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Social life cycle assessment of rice production (A case study of Talesh County, Northwest Iran)

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ABSTRACT

The social life cycle is an emerging field in the agricultural and food industry that quantifies social impacts, e.g., working conditions, community impacts, and human rights concerns. The publication of guidelines for social life cycle assessment of products and services in 2009 brought about a new and remarkable development in life cycle assessment. In the current situation that we are moving towards sustainable development and responsible production and consumption, it is necessary to focus on improving not only the environmental conditions but also the social conditions of production. Social life cycle assessment is presented as the most effective technique to assess the social impacts of products during their life cycle. The present research was conducted in Talesh County, Guilan Province in 2025 to investigate the social effects of rice production by using social life cycle assessment. So, 416 participants were randomly sampled from five stakeholder groups, including rice mill managers (n = 49), rice mill workers (n = 81), rice farmers (n = 95), rice field workers (n = 95), and the local community (n = 96). In the present study, in order to investigate the social impacts of rice production, four social indicators were evaluated: "human rights", "working conditions", "cultural heritage and community development", and "socio-economic consequences". The results showed that the social conditions governing the rice production cycle in Talesh County were at a moderate level. Some social indicators, such as "working conditions," were found to have an average status from the perspective of the stakeholder groups of factory managers, factory workers, rice farmers, and rice field workers. The criterion "cultural heritage and community development" was revealed to be weak and need improvement from the perspective of factory workers, rice farmers, and rice field workers. Based on the results, the sub-criterion of "working conditions" did not gain a good score. In the two sub-criteria of freedom of association and collective negotiations of employees with the employer and fair rights, rice farm workers did not have a favorable situation while a large number of workers were unaware of their basic rights, resulting in labor and employer conflicts and the reluctance of workers to do the work properly and the resulting dissatisfaction of both groups. If wage inequalities and gender gaps in this sector are reduced, households' living conditions and well-being will be significantly improved. By prioritizing workers' welfare, the sector can have a more sustainable and responsible workforce. As workers' satisfaction increases in all aspects, the aspects of social sustainability will be in more favorable conditions.

Keywords: Social effects, Social sustainability, Food security, Sustainable development.

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INTRODUCTION

According to sociologists, the main actors in the development process are humans, whose social organization patterns play a major role in determining appropriate solutions and measures to achieve sustainable development. If social factors are overlooked in the development process, the effectiveness of the development plans and programs will be seriously jeopardized (Portahari *et al.* 2011). In other words, social sustainability considers how people, society, and societies communicate (Safeie-Noghlbari *et al.* 2024). Considering the existing physical boundaries, social sustainability results from actions in the social fields of individuals and society, so it includes a range of skill development and inequalities in the bio-environmental and spatial fields. In addition, the measurement of social sustainability requires newer concepts such as happiness, well-being, and quality of life, in addition to traditional criteria like justice and health (Colantonio *et al.* 2009).

Social sustainability, which is a link between different dimensions of sustainable development (Colantonio 2009), is defined as a healthy, fertile, and harmonious life with nature. Also, ensuring a "better future for all" is one of the pillars of defining social sustainability, with the emphasis put on their vital role in environmental management and development (Portahari *et al.* 2011). An essential aspect of sustainable development is sustainable agriculture (Gómez-Limón & Riesgo 2009), which has three main goals: economic productivity, environmental quality, and social responsibility. Typically, these goals should be examined together (Korfmacher 2000). The first definition of sustainable development was as follows: "Development that meets our needs today without compromising the capabilities of future generations" (Ihuah *et al.* 2014). In the literature of sustainable development, less attention has been paid to the aspects of social sustainability. Sustainability cannot be achieved unless we accomplish a basic and acceptable level of sustainability in social dimensions (Tavakkoli 2014). The report of sustainable development guidelines for measuring social sustainability includes four indicators of how to operate and achieve an ideal job, human rights, society, and responsibility (Shams al-Dini *et al.* 2016). In addition, all social dimensions have a chain relationship (Mota *et al.* 2015). Sustainable development seeks to provide a solution to meet basic human needs, protect the environment, achieve equality, ensure social self-determination and cultural diversity, and maintain ecological integrity. Although the concept of sustainable development has undergone changes in the past (Tomislav 2018) and there have been several definitions of sustainable agriculture, the most general definition of sustainable agriculture is that it includes all economic, social, and ecological aspects. In other words, agriculture will be sustainable when it is socially feasible and compatible, economically justifiable, politically appropriate, managerially feasible, and environmentally compatible (Salmanzadeh 1991).

In the past years, many efforts have been made to introduce a coherent method that encompasses all the basic elements of sustainable development (Benoît & Mazijn 2009; Benoît *et al.* 2010). One of these powerful tools is life cycle assessment. When production and services are considered from the perspective of sustainable development, the life cycle assessment technique, as a comprehensive technique capable of covering all dimensions of sustainable development, provides a clear vision for the future and achieving sustainable development (Benoît *et al.* 2010; Lehman *et al.* 2013; Zamagni *et al.* 2013).

Currently, sustainability is becoming an essential goal worldwide (Chang *et al.* 2016). Life cycle analysis, life cycle cost, and analysis of the social effects of the life cycle are analytical tools that contribute to determining the pattern for the transition to sustainable production and consumption. The environmental life cycle assessment describes the environmental effects of products or services during their life cycle; the life cycle cost assessment deals with the costs spent by different actors during the life cycle; and the social life cycle assessment deals with the social functions of people who are involved in the activities they are related to the company's product life cycle. Here is where it can be said that if these tools are used together, they will give the appropriate results in terms of sustainability, and as a result, a life cycle sustainability assessment can be done (Benoît *et al.* 2010). In the agricultural and food industry, the social life cycle is an emerging field that quantifies social impacts such as working conditions, community impacts, and human rights concerns (Voglhuber-Slavinsky *et al.* 2022). Social life cycle assessment, as one of the three sides of this comprehensive assessment, creating a new and tremendous development in life cycle assessment (Benoît *et al.* 2010). In the current situation that we are moving toward sustainable development and responsible production and consumption (Araújo *et al.* 2019), it is necessary to think about improving not only environmental conditions but also the social conditions of product production (De Oliveira *et al.* 2018). Social life cycle assessment has been presented as the most effective technique for assessing the social impacts of products during their life cycle (Macombe *et al.* 2018).

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After wheat, rice occupies the largest cultivation area of agricultural lands in the world and plays an important role in the nutrition, income, and employment of people in the world, including Iran (Khani *et al.* 2023). Rice is one of the most basic daily needs of Iranians, and as a staple good, is in the consumption basket of Iranian households (Khani *et al.* 2023). The main rice production areas in Iran are the northern provinces of Mazandaran, Guilan, and Golestan. Although it is also cultivated in Fars and Khuzestan provinces and several other provinces, the largest share of production is related to the three northern provinces. Meanwhile, Guilan Province, with an average area of 174,016 hectares of rice cultivation and 661,486 tons of paddy production, ranks second in rice production (Ministry of Agriculture Jihad, 2022). Rice production and economy in Guilan are crucial. Given the employment of over 50% of the residents of the province in rice production and the allocation of about 31.2% of Iran's total rice production to Guilan, its cultivation and economy in this province is in a position that deserves comprehensive attention (Ahmadzadeh 2020). Talesh County is located in the western region of Guilan Province. With an area of 2,160 square kilometers and a rice cultivation area of 7,347.6 hectares, this county is considered one of the important rice cultivation areas. Considering that about 14,825 farmers are engaged in rice cultivation in this county, it can be said that the average rice cultivation area for each farmer is about 0.495 hectares. The main purpose of the present research was to evaluate the social effects of rice production in Guilan Province, determine the existing social situation, and evaluate its expected situation. The results will undoubtedly be helpful in formulating strategies and supporting policies for the sustainable development of rice production.

MATERIALS AND METHODS

The statistical population was composed of rice mill managers, rice mill workers, rice farmers, rice field workers, and the local community of Talesh County, Northwest Iran. The time domain of the research was the agricultural year 2024, and the spatial domain was Talesh County in Guilan Province. The required data was collected using a researcher-made questionnaire after its validation and reliability were verified. Microsoft Excel and SPSS software were used for data analysis using descriptive and inferential statistics. The study evaluated the social effects of rice production using the life cycle assessment method. The life cycle assessment technique is used as a comprehensive technique that can cover all aspects of sustainable development. It conforms to ISO 14040 (ISO 2006b and ISO 2006c) and ISO 14044 standards. As depicted in Fig. 1, it has four steps at the operational level: defining the goal and scope, listing the product life cycle, evaluating the effects of the product life cycle, and interpreting the results.

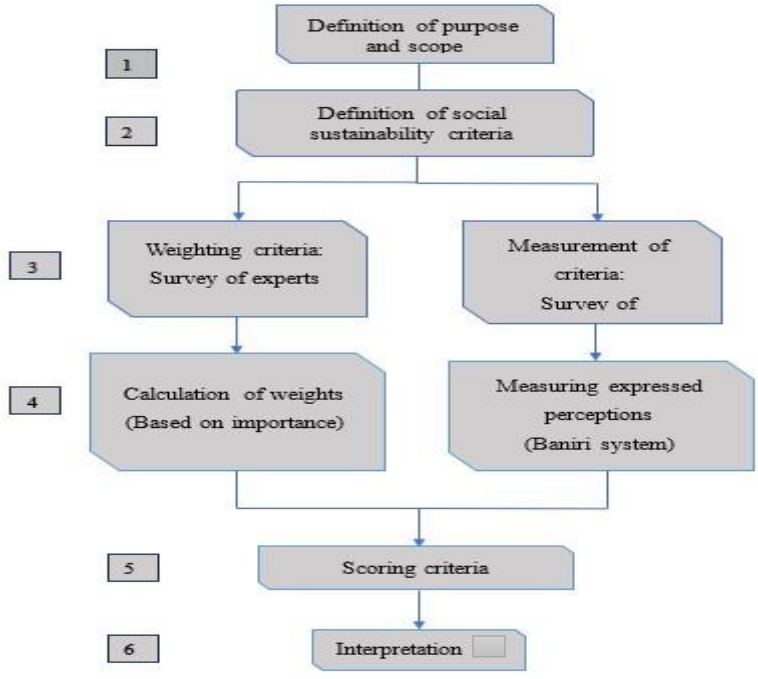

Fig. 1. The research Empirical model framework. (Manik *et al.* 2013).

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The criteria developed by the International Environment Program and the Society of Environmental Toxicology and Chemistry were used for social evaluation. They include human rights, working conditions, cultural heritage and community development, and social-economic consequences, each with its own sub-criterion.
In the current study, various indicators were developed to assess criteria derived from the methodological sheets for subcategories within Social Life Cycle Assessment (Table 1).

Table 1. Beneficiaries, criteria, and sub-criteria of the study.

Beneficiaries	Criteria (A_i)	Sub-Criteria (A_{ij})	Reference
Factory managers	Human rights (A1)	Lack of child labor (A11) no employment of forced labor (A12) Equal opportunities, non-discrimination (A13)	(Safeie Noghlbari *et al.* 2024)
Factory workers	Working conditions (A2)	Freedom of assembly and collective negotiations of employees with the employer (A21) Fair rights (A22) Convenient working hours (A23) Occupational health and safety (A24) Social benefits (A25)	(Sawaengsak *et al*. 2019)
Rice farmers Rice field workers	Cultural heritage and community development (A3)	Preventing the migration of indigenous people (A31) Respect for cultural heritage and local subcultures (A32) Respecting the customary rights of the native inhabitants of the region (A33) Participation and employment of communities (A34) Healthy living conditions (A35) Clarification of social/environmental issues (A36)	(Safeie Noghlbari *et al.* 2024)
Local community	Socio-economic consequences (A4)	Participation and local employment (A41) Contribute to economic development (A42) Technology transfer (A43) Public commitment to sustainability issues (A44)	(Sawaengsak *et al*. 2019)

The research used a panel of experts, including faculty members of universities across Guilan Province, to validate and assign weights to criteria and sub-criteria. A simple relative weighting method was used to assign weights to social criteria and sub-criteria based on experts' views (Manik *et al.* 2013). Based on the literature review, the number of experts needed in this stage was eight people. For this purpose, a questionnaire was prepared in which the experts were asked to give scores to the criteria and sub-criteria of social effects based on their importance from 1 showing the least importance to 7 showing the most importance. In Table 2, the weights obtained for each of the indicators are adjusted with a simple proportionality. In this way, the new weights of each of the indicators are obtained.
In the next step, the identified criteria were evaluated based on the perspective of the stakeholders. The stakeholders identified in the present study were rice mill managers, rice mills workers, rice farmers, workers in rice fields, and the local community (people who live in the area where rice is grown).

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Table 2. The calculated weight and adjusted weight of the sub-criteria.

Sub-criteria	Calculated weight	Adjusted weight	Total adjusted weight
A11	0.341	1.023	3
A12	0.335	1.005	
A13	0.324	0.972	
A21	0.190	0.950	5
A22	0.198	0.990	
A23	0.208	1.040	
A24	0.209	1.045	
A25	0.195	0.975	
A31	0.159	0.954	6
A32	0172	1.032	
A33	0.159	0.954	
A34	0.210	1.260	
A35	0.150	0.900	
A36	0.149	0.894	
A41	0.288	1.152	4
A42	0.258	1.032	
A43	0.227	0.908	
A44	0.227	0.908	

Source: Research findings.

The opinions of each group of stakeholders were evaluated using a questionnaire tool. Five specific questionnaires (for each beneficiary) were prepared. The validity and reliability of each questionnaire were checked. Finally, the questionnaires were completed in person at the site through face-to-face interviews. The general framework of the study was composed of the following steps:

Step 1. Specifying the beneficiaries and the relevant social issues

These evaluations were conducted at two levels:

1. Evaluation of social effects at the criteria level (including human rights, working conditions, cultural heritage, community development, and socio-economic consequences)

2. Evaluation of social effects at the sub-criteria level (e.g., no employment of child labour, no employment of forced labour, equal opportunities, and no discrimination)

Step 2. Scoring of sub-criteria

The questions related to social criteria were extracted using the global standard of sustainability, including the global bioenergy partnership and the assessment of the sustainability of food and agricultural system s. However, some of these questions were adapted according to the conditions of the society, internal laws, and the type of data. The descriptive method used in this research was in compliance with norms on a dichotomous scale (yes/no).

The percentage of people who gave the expected (standard) answer to each of the questions below the criteria was calculated using Eq. (1). By scoring the results expressed from the sub-criteria based on Table 3, the actual results expressed (ACT_{ER}) were extracted. Further, according to Eq. (2), the actual performance results (PRact) were calculated by dividing the actual stated results ($\sum ACT_{ER}$) by the sum of the ideal results of the same sub-criteria ($\sum$ACTmax), which is a value between 0 and 1.

The stated results of the sub-criteria(ER_{ij}) were calculated using Eq. (1) in which *i* represents the index number and *j* represents the sub-criterion number.

$$ER_{ij} = \frac{\text{"The number of yes or no responses to the question of each indicator"}}{\text{"The total number of responses to the index question"}} \times 100 \quad (1)$$

After scoring the results of the sub-criteria(ER_{ij}), the actual stated results (ACT_{ER}) were obtained for each sub-criterion. Meanwhile, the actual performance results under the criteria (PRact) were calculated by Eq. 2.

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$$PR_{act} = \frac{\sum ACT_{ER}}{\sum ACT_{max}} \quad (2)$$

in which $\sum ACT_{ER}$ is the sum of the actual expressed results of each sub-criterion and $\sum ACTmax$ is the sum of the ideal results of the same sub-criterion (Sawaengsak *et al.* 2019).

Table 3. The scoring and categorization of the actual stated results.

The results are stated (ER_{ij})	Actual stated results ACT_{ER}
80% <ER_{ij} ≤100%	5
60% < ER_{ij} ≤80%	4
40% < ER_{ij} ≤ 60%	3
20% < ER_{ij} ≤ 40%	2
0% < ER_{ij} ≤ 20%	1

Source: (Sawaengsak *et al.* 2019).

Step 3. Determining the weight coefficient of each sub-criterion

In order to assign weight to each of the social criteria and sub- criteria in the current research, a questionnaire was prepared in which the experts were asked to use the simple relative weighting method (Manik *et al.* 2013) to give points from 1 to 7 to each of the social sub-criterion based on their importance. Score 7 represented the highest importance, and score 1 represented the lowest. Finally, the weight of each of these sub- criteria was calculated so that the set of weights obtained under the criteria of each index was supposed to be equal to 1. In the present study, in scoring the performance of each of the social sub-criteria, it was necessary to assign weights to each of them based on the total number of all the sub- criteria of each criterion so that the weights for each of the criteria were adjusted with a simple proportion and the new weights of each of the sub- criteria were specified. In this method, the maximum value of the adjusted weight of each sub-criterion could be greater than one (Sawaengsak *et al.* 2019).

Step 4. Determining the adjusted performance score of the sub-criteria and the effective performance score of social indicators

The adjusted performance result of the sub-criteria (PR_{adj}) was calculated by multiplying the PR_{ACT} of each sub-criterion by the adjusted weight (W) of that sub-criterion based on Eq. (3) (Sawaengsak *et al.* 2019).

$$PR_{adj} = PR_{act} \times W \quad (3)$$

PR_{adj} was calculated using the rating system in Table (4), and the adjusted performance score (PS_{adj}) was estimated for each sub-criterion. After estimating PS_{adj} for each social effect sub- criteria, the effective performance score of each criterion (IPS) was calculated using the average PS_{adj} scores. When the calculated decimal number was up to 0.5, it was rounded to a lower number, and when it was higher than 0.5, it was rounded to a higher number (Sawaengsak *et al.* 2019).

Table 4. Determining the adjusted performance score and ranking of the adjusted performance score

(PR_{adj}) Adjusted performance result	Adjusted Performance Scor (PS_{adj})	Adjusted performance rating
80% < PR_{adj} ≤ 1.0	5	Best
60% < PR_{adj} ≤0.80	4	Good
40% < PR_{adj} ≤ 0.60	3	Moderate
%20 < PR_{adj} ≤ 0.40	2	Limited
0% ≤ PR_{adj} ≤ 0.20	1	Unacceptable

Source: (Sawaengsak *et al.* 2019).

To identify the effects of social metrics, Fig. 2 shows the steps to achieve effective and adjusted performance scores, respectively.

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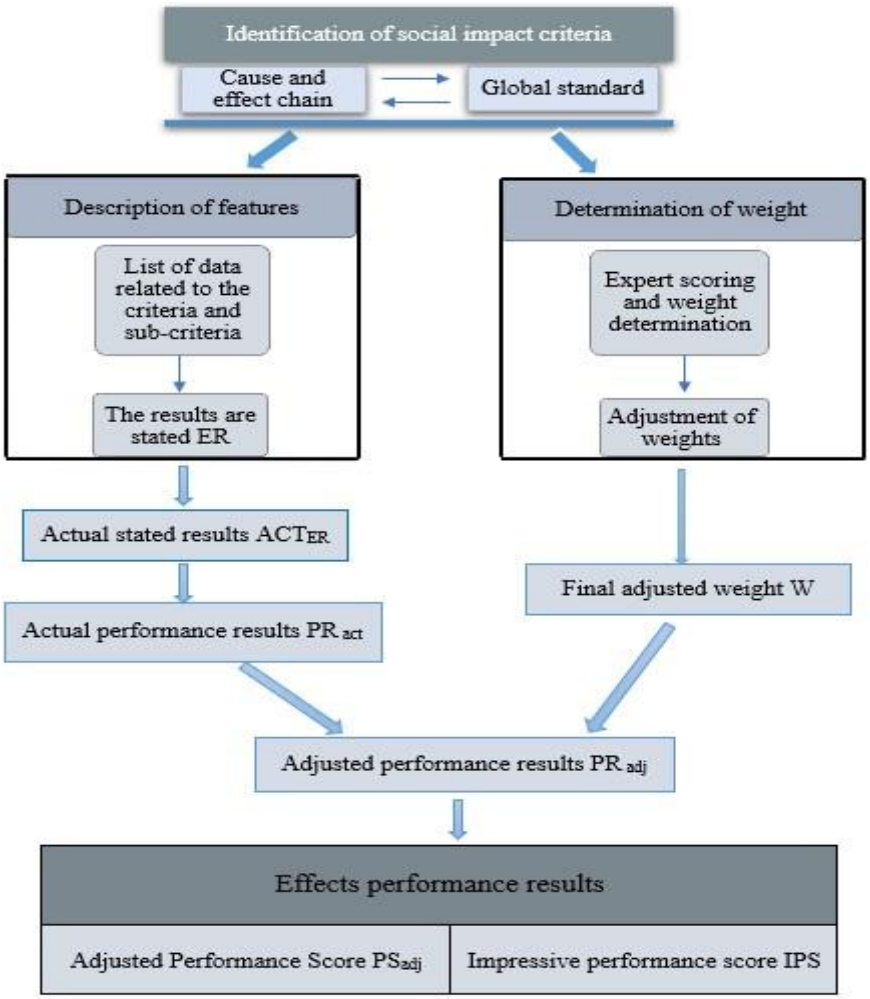

Fig. 2. The framework developed for social impact assessment (Sawaengsak *et al.* 2019).

Population size and determination of sample size

The Population size was rice mill managers, rice mill workers, rice farmers, rice field workers, and the local community in Guilan Province. The sample size was determined by Cochran's formula with the known population size, as shown in Eq. (4) (Hafeznia 2019).

$$\boldsymbol{n_0} = \frac{Nz^2pq}{Nd^2+z^2pq} \quad (4)$$

in which n_0 represents the sample size, N represents the community size, Z is 1.96, p is 0.5, q is 0.1, and d represents the allowed error value.

RESULTS AND DISCUSSION

Some descriptive characteristics of the studied samples are shown in Table 5. The statistical sample included rice mill managers (49 people), rice mill workers (81 people), rice farmers (95 people), rice field workers (95 people), the local community (96 people), and experts in agricultural economy, rural development, and agricultural jihad (8 people). In addition, there were both men and women in the studied sample. The lowest number of samples was related to experts, and the highest number of samples was related to the local community. After collecting the questionnaires, the collected information was classified and entered into Excel and SPSS software to perform calculations. First, the questionnaires related to experts' scoring of social criteria were examined and analyzed. Then, the percentage of people who gave the expected (standard) answer to each of the questions under the indicators was calculated using Eq. 1.

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Table 5. Statistical information collected from the participants.

Samples	Model society			Education		Average age (year)	Average work experience (years)
	Population size	Sample size (a=10%)	%	Diploma and sub-diploma	University education		
Factory managers	101	49	11	45	4	62.3	22.9
Factory workers	505	81	19	70	11	37.4	13.7
Rice farmers	14825	95	23	76	19	50	22.7
Rice field workers	14825	95	23	77	18	43.2	15.6
Local community	200649	96	22	69	27	38	13
Experts	8	8	2	4 masters, 4 PhD		41.5	14.5

Source: Research findings.

Based on the results, the indicator "human rights" generally had an average score (Table 8). As can be seen in Table 7, the sub-criterion "non-employment of child labour" gained a full or very high score in the groups of factory workers and rice farmers, which was the highest score. It had a good score in the two groups of factory managers and rice field workers. This result is consistent with the result reported by Safeie Noghlbari *et al.* (2024), according to whom a small number of people under the age of 18 were engaged in olive oil production. However, it does not agree with the result of Vinci *et al.* (2024), who found that children were often used as labour in the cocoa production chain. They ascribed its reason to the fact that most children in West Africa (here Ghana and Ivory Coast as their case studies) lived in extreme poverty. Therefore, it seems that as the economic situation improves in the countries and poverty becomes less severe, fewer children are exposed to the risk of child labour. Regarding the indicator "absence of forced labour," the two groups of factory managers and factory workers got average scores, rice farmers got very good scores, and rice field workers got good scores. This result is consistent with Vinci *et al.* (2024), who found that this indicator was in a favourable situation. Nonetheless, it is inconsistent with Vinci *et al*. (2023), who studied Brazil and India and revealed that rice was produced using forced labour. Although we showed that the subsistence situation of the forced labour in rice production in the study area was low, this situation was still far from complete eradication. In the sub-criterion "equal opportunities and non-discrimination" compared to the other two sub-criteria in the human rights criterion, the situation was comparatively weaker, and it had an average score in the groups of factory managers, factory workers, and rice farmers. The group of rice field workers got a weak score to this sub-criterion. This result is consistent with Vinci *et al.* (2023). Based on their results, it can be understood that Sri Lanka, Senegal, and Bangladesh were the countries where the gender gap, i.e., the difference between the average income of women and men, was high. Given that the contribution of women in the agricultural and economic sectors is very important, if wage inequalities and gender gaps (for the same job) in this sector are reduced, the living conditions and well-being of households will be significantly improved.

The criterion "working conditions" generally had an average score (Table 8). In this criterion, the sub-criterion "freedom of association and collective negotiations of employees with the employer" had an average score with a poor score in the group of factory managers, a good score in the group of factory workers, and a poor score in the group of rice field workers. This result is consistent with the result of Safeie Noghlbari *et al.* (2024), according to whom the availability of workers' membership in unions was not favourable and a large number of workers were not familiar with their respective unions. Providing conditions for workers' membership in unions and holding meetings with workers and employers improves the conditions of labour and employer rights and, as a result, reduces the existing differences between labour and employer groups.

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Table 6- The results of actual performance and adjusted performance at the sub-level of social indicators

	Factory managers			Factory workers			Rice farmers			Rice field workers			Local community		
	PR_{act}	W	PR_{adj}	PR_{act}	W	PR_{adj}	PR_{act}	W	PR_{adj}	PR_{act}	W	PR_{adj}	PR_{act}	W	PR_{adj}
A1. Human rights															
A11. Lack of child labor	0.6	1.023	0.613	1	1.023	1.023	0.8	1.023	0.818	0.6	1.023	0.613	×	×	×
A12. Absence of forced labor	0.571	1.005	0.574	0.584	1.005	0.587	1	1.005	1.005	0.7	1.005	0.703	×	×	×
A13. Equal opportunities and non- discrimination	0.566	0.972	0.550	0.55	0.972	0.534	0.55	0.972	0.534	0.4	0.972	0.388	×	×	×
A2. Working conditions A2															
A21. Freedom of assembly and collective negotiations of employees with the employer	0.4	0.95	0.38	0.65	0.95	0.617	×	×	×	0.3	0.95	0.285	×	×	×
A22. Fair rights	0.68	0.99	0.673	0.571	0.99	0.565	0.5	0.99	0.495	0.333	0.99	0.33	×	×	×
A23. Suitable working hours	0.5	1.04	0.52	0.533	1.04	0.554	0.2	1.04	0.208	0.4	1.04	0.416	×	×	×
A24. Occupational health and safety	0.784	1.045	0.819	0.587	1.045	0.612	0.84	1.045	0.877	0.6	1.045	0.627	×	×	×
A25. Social benefits	0.55	0.975	0.536	0.575	0.975	0.560	0.8	0.975	0.78	0.4	0.975	0.39	×	×	×
A3. Cultural heritage and development															
A31. Preventing immigration of indigenous people	0.6	0.954	0.572	×	×	×	0.6	0.954	0.572	×	×	×	0.4	0.954	0.381
A32. Respect for cultural heritage and local subcultures	0.8	1.032	0/825	×	×	×	0.4	1.032	0.412	×	×	×	0.4	1.032	0.412
A33. Respecting the customary rights of the native inhabitants of the region	0.733	0.954	0.699	×	×	×	0.8	0.954	0.763	×	×	×	0.6	0.954	0.572
A34. Participation and employment of communities	0.4	1.26	0.504	×	×	×	×	×	×	×	×	×	0.3	1.26	0.378
A35. Healthy living conditions	0.9	0.9	0.81	0.35	0.9	0.315	0.55	0.9	0.495	0.4	0.9	0.36	0.4	0.9	0.36
A36. Clarification of social/environmental issues	0.8	0.894	0.715	×	×	×	×	×	×	×	×	×	0.6	0.894	0.536
A4. Social economic consequences															
A41. Local participation and employment	0.4	1.152	0.460	×	×	×	×	×	×	×	×	×	0.4	1.152	0.460
A42. Contribute to economic development	0.6	1.032	0.619	×	×	×	×	×	×	×	×	×	0.4	1.032	0.412
A43. Technology transfer	0.6	0.908	0.544	×	×	×	×	×	×	×	×	×	0.2	0.908	0.181
A44. Public commitment to sustainability issues	0.725	0.908	0.658	×	×	×	×	×	×	×	×	×	0.55	0.908	0.499

Source: research findings

Table 7. The adjusted performance score under social criteria by beneficiaries.

Sub social criteria	Factory managers	Factory workers	Rice farmers	Rice field workers	Local community
A11. Lack of child labor	4	5	5	4	×
A12. Absence of forced labor	3	3	5	4	×
A13. Equal opportunities and non- discrimination	3	3	3	2	×
A21. Freedom of assembly and collective negotiations of employees with the employer	2	4	×	2	×
A22. Fair rights	4	3	3	2	×
A23. Suitable working hours	3	3	2	3	×
A24. Occupational health and safety	5	4	5	4	×
A25. Social benefits	3	3	4	2	×
A31. Preventing immigration of local people	3	×	3	×	2
A32. Respect for cultural heritage and local subcultures	5	×	3	×	3
A33. Respecting the customary rights of the native inhabitants of the region	4	×	4	×	3
A34. Participation and employment of communities	3	×	×	×	2
A35. Healthy living conditions	5	2	3	2	2
A36. Clarification of social/environmental issues	4	×	×	×	3
A41. Local participation and employment	3	×	×	×	3
A42. Contribution to economic development	4	×	×	×	3
A43. Technology transfer	3	×	×	×	1
A44. Public commitment to sustainability issues	4	×	×	×	3

Source: Research findings.

After calculating PS_{adj} for each sub-indicator, the performance score of the social criteria (IPS) was obtained.

Table 8. The effective performance score of the social indicators.

Class of social criteria	Factory managers	Factory workers	Rice farmers	Rice field workers	Local community	Overall result
A1. Human rights	3	4	4	3	×	3
A2. Working conditions	3	3	3	3	×	3
A3. Cultural heritage and community development	4	2	3	2	2	3
A4. Economic and social consequences	3	×	×	×	2	2

Source: Research findings

The "fair salary" criterion gained a good score from the group of factory managers, a poor score from the group of rice field workers, and an average score from the two groups of factory workers and rice farmers. This result is consistent with Vinci et al. (2023). They found that workers in India and Sri Lanka received low wages for rice production, depriving them of good living conditions, so they could not meet the basic needs of themselves and their families. If the workers receive salaries and wages suitable for their working conditions, they can provide for their basic needs, have adequate free time to rest, and have favourable living conditions. The criterion "suitable working hours" gained an average score from the groups of factory managers, factory workers, and rice field workers and a poor score from the group of rice farmers. This result supports the findings of Vinci *et al.* (2024), according to whom the average working hours in Ghana for cocoa production was 30.2 hours per week, while the

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average working hours should be between 40-48 hours per week. Higher or lower working hours can lead to a person's inability to achieve his professional goals. The more suitable the working hours of the workers are, the better and more professional they will be in doing their work. Regarding the indicator "occupational health and safety", the factory managers and rice farmers got the highest score (very good) and the factory workers and rice field workers got a good score. This result does not agree with the result of Rivera-Huerta *et al.* (2019). The category "health and safety" was evaluated through the sub-sets of "health and safety" and "safe and healthy living conditions." Based on the results, the health and safety conditions in livestock farms were unsuitable. However, this result is consistent with the result of Safeie Noghlbari *et al.* (2024). They showed that although olive oil production in Iran has favourable social conditions, efforts should be made to improve it as much as possible because damage to the agricultural sector may be seriously harmful to people. Therefore, it is mandatory to have an official policy regarding health and safety, which should be determined by law because these incidents can cause serious injuries or negative effects on the workers themselves and the family income by reducing the worker's physical capacity or dismissal from the job. Regarding the criterion "social benefits," the group of rice farmers got a good score, the group of rice field workers got a poor score, and the two groups of factory managers and factory workers got an average score. Similarly, Safeie Noghlbari *et al.* (2024) showed that in the production of olive oil in Iran, just a few workers had a written contract, household allowance, insurance, etc., making the overall conditions unfavourable.

The results in Table 8 indicate that the criterion "cultural heritage and community development " had an average score. In addition, according to the scores in Table 7, regarding the criterion "preventing the migration of native people," the factory manager and rice farmer groups had an average score and the local community group had a weak score. This result agrees with Vinci et al. (2024) who concluded that the use of migrant workers in Ghana and Ivory Coast had increased the risk of discrimination, unfair working conditions, and conflict with local communities. Because smallholder cocoa farmers had little financial ability to hire the required labour from their local community, they used cheaper labor sources such as migrant labour. In fact, as the working conditions become more favourable for people in the community, their migration reduces. In the sub-criterion "respect for cultural heritage and local subcultures", the group of factory managers had a very good score, while the group of rice farmers and the local community had an average score. This result is consistent with Safeie Noghlbari *et al.* (2024) who showed the favourable conditions for this social sub-index in the olive oil production cycle. Better factory conditions and higher crop quality will be instrumental in publicizing the crop throughout the community. Under the criterion “respect for the customary rights of native residents of the region,” factory managers and rice farmers had a good score and the local community had an average score. This result is consistent with Safeie Noghlbari *et al.* (2024) who demonstrated the favourable conditions for this social sub- criterion in the olive oil production cycle, so that the values and traditions have been paid attention to in the production of this product. The observance of citizenship rights by the factory managers has also improved these social criteria in society. Holding more meetings between factory managers and local communities, reporting more problems and obstacles in the society, and paying more attention to the rights of citizens and the values and traditions of the society can strengthen social and even economic indicators. In terms of the sub-criterion "community participation and employment," the factory managers had an average score and the local community had a weak score. This result is inconsistent with Safeie Noghlbari *et al.* (2024) who reported the favourable conditions for this sub-criterion in the production of olive oil, where the innovation and initiatives of the local community were used in the production of this crop. As more initiatives and innovations of the local community are supported in crop production and as more local workforce with higher experience are used, the living conditions are improved to a greater extent at the community level. The sub-criterion "healthy living conditions" showed that factory managers had the highest score, rice farmers had an average score, and factory workers and rice field workers, and local community had a poor score. This result is consistent with Rivera-Huerta *et al.* (2019) who reported that participation in the improvement of society both in infrastructure and in the development of local residents is part of the social responsibility of factories. In terms of the sub-criterion "transparency of social/environmental issues," the factory managers gained a good score and the local community gained a medium score. This result supports the result of Vinci *et al.* (2024) who found that rice cultivation had no severe environmental impact. Compared to other factories that emitted more environmental pollutants, the rice factory had less environmental impact, and due to the seasonality of the work of these factories, it can be said that the amount of pollution is relatively small compared to the benefits they have for society. However, by updating their tools and machines, which have

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relatively lower energy consumption, depreciation, and waste, these factories can reduce the amount of pollution and create more favourable conditions.

The criterion "social-economic consequences" generally had a weak score (Table 8). Besides, according to Table 7, regarding the indicator "participation in local employment", the group of factory managers and the local community gained an average score. This result is consistent with Safeie Noghlbari *et al.* (2024) who reported favourable conditions for this sub-criterion in the production of olive oil, in which local labour was involved. The use of the local workforce who is experienced in crop production in their community will create better living conditions at the community level. Regarding the indicator "contributing to economic development", the factory manager group had a good score and the local community had an average score. This result agrees with Safeie Noghlbari *et al.* (2024). They reported that olive oil production had driven economic development in the studied community. Economic development in societies is possible by increasing production. Increasing the number of crop-related factories in a community can enhance economic development and ultimately improve the quality of life in that community. In addition, in terms of the sub-critorion "technology transfer," the factory manager group had an average score and the local community group had an unacceptable score. This result is in contradiction to Safeie Noghlbari *et al.* (2024) who reported favourable conditions for this sub-criterion in the production of olive oil, where the innovation and initiatives of the local community were used in the process of crop production. The more the new and modern technologies, initiatives, and innovations used in society, the more favourable conditions will be achieved in the development and improvement of the conditions of the societies. In terms of the sub-indicator "general commitment to sustainability issues", the factory manager group got a good score and the local community group got an average score. This result does not agree with Rivera-Huerta *et al.*'s (2019) study, which showed that public commitment to sustainability issues had a weak performance. Comprehensive attention to all sustainability issues, such as supporting innovation and helping the factory to develop the local economy and promote the region, can improve performance and as a result, improve economic and social conditions in society.

CONCLUSIONS AND SUGGESTIONS

The results of this study were related to the measurement of social performance and the judgment of experts regarding the extent of their compliance with social norms. In the analysis of the social sustainability of rice production in Talesh County, the overall result of the performance score of the IPS effect category was calculated for the social effect category of human rights (3), working conditions (3), cultural heritage and community development (3), and social-economic consequences (2). Finally, it can be stated that the indicators selected in this research could well evaluate the conditions of social sustainability of rice production in Talesh County. Also, rice production by employing local people was found to play an important role in preventing the migration of the villagers to urban areas. It can also contribute to local employment and social welfare in rural areas and play an effective development role in the neighbouring villages.

Due to the unfavourable conditions for familiarization of workers with labour unions and collective negotiations of factory workers with employers, it is suggested that the government or the private sector (factory managers) help workers become familiar with labour unions and understand their legal rights. In order to improve the conditions of healthy living conditions, it is also suggested that rice farmers and labour unions be involved in efforts to increase wages and provide the necessary opportunities for training and further education of workers. Furthermore, factory managers can improve the socio-economic status of the community by introducing new technologies in the production cycle and employing the local labour force. Establishing support programs for local farmers, such as financing, training, and providing technical advice, can help increase productivity and improve their living conditions. Forming cooperatives can help farmers share resources, reduce costs, and increase their bargaining power. Encouraging farmers to maintain biodiversity in rice fields, such as growing different rice varieties and preserving local ecosystems, can contribute to social and environmental sustainability. Establishing local markets for selling rice products can help increase farmers' incomes and reduce dependence on large markets. Supporting scientific research on sustainable rice production and new cultivation methods can help improve the quality and quantity of the product. Implementing the above-mentioned suggestions can promote the social sustainability of rice production in Shaft County and improve the living conditions of farmers and local communities.

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