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Article

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Cogent Economics & Finance

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Suggested Citation: Taruvinga, Amon; Jonga, Siyabonga; Zamisa, Owethu; Forbanka, Derick Nomuh (2023) : Rural women's participation in wild honey hunting and associated income, dietary diversity, and food insecurity implications: Evidence from South Africa, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 11, Iss. 2, pp. 1-11, <https://doi.org/10.1080/23322039.2023.2282864>

This Version is available at:

<https://hdl.handle.net/10419/304272>

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To cite this article: Amon Taruvinga, Siyabonga Jonga, Owethu Zamisa & Derick Nomuh Forbanka (2023) Rural women's participation in wild honey hunting and associated income, dietary diversity, and food insecurity implications: Evidence from South Africa, Cogent Economics & Finance, 11:2, 2282864, DOI: [10.1080/23322039.2023.2282864](https://doi.org/10.1080/23322039.2023.2282864)

To link to this article: <https://doi.org/10.1080/23322039.2023.2282864>



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Received: 05 June 2023
Accepted: 08 November 2023

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DEVELOPMENT ECONOMICS | RESEARCH ARTICLE

Rural women's participation in wild honey hunting and associated income, dietary diversity, and food insecurity implications: Evidence from South Africa

Amon Taruvinga^{1*}, Siyabonga Jonga¹, Owethu Zamisa¹ and Derick Nomuh Forbanka²

Abstract: Wild raw honey hunting and consumption is very popular among rural communities in South Africa as a source of income and food for households. Although men traditionally dominate wild honey hunting, in recent years participation of women has increased. However, evidence of the participation of rural women in wild honey hunting is often lacking. This study focused on assessing the status of wild honey hunting by women, factors that influence their decision to participate and associated income, dietary diversity, and food insecurity implications. A cross-sectional survey of 200 rural women purposively selected from Ncera communal area in the Eastern Cape Province of South Africa was conducted. The study revealed that an emerging number of rural women were actively involved in wild honey hunting and participation is triggered by age, access to extension services and livelihood diversification, while access to formal honey markets discouraged wild honey hunting. Results further revealed a positive income, dietary diversity, and a significant reduction in food insecurity among participants compared to non-participants.

Subjects: Rural Development; Gender & Development; Sustainable Development

Keywords: wild honey; beekeeping; rural women; rural development agencies; honey markets

1. Introduction and background

Honey is produced in Africa using different methods to include, improved beekeeping (using frame hives), beekeeping using local hives and wild honey hunting (Chiemela et al., 2022). Beekeeping using local hives and wild honey hunting are mostly of a small scale practiced in rural areas and characterized by unmanaged wild honey-bee colonies and managed honey-bee colonies using local hives. Beekeeping using local hives and wild honey hunting methods still dominates the amount of honey produced and consumed in most rural areas. This is due to the low uptake of modern commercial apiculture in these areas (Hans et al., 2018) and claims of adulteration of managed honey-bee colonies including processed honey sold in formal markets (Cordella et al., 2005; Fakhlaei et al., 2020). The recent increase in the economic value of honey because of its multiple benefits shortage on the market and difficulty to detect adulteration (Wang et al., 2015) makes it highly vulnerable to adulteration (Fuhrman, 2018). Beekeeping using local hives and wild



honey hunting more often do not produce a lot of honey per production cycle and some of the harvesting methods used (burning) destroy honey-bee colonies a reason why modern commercial apiculture is recommended in these rural areas.

Honey adulteration can be done directly, indirectly and through blending. Direct adulteration is commonly done through the direct addition of certain amounts of sucrose syrup (industrial sugar syrups, sugar beet) into the honey (Fakhlaei et al., 2020; Mehryar & Esmaili, 2011). Indirectly, adulteration of honey happens when sugars are incorporated into honey via bee-feeding (Chen et al., 2014). Blending involves mixing of synthetic low-quality honey with pure honey (Cordella et al., 2005; Fakhlaei et al., 2020). Thus far, managed honey-bee colonies are more vulnerable to indirect adulteration through feeding of bees with sugar syrups especially during periods of the year when nectar and pollen (floral density) is low. Also, processed honey is vulnerable to blending and direct adulteration as producers seek to maximize on volumes and improve the taste of the final product. To the contrary, raw honey from unmanaged wild honey-bee colonies presents a low risk of all forms of adulteration.

Adulteration of honey is therefore more possible for managed honey-bee colonies and processed honey and less possible for raw honey from unmanaged wild honey-bee colonies. This, however, does not mean that all managed honey-bee colonies and processed honey sold in formal markets have adulterants as commonly perceived. Also, the fact that raw honey from unmanaged wild honey-bee colonies has low risk of adulteration does not mean that such honey is free from adulterants as also commonly claimed. Against this background, wild raw honey from unmanaged wild honey-bee colonies has therefore gained some trust from rural communities compared to processed honey from managed honey-bee colonies normally sold in formal markets.

Wild raw honey from unmanaged wild honey-bee colonies is commonly perceived to be organic. According to the European Commission Council Regulation 1804/1999 qualification of organic honey should be bound to the characteristics of hive treatments, quality of the environment, the extraction and storage processes (Council Regulation, 1999). Organic honey should therefore be obtained from blossoms of organic plants free of pesticides and herbicides with no external supplementary feeding (Council Regulation, 1999). Such foraging material should be certified to be organic with a corresponding certification. Thus far, the location of the hives for organic honey should be far from urban areas, motorways, industrial areas, and extensive cultivation (agricultural production sources) areas (3 km) normally located in the mountains and forests. Pests and disease management should also be natural (Sagarpa, 2003), while the honey extraction process should be done at the same temperature with the hive using the decanting method.

The perceptions shared by local communities with regard to wild raw honey from unmanaged wild honey-bee colonies being viewed as organic are therefore not far-fetched although the entire process does not perfectly satisfy the standard definition of organic honey. Firstly, most wild raw honey from unmanaged wild honey-bee colonies is harvested from mountains and forests far away from urban areas, motorways, and industrial areas. Pests and disease management is also natural with no supplementary feeding. The only possible contamination may be from pesticides and herbicides used by nearby farmers, although in some rural areas there is no extensive cultivation that uses pesticides and herbicides. Thus far, rural communities who share boundaries with natural forests can be supported to produce organic honey.

Literature, however, highlights that, some traditional methods used for hunting wild honey have negative environmental effects. Some wild honey hunters remove brood-combs and sometimes discard the entire colonies during honey harvesting (hunting). In some cases, wild honey hunters cut down trees with honeybees to access the honey (Ribeiro et al., 2019), and some burn or pacify honeybees with smoke from smouldering dung or leaves to avoid bee stings during harvesting (Meddour-Sahar et al., 2013). When these smouldering materials are discarded, they cause unmanaged wildfires destroying nearby habitats, flora, and fauna (Meddour-Sahar et al., 2013; Park &

Youn, 2012). Honeybee burning negatively affects honeybee population and pacifying honeybees with smoke, although commonly practiced even in improved beekeeping systems, the welfare implications to the honeybees and quality of honey are poorly understood. Also, destruction of brood-combs and discarding the entire colonies during harvesting affects the honeybees' welfare as stipulated in organic regulations.

Some rural areas in Africa share boundaries with natural forests far away from urban areas, motorways, and industrial area. Agricultural activities are very limited, more focusing on livestock, home gardens and indigenous cereal and legume crops where the use of pesticides and herbicides is very minimum. The distance of these crop production fields is also very far (>3 km) from forests where bees normally forage. The promotion of organic honey production in such areas is highly possible for purposes of improving rural livelihoods. In Mexico, the states of Campeche, Quintana Roo and Yucatán are popular for beekeeping among the indigenous Mayan communities (Sagarpa, 2003), leveraging undisturbed natural areas. In Kenya, the Kitui county (Mwingi district) has extensive woodlands and bushland used by local communities to produce high-quality honey compared to other regions in the country (Egelyng et al., 2017). Rural areas that share boundaries with undisturbed forests with good floral diversity could therefore be identified for the promotion of organic honey production. Training is, however, required to educate wild honey hunters on sustainable beekeeping and harvesting skills like to avoid the removal of brood-combs and discarding the entire colonies during harvesting, the use of protective clothing and the use of smokers (that uses environmentally safe material) carefully managing them to avoid unmanaged wildfires.

Honey and honeybees are a source of food and medicine, can generate income, and provide pollens, wax, propolis, royal jelly and venom (Mudekwe, 2017). Although traditionally a domain for males (Weber, 2013), wild honey hunting is slowly gaining popularity with females in recent years because of the low labour requirements and the claimed income and food source benefits (Raina et al., 2009). The emerging interest in wild honey hunting by rural women presents an additional livelihood option worth understanding and possibly promoting in the broader context of household food security from its income effect and source of food. Understanding factors that condition participation is therefore necessary, for the purposes of identifying potential barriers and opportunities faced by rural women as they try to consider wild honey hunting as a livelihood source. Most of the socio-economic (age, gender) and institutional (extension, credit, markets) factors suggested by literature to promote participation in beekeeping (Berem et al., 2010) do not specifically focus on rural women and wild honey hunting, but rather, male-dominated donor-funded modern apiculture projects.

This paper therefore investigated the potential interest of wild honey hunting among rural women, factors that influence their decision to participate and associated income, dietary diversity, and food insecurity implications. This was against a background where, wild raw honey remains popular and highly trusted in most rural areas compared to processed honey from formal markets on one hand, and limited knowledge on factors that influence the decisions of women to participate on the other hand. In addition, the potential income from local raw honey sales has been claimed to significantly contribute towards household food security, although mostly generalized with limited empirical evidence.

2. Problem statement

Wild raw honey is widely consumed in most rural areas normally supplied by male wild honey hunters (Yator, 2021). Most of the wild raw honey is traded locally because of formal market entry barriers (Hans et al., 2018). Most wild raw honey consumers claim that it is organic compared to processed honey from formal markets. This perception has contributed to the high demand of wild raw honey in rural areas (informal markets). Against this background, honey is seen as a potential income and food source for rural communities (Mudekwe, 2017). Although traditionally a domain dominated by men (Weber, 2013), wild honey hunting has attracted participation of women in

recent years given the claimed food source and income potential. This development has attracted interest from several rural development agencies who have responded by offering training and support to women beekeeping projects (Qaiser et al., 2013). This study therefore questioned the status of wild honey hunting and factors that influence the decision of rural women to consider wild honey hunting for purposes of improving evidence-based programming. This was against a background where livelihood choices (wild honey hunting) are influenced by different socio-economic, technical, and institutional factors specific to individuals as they try to maximize their utility (Taruvunga et al., 2022). The study also questioned the income, dietary diversity, and food insecurity implications of participating in wild honey hunting given limited empirical studies that have investigated the honey, income, and food security nexus (Abro et al., 2022) among rural women. This therefore calls for more studies across cultures and geo-political regions for purposes of understanding barriers and opportunities that may be targeted by rural developmental agencies as they try to promote beekeeping as a livelihood among rural women.

3. Objectives

The study was guided by the following objectives.

- (1) To assess the status of wild honey hunting among rural women.
- (2) To estimate factors that influence the decision of rural women to participate in wild honey hunting.
- (3) To estimate the income, dietary diversity, and food insecurity implications of participating in wild honey hunting among rural women.

4. Methodology

The study was conducted in Ncera communal area in the Eastern Cape Province of South Africa. The communal area (Ncera) was purposively selected because of ideal bee foraging conditions (vegetation, rainfall, and temperature). Ncera communal area receives an annual rainfall of 780 mm, and an estimated average maximum daily temperature of 22.9 °C (Ncera Farms, 2011). Ncera communal area is dominated by the false thornveld and the grassveld vegetation types (Ncera Farms, 2011). The study used a cross-sectional design to understand factors that influence the participation of rural women in wild honey hunting and associated income, dietary diversity, and food insecurity implications. A sample of 200 women headed households was purposively selected from the study area for this study based on availability and willingness to participate. An open-ended questionnaire was used to collect information (institutional, socio-economic, participation in wild honey hunting, dietary diversity, and food insecurity access) from the participants.

5. Conceptual framework

The study assumed that rural women pursue various livelihood options ranging from on-farm (crop and livestock production) to off-farm (wild honey hunting, wild mushroom collection, etc.) activities. Thus far, the decision to select these livelihood activities is assumed to be based on utility/profit maximisation as conditioned by various household level socio-economic and institutional factors. Comparable previous studies have also used the utility or profit maximisation theory to explain agricultural enterprise selection choices (Mukarumbwa & Taruvunga, 2023; Taruvunga et al., 2022). The utility associated with each livelihood activity pursued by the i^{th} rural woman is not directly observable, while the livelihood activities selected are observable and unordered. Wild honey hunting can therefore be explained by the random utility maximisation theory as follows. A rational rural woman will choose wild honey hunting (livelihood option “j”) over other livelihoods options “k” if, and only if, the perceived utility from wild honey hunting “j” is greater than the utility from other livelihood options (say, “k”) depicted as illustrated in equation 1:

$$U_{ij}(\beta_j'X_i + \varepsilon_j) > U_{ik}(\beta_k'X_i + \varepsilon_k), \forall j \neq k \quad (1)$$

Where:

- U_j and U_k are the perceived utility by household i of livelihood options j and k , respectively.
- X_i the vector of explanatory variables that influence the perceived desirability of each choice,
- θ'_j and θ'_k are utility shifters, and
- ε_j and ε_k are error terms assumed to be independently and identically distributed.

A binary choice econometric analysis should be able to relate observable socio-economic and institutional variables to the livelihood choices made by the i^{th} rural woman from the study area. The same analysis should also generate propensity scores for matching wild honey hunters with non-wild honey hunters to estimate the impact of participating on income, dietary diversity, and food insecurity as detailed in the next section.

6. Analysis

Binary choice models (e.g., probit or logit) can be used to estimate factors that influence individuals' choices between different alternatives. A Probit model was used to estimate factors that influence the decision of rural women to participate in wild honey hunting. The dependent variable was binary taking two values (1 or 0); 1 if the respondent participated in wild honey hunting and 0 otherwise as illustrated in equation 2 (Asfaw et al., 2012).

$$Y_i^* = \alpha Z_i' + \mu_i \quad (2)$$

$$Y_i = 1 \text{ if } Y_i^* > 0$$

$$= 0 \text{ if } Y_i^* \leq 0$$

Where: Y represents participation in wild honey hunting, Y_i^* is the latent variable that takes the value 1 if the respondent participates in wild honey hunting, and 0 if not. Z is the vector of respondent's characteristics, and α is the vector of parameters and μ_i is an error term.

The propensity score matching (PSM) analysis explored how changes precipitated by the wild honey hunting subsequently impacted changes in the participants' income, dietary diversity, and food insecurity. The primary outcomes of interest were the reported changes in the participants' income, dietary diversity, and food insecurity status. Propensity score matching (PSM) is a semi-parametric method that gives an average treatment effect on the treated (ATET) (Heckman, 1996; Rosenbaum, 2002). Participation in wild honey hunting was the treatment variable, while reported changes in income, dietary diversity, and food insecurity were the outcome of interest. Women who were non-wild honey hunters from the sample were the control group.

Given that the two groups were homogenous and mutually exclusive (based on wild honey hunting), this necessitated the creation of a counterfactual of what can be observed by matching wild honey hunters (treatment) and non-wild honey hunters (control) groups (Nkala et al., 2011). The PSM therefore matched wild honey hunters' group to non-wild honey hunters' group with similar values of X as summarized in equation 3 (Nkala et al., 2011):

$$ATT = E \left[\frac{Y_{d=1}}{d} = 1, p(X) \right] - E \left[\frac{Y_{d=0}}{d} = 0, p(X) \right] \dots \dots \dots (3)$$

Where:

- ATT is the average treatment effect on the treated (wild honey hunters),
- $y_{d=1}|d=1$ is the reported changes in income, dietary diversity and food insecurity status observed in the wild honey hunters subsample,
- $y_{d=0}|d=0$ is the change observed in the non-wild honey hunter group,
- $p(X)$ is the propensity score, which is defined as conditional probability of being in the wild honey hunters group conditional on X .

The PSM firstly performed a Probit regression by calculating the participants' propensity to be in the wild honey hunters' group, that is, $p(X)$ was calculated in the first stage (Nkala et al., 2011). The second stage used propensity scores obtained in the first stage to match wild honey hunters and non-wild honey hunters using the nearest neighbour method. This generated an ATET value that indicated the impact of wild honey hunting on income, dietary diversity, and food insecurity.

7. Results and discussion

This section presents results of the study. Initially the paper presents descriptive results followed by the Probit regression model and Propensity Score Matching results.

8. Participation in wild honey hunting among rural women

Figure 1 presents the participation status of rural women in wild honey hunting. The results reveal that 32% of the respondents were actively involved in wild honey hunting, while 68% were not actively involved. Although the number of participants was relatively low compared to non-participants, the paper argues that, for an enterprise historically dominated by men (Weber, 2013), because of several risk and cultural factors (Ahikiriza, 2016; Yator, 2021), a 32% active participation is highly promising.

These findings suggests a clear signal from women calling for the need to be actively involved in beekeeping. The next section presents household dietary diversity scores of wild honey hunters and non-wild honey hunters as summarized in Figure 2.

9. Dietary diversity implications of wild honey hunting among rural women

The distribution suggests dominance of wild honey hunters from HDDS of 6 to 11, while non-wild honey hunters were concentrated between HDDS of 4 and 9.

Figure 1. The participation status of rural women in wild honey hunting from the study area.

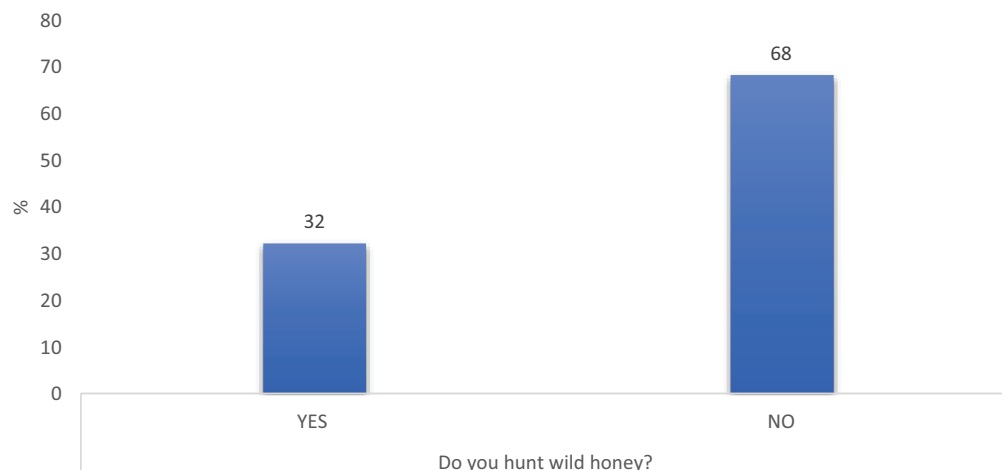
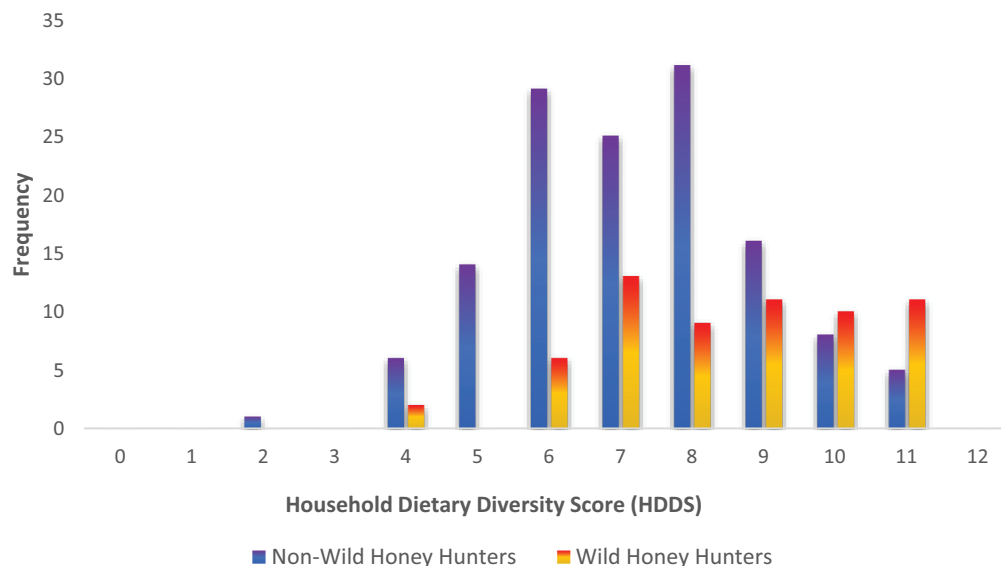


Figure 2. The distribution of the participants' household dietary diversity scores (wild honey hunters and non-hunters) from the study area.



The distribution suggests higher HDDS among wild honey hunters compared to non-wild honey hunters. These findings imply that participating in wild honey hunting may improve households' dietary diversity. This could be directly through the consumption of honey, which broadens the food groups (sweets food group) consumed, and indirectly through the income effect (where households can use income from honey to purchase other food groups).

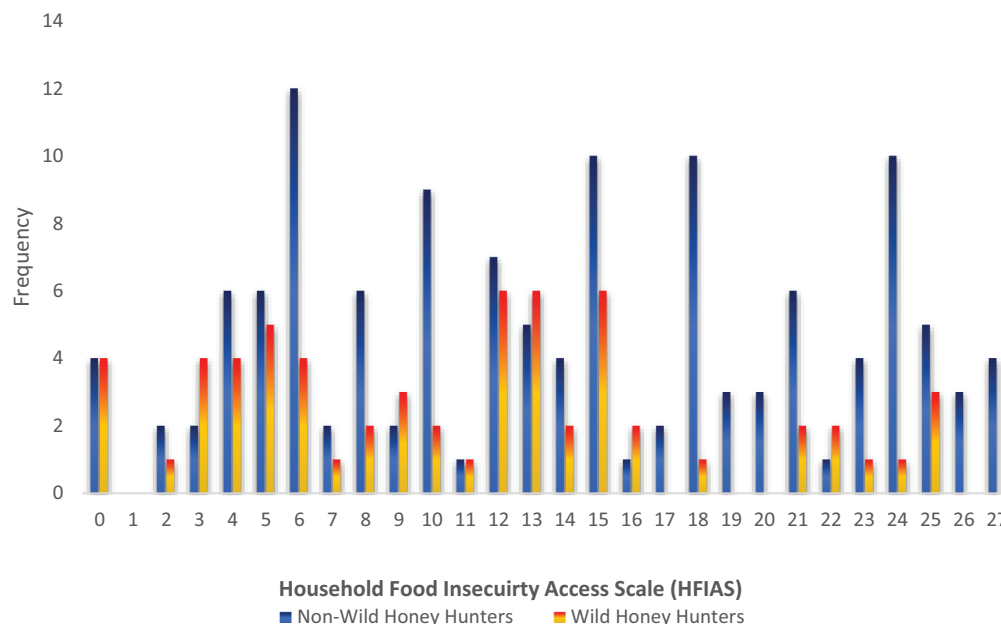
10. Food insecurity implications of hunting wild honey among rural women

This section presents the food insecurity implications of hunting wild honey as illustrated in Figure 3.

11. Factors that influence wild honey hunting among rural women

This section presents Probit regression estimates and the marginal effects for factors that influence wild honey hunting among rural women as summarised in Table 1.

Figure 3. The distribution of the participants' household food insecurity access scales frequencies (wild honey hunters and non-hunters) from the study area.



The decision to hunt wild honey among rural women is positively influenced by age. Results indicate that, a unit increase in age among rural women is likely to promote wild honey hunting by 13% *ceteris paribus*. Wild honey hunting requires experience and courage given the risk associated with wild honey hunting. These attributes are normally associated with older than young women. Previous studies also noted that, younger women were more involved in modern beekeeping than their older counterparts because of easy access to training (Yator, 2021). This therefore suggests that older women because of a lack of training and access to modern beekeeping would resort to wild honey hunting leveraging their tacit knowledge and experience.

Access to extension services also positively influences the decision of rural women to hunt wild honey. Model results show that, per every positive unit change in access to extension services by rural women, there is a 16% probability of wild honey hunting *ceteris paribus*. Even though agricultural extension services are poor in most rural areas in Africa and skewed in favour of men (Yator, 2021), they provide necessary support services to rural communities, especially on non-conventional enterprises like wild honey hunting (beekeeping) (Mburu, 2015).

Access to formal honey markets negatively influences the decision of rural women to participate in wild honey hunting. Per every unit increase in access to formal honey markets, results reveal a 48% probability of not considering wild honey hunting among rural women *ceteris paribus*. Respondents noted that formal markets discriminated against unprocessed wild raw honey to such an extent that trying to sell unprocessed wild raw honey in such markets was close to impossible. Access to formal honey markets would therefore mean, one must own expensive modern frame hives, protective clothing and a honey extractor for processing and bottling of the type of honey required by the formal markets. Respondents also noted that, training was also necessary to enhance a clear understanding of how these modern frame hives and honey extraction equipment operate. These sentiments are in line with previous observations from various studies that argued that because of several roles that women have, in most cases they do not have time to attend trainings that enable them to learn more on improved technologies (Ahikiriza, 2016; Moser & Moser, 2005).

Lastly, the number of livelihoods options practiced positively influences the decision of rural women to participate in wild honey hunting. Model results indicate that, per very unit increase in rural livelihoods diversity (number of livelihoods), there is a 6.5% probability of considering wild honey hunting as a livelihood option among rural women *ceteris paribus*. Livelihood diversification encourages risk taking behaviour and the propensity to try multiple survival initiatives. Thus far, it becomes easier for highly diversified women to participate in wild honey hunting because of the risk taking behaviour encouraged by diversification.

12. Impact of wild honey hunting on income, dietary diversity, and food access among rural women

The PSM enabled estimation of how participating in wild honey hunting impacted the reported changes in household income, dietary diversity, and food insecurity access. This was possible through matching of the control and treated groups using propensity scores generated from the first stage results (Probit regression) using the nearest neighbor matching method. The matching was done in the region of common support as illustrated in Figure 3. The left panel of Figure 4 shows the propensity score distribution for the raw data, while the right panel refers to the matched data. The common support condition is therefore satisfied given the overlap for the treated and control groups with respect to the distribution of the propensity scores.

Table 2 presents the treatment effects estimation based on observations within common support only. Results indicate that participation in wild honey hunting by women increases income by R539. Wild honey is normally sold locally in its raw state by wild honey hunters generating the much-needed household income. Wild honey is trusted by local consumers (informal markets) because they claim that it is original compared to processed honey sold in formal markets. Local informal demand for raw honey is therefore claimed to be high. This concurs with Abro et al. (2022)

Figure 4. Propensity score distribution and the common support condition for the wild honey hunters (treatment group) and non-hunters (control group).

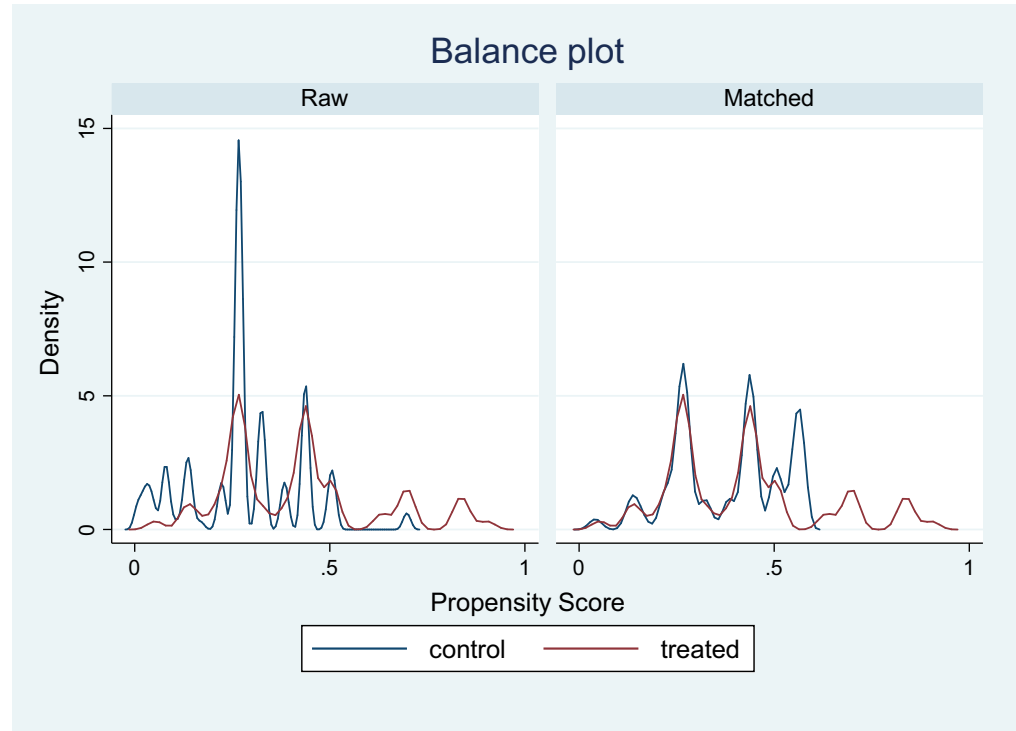


Table 1. Probit regression estimates for the factors that influence wild honey hunting among rural women

Variable	Coefficient	Standard Error	z	P> z	dy/dx
Age	0.3810488	0.1610756	2.37	0.018**	0.1321655
Household Income	0.0002287	0.000151	1.52	0.130	0.0000793
Access to extension services	0.4678742	0.2069441	2.26	0.024**	0.1622806
Access to formal honey markets	-1.373158	0.4304659	-3.19	0.001***	-0.476275
Employment status	-0.1147459	0.4280909	-0.27	0.789	-0.0397992
Number of livelihoods options	0.1881157	0.057458	3.27	0.001***	0.0652473
Education	0.2559284	0.2330852	1.10	0.272	0.0887679
Household size	-0.0322496	0.0464031	-0.69	0.487	-0.0111857
Marital status	-0.0083337	0.1837346	-0.05	0.964	-0.0028905
_cons	-2.519008	0.8763376	-2.87	0.004	-

Log likelihood = -108.0614; LR Chi square (9) = 34.62; Prob > Chi square = 0.0001; Pseudo R² = 0.4381; Number of obs = 200

***, Significant at 1%; **, Significant at 5%; *, Significant at 10% confidence level.

who noted that participation in beekeeping increased income by 3,418 Ethiopian Birr (ETB) per person, suggesting a 51% increase in income.

Results also reveal that, participation in wild honey hunting by women increases their dietary diversity by one score. Access to honey through participation in wild honey hunting enhance women to broaden their food groups. This could be possible through access to the sweets food group (sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes) or other food groups leveraging income obtained from honey sales.

Table 2. Income, dietary diversity, and food insecurity access implications of participating in wild honey hunting

Wild Honey Harvesters (1) vs Non-Wild Honey Harvesters (0)	Coefficient	AI Robust Standard Error	z	p > z
ATET				
Income	539.2555	112.9457	4.77	0.000***
Dietary Diversity Score	1.279563	0.3031647	4.22	0.000***
Food Insecurity Access Score	-4.090079	1.478328	-2.77	0.006***

Lastly, results indicate that, participation in wild honey hunting by women decreases their food insecurity by four scores. This is likely to be through the income effect generated through sales of wild honey locally (informal markets), given that income is a significant driver of food security from the study area. Extra income generated from selling wild honey would help wild honey hunters to buy several food groups and reduce their food insecurity.

13. Conclusion and policy insights

The study concluded that there is an emerging increase in the interest of wild honey hunting by rural women, even though, traditionally, wild honey hunting and modern beekeeping using frame hives have been a domain dominated by men. The study noted that wild honey hunting among rural women is, on the one hand, positively conditioned by age, access to extension and livelihood diversity, while negatively influenced by access to formal honey markets on the other hand. Participating in wild honey hunting improves the income and the dietary diversity of the participants as well as reducing their food insecurity. The paper therefore argues that the demand for wild honey hunting among rural women is growing possibly triggered by the positive income, dietary diversity, and food security implications. This therefore suggests a clear signal for the need to promote sustainable wild honey harvesting among rural women. This could be through targeting the reduction of technical risk factors that surround wild honey hunting including sustainable harvesting techniques and promoting commercial sustainable beekeeping using frame hives, training and value addition as well as improving access to institutional frameworks (access to extension services).

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Citation information

Cite this article as: Rural women's participation in wild honey hunting and associated income, dietary diversity, and food insecurity implications: Evidence from South Africa, Amon Taruvinga, Siyabonga Jonga, Owethu Zamisa & Derick Nomuh Forbanka, *Cogent Economics & Finance* (2023), 11: 2282864.

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