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Agricultural Productivity, Aging Farming Workforce, Sustainable Agriculture, and Well-Being: Household Survey Data From Central Thailand

Sylvia Szabo[1], *Chidchanok Apipoonyanon*[2], *Malay Pramanik*[3], *Takuji W. Tsusaka*[4]* and *Kevin Leeson*[5]

[1] Department of Social Welfare and Counselling, Dongguk University, Seoul, South Korea, [2] Department of Development and Sustainability, School of Environment, Resources and Development, Asian Institute of Technology (AIT), Pathum Thani, Thailand, [3] Tata Jamsetji School of Disaster Studies, Tata Institute of Social Sciences, Mumbai, India, [4] Organization for Advanced and Integrated Research, Kobe University, Kobe, Japan, [5] College of Sciences and Engineering, University of Tasmania, Hobart, TAS, Australia

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***Correspondence:**
Takuji W. Tsusaka
takuji.tsusaka@gmail.com

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INTRODUCTION

Agriculture and food systems are critical for maintaining food and nutrition security, driving economic development, alleviating poverty, and preserving ecological functions and services on national and international agendas (Whitfield et al., 2018). Furthermore, the system intersects all the United Nations' (UN) agenda items for sustainable development goals (SDGs), highlighting a growing global concern for, and sometimes contentious debate, over food system sustainability (FAO, 2019). In the twenty-first century, agricultural and food systems have faced a complex set of local and global challenges (Whitfield et al., 2018). This includes poor diets, poverty, and environmental concerns related to water, land scarcity, and climate change as some of the major global problems (Diama et al., 2020). In order to address these issues, we need to incorporate dietary and on-farm diversity with a holistic solution and smart food approach (Diama et al., 2020).

It is generally accepted that agriculture and food systems must adapt to uncertain and changing climatic conditions by building resilience and food system sustainability (Whitfield et al., 2018; Diama et al., 2020). This requires an understanding of the dynamics and interactions of the system and how changes in agricultural practices have been shaped through learning and social interactions (Whitfield, 2015); the innovative ways that human beings adapt within changing environments (Reij and Waters-Bayer, 2001); and the multifaceted priorities and value systems of individual consumers and producers (Lusk and Briggeman, 2019). Population structure plays a significant role in understanding the key factors affecting agricultural production, including its volume and future direction (Guancheng et al., 2015). Population structure and population change can also help to identify choices regarding agricultural inputs and crop selection. Accordingly, the movement of labor from rural to urban areas during the urbanization process brings changes in agricultural form, type and pattern in rural areas (Knodel and Chayovan, 2009).

In Thailand, a high rate of rural to urban migration and declining family size plays a significant role in influencing the involvement of aging populations in agricultural production. For example, aging people are considered likely to encourage greater use of machinery to address labor shortage issues. This is a direct result of an increasingly aging population and mobility of the rural population

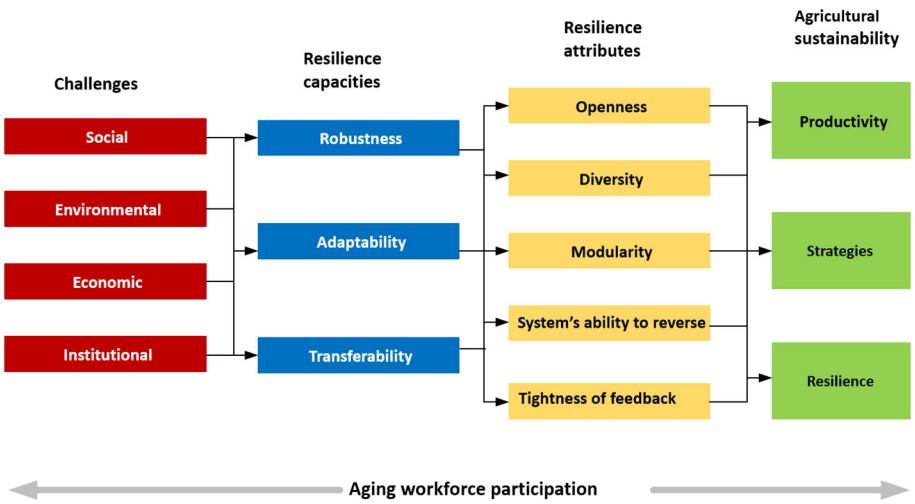

FIGURE 1 | Conceptual framework showing inter-linkages between different elements affecting the resiliency of agricultural systems.

TABLE 1 | Sample size estimated for the present survey.

District/Sub-district	Household (*N*)	Percentage (%)	Sample size (*n*)
Ban Sang District			
(1) Bang Taen	1,454	35	128
(2) Bang Pla Ra	833	20	73
Si Maha Phot District			
(3) Dong Krathong Yam	1,315	32	117
(4) Bang Kung	536	13	47
Total	4,138	100	365

Source: Department of Provincial Administration (2021).

in Thailand, which has reduced agricultural labor supplies and led to a rise in labor costs. Recent research by Rigg et al. (2020) has shown that young people who remain in rural areas gradually increase their earnings by undertaking non-farming work. Phongsiri et al. (2017) also indicate that young people are not interested in agriculture due to negative perceptions of low social status. This triggers significant involvement of the aging population in farming practices at every stage of production (e.g., pre-planting, growth-related, and post-growth), which can also reduce farming productivity (Seok et al., 2018).

Previous studies in Thailand have shown that aging farmers are often dependent on hired labor, which increases production costs (Formoso, 2016). In contrast, the aging rural population encourages restructuring of internal driving factors for agricultural production, including the use of technology, controlling farm accidents and minimizing health risks. Perceptions of these factors, albeit important, remain unexamined. The changes in labor input in the process of land-use transitions affect agricultural production in terms of labor quantity and quality. Therefore, the dominant influence is mainly through the supply of agricultural labor, agricultural land use, and the agricultural output structure. The effects of an aging population engagement are presented through large-scale production and socio-economic functions. **Figure 1** shows the conceptual framework of the present study, illustrating the inter-linkages between different elements which affect the resiliency of agricultural systems.

MATERIALS AND METHODS

Sample Selection

This study collected household data from four sub-districts in Prachinburi Province, Thailand (**Table 1**). First, we applied a multi-stage sampling strategy by separating total households into several groups of farm households, such as agriculture and aquaculture (**Figure 2**). In the first step, we adopted purposive sampling to maintain the homogeneous representation of every farming group, which included agricultural production (i.e., rain-fed and irrigated rice production) and pond aquaculture (fish and shrimp). We then applied the random sampling method to select farm households from every village with cooperating local fieldworkers at the Rice Center and the Bureau of Registration Administration (BORA) of the Department of Provincial Administration (DOPA).

To calculate the minimum suggested sample size, Yamane's method (Yamane, 1973) was used (see Equation 1). By doing this, we obtained a sample size of 365 households from the total population of 4,138 households in the province.

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

Where n indicates the minimum sample size, N refers to the total population, and e indicates the acceptable margin of error (0.05 or 5%).

The distribution of sampled households across Prachinburi province was determined using the following

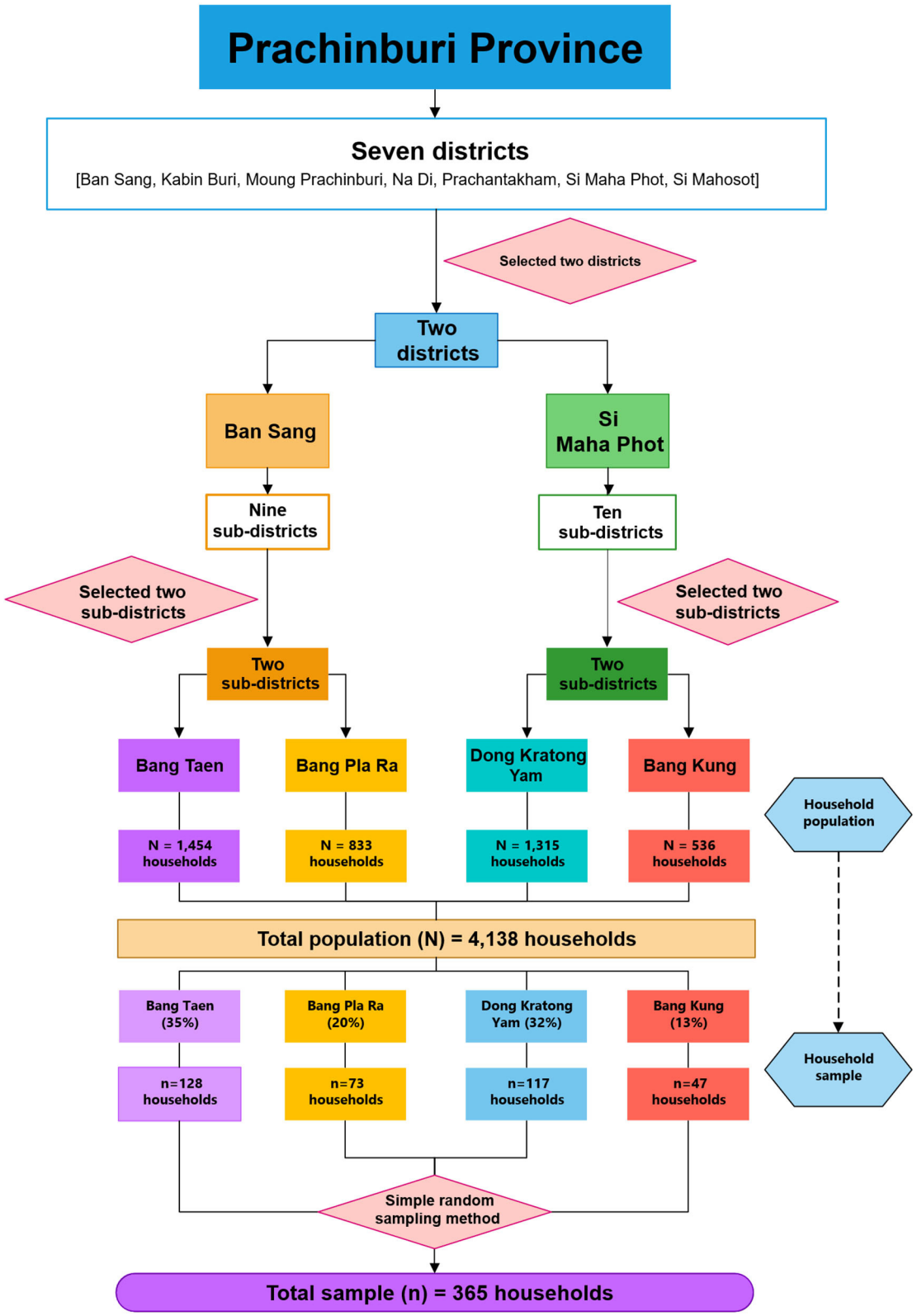

FIGURE 2 | Schematic diagram showing multi-stage sampling procedure for dividing the total households into different farming household groups.

method (Equation 2).

$$Ka = \frac{(N \times 365)}{Tp} \quad (2)$$

Where *Ka* refers to the number of households selected from four sub-districts, *N* indicates the population of the sub-districts, and *Tp* indicates the total population of the province.

Development of the Questionnaire

A structured draft questionnaire was developed to guide the interviewing process and then shared with local stakeholders and collaborators involved in the project. The questionnaire was divided into four parts: (1) household demographic characteristics; (2) the current situation of agricultural sustainability, production and productivity; (3) the livelihoods and well-being of aging farmers; and (4) strategies to improve agricultural productivity and sustainability. A pilot survey was carried out with a sample of 30 households within the study area. Following rigorous field-testing, the questionnaire was finalized for implementation.

Survey Administration and Analysis

The survey was administered to households in four sub-districts within the Prachinburi region from August to October 2018. The survey procedure was conducted in three steps: (1) the survey questionnaire was translated into Thai; (2) the questionnaire was distributed to 128 respondents in Bang Taen, 73 in Bang Pla Ra, 116 in Don Kratong Yam, and 47 in Bang Kung; and (3) the cover letter explained the aim and importance of the survey, the potential participation benefits, and the criteria for respondent selection. In addition, the cover letter assured all participants of complete confidentiality. Including research assistants, a total of 365 selected respondents were interviewed.

Key Variables

The explanatory variables were selected based on the existing literature. For example, several studies conducted in different geographical contexts examined the relationship between farmers' age and productivity (Poungchompu et al., 2012; Guancheng et al., 2015). These studies used variables measuring types of agricultural production, geophysical, social and climate-related barriers to greater agricultural productivity, mentoring, use of technology, retirement, health concerns, and risks of farm accidents of the aging workforce. Farm and farmers' characteristics (i.e., age, gender and education, household income, household size, farming experience) are typically used in analyses examining agricultural sustainability (Zou et al., 2018; Filloux et al., 2019). Selected variables and data coding are presented in **Table 2**. All variables and related coding are available in the dataset file (**Supplementary Material**).

TABLE 2 | Selected variables, their description, measurement and relevant reference literature.

Variables	Descriptions and Measurement	Relevant literature
Age	Age of respondents (1 = elderly, 0 = other)	Rigg et al. (2020)
Gender	Gender of respondents (1 = male; 0 = female)	Kideghesho and Msuya (2010)
Education	Education levels of respondents (1 = primary level, 0 = other)	Guancheng et al. (2015), Rigg et al. (2020)
Farm experience	Length of farming experience of respondents (years)	Anim (2011), Ntshangase et al. (2018)
Farm size	Size of farmland (hectares)	He (2013), Griffin et al. (2019)
Household poverty	Household where income is below the poverty line (USD $5.50 per day)	Griffin et al. (2019), Rigg et al. (2020)
Adult in family	Total number of adults in a family (number)	Ntshangase et al. (2018)
Total production	The total output of agricultural production (kilogram)	Dzuganov et al. (2020)
Climate change	Perceived the effect of drought or flood on the agricultural system (1 = a major problem, 0 = other)	Connor et al. (2020), Isaac et al. (2020)
Agricultural technology	Difficulty with agricultural technology (1 = a major problem, 0 = other)	Phongsiri et al. (2017), Philip et al. (2019), Dzuganov et al. (2020), Hoang (2020)
Farm investment	Difficulty with on-farm finance service support (1 = a major problem, 0 = other)	Abid (2014)
Farm labor	Difficulty with use of farm labor capacity (1 = a major problem, 0 = other)	Souvi et al. (2021)
Integrated farming system	Whether an integrated farming system is adopted by the farmer (1 = adopted, 0 = other)	Salaisook et al. (2020)
Organic farming system	Whether an organic farming system is adopted by the farmer (1 = adopted, 0 = other)	Karnasuta and Laoanantana (2021)
Vegetable garden area	Area planted to vegetable crops (rai = 0.16 ha)	Suwanmaneepong and Mankeb (2017)
Fish pond area	Area of pond for fish culture (rai = 0.16 ha)	Salaisook et al., 2020
Agricultural market	Difficulty with access and use of agricultural market information (1 = a major problem, 0 = other)	Hoang (2020), Thi and Bui (2021)
Irrigation service	Difficulty with the irrigation system and access to irrigation service (1 = a major problem, 0 = other)	Kapil et al. (2020)

POTENTIAL RESEARCH PATHWAYS

The dataset provides insights into the agricultural practices, sustainability, nutritional diversity, environmental and health benefits, barriers and opportunities in the Thai agricultural sector, with a focus on central Thailand. As Thailand is rapidly urbanizing and its population is experiencing rapid aging, examining ways of enhancing agricultural practices, diversifying production, and consumption behind traditional rice mono-cropping is of critical importance. Accordingly,

engagement in the agricultural sector is becoming essential for policy advocacy.

Using the present dataset, researchers are presented with an opportunity to analyse the factors influencing sustainable agriculture, specifically agricultural productivity, aging farming workforce, and community well-being. Further analyses of this dataset can be undertaken by combining these data with other existing datasets. This also includes administrative data from Thailand's sub-district (tambon) offices as well as spatial data. The data can be used for comparative studies and constituting a baseline for further studies in this region. Linking with nutritional and health data can contribute to an understanding of the food security status of the aging agriculture workforce. This is also useful for mapping the health, nutrition, and its association with agricultural production throughout the region. The recent agriculture policy (Thailand 4.0) focuses on increasing yield per rai by reducing inefficiencies. The dataset will also help to understand the factors, roles, and potential issues of the aging workforce. It will help to initiate potential policies for agricultural sustainability through the involvement of an aging workforce.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

SS and CA designed the study. CA collected the data. MP, CA, SS, TT, and KL drafted the article. All authors revised the article critically and approved the final version and agree to be accountable for all aspects of the work. All persons designated as authors qualify for authorship.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2021.728120/full#supplementary-material

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