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Unpacking the relationship among rural livelihoods, indigenous plant's cultivation and food security: evidence from South Africa

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Abstract

The neglect in the cultivation and utilization of highly diverse indigenous plants poses a serious threat to food security status and rural development in most developing countries. Here, we (1) profiled the ethnobotanical and food security analysis of 31 selected indigenous fruits, grains and vegetables and (2) estimated the determinants of cultivating indigenous plants and rural livelihood in South Africa. The data utilized herewith relied on a survey in 12 selected rural areas of the North West Province of South Africa. Descriptive statistics and probit regression analyses were employed to achieve the research objectives. The study revealed that the total income made from cultivating indigenous plants was significantly higher among those who owe land than the participants who do not owe the land. Likewise, the rural households that utilizes indigenous grains, fruits and vegetables had between 58-59% probability of being food secured than their counterparts. Furthermore, the probit regression result indicated that land ownership, rural livelihood assets and ethnobotanical indices were the principal determinant (p<0.05) of indigenous plants cultivation in the study area. We concluded that cultivation and consumption of indigenous plants was important for the food security of rural households. Therefore, policy interventions targeted at improving the present South Africa's land tenure pattern, awareness and indigenous plants farming incentives for more efficient and productive production have the potential to increase the plants wider acceptance, cultivation, rural livelihoods and food security in the marginalized communities of the country.

Key words: Empirical modelling, Food Sovereignty, Frequency index, Undervalued plants, Use-value, Rural development

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Introduction

Africa is endowed with many plants with nutritional value for mitigating food insecurity but this diversity of plants is threatened by negligence, insufficient knowledge and population growth which affects the biodiversity (Hunter & Fanzo 2013; Bvenura & Sivakumar 2017). Indigenous grain, fruit and vegetables are essential for healthy ecosystems which provide the conditions and processes that sustain all life. They form the basis for potential agricultural food production, following the global dependence on a relatively few major crops. Studies conducted in the southern Africa have also shown that indigenous food plants play a crucial role in the livelihoods

of rural communities (Legwaila *et al.* 2011; Chivandi *et al.* 2015; Omotayo & Aremu 2020a). However, the indigenous plants' cultivation currently characterized by problems such as small-scale cultivation, harvesting from the wild and poor awareness of their potentials.
Therefore, the cultivation of indigenous plants needs to be encouraged due to their inherent benefits including high biodiversity, adapted to specific marginal soil, climatic conditions, often can be cultivated with minimal external inputs and increasing dietary diversity and food intake (Shackleton *et al.* 2015). In order to enhance the understanding of the potentials of indigenous grain, fruit and vegetables in the face of food shortage and insecurity in South Africa. The current research applied a trans-disciplinary approach on the ethnobotanical and rural livelihoods in recording information pertaining to the rural livelihoods, cultivation of indigenous plants and food security in South Africa. Knowledge on the use and potential of the selected indigenous plants is a noteworthy research effort. Hence, the findings from this study can facilitate policy formulation and strategic investment options that would alleviate associated poor livelihood and food insecurity in rural South Africa.

Material and Methods

The study was conducted in the North West Province, South Africa. The data was collected using face-to-face interviews among rural households, across 12 communities within the four districts of the province**.** As detailed by Omotayo *et al*. (2020), the selection of the communities was based on their social dynamics and low socio-economic status of the inhabitants, substantive biodiversity and climatic conditions which help cultivate the plants with minimal external inputs. A descriptive statistic was employed to analyze and summarize the data on reported indigenous grains, fruits and vegetables plants (Appendix A), parts used, mode of preparation and uses. The per capita food expenditure was used as an indicator of food security is well documented in the literature (Faridi & Wadood 2010) as well as the Foster-Greer-Thorbecke (FGT) index. To provide a detailed analysis of the factors influencing the cultivation of indigenous plants among households, the study applied a discrete choice probit model for binary choice (yes, no) responses to questions on the cultivation of indigenous plants. The probit model is a statistical probability model with two categories in the dependent variable (Omotayo 2018; Olagunju *et al.* 2021).

Results and Discussion

Description of the rural participants

The average age (46.91 years) of these household heads reveals that, household head in the rural North West, South Africa are youths. These people have grown enough that they are in a better position to establish their livelihoods thereby making these households less prone to both current and future food insecurity and poor livelihood. In addition, the gender distribution of the participants indicates that 53% of the households were headed by females compared to 47% for male-headed households in the study. In addition, with mean household size of the participants was 4 members with an average income (R11134.85) per annum.

Participants food security and land ownership

Table 1 shows that 59.40 % of the farming households were food secure, while 40.60% were food insecure. Those that own land and utilizes their lands for indigenous plant cultivation were also 54.89%. These confirms the importance of indigenous food plants for household's food security. It corroborates existing literature that indigenous food plants are important for food security in the developing nations of the world (Omotayo & Aremu 2020b).

Table 1: Distribution of the households food security and land ownership

Variable	Frequency	Percentage

Food security status		
Food insecure	54	40.60
Food secure	79	59.40
Land ownership status		
Non land owner	60	45.11
Land owner	73	54.89
Total	**133**	**100**

Land ownership and total income from indigenuous plants by the participants

The participants' Kernel density distributions of total income was disaggregated by their land ownership status (Figure 1). The natural log (ln) of the average total income made from indigenuous plant cultivation was significantly higher among those who cultivate indigenous fruits, grains and vegetables on their own land than the participants who cultivate indigenous plants on land through other land tenure patterns. While observable differences were noted between those who cultivate indigenous plants on their land and the non owners. This corroborates existing literature on the importance of land ownership for the cultivation of indigenous fruits, grains and vegetables and livelihood of the rural people (Olowo et al. 2022).

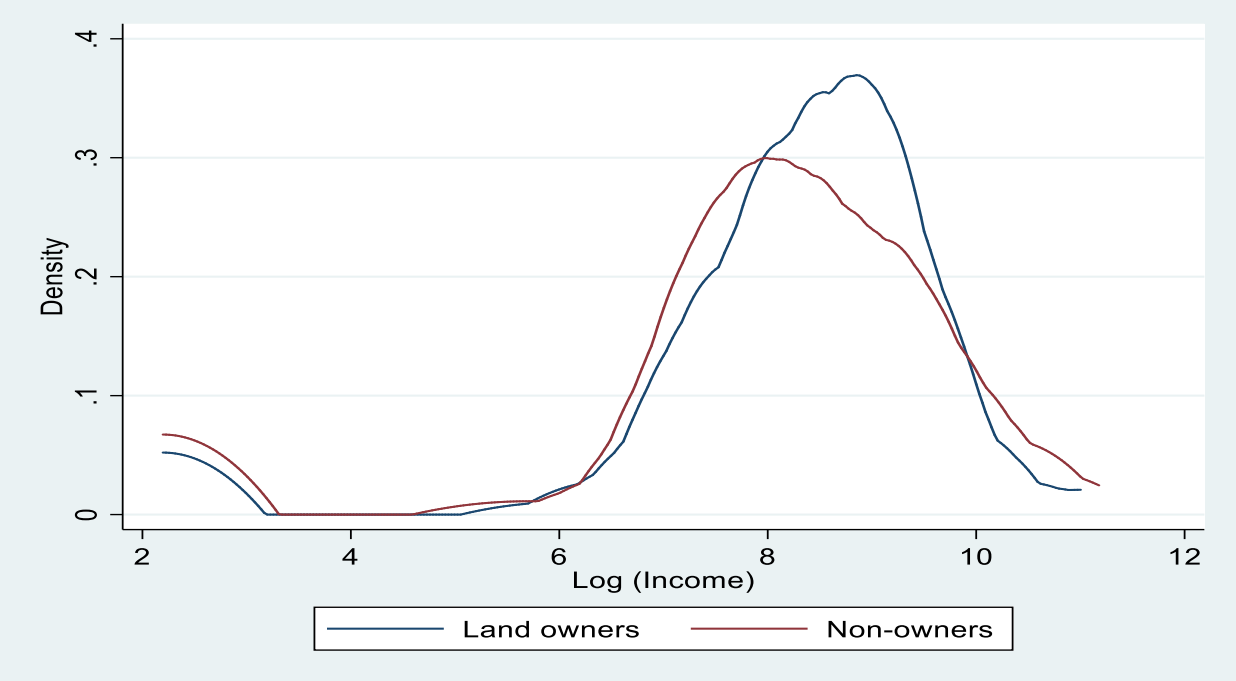

Figure 1. Kernel density distributions of total income disaggregated by land ownership

Probit regression estimates of the determinants of indigenous plants cultivation

We estimated the factors influencing the cultivation of indigenous plants among households in rural North West province of South Africa. In addition, test for multicollinearity among the variables was carried out with the mean variance inflation factor (VIF) of 1.34. the measures of goodness of fit for the model, including the Wald chi^2, Pseudo R^2 and Archer and Lemeshow (2006) were equally reported. According to all the employed diagnostics measures, it was concluded that the Probit model is a good fit for the objective. The results show that the human capital variables such as household's district of residence ($p<0.01$), households' size ($p<0.01$), extension advisory service and training ($p<0.01$), households access to market ($p<0.01$) and access to seed and incentives ($p<0.05$) were positive and statistically significant in the study area. However, the financial capital asset of the coefficient of the household's average income and total expenditure were negatively (-0.0001, -0.0037) significant ($p<0.01$, $p<0.05$) indicating that there is a reduction in the farmers' average income and total expenditures as the probability of

cultivating indigenous plants increases. Contrary wise, the parameter of financial return from indigenous plants cultivation was positive (1.6933) and significant ($p<0.01$). Furthermore, the coefficients of the natural capital through the ownership of land were positive (1.5146) and significant ($p<0.01$). In the same vein, the social capital parameter, being a member of cooperative society was positive (0.2370) and significant ($p<0.1$). Intriguingly, the parameter of the households' possession of physical assets was equally positive and significant ($p<0.1$) to the households' probability of cultivating indigenous plants in the study area.

Conclusions and Outlook

The current study indicated that the financial capital asset, social capital, natural capital, physical assets and human capital assets were factors that determined the cultivation of indigenous plants among rural households. Likewise, the natural log (ln) of the average total income made from indigenuous plant farming households was significantly higher among those who cultivate indigenous fruits, grains and vegetables on their own land than the participants who cultivate indigenous plants on land went through other land tenure patterns. In addition, households that utilizes indigenous plants have 58-59% probability of being food secured in the study area while 59.40 % of the households were food secure, indicating that these were the participants that utilizes the indigenous plants. Therefore, indigenous plants cultivation and consumption was important for rural household's food security. This study advocates for the stimulation of indigenous plants cultivation for food supply, economic prosperity, improved livelihood and sustainability. Based on the finding, policy interventions directed at the improvement of the present land tenure pattern and incentives for the cultivation of indigenous plants will increase their wider acceptance, improve the livelihoods and food security in South Africa.

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Appendix A

Table 1: Indigenous plants used by rural households in North West Province, South Africa

	Scientific name & Family name	[$]Vernacular name
	Indigenous grains	
1	*Cajanus cajan* (L.) Millsp. **Leguminosae/Fabaceae**	Pigeon bean (E); Dinawa (Ts)
2	*Pennisetum glaucum* (L.) R.Br. **Poaceae**	Pearl millet (E); Nyalothi, Ntweka, Amabele (Z); Muvhoho (V); Babala, Manna (Ts)
3	*Sorghum bicolor* (L.) Moench **Poaceae**	Sorghum (E); Graansorghum (A); Mabele (Ts); Amabele (Z)
4	*Tylosema esculentum* (Burch.) A.Schreib. **Leguminosae/Fabaceae**	Marama bean (E)
5	*Vigna subterranean* (L.) Verdc. **Leguminosae/Fabaceae**	Bambara groundnut (E)
6	*Vigna radiata* (L.) R.Wilczek **Leguminosae/Fabaceae**	Mung bean (E)
7	*Vigna unguiculata(L.)Walp.* **Leguminosae/Fabaceae**	Cowpea (E)
	Indigenous vegetables	
8	*Amaranthus* sp **Amaranthaceae**	Thepe (Ts); Amaranthus (E); Infino (Z)
9	*Bidens pilosa* L. **Asteraceae**	Mokolonyane (Ts); Blackjack (E); gewone knapsekêrel (A); Uqadolo (Z)
10	*Brassica juncea* (L.) Czern. **Brassicaceae**	Ethiopian Mustard (E)
11	*Corchorus olitorius* L **Malvaceae**	Jew's mallow, wild jute (E); Wildejute (A); Thelele,(NS); Delele, Gushe (T)
12	*Cleome gynandra* L **Cleomaceae**	Lerotho (Ts); Cat's whiskers (E); Oorpeultjie (A)
13	*Chenopodium album* L **Amaranthaceae**	Fat hen (E)
14	*Colocasia esculenta* (L.) Schott **Araceae**	Amadumbe, Amadombi, Mufhongwe (Z)
15	*Cucurbita pepo* L **Cucurbitaceae**	Pumpkin (E); Lephutsi (Ts)
16	*Manihot esculenta* Crantz **Euphorbiaceae**	Muthupula (Ts); Ntsumbula (Tso); Umdumbula Othobola (Z)
17	*Lagenaria siceraria (*Mol.) Standl. **Cucurbitaceae**	Bottle gourd (E); Kalbas (A); Moraka (Ns); Segwana (Ts); Iselwa (X, Z)
18	*Tetragonia decumbens* Mill. **Aizoaceae**	Dune spinach (E); Duinespinasie (A)
19	*Annona senegalensis* Pers. **Annonaceae**	African Custard-apple (E); Custard Apple (E), Isiphofu (Z); Mokamanawe (Ts)
	Indigenous fruits	
20	*Diospyros simii* (Kuntze) De Winter. **Ebenaceae**	Climbing Star-apple (E); Kraaibessie (A)
21	*Dovyalis caffra* (Hook.f. & Harv.) Sim **Salicaceae**	Kei-apple (E); Kei-appel (A); Motlhono (NS); Umqokolo (Z)
22	*Diospyros lycioides* Desf. **Ebenaceae**	Monkey plum (E); bloubos (A); Lethanyu (T); Monkga-nku (S)
23	*Dovyalis zeyheri* (Sond.) Warb. **Salicaceae**	Wild apricot (E); Wilde-appelkoos (A); umNyazuma (Z); umQokokolo (X); Morethema (NS)
24	*Carissa macrocarpa* (Eckl.) A.DC. **Apocynaceae**	Natal plum, big num-num (E); grootnoem-noem (A); Amatungulu (Z)
25	*Citrus* sp. **Rutaceae**	Lemon (E)
26	*Mimusops zeyheri* Sond **Sapotaceae**	Transvaal red milkwood (E); Moepel (A); Mmupudu (NS); umpushane (Z); Nhlantswa (T)
27	*Parinari curatellifolia* Planch. ex Benth. **Chrysobalanaceae**	Bosappel (A); Mmola (NS); Mbulwa (Tso); Mobola (Ts); Muvhula (V)
28	*Persea americana* Mill. **Lauraceae**	Avocado (E)
29	*Sclerocarya birrea* (A.Rich.) Hochst. **Anacardiaceae**	Marula (E); Morula (NS); Mufula (V); ukanyi (Tso)
30	*Strychnos spinosa* **Loganiaceae**	Corky-bark Monkey-orange (E); Kurkbasklapper (A); Morapa (NS)
31	*Vangueria infausta* Burch. **Rubiaceae**	Chirinda wild-medlar, (E); Bosmispel, Blinkblaarmispel (A); Mobilo (Ts)

[$]Vernacular names: A=Afrikaans, E=English, Z=Zulu, NS=Northern Sotho, Ts=Setswana, Tso=Xitsonga, X=Xhosa, S=Sotho. *Occurrence: W=Wild and D=Domestic