Security Drivers and Pragmatic Interventions

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This entry sought to identify trends in publications in the direction of sustainable food security by examining its drivers that are critical for shaping food policy. The sustainable food security drivers in food supply chain include food security governance involvement, input resource management, output management, information sharing, and interventions. Quality management is an ideal pragmatic intervention that has critical positive potential to improve the state of sustainable food security in the food supply chain.

Keywords: food security ; sustainability ; food supply chain ; quality management ; drivers ; interventions

1. Sustainable Food Security Drivers and Pragmatic Interventions in the Agriculture Sector

The literature indicated the most common driver of sustainable food security is the food security governance decisions [1][2][3][4][5][6], which subsidy and assistance programs are the most implemented interventions globally. The state of government policy, transformation programs, and subsidies, positively leaned towards attaining the "availability" domain in food security [5]. Nonetheless, such policies have obscured the environmental impact, resulting in a higher environmental cost per unit of rice output, but with approximately twice the level of fertilizer and pesticide input. It was recommended that the policy development should consider various scales of farm households and cropping patterns that were consistent with farmland grain-planting suitability.

Most of the interventions implemented in agriculture were meant to improve yield and to lower the environmental costs, with better economic gains across land and water [1][5][7][8][9][10][11]. Consequently, better resource efficiency with less costly input is in tandem with the market's participation. This caused the self-determination of prices to increase the net income of farmers and laborers, hence improving household food security states [12][13]. Salary, food prices, and accessibility to food markets all influence food purchases and should be considered as part of the food security drivers.

From the perspective of land usage, it was found to be equivalent to water and energy footprints [12][14]. The status of the tenure and ownership of the lands determined the fate of the land usage (households with customary land tenure had a 17.4% lower probability of adopting crop diversification). Crop diversification was observed to be an intervention that exhibited a strong impact on the household food security state [9]. Several interventions were implemented to improve water efficiency, including (i) terracing, (ii) area closure, (iii) planting fodder grasses, (iv) planting legumes and trees, (v) soil bund construction, (vi) crop rotation, (vii) stop free grazing, (viii) waterways, (ix) manure, (x) inorganic fertilizer, (xi) dams inspection, and (xii) cut off drains [12].

The household food security state was also greatly influenced by the farmers' and laborers' competency level [14]. The effort to systematically improve the farmers' technical knowledge (in labor technical productivity change) in the agricultural production process would contribute to the betterment of the agricultural industry [13]. This study suggested that agroecological projects, workshops, seminars, and training events should be conducted continuously. This would provide the opportunity for farmers and workers to increase their knowledge, thus encouraging them to gradually adopt more advantageous agripractices for sustainability and improved food security [15].

However, it should be noted that poorly developed countries can lack incentives that cause growth and agricultural efficiency. It should be stressed that, apart from assistance at the national level, alleviating the global problem of hunger requires the participation of the international community [16].

2. Sustainable Food Security Drivers and Pragmatic Interventions in the Manufacturing Sector

Manufacturing is the most substantial contributor to the environmental impact categories, including water, energy, land usage, acidified air emission, ozone depletion, global warming potential, and waste generation [17].

The closed-loop supply chain model is a novel intervention used to intigate the realization of sustainable operations that positively affected profitability (15-year operation lifetime that breaks even in a maximum 10-year payback time), the energy self-sufficiency indicator (cogeneration plant is completely self-sufficient in electric energy), and the employment possibilities [18]. Postfarm gate recycling processes and the optimization of the performance of packaging utilizations are among the pragmatic interventions, which can reduce the environmental impact [17][18][19][20].

Another form of recycling process was located, which is by investigating the potential of reusing reconditioned water to reduce wastes and save costs [19][20]. For example, water was successfully recovered in the dairy industry via a combination of ultrafiltration and reverse osmosis processes.

From the perspective of managing the manufacturing practices in the context of sustainable food security, Ocampo [21] identified seven sustainable manufacturing practices. These were ranked in the following order: total quality management, resource efficiency, material efficiency, just-in-time, green manufacturing, waste elimination at source, and ecoefficiency. In the food industry, quality management and innovation have shown a significant impact on green performance [22]. Ocampo [21] suggested that total quality management was the most suitable intervention as it focuses on meeting customer expectations of integrating sustainability considerations in finished food products.

The trends in literature show that food waste produced from manufacturing can come from unavoidable waste (e.g., animal fat, slaughter waste) and have no-value final products [59]. The results postulated that major drivers and interventions are based on the input resource management, where product waste was cited the most. In the recent advances of integrated systems, quality management approach has become more a conventional intervention in the manufacturing sector in addressing the waste issues [23][24].

The conventional purpose of a quality improvement program in the food industry is to improve product quality and to reduce production costs by minimizing variations and reducing wastes [25]. Nevertheless, the purpose was revolutionalized to support the effort for green food production, primarily by reducing wastes effectively [23][24][26]. Powell et al. [23] demonstrated the success of lowering milk loss and subsequently, reducing wastewater. Food waste (environmental impact) reduction was implemented through the use of basic quality tools, such as brainstorming, process flow, project charter, key performance indicators, measurement system analysis, material balance analysis, critical-to-quality, cause and effect figure, design of experiment, Pareto chart, control chart, mistake proofing, lean tools such as value stream mapping (VSM), and the six sigma tools, such as statistical process control (SPC) through define, measure, analyze, improve, and control (DMAIC) [23][26].

In principle, Lean Six Sigma (LSS) has a positive effect on sustainable food sustainability, incorporating two solid Lean and Six Sigma as quality [23][24]. The LSS can promote process capability, employee's engagement, empowerment, and educate employees on the consequences of waste [24][27][28][29].0

The soft benefits of the quality improvement techniques include being able to educate the employees on the consequence of waste, and how to minimize wastes as quality improvement programs that promote employee involvement in the process [32,45,50,52,54]

3. Sustainable Food Security Drivers and Pragmatic Interventions in the Food Logistics Sector

The result postulated that the logistics affected mostly on the accessibility category of food security principles driven by input, output resource management, and food security governance involvement. Transportation costs and greenhouse gas (GHG) emissions are the dominant paradigm in the food logistics and distribution process [30][31][32]. Effective food distribution for business today not only considers the operation base, shelf-time, organoleptic and biophysical characteristics, but also must be economically efficient and environmentally friendly. The intervention that enables minimization of carbon dioxide emissions and distribution costs is through reassessment of distribution [31]. Evidently, the feature that makes food supply chains unique and more daunting than perishability is the intense heterogeneity of the industry, with hundreds of thousands of small producers supplying tens of thousands of middle players serving thousands of sale points, and hundreds of retailers each operating a distribution chain [33].

The impact of logistics performance on food security varies according to region [34][35][36]. In South Africa, the delivery infrastructure impaired rural food security due to poor road conditions, which threatened personnel safety and security. As a result, food shelf-life in retail was shortened due to late delivery or even no distribution at all to some remote counties [30]. Complications from such problems often lead to higher food prices, and the lack of nutrient diversification at retail levels. In order to meet the challenges, food policy intervention at different levels, including infrastructural development, support of entrepreneurship, adaptive production, land reformation, and skill-building needs to be brought to the forefront so as to achieve better food security states [33][37][38][39].

4. Sustainable Drivers and Pragmatic Interventions in the Retail and Restaurant Sector

In the retail and restaurant sector, food loss/waste, locations, and food prices critically affect food security through high food waste volume [40][41][42].

"Take back" agreement at the retail level is deemed to be the culprit of food waste generation, particularly bakery items [40]. In business terms, suppliers often agree to take back products that are of unsatisfactory quality or approaching expiry. Meanwhile, at the restaurant level, food waste generation is invariably due to low-quality products, e.g., overripe and underripe produce from suppliers. An innovative approach to avoid the rejected food from becoming food wastes, the function of the food is often changed to animal feed, and the source of biogas [43].

It was observed that poor green practices in the restaurant are believed to be the main cause of food wastes [42][43]. First-in-first-out (FIFO) policy is a highly recommended practice to avoid wilted and spoilt food, especially salad and steak, that are usually prepared at the earliest stage of food preparation [42]. The lack of communication with the customers in informing them about the size or portions also led to food waste generation [42]. According to Pulkkinen et al. [41], consumers are willing to choose low carbon footprint meals if they were informed and given an option. The lack of green practices information was also found to disappoint consumers, thereby highlighting the importance of communication as an intervention to avoid food wastes [43].

Schubert et al. [43] ranked the important green practices or interventions at the restaurants from the consumer's perspective. Reducing energy usage and wastes, using biodegradable or recycled products, serving locally grown food, and using organic products are the top four practices expected by consumers. The least mentioned interventions were donations to environmental projects and paying fees to reduce their ecological footprints.

Food insecurity also affects the different groups of the population, e.g., low-income and senior citizens, who may be affected by limited food choices, financial aids program availability, location of restaurants, and retail and food prices [44]. Thus, a subsidy program such as Nutrition North Canada was introduced to reduce the burden of the cost of nutritious food for residents living in remote areas. Nonetheless, [45] emphasized that the success of such subsidy programs depended on the managers and retailers who were responsible for the full accountability of such programs, such as claims accuracy, transparent fiscal reporting, retail competitions, and prohibitive freight costs.

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