Social impact and social performance of paddy rice production in Iran and Malaysia

Somayeh Rezaei Kalvani1 · Amir Hamzah Sharaai1,2 · Mohammad Firdaus Masri1 · Nurul Faeiqah Mat Yunus1 · Mohd Ridzuan Afendi1 · Onyeiwu Brendan Uchechukwu1

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Abstract
Purpose Sustainable agri-food production is incredibly important for society. Despite Iran and Malaysia being one of the highest production countries for paddy rice, there is no study on the social life cycle assessment (S-LCA) for rice production for both countries in the literature. The lack of data and complexity of social issue are the challenges of conducting the S-LCA study. This study compared the social impacts from the related stakeholders in the life cycle of paddy rice production between Malaysia and Iran.

Methods This study applied S-LCA based on UNEP (UNEP/SETAC Life Cycle Initiative, 2020) as an evaluation technique to investigate social issues and social performance of paddy rice production in Malaysia and Iran. This research included workers, local communities, and farmers as the stakeholders. The inventory data were collected by using questionnaires. The subcategories for evaluation were adapted from UNEP 2020 guideline. The items in the questionnaire were separately validated by experts in Malaysia and Iran, and the reliability was done by conducting pilot studies in Malaysia and Iran. The questionnaires were distributed by multistage sampling method. The following four steps were conducted following the ISO14040 framework: (1) goal and scope definition, (2) social life cycle inventory analysis (S-LCI), (3) social life cycle impact assessment (S-LCIA), and (4) interpretation.

Results and discussion The result showed that the social performance of workers and farmers in Malaysia was better than Iran because of low cost with high yield for farmers, contributing to increased income. Rice cultivation in Iran for local community did not show good performance regarding health and safety because of burning of rice residue. Around 62% of local Iranian people reported air pollution from rice residue burning. However, the overall social performance for local community was not different in Iran and Malaysia, showing good performances with respect to job opportunity. Sexual harassment was identified as one of the negative social issues in Iran with the score of 60%, including unwanted sexual attention. Moreover, the farmers showed poor performance in Iran, resulting from low satisfactory from income, and low yield and high cost of paddy production in Iran.

Conclusion The key investigation from this research revealed that social performance of crop production in different geographical areas could show different results. The key finding from this study reported that modern agriculture could increase social and economic performance by reducing the production cost, and increasing productivity and social performance in terms of satisfactory from income for farmers. The result of this study can be used for policy makers to improve social performance by using modern agriculture.

Keywords Paddy production performance · S-LCA · Sustainable rice production · Human well-being · Social performance · Social impact

Abbreviations

LCA Life cycle assessment
S-LCA Social life cycle assessment

1 Introduction

Rice is an immensely important stable food for the human population in the world, specifically in the South, East, and Southeast Asia (Pishgar-Komleh et al. 2011). Rice is the second highest grain production after maize production in the world (FAO). More than 90% of rice production and consumption occur in the Asian countries like Indonesia, China, India, Bangladesh, and Japan (Bhuyan et al. 2020).
The population of Asian countries are increasing 1.8% annually, meaning that the demand for rice is increasing (Pishgar-Komleh et al. 2011). Hence, a sustainable rice production is a big challenge for the policy makers (Roy et al. 2016).

Currently, sustainability is becoming an essential aim in the world (Chang et al. 2016). Sustainability has three pillars including economic, environmental, and social aspects. Enhancement of social condition can increase human well-being (UNEP 2009). Social life cycle assessment (S-LCA) is a technique for evaluating social performances of products throughout their life cycle (UNEP 2009).

To date, there are several S-LCA researches in the agricultural sector globally, such as olive production in Italy (Iofrida et al. 2020), pork in Sweden (Zira et al. 2020), cocoa in Malaysia (Sharafi et al. 2020), honey in Italy (D’Eusanio et al. 2018), dairy farm in Ireland (Chen and Holden 2017), citrus in Italy (Iofrida et al. 2019), soybean in Brazil (Pashaei Kamali et al. 2017), sugar in Thailand (Prasara-A and Gheewala 2018), and milk (Revéret et al. 2015), and eggs in Canada (Pelletier 2018). Only a limited study (Prasara-A and Gheewala 2019) considered the S-LCA of rice production in Thailand. The majority of sustainability evaluation studies of rice production focused on environmental sustainability. The social performance of paddy rice is hardly regarded.

There were limited studies that evaluated S-LCA in Iran and Malaysia. Only one study evaluated the social LCA of building material in Iran (Shirazi 2014). According to Kalvani and Sharafi (2021), the literature on the evaluation of sustainable rice production is not sufficient. Only one scholar has evaluated the social LCA of paddy rice production in Thailand (Prasara-A and Gheewala 2018, 2019). Most of the researchers evaluated environmental sustainability of paddy rice production using LCA approach (Nabavi-Pelesarai et al. 2019; Ariyarathna et al. 2016; Hokazono and Hayashi 2015; Mollafilabi 2019). This study evaluated and compared the S-LCA of paddy rice production in Iran and Malaysia for the first time. This study provided the guideline for the rice production in Iran and Malaysia by identifying the new social dimensions using UNEP (2020) Guideline to enhance human well-being by increasing social performances, and to increase the income for government and reduce poverty for workers, local community, and farmers. The specific objective of this study is to evaluate and compare social performance of paddy rice production in Iran and Malaysia.

2 Methodology

Social LCA is a technique for evaluating social and socioeconomic impacts of products alongside the product life cycle. In this study, the S-LCA technique (UNEP 2020) was used.

The S-LCA method was based on the ISO14400 framework with four steps: (1) goal and scope definition, (2) social life cycle inventory analysis (S-LCIA), (3) life cycle impact assessment (S-LCIA), and (4) interpretation (Fig. 1).

This study provided the guideline for the rice production in Iran and Malaysia by identifying the new social dimensions using UNEP (2020) Guideline to enhance human well-being by increasing social performances, and to increase the income for government and reduce poverty for workers, local community, and farmers. The specific objective of this study is to evaluate and compare social performance of paddy rice production in Iran and Malaysia.

3 Goal and scope definition

The goal of this study is to evaluate and compare the social performance of modern (in Malaysia) and traditional (Iran) paddy rice production using Social-LCA. The system boundary in this study was cradle to gate as illustrated in Fig. 4.
3.1 Site selection

The sites of this research were in northern Iran where the largest rice was produced, including the Gilan provinces of Iran and state of Selangor in Malaysia (Fig. 2).

3.2 Paddy rice production in Malaysia and Iran

Rice farms in Iran consisted of mostly small farms (smaller than 10 ha) owned by smallholder. Most of them were not contracted with rice company. They usually employed temporary labours when needed.

Paddy rice production in Malaysia is the major economic activity with the mean area of 651,000 ha in the 1900s. However, with regard to the land use, paddy rice is the third main crop after palm oil and rubber concessions in Malaysia (ICDC 2002). The paddy rice production in Malaysia contributed only 0.4% of global paddy production (Mahmudul et al. 2010). Most rice farms in Malaysia are smaller than 2 ha. Only 3% of the rice farms are larger than 3 ha (Firdaus et al. 2020). The northwest of Selangor is identified as a productive land for crop cultivation in terms of soil fertility and moderate climate (Er and Mokhtar 2013).

Figure 3 compares the paddy rice yield in Malaysia (Selangor) and Iran (Gilan). Selangor had slightly higher paddy rice yield compared with Gilan. The paddy rice yield in Malaysia has increased from 6.7 ton/ha in 2016 to 7.7 ton/ha in 2021. However, in Iran, the yield decreased from 5.7 ton/ha in 2016 to 4.8 ton/ha in 2021.

3.3 System boundary

The system boundary of paddy rice production in this study is illustrated in Fig. 4. It started from the farming to the drying in the factory. It included land preparation, planting, fertilization, weed and pest control, harvesting, transportation, and drying. In this study, three stakeholders were selected including worker, local community, and farmers. The workers refer the employees in paddy rice mile and farm. The

Fig. 2 Map of study area
local communities are defined as people living near the farm rice. The farmers are defined as persons who are the farm owners and manage the farms.

The consumers as important stakeholders that would profit from organic food were excluded from this study because paddy rice are sold to the rice factories. The rice company packed the rice and then sold to the consumers across the countries. It is difficult to find rice consumers across Malaysia and Iran. The data were collected from spring to fall 2021 in Iran and from October to November 2021 in Malaysia.

3.4 Stakeholders involved

In this study, the stakeholders involved included workers, local community, and value chain actors (farmer). One study (Prasara-A and Gheewala 2018) showed that more than 80% of social impacts of agricultural products occurred during the plantation stage, meaning that the cultivation step had a main role in social impacts. Thus, this study focused more on the cultivation stage of paddy rice production. The consumer stakeholders were excluded because of the difficulty in obtaining data.

3.5 Social life cycle inventory

The inventory is one of the steps of S-LCA process to obtain data. The data were collected by using survey. In some cases, in Gilan province of Iran, face-to-face interviews were done as initial stages before conducting the survey. This is done by having the informal interview to get extra
information to develop all of the items apart from the literature studies. The data were collected from spring to fall 2021. Some stakeholders had different roles. For example, in some cases, the farm owner was both a machine contractor and worker. In this research, three stakeholders were chosen for evaluating the social impact, including workers, local communities, and farmers (Tables 1 and 2). Some of different subcategories were selected in Iran that were not considered in Malaysia, for example forced labour, sexual harassment, employment relationship for workers, and land rights, and water rights for farmers. The selection of subcategory was based on the important social issues that have been detected based on the interviews with stakeholders before the actual survey was done. Three questionnaires were designed for each stakeholder involved in this study for Iran and Malaysia to assist the responders to answer the questions easily. The questionnaires included two sections: Sect. 1 was about background of the respondents and Sect. 2 was about social impacts.

The sampling is the process of selecting a small group carefully from large population that allows scholars to knows the feature of the total population (Alvi 2016). Sample should be selected in the manner that finding reflects the total population. Collection of sample is important since it is not possible to study total population.

The sampling method in this study was a multistage sampling method. It consists of combination of three probability sampling techniques which are clustered sampling, stratified sampling and simple random sampling.

### 3.6 Sample size

The sample size was accounted based on the Cochran formula (Cochran 1997) which was designed for unknown population size. In this study, the sample size was evaluated using Eq. 1 because of the lack of data for population size. The additional 10% of sample size was added to adjust some issues like withdrawal and missed data.

\[
N = \frac{Z^2pq}{e^2}
\]  

(1)

where \( N \) is the required sample size, \( e \) is the margin of error \((e=0.5)\), \( p \) is the population proportion \((p=0.1)\), \( q = 1 - p \), and \( z \) = score from \( z \) table (significance level 0.05; \( z = 1.96 \) and (significance level 0.01; \( z = 2.58 \)), and \( n \) refers to the population size.

The assessment of sample size for known population was evaluated by using Eq. 2.

\[
N = \frac{z^2 \times p(1-p)}{e^2} \times \frac{1}{1 + \frac{z^2 \times p(1-p)}{n \times e^2}}
\]  

(2)

where \( N \) is the required sample size, \( e \) is the margin of error \((e=0.5)\), \( p \) is the population proportion \((p=0.1)\), \( q = 1 - p \), and \( z \) = score from \( z \) table (significance level 0.05; \( z = 1.96 \) and (significance level 0.01; \( z = 2.58 \)).

Table 1 shows the number of sample size that responded to the questionnaires in Iran and Malaysia.

### 3.7 Validity of questionnaire

Validity and reliability are identified as the key index for measurement of quality of the questionnaires (Mohajan 2017).

### Table 1 Involved stakeholders and sub-categories in Iran

| Stakeholders       | Subcategory                      |
|--------------------|----------------------------------|
| Workers            | Health and safety                |
|                    | Discrimination                   |
|                    | Wage                             |
|                    | Forced labour                    |
|                    | Sexual harassment                |
|                    | Employment relationship satisfactory |
| Local community    | Health and safety                |
|                    | Local employment                 |
| Farmers            | Water rights                     |
|                    | Land right                       |
|                    | Assistance with technology development |
|                    | Assistance with loan             |
|                    | Healthy and safety               |

### Table 2 Involved stakeholders and sub-categories in Malaysia

| Stakeholders       | Subcategory                      |
|--------------------|----------------------------------|
| Worker             | Discrimination                   |
|                    | Safety and health                |
|                    | Child labour                     |
|                    | Working hours                    |
|                    | Fair salary                      |
|                    | Employee benefit                 |
| Farmer             | Income                           |
|                    | Safety and health                |
|                    | Assistant with technology develop |
| Local community    | Job opportunity                  |
|                    | Health and safety                |
|                    | Community engagement             |
|                    | Delocalization and migration      |
In this research, the validity of all items used in the questionnaire (content validity) was conducted to test whether the number of each item was sufficient or other items had to be added. In addition, consultation with the experts for improving the questionnaire was done. The experts evaluated the suitability and efficiency of the questionnaires. Eight validators in Malaysia were professors from the Faculty of Environmental Studies, Universiti Putra Malaysia (UPM). Six validators in Iran compromised of assistant professor from Razi University, Tehran University, and Rice Research Institute in Gilan. The questionnaire was distributed to the validators for the validation in both countries. Then, the content validity index of items (I-CVI) was conducted for each item (Mweshi et al. 2017) to evaluate the validity of questionnaires by experts. The questionnaires were developed by inserting validation box beside each item in questionnaires; then, the validators were asked to tick the 4-point Likert scale. The values recorded were as follows: score 1 = not relevant, score 2 = somewhat relevant, score 3 = relevant, score 4 = very relevant.

I-CVI is evaluated as the number of panellists giving a scoring of 3 or 4, divided by the number of panellists. I-CVI is the proportion of agreement about relevant of each item. The I-CVI = 1 means that all panellists agree with the item (Mohajan 2017). The I-CVI should not be lower than 0.78 for doing piolet test (Mohajan 2017).

Tables 4 and 5 illustrate the modified questionnaires in Malaysia and Iran based on I-CVI and subcategory, respectively. As it can be seen in Tables 4 and 5, the I-CVI for each subcategory was bigger than 0.78 which is valid for doing piolet study. In Iran, the satisfactory from income and satisfactory from factory were added as subcategories to farmers after validating the questions which were suggested by experts from Iran.

### 3.8 Reliability of items in the questionnaire

A pilot study was done in a small scale using questionnaires to discover and predict the further challenges during survey in 2017. It was necessary to check whether the questionnaires were clear for the subjects that were designed for. The aim of the pilot study was to validate the suitability of questionnaire and to make sure that the questionnaires were well designed and understandable for respondents (Hazzi and Maaldaon 2015).

The reliability test was conducted using Cronbach’s alpha to obtain between 0.65 and 0.95 values. The questionnaires had high reliability because the alpha Cronbach value in this study was bigger than 0.7 for all of involved stakeholders.

### Table 3 The numbers of respondents in Iran and Malaysia

| Stakeholder     | The number of samples in Iran | The number of samples in Malaysia |
|-----------------|-------------------------------|----------------------------------|
| Worker          | 250                           | 106                              |
| Local community | 350                           | 482                              |
| Farmer          | 100                           | 468                              |

### Table 4 The Item CVI for each item in Iran

| Stakeholders  | Subcategory                      | Content validity index (I-CVI) |
|---------------|----------------------------------|--------------------------------|
| Workers       | Health and safety                | 1                              |
|               | Discrimination                   | 1                              |
|               | Wage                             | 1                              |
|               | Forced labour                    | 1                              |
|               | Sexual harassment                | 0.9                            |
|               | Employment relationship          | 1                              |
|               | Job satisfaction                 | 1                              |
| Local community| Health and safety                | 1                              |
|               | Local employment                 | 1                              |
| Farmers       | Water rights                     | 1                              |
|               | Land right                       | 1                              |
|               | Assistance with technology       | 1                              |
|               | development                      |                                |
|               | Assistance with loan             | 1                              |
|               | Healthy and safety               | 1                              |

### Table 5 The Item CVI for each item in Malaysia

| Stakeholders  | Subcategory                      | Content validity index (I-CVI) |
|---------------|----------------------------------|--------------------------------|
| Worker        | Discrimination                   | 0.8                            |
|               | Safety and health                | 0.9                            |
|               | Child labour                     | 0.8                            |
|               | Working hours                    | 0.9                            |
|               | Fair salary                      | 0.9                            |
|               | Employee benefit                 | 1                              |
| Farmer        | Income                           | 0.9                            |
|               | Safety and health                | 0.9                            |
|               | Assistant with technology        | 0.9                            |
|               | development                      |                                |
|               | Living standards                 | 0.8                            |
| Local community| Job opportunity                 | 0.9                            |
|               | Health and safety                | 0.9                            |
|               | Community engagement             | 0.9                            |
|               | Delocalization and migration     | 0.8                            |
(Taber 2018). Hence, according to the obtained result (Tables 6 and 7), the questionnaires were suitable and well designed for the data collection.

3.9 Life cycle impact assessment (S-LCIA)

The third step of S-LCA was the social life cycle impact assessment (S-LCIA). There were two steps involved: (1) characterization and (2) weighting. In the current study, the method for S-LCIA was the reference points approach based on Parent et al. (2010). According to the UNEP 2020 Guideline, the reference point approach was used when the aim of conducting S-LCA was to assess the social performance of products (UNEP 2020). The reference unit for wage and income are ringgit and rial for Malaysia and Iran, respectively. Other social indicators are presented in percentages.

3.10 Characterization

All social subcategories evaluated in this study were adapted from UNEP Guideline 2020. The inventory data were in percentage of yes or no reply to each question. All indicators were illustrated as percentage. This method for characterization was adapted from Aparcana and Salhofer (2013) and Manik et al. (2013). The value for characterization result was between 0 and 100. In this study, the important social aspects adapted from UNEP (2020) were considered: wage, health and safety, discrimination, forced labour, child labour, sexual harassment, employment relationship, and working hours for worker stakeholders. Health and safety, and local employment were examined for the local community stakeholders. Water rights, land right, assistance with technology development, assistance with loan, and health and safety were examined for farmer stakeholders.

| Stakeholders   | Subcategories                     | Number of items | Cronbach’s alpha |
|----------------|-----------------------------------|-----------------|------------------|
| Worker         | Discrimination                    | 10              | 0.788            |
|                | Safety and health                 | 10              | 0.834            |
|                | Child labour                      | 11              | 0.894            |
|                | Working hours                     | 12              | 0.694            |
|                | Fair salary                       | 10              | 0.714            |
|                | Employee benefit                  | 12              | 0.953            |
| Farmers        | Income                            | 10              | 0.855            |
|                | Safety and health                 | 10              | 0.911            |
|                | Assistant with technology development | 10             | 0.904            |
|                | Living standards                  | 10              | 0.906            |
|                | Job opportunity                   | 10              | 0.746            |
|                | Health and safety                 | 10              | 0.829            |
|                | Community engagement              | 10              | 0.941            |
|                | Delocalization and migration      | 10              | 840              |

3.11 Normalization

Normalization is a step to simplify comparison between different social indicators. The normalization was not needed since all the units were in the same unit (percentage) (Prasara-A and Gheewala 2019).

3.12 Weighting

In the weighting step, experts applied weight to the normalized results to show the importance of each social aspect. The following step has been conducted for assessment of...
social weighted social indicators which were adopted by (Prasara-A and Gheewala 2019).

1. Grading importance: Experts were asked to rate from 1 to 10 for each item. The weighting was conducted by inserting weighting box beside each item in questionnaires. The subcategory considered as more important should have greater weight. Number 1 meant least important and 10 was most important.

2. Assessing weighing factor for different indicators: The weighting factor for social subcategories was evaluated as the average importance social for each indicator to summarize it to value one. This number shows the weighted factor for different social indicator.

3. Weighting different social indicators: After calculating the weighting factors for each social indicator, the weighting factor was multiplied to the indicator result to obtain weighted performance indicator result. Finally, the weighted social performance for each stakeholder was evaluated by summing up the weighted social performance of all social issues for each stakeholder (Thuayjan et al. 2022).

The weighting factor in this study was evaluated using Eqs. 3 and 4 which were adopted by Thuayjan et al. (2022):

\[ WFi = \frac{MI_i}{\Sigma I_i} \]  

where \( WFi \) refers to the weighting factor for each indicator, \( MI_i \) refers to the mean of importance value from all experts for social index, and \( \Sigma I_i \) refers to total of mean of importance value for all social indexes for the same stakeholders.

\[ WF = \frac{MI}{\Sigma I} \]  

where \( WF \) refers to the weighting factor for each social issue, \( MI \) refers to the mean of important value from all experts to the special social issue, \( \Sigma I \) refers to the total mean of importance value of all social index in the similar stakeholder.

3.13 Interpretation

The weighted performance indicator result was presented from 0 to 100. To alleviate the interpretation, the classification was used following the approach of Sawaengsak et al. (2019). The weighted indicator result was classified to five classes between 0 and 100. The width of each class was 20. According to Table 8, value 0 to 20 showed poor performance and it showed with red colour, while 80 to 100 percentage showed the best performance and it showed with dark green colour. The meaning of weighted index is illustrated in Table 8.

4 Result and discussion

Table 9 shows the characterized social performance result for workers, local community, and farmer in Iran and Malaysia.

The result for the workers of rice cultivation showed bad performance in Iran with regarding to health and safety, wage, and worker satisfactory. The result for worker in Malaysia showed good performance in health and safety dimension (87%).

Rice cultivation in Iran for the local community did not show good performance regarding health and safety because of burning of rice residue. Around 62% of local Iranian people reported air pollution from rice residue burning. However, the performance was good in Malaysia and Iran in term of job opportunity for local community.

Sexual harassment was identified as one of the negative social issue in Iran with the score of 60% including unwanted sexual attention. In addition, most of the female workers did not prefer to work without their family (husband) in remote farms because they were afraid of sexual harassment.

Rice cultivation did not show a good performance for farmers in Iran with regard to satisfactory from income (0.14%), health and safety (2%), and marketing (2.4%).

Table 9 shows the characterized social performance result for workers, local community, and farmer in Iran and Malaysia.

| Weighted index (WI) | Classification | Colour scheme |
|---------------------|----------------|---------------|
| 0>WI>20            | Poor           | Red           |
| 21>WI >40          | Fair           | Yellow        |
| 41>WI>60           | Moderate       | Green         |
| 61>WI>80           | Good           | Light green   |
| 81>WI>100          | Very good      | Dark green    |

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movement control by the government. Farmers had to use local workers with high wage. Another issue was the price of rice that did not increase during harvesting time. The farmers had to sell the products at a low price to brokers because they could not store rice. For health and safety of farmers, 98% of the farmers had health and safety issues because of high stress. For the marketing of rice in Iran, most of the farmers were not satisfied about marketing since there was no good marketing in harvesting time. The government fixed the rice price by importing rice in harvesting season.

Rice production showed a bad performance for farmers in Iran with respect to water rights with the score of 35%. There was a lack of water for irrigation of rice and 93% of the farmers reported stolen water during irrigation.

Table 10 shows the weighted social performance of the different subcategories for each stakeholder in Iran.

Figure 5 shows the social performance of paddy rice workers in Iran and Malaysia. It can be seen that workers in Malaysia had better social performances than in Iran in terms of fair wage, health, and safety dimensions. Only 21% of Iranian workers were satisfied with their wage. However, 87% of Malaysian workers were satisfied, and based on classification, the wage subcategory shows poor (red colour) and moderate (yellow colour) performance in Iran and Malaysia, respectively. The rate of discrimination between workers in Malaysia was lower than Iran, meaning that the equality between men and women, foreign, and local workers was higher than Iran. Discrimination subcategory shows good performance (light green colour) in Malaysia, while it shows fair performance (orange colour) in Iran. The employers in Malaysia provided better health and safety equipment for workers compared to the employers in Iran and according to classification health and safety shows very good performance (dark green colour) in Malaysia and fair performance in Iran (orange colour).

Figure 6 illustrates the social performances of local community in Iran and Malaysia. Paddy rice production provides an employment opportunity to the local people in Iran and Malaysia. The results of this research showed that the job opportunity for local communities in Iran was better than in Malaysia. However, the health and safety of local community in Malaysia had better performance than in Iran due to the burning of rice residues with the score of 38% in Iran.

Figure 7 compares the social performances of farmers in Malaysia and Iran. The farmers in Malaysia had better performances than those in Iran with the score of 58% and 2%, respectively. Approximately 98% of farmers were under stress because of the heavy rainfall in harvesting time and they were not able to sell rice products at an appropriate
Table 10  Weighted social performance of different subcategory for each stakeholder

| Stakeholder involved | Subcategory                  | Result | Weighing factor | Weighed result |
|----------------------|------------------------------|--------|-----------------|----------------|
| Worker               | Health and safety            | 21     | 0.16            | 3.3            |
|                      | Discrimination               | 40     | 0.11            | 4.4            |
|                      | Wage                         | 17     | 0.16            | 2.27           |
|                      | Forced labour                | 64     | 0.16            | 10.24          |
|                      | Sexual harassment            | 40     | 0.18            | 7.2            |
|                      | Employment relationship      | 21     | 0.09            | 1.89           |
|                      | worker satisfactory          | 28     | 0.13            | 3.64           |
| Local community      | Health and safety            | 38     | 0.5             | 19             |
|                      | Local employment             | 99     | 0.5             | 49.5           |
| Farmer               | Water rights                 | 35     | 0.12            | 4.2            |
|                      | Land rights                  | 80     | 0.12            | 9.6            |
|                      | Assistance with technology development | 52     | 0.1             | 5.2            |
|                      | Assistance with loan         | 1      | 0.08            | 0.08           |
|                      | Health and safety            | 2      | 0.15            | 0.3            |
|                      | marketing                    | 2.4    | 0.17            | 0.40           |
|                      | Satisfactory from factory    | 74     | 0.13            | 9.62           |
|                      | Satisfactory from income     | 0.4    | 0.13            | 0.052          |

Fig. 5  Social performance of workers in Iran and Malaysia

Fig. 6  Social performances of local community in Iran and Malaysia
price because the government imported rice in harvesting season.

Only 0.4% of Iranian farmers were satisfied with their income because the selling price of rice in Iran was not in line with the inflation in the country. Inflation rate in Iran was 39.34%, while 2.5% in Malaysia in 2021 (FAO). In Iran, the price of rice is relatively fixed; however, the cost of workers, transportation, and agricultural machinery is high. Malaysian farmers had more assistance with technology development than Iran with the score of 78%. However, in Iran, buying modern agricultural machinery is not affordable because the area of farm land limits its usage.

In Iran, the income from rice production was not sufficient because of the low yield and lack of good marketing. Farmers had to sell rice at a low price to brokers. Farmers were also not supported by the government, especially since the government tried to fix the price by importing rice in harvesting time.

Figure 8 compares the weighted social performance in Iran and Malaysia. The social performance of workers in Malaysia was better than in Iran because of good performance in health and safety, discrimination, and wage fair dimensions. The result showed that the social performance for farmers in Malaysia had a better performance than in Iran owing to the high yield and lower production cost by using modern agriculture. In modern agriculture, the cost for per hectare of rice production is lower than traditional agriculture and modern agriculture can produce higher yield per hectare (Devi and Ponnarasi 2010). However, local community had the better performance in Iran than Malaysia because of high job opportunity for the local community.

Table 11 compares the overall weighted social performance of paddy rice production in Iran and Malaysian based on three stakeholders. The result showed that the workers and farmers in Malaysia showed good performances with the higher score in comparison to those of

![Fig. 7 Social performances of farmers in Iran and Malaysia](image1)

![Fig. 8 Weighted social performance in Iran and Malaysia](image2)
Iran with 62 and 66, respectively. The farmers showed poor performance resulting from low satisfactory from income, and low yield and high cost of paddy production in Iran. The local community showed a good performance in both cases. However, the weighted social performance of local community in Iran was slightly higher than Malaysia.

5 Discussion

The outcomes of this research provide rich information about the positive and negative social performances of paddy rice production in northern Iran and western Peninsular Malaysia. The finding from this study indicated that the modern agriculture showed better performance for the worker and farmers. Health and safety for local community in modern agriculture showed better performance as a result of low rice residue burning and low air pollution.

The important social issues that affected the overall social impact on workers in Iran were health and safety, and wage. The farmer stakeholders showed relatively low performance in Iran. The main investigated social issue in Iran for farmers was associated with loan, health and safety, and marketing.

The limitation of this study was data collection, which was a time consuming step of doing S-LCA approach. However, in this study, the main social issue was evaluated because of time limitation. For a comprehensive social evaluation, some indicators had to be regarded, for example delocalization, freedom of association, and collective.

Prasara-A and Gheewala (2019) evaluated social life cycle of rice cultivation in Thailand. The result showed that the rice cultivation had the best performance in working hour, forced labour, and child labour. Health and safety of workers showed high performance. The rice production in Thailand showed good performances on local community considering health and safety with 100%. There was no good marketing for rice in Thailand and farm owner sold freely. The farmers did not have access to loans and technology development.

The result of social performance of paddy rice production for workers was similar with the result in Thailand and Malaysia which showed good performance (Table 12). However, the result was different from Iran, with fair performance, because of low score for health and safety, discrimination, and wage.

The result of the social performance of paddy rice for farmers in Iran was similar to the results reported by Prasara-A and Gheewala (2019) in Thailand since both cases did not show good performances in marketing and assistance with loan. However, Malaysia showed a good performance for the farmer stakeholders. The result of social performance of local community was the same in all of these three cases of studies with good performance.

| Stakeholder | Weighted social performance in Iran | Weighted social performance in Malaysia |
|-------------|-----------------------------------|----------------------------------------|
| Worker      | 29.64                             | 62                                     |
| Local community | 68.5                           | 64                                     |
| Farmer      | 15.6                              | 66                                     |

| Prasara-A and Gheewala (2019) in Thailand | Good performance | Good performance | No good loan |
| Current study in Iran | Equitable performance | Good performance | Poor performance |
| Current study in Malaysia | Good performance | Good performance | No good health and safety |
| Current study in Malaysia | Good performance | Good performance | No satisfy from income |
| Current study in Malaysia | Good performance | Good performance | No good loan |

Table 12 Comparison of social performance of paddy rice production in different countries
6 Conclusion

This research used social-LCA to compare the social performance of paddy rice production in different farming methods. In Malaysia, the farmers use modern technology to plant rice. However, in Iran, rice cultivation is a combination of traditional and modern technology. The result indicated that the social performance of workers and farmer stakeholders in modern and multiple farming were significantly different. The workers and farmers using modern agriculture showed good performance with high score due to the fact that modern agriculture had lower cost, and slightly more yield, contributing to satisfactory income for farmers.

Social performance on local community was not different and both of them showed good performance. However, social performance on health and safety of the local community in modern farming showed the better performance because in Iran, burning rice residues contributed to air pollution.

This study is important especially to the countries like Iran to take into consideration the social performance of other country such as Malaysia where the implementation of modern agriculture is applied in order to achieve a better social performance of their stakeholders. This paper gives the insight of the better forms and applications of modern agriculture but it is subjected to capability to apply it due to certain restriction like budget allocation.

Further evaluation could be accounted by integrating lifecycle costing approach with S-LCA method to provide a more comprehensive sustainability evaluation of social and economic dimensions. Consumer stakeholder should be evaluated in further studies. Besides that, the environmental impact of burning of rice residue should be evaluated in future studies.

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Data availability The datasets generated during (10/02/2021–01/12/2021) and analyzed during (01/01/2022–10/03/2022) of the current study are not publicly available because of some sensitiveness of the data; it is about specific organization. Name of the organization (paddy rice company in Malaysia and Iran) will not be disclosed, but are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

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Authors and Affiliations

Somayeh Rezaei Kalvani1 · Amir Hamzah Sharraei1,2 · Mohammad Firdaus Masri1 · Nurul Faeiqah Mat Yunus1 · Mohd Ridzuan Afendi1 · Onyeiwu Brendan Uchechukwu1

1 Department of Environment, Faculty of Forestry and Environment, Universiti Putra Malaysia, 43400 UPM Serdang, Malaysia
2 Institute of Tropical Agriculture and Food Security, Universiti Putra Malaysia, 43400 UPM Serdang, Malaysia