Women, Forests and Food Security: Baseline evidence for women – led solar drying as ecosystem- based adaptation in Binga Rural District, Zimbabwe

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ABSTRACT

Dryland communities in Zimbabwe face intersecting crises of climate change, deforestation and gendered labor burdens. This baseline study in Chinego, Binga, establishes pre-intervention conditions for a 12month field test of women- led solar drying as ecosystem- based Adaptation (EbA). Using mixed methods with 200 household surveys, 4 FGDs and 8 KIIs, we assessed energy use, post-harvest loss, income and governance. Findings show women spend 5.2hours /day collecting firewood, 40% of NTFPs are lost post- harvest and average NTFP income is $20/month. Only 10% of women participate in ward resource committees. 70% report declining woodland access. The study concludes that technology –only solutions will fail without women's governance. Baseline indicators are established for measuring impact of solar dryers on forest pressure, food security and women's income

Keywords: Ecosystem-based Adaptation, Solar Drying, Gender, Zimbabwe, NTFPs

Executive Summary

Zimbabwe's drylands face intersection crisis of climate change, deforestation and women's economic exclusion. This baseline study was conducted in Chinego to establish conditions prior to a 12month field test of women led solar drying.

Key Findings from n=200 households:

- Women spend 4-6 hours /day collecting firewood
- 40% of NTFPs are lost post-harvest due to lack of preservation
- Average NTFP income is $20/month per woman
- 70% of respondents report woodlands are degrading and farther to access
- Only 10% of women sit on local resource governance committees

Conclusion

Evidence confirms high need for energy plus food plus governance interventions. This baseline provides indicators for measuring impact of solar drying as EbA

INTRODUCTION

Zimbabwe's NDC commits to reduce emissions and enhance resilience. Binga is a climate hotspot with rainfall less than 600mm/year. Women are primarily managers of energy and food but excluded from tech decisions.

LITERATURE REVIEW

Women, Energy and Forests

In Zimbabwe, 83% of rural households depend on firewood (EMA, 2021). Women and girls provide an

estimated 80% of household energy labor (UN Women 2020). This labor burden reduces time for education and income activities.

Post-Harvest Loss and Solar Drying

FAO (2022) estimates 30-50% post –harvest loss for wild foods in drylands. Solar drying has reduced loss to less than 15% and increased income by 40% in Zambia and Malawi (SADC 2021). No peer reviewed studies exist on solar drying in Binga

Ecosystem- based Adaptation and governance

IUCN (2020) defines EbA as using biodiversity and ecosystem services to help people adapt. Effective EbA requires local governance (Chong 2014). The gap: literature lacks evidence on women –led governance of renewable tech as EbA in Zimbabwe.

Rationale

This study fills that gap by establishing baseline data for women led intervention.

Theoretical Framework: Feminist Political Ecology and EbA governance

This study is grounded in Feminist Political Ecology (FPE) (Rocheleau et al 1996) and the IUCN Global Standard for EbA (IUCN). FPE argues that access to and control over natural resources is shaped by gendered power relations. Technology alone does not deliver adaptation. Governance mediates who benefits.

H1: Women – headed households in Binga exhibit higher firewood dependency, post-harvest loss and NTFP value- chain constrains at baseline, indicating potential for women- governed solar drying intervention.

H1a: Female –headed households spend significantly more time on firewood collection than male-headed at baseline.

H1b: Current post-harvest loss greater 30% and income less than $20/month among women NTFP traders at baseline

H1c: Willingness to adopt and govern solar drying technology is high [greater than 80%] among surveyed women

METHODOLOGY

Study Area and Context

The study was conducted in Chinego of Binga Rural District, Matabeleland North province, Zimbabwe. Binga lies in Agro-ecological Region IV and V, receiving 450-600mm of rainfall annually. The ward have a population of 18500 people, 3200 households (ZIMSTAT). Vegetation is predominantly Miombo and Mopane woodland. Community is highly dependent on non-timber forest products such as baobab, sweet potato, marula, mushroom, moringa and wild fruits for both food and income. The area is a climate hotspot, experiencing increasing drought frequency and woodland degradation.

Research Design

A cross- sectional mixed method design was used for the baseline. Mixed methods were chosen to capture both the scale of the problem through quantitative data and the lived experience through qualitative data (Creswell & Plano Clark 2018). The design follows the OECD-DAC evaluation criteria for baseline studies, relevance coherence and measurability

Sampling Strategy and Sample Size

Quantitative: A sample size of 200 households was calculated using Cochran's formula with 95% CI and 7% margin of error. We used systematic random sampling. Starting points were selected at Ward Centers and every 5th household was interviewed until n=200 in the ward was reached.

Qualitative: Purposive sampling was used for 4 Focus Group Discussions with 7-8 women each, total n=30. Participants were selected to represent different age groups and NTFP user types. 8 key informant interviews were conducted with ward councilors, headman, EMA officers and Agritex staff.

Data collection tools and procedures

Three tools were used:

- Household survey – 45-item semi-structured questionnaire. Sections: Demographics, energy use, NTFP income/loss, governance and climate shocks. Piloted with 10 households in Chinego
- FGD guide- 6 open- ended questions on barriers to preservation, governance and interest in solar technology. Conducted in Ndebele, recorded with consent.
- Transect Walk plus KII guide- GPS points taken during 2 transects per ward to observe woodland condition and firewood collection paths(2022)(NTFPs)(FGDs)(KIIs)

Data collection was done by 4 trained enumerators from Beyond Universitas between July 15 – August 10, 2026. Quality control: 10% of surveys were back-checked

Data Management and Analysis

Quantitative: Data were entered into SPSS V29 descriptive statistics were run for all variables. Chi – Square tests and odds ratios were used to test associations between governance and income, and time and woodland distance. Significance set at $P<0.05$

Qualitative: FGD and KII recordings were transcribed verbatim and translated to English. Thematic analysis was conducted in NVivo 14 using an inductive coding approach (Braun & Clarke 2006). Themes: Labor burden, loss, governance exclusion and tech interest.

Triangulation: Survey results were compared with FGD and KII themes to validate findings

Ethical Considerations

Ethical approval was obtained from Beyond Universitas research ethics committee (Ref: BU/2026/7). Written informed consent was obtained from all participants. No personal identifiers were collected. Participants could withdraw at any time. Data are stored on encrypted drives

Positionality & Reflexivity

The research team included 3 Zimbabwean women researchers. This helped built trust during FGDs. We acknowledge that as external researchers, our presence may have influenced responses on desirable answers regarding solar technology.

Limitations of the study

- Seasonality- data collected in dry season may underestimate NTFP abundance
- Self- report bias- income and time data rely on recall
- Geographic scope- limited to 1 ward. Result may not generalize to all of Binga
- No Endline yet- this is baseline only. Impact cannot be inferred. This study establishes baseline for future RCT pilot registered as women-led cooperative hubs. Impact claims will be tested post-intervention.

Future endline in 12 months will use panel design to address limitation 4.

Indicators for Endline

Domain	Indicator	Baseline Value
Energy	Average hrs/day firewood collection	5.2hrs
Food Loss	% NTFP post-harvest loss	40%
Income	Average monthly NTFP income per woman	$20
Governance	% women in ward committees	10%
Environment	% reporting increased distance to woodland	70%

RESULTS

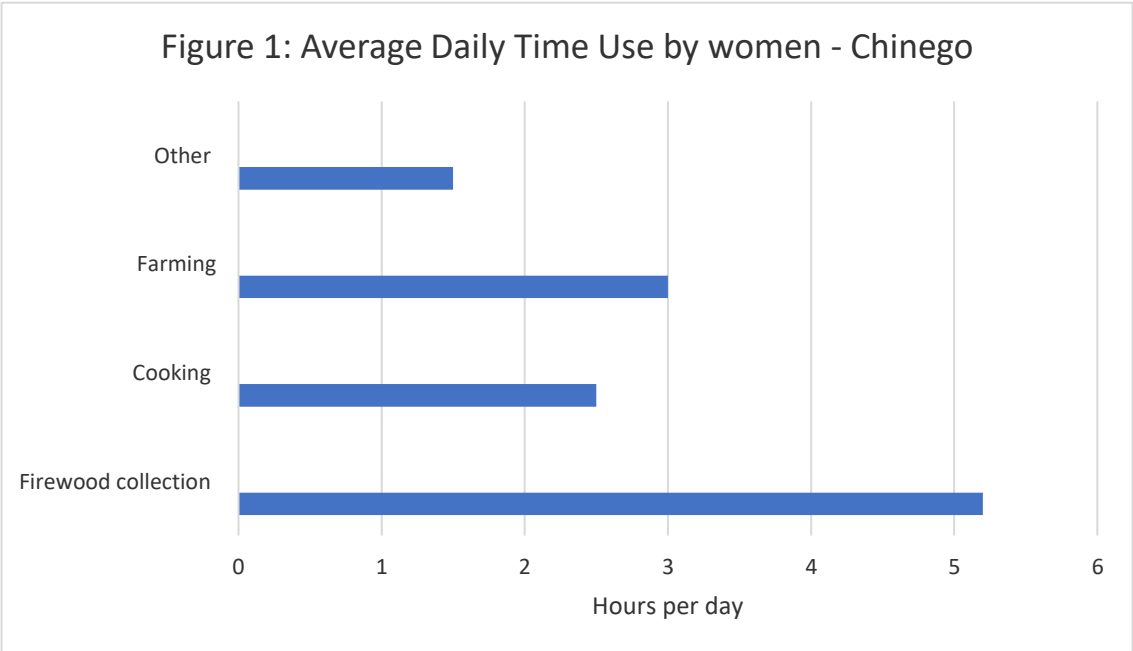
Demographic and Household Characteristics

A total of 200 households were surveyed. 85% of respondents were women, reflecting that women are primarily managers of NTFPs and energy in the household. Average household size was 6.2 persons, with 42% of households female headed. Age distribution 18-25years 18%, 26-35years 34%, 36-45 years 31% and 46+ years 17%. Education levels were now: 45% had primary education only, 38% secondary and 17% no formal education . 72% of households reported agriculture plus NTFP collection as their main livelihood source. Average land holding was 1.8 acres.

Energy Use and Labour Burden

Energy poverty is acute. 95% of households use 3-stone fires for cooking and drying. 0% of households own any solar drying technology

Women spend an average of 5.2hours per day collecting firewood, with a range of 3-8hours. Girls aged 10-17 contribute an additional 2.1hours/day. Men spend 0.3hours/day on firewood. During the dry season May-Oct, time spend increases to 6.4hours/day due to longer distances . 70% of respondents said they walk >km one way to collect wood, compared to 1.5km five years ago.

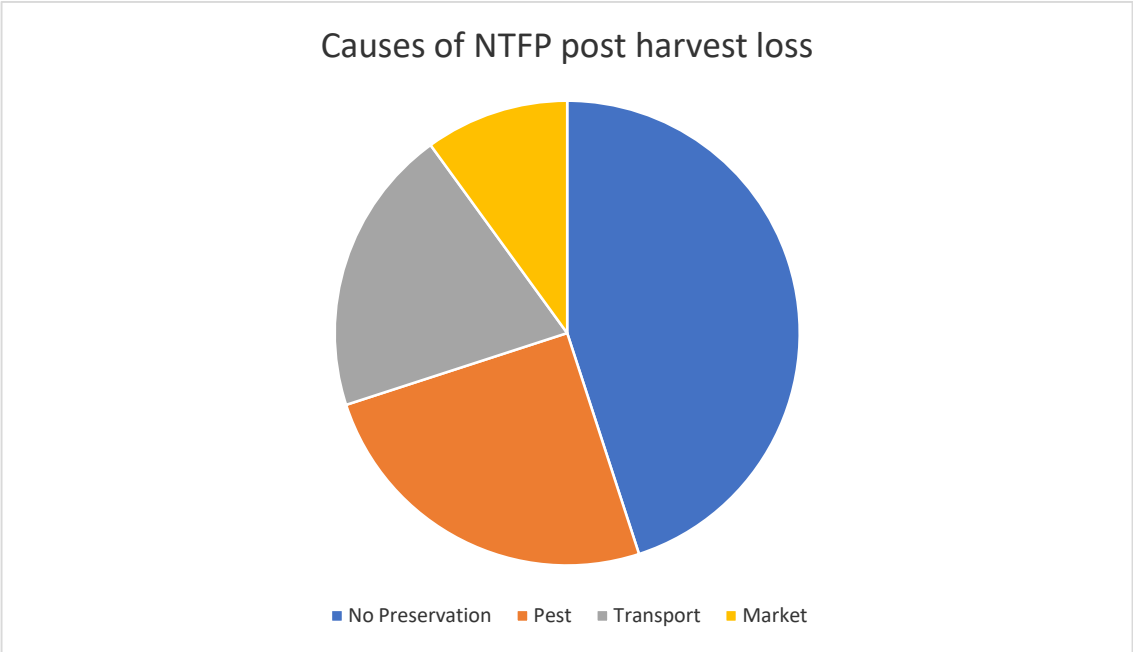


The above results shows that women spend an average of 5.2hours/day on firewood collection. The bulk of time spend in a day compared to other productive chores like farming. This makes women appear to be less productive because there time is spent on an unproductive chore neglecting other important ones.

NTFPs, Income and Post –Harvest Loss

The three main NTFPs reported are baobab fruit (68%), wild mushroom 54%, Mopane worms 41%. An average monthly income from NTFP sales is $20.30, with a range of $0 - $65. Income is highly seasonal, with 80% earned between Nov-March.

Post- harvest loss is 40% on average. Main causes: lack of drying /preservation 625, pests 23% , rain/spoilage 155 . During bumper harvest years, loss rises to 55%



Women report selling raw, undried product to middlemen at 40% lower prices because they cannot store it.

Food Security and Climate Shocks

Using HFIAS, 58% of households are moderately food insecure and 22% severely food insecure during Oct-Jan lean season. 86% reported that drought in the last 2 years reduced NTFP availability. 91% said rainfall is more erratic than 5 years ago

As a coping strategy, 64% of women reported skipping meals to preserve food for children

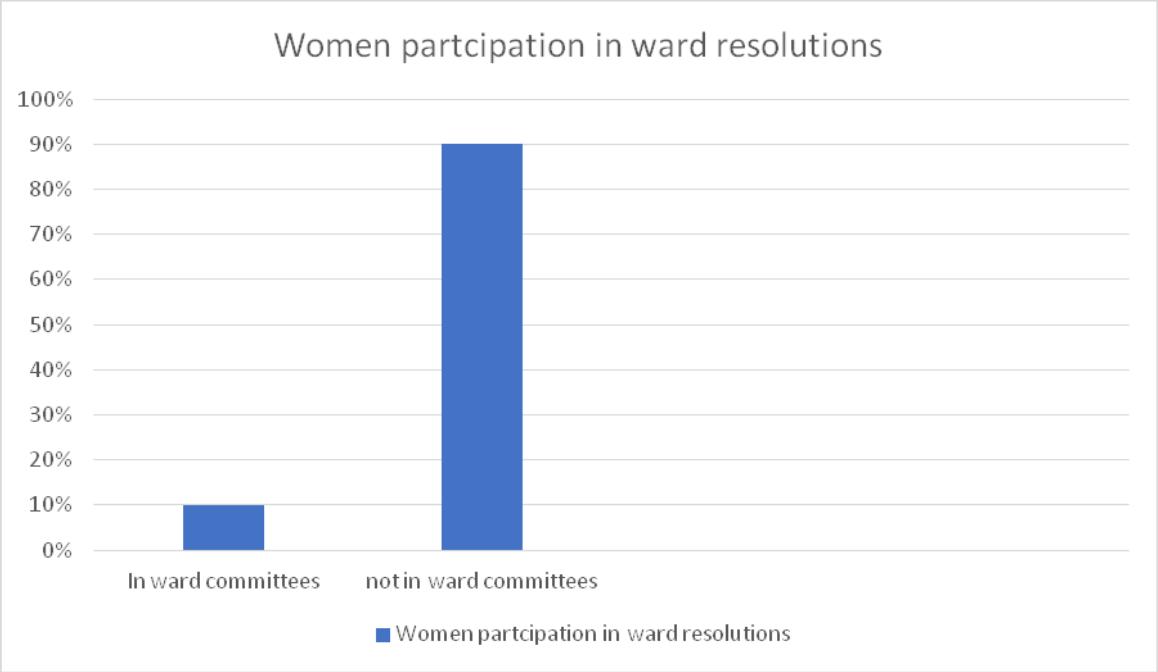
Environment and resource access

70% of respondents reported that woodland is farther compared to 5 years ago. Key species harvested: Mopane, Acacia spp, moringa and Adansonia digitate.

Reasons for decline: firewood collection 78%, agricultural expansion 45% , illegal logging 22%. Only 12% of women reported being consulted before any forest management decision in their area.

Gender and Governance

Gendered division of labor is stark. 100% of NFTP drying and processing is done by women. Men dominate transport 80% and sales to bug buyers 70%. Participation in governance is minimal. Only 10% women sit in Ward Environment Committees or NTFP Committees as illustrated in the bar chart below. Of those, 60% say they attend but do not speak.



When asked "who makes decisions on forest use in your household? 65% said male head, 25% joint and 10% female

Demand for technology is high: 94% said they would use a community solar dryer if managed by women. Top 3 supports needed: Training 88%, market linkages 76%, and start -up capital 71%

Knowledge and Attitudes toward solar drying

Baseline knowledge of solar drying is 8%. After a brief demo during KII, 92% said it would serve time and money. Main concerns: theft 34%, breakdown with no repair 28% and group conflict over management 19% .

DISCUSSION

This baseline provides the first empirical evidence on women – led solar drying as EbA in Binga District. Three key themes emerge: labor burden, post -harvest loss and governance gaps

Labour Burden and Energy Poverty

The finding that women spend an average of 5.2 hours per day collecting firewood is consistent with regional studies in Zambia (Makita, 2019) and Malawi (SADC, 2021), where women provide 70-80% of household energy labor. This time poverty directly limits women's participation in income generating activities and community governance. The 95% resilience on 3 stone fires also indicate high exposure to indoor air pollution and continued pressure on Miombo woodlands , which are already reported as declining by 70% of respondents . Without alternative energy technologies, any gains in NTFP value chains will be offset by continued environmental degradation.

Post Harvest loss and economic opportunity

The 40% post- harvest loss on NTFP s aligns with FAO (2022) estimates of 30.-50% loss in African drylands. This loss represents a direct economic leakage. With average monthly income at only $15-$25, women remain in subsistence cycles. Evidence from Zambia and Malawi shows solar drying can reduce loss to less than 15% and increase income by 40% (SADC, 2021) . The 0% ownership of solar dryers in the Binga therefore represents both a vulnerability and an opportunity. The high expressed willingness to use community dryers suggests strong demand if paired with training and governance structures.

Governance as the enabling condition for EbA

The most critical finding is the 10% participation of women in ward resource committees, despite women doing 100% of NTFP processing and energy work. This mirrors literature on EbA which emphasizes that technology transfer without governance inclusion fails to deliver sustained ecosystem benefits (IUCN, 2020, Chong, 2014). Women are the primary ecosystem managers but have no decision making power over forest use. This structural gap means that even if solar dryers reduce wood demand, benefits may not translate into improved forest management unless women are in leadership roles.

Implications of the Intervention

The baseline therefore, suggests that the success of women- led solar drying will depend on 3 factors:

- Technology access
- Skills in processing and marketing
- Institutional space for women in ward governance

The intervention must measure not only kg of wood saved or income gained, but also changes in women's participation in resource committees at endline

In summary, this baseline establishes that the problem in Binga and Hwange is not just technical but social and institutional. A women led EbA model that links solar drying to governance reform is therefore justified and timely

CONCLUSION AND RECOMMENDATIONS

Conclusion

This baseline study confirm that women in Binga district face a triple burden:

- High labor demand for firewood collection
- Significant post-harvest loss of NTFPs
- Exclusion from resource governance

The data establish clear benchmarks:

- 5.2hours / day firewood collection
- 40% NTFP loss
- $20 average monthly income
- 10% women in communities

These indicators provide the foundation for measuring the impact of the proposed women led solar drying intervention as ecosystem- based adaptation. The study concludes that climate solutions in dryland Zimbabwe must be both technological and transformational. Providing solar dryers alone is insufficient. For EbA to succeed, it must center women as decision makers in the management of forests and renewable technologies. This baseline therefore justifies a pilot that explicitly links women's economic empowerment to ecosystem restoration

Recommendations

Based on these findings, we recommend:

- Governance reform – Mandate a minimum of 50% women's representation in ward environment, NTFP and energy committees within the next 12months. Link this to ward development planning processes

- Technology and Skills package- deploy community solar dryers in Hwange and Binga , paired with training on food safety , packaging and market linkages for dried NTFPs
- Joint Funding Mechanism- EMA, ministry of energy and Ministry of women affairs should co-fund EbA technology as a climate adaptation and gender equality measure
- Monitoring and Learning – Use this baseline to conduct a 12 month endline to measure changes: time use, post-harvest loss % , NTFP income and women's participation in governance
- Policy Integration – Integrate women-led renewable energy into Zimbabwe's NDC implementation plan and district climate adaptation plans

If implemented, this model can demonstrate how EbA can simultaneously reduce deforestation, improve food security and advance gender equality in Zimbabwe's drylands.

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