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Data Article

Data from a survey of coffee cultivation in lowland and highland areas to support agriculture during climate change

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ABSTRACT

This survey aimed to acquire and generate significant information on coffee cultivation in high and low elevations to support agriculture during climate change. This survey dataset helps understand coffee cultivation in highland and lowland areas with diverse climates and environmental conditions for coffee researchers to use this data to improve

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cultivation and production techniques. In the business scope, this dataset provides a critical vision on the value proposition of the coffee business to maintain conservation and wealth creation of the coffee chain. Similarly, coffee chains can use this data as an example to assess sustainability and carbon literacy. The structured interviews and field trips were conducted at coffee plantations in southern and northern Thailand. The transcript results were manually coded for thematic analysis. This dataset offers insights into anthropogenic plant migration and plant distribution for researchers and academics to use as a valuable resource and good reference in agricultural and biodiversity research. Today, agriculture faces many challenges, such as climate change, water shortage, and improper land management. This information on coffee cultivation at high and low altitudes may help others grow crops in ever-changing climates.

Specifications Table

Subject	Ecological Modelling; Environmental Science: Climatology; Management, Monitoring; Pollution; Waste Management and Disposal;
Specific subject area	Survey, Plant Migration, Non-invasive Plant, Plant Adaptation, Native Plant.
Data format	Raw, Filtered.
Type of data	Table, Survey Data, Figure.
Data collection	Data collection is based on the hypothesis that lowland coffee cultivation provides a unique dataset that exemplifies agriculture during climate change. The data were collected through face-to-face surveys and field trips to coffee plantations in lowland and highland areas from October - November 2023. Data were measured on coffee growing techniques in both lowland and highland areas.
Data source location	Institution: Chiang Mai University, Chiang Mai, Thailand. Lowland coffee cultivation data were collected from Hua Hin district, a seaside resort on the Gulf of Thailand, in the coastal part of Prachuap Khiri Khan province, Southern Thailand. Highland coffee cultivation data were collected from Mae Suai district in the western part of Chiang Rai province, Northern Thailand.
Data accessibility	Repository name: Mendeley Data. Data identification number: https://doi.org/10.17632/fvkp8n8bxt.1 Direct URL to data: https://data.mendeley.com/datasets/fvkp8n8bxt/1 Instructions for accessing these data: The dataset contains images and Excel files for coffee cultivation in high and low elevations and is free to the public. It is mandatory to follow proper citation guidelines when using this dataset.

1. Value of the Data

- Information about coffee cultivation in high and low elevations is precious for future cultivation during climate change along with examples of successful adaptation of coffee trees in lowland areas. Researchers can use these data to replicate this study in other regions. This dataset provides insights into the geographic origins of coffee cultivation in highlands and lowlands with different climates and settings for coffee research to improve cultivation and production techniques.
- The dataset is available in English. This information can be reused as a guide for other researchers. To consider important factors in meeting the needs of a particular plant in plant adaptation studies. More importantly, this dataset provides a vital vision of the coffee busi-

ness's value proposition to maintain wealth creation and conservation of the coffee chain, and provides examples of assessments to raise the status of the coffee chain in terms of sustainability and carbon literacy.
- Public disclosure of these datasets, surveys, and data collection protocols will help other interested researchers in the fields of, crop management, agriculture, and agribusiness can: 1) more easily replicate and review our findings, 2) use these data as models to create another survey tailored to their studies, 3) allow other researchers to evaluate additional meta-analyses, and 4) conduct additional research using their perspectives, analytical methodologies, and research questions to generate new knowledge and findings.
- Dataset contains one of the earliest, newest, and best examples of lowland coffee cultivation involving the natural migration of plants by humans, sustainable economic and social indicators, and the benefits of cultivation techniques that support agriculture during climate change.
- Despite the small sample size compared to highland and lowland coffee cultivation. Our dataset is a valuable addition to modern ecological and agribusiness modelling. This is because there was no survey like our study. Subsequently, there is also a keyword search "Agriculture and Climate Change" on ScienceDirect on January 27, 2024. Search results revealed that research on this topic has increased rapidly since 2021. Hence, insights come from our qualitative data and our quantitative data, are therefore quite limited.
- For academics researching agriculture and climate change now and in the future. Our dataset will be a valuable resource and a good reference. The open datasets we present are therefore useful in supporting agriculture during climate change.

2. Background

Climate change will cause food shortages and land management. Due to changing weather and soil conditions, agricultural lands are unsuitable to produce food. The context behind our dataset is we believe that important information about successful crop management during climate change will open doors of opportunity for farming in an ever-changing climate that seems impossible. Theoretically, native plants (depend on altitudes, such as Coffea arabica) were brought from highlands of Ethiopia to Asia in tropical climates [1]; we normally plant them at similar heights, and/or build a greenhouse and simulate the climate to grow them [2,3]. However, if we can generate the key factors to meet the need for Coffea arabica development in a tropical region at different altitudes. As a result, this will support the adaptation process in Coffea arabica to develop towards climate change. Coffea arabica would later become a local plant in Asia and will not be an invasive plant that disrupts native plant life and ecosystems. In contrast, recent study has shown that the quality of coffee cups from chemical parameters varies according to the place of cultivation and the evaluation of raw Arabica coffee beans produced [3]. However, current research suggests that Arabica coffee can be grown in low-altitude areas using a bespoke cultivation system [4]. It can help resolve key factors in the development of Arabica coffee and maintain cup quality by keeping chemical parameters at a high evaluation level. Especially, the proposed dataset is built in this context against the methodological background of growing plants under a greenhouse and simulated climate conditions. Therefore, our current preliminary data set has clear advantages. Because it goes beyond the traditional technique of taking native plants and growing them in different geographic areas and weathers.

3. Data Description

In this article, a dataset describing coffee cultivation during climate change is presented. 110 images and 5 Excel spreadsheets were generated from surveys of coffee cultivation in lowland and highland areas. All images are original and have not been applied to image processing techniques to improve image quality and brightness. Photos were chosen based on three main

Fig. 1. Coffee cherries are grown in lowland (left) and highland (right) areas.

priorities: originality of quality and brightness of the image, comprehensive business and farm activities, and the environment in the coffee plantation. There were only 7 images that removed the business's branding. Fig. 1 uncovers the samples of coffee fruits (coffee cherries) grown near the coast and at high altitudes.

3.1. Raw data

Images technically documented coffee farm environments, coffee trees, and business activities. Excel spreadsheets were economics, transcripts, and discussion questions. Fig. 2 illustrates a folder structure of the coffee cultivation dataset. Furthermore, Table 1 depicts a brief description of the proposed dataset.

Excel spreadsheet named Economics.xlsx. It is a coded script that evaluates coffee farm production practices based on socio-economic factors. Transcripts.xlsx are also the encoded scripts that create tables from recorded audio files. Discussion-questions.xlsx are straightforward questions to use in a face-to-face interview.

3.2. Filtered data

The dataset was filtered according to the criteria of Wealth Creation and Sustainability: A Comparative Study of Coffee Growing in the Highlands and Lowlands. Entity relationship

Table 1
Brief description of the proposed dataset on data collection.

No.	Facts	Highland Coffee Cultivation	Lowland Coffee Cultivation
1	Survey period	November, 2023.	October, 2023.
2	Elevation	1051.7 m or 3450.4 feet	29.0 m or 95.1 feet
3	Climate	Sunny	Extremely Sunny
4	Temperature	23°C - 24°C	30°C - 33°C
5	Wind and Shadow	0-5 km/h, and most shadow	3-15 km/h, and less shadow
6	Original 24-bit image	JPG; 1280×720 px, 305-727 KB.	JPG; 1280×720 px, 215-803 KB.
7	Original sound	MPEG-4 Audio (M4A); 33.73 KB.	M4A; 38.85 KB.

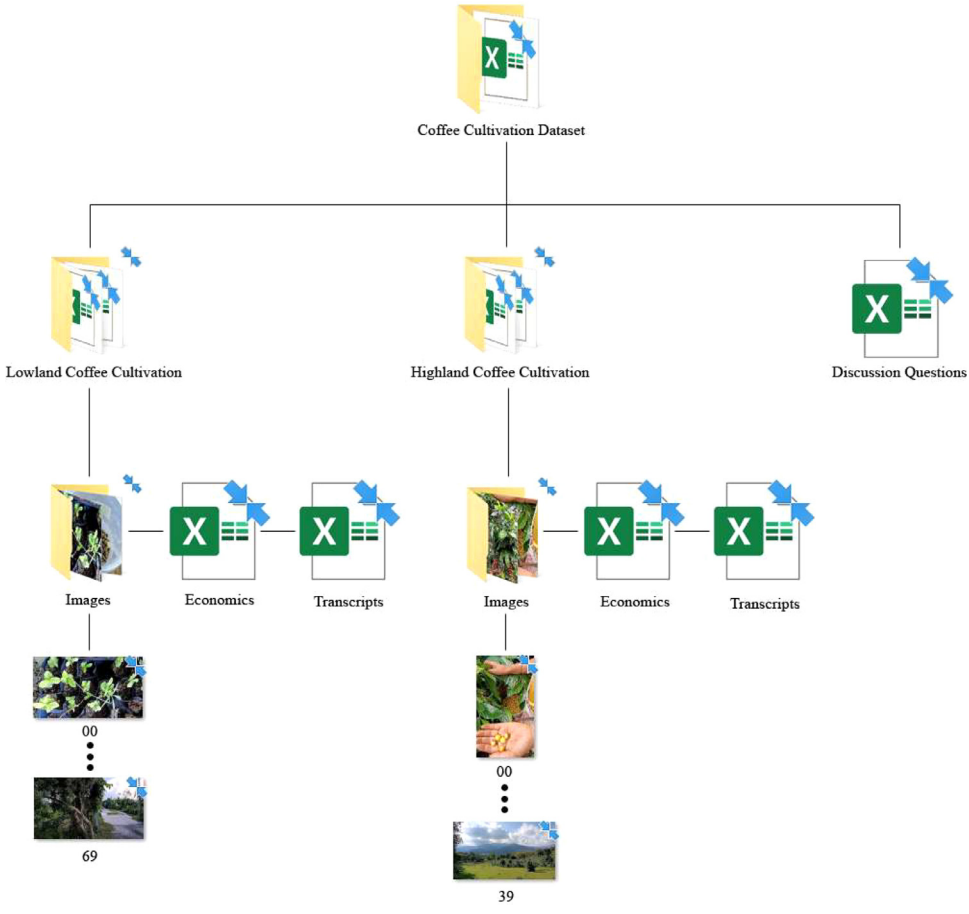

Fig. 2. Folder structure of the proposed dataset.

diagram (ERD) techniques were then used to model and design relationships in the data, as shown in Fig. 3.

4. Experimental Design, Materials and Methods

The survey design was based on our findings on digital agriculture for plant migration in climate change [4,5]. This survey examines how anthropogenic plant migrations can adapt to native plants during climate change. First, choose a specific type of plant. The coffee plant was selected, and the studies confirmed that elevation has greatly impacted coffee cultivation [6]. Coffee plantations are usually found in highland areas. Interestingly, an adaptation process of a coffee plant in lowland areas could provide a unique dataset to support farming during climate change. The surveys consisted of three parts: face-to-face interviews with the coffee farm owners, field trips to coffee plantations in lowland and highland areas, and evaluation of the circular economy, green economy, carbon footprint reduction, and digital agriculture for sustainable production practices of small and medium enterprises. A number of farmers in each area were interviewed. The transcripts were coded manually written on paper. Codes were elaborated

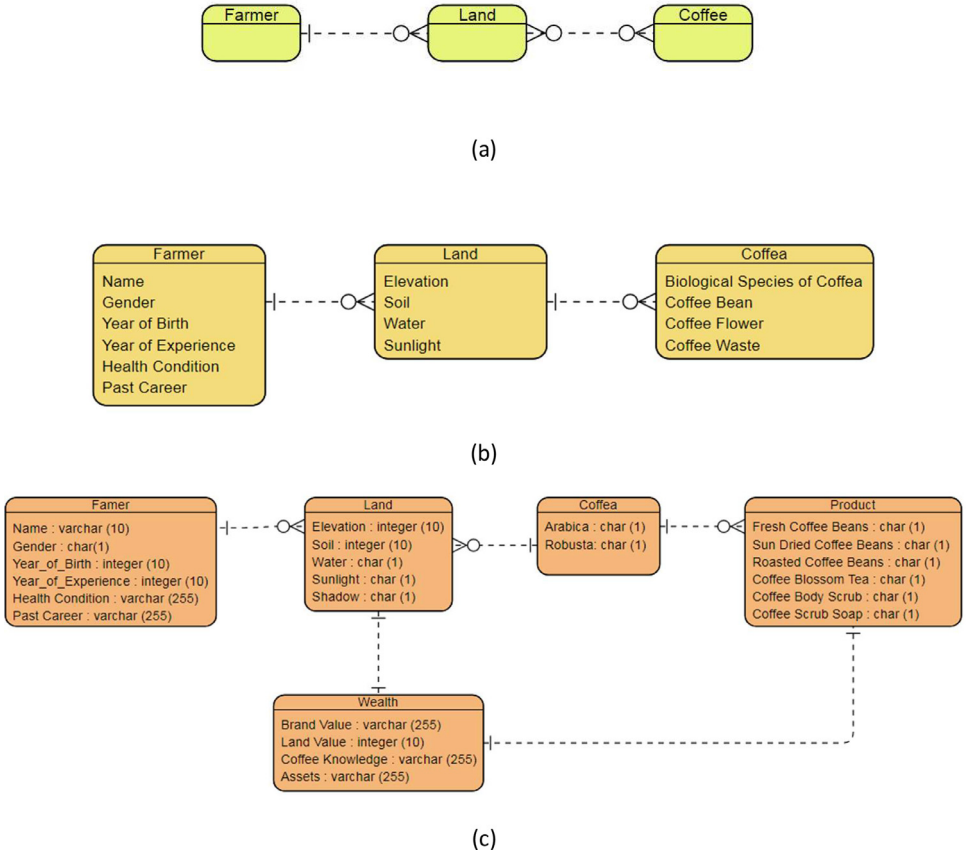

Fig. 3. Conceptual model (a), logical model (b), and physical model (c).

concerning coffee cultivation techniques (especially in the highlands and lowlands areas), environment and climate change (particularly the impact on coffee plantations and sustainability), and wealth creation and preservation (specially creating value and brands in agribusiness and management) for thematic analysis. Finally, the results of the analysis were correctly confirmed by the interviewees. The data collection protocol and methods were carried out according to our previous publication [7,8].

4.1. Face-to-face interviews

A face-to-face interview is a structured interview conducted by a skilled interviewer (TC) that uses a standardised interview protocol and methodology with a set of questions designed to record the participant's answers [5]. This interview technique allows the interviewer to ensure that participants have a genuine sense of their answers and accurate information in response to the direct discussion and designed a set of questions. Conversations were recorded using an electronic device and saved in M4A audio file format. Each conversation lasted about 40 minutes. Hence, these transcripts were manually coded and tabulated into an Excel spreadsheet in the Data Accessibility section. Face-to-face interviews are a fast and efficient method of gathering large amounts of information from a study population [8,9].

4.2. Field trips

The observer (TC) travelled by local buses and motorbikes to explore coffee plantations from October to November 2023 in Hua Hin district (lowland areas), Prachuap Khiri Khan Province, Southern Thailand, and Mae Suai district (highland areas), Chiang Rai Province, Northern Thailand. Each site visit takes approximately 2-3 hours. Coffee farm owners obtained consent before taking photographs of the farm and surrounding area. Photos are captured using the observer's mobile phone. Therefore, images are recorded based on present circumstances: coffee farm environments, a coffee plant, and business activities. The field trip protocol was carried out according to our previous publication [5,7]. Field trips are visits by observers to search for geographic evidence of coffee cultivation during climate change.

4.3. Economic and social evaluation

Coffee farms are small and medium-sized enterprises (SMEs). SMEs have been assessed for sustainable production practices including the circular economy, green economy, reducing carbon dioxide emissions, and digital agriculture. The assessment of sustainable production practices is based on criteria (economic model, symbol of sustainability, and definition of sustainability) in our previous publication [10]. Our research approach is the evaluation and use of sustainable, renewable, and natural materials. For example, SMEs' production and products are assessed using the criteria and definitions of sustainable packaging [10] and economic models [10,11] to achieve sustainability status. In addition, carbon footprint reduction is also mapped to carbon knowledge and carbon footprint components [12]. The carbon literacy of individuals in SMEs was assessed based on carbon knowledge [12] and carbon footprint literacy [12] to achieve the carbon literacy status. For example, individuals in SMEs were asked to describe their greenhouse gas (GHG) emissions. At least people in SMEs should explain correctly that using an electric kettle to boil water will emit less GHG emissions than using an electric oven or microwave. The practice of digital agriculture on coffee farms was assessed using the definition of digital agriculture contained in our current research article [4,5]. Therefore, the data in this section was generated, extracted, and filleted from information obtained from face-to-face interviews and field trips. Finally, we present an overall economic and social valuation for lowland and highland coffee farms.

Limitations

Limitations in the data generation of this dataset are: 1) respondents had limited knowledge about climate change, circular economy, green economy, and digital agriculture; 2) coffee growing locations in lowland areas are limited and relatively rare in Thailand, whilst coffee cultivation is found in many highland areas in Thailand, 3) It is the post-harvest period where surveys are conducted in lowland coffee plantations, and 4) This preliminary data is small because the data was measured using coffee growing techniques in both lowland and highland areas to normalise the data. Despite these limitations, this dataset is a unique example of crop cultivation during climate change.

Ethics Statement

Not applicable. The research did not involve human or animal subjects. The data is not collected from social media platforms. No ethical approval for this survey was required. This study used a non-experimental voluntary survey. The researchers ensured they adhered to all ethical considerations throughout the data collection process. The researchers obtained verbal consent

from the participants before conducting the surveys. The research was conducted in a setting where ethical approval was not mandatory for survey studies. Participants' identities are significantly protected as no personal information is sought.

Declaration of Competing Interests

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. The generative AI writing app is not used for writing.

Data Availability

Coffee Cultivation Dataset: Agriculture in Times of Climate Change (Original data) (Mendeley Data).

CRediT Author Statement

Thanapong Chaichana: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration, Funding acquisition; **Graham Reeve:** Validation, Investigation, Resources, Supervision, Writing – review & editing; **Pairach Piboonrungroj:** Validation, Investigation, Resources, Supervision, Writing – review & editing, Funding acquisition; **Jirapond Muangprathub:** Validation, Investigation, Resources, Supervision, Writing – review & editing; **Jadsada Kunno:** Supervision; **Mark Gregory Robson:** Supervision; **Brett Drury:** Validation, Investigation, Resources, Supervision, Writing – review & editing.

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