



## RESEARCH ARTICLE

### ENHANCING THE ADOPTION OF AGROECOLOGICAL, CLIMATE SMART, AND ENVIRONMENTALLY SUSTAINABLE PRACTICES THROUGH YOUTH-LED INITIATIVES IN THE SUGAR INDUSTRY

\* Goudian Gwademba, Melvin Achieng, Phinnaline Achieng, Bramwel Soita, Daniel Mukhwana Deutsche Welthungerhilfe, E. V.

Agroecological, Climate Smart, and Environmentally Sustainable Practices Through Youth-Led Initiatives

#### ARTICLE INFO

##### Article History

Received 20<sup>th</sup> July, 2024  
Received in revised form  
16<sup>th</sup> August, 2024  
Accepted 27<sup>th</sup> September, 2024  
Published online 30<sup>th</sup> October, 2024

##### Keywords:

Climate Resilience, Biodiversity Loss, Agroecology Approaches, Climate smart, Environmental Consciousness.

\*Corresponding author:  
Goudian Gwademba

#### ABSTRACT

This thesis investigates the implications of Artificial Intelligence (AI) on Occupational Health and Safety (OHS) practices, aiming to provide insights into the challenges, opportunities, and best practices associated with AI adoption in workplace safety management. Through a mixed-methods approach incorporating quantitative analysis, qualitative analysis, and literature review, the study explores the impact of AI technologies on hazard identification, risk assessment, incident prevention, and safety culture enhancement in various industries. Key themes include the effectiveness of AI-driven safety interventions, factors influencing AI acceptance among OHS professionals, ethical considerations, regulatory implications, and recommendations for responsible AI use in safety management. The findings contribute to advancements in OHS research, inform organizational practices, and guide future inquiries into the intersection of AI and workplace safety.

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Citation: Goudian Gwademba, Melvin Achieng', Phinnaline Achieng' et al. 2024. "Investigating the implications of Artificial intelligence on occupational health & Safety.", International Journal of Recent Advances in Multidisciplinary Research, 11, (10), 10305-10308.

## INTRODUCTION

Agriculture dominates the Kenyan economy, contributing approximately 33 percent of Kenya's Gross Domestic Product (GDP). The agriculture sector employs more than 40 percent of the total population and 70 percent of the rural population (ASTGS, 2019-2029). When agricultural operations are sustainably managed, they can preserve and restore critical habitats, help protect watersheds, improve soil health and water quality thus enabling farming communities to develop Climate resilience, however unsustainable practices have serious impacts on people and the environment leading to biodiversity loss. Worldwide, sugarcane covers 65 million acres of land, and a dozen countries use at least 25% of their farmland to grow it (Framework for the Sugar Sub-Sector in Kenya, 2010). In Kenya the sugar subsector supports over eight million Kenyans who draw their livelihoods directly from sugar production and indirectly through linked enterprises in supply of goods, related services and social amenities. (Republic of Kenya 2023).

However, the sector is faced by several challenges such as soil degradation due to the high reliance and intensive use of inorganic fertilizers which has led to high acidity levels and climate variability. Agroecology approaches have therefore emerged as prerequisite to addressing the many challenges facing current agri-food systems such as climate change, soil degradation, biodiversity loss, and environmental pollution. This paper addresses the application of ecological and social principles within the sugarcane farming systems, with a focus on the untapped opportunities for youth. Such principles include soil health, recycling/circularity, input reduction, synergies, and biodiversity management.

## METHODOLOGY

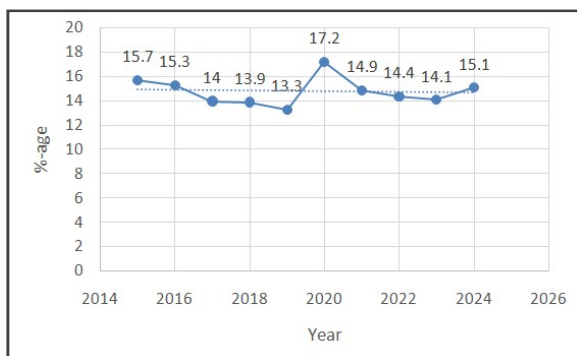
The study used the Tool for Agroecology Performance Evaluation (TAPE) developed by the Food and Agricultural Organization of the United Nations (FAO, 2019) to measure the multidimensional performance of agricultural systems with a focus on smallholder sugar cane farming at different scales and in different contexts using the ten elements of agroecology:

diversity, co-creation and sharing of knowledge, synergies, efficiency, recycling, resilience, human and social values, culture and food traditions, responsible governance, and circular and solidarity economy. The TAPE tool was used to evaluate sugar cane farming systems and projects to bring an agroecological focus to diverse activities across the dimensions of sustainability and combined with other agricultural indicators, the tool was used to provide additional characterizations of land tenure, economics, diet, and women/youth empowerment. TAPE can be used to assess all types of production systems in the agricultural sub-sectors, it is adaptable to local contexts and languages and is flexible enough to be complemented with any other methodology or indicators, to inform additional dimensions of sustainability not covered by the core criteria or to provide deeper analyses on a specific topic. The following 'steps' of assessment were considered for this study.

## DISCUSSION

The study used the TAPE tool to evaluate smallholder sugarcane farming systems in Bungoma, Siaya and Kakamega counties and found that more agroecologically advanced farming systems improved youth engagement with farming, income from agropastoral practices, dietary diversity, and other production and environmental sustainability indicators. Approaches to climate smart agriculture that are based on knowledge and skilled labour, such as agroecology, can provide a promising solution as a source of decent jobs, by offering rural employment opportunities that meet the aspirations of rural youth and contribute to decent work (FAO, 2019). The study monitored the extent of decent work in agriculture, especially for young people as discussed below.

**The youth NEET rate - 13th ICLS** (the proportion of youth (aged 15-24 years) not in education, employment or training - 13th ICLS. The study adopted the approach of SDG indicator 8.6.1, which conveys the proportion of youth (aged 15- 24 years) not in education, employment or training - 13th ICLS (also known as "the youth NEET rate") and collected data on youth in household in Kakamega, Siaya and Bungoma counties. This data was then compared with the number of young people working in agricultural activities within the sugarcane farming system assessed, the number of youths in education, the number of those working outside the sugarcane farming system (but living in the system) and the number of those who have emigrated as shown in figure 1 below



Source: Research data, 2024

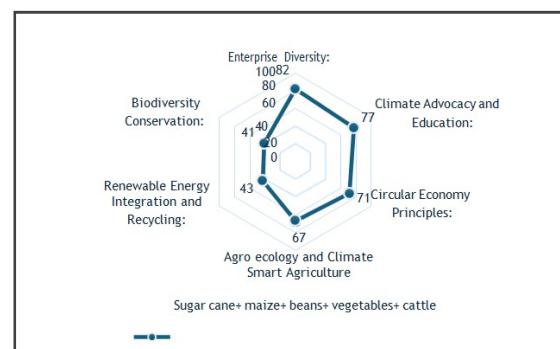
**Figure 1: Percentage proportion of the ProSoil Project Participants Household population (16 to 24 years) who are not in education, employment or training**

The data was combined with data about young people's perception of agricultural work by asking them if they would like to continue the activity of their parents/family or if they would emigrate if they had the chance.

**Youth employment and emigration indicators:** The criterion for employment and emigration indicators were calculated by considering the available Youth employment opportunities to confirm that Youth-centered initiatives can play a crucial role in driving agroecological, climate smart and environmentally sustainable practices within the sugar industry, shaping a sustainable future through innovative approaches and advocacy efforts. These initiatives empower young people to be catalysts for change, in adopting and promoting practices that prioritize environmental sustainability and climate resilience within the sugar industry. With a target population of 3000 young people the study undertook a more in-depth assessment on youth employment and emigration as a proxy for local opportunities for young people as tabulated in table 1 below.

A more in-depth assessment on youth employment as a proxy for local opportunities for young people confirmed that a majority of young people had already left the community for lack of opportunities (44.17%) while 32.10% of young people wanted to be producers of sugar cane if the environment was conducive and had the requisite resources, while 25.90% of young people would emigrate, if they had the chance. Conversely 33.77% of young people were working outside the sugarcane production system as compared to 23.93% of young people working in the sugarcane agricultural production system assessed.

**TAPE Tool for Agroecology Performance Evaluation:** The TAPE tool was tested in several pilots or case studies. The purpose of the studies had particular emphasis on (i) the overall stepwise approach and (ii) the CAET and the Core Criteria of Performance within the framework of projects assessing sustainability in agriculture, farm networks engaged in monitoring multidimensional performance, measuring agroecological performance with an eye to improvement through time, as shown below in Figure 2



Source: Research data 2024

**Figure 2. Results of Step 1 and Step 2 applied to a farm in Bungoma County**

Prior collected data was used to populate the tool to assess performance wherever possible to try to reduce enumeration time and increase efficiency as presented in figure 2 above. The result of a test conducted on farm in Bungoma county in western Kenya region.

**Table I. The step-by-step analytical framework of agroecology**

STEP 0 ↓	Description Systems And Context	Review primary and secondary information: <ul style="list-style-type: none"> <li>• Production systems, type of household, agroecological zones</li> <li>• Existing policies (incl. climate change)</li> <li>• Enabling environment</li> </ul>
STEP 1 ↓	Characterization of Agroecological Transition (CAET)	Undertake on farm/household survey: <ul style="list-style-type: none"> <li>• Describe status</li> <li>• Based on 10 elements of agroecology with descriptive scales</li> <li>• Can be self-assessed by producer</li> </ul>
	STEP 1b ↓	Transition Typology
STEP 2 ↓	Criteria Of Performance	Undertake on farm/household survey: <ul style="list-style-type: none"> <li>• Measure progress and quantify impact</li> <li>• Addressing 5 key dimensions for policy makers and SDGs</li> <li>• Time/cost constraints: keep it simple!</li> </ul>
STEP 3 ↓	Analysis And Participatory Interpretation	At territory/community scale: <ul style="list-style-type: none"> <li>• Review CAET results, explain with context, enabling environment</li> <li>• Review Performance results and explain with CAET</li> <li>• Analyze contribution to SDGs</li> </ul>

Source: Research data, 2024

**Table II. Youth employment opportunities Indicators**

DOMAIN	INDICATORS	No. of Young People	% of Young People
Employment / activity	% of young people working in the agricultural production of the system assessed	718	23.93
	% of young people in education or training	811	27.03
	% of young people working outside but currently living in the system assessed	1013	33.77
	% of young people not in education, nor working in agricultural nor in other activities	347	11.57
	% of young people who already left the community for lack of opportunities	1325	44.17
Emigration	% of young people who want to continue the agricultural activity of their parents	963	32.10
	% of young people who would emigrate if they had the chance	777	25.90
	% of young people who already left the community for lack of opportunities	289	9.63

Source: Research data, 2024

The high level of diversity on the farm (Sugarcane, Maize, Beans, vegetables and dairy cattle production as well as activity as Climate Advocacy and Education), together with the relatively high score in circular economy (products sold directly to neighboring households through social networking groups), explains the high level of productivity but also of income and added value compared to the average in the country. However, limited synergies in renewable Energy Integration and Recycling were found between the different sub-production systems which explains the relatively low score in agricultural biodiversity (significant share of the farmland is in sugarcane monocropping) as well as the high exposure to external inputs (synthetic pesticides and inorganic fertilizers).

## CONCLUSION

The purpose of this study was to evaluate the adoption of agroecological, climate smart, and environmentally sustainable practices through youth-led initiatives among smallholder farmers in Kakamega, Siaya and Bungoma Counties in Kenya with the aim of inculcating environmental consciousness and through the evaluation of SDG indicator 8.6.1 (also known as "the youth NEET rate"), resolved that while the sugar subsector continues to play significant economic and social roles in both the agriculture sector and the national economy, young people are often sidelined in agricultural decision making in the sugarcane subsector which hinders the implementation of the innovative practices that the youth possess.

Furthermore, through an agroecology performance evaluation the study qualified that diversification is key to agroecological transitions to ensure food security and nutrition while conserving, protecting and enhancing natural resources. Through the assessment of how sugarcane farmers applied and or adopted sustainable agricultural land management practices the study established that agricultural innovations responded better to local challenges when they were co-created through participatory processes that involved youthful population. Finally, through an appraisal of youth employment and emigration indicators, the study concluded that since young people are more likely to adopt new technologies, this trend can be harnessed to revitalize the sugar industry, especially for regions that are faced with soil degradation, low yields, inefficiencies and market fluctuations. Through the integration of mobile applications tailored to the sugar farming sector, the youth can be able to access real time information on the best agricultural practices such as precision farming and soil management practices. These platforms can also be critical in offering training modules that will enable the youth to stay updated with the innovative sugarcane varieties and planting techniques that can enhance resilience against climate change, pests and diseases. This will enable the young farmers to make data driven decisions that enhance yield quality and profitability.

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