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ARTICLE

Mapping the Role of Millet Mission in Localising SDGs: Evidence from the Indian States with Special Reference to Odisha

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ABSTRACT

Climate change is one of the biggest challenges of the twenty-first century, necessitating adaptation to climate-resilient agricultural practices (e.g., millet cultivation) to withstand shocks. The Odisha Millet Mission (OMM) is a unique flagship programme launched by the Government of Odisha in 2017–2018 to improve the entire millet ecosystem from cultivation to consumption. In this context, this paper outlines the progress of the millet mission across Indian states, with special reference to Odisha. In addition, this paper assesses the role of OMM in localising the Sustainable Development Goals (SDGs) by mapping the outcomes of such a mission to the global targets using a structured qualitative SDG mapping framework (following the Food and Agriculture Organization (FAO)'s Climate Smart Agriculture-SDG framework). It finds that OMM contributes to the localisation of the major (directly influencing) and contributing (indirectly influencing) outcomes of the OMM initiative on achieving the SDG targets. In addition to advancing climate action (SDG 13), food security (SDG 2), and income objectives (SDG 1), a millet farming approach can contribute to priority goals, including gender equality and social equality (SDG 5), urban development, and employment (SDG 8). Therefore, these findings showcase the mission's comprehensive approach to sustainably increase agricultural productivity and incomes (economic), reduce Greenhouse Gas (GHG) emissions, build resilience and adapt to climate change (environment) and empower disadvantaged people (social). Eventually, OMM will offer a scalable, best-practice guide for SDG localisation across other states to support millet revival, strengthen agrarian economies, and build adaptive capacity.

Keywords: Climate Change; Odisha Millet Mission; Millet Cultivation; Sustainable Development Goals

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1. Introduction

In the context of climate change in agriculture, the input-intensive 'Green Revolution' is making it harder for smallholders to meet their livelihood needs. Despite the success in increasing yields and making the country self-reliant, the Green Revolution in recent decades has been detrimental to natural resources, human health, and agriculture itself[1–3]. Loss of soil fertility, soil erosion, soil toxicity, diminishing water resources, pollution and salinisation of underground water, dependence on external inputs, increased incidence of human and livestock diseases, and political and social costs are among the negative impacts of the green revolution.

Climate change is very likely to affect food security at the global, regional, and local levels. It is already disrupting the production of important crops such as rice, wheat, and maize in both temperate and tropical regions, and without concerted climate adaptation (and mitigation) efforts, this trend will accelerate as temperatures continue to rise [4]. It can disrupt food availability, reduce access to food, and affect food quality [5–7]. The dual challenge of climate change (adaptation and mitigation), coupled with the urgent need to increase agricultural production by 60% by 2050 to meet food security [8], underscores the imperative for a comprehensive approach.

In this backdrop, climate-resilient agricultural practices can buffer farmers against climate-related damage and help make their operations more resilient and sustainable in the long term. Millets are climate-compliant crops (compared to wheat and rice) in terms of both marginal growing conditions and nutritional value [9,10]. As rain-fed crops, they are robust and grow well in dry zones, even under marginal soil fertility and moisture conditions [11–13]. It is a carbon-neutral crop that can grow in arid regions where other cash crops are not easily grown, making it the most climate-resilient crop even at 64 ℃ [14].

Further, due to their low production costs and nutrient requirements, millets can provide economic security and high profits to small and marginal farmers. Therefore, to ensure food and nutrition security for our country, it is important to increase the production of these crops and simultaneously restore control over production, distribution, and consumption to the people. Millet cultivation also supports agroecological practices and maintains local agrobiodiversity in the regional context [15]. Nationwide, millets are being recognised and promoted as tools for a resilient food supply and sustainable development [10]. In recent times, millet cultivation has also occupied centre stage in agricultural policy, with some states (Assam, Bihar, Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttarakhand and Uttar Pradesh) selected to implement State Millet Missions in India.

Millet cultivation has been a popular practice in Odisha since independence. During the 1980s, a visible transformation in cultivation practices, favouring wheat and rice, was evident owing to the Green Revolution [16]. Recognising the significance of millet cultivation in a rainfed state like Odisha, the Government of Odisha launched a special mission-mode programme to promote millets in tribal areas, known as the Odisha Millet Mission (OMM), in 2017. In 2018, significant momentum in OMM's progress was evident when the government declared the year as the National Year of Millet. OMM's vision is to improve the livelihoods of small and marginal farmers in rainfed regions. The programme aims to revive millets through end-to-end value chain interventions. To complete the supply chain, the government has created an assured market for the produce. To ensure millets reach food plates, the government conducts regular campaigns and rallies to raise awareness of their benefits. The government has also made it part of the public distribution system. The rationale for the mission can be outlined as follows: first, as farmers began switching to high-profit commercial crops such as cotton, maize, paddy, and vegetables, it could disrupt millet cultivation. Moreover, changes in food habits, drudgery in processing millets, lack of storage facilities, and government support led to a decline in the area under cultivation and consumption of millets. The reduction in millets led to nutritional deficiencies and an unsustainable cropping system. These problems provoked the formation of the Millet mission [17]. Second, the intent to revive millets stemmed from an environmentally sensitive approach that recognises millets as climate-resilient crops with higher survival rates in rain-fed areas. Third, the produce's comparatively higher nutritional value is another factor contributing to the movement.

SDG localisation simply means integrating the glob-

al sustainability goals into plans, policies, and actions that meet local requirements and needs, especially for vulnerable groups. However, in the existing literature, there is little attempt to explore the localisations of SDG [18]. Agriculture is crucial to achieving goals such as poverty reduction (SDG 1), zero hunger (SDG 2), and climate action (SDG 13) [19]. This is also demonstrated by FAO's CSA case studies.

Empirical studies link millets to SDG synergies: to achieving goals such as poverty reduction (SDG 1), zero hunger (SDG 2), and climate action (SDG 13) [19]. Finger millets boost smallholder incomes and productivity [20] and cut water/carbon footprints compared to rice [21]. OMM is considered an effective policy intervention for addressing the challenges of nutrition, food security, and climate-resilient agricultural practices, and therefore holds considerable promise for localising the SDGs [14,15].

At this juncture, it is crucial to understand the policy mechanism for implementing the mission. In the top-down channel of the OMM implementation process, the High-Powered committee sets policies, and the Agricultural Technology Management Agency (ATMA) Directorate is responsible for program management. The district management team is responsible for coordination and resource allocation. At the ground level, Farmer Producer Organizations (FPOs)/Self Help Groups (SHGs) are responsible for implementing the mission under the guidance, instruction, and counselling of the Community Based Organizations (CBOs)/Non-Governmental Organizations (NGOs). In fact, FPOs are considered a pathway in the process of SDG integration in sustainable agriculture plans

Farmer collectives are critical in implementing the millet mission at the national level. As it is difficult to foster multifunctionality (combining farming activities with local social services) in agriculture through individual farmers' initiatives, this calls for farmer collectives to search for pathways towards climate-resilient agricultural practices. Millet farming is one approach within the broader concept of Climate-Smart Agriculture (CSA). Three broad pillars of climate-smart agricultural practices are to sustainably increase agricultural productivity and incomes, build resilience and adapt to climate change, and reduce and/or remove GHG emissions [8]. This study utilises the novel methodological framework of CSA to assess the localisation of SDGs by OMM intervention. This evidence-based study employs desk research, utilising available policy documents and independent research works, to assess the role of OMM in localising the SDGs.

For convenience, this paper is divided into five sections. The next section discusses the study's objectives. Section 3 presents the study's methodology. Specifically, the method for mapping outcomes to the SDG targets is outlined. Section 4 considers the results and discussion of the study. Conclusions appear in Section 5. Limitations of the study are outlined in the last section.

2. Objectives

The objectives of this paper are:

- To outline the progress of the millet mission across Indian states, with special reference to Odisha;
- To assess how OMM localises the SDGs by mapping outcomes to sustainability targets.

3. Materials and Methods

- **Theory of change**: A theory of change explains the process of how a change will occur; it illustrates the relationships between actions and outcomes and how they can work together to bring about a desired change [22]. A well-defined theory of change is crucial for an organisation looking to make a difference. By clearly outlining the change, it is possible to ensure that programs are impactful and effective. The purpose of a logic model is to describe a program and its theory of change, explaining how resources and activities will achieve the program's goals [23]. A logic model is a matrix-based presentation of a program, from the resources and activities that will take place to the deliverables and goals the program will produce [24].
- **Mapping exercise**: Following the methodology suggested by the Food and Agriculture Organisation [25], this study integrates OMM outcomes into the SDG-mapping. Following the FAO [8], three distinct pillars of CSA are identified: sustainably increasing agricultural productivity and incomes, building resilience and adapting to climate change,

and reducing and/or removing GHG emissions. The first pillar of CSA relates to the economic dimension, while the other two pillars represent the environmental dimension. The action category and measurable indicators complying with the pillars of CSA are listed in **Table 1**.

Table 1. List of measurable indicators.

CSA Pillars (Dimension)	CSA Action Category	Measurable Indicators
CSA Pillar 1: Sustainably increase agricultural productivity and incomes (Economic)	Increase resource use efficiency	Increase the production per unit of inputs; Reduce the material footprint of food production
	Diversify production systems	Farm and non-farm livelihood through the creation of additional income sources; Meet nutrition and food security requirements
	Manage agro-ecosystems, ecosystem services and biodiversity	Reduce use of external inputs; Sustainable soil management; Creation of a habitat for wild animal species
CSA Pillar 2: Build resilience and adapt to climate change (Environmental)	Diversify production systems	Introduction of crop rotation; Adoption of agroforestry
	Adjust production activities to reduce risk exposure, sensitivity, and adapt to changing conditions	Adapt to changing weather conditions by constructing water harvesting ponds
	Manage agro-ecosystems, ecosystem services and biodiversity	Increase the capacity of agro-ecosystems to absorb climate shocks
CSA Pillar 3: Reduce and/or remove GHG emissions (Environmental)	Increase resource use efficiency	Reduce the use of energy-intensive farming inputs; Loss of nutrients in the form of GHG emissions
	Retain and sequester carbon in agro-ecosystems	Absorb, store and retain carbon
	Replace fossil fuel-based energy with renewable energy	Substitution of fossil fuels with energy from renewable resources; Use of solar energy to power irrigation pumps
CSA Pillar 4: Empowerment of disadvantaged people (Social)	Social inclusion of disadvantaged people	Participation of marginal and small farmers; Participation of women in farm or non-farm activities
	Empowerment	Women's participation in the decision-making process
	Support for the community	Creating awareness; Changing consumption pattern

Source: Author's compilation from FAO [8].

The relevant information on the OMM outcomes is compiled from secondary sources (annual reports, the official OMM website, the Compendium Case Study report, the baseline survey report, and independent research studies). Mapping these outcomes to the SDGs shows how they can contribute to localising the SDG targets. In this mapping exercise, the outcomes of the OMM initiative are categorised as either major (directly influencing) or contributing (indirectly influencing) to achieving the SDG targets. In fact, the SDG targets serve as a guideline for measuring and monitoring the progress of the local initiative. In the conceptual framework (**Figure 1**), the millet mission is shown to align with the principles of CSA and to have far-reaching implications for achieving sustainable development.

- **SUSTAIN Score**: To quantify the qualitative SDG mappings, a five-point ordinal scale is used [26]. A score of +2 is assigned for a direct and significant contribution. A score of +1 indicates an indirect or moderate contribution. A score of 0 indicates no significant positive or negative impact; this category also applies to "Not Applicable" cases. A score of −1 is given if the activity indirectly or moderately hinders the goal. Finally, a score of −2 is given for directly and significantly undermining the goal.

The SUSTAIN score is calculated using the following formula:

$$\text{SUSTAIN (\%)} = (\text{Total points scored}/\text{Maximum possible score}) \times 100$$

In the formula, the total points scored is the sum of all scores across 17 SDGs, and the maximum possible score is 34 (17 SDGs × 2 points each). Once the SUSTAIN score is derived, a sensitivity analysis is conducted to assess robustness by varying the policy-focused weighting

scenarios, ensuring substantive goal-alignment evaluations.

Sensitivity analysis is also employed to assess changes in the overall score by altering SDG weights, such as prioritising social over environmental goals. The original score is tested under three scenarios by doubling the weights for each pillar: environmental (SDGs 6, 7, 13, 14, and 15), social (SDGs 1, 2, 3, 4, 5, and 10), and economic (SDGs 8, 9, and 12). Therefore, three distinct scenarios were constructed, each representing a different strategic priority. This helps verify the robustness of the results, ensuring that decisions remain reliable across varying priorities.

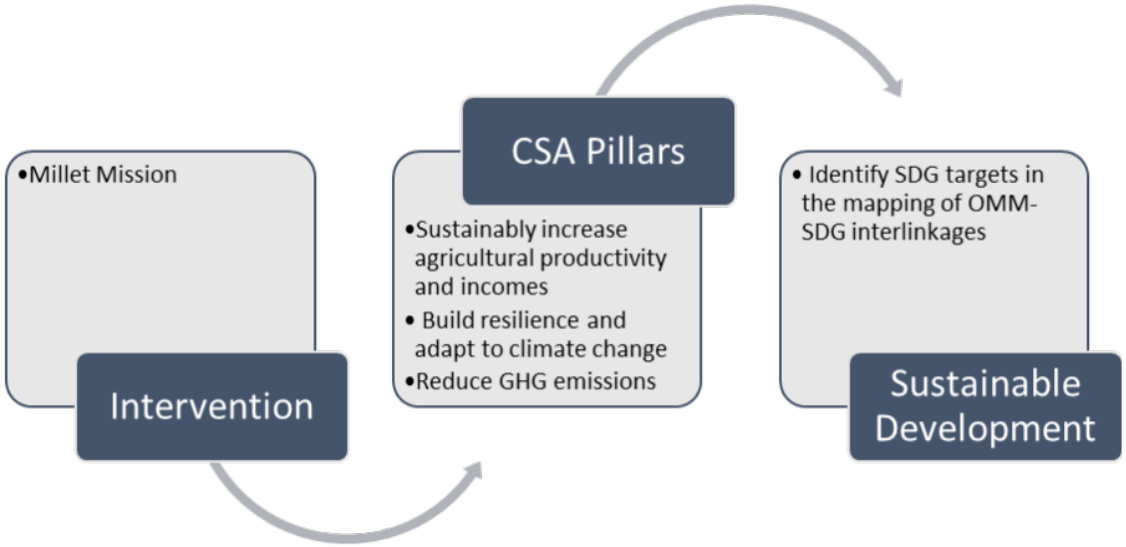

Figure 1. Linkages between millet mission intervention and sustainable development through compliance with the CSA pillars.
Source: Author's compilation.

4. Results and Discussion

4.1. Trends in Farmer-Producer Organisations in India

Figure 2 depicts the growth pattern of FPOs in India from 2003 to 2024. The evolutionary process can be linked to minimal FPO promotion efforts before 2013 and a strategic push from 2014, in the form of FPO-enabling laws. Until 2012, FPO formation remained minimal, at 150 FPOs annually, then accelerated due to National Bank for Agriculture and Rural Development (NABARD) initiatives Producers Organization Development and Upliftment Corpus (PRODUCE) fund, and the boom after 2019 aligns with the central sector schemes launched in 2020. Approximately 9,200 FPOs were established from 2003 to 2019, followed by a nearly fourfold increase in registrations over the next four years, resulting in approximately 44,000 FPOs registered with the Ministry of Corporate Affairs as of 2024 (**Figure 2**). Around 9,039 FPOs were formed in 2021, the highest annual total. The central and state government's policy interventions to empower and strengthen grassroots agricultural collectives led to this robust growth and the formation of FPOs. The five-year tax exemption initiative in the Union Budget 2018 provided impetus, and the launch of the central sector scheme to promote 10,000 FPOs nationwide under the Union Budget 2020 further spurred the proliferation of FPO formation.

Further, analysing data on operational status and other legal compliance indicates that approximately 61% (26,940) of the registered FPOs are currently active and compliant with statutory requirements. Unexpectedly, the compliance status of a staggering number of FPOs (14,980) remained unclear due to their inability to update their records. Moreover, 1,340 FPOs are classified as non-compliant, and 1,080 have been dissolved or are subject to voluntary removal [23]. These estimates foreground the constraints related to structural deficiencies, reporting limitations and long-term viability within the sector (**Figure 3**).

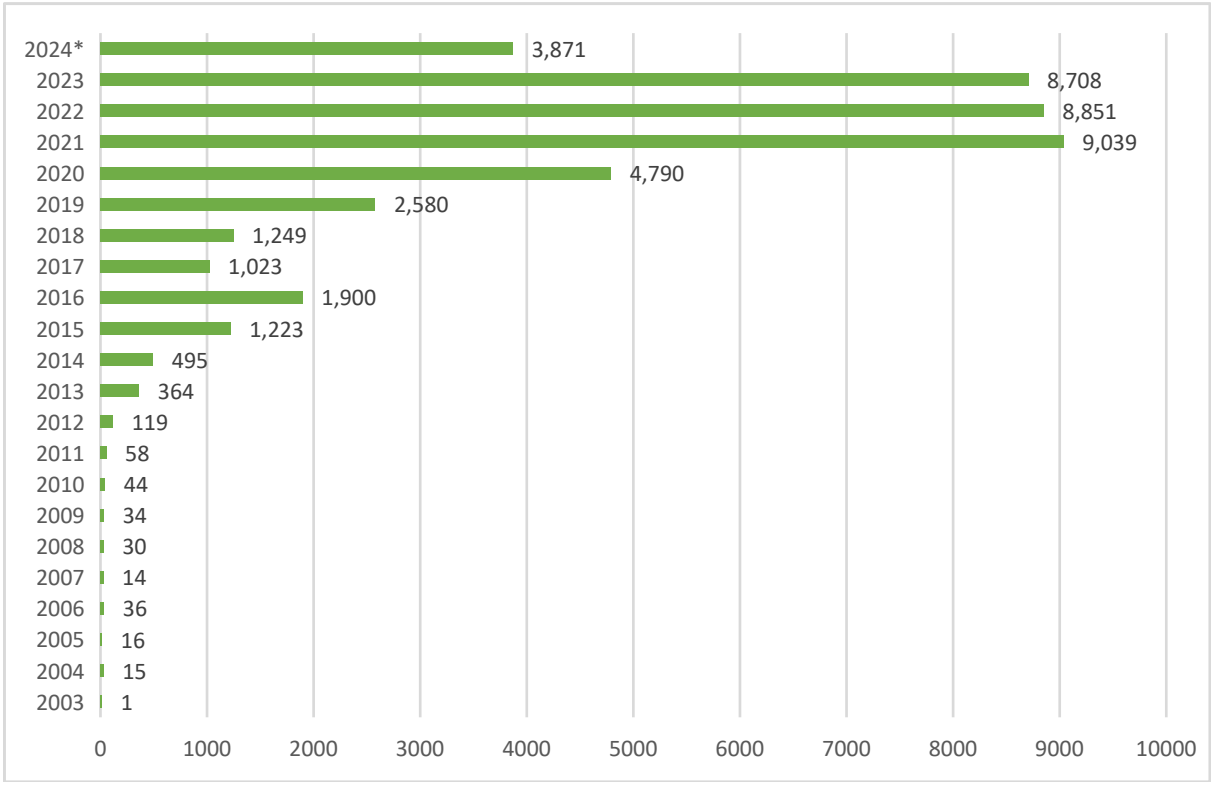

Figure 2. Trends in FPO formation till September 2024.

Source: Abraham et al. [27].

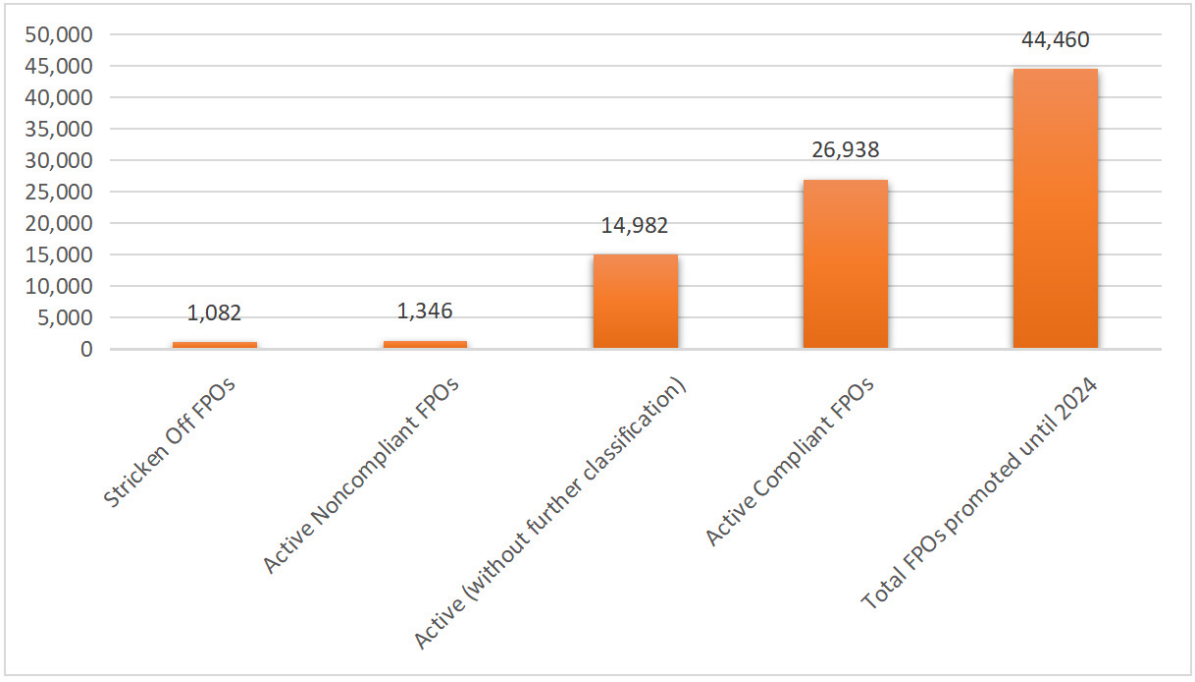

Figure 3. FPO status until September 2024.

Source: Abraham et al. [27].

4.2. Farmer-Producer Organisations across Indian States

The spatial distribution of FPOs across the country shows noticeable regional disparities, with 56% of FPOs concentrated in three states: Maharashtra (35%), Uttar Pradesh (16%), and Madhya Pradesh (6%). Punjab and Haryana, known as the 'Granary of India', collectively account for only 1460 FPOs, i.e., 3.3%. The northeastern states report the lowest FPO count, reflecting a skewed operational presence. Despite lower absolute numbers, the growth rate of FPOs in the northeastern states over the last decade has been quite impressive, ranging from 23% to 50%. Maharashtra and Karnataka have also exhibited remarkable growth of 34% and 30%, respectively, while other states show moderate growth [27].

4.3. Odisha Millet Mission

The OMM programme aims to revive millets through promotional measures along the entire value chain, i.e., production, processing, selling and consumption. Community seed centres, custom hiring centres, promotion of improved agronomic practices, regular training programmes, incentive support, field schools, and bio-inputs enterprises promote millet production. Processing units at Gram Panchayat & Block levels, post-harvest technology (ragi thresher), and post-harvest and primary processing enterprises for millets promote their processing. Benchmarking the prices of little millet and foxtail millet, promoting FPOs for marketing and sales, and establishing millet tiffin centres boosted sales in the millet value chain. Lastly, to promote consumption millets are included in the Public Distribution System (PDS), Mid-Day Meals (MDM) and Integrated Child Development Scheme (ICDS) along with promotion of ready-to-eat foods with millets such as ladoo, murukku, bakery items through local enterprises, exposure to various recipes through training, food festivals and campaigns, consumption campaign with SHGs and other agencies [28].

A comprehensive view of the OMM's desired outcome is depicted using a logic model (**Figure 4**). It provides an overview of the activities undertaken, using inputs/resources to achieve the desired outputs and outcomes.

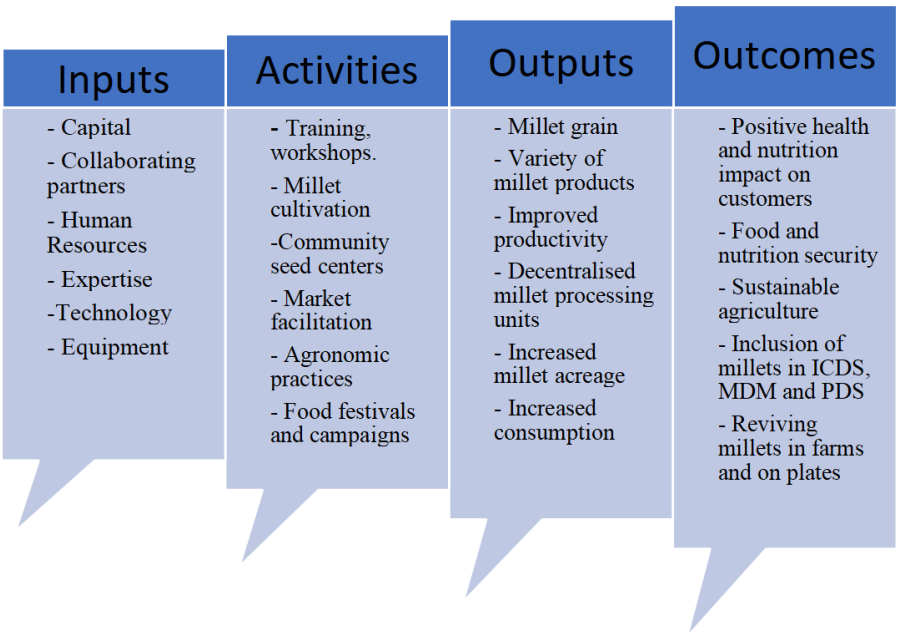

Figure 4. Logic Model.

Source: Author's compilation.

From **Table 2**, it can be inferred that the programme was initially launched in 2017 across 30 blocks in the 7 tribal-populated districts of southern Odisha. In the same year, it covered 6,000 ha using improved agronomic practices for millet cultivation and engaged 8,030 farmers. Owing to the enthusiasm generated by the programme

amongst the millet-growing farmers in the first phase, the programme was further extended on a large scale to cover most parts of the state. In just seven years, the mission had extended its reach to all 30 districts of the state (100% district coverage) and covered 177 of the state's 340 blocks. Meanwhile, farmer engagement grew by a massive 28 times, accompanied by a surge in area coverage of approximately 13 times compared with the figures from the initial year of implementation. Further, the yield of millets increased from 12.5 quintals per ha to 16.42 quintals per ha by the end of 2020–2021. To establish attribution, a baseline comparison reveals OMM's direct impact after its implementation (**Table 3**).

Custom hiring centres, bio-inputs, seed centres, and agronomic training under OMM alleviated adversities and enabled the mission's scalability through FPO/SHG. **Table 3** confirms that OMM interventions drove significant improvements in yields (119.8%), total production (286.3%), and value of the produce (119.2%). However, this baseline comparison measure (also known as pretest-posttest designs) suffers from the presence of cofounding factors that correlate with both the intervention and the outcome, and thereby potentially masking or exaggerating the true effect of the intervention.

Table 2. Indicator-wise progress of OMM.

Indicators	2017–2018	2018–2019	2019–2020	2020–2021	2021–2022	2022–2023	2023–2024
Number of districts covered	7	11	14	14	15	19	30
% of the districts of the state	23.30	36.67	46.67	46.67	50.00	63.33	100
Number of blocks covered	30	55	72	76	84	143	177
% of blocks of the state	9.55	17.52	22.93	24.20	26.75	45.54	56.37
Number of farmers engaged	8,030	29,056	51,045	108,731	118,561	158,000	243,000
Area coverage (in ha)	6,000	13,000	21,552	47,339	54,495.83	74,500	79,500
Yield (per ha)	12.5	13.10	14.14	16.42	NA	NA	NA

Note: NA—Data not available. Figures relating to percentage calculations are rounded to two decimal digits.
Source: Author's compilation from Annual Reports (2017–2018, 2018–2019, 2019–2020, 2020–2021 and 2023–2024) and Govt. of Odisha reports on OMM.

Table 3. Millet performance in Odisha (baseline vs. initial year).

Indicators	Pre-OMM Scenario (2016–2017)	Post-OMM Scenario (2017-2018)	Change (%)
Total area under millet cultivation (in hectares)	2,949	5,182	75.7
Total quantity of produce (in quintals)	17,065	65,929	286.3
Value of produce per hectare (in ₹)	9,447	20,710	119.2
Yields (quintal per hectare)	5.79	12.72	119.8

Source: NCDS Study Team [29].

In addition to considering the OMM outcomes in a pretest-posttest comparison, it is imperative to assess the intervention's impact on participating farmers compared with non-participating farmers. **Table 4** reported substantially good agricultural practices, and significantly higher productivity and incomes among OMM recipient farmers compared with non-recipients in the Koraput district of Odisha [30].

Table 4. Comparison of participating vs. non-participating farmers.

Metric	Measurement	Mean of Participating Farmers	Mean of Non-Participating Farmers	*t*-Test
Adoption of Good Agricultural Practices	Dummy (1 = Yes, 0 = No)	0.835	0.603	5.08***
Access to market information	Dummy (1 = Yes, 0 = No)	1.894	1.448	1.14
Finger millet yield	Quintals/ha	1,908.97	1,158.09	29.62***
Net income	Rs/ha	30,347.58	19,139.62	26.60***

Note: *** denote significance levels at 1% level.
Source: Authors' compilation from Mishra et al. [30].

4.4. Mapping the Outcomes of OMM to the SDGs

SDG mapping serves as a theoretical framework for understanding how an activity is fundamental to achieving the SDGs and the drivers of value creation. By mapping the linkages between the OMM outcomes and the SDGs, this study aims to validate the OMM's current efforts to incorporate relevant SDGs into mission operations. Aligning with the sustainable development agenda can lead to greater efficiency, cost savings, and competitiveness, and enhance the social license to operate. To proceed with mapping, the linkage between OMM outcomes and respective SDGs is explained in the following sub-sections, which discuss how each CSA pillar operationalises these SDG contributions in practice.

4.5. CSA Pillar 1

CSA pillar one focuses on sustainably increasing agricultural productivity and incomes. The preliminary implementation data show that 85% of participating farmers were smallholders. Incentives for millet farming, such as guaranteed procurement at Minimum Support Price (MSP), provide a form of social protection for these marginalised communities (SDG 1.3). It reduces the economic risk of poor participants. This is supplemented by ensuring subsidised access to quality seeds, bio-fertilisers, bio-inputs, and agricultural implements, and by providing enriched training for these small-scale producers (SDG 1.4). Such benefits, in the form of MSP-linked procurement, incentives, subsidised input supply, and comprehensive training, thereby increase both productivity and incomes of small-scale food producers. Value addition activities under the mission significantly contribute to farmers' incomes and agricultural productivity [31,32]. Additionally, encouraging women from non-agricultural tribal households to participate in SHGs and FPOs empowers them and increases family income [33]. Access to agricultural equipment through the Custom Hiring Centre established under OMM reduces drudgery, increases productivity/or reduces working hours, and increases the return on labour [26]. Proper use of agronomic practices reduces input costs, thereby increasing incomes (SDG 2.3). This also leads to income growth of the bottom 40% population who transitioned to sustainable livelihoods through millet farming (SDG 10.1)

Apart from income effects, OMM's economic interventions also spearhead improvements in nutrition and health outcomes. The mission promotes consumption of millet and integrates these nutrient-dense grains into Integrated Child Development Services (ICDS), mid-day meals, and supplementary nutrition programs. Consuming nutritionally rich millets helps combat maternal and child malnutrition and other chronic health issues, and prevents non-communicable diseases through low-glycemic, fibre-rich diets that reach numerous households via PDS distribution [34] (SDG 3.1, 3.2, and 3.4). For sustainable production [35] and economic sustainability, innovation is an important driver of productivity growth [36]. Although innovation is a complex process, it plays an important role in growth [37]. Under OMM, the adoption of innovative measures and new technologies in farming contributes to achieving higher levels of economic productivity [32] (SDG 8.2).

4.6. CSA Pillars 2 and 3

The environmental dimension of CSA, represented in pillars 2 and 3, focuses on resilience-building, reducing environmental footprint and resource-use efficiency to lower pressure on water, land, and other components. As millets are a climate-resilient crop, promoting millet farming among small-scale farmers helps build the economic and livelihood resilience of the poor and those in vulnerable situations to climate-related extreme events through low-input farming systems that require minimal irrigation and synthetic fertilisers (SDG 1.5). The mission harnesses the potential of millets to adapt to climatic conditions and withstand climatic shocks [32] (SDG 2.4). Further setting up of community seed centres to conserve and promote diverse millet landraces through participatory variety trials protects the genetic agro-biodiversity necessary for adapting to a new climate regime and future breeding [32] (SDG 2.5). Large-scale investments in agricultural research for increasing productivity, reducing costs, farmer training and rural infrastructure development strengthen the entire millet value chain (SDG 2.a).

The mission advocates reducing health risks associated with exposure to hazardous agricultural chemicals by shifting farmers away from chemical fertilisers toward

vermicompost, farmyard manure, and other bio-inputs (SDG 3.9). Millets are a remarkably resource-efficient crop in terms of water requirement. Compared with finger and pearl millet, sugarcane, rice, and cotton require almost 6, 3, and 2 times as much water (**Figure 5**), thereby making them the best alternatives for mitigating rising water stress. Millets can also be grown with lower chemical inputs, which helps avert pollution of local water bodies and groundwater by preventing chemical runoff. So, OMM's push to promote millet farming reduces pressure on water resources and the environment (SDG 6.3). Concurrently, promoting improved agronomic practices such as the System of Millet Intensification (SMI), line transplantation, line sowing, and protective supplemental irrigation reduces water use and increases water-use efficiency (SDG 6.4).

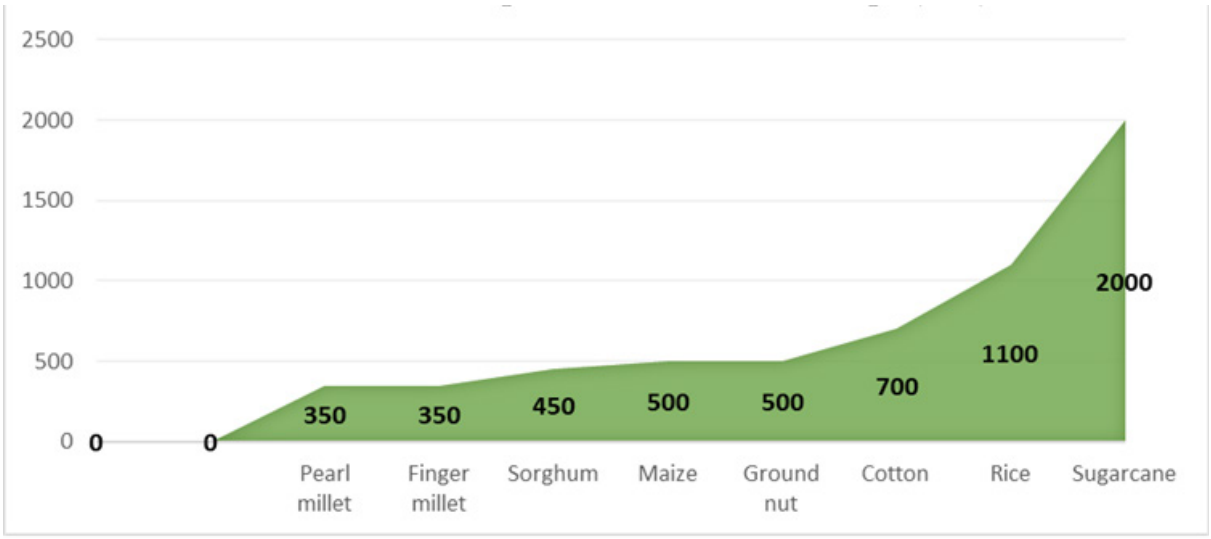

Figure 5. Water requirement of various crops (mm).

Source: Rao et al. [38].

By introducing initiatives such as solar-powered processing and drying units, the mission reduces the carbon footprint of post-harvest operations (SDG 7.2). OMM encouraged the preservation of traditional agricultural practices and knowledge by promoting location-specific local millet varieties and sharing knowledge about low-cost indigenous farming techniques (SDG 11.4).

Millet cultivation actively assists in sustainable food production and consumption, a target of SDG 12 [39–41]. It provides an alternative, sustainable pathway for production and consumption that differs from traditional agricultural practices [42]. It emerges as a promising solution for sustainable farming due to its minimal input requirements and resilience in dry environments [43]. Millets require significantly less energy (0.2–0.5 kWh/kg) than rice or wheat (1–1.2 kWh/kg), demonstrating better resource use in terms of water and chemical fuel (**Figure 6**), and aligning directly with the goal of minimal resource use (SDG 12.2). As millets grow with low chemical inputs, this leads to efficient use of chemical products in food production [43,44] (SDG 12.4). Proper training in post-harvest management, the availability of post-harvest processing equipment, and improved storage facilities, along with local processing facilities, reduce food loss (SDG 12.3).

Millet-based production systems help reduce the carbon footprint by emitting fewer greenhouse gases (GHGs) than rice, wheat, and maize. They have the least total emissions, nearly 0.5 kg CO_2 eq/kg, balanced between CO_2 and non-CO_2. Further, millet production is associated with lower N_2O emissions (a powerful GHG linked to fertiliser use) because millets require minimal to no synthetic fertilisers or pesticides (**Figure 7**). So, millet production strengthens the resilience and adaptive capacity of the agricultural sector to climate-related hazards [9,45] (SDG 13.1). The principal objective of OMM is to strengthen the capacities of individual food producers and other stakeholders in the food system to build productive, resilient and sustainable food production systems

and value chains in the context of climate change (SDG 13.3). Small-scale local facilities (processing) mean that food travels shorter distances, limiting GHG emissions associated with transport [8] (SDG 13.3).

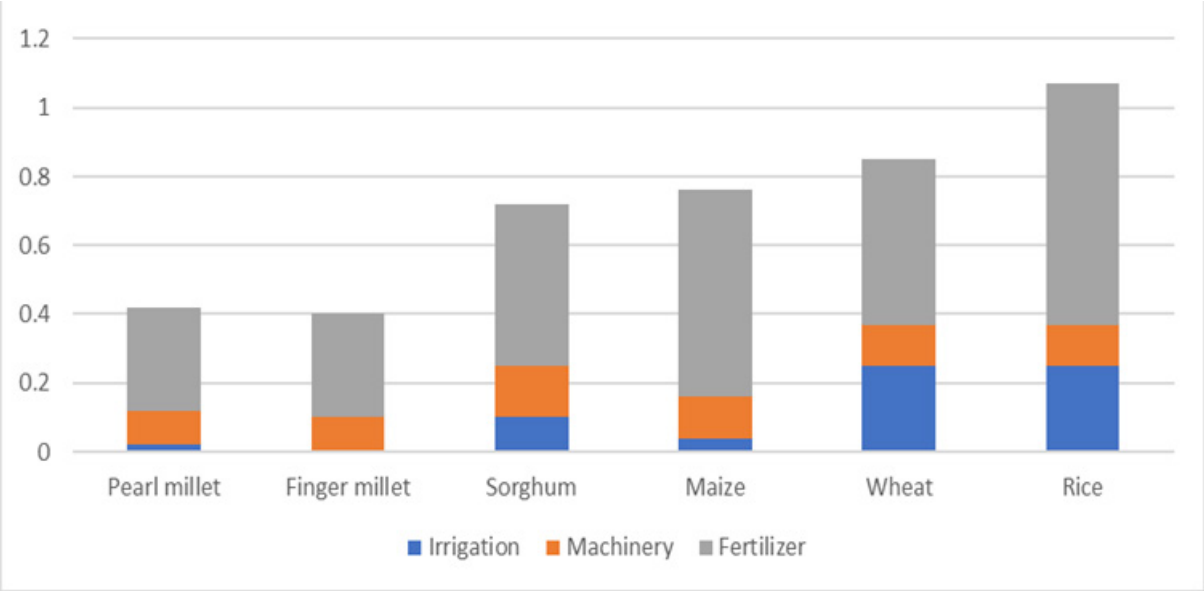

Figure 6. Energy Requirement (kWh/kg).

Source: Rao et al. [38].

Figure 7. Greenhouse Gas Emission (CO_2 eq per kg).

Source: Rao et al. [38].

From an environmental viewpoint, millets improve soil health and strengthen biodiversity [46]. Further incentivising farmers to promote and adopt improved agronomic practices and protective irrigation increases productivity and resource-use efficiency (SDG 15.1). It enhances soil microbial activity and reduces pest occurrence, thereby nurturing living soils and restoring degraded land and soil (SDG 15.3).

4.7. CSA Pillar 4

Pillar 4 of CSA focuses on the social dimension parameters, such as the empowerment of marginalised

groups, their social inclusion, gender equality, employment, and other forms of community support. The mission prioritises initiatives targeting vulnerable populations, such as households below the poverty line, scheduled tribes, and smallholders. In this way, the mission aims to lift families out of extreme poverty and reduce multidimensional deprivation, enabling sustained improvements in household well-being for the most excluded (SDG 1.1, 1.2). Owing to socioeconomic factors, millets offer a cost-effective farming option for mitigating rural poverty [47].

Table 5 compares the nutritional profiles of rice, wheat, and finger millet. Although wheat offers the highest protein content and rice offers the highest carbohydrate content, they lag in other nutrients. Finger millet outshines both rice and wheat owing to its higher levels of calcium, vitamin B1, fibre, and minerals that are crucial for bone health, better digestion and enhanced metabolism. Therefore, the revival of millet through OMM has increased the availability of a wider variety of foods, ultimately contributing to more nutritious, healthier diets for food producers and their communities [4,15] (SDG 2.1 and 2.2). Increased productivity improves food availability and access, thereby facilitating food security (SDG 2.1) [48].

Table 5. Nutritional content of millets.

Particulars	Wheat	Rice	Finger Millet
Protein (gm)	12.1	6.8	7.3
Carbohydrate (gm)	71.2	78.2	72.0
Fat (gm)	1.5	0.5	1.3
Fibre (gm)	2.0	1.0	3.6
Minerals (gm)	1.5	0.6	2.7
Calcium (mg)	48	10	344
Vitamin B1 (mg)	0.4	0.1	4.2

Source: Longvah et al. [49].

In addition to nutrition, OMM deliberately embeds gender-responsive measures within its design and implementation architecture. It encompasses gender-sensitive agricultural policies and processes that support the equal opportunities of women and men [50]. Involving women in millet farming and related entrepreneurial endeavours leads to greater gender inclusion in the agricultural sector. First-generation women entrepreneurs are responsible for managing all millet-related enterprises (SDG 5.5). Establishing local processing facilities, Millet Shakti Tiffin Centres, Millets Shakti Outlet, (women) millet enterprises promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation. (SDG 8.3, 8.5). Eventually, these cohesive, gender-sensitive, and livelihood-enhancing strategies promote social inclusion and reduce embedded inequalities among the bottom 40% by ensuring democratic representation, equitable sharing of benefits from climate-resilient practices, and alleviating discrepancies across caste, gender, and economic lines (SDG 10.2).

The exhaustive mapping presented in **Table 6** clearly shows OMM's robust, multidimensional alignment with SDG targets across the economic, environmental, and social pillars of CSA. Direct influences, categorised as 'Major', are exceptionally noticeable in crucial areas like poverty reduction via subsidies and assured procurement (SDG 1), achieving zero hunger through increased availability and accessibility of nutritious food (SDG 2), and climate mitigation action by promoting low-emission, climate-adaptive and sustainable farming systems (SDG 13). Simultaneously, indirect contributions categorised as 'Contributing' extend the mission's reach to complementary goals. It includes combating malnutrition, maternal mortality, and NCDs through nutrient-dense diets (SDG 3), integrated water management, with lower irrigation requirements for millets than for water-guzzling crops (SDG 6), and responsible consumption and production patterns through resource optimisation and reduced post-harvest losses (SDG 12). Beyond validating OMM's potency as a localised intervention, this organised visual framework also positions it as a practical, imitable blueprint for incorporating global sustainability agendas into regional agricultural policies, offering actionable insights to augment similar initiatives across other climate-vulnerable Indian states.

4.8. SUSTAIN Score and Sensitivity Analysis

Extending the qualitative mapping presented in **Table 6**, a standardised scoring system is applied across all 17 SDGs in **Table 7**.

Table 6. Linkages between OMM outcomes and SDG targets.

SDG	Economic Dimension (CSA Pillar 1)	Environmental Dimension (CSA Pillar 2 + 3)	Social Dimension (CSA Pillar 4)
SDG 1	Major (1.3, 1.4)	Contributing (1.5)	Contributing (1.1, 1.2)
SDG 2	Major (2.3)	Major (2.4, 2.5, 2.a)	Contributing (2.1, 2.2)
SDG 3	Contributing (3.1, 3.2, 3.4)	Contributing (3.9)	
SDG 5			Major (5.5)
SDG 6		Major (6.3, 6.4)	
SDG 7		Contributing (7.2)	
SDG 8	Major (8.2)		Major (8.3, 8.5)
SDG 10	Contributing (10.1)		Contributing (10.2)
SDG 11		Major (11.4)	
SDG 12		Major (12.2,12.4, 12.5) Contributing (12.3)	
SDG 13		Contributing (13.1, 13.2, 13.3)	
SDG 15		Contributing (15.1, 15.3)	

Source: Author's compilation.

Table 7. Quantitative SDG mapping for OMM outcomes.

SDG Target	Description	Score
SDG 1.1, 1.2, 1.3, 1.4, 1.5.	Lift the vulnerable group out of poverty. Training, subsidies and MSP procurement. Resilience to climate shocks through low-input millets.	2
SDG 2.1, 2.2, 2.3, 2.4, 2.5, 2. a	Food and nutrition security via PDS/ICDS/MDM inclusion. Productivity and income increase for marginal farmers. Sustainable agriculture system. Genetic diversity via seed centres. Investment in agricultural research and rural infrastructure.	2
SDG 3.1, 3.2, 3.4, 3.9	Maternal mortality, malnutrition and NCDs reduction. Low chemical inputs	2
SDG 4	NA	0
SDG 5.5	Women-led enterprises	2
SDG 6.3, 6.4	Reduced water pollution and increased water use efficiency.	2
SDG 7.2	Renewable energy usage	1
SDG 8.2, 8.3, 8.5	Innovation, jobs, productivity	2
SDG 9	NA	0
SDG 10.1, 10.2	Increased income and inclusion of the bottom 40% population.	2
SDG 11.4	Preservation of traditional agricultural practices and knowledge by promoting location-specific local millet.	1
SDG 12.2, 12.3, 12.4, 12.5	Resource use efficiency and reduced food loss	2
SDG 13.1, 13.2, 13.3	Climate change mitigation	1
SDG 14	NA	0
SDG 15.1, 15.3	Soil health and biodiversity	1
SDG 16	NA	0
SDG 17	NA	0
	Total	20
	SUSTAIN Score (%): Total points scored/Maximum possible score	(20/34) × 100 = 58.82%

Note: NA stands for no available evidence on the attainment of the particular goal.
Source: Author's compilation.

A SUSTAIN score of 58.82% confirms OMM's wide-ranging alignment with SDGs and its contribution to localisation of various targets, particularly in poverty, hunger and decent work. **Figure 8** illustrates this alignment through a radar chart.

Table 8 highlights the SUSTAIN score's stability under diverse CSA scenarios. In addition to the unweighted case (original in **Table 7**), three other weighted priorities are defined based on the environmental, social, and economic dimensions. In fact, weightings for the specific SDGs are doubled across the environmental (SDGs 6, 7, 13, 14, and 15), social (SDGs 1, 2, 3, 4, 5, and 10), and economic (SDGs 8, 9, and 12) dimensions. Compared to the baseline of 58.82%, the score rises to 88.23%, 76.47%, and 70.59% under social, environmental, and economic weighting, respectively. This variability highlights OMM's adaptability within the key focus area (particularly in the social and environmental dimensions) while maintaining strong overall SDG alignment. Together, these quantitative metrics verify the mission's multidimensional contribution to localisation, spanning economic productivity, social inclusion and ecological resilience.

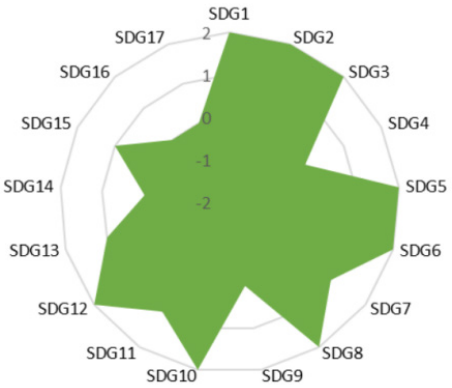

Figure 8. Radar Chart of SDG scores.
Source: Author's presentation.

Table 8. Sensitivity analysis of SUSTAIN score.

SDG	Original	Environmental Weighting	Social Weighting	Economic Weighting
SDG 1	2	2	**4**	2
SDG 2	2	2	**4**	2
SDG 3	2	2	**4**	2
SDG 4	0	0	0	0
SDG 5	2	2	**4**	2
SDG 6	2	**4**	2	2
SDG 7	1	**2**	1	1
SDG 8	2	2	2	**4**
SDG 9	0	0	0	0
SDG 10	2	2	**4**	2
SDG 11	1	**2**	1	1
SDG 12	2	2	2	**4**
SDG 13	1	**2**	1	1
SDG 14	0	0	0	0
SDG 15	1	**2**	1	1
SDG 16	0	0	0	0
SDG 17	0	0	0	0
Total	20	26	30	24
SUSTAIN Score	58.82%	76.47%	88.23%	70.59%

Note: Bold figures indicate that these scores are doubled (in comparison to the unweighted original case) when priority is assigned.
Source: Author's compilation.

5. Conclusions

This study was initiated to address two primary objectives: first, to illuminate the potential reach of the millet mission across Indian states, with special reference to Odisha, and second, to evaluate OMM's contribution

to localising the SDGs by mapping outcomes to global sustainability targets. Since its launch in 2017 in seven districts of southern Odisha's tribal belt, the mission has grown exponentially, covering the entire state within a six-year timeframe. Meanwhile, all other parameters, such as block coverage, farmers' involvement, and area under cultivation, have witnessed a phenomenal surge over the period. Simultaneously, the FPO count in India also escalated rapidly (to 44,000) due to tax exemptions, central sector schemes, and other policy reforms. Besides this, the study results also affirm that OMM is the mediator in reviving millets and integrating them into India's food and farming future. With its simultaneous focus on production, processing, consumption, marketing, and the inclusion of millets in government schemes, people are recognising the nutritional superiority and health benefits of millets, leading to greater attention and prioritisation. It can be an effective way to develop climate-resilient agricultural practices that help achieve the global goals and associated targets. In addition to advancing climate action (SDG 13), food security (SDG 2), and income objectives (SDG 1), a millet farming approach can contribute to priority goals, including gender equality and social equality (SDG 5), urban development, and employment (SDG 8).

With these evidence-based insights on OMM outcomes and SDG interlinkages, this paper can inform policymakers in making strategic decisions to achieve better results from the millet mission initiative:

Firstly, policymakers can strategically scale the mission by empowering and nurturing FPOs and SHGs to act as indispensable intermediaries throughout the agri-supply chain, from input supply to procurement.

Secondly, there is a need to implement regulations to track and monitor FPOs' long-term compliance, ensuring that FPO operations are well justified and that government support and funding are well spent. In monitoring and evaluating the programme, a cohesive policy across state departments needs to be implemented through a whole-of-government approach.

Lastly, on a national scale, the mission's broad value chain, ranging from community seed centres and input supply to procurement and PDS inclusion, can be replicated in other states to strengthen the resilience of marginal farmers, enhance nutrition security, and counter climate threats. The OMM model demonstrates effective scalability within Odisha's specific context (rainfed region, tribal population). For instance, states like Punjab or the northeastern regions would need customised modification throughout the value chain (seed systems, processing infrastructure, market linkage), unlike Odisha's indigenous design. So, policymakers should not position OMM as a universal best practice to be replicated directly across diverse Indian states. It should be considered as a contextually replicable framework with proven elements (community seed centres, custom hiring centres, PDS integration). Further, national FPO data reveals challenges, such as 39% non-compliance, underscoring the need for prerequisite analysis before interstate adoption. This also aligns with SDG 17's emphasis on context-specific partnerships over one-size-fits-all solutions.

Limitations of the Study

This study captures descriptive alignments rather than quantified impact levels, using a qualitative approach that draws on secondary sources, including baseline surveys, annual reports, official OMM documentation, and independent research. Furthermore, the mapping criteria don't include standardised scoring protocols and rely on the researcher's judgment, which can introduce subjectivity (a form of attribution bias). It is not possible to test causal pathways in this methodological framework. Therefore, further research should incorporate primary field data collection from stakeholders to strengthen attribution and address these methodological constraints.

Author Contributions

Conceptualization, M.K.B. and A.L.; methodology, M.K.B. and A.L.; software, M.K.B.; validation, A.L. and M.K.B.; formal analysis, M.K.B.; investigation, M.K.B.; resources, M.K.B.; data curation, M.K.B.; writing—original draft preparation, M.K.B.; writing—review and editing, A.L.; visualization, M.K.B.; supervision, A.L.; project administration, M.K.B. Both authors have read and agreed to the published version of the manuscript.

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