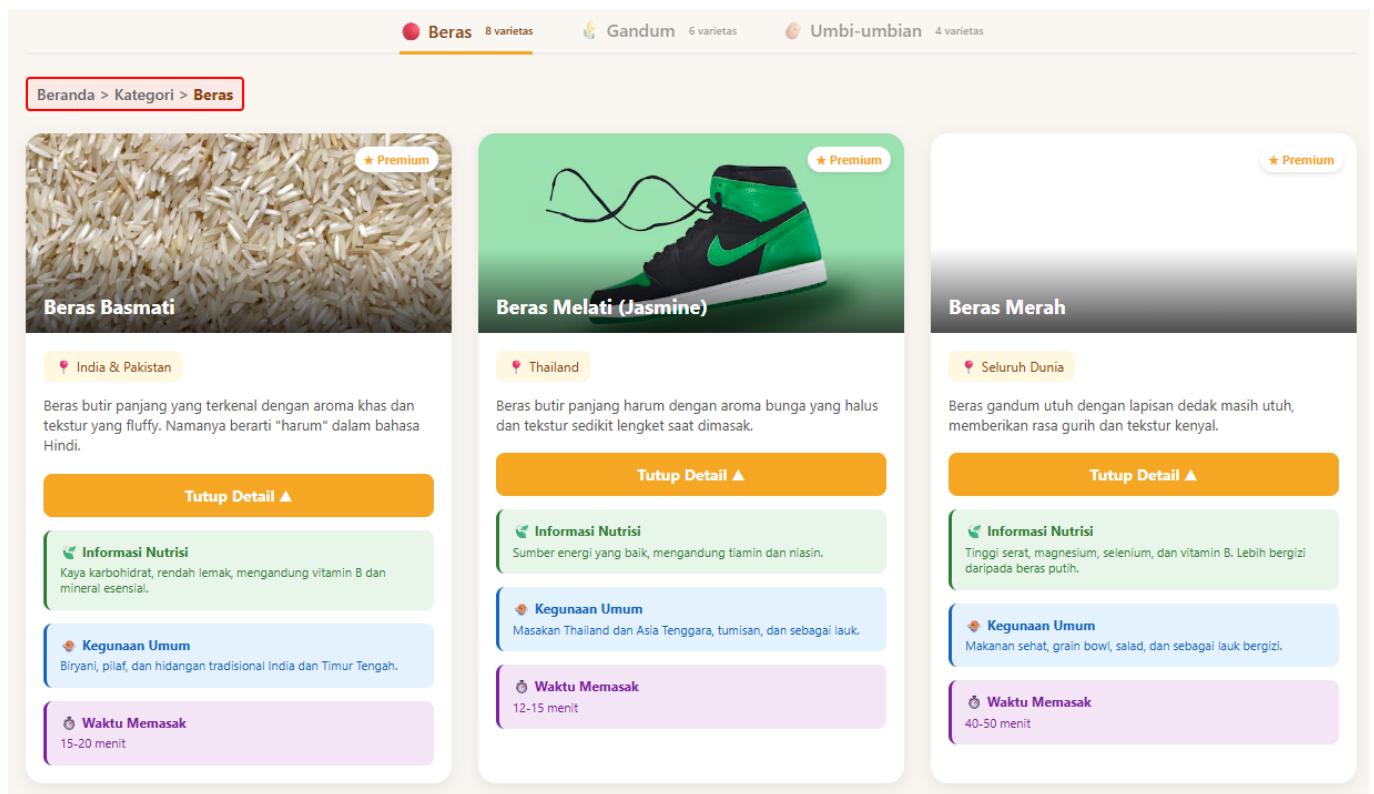


Fig. 7. Rice Variety Detail Interface

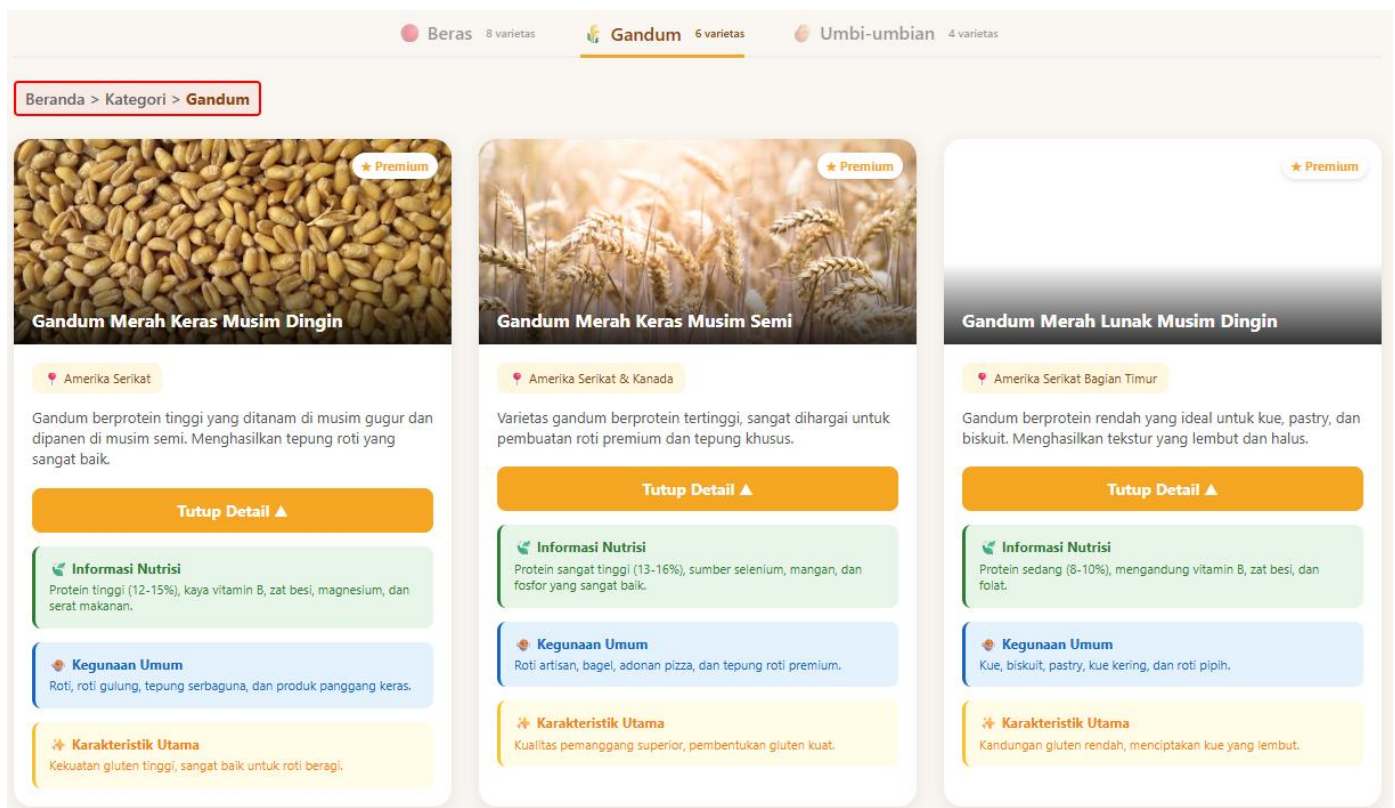


Fig. 8. Wheat Variety Detail Interface

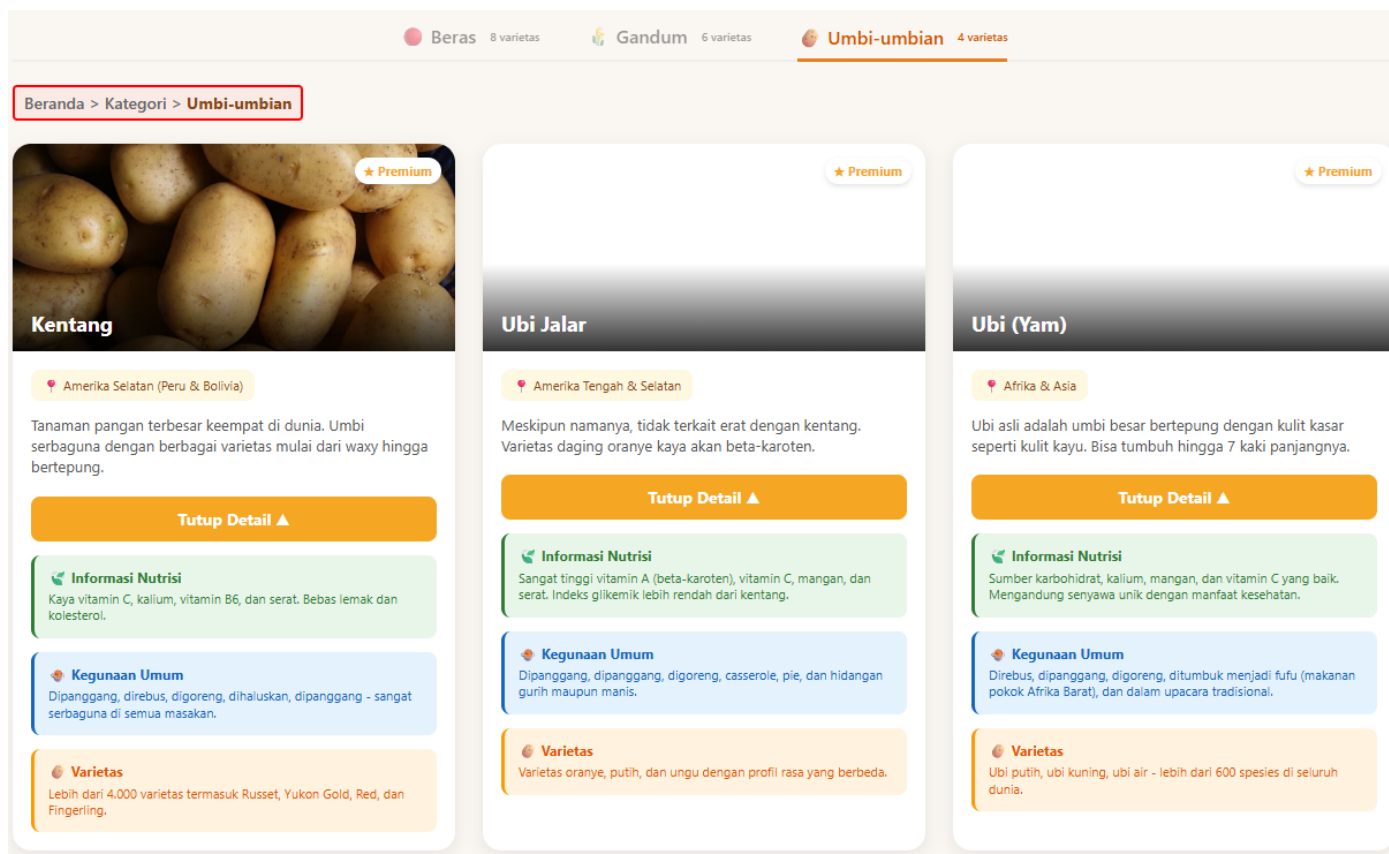


Fig. 9. Tuber Variety Detail Interface

4.4. Limitations

This study has several limitations. The questionnaire and usability data are descriptive and do not support population-level inference because no probability sampling frame is specified. The usability test included 30 participants, with only three participants classified as having accessibility needs, so disability-specific conclusions remain limited. WCAG 2.1 was used as a design target, and selected color pairs were calculated explicitly, but a complete criterion-by-criterion conformance audit was not reported. The study also lacks a baseline or control interface, so causal improvement cannot be assigned to UCD, visual cards, contrast, or any single feature. Table 1 is an exploratory feature-positioning matrix rather than a standardized accessibility comparison. These limitations define the scope of the conclusions.

5. Conclusion

Pangan Zone demonstrates a traceable process for translating user requirements into an accessibility-oriented food-education interface. Questionnaire results from 127 users identified simple navigation, visual presentation, categorization, adjustable text, and contrast as relevant design priorities. In usability testing, 146 of 150 task attempts were successful, giving an overall completion rate of 97.3%, and the SUS item means in Table 7 yielded an approximate score of 86.8

using the standard scoring procedure. For the documented Charcoal text and Cream White background pair, the WCAG contrast calculation produced 11.82:1, above the 4.5:1 Level AA threshold for normal text. The evidence supports high usability for the tested prototype and documents how user requirements informed the interface. It does not establish complete WCAG conformance, causal superiority over another interface, or disability-specific effectiveness beyond the small accessibility subgroup.

Future work may extend the current evaluation with a complete WCAG audit, a larger accessibility-focused participant sample, additional crop categories, and a controlled comparison with a baseline interface. Such work would allow separate testing of whether specific design choices affect efficiency, comprehension, accessibility outcomes, or learning, whereas the present study is limited to the prototype and measurements reported here.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have

appeared to influence the work reported in this paper.

Authors' Contributions

Rasmila: Conceptualization, Methodology, Supervision, Writing – review & editing. Ulung Wira Yuda: Investigation, Visualization, Writing – original draft. Arek Satria: Software, Validation, Visualization. Ahmad Juan Syahwali: Data curation, Formal analysis. Bagus Piwari: Resources, Software. Muhammad Hawari Mukram: Project administration, Resources.

Declaration of Generative AI in Scientific Writing

During the preparation of this work, the authors used generative AI tools for language refinement and grammar checking purposes only. The authors reviewed and edited the output and take full responsibility for the content of this publication.

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