

Article

# Challenges in evaluation standards for public investment projects (PIP) in Lao PDR: Evaluation of quality of life by a combination of OECD, ADB, and PCAP evaluation approaches

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**Abstract:** Minority people are living in society in Laos, and the Lao government is struggling to promote their lives. In rural areas, minority people are having difficulties accessing good food and safe drink intake (GFSDI). In this survey, the author 1) investigated the GFSDI of minority people by using logistic regression and to find the effectiveness and efficiency of the PIP projects via the result of GFSDI; 2) used an evaluation approach modified from OECD, ADB, and PCAP, which is called the mixed economic evaluation ‘ECEVA’, to find the effectiveness and efficiency of the PIP projects by employing ECEVA and AECEVA. The author used the primary set of data collected from the field survey by interviewing 518 villagers who were minority people and worked with the PIP projects in 11 provinces. As a result, the AECEVA showed that PIP projects were quite effective and efficient in supporting the quality of life of minority people in rural areas. Interestingly, the result of logistic regression also showed that the GFSDI of minorities could demonstrate the effectiveness and efficiency of the PIP projects in Laos.

**Keywords:** GFSDI; SDGs; minority people; non-monetary variables; economic evaluation**JEL Classifications:** O22; P35; R53

## 1. Introduction

In Laos, there exists a diverse range of minority groups originating from various tribes within the society. The Lao government is currently facing challenges in enhancing the quality of life for these minority communities, with a focus on both present and future development. The government of Lao PDR officially recognizes 49 ethnic groups, which are further classified into four ethnolinguistic families. Among these families, the Tai-Kadai family encompasses the Lao, Lue, Phou Tay, and other lowland groups. Remarkably, these minority populations collectively constitute 67% of the entire national population in Laos [1]. The concept of quality of life (QOL) encompasses more than four indicators, including happiness, good health, access to nutritious food and beverages, and more. It is particularly important to ensure that individuals residing in rural areas have opportunities for well-being [2]. QOL has garnered interest from policymakers and social service providers. In the year 2018, the government of Laos took a proactive step by issuing a directive to address aspects of

community well-being. This directive aimed to promote the Sustainable Development Goals (SDGs) in areas such as education, culture, health, housing, human resources, agriculture, sports, justice, security, and safety, as well as family and child welfare. This initiative's national review [3] primarily emphasizes that this directive is for the welfare of individuals, with a particular focus on the citizens of Laos. All individuals in Laos must prioritize the upkeep of their physical well-being and lead secure lives by availing themselves of adequate nutrition and other aspects of well-being. Regrettably, a minority within the Lao population continues to lag behind the intended objective.

Maintaining an adequate quantity of food and drink (F&D) on a daily basis is crucial for sustaining life. However, in rural areas, minority populations face challenges in accessing safe and sufficient F&D, which consequently affects their quality of life (QOL). To assess and evaluate QOL in various projects, surveys and studies incorporating F&D indicators have emerged as a central component. The initial national socio-economic development plan (1975–1980) emphasized the importance of ensuring the well-being and QOL of the Lao people, particularly minority communities, by providing them with access to both good well-being and proper nutrition. A comprehensive understanding of F&D intake aligns with the UNDP's agenda, which emphasizes the holistic consideration of physical happiness in order to sustain the QOL of individuals. The F&D indicator has proved to be a good explainer for future health and safety [4]. F&D serves as a subjective evaluation of an individual's quality of life (QOL). Scholars acknowledge F&D as a dependable factor influenced by numerous independent variables. Consequently, the author of this study employed F&D as a means to gauge the quality of life among minority groups in Laos. The F&D initiative represents a method to enhance the overall well-being of individuals. In this survey research, the notion that minorities residing in rural areas should have access to safe food and drink was embraced.

In order to construct our analysis model, the author incorporated evaluation approaches from three sources: the OECD, ADB, and PCAP in Laos. This amalgamation of evaluation methods is referred to as 'ECEVA', which stands for economic evaluation estimation. The ECEVA method utilized a non-monetary-based variable known as 'NMB' to evaluate the effectiveness and efficiency of projects. Consequently, the author has made a contribution by presenting a comprehensive approach to economic evaluation, enabling evaluators to apply the ECEVA method in their survey evaluations. Additionally, the author provided insights for evaluators, policymakers, and professionals to enhance their understanding of quality of life (QOL) by introducing an indicator called 'good food and safe drink intake' (GFSDI) to measure QOL. Furthermore, the results of this survey evaluation can be utilized by evaluators and policymakers to develop programs aimed at promoting Sustainable Development Goals (SDGs) and improving the lives of individuals in their respective countries in the future.

There are two sections of analysis in this study: 1) The author analyzed the effectiveness and efficiency of public investment projects (PIP) in association with the effect of non-monetary based variables (NMB); in this case, we employed ECEVA; 2) we investigated the indicator called good food and safe drink intake, 'GFSDI' of

the minority villagers; this GFSDI presents the effectiveness and efficiency of the PIP projects [5]. In this case, we employed logistic regression.

## **2. Review of literature**

F&D encompasses many intricate measurements that incorporate non-monetary-based variables (NMB) like food and drink consumption patterns, age, marital status, and level of knowledge [6]. The NMBs have no capacity to enhance the quantity of food and beverage consumption among individuals. Several scholars have investigated the factors related to quality of life (QOL) in conjunction with the level of food and drink intake. These factors include eating behavior, tradition and culture, and geographical areas, all of which have a significant impact on QOL [7]. It is frequently reported that consuming safe food and beverages can contribute to the development of both physical and psychological well-being for individuals [8].

Nalin et al. [9] found that several studies have indicated a robust correlation between the consumption of safe food and drink and the potential for achieving sustainable development within a nation, where individuals with safe food and drink intake tended to report better QOL [7]. Nevertheless, despite certain research findings suggesting a decline in safe food and drink consumption with a decrease in income, the correlation between income and safe food and drink intake is not consistently supported [10]. In a study conducted by Schnettler et al. [11], the correlation between safe food and drink intake and life satisfaction was investigated. The findings of the research revealed noteworthy positive associations and significant interaction effects between the consumption of safe food and drink and overall life satisfaction, and the results showed positive relationships and significant interaction effects between safe F&D intake and life satisfaction.

Some studies in developed countries examined work-family conflict and safe F&D intake [12,13]. According to a study conducted by Griep et al. [14], it was observed that the educational level of women played a role in the interaction between work-family conflict and their consumption of safe food and drinks. The study found that highly educated women were more likely to have decreased intake of safe food and drinks. Additionally, when considering gender differences, women reported experiencing more negative effects on their safe food intake due to the proportion of work that is empowered by women.

This study examined the effectiveness and efficiency of PIP projects by incorporating NMB factors and the GFSDI factor. The GFSDI factor, serving as an indicator of quality of life, signifies the ability of people to access sufficient daily food and consume clean water for their everyday needs [15]. The author conducted surveys and gathered data from minority villagers in Laos.

## **3. Methods**

### **3.1. Evaluation method**

This survey covered two dimensions of analysis, including economic evaluation estimation and logistic regression estimation. 1) To estimate the effectiveness and efficiency of the PIP project, this investigation employed the criteria for evaluation of

the ADB and OECD DAC [16,17]. As shown in **Table 1**, in order to evaluate the effectiveness and efficiency of the PIP, the author utilized five elements of evaluation. However, it is important to note that the author focused solely on two criteria, namely effectiveness and efficiency. This decision was made due to the fact that the survey specifically examined the implementation phase of PIPs with the intention of investigating the connection between the input, output, and objectives of the projects. As a result, effectiveness and efficiency became the primary areas of interest. It is worth mentioning that within the principles of evaluation, there are four stages of assessment. The first stage involves the evaluation of new projects, where all five evaluation criteria are required. The second stage pertains to the evaluation of the implementation phase of a project, during which evaluators typically only assess effectiveness and efficiency. The third stage focuses on the evaluation of project termination, where effectiveness and efficiency are the two required criteria. Lastly, the fourth stage involves the ex-post evaluation, which concentrates on similar criteria as those mentioned for projects that have reached their termination [18]. 2) Simultaneously, those NMB variables are also employed for investigating the designed logistic regression. After gaining the results, we interpret the odd ratio results from the maximum likelihood estimation and again examine the NMB variables' effectiveness and efficiency through the GFDSI of only female minorities in Laos. The GFDSI is one of the QOL indicators mentioned in SDG3 [19]. We can employ this GFSDI, which refers to the effectiveness and efficiency of the PIP projects [5].

**Table 1.** A comparison between ADB, OECD, and this study.

Criteria	OECD	ADB	This research approach is based on NMB <sup>2</sup> factors
Relevance	Achievement of project	Achievement of project	Achievement <sup>3</sup> for the SDGs, NSEDP In activities of projects: are male and female minorities involved? And how do project implementors select male and female minorities to work with them? Indicators are 'gender, work time, age, and educational level'. All indicators should be consistent with the SGDs and NSEDP of Laos.
Effectiveness	Output (activities) align with objectives	Activities consist of the goals of the project	For the implementation of inputs of projects: wages of male and female minorities who are involved in the PIP projects can cause female laborers to buy food preferences, wages can increase the psychology of female laborers, and wages can promote the marital status of females. All indicators should be consistent with the SGDs and NSEDP of Laos
Efficiency	Input: materials, human resources, prices of material inputs, and wages of labor inputs	Input management: human and materials	For long life project: satisfaction of minorities who are affected by projects. All indicators should be consistent with the SGDs and NSEDP of Laos.
Sustainability	Long life project	long life project	For risks and issues in association with minorities' lives. All indicators should be consistent with SGDs and NSEDP of Laos.
Impact	Risk: negative effect of the project on beneficiaries' lives	Risk: environment issues, social issues	

Source: [16,17].

The five criteria in **Table 1** encompass relevancy, effectiveness, efficiency, impact, and sustainability. Each criterion was meticulously defined by the proponents of this approach, as outlined below.

- 1) The consistency of project activities with the planned goal set by the project host can be measured by the criterion of relevance. At the national level, before accepting and executing a project, an evaluator will utilize this criterion to assess

if the project's activities and objectives align with the developmental goals established by the government and the donor concerning ODA projects. However, in our analysis of ongoing projects [18], we did not employ this criterion as the relevance of the project will be evaluated in a separate new project.

- 2) The evaluation of project effectiveness involves assessing the coherence between project activities and outcomes to determine whether the project objectives have been successfully accomplished. This evaluation is specific to project analysis, as it allows for a comprehensive understanding of the ongoing project's effectiveness. The criterion of effectiveness encompasses both the outputs and objectives of the project, serving as a means to gauge the success of project planning and management by the project implementers [17,18].
- 3) Efficiency is a metric used to assess the level of accomplishment in terms of inputs within a project. It involves evaluating the utilization of project inputs such as costs, labor, materials, and other supportive tools. When these inputs are meticulously planned and managed, it signifies that the project has the potential to thrive in its activities or physical undertakings, such as road projects. The significance of this criterion lies in its ability to provide valuable insights during the analysis of ongoing projects. Understanding the efficiency of a project is essential in order to evaluate its progress efficiently [17].
- 4) The evaluation of impact serves as a measure to determine whether a project has a detrimental effect or not. A project has the potential to generate negative consequences, such as the creation of noise and dust pollution in the case of a road project, which can adversely affect the lives of nearby residents. Similarly, a project focused on crop plantations can impact the health of villagers or buyers if excessive chemical fertilizer is utilized. However, it is important to note that this criterion was not considered in our analysis, as it will be utilized during the project's termination and ex-post evaluation. In our current evaluation, we solely focus on ongoing projects [16].
- 5) The duration of a project's existence, known as sustainability, is a factor to consider for evaluation. Typically, projects need to be sustained for a significant period of time, even after the termination stage. For example, a road project should ideally be sustained for a minimum of 5 to 10 years, or even longer, as determined by engineers based on the mechanical lifespan. However, in our analysis, we do not rely on this criterion. While it is commonly used for evaluating completed projects, we do not apply it to ongoing projects [18].

In **Table 1**, the variables we have designed are denoted in column 4. We have chosen these variables based on the established principles and methods of the ADB and OECD, which are aligned with two criteria: effectiveness and efficiency. These criteria are important at the national level of development, as they contribute to the attainment of development goals such as the SDGs outlined by the UN and the NSEDP mentioned in the MPI of Laos. These goals play a vital role in the successful implementation of the ODA and PIP initiatives. Hence, the indicators or variables presented in **Table 1**, which were utilized in our study, are derived from microeconomic perspectives. Specifically, the indicators listed in column 4 of **Table 1** are microeconomic-based variables. This perspective is extensively elucidated in our analysis results. Consequently, these variables were thoroughly examined. It is

important to note that our research does not incorporate the criteria of relevance, impact, and sustainability. However, we have employed the criteria of effectiveness and efficiency. To assess the effectiveness of the project, variables such as 'gender, work time, age, and educational level' were utilized [6,12]. On the other hand, to evaluate the efficiency of the project, we considered wages, food preferences, the psychology of laborers, and marital statuses.

### **3.2. Factors in the analysis**

The primary analysis of this study is to conduct a comprehensive evaluation of male and female minorities belonging to five tribes in Laos, with a specific focus on their association with a factor known as 'good food and safe drink intake'. We conducted surveys and interviews across various regions of Laos, spanning from the northern to the southern areas where the PIP projects are situated. Our main emphasis was on evaluating the effectiveness and efficiency of these projects, and to accomplish this, we utilized an indicator called 'good food and safe drink intake (GFSDI)' to gauge the extent to which males and females have access to GFSDI. If both can avail themselves of GFSDI, it signifies that the PIP projects have been successful in promoting this aspect, thereby demonstrating their effectiveness and efficiency. The NMB variables that were linked to the effectiveness and efficiency of projects encompassed factors such as gender, working hours, physiological condition, dietary preferences, educational background, age, and marital status. These indicators were carefully devised and unanimously approved by the research team. Additionally, the NMB variables were evaluated using a set of five ranking scales, which were established within the range of 1 to 5 for the ECEVA evaluation, while in our logistic regression analysis, the GFSDI was determined between 0 and 1. Certainly, the NMB variables are explained as follows: In relation to the logistic regression analysis for 'Gender', the author highlights that the involvement of females in the PIP projects can enhance project effectiveness when compared to males. Consequently, we conducted interviews with females to inquire about their GFSDI. Regarding 'worktime', the author observes that the full-time engagement of female minorities also correlates with project effectiveness, which was assessed through their responses to the GFSDI. Concerning 'Age', the author specifically focuses on adults aged 45 and above, examining their GFSDI answers in relation to project effectiveness. As for 'Education', the author raises a question regarding whether females with vocational education can contribute to increased project effectiveness. This query is addressed through their GFSDI responses. In terms of 'psychological status', we have categorized females with the highest emotional health, which is achieved through the consumption of nutritious food and safe beverages. These individuals are capable of enhancing work efficiency in PIP projects. Additionally, the factor of 'food preference' plays a role, as females desire more delicious and health-promoting food and drinks, thereby further improving their overall ability to work efficiently on PIP projects. Lastly, the author emphasizes that single females can also contribute to enhanced work efficiency in PIP projects. After conducting a thorough analysis of our variables, we have established a range of responses for the NMB variables for the ECEVA model with a scale of 1 to 5, including 1 meaning 'do not agree', 2 meaning

‘agree’, 3 meaning ‘fairly agree’, 4 meaning ‘well agree’, and 5 meaning ‘fully agree’. We utilized these scales to inquire about the degree of GFSDI possessed by female minorities. The GFSDI has a score of 0 and 1 for females to provide answers (0 means females cannot access GFSDI; 1 means female can access GFSDI). The GFSDI, as perceived by females, serves as a measure for evaluating the effectiveness and efficiency of the PIP projects.

The author used a random sampling technique to select the number of male and female minorities who were involved in the survey. These workers worked on the targeted public investment projects (PIP) in the surveyed regions. PIPs were selected by the author, including 1) the PIP for rubber plantation and crop production; and 2) the PIP for technical promotion of rice farming. Throughout the two years from 2019 to 2021, a survey was carried out in Laos, specifically targeting female villagers. The survey methodology involved conducting face-to-face interviews with these villagers. The research team focused on areas known as PIP sites, where female minorities were engaged in work related to PIPs. To collect data, questionnaires were utilized, and the responses were recorded. The author and other team members distributed answer sheets and posed questions to the villagers. In order to analyze and evaluate the results of the NMB variables via the ECEVA model, an economic evaluation approach was employed, considering effectiveness and efficiency as the key criteria. Additionally, the author utilized logistic regression with the STATA software to accurately interpret the GFSDI for the effectiveness and efficiency of the PIP projects.

### 3.3. Mathematical formulation

The primary analysis of this research is to provide results on how the effectiveness and efficiency of PIP are explained by NMB factors and the GFSDI. Economic evaluation based on a mathematical formulation called the ‘accumulated grade point average’ was deployed to evaluate both male and female answers for the effectiveness and efficiency of the PIP projects. The mixed economic evaluation approach modified by the author was ‘ECEVA’s estimation, which was derived from the accumulated grade point formula; it was a modified technique that could help an evaluator, decision-maker, and policymaker gain results from beneficiaries, not the results from project owners, which are usually evaluated in the evaluation techniques of ADB, OECD, and PCAP in Laos. The ECEVA analysis requires some assumptions, and in our analysis, we generate the results from male and female minorities who are involved in our survey. Besides the ECEVA model, this study also aimed to investigate the GFSDI via logistic regression and focused only on female minorities. We already mentioned that the GFSDI is the QOL used for measuring the effectiveness and efficiency of the PIP projects in logistic regression. In parts 1) and 2), the author used the ECEVA model to analyze the results and figure out the result of the AECEVA; for part 3, we explained the utilization of a logistic regression. Below is the formulation:

- 1) Initiate the ECEVA estimation with the accumulated grade point formula

$$\text{Accumulated Grade Point Average} = \frac{\text{Scales responded by villagers} \times \text{points checked by evaluator}}{\text{The sum of scales}} \quad (1)$$

- 2) The author modified Equation (1) to be the ECEVA estimation as shown below: Begin with a single estimation.

$$ECEVA_{ci} = X1_{ci} \times P1_{ci} + X2_{ci} \times P2_{ci} + \dots + Xk_{ci} \times Pk_{ci} / X1_{ci} + X2_{ci} + X3_{ci} + \dots + Xk_{ci} \quad (2)$$

Thus, we have total estimation:

$$the\ ECEVA_{ct} = \sum_{i=1}^n ECEVA_{ci} \quad (3)$$

Then, find the average result from the total estimation.

$$AECEVA_{ct} = \frac{\sum_{i=1}^n ECEVA_{ci}}{n} \quad (4)$$

Now, explain:

*ECEVA* is an economic evaluation estimation that refers to the measurement of the effectiveness and efficiency of PIP, resulting from two components: 1) the scales of NMB factors answer for effectiveness and efficiency of the PIP, this scale provided by respondents; 2) the points checked by evaluators;  $c$  is criteria [ $c = 1$  is effectiveness,  $c = 2$  is efficiency],  $i$  refers to the individual villager [1, 2, 3, ...,  $n$ ];  $t$  is summation;  $k$  is factor [1, 2, 3, ...,  $k$ ];  $n$  is the total number of villagers or minorities involved in the survey.

$X1_{c1}$  is an effectiveness scale of the factor ‘gender’ of villagers [1, 2, 3, ...,  $n$ ]. We asked male and female minorities whether they think this project is effective in promoting females’ work.

$X2_{c1}$  is an effectiveness scale of ‘work time’ of villagers [1, 2, 3, ...,  $n$ ]. We asked participants if they think this project is effective in providing work hours appropriately for them.

$X3_{c1}$  is an effectiveness scale of the ‘age’ of villagers [1, 2, 3, ...,  $n$ ]. We asked them if they thought the project was effective in opening work opportunities to many villagers without considering their ages. Sometimes, old workers can work better than younger workers. We incorporate this idea into our analysis.

$X4_{c1}$  is an effectiveness scale of the ‘educational level’ of villagers [1, 2, 3, ...,  $n$ ]. We asked those respondents if they think the project is effective for selecting them to work and assigning a job position based on their education.

$X5_{c2}$  is an efficient scale of ‘food preference’ of villagers [1, 2, 3, ...,  $n$ ]. We asked those respondents if they think the project is efficient for providing sufficient wages that give them the ability to buy their preferred food and drinks, compared to before they did not work with the projects.

$X6_{c2}$  is an efficient scale of the ‘psychology status’ of villagers [1, 2, 3, ...,  $n$ ]. We asked the minorities if they think the project is efficient for enhancing their emotional health through receiving wages from the projects; income produces their desire to actively work.

$X7_{c2}$  is an efficient scale of the ‘marital status’ of villagers [1, 2, 3, ...,  $n$ ]. We asked males and females if they think the project is efficient for promoting their marriage, and whether wages or incomes earned from the projects are the factors that motivate them to make a marriage decision.

$Pk_{1i}$  is a point or score of the effectiveness provided by evaluators to a male or female villager ‘ $i$ ’ [1, 2, 3, ...,  $n$ ]; and  $k$  factor [1, 2, 3, ...,  $k$ ], the score ranges from 0-10.

Pk2i is a point or score of the efficiency provided by evaluators to a male or female villager 'i' [1, 2, 3,..., n]; and k factor [1, 2, 3,..., k], the score ranges from 0-10.

AECEVA is an average estimation of the effectiveness or efficiency of PIP resulting from NMB factors of minorities who worked with PIP.

To interpret the results of AECEVA, the author made these ranks of scales; if the result was higher than 0.5, it means there is effectiveness or efficiency of the PIP to support villagers or minorities:

A: [0.8–1] means good effectiveness- and efficiency of the PIP project to support villagers.

B: [0.5–0.79] means fair effectiveness and fair efficiency of the PIP project to support villagers.

C: [0.2–0.49] means low effectiveness- and efficiency of the PIP project to support villagers.

D: [0.0–0.19] means no effectiveness- or efficiency of the PIP project to support villagers.

### 3) Logistic model

The author investigated the GFSDI via logistic regression and focused only on females, we interpreted the odds ratios after generating the results from the Maximum Likelihood technique; the regression and method of estimation are shown below:

Begin with the basic logistic regression of multiple variables [20],

$$\text{The Logit } (Y) = \text{Ln} \left( \frac{p}{1-p} \right) = \text{Ln} e^{\alpha + \beta_1 X_1 + \dots + \beta_k X_k}; e \text{ is odd of event} \quad (5)$$

Let,

$$p = \frac{e^{\alpha + \beta_1 X_1 + \dots + \beta_k X_k}}{1 + e^{\alpha + \beta_1 X_1 + \dots + \beta_k X_k}} = \frac{1}{1 + e^{-(\alpha + \beta_1 X_1 + \dots + \beta_k X_k)}} \quad (6)$$

Then, the author extent the odds ratio from two relative events (A or B) as follows.

$$e^{\hat{\beta}\{A \text{ vs. } B\}} = \frac{e^{\hat{\beta}\{A\}}}{e^{\hat{\beta}\{B\}}} = \frac{p_A/(1-p_A)}{p_B/(1-p_B)} \quad (7)$$

Then, use log form for the likelihood function and estimate the odd ratio with Maximum Likelihood in STATA. The final model is:

$$\text{Ln}[L(\mu, \sigma | X_1, \dots, X_k)] = \text{Ln} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(X_1 - \mu)^2/2\sigma^2} + \dots + \text{Ln} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(X_k - \mu)^2/2\sigma^2} \quad (8)$$

The author analyzed this logistic regression with these hypotheses:  $H_0 = 1$ , there is no GFSDI to show the effectiveness and efficiency of the PIP projects;  $H_1 \neq 1$  there is the effectiveness and efficiency of the PIP projects via the indication of the GFSDI.

Of course, we assumed  $\mu = 0, \sigma = 0$  for the normal distribution of the likelihood function, the regression of the logit model is given below with the explanation of variables.

$$\text{Logit}(Y) = \text{Log} \left( \frac{p}{1-p} \right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_6 X_6 \quad (9)$$

Y: GFSDI (p | Yes: 1; No: 0), for the GFSDI we determined only two choices of answer for the female villagers 0 and 1 (0 means females cannot access GFSDI; 1 means female can access GFSDI).

X<sub>1</sub>: Female gender answers for GFSDI are divided into five groups [1 no chance, 2 once a week, 3 few days a week, 4 five weekdays, 5 all seven days].

$X_2$ : The work time of females who answer for GFSDI is divided into five groups [1: less than 4 h, 2: 4 h, 3: 4–6 h, 4: 6–8 h, 5: 8 h with overtime].

$X_3$ : The age of females who answer for GFSDI is divided into five groups [1: below 18 years old, 2: 18–25 teens, 3: 26–30 young adults, 4: 31–45 middle-aged adults, 5: above 45 old adults].

$X_4$ : The education of females who answer for GFSDI is divided into five groups [1: no education, 2: primary, 3: secondary, 4: high school, 5: vocational school].

$X_5$ : The food preferences of females who answer for GFSDI are divided into five groups [1: no preference, 2: low preference, 3: moderate preference, 4: high preference, 5: the highest preference].

$X_6$ : The psychological status of females who answer for GFSDI is divided into five groups [1: no emotional health, 2: low emotion, 3: moderate emotion, 4: high emotion, 5: the highest emotion].

$X_7$ : The marital status of females who answer GFSDI is divided into five groups [1: a family with more than 2 children, 2: a family with 1–2 children, 3: a family with no child, 4: a divorced person or widower, 5: a single person].

4) Data was surveyed in 2019–2021. In the survey, a total of 518 participants, including 239 females, were included. Among them, 205 individuals hail from the northern region, 168 individuals belong to the middle part, and 145 individuals are from the southern region of Laos. **Table 2** presents a comprehensive overview of the five tribes that were observed in the study. These tribes, namely Lao Thueng, Phou Tay, Lue, Hmong, and Akar, hail from some provinces spanning from the northern to the southern regions of Laos. The PIP projects, known as the projects for enhancing quality of life and promoting nutrition among minority people in rural regions, were actively engaged in the Sam Sarng Districts Program initiated by the Lao government. The project primarily focuses on agricultural farming, specifically rice farming, crop planting, and rubber planting, to generate income for rural inhabitants who are minorities and improve the livelihoods of each minority group in Laos.

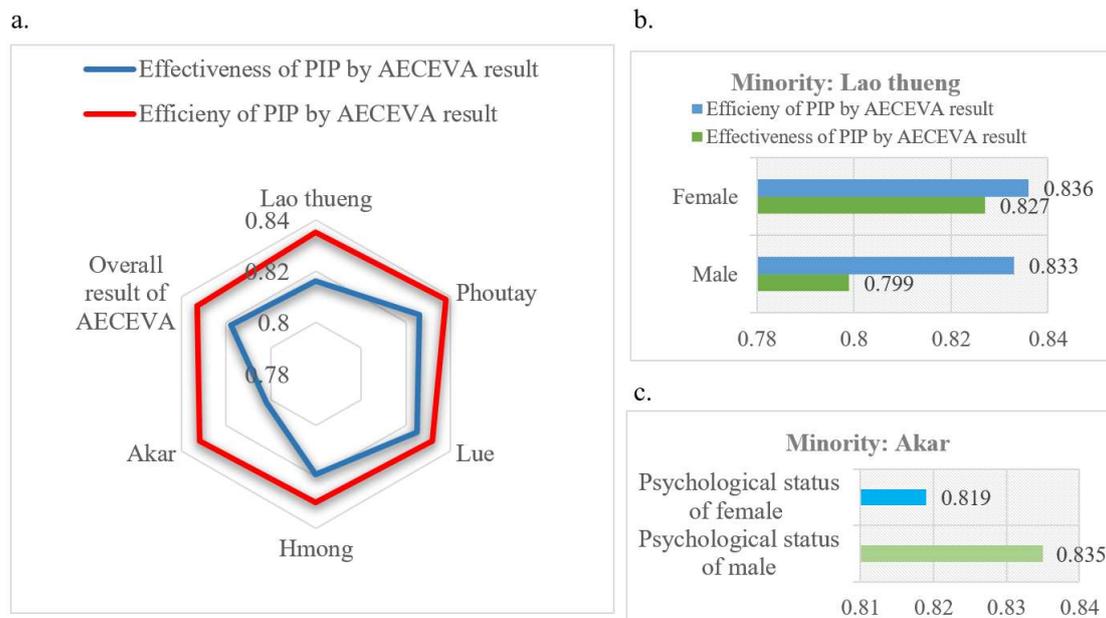
**Table 2.** Several minorities came from provinces in Laos, classified by minorities and genders.

Provinces	Male					Female					Total
	Lao thueng	Phou tay	Lue	Hmong	Akar	Lao thueng	Phou tay	Lue	Hmong	Akar	
Phongsaly	3	6	1	3	4	5	1	5	4	1	33
Oudomxai	4	5	3	2	3	4	2	4	3	2	32
Luangprabang	3	4	2	4	5	7	3	3	5	3	39
Xayabouly	5	7	5	3	6	6	2	6	4	2	46
Huaphan	2	8	4	5	3	5	4	5	3	3	42
Xiengkhuang	4	5	3	6	2	4	2	3	4	4	37
Vientiane	2	6	2	5	4	7	2	2	3	3	36
Vientiane C	4	4	4	4	5	6	1	4	2	2	35
Borlikhamxay	3	5	5	3	6	8	3	5	4	1	43
Savannakhet	2	3	4	2	5	5	4	6	5	3	39
Saravan	4	6	9	4	4	4	5	5	6	2	50
Champasack	3	5	4	4	3	6	3	4	5	3	40
Attapue	6	7	5	5	4	6	4	3	4	2	46
Total	45	71	51	50	54	73	36	55	52	31	518

Source: Author's survey in 2019–2021.

## 4. Results

**Figure 1a** presents the findings of the AECEVA survey, which was conducted among five distinct minority groups of villagers, namely Lao Thueng, Phou Tay, Lue, Hmong, and Akar. The majority of participants, accounting for more than half, expressed their satisfaction with the PIP projects initiated by the Lao government. These projects aimed to improve the quality of life and nutrition among the villagers. The AECEVA results consistently exceeded 0.8, indicating the commendable effectiveness and efficiency of these projects. For instance, in **Figure 1b**, both males and females agreed that the PIP projects could enhance gender equality in terms of work opportunities. Females were provided with good chances to work under the PIP projects. In **Figure 1c**, both males and females had psychological statuses higher than 0.8, indicating that the workers had good emotional health and active behavior in their work on the PIP projects. This can be attributed to the motivating factor of having income. Furthermore, the PIP projects were also found to be efficient in promoting food preferences and marriage among the participants.



**Figure 1.** The effectiveness and efficiency of PIP projects by minorities and AECEVA result in.

Source: Author's survey in 2019–2021.

In **Table 3**, the overall AECEVA findings indicated that the effectiveness and efficiency scores were 0.818 and 0.833, respectively. The high AECEVA results can be attributed to the fact that minorities expressed that the PIP projects had the potential to improve their lives through various means. These included promoting gender equality, implementing appropriate interventions in work schedules, providing suitable job opportunities based on their educational levels, enhancing their psychological well-being through increased wages, enabling access to better food consumption and preferences, and even facilitating marriage through the income generated from working on these projects. When examining each minority group individually, the AECEVA results for Lao Thueng demonstrated an effectiveness score of 0.816 and an efficiency score of 0.835 for PIP projects supporting NMB

factors in their lives. Similarly, Phou Tay exhibited an effectiveness score of 0.826 and an efficiency score of 0.838, while Lue showed an effectiveness score of 0.825 and an efficiency score of 0.832. Hmong displayed an effectiveness score of 0.819 and an efficiency score of 0.830, whereas Akar had an effectiveness score of 0.802 and an efficiency score of 0.832 for PIP projects supporting their lives.

**Table 3.** ECEVA results.

Minorities/tribes	Effectiveness of PIP by AECEVA result	Efficiency of PIP by AECEVA result
Lao Thueng	0.816	0.835
Phou Tay	0.826	0.838
Lue	0.825	0.832
Hmong	0.819	0.830
Akar	0.802	0.832
The overall result of AECEVA	0.818	0.833

Source: Author's calculation.

**Table 4** presents the GFSDI associated with the effectiveness and efficiency of the PIP projects. Our analysis considered these variables, including gender, work time, age, educational level, psychological status, food preference, and marital status. The majority of female villagers reported being able to access GFSDI after participating in the PIP projects provided by the Lao government. Interestingly, the unadjusted odd ratios for the GFSDI of females were found to be quite high. Specifically, the results for female groups 4 and 5 showed odd ratios of 174.166 and 23.333, respectively, with a  $p$ -value less than 0.05. This suggests that females in these groups have a significantly higher likelihood of accessing GFSDI. Furthermore, it indicates that they can afford to spend their earnings from the PIP projects on consuming GFSDI as desired, potentially for at least five to over seven days per week. However, when considering the adjusted odd ratios, the results are not statistically significant. This implies that females in 5 groups consuming GFSDI do not demonstrate the clear effectiveness of the PIP projects. We continue our explanation of the unadjusted odd ratios for the variable 'work time', Females who work for 6–8 h displayed a distinct result of 63.583, which is higher than the other group. This suggests that females who work during this time frame have better access to GFSDI compared to the other group. However, the remaining groups also mentioned that they can access GFSDI due to their earning income from projects, which motivates them to make purchases. The  $p$ -values for both the unadjusted and adjusted odd ratios are less than 0.05 for groups 3, 4, and 5, indicating significance. However, the  $p$ -value for group 2 is insignificant. Therefore, females who work for more than 4 h express that they can access GFSDI with the support of the PIP project through the wages they earn. This demonstrates the effectiveness of the PIP project when interpreting the second variable of our research. Let us now turn our attention to the unadjusted odd ratios pertaining to the age of females, which serves as our third variable. The analysis reveals that female groups 4 and 5 exhibit odd ratios of 157.5 and 99, respectively, both of which are statistically significant. Additionally, we observe significant results for groups 2 and 3 when

examining the adjusted odd ratios. However, upon further investigation of the  $p$ -values associated with these adjusted odd ratios, we find that only group 2 lacks significance. In conclusion, our findings indicate that females aged between 26–30 years, 31–45 years, and above 45 years have access to GFSDI, thereby suggesting the effectiveness of the PIP based on these variables. Based on the educational level of the female participants in our survey, the unadjusted odds ratios for groups 3, 4, and 5 are 10.714, 33.428, and 17.714, respectively, all of which are statistically significant. However, group 2 does not show a significant odds ratio. Upon examining the adjusted odds ratios, we found that none of the results were statistically significant. This suggests that the educational level of females, including secondary school, high school, and vocational school, plays a role in motivating them to consume GFSDI due to their knowledge of the benefits associated with good food and safe drinks for health. Although the unadjusted odds ratios support this finding, the lack of significance in the adjusted odds ratios leads us to conclude that the PIP project is not effective in improving accessibility to GFSDI based on females' educational level alone.

**Table 4.** Results from logistic regression by interviewing 239 females.

Safe F&D	Unadjusted odds ratio			Adjusted odds ratio		
	Coefficient	Odds	P >  Z	Coefficient	Odds	P >  Z
Female gender (Chance to access good food and safe drinks intake)						
2. Once a week intake	0.328	1.388	0.729	−2.399	0.091	0.153
3. A few days a week intake	2.793	16.333	0.000	−1.406	0.245	0.297
4. Weekday intake	5.160	174.166	0.000	(0.807)	2.242	0.576
5. All seven days in a week	3.149	23.333	0.000	−15.699	0.208	0.245
Worktime of female						
2. 4 h	1.370	39.375	0.070	1.620	5.055	0.184
3. 4–6 h	3.252	25.861	0.000	2.667	14.393	0.019
4. 6–8 h	4.152	63.583	0.000	3.348	28.438	0.004
5. 8 h with overtime	3.650	38.500	0.000	2.486	12.009	0.033
Age of female						
2. 18–25 years old (teens)	2.667	14.4	0.004	2.620	13.738	0.065
3. 26–30 (young adults)	4.119	16.5	0.000	4.321	15.237	0.002
4. 31–45 (middle-aged adults)	5.059	157.5	0.000	4.754	116.036	0.001
5. Above 45 (old adults)	4.595	99	0.000	3.899	49.363	0.004
The educational level of female						
2. Primary school	(0.788)	6.454	0.420	−1.183	0.306	0.429
3. Secondary school	2.816	10.714	0.002	1.586	4.886	0.261
4. High school	3.509	33.428	0.000	2.271	9.685	0.106
5. Vocational school	2.874	17.714	0.001	1.409	4.094	0.313
Emotional health of females (psychology status)						
2. Low emotional health	0.980	2.666	0.178	1.133	3.105	0.289
3. Moderate emotional health	2.028	7.600	0.005	2.501	12.195	0.021
4. High emotional health	3.070	21.555	0.000	2.664	14.356	0.015
5. The strongest emotion	3.036	20.833	0.000	2.544	12.739	0.025

**Table 4.** (Continued).

Safe F&D	Unadjusted odds ratio			Adjusted odds ratio		
	Coefficient	Odd	P >  Z	Coefficient	Odd	P >  Z
Food preferences (excluded from safe food and drink)						
2. Low preference	2.772	16	0.018	2.349	10.479	0.122
3. Moderate preference	4.718	112	0.000	4.055	57.666	0.006
4. High preference	5.209	183	0.000	3.857	47.337	0.011
5. The highest preference	5.529	252	0.000	4.033	56.440	0.008
Marital status of females						
2. A female with 1 to 2 children	3.039	20.9	0.001	3.798	44.640	0.01
3. A female with no child	4.784	119.625	0.000	4.715	111.586	0.000
4. Female with divorce or widower	5.050	156.062	0.000	3.765	43.187	0.000
5. Single female	4.756	116.285	0.000	3.257	25.981	0.002

Significant level 5%.

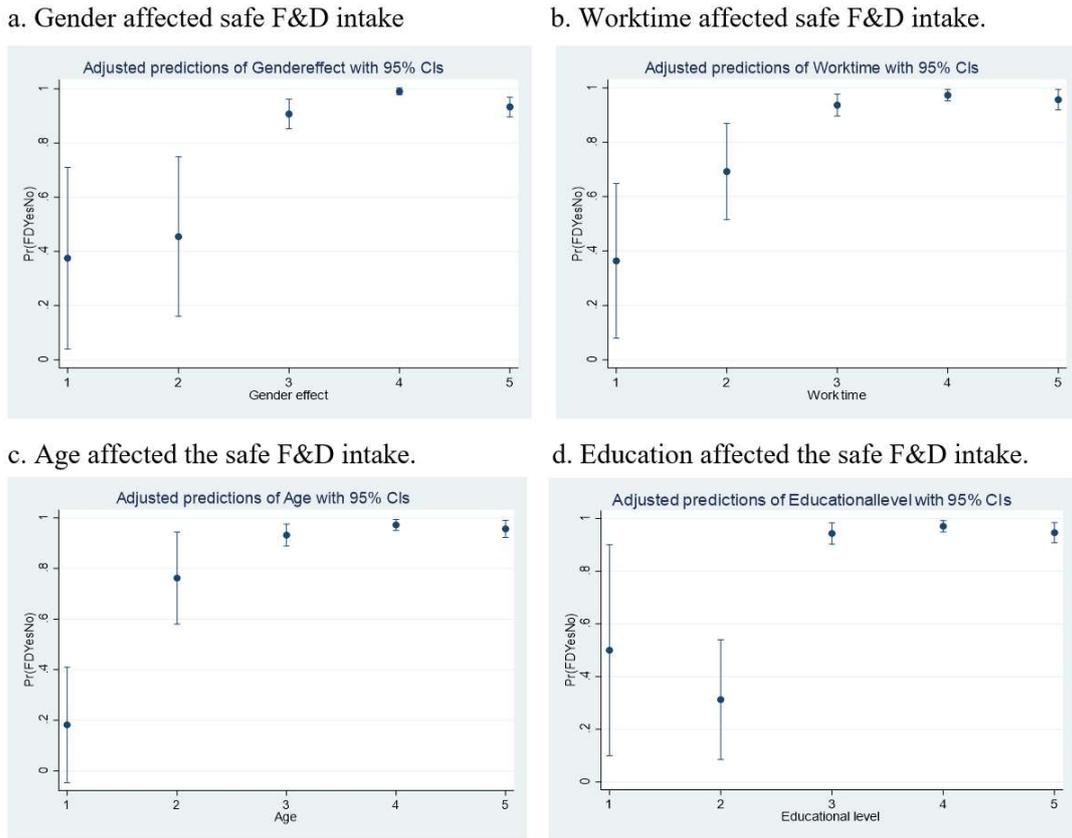
Source: Author's survey in 2019–2021.

Let us delve into the analysis of efficiency. The unadjusted odds ratio for females in relation to psychological status or emotional health is 21.555. For female groups 4 and 5, this ratio stands at 20.833. These ratios exhibit significance, as indicated by  $p$ -values below 0.05. Group 3 also demonstrates significance in terms of  $p$ -value, although the odds ratio is relatively small. However, we cannot accept the odds ratio for group 2 due to its lack of significance. Upon closer examination of the adjusted odds ratio, we observe significance in groups 3, 4, and 5, but insignificance in group 2. This implies that females in group 4, who possess high emotional health, and group 5, who exhibit the strongest emotional health, have better access to GFSDI compared to group 2 (low emotional health) and group 3 (medium emotional health). This is because females in groups 4 and 5 express their desire for GFSDI to improve their health, and they associate good health with efficient work and the efficiency of PIP projects. Moreover, we have discovered that the unadjusted odds ratios for females' preferred food choices are 16, 112, 183, and 252 for groups 2, 3, 4, and 5, respectively. These findings demonstrate statistical significance. However, upon examining the adjusted odds ratios, we observed that only group 2 did not exhibit significance. The remaining groups displayed significance with a  $p$ -value below 0.05. This implies that females in group 3, who possess a moderate preference, as well as those in groups 4 and 5, who have a high and the highest preference, respectively, for their most enjoyable food and beverages, expressed a continued desire to access GFSDI. This desire is driven by their wages and incomes, which can influence their access to GFSDI in order to maintain their health. Despite their preference for delicious food and drinks, they still wish to consume GFSDI. Finally, the unadjusted odd ratios for females' marital status reveal significant results. Specifically, for groups 2, 3, 4, and 5, the ratios are 20.9, 119.625, 156.062, and 116.285, respectively. These findings are statistically significant, with a  $p$ -value of less than 0.05. Additionally, the adjusted odd ratios among these groups also yield significant results. It is evident that females belonging to different marital status groups, such as those with 1 to 2 children (group 2), those without children but with husbands (group 3), those who are divorced or

widowed (group 4), and single females (group 5), exhibit a preference for healthier lifestyles. They express a desire to consume GFSDI in order to build their active involvement in PIP projects, for which PIPs provide them with income. Consequently, these income incentives contribute to their inclination toward consuming GFSDI. Based on our results, it has been determined that the PIP projects exhibit a commendable level of effectiveness and efficiency. This conclusion is drawn from the significant results obtained from analyzing seven variables, out of which five demonstrated the effectiveness and efficiency of the PIP projects. These findings were derived from the responses of female minorities in Laos, as reported by the GFSDI.

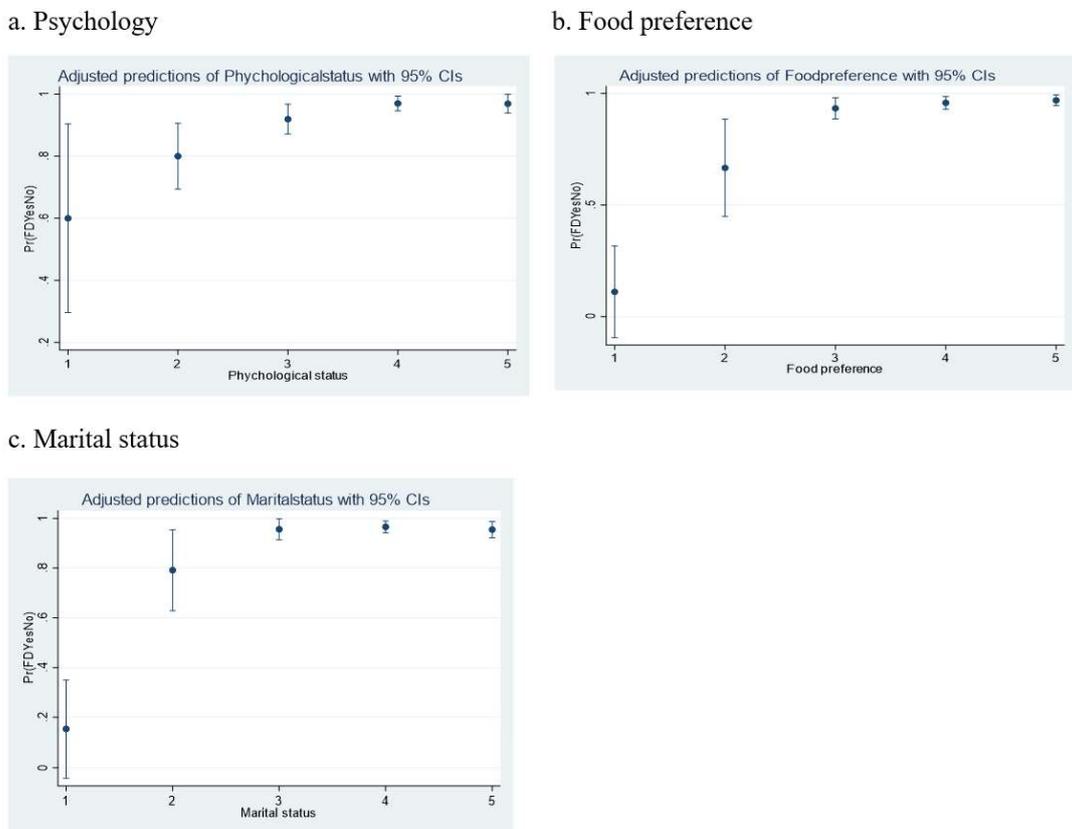
In **Figure 2**, the graphs show the results of GFSDI based on females' opinions. In the effectiveness criteria of our analysis, **Figure 2a** depicts the involvement of women in the PIP program, highlighting their potential to significantly influence the consumption of nutritious food and safe drinks. This is attributed to their income from employment, which enables them to afford GFSDI for better health. Similarly, **Figures 2b–d** also presented a perspective on the GFSDI of minority females. For instance, the extended working hours of minority females indicated their high desire to consume GFSDI in order to maintain their health. Furthermore, elderly females expressed a strong desire to consume GFSDI to improve their health, while a minority of females with high school or vocational education demonstrated a firm commitment to consuming GFSDI. In summary, the opinions of all female respondents collectively underscore the significant influence of their GFSDI, which results in the effectiveness of the PIP projects.

**Figure 3** presents the graphs illustrating the GFSDI in terms of efficiency criteria. Furthermore, **Figure 3a** demonstrates that the strongest emotional level of female workers can serve as a motivation for their consumption of GFSDI. Additionally, **Figures 3b** and **3c** reveal that despite having a preference for delicious food and drinks, females still express a desire to consume GFSDI due to its health benefits. Moreover, it is observed that single or unmarried females are more inclined to have a higher capacity for consuming GFSDI in their daily lives.



**Figure 2.** GFSDI and its effectiveness.

Source: Author’s survey in 2019–2021.



**Figure 3.** GFSDI and efficiency.

Source: Author’s survey in 2019–2021.

## 5. Conclusion

This study comprised two main components. The first part aimed to assess the effectiveness and efficiency of PIP projects by utilizing the NMB variables. The findings from the AECEVA indicated that the PIP projects were successful in enhancing the quality of life for minority villagers residing in rural areas of Laos. The AECEVA results demonstrated that all five tribes had a value higher than 0.8, signifying their views on the effectiveness and efficiency of the PIP projects. Additionally, feedback from minority villagers confirmed that their lives had significantly improved as a result of the PIP projects implemented in their respective rural communities. In the second part of the analysis, the results obtained from the logistic regression analysis also aligned with the AECEVA findings. This indicated that the GFSDI, as determined through maximum likelihood estimation and our logistic regression model, played a role in influencing female minorities to consume GFSDI. The consumption of GFSDI, in turn, was linked to the overall quality of life for these minority females. Therefore, the GFSDI results further supported the notion that the PIP projects effectively and efficiently supported the lives of female villagers who participated in our survey study.

## 6. Recommendation

We provided recommendations to improve the effectiveness and efficiency of PIP in Laos, as highlighted as follows:

- 1) Strengthen the Lao government's ownership by actively seeking additional cooperative donors who are willing to collaborate and participate in PIPs under the Sam Sang District Program. This will further improve the objective of the PIPs, which aim to promote the quality of life in many areas, including urban and rural areas where minority communities are residing.
- 2) Implement a well-defined procedure for streamlining the management of PIP projects in relation to the promotion of employment and income; this can ensure the effectiveness and efficiency of the implementation of the PIP projects under the activities of rubber and crop plantations and rice farming.

**Author contributions:** BX designed the conceptualized evaluation principle, which was derived from the ADB and OECD frameworks mentioned in this article; conducted a survey and gathered the perspectives of the project beneficiaries; and in the final section of the research, BX made recommendations. SH meticulously documented the data, and while our analysis was conducted using the STATA software, the author made the analysis results, unveiled and interpreted the results of our research. In addition, PS also conducted a comprehensive review of the relevant literature pertaining to the conceptualized model in our research and collected data from the project sites. SC played a role in reviewing, revising, and formulating the analysis model of the research, drawing inspiration from methods of evaluation from the PCAP evaluation approach, and concluding the final results. Finally, it is important to note that all authors have thoroughly reviewed and unanimously agreed upon the final version of the manuscript prior to its publication.

**Conflict of interest:** The authors declare no conflict of interest.

## Notes

1. Non-monetary factors ‘NMB’ classified by the author include ‘gender, work time, education, age, psychological status, food preference, marital status’, further explanation mentioned in the review of literature section by Sandrine Pe’neau et al. 2009.
2. Non-monetary based factors (NMB) are indicators used to measure the achievement of each criterion stipulated by the author for example ‘effectiveness’ will be interpreted by NMB such as the ‘work time effect’ of minorities who work with the PIP project.
3. It is the success of a project in afterward the project’s implementation and completion, the author relies on the results measured from indicators aligned with the sustainable development goals (SDGs) by the United Nations and the National Socio-Economic Development Plan (NSED P 1985–2021) of Laos.

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