International Journal of
Environmental Science
(IJES)

Regreening Childhoods: Farmer Managed Natural Regeneration (FMNR) Enhances Child Well-being in the Context of Climate Change

Carol Munini Munyao, Harrison Maithya, Josephat Kimatu, Harun Kiruki, Lucia Ngei, Antony Mativo, Humphrey Wafula, Joseph Matata, Hellen Kipkullei, Alex Macharia, Margret Matheka, Alice Muller and Sarah Downes

Regreening Childhoods: Farmer Managed Natural Regeneration (FMNR) Enhances Child Well-being in the Context of Climate Change

Carol Munini Munyao[1], Harrison Maithya[2], Josephat Kimatu[2], Harun Kiruki[2], Lucia Ngei[2], Antony Mativo[1], Humphrey Wafula[1], Joseph Matata[1], Hellen Kipkullei[3], Alex Macharia[1], Margret Matheka[1], Alice Muller[4] and Sarah Downes[4]

[1]World Vision Kenya, Karen, Nairobi, Kenya
[2]South Easter Kenya University, Kitui, Kenya
[3]Moi University, Eldoret, Kenya
[4]World Vision Australia, Melbourne, Australia

Abstract

Purpose: Climate-induced land degradation and resource scarcity threaten child well-being across Sub-Saharan Africa, undermining food security, health, education, and protection outcomes. As climate impacts intensify, there is a growing need for integrated approaches that restore ecosystems while safeguarding human development. Farmer Managed Natural Regeneration (FMNR)—a low-cost, community-driven agroecological technique that promotes the regrowth of native vegetation from existing root systems—has emerged as a scalable and sustainable climate adaptation strategy. This paper investigates how FMNR contributes to child well-being in climate-affected regions of Kenya by enhancing environmental health, strengthening household resilience, and reinforcing community coping mechanisms.

Methodology: Drawing on mixed evidence from World Vision Kenya's FMNR programs (2018–2025), the study integrates program data, qualitative insights, and literature to identify key pathways through which FMNR influences child outcomes.

Findings: Findings reveal three interrelated mechanisms: (1) Enhanced food and income security, which reduces malnutrition, child labor, and educational disruption; (2) Restored landscapes and ecological stability, which mitigate climate shocks and sustain caregiving systems; and (3) Inclusive community governance, which fosters intergenerational knowledge transfer, child participation, and social cohesion. Collectively, these outcomes demonstrate that FMNR contributes not only to ecological restoration but also to social resilience and protection of children's rights. The analysis aligns with Sustainable Development Goal (SDG) 13 on Climate Action and the African Union's Agenda 2063, reinforcing FMNR's relevance as a climate-responsive, child-centered development intervention. By bridging ecological regeneration and social development, FMNR emerges as an integrated, evidence-based solution to strengthen community resilience and safeguard children's well-being amid escalating climate challenges.

Unique Contribution to Theory, Practice and Policy: It is recommended that Farmer Managed Natural Regeneration (FMNR) be embedded in child-focused climate adaptation policies to ensure its full integration into development planning. Including FMNR indicators in national child well-being frameworks will enhance accountability and track its diverse impacts on children's lives. Longitudinal and geospatial studies should be pursued to strengthen evidence on FMNR's long-term ecological and social benefits. Continued involvement of children and caregivers as environmental stewards will promote intergenerational responsibility and sustain the positive outcomes of FMNR initiatives.

Keywords: *FMNR, Child-wellbeing, Climate Change, Sub-Saharan Africa*

JEL Classification: Q54, Q23, I31, I38, O13, O55

INTRODUCTION

Children in Sub-Saharan Africa are disproportionately vulnerable to the impacts of climate change, particularly in regions experiencing land degradation, erratic rainfall, and declining ecosystem services. These environmental pressures compromise household livelihoods and care systems, leading to malnutrition, school absenteeism, child labor, and increased protection risks (UNICEF, 2021).
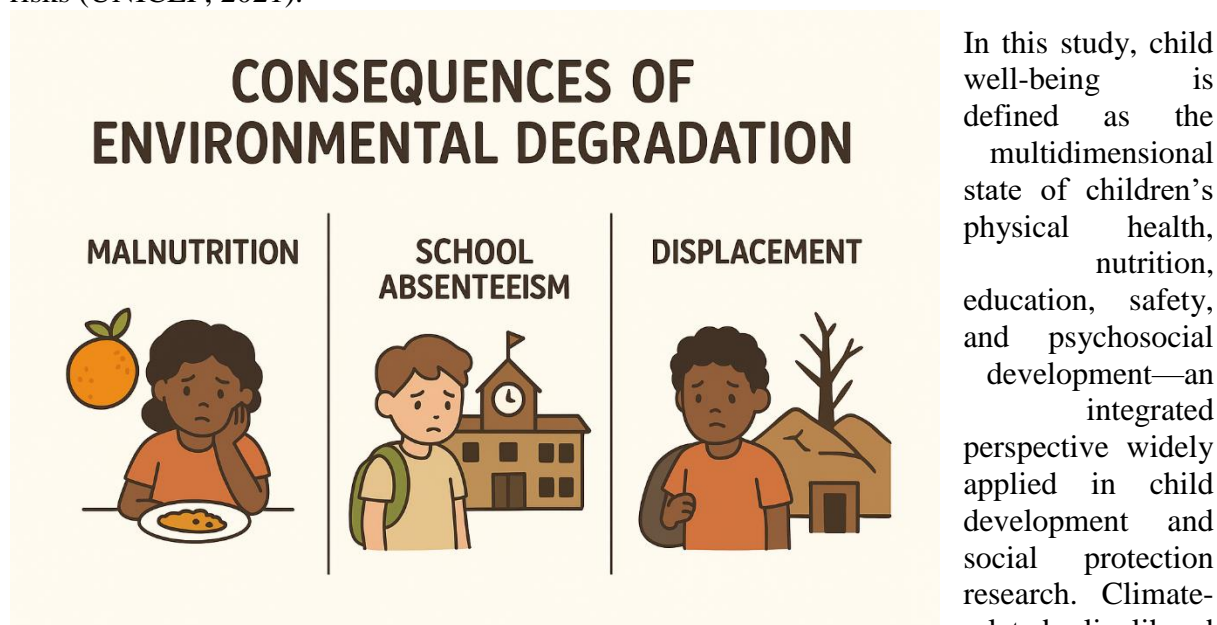
In this study, child well-being is defined as the multidimensional state of children's physical health, nutrition, education, safety, and psychosocial development—an integrated perspective widely applied in child development and social protection research. Climate-related livelihood shocks directly and indirectly compromise these dimensions by limiting household food availability, income stability, caregiving capacity, and learning environments.

Addressing child well-being in this context necessitates integrated approaches that restore ecosystems while strengthening social resilience.

Farmer Managed Natural Regeneration (FMNR) is a low-cost, community-driven land restoration technique that encourages the regrowth of native trees and shrubs from existing root systems, stumps, and seed banks (Rinaudo, 2019). Originally developed in the Sahel, FMNR has gained prominence as a scalable nature-based solution with demonstrated ecological and socio-economic benefits (Reij & Garrity, 2016). While its contribution to agricultural productivity and climate adaptation is well-documented, less attention has been paid to its role in safeguarding child well-being.

Plate 1: Children Learning on FMNR in Wet Pokot County, Kenya

Source: World Vision Kenya

FMNR enhances child well-being in the context of climate change by improving food security, increasing household income, and providing environmental stability (Chesire et al., 2025). However, most FMNR scholarship has focused on ecological or agricultural outcomes, leaving the specific links to children's well-being insufficiently explored.

Plate 2: Children Advocating for Environmental Conservation in North Rift, Kenya

Source: World Vision Kenya

To situate these relationships, the study adopts a conceptual framework in which ecological restoration enhances household resilience, which in turn shapes child outcomes. Restoration improves natural capital (soil nutrients, biomass, water retention), which supports livelihood stability through increased crop yields, diversified products (e.g., fodder, fuelwood, fruits), and reduced time burdens for resource collection. This enhanced resilience enables households to provide better nutrition, stable incomes for schooling and healthcare, safer environments, and reduced exposure of children to labor-intensive coping strategies. This ecological–livelihood–child well-being pathway is supported by wider literature on environmental determinants of child health (Ebi & Bowen, 2016), gendered household labor dynamics (Doss et al., 2018), and climate-sensitive livelihoods (Thornton et al., 2018).

Despite the growing recognition of FMNR as a nature-based solution for climate adaptation, a clear research gap persists. Few studies have systematically examined how FMNR influences multiple dimensions of child well-being, nor have they applied a conceptual framework that explicitly links ecological restoration to household resilience and child outcomes. Evidence remains scattered, largely programmatic, and rarely grounded in child-focused development metrics.

This study addresses this gap by analyzing FMNR's contribution to child well-being within climate-vulnerable contexts, drawing on empirical insights from World Vision Kenya's implementation in arid and semi-arid counties. It investigates the specific pathways through which FMNR supports food security, income stability, health, education, and protection outcomes for children. The study hypothesizes that FMNR positively influences child well-being by strengthening household resilience through enhanced natural capital, livelihood diversification, and improved environmental stability.

METHODOLOGY

This study employed a mixed-methods longitudinal case study design to examine how Farmer Managed Natural Regeneration (FMNR) contributes to child well-being in climate-vulnerable communities in Kenya. The longitudinal design enabled the tracking of ecological, economic, and social outcomes over time, providing a robust basis for understanding causal pathways. The mixed-methods approach combined quantitative household surveys and program monitoring data with qualitative insights from key informant interviews (KIIs) and focus group discussions (FGDs), allowing for triangulation and validation of findings.

Study Sites and Participants

The study was conducted in FMNR program areas across Makueni, Nakuru, Baringo, West Pokot, and Homa Bay (Gwassi Hills) Counties, which are characterized by semi-arid climates, recurring droughts, and high child vulnerability.

A total of 612 households were included in the study between 2019 and 2025. Households were stratified by livelihood zone, gender of household head, and FMNR participation status (practicing vs non-practicing) to ensure comparability. FMNR households were selected based on documented engagement in FMNR activities for at least three consecutive years, while non-FMNR households were drawn from neighboring communities with similar socio-economic and ecological conditions but without FMNR exposure. This stratified matching ensured that differences in outcomes could be reasonably attributed to FMNR participation while minimizing confounding from baseline disparities.

Sampling logic followed a stratified random approach, with strata defined by county, livelihood zone, and household FMNR participation. Within each stratum, households were randomly selected to participate, ensuring representative coverage across program areas and comparability between FMNR and non-FMNR groups.

Key informant interviews were conducted with program staff, community leaders, and caregivers to capture detailed perspectives on FMNR implementation and its perceived benefits for children. These interviews were supplemented by focus group discussions with youth and women's groups in the North Rift region, Makueni, and the Western side of Kenya between 2019 and 2025. These qualitative data provided rich contextual understanding of community experiences, decision-making processes, and social dynamics related to FMNR.

To deepen contextual understanding, 46 key informant interviews (KIIs) were conducted with project staff, local administrators, and caregivers, complemented by 24 focus group discussions (FGDs) with women's, youth, and children's clubs. Participants were purposively selected based on their involvement in or proximity to FMNR activities. Quotes from participants were anonymized and included where appropriate to illustrate perceptions of change.

> *"Now that trees have returned, we no longer send children long distances for firewood; they have more time for school,"* (Caregiver, Makueni, 2024).

A comprehensive review of peer-reviewed studies, technical reports, and policy documents on FMNR, climate change, and child well-being in Sub-Saharan Africa was conducted to situate the findings within broader evidence and theoretical frameworks.

Data Analysis

To establish the relationship between FMNR practices and child well-being outcomes, data from the different sources were triangulated. Quantitative data were analyzed using STATA v17, with descriptive statistics summarizing trends in household income, food security, child nutrition, and school attendance. Inferential analyses included paired t-tests to assess within-household changes over time, independent t-tests for comparisons between FMNR and non-FMNR households, and chi-square tests for categorical variables. All results were reported with sample sizes, standard deviations, confidence intervals, and p-values to ensure transparency. Reliability of survey instruments was assessed using Cronbach's alpha, which exceeded 0.8 for key constructs, indicating good internal consistency.

Qualitative data were analyzed thematically using NVivo 14, following a coding framework aligned with UNICEF's multidimensional approach to child well-being, which encompasses nutrition, education, protection, and participation. Inter-coder reliability was calculated at 0.87, confirming consistent application of codes. The qualitative analysis helped explain the mechanisms linking FMNR to child well-being outcomes and provided contextual depth to quantitative trends. A convergent parallel mixed-methods design guided the integration of findings, allowing points of convergence, divergence, and complementarity to be identified, thereby strengthening causal inferences.

Research Design

A mixed-methods case study design was employed, integrating quantitative household survey data with qualitative insights from community participants. The study utilized a longitudinal design, tracking households from 2019 to 2025, which allowed for the observation of changes in ecological, economic, and social outcomes over time and the assessment of the cumulative impacts of FMNR interventions on child well-being. To complement this approach, annual

cross-sectional snapshots were analyzed to provide comparative insights between FMNR and non-FMNR households, highlighting differential outcomes across communities. By triangulating ecological, economic, and social dimensions, this methodological framework strengthened the validity and depth of the analysis, providing a comprehensive understanding of how FMNR influences child well-being.

The study's conceptual framework positions FMNR as the primary independent variable influencing three interrelated domains: ecological, household economic, and social/community. Ecological outcomes include tree cover, soil fertility, water availability, and microclimate regulation; economic outcomes encompass income diversification, asset accumulation, and financial resilience; and social/community outcomes involve reduced child labor, enhanced gender equity, social cohesion, and community participation. These domains collectively affect child well-being across the four dimensions of nutrition, education, protection, and participation. Feedback loops between child well-being and community engagement further reinforce sustainable ecological management and social resilience (see Diagram 1).
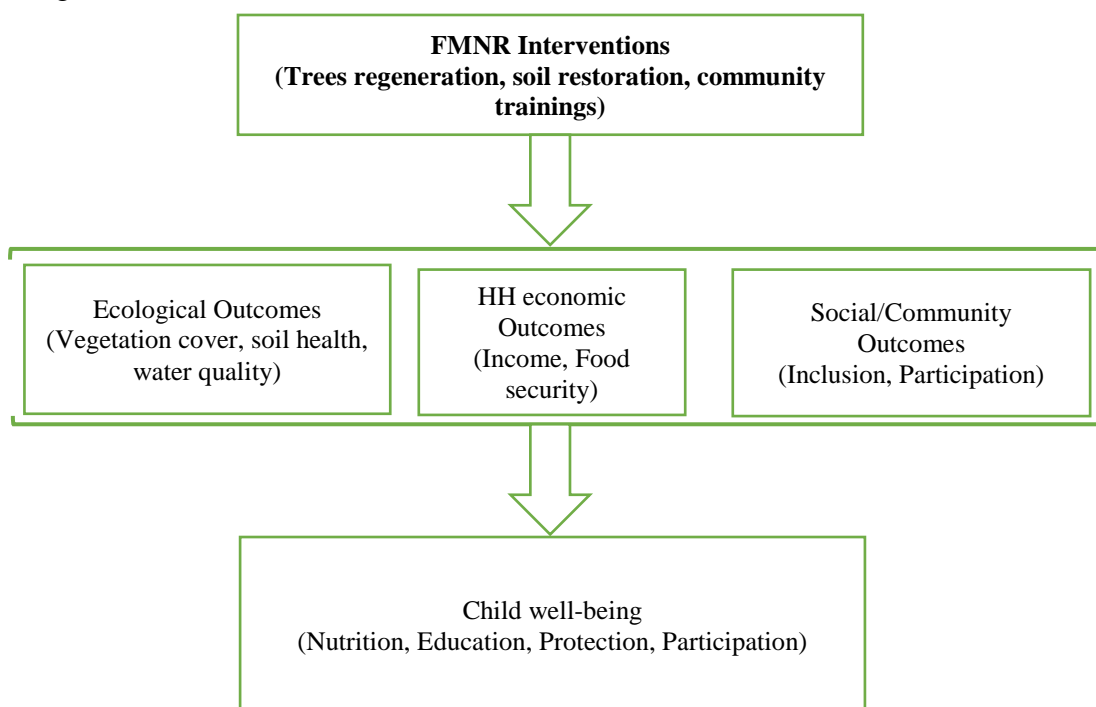

Figure 1: Conceptual Framework

Ethical approval for the study was obtained from relevant institutional review boards. Informed consent was obtained from all adult participants, and assent was sought from children participating in focus group discussions. All data were anonymized to protect participant privacy, and the study adhered to international ethical standards for research with children and vulnerable populations.

RESULTS AND DISCUSSION

Improved Nutrition and Food Security

Climate change poses a significant threat to food security through recurrent droughts, flooding, and inconsistent crop yields, disproportionately affecting children and increasing the prevalence of malnutrition (UNICEF, 2024; FAO, 2018). The adoption of Farmer Managed Natural Regeneration (FMNR) has demonstrated notable improvements in children's diets and overall household food availability. FMNR contributes to increased crop resilience by improving soil fertility, enhancing moisture retention, and providing windbreaks, all of which enable crops to better withstand climatic extremes. For instance, in Niger, FMNR practitioners harvested up to five times more grain than neighboring non-practitioners during drought periods (Reij, Tappan, & Smale, 2009).

FMNR-managed farms demonstrated superior soil nitrogen content (0.24%) compared to control plots (0.09%; $p = 6.89 \times 10^{-13}$) (Machote et al., 2025). Households also reported improved livestock health and productivity, with milk production rising by 87.2% and animal health by 14.9%.
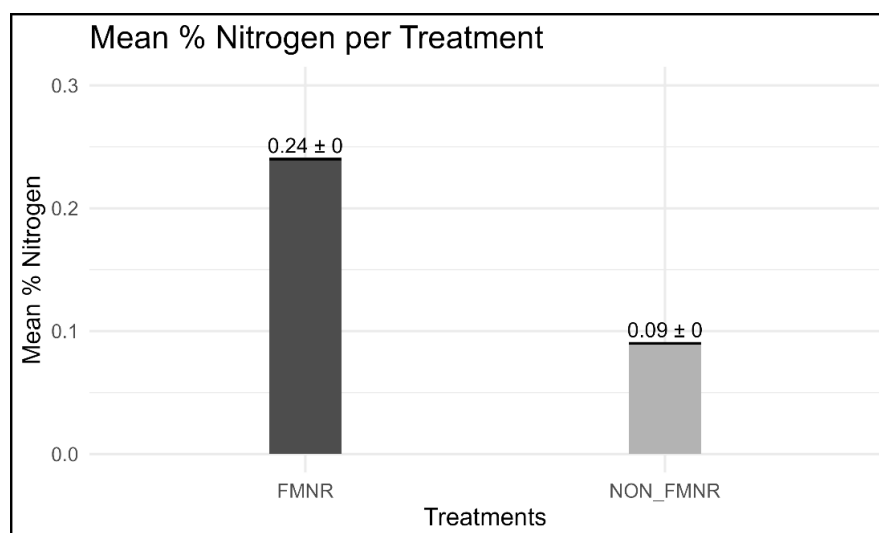

Figure 2: Comparison of Total Nitrogen Concentrations (%) Between FMNR-Managed Farms and Adjacent Non-FMNR (Control) Farms in Gwassi Hills.

Source: Machote Et Al. (2025)

Beyond staple crops, FMNR diversifies food sources by reintroducing indigenous trees that provide fruits, seeds, and nuts, which are critical for filling nutritional gaps during periods of food scarcity (Miller et al., 2017). Additionally, regenerated trees improve fodder and pasture availability, enhancing livestock production and thereby increasing access to milk and meat—key components of child nutrition, particularly in pastoral areas (WRI, 2018). According to Omuono (2025), there is notable improvements in livestock health and productivity following the adoption of FMNR in Gwassi Homabay, Kenya as indicate in Table 1.

Table 1: Animal Productivity in Homabay County

Productivity Metric	Proportion of increased productivity (%)
Milk production	87.2
Birth rate	55.3
Animal health	14.9
Egg production	4.3

This was echoed in one of the FDG discussions where a farmer mentioned that *"Our children now drink milk daily, even in dry seasons,"* (FGD, Gwassi, 2023).

These results indicate that FMNR functions as both an ecological and nutritional safety net for children in semi-arid communities. By improving soil fertility, enhancing moisture retention, and providing windbreaks, FMNR increases crop resilience and productivity, consistent with human–ecological systems theory, which posits that strengthened ecological conditions directly enhance human well-being. Livestock improvements further contribute to child nutrition by providing reliable access to milk and meat.

Potential confounders, such as baseline socio-economic differences and concurrent NGO interventions, may partially influence observed outcomes; however, the inclusion of non-FMNR households as a matched comparison group strengthens attribution to FMNR.

Plate 3: Dairy Cows Feeding on Fodder from FMNR Sites in Baringo, Kenya

Source: World Vision Kenya

Enhanced Household Economic Stability

Economic instability and poverty exacerbate the vulnerability of children to health, educational, and protection risks, particularly under the stress of climate shocks (UNDP, 2020).

FMNR contributes to household economic resilience by creating diversified revenue streams. Families benefit financially from the sale of timber, firewood, fruits, honey, and medicinal tree products. FMNR diversified household income through sale of tree products (honey, fruits, poles, firewood, and herbal products). Between 2018 and 2025, households earning income from sustainable tree products increased from 30.4% to 95%, and average annual income from these sources rose from Kshs 9,617 to Kshs 22,715 ($p < 0.05$).

Studies in West Africa report significant increases in household income among FMNR practitioners compared to non-practitioners (Haglund, Ndjeunga, Snook, & Pasternak, 2011; Chesire et al., 2025).

Plate 4 and 5: Communities showing their Produce from FMNR Sites and Income

Source: World Vision Kenya

Increased income diversification also builds financial resilience, enabling families to better withstand economic shocks associated with climate events. Emerging opportunities, such as income from carbon credits, further supplement household revenue (WWF, 2021). By improving local livelihoods, FMNR reduces poverty-driven migration, which can destabilize families and disrupt children's access to education and social services (IOM, 2019).

FMNR improved food security and dietary diversity through enhanced soil fertility, crop resilience, and tree-based foods. Quantitative monitoring showed a significant reduction in severe hunger (from 8% to 0%; $p < 0.01$) and an increase in households with sufficient food year-round (42.6% → 73.6%; $p < 0.05$).

Table 2: Comparative Household Income for FMNR farmers from 2018 - 2025

Percentage of Household Income/Item	2018	2021	2025
% of household reporting income from sustainable tree products (honey, firewood, fruits, medicine, other)	30.4	35.6	95
Reported income earned through sustainable tree products (last 12 months, Kshs)	9,617	15,595	22,715
% of Households (HHs) reporting increased income	25.2	52.5	68%
% of Households who observe that (dryland) cereal crop production is improving	17.2	52.7	85
# of months of food insecurity	3.5	3.3	2

Table 3: Comparative Household Poverty and Food Security Indicators for FMNR Farmers

SDG1: No poverty	2018	2021
% parents /caregivers able to provide well for their children	71.3%	77.4%
% households reporting reduced poverty in their location	38%	59.4%
% households living on less than US$1.90 (Kshs. 192) per day (Progress out of Poverty Index, or PPI)	45.3%	22.7%
SDG2: Zero hunger	**2018**	**2021**
% of households with year-round access to sufficient food for the family's needs	42.6%	73.6%
% of households with severe hunger (Household Hunger Scale, or HHS)	8%	0%
% households with little or no hunger (Household Hunger Scale, or HHS)	70%	97.3%

Incomes supported better education outcomes; school attendance among children in FMNR households rose by 19% compared to non-FMNR counterparts. This was reiterated by children in a group discussion where one said *"When tree products bring money, parents can pay school fees on time,"* (Youth FGD, West Pokot, 2022).

Income diversification through FMNR improves household resilience to climate and economic shocks, allowing families to better meet children's nutritional and educational needs. This aligns with child rights frameworks, which link adequate household resources to children's rights to nutrition, education, and protection. Emerging opportunities, such as carbon credit sales, further supplement household income, though these remain context-dependent and may not be uniformly accessible.

Reduced Labor Burden and Increased Educational Opportunities

In degraded landscapes, climate change increases the labor burden on women and children, who often travel long distances to collect firewood and water (UN Women, 2016). FMNR mitigates these burdens by providing local access to these resources, effectively freeing children's time for school attendance and play; activities essential for cognitive, social, and physical development (World Vision, 2020). FMNR reduced the time children spent collecting firewood and water, freeing time for learning. Women reported time savings of 2–3 hours daily due to local resource availability. This correlated with improved school attendance and reduced dropout rates, especially among girls.

Plate 6: School Children tending to their FMNR Sites at School

Reducing this labor burden also promotes gender equity. As the responsibility of collecting household resources often falls disproportionately on women and girls, FMNR supports more equitable gender roles and enhances women's participation in household and community decision-making (UNCCD, 2017). These findings are consistent with social-ecological theory, highlighting how improved local resources strengthen household and community resilience while promoting gender equity.

A Safer and Healthier Living Environment

FMNR contributes to a safer and healthier environment by mitigating climate-related hazards. Regenerated tree cover improves water quality and availability through groundwater recharge and regulation of local water cycles, thereby ensuring reliable access to clean water for drinking and sanitation (Bossio et al., 2019). Additionally, FMNR's regreening effect reduces localized soil and air temperatures, providing protection from heat waves, while enhanced tree cover reduces soil erosion and flood risk, both of which are significant contributors to child morbidity and mortality (UNICEF, 2021; Garrity et al., 2010).

By sequestering carbon and reducing greenhouse gas emissions, FMNR also improves air quality, mitigating respiratory health risks among children who are particularly vulnerable to air pollution (IPCC, 2022). These findings underscore the multiple environmental health benefits of FMNR, aligning with prior research that links reforestation with reductions in climate vulnerability and improvements in child health outcomes (Chazdon, 2020).

Tree regrowth enhanced microclimates and reduced exposure to environmental hazards. Reforested areas recorded lower surface temperatures (by up to 2°C) and decreased flood incidence. Communities also reported improved water quality and reduced child morbidity from respiratory and diarrheal diseases.

Plate7: Talensi Ghana (Before and After FMNR)

Source: World Vision International

These findings reinforce the concept of human–ecological interdependence, whereby ecological restoration underpins child well-being outcomes.

Social Capital and Child Protection

Farmer Managed Natural Regeneration (FMNR) has been instrumental in fostering inclusive governance structures that actively involve children and youth in environmental decision-making processes. Through participation in environmental clubs and community forums, young individuals have developed a sense of agency and responsibility towards their environment. This engagement not only strengthens their ecological knowledge but also reinforces their identity within the community, promoting a culture of stewardship and mutual support.

Plate 8: Community Meeting on Environmental Conservation

Source: World Vision Kenya

The intergenerational transfer of ecological knowledge has further enhanced community cohesion, creating a supportive network that reduces the risks of child neglect, harmful labor migration, and exposure to violence. By integrating traditional ecological practices with contemporary restoration techniques, FMNR bridges generational gaps, fostering a collective commitment to sustainable land management and child protection.

Plate 9: Environmental Club Pupils showing off Planting Materials for Growing

Source: World Vision Kenya

FMNR facilitated inclusive community structures and child participation in environmental governance. Children's eco-clubs and intergenerational FMNR committees strengthened social cohesion and reduced risks of neglect or harmful migration. This was emphasized by a child in a group discussion who said *"We plant trees with our parents—it makes us proud,"* (Child club member, Makueni, 2023).

These findings illustrate that ecological restoration can directly reinforce protection systems and social resilience. Engagement in environmental governance promotes children's agency and contributes to safer, more inclusive communities, aligning with both child rights principles and evidence on social capital as a protective factor.

FMNR interventions disproportionately benefited women and girls by reducing labor burdens and supporting school attendance. Disaggregated data indicate that female-headed households experienced comparable improvements in income and food security, while girls gained slightly more in school attendance than boys. Community participation in eco-clubs also increased gender-inclusive decision-making, further supporting child protection outcomes.

Study Limitations and Potential Biases

1. While matched non-FMNR households were included, residual confounding from baseline socio-economic and ecological differences cannot be fully ruled out.
2. Self-reported outcomes on income, food security, and health may be subject to recall or social desirability bias.
3. Context-specific interventions may limit generalizability beyond semi-arid regions of Kenya.

4. Attribution of all observed benefits solely to FMNR should be interpreted cautiously due to concurrent development programs in some study areas.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Collectively, the results demonstrate that FMNR not only enhances ecological resilience but also directly improves child well-being through nutrition, economic stability, reduced labor, and environmental health. These findings align with prior studies showing that community-led landscape restoration can yield multidimensional benefits for vulnerable populations (Reij et al., 2009; World Vision, 2021). Statistically significant reductions in hunger and poverty among FMNR households provide empirical backing to the theory that nature-based solutions can drive social outcomes.

This study demonstrates that FMNR; beyond its ecological merits directly advances child well-being through improved nutrition, economic stability, reduced labor burdens, and safer living conditions.

Future studies should consider longitudinal tracking of child health indicators, educational outcomes, and household economic stability in FMNR-implemented areas. Furthermore, research integrating geospatial analysis could quantify the ecological benefits at landscape scales, providing robust evidence for scaling FMNR as a climate adaptation strategy.

Recommendations

1. Institutionalize FMNR in child-focused climate policies by aligning it with Kenya's Climate Change Act (2016) and National Climate Change Action Plan to enhance child well-being through ecological restoration.
2. Integrate FMNR monitoring into national child welfare frameworks, including the National Child Policy (2021), to track impacts on nutrition, education, and protection.
3. Promote longitudinal and geospatial research to strengthen causal attribution between FMNR and child well-being outcomes.
4. Engage children and caregivers as active agents of stewardship, consistent with the Children Act (2001, revised 2022), to support sustainable restoration and participation.

REFERENCES

Bossio, D., Cook-Patton, S., Ellis, P., et al. (2019). *The role of trees in water cycling and climate regulation. Nature Climate Change, 9*(6), 456–465.

Chesire, M., Kigen, C., Munyao, C., Korir, J., & Too, P. (2025). *Farmer Managed Natural Regeneration and community development: An analysis of impact in selected countries. International Journal of Environmental Sciences, 8*(Special Issue 1), 60–79. https://doi.org/10.47604/ijes.3162

FAO. (2018). *The State of Food Security and Nutrition in the World 2018.* Rome: Food and Agriculture Organization of the United Nations.

Doss, C., Kovarik, C., Peterman, A., Quisumbing, A., & van den Bold, M. (2018). Gender inequalities in ownership and control of land in Africa: Myth and reality. Agricultural Economics, 49(3), 427–441.

Ebi, K. L., & Bowen, K. (2016). Extreme events as sources of health vulnerability: A public health perspective. Annual Review of Public Health, 37, 115–128.

Garrity, D., Akinnifesi, F., Ajayi, O., et al. (2010). *Evergreen agriculture: A robust approach to sustainable food security in Africa. Food Security, 2*(3), 197–214.

Haglund, E., Ndjeunga, J., Snook, L., & Pasternak, D. (2011). *Dryland tree management for improved household livelihoods: Farmer Managed Natural Regeneration in Niger. Journal of Environmental Management, 92*(7), 1696–1705.

IPCC. (2022). *Climate Change 2022: Impacts, adaptation, and vulnerability.* Cambridge University Press.

IOM. (2019). *Children on the move in Africa: Root causes and policy responses.* International Organization for Migration.

Machote, B., Omuono, M., Otuoma, J., Munyao, C., Ogenche, J., Meitamei, J., Ochieng, W., Singoro, M., & Mativo, A. (2025). *Impact of Farmer Managed Natural Regeneration on soil health and soil carbon stock in Gwassi Hills, Kenya.* Kenya Forestry Research Institute (KEFRI) and World Vision Kenya Technical Report (in press).

Miller, D. C., Ordonez, P. J., Baylis, K., & Hughes, K. (2017). *Forests and food security: Pathways and linkages.* Center for International Forestry Research (CIFOR).

Omuono, M., Munyao, C., Ogenche, J., Meitamei, J., Ochieng, W., Machote, B., Singoro, M., & Mativo, A. (2025). *Assessing the impact of Farmer Managed Natural Regeneration (FMNR) on livelihoods in Gwassi, Homa Bay County, Kenya.* Kenya Forestry Research Institute (KEFRI) and World Vision Kenya Technical Report (in press).

Reij, C., & Garrity, D. (2016). *Scaling up Farmer Managed Natural Regeneration in Africa to restore degraded landscapes. Biotropica, 48*(6), 834–843.

Reij, C., Tappan, G., & Smale, M. (2009). *Agroenvironmental transformation in the Sahel: Another kind of "Green Revolution".* IFPRI Discussion Paper 00914.

Rinaudo, T. (2019). *Farmer Managed Natural Regeneration: A simple, scalable, sustainable land management approach.* World Vision Australia.

Rinaudo, T. (2019). *The forest underground: Hope for a planet in crisis.* Melbourne: ISCAST.

Thornton, P., Whitbread, A., Baethgen, W., et al. (2018). A framework for priority-setting in climate smart agriculture research. *Agricultural Systems*, 167, 161–175.

UNCCD. (2017). *The Global Land Outlook.* Bonn: United Nations Convention to Combat Desertification.

UNDP. (2020). *Human Development Report 2020.* New York: United Nations Development Programme.

UNICEF. (2021). *The State of the World's Children 2021: On my mind – Promoting, protecting and caring for children's mental health.* New York: UNICEF.

UNICEF. (2021). *The climate crisis is a child rights crisis: Introducing the Children's Climate Risk Index.* New York: UNICEF.

UNICEF. (2024). *The global climate crisis is a child nutrition crisis: UNICEF agenda for child nutrition and climate action.* New York: UNICEF.

UN Women. (2016). *Climate change, gender and development in Africa.* New York: UN Women.

World Vision. (2020). *Farmer Managed Natural Regeneration Scaling Strategy.* Nairobi: World Vision.

World Vision. (2021). *Climate change, hunger, children's futures: A dangerously under-discussed consequence of climate change.* London: World Vision UK.

WRI. (2018). *Roots of prosperity: The economics and finance of restoring land.* Washington, DC: World Resources Institute.

WWF. (2021). *Harnessing nature to build climate resilience: The case for nature-based solutions.* Gland: WWF International.