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1 The role of food from natural resources in reducing vulnerability to poverty: a
2 case study from Zimbabwe

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6

7 **Abstract**

8 Vulnerability to poverty is a major problem in the rural areas of Sub Saharan Africa.
9 Rural Households are confronted with various covariate and idiosyncratic shocks and are
10 often severely constrained in coping with such events. They frequently resort to food from
11 natural resources such as indigenous fruits during times of crisis. The availability of such food
12 sources is increasingly at risk due to deforestation and biodiversity loss.

13 The objective of this paper is to quantify the contribution of indigenous fruit trees
14 towards reducing vulnerability to food insecurity and poverty. The methodology used is a
15 multi-period stochastic household income model. The data were collected in a case study in
16 Zimbabwe using detailed monthly income and expenditure records of a sample of 39 rural
17 households in two areas. The two regions differ in their agricultural system. In one area
18 horticulture, off-farm activities and exotic fruits are a major source of income while in the
19 other area indigenous fruits are a more important source of income. This paper concentrates
20 on the latter area.

21 Model calculations show that rural households in Zimbabwe are highly vulnerable to
22 seasonal fluctuations in income and therefore a critical period where households run high risk
23 of being food insecure can be identified. While indigenous fruits, as a low cost natural
24 resource, can facilitate income smoothing, the role of other sources of income must not be
25 neglected. The paper concludes that diversified season-specific income generating portfolios
26 must be designed of which indigenous fruit trees have a role to play.

27

28 Keywords: Vulnerability, poverty, food security, seasonal fluctuations, wild food
29 resources, Zimbabwe

30

31

32 **1. Introduction**

33 Poverty is the major problem in rural areas of Sub Saharan Africa. In Zimbabwe in
34 1995, 48% of the rural population lived below the poverty threshold (Alwang et al., 2002).
35 Many of those, however, are at risk to fall deeper into poverty as a consequence of various
36 micro and macro shocks such as family tragedies, complete harvest failures, energy crisis and
37 political upheavals. Likewise, people whose income is above the poverty line may fall back
38 into poverty. Hence, any analysis of poverty reduction measures must treat poverty in a
39 dynamic context and identify risk-reducing strategies that lower the probability of people
40 falling back or falling deeper into poverty. Generally, risk-management strategies such as
41 diversification and income skewing aim at income smoothing from an ex-ante perspective.
42 Risk-coping strategies include self-insurance like precautionary savings, i.e. building up of
43 assets, and group-based risk sharing. They deal with risk from an ex-post perspective and aim
44 at consumption smoothing (Dercon, 2000). The collection of wild foods is a commonly used
45 risk-coping strategy by rural dwellers in developing countries. Wild foods, e.g. fruits, bush-
46 meat, honey, mushrooms, etc., are food from natural resources, which are collected in
47 communal areas and along roads. They are an especially important income source for poor
48 people since entry barriers for collection and use are low (Deweese, 1994). A variety of edible
49 wild fruits are a popular natural resource in Southern Africa (Maghembe et al., 1998,
50 Cavendish, 2000). They are extensively used by the local population and, apart from own
51 consumption; they are increasingly being sold in markets (Maghembe et al., 1998; Ramadhani
52 and Schmidt, 2002). Indigenous fruits (IF) are available during times of drought and famine,
53 thereby contributing to food security (Rukuni et al., 1998; Mithöfer and Waibel, 2003). In the

54 past, the fruits were a public good, but growing competition over the fruits due to an
55 increasing population led to increased rivalry and has changed the status of the resource to an
56 open access good (Ramadhani, 2002). Despite their role in sustaining food security, research
57 and development has only recently recognized their importance. Wild harvesting of forest
58 products, especially fruits, is considered as a first major step in their domestication and
59 commoditization (Simons and Leakey, 2004). Therefore, research in the last decade has
60 focussed on efforts to domesticate indigenous fruit trees in addition to conservation strategies
61 (Akinnifesi et al., 2004).

62 This paper analyses the role indigenous fruit tree products as currently available in
63 Zimbabwe play in reducing vulnerability to poverty.

64

65 **2. Theoretical background and methodology**

66 Common measures of poverty are static. In contrast, vulnerability is a dynamic concept
67 and captures the response to changes over time (Webb and Harinarayan, 1999; World Bank,
68 2001). An individual's or household's exposure to risk factors and their ability to cope with
69 them determine the degree of vulnerability. Income risk and the failure to cope with it result
70 in household consumption fluctuations. It affects nutritional, health and educational status as
71 well as contributing to inefficient and unequal intra-household allocations (Dercon, 2000).
72 Vulnerability results from poverty, but at the same time can reinforce downward trends of
73 income processes and lead to poverty (Morduch, 1994). Information on factors that determine
74 vulnerability can help to design anti-poverty intervention strategies.

75 Several concepts of vulnerability have been suggested (Hoddinott and Quisumbing
76 (2003) provide a review) including vulnerability as expected poverty (Pritchett et al., 2000),
77 as low expected utility (Ligon and Schechter, 2003) and as uninsured exposure to risk
78 (Glewwe and Hall, 1998). Vulnerability measures based on either assets or income may not
79 reflect households' overall exposure to risk since the total determines the capacity of a

80 household to counteract risk (World Bank, 2001). Moreover, vulnerability is a dynamic
81 process of cumulative conditions. Significance of causal factors and their combination change
82 over time and place (Webb and Harinarayan, 1999). Fluctuations in vulnerability not only
83 result from changes in causal factors, but also from coping mechanisms available (Campbell
84 et al., 2002).

85 In this paper, following Pritchett et al. (2000) vulnerability, Vu , is defined as expected
86 poverty and is measured as the probability of falling below the poverty line, PL . The
87 magnitude of vulnerability increases with the time horizon, t . A household, n , experiences a
88 period of vulnerability if the household income, Hi , is below the poverty line¹. Over m
89 periods, the vulnerability is the probability of observing at least one period of poverty within
90 those m periods, which is one minus the probability of no period of poverty at any of the
91 periods.

92

$$93 \quad Vu(m, PL) = 1 - [(1 - P(Hi_t^n < PL)) * \dots * (1 - P(Hi_{t+m}^n < PL))]. \quad (1)$$

94

95 Poverty is usually measured based on cross section data, whereas measures of
96 vulnerability require panel data including information on household assets, formal and
97 informal safety nets and covariate and idiosyncratic risks that a household or individual is
98 exposed to. Since panel data were not available, this study uses a stochastic household income
99 simulation model, whose database is cross section data from household case studies in
100 Zimbabwe.

101 The household income in period m is defined as the sum over gross margins, \tilde{GM} , of
102 all activities, a , plus additional cash, \tilde{IC} , e.g. informal loans, and the surplus carried over

¹ Contrary to the definition above, Pritchett et al. (2000) define vulnerability based on expenditure and not on income.

103 from the previous period, $m-1$. The surplus from the previous period is that period's
 104 household income, $\tilde{H}i_{m-1}$, net of household cash expenditure, $\tilde{E}x_{m-1}$, household consumption,
 105 Co_{m-1} , and school fees, $\tilde{S}F_{m-1}$, of that period² (equation (2)). Household consumption is based
 106 on minimum food requirements (= MFR) estimates from Alwang et al. (2002), which is ZWD
 107 13 per AEQ and day. Income flows and vulnerability to income poverty depend on seasonal
 108 fluctuations, which are addressed by defining several periods per year, m . \sim denotes the
 109 stochastic nature of income and expenditure.

110

$$111 \quad \tilde{H}i_m = \tilde{H}i_{m-1} - \tilde{E}x_{m-1} - Co_{m-1} - \tilde{S}F_{m-1} + \sum_{a=1}^A \tilde{G}M_{am} + \tilde{I}C_m, \quad (2)$$

112 with $IC = 0$, if:

$$113 \quad \tilde{H}i_m = \tilde{H}i_{m-1} - \tilde{E}x_{m-1} - Co_{m-1} - \tilde{S}F_{m-1} + \sum_{a=1}^A \tilde{G}M_{am} \geq Co_m + \tilde{E}x_m + \tilde{S}F_m,$$

114 and $\tilde{I}C = Co_m + \tilde{E}x_m + \tilde{S}F_m - \left(\tilde{H}i_{m-1} - \tilde{E}x_{m-1} - Co_{m-1} - \tilde{S}F_{m-1} + \sum_{a=1}^A \tilde{G}M_{am} \right)$, if:

$$115 \quad \tilde{H}i_m = \tilde{H}i_{m-1} - \tilde{E}x_{m-1} - Co_{m-1} - \tilde{S}F_{m-1} + \sum_{a=1}^A \tilde{G}M_{am} < Co_m + \tilde{E}x_m + \tilde{S}F_m.$$

116

117 The assets carried over from the previous year and surplus available in t_0 is assumed to
 118 be equal to the surplus that households had accumulated by the end of the monitoring season
 119 in 2000. The model incorporates two specific risk-coping strategies: (1) households can
 120 access additional sources of cash, and (2) households can increase indigenous fruit collection.
 121 All households have access to additional sources of cash, e.g. from a savings account, with
 122 either own accumulated savings or remittances and transfers from other family members,

² Note that, due to using gross margins for household income calculations, the variable cost of production activities have already been accounted for.

123 savings clubs and informal loans. These informal loans do not require collateral or charge
124 interest, similar to observations of other rural household surveys as also shown by Fafchamps
125 and Lund (2002).

126 Indigenous fruits are available during the critical period, i.e. from August to January. In
127 the model, whenever the household income falls below minimum food requirements plus cash
128 requirements for production and household expenditure during this period, the model
129 household increases fruit collection from the Communal Areas. However, the extent to which
130 the household increases fruit collection is limited to a contribution of 42% to the natural food
131 basket, which is the average across other studies (i.e. Campbell et al., 1997; Shackleton and
132 Shackleton, 2000; Shackleton et al., 2002; Shackleton and Shackleton, 2003).

133 Receipt of remittances and the share of off-farm activities reflect further risk-
134 management and -coping strategies and are employed in the model up to the level found
135 among the survey households. Cattle and poultry are most widely owned and are the main
136 assets sold (Kinsey et al., 1998)³. From a risk-management perspective, the model captures
137 the degree of income diversification in the research location since it uses income data from
138 observed activities. By using gross margins, one indicator captures climatic, i.e. yield
139 fluctuations, as well as market risk, i.e. price variability.

140 In order to pool the cross-section sample for identifying the distributions of each income
141 and expenditure category, adult equivalent units are used as common denominator. The
142 distributions were fitted to the seasonal cross section data of each enterprise by using BestFit
143 (Palisade, 2004) and the distribution with the best-fit statistic ranked by Chi-square test was
144 employed. The model results for the seasonal household income obtained from the
145 simulations can be interpreted as the income of an average household of the research site.

³ This risk-coping strategy is not accounted for by using gross margins, since the sale of livestock is counterbalanced by the reduction in stock. However, if this risk-coping strategy is to function in the long run, the sale of livestock has to occur at a lower rate than reproduction.

146 Since all households of the research location use indigenous fruits, no comparison
147 between indigenous fruit users and non-users can be drawn. The latter implies that no
148 ‘without IF’ scenario can be defined. Thus, the contribution of IF towards remaining above
149 the poverty line is assessed by subtracting the IF income from the household income while
150 holding all other factors constant. The poverty model assesses three different scenarios
151 depending on the degree to which indigenous fruits are used to substitute MFR.

152 The model excludes dependency between the periods, e.g. inputs into agricultural and
153 horticultural production from August to January as expressed by negative gross margins,
154 which could be expected to result in higher gross margins during harvesting time from March
155 through to June. Neglect of these dependencies can be interpreted as the risk of crop failure,
156 e.g. due to averse climatic conditions in the latter half of the cropping period. If a farmer
157 plants her crops in the beginning of the wet season and uses rather high quantities of inputs,
158 she still faces the risk of a short rainy season. If this happens, and rains fail to continue until
159 February, the crop dries up and the inputs used are sunk.

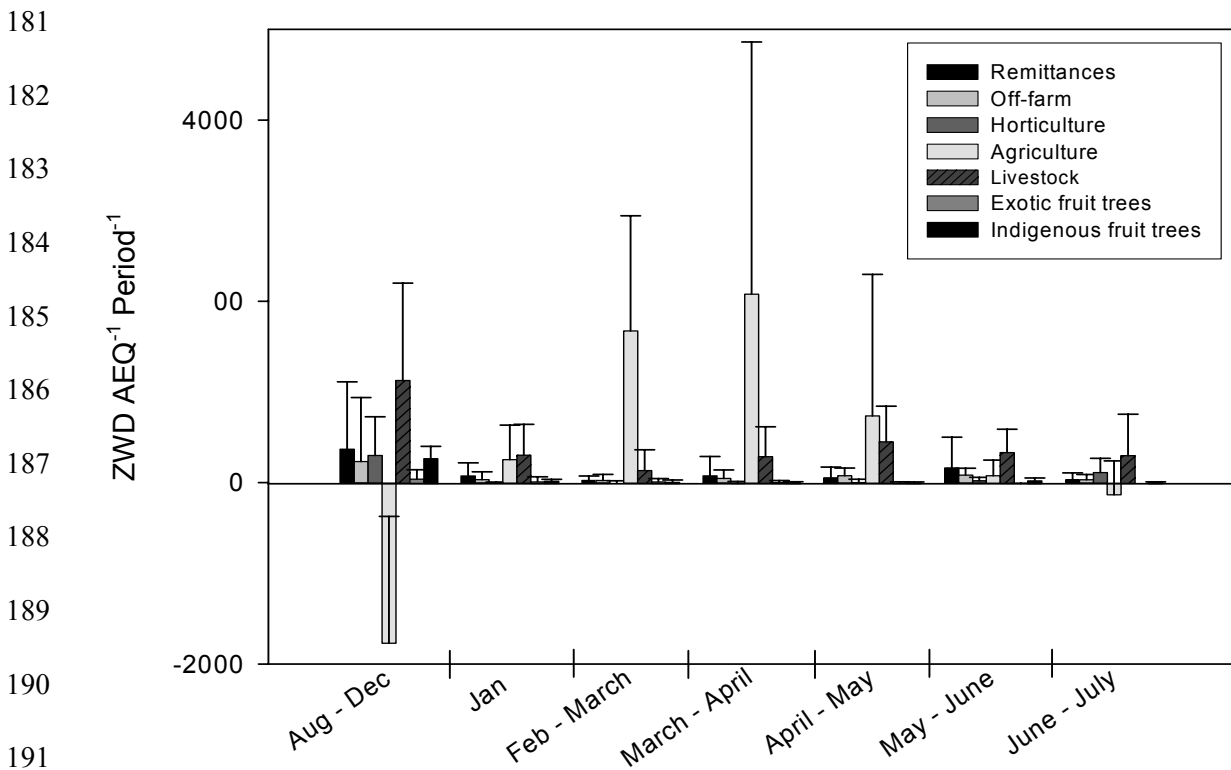
160

161 **3. Description of study area and data**

162 Income, expenditure and labour data were collected periodically from 19 farm
163 households of Ward 16 in Murehwa District and 20 households of Takawira Resettlement
164 Area in Zimbabwe covering the period from August 1999 to August 2000. Data on the most
165 preferred indigenous fruit tree species by rural communities in the region, namely Uapaca
166 kirkiana, Strychnos cocculoides and Parinari curatellifolia (Kadzere et al., 1998) are used as
167 an indicator of the role of natural food resources in reducing vulnerability.

168 The components of household income and expenditure of households living in Takawira
169 Resettlement Area (valued at 1999 prices) are provided in Figure 1. Income of farm
170 household enterprises fluctuates in the course of the year and includes cash income as well as
171 the value of own consumption. Income of households in Murehwa is higher than of those in

172 Takawira. Murehwa is closer to capital city, Harare, than the resettlement area; also, Murehwa
 173 has a better-developed market since many buses going to Mozambique and Malawi stop here.
 174 Remittances and off-farm activities generate a higher income in the period August to January
 175 and remain relatively stable thereafter on a lower level. Horticultural income increases from
 176 June onwards and then also reaches a peak in the period August to December in Takawira,
 177 whereas in Murehwa it is relatively stable from May to February. Indigenous fruit income
 178 starts rising in August and then decreases from January onwards. All these enterprises move
 179 anti-cyclically to agricultural activities that require expenditures for inputs in the period
 180 August to November and then generate income from February through April.



192 Fig. 1. Gross margins and standard deviation by household enterprise and season, Takawira
 193 Resettlement Area*.

194 * 1999 prices (in December 1999, 38 Zimbabwe Dollar (ZWD) = 1 US Dollar); AEQ = adult equivalent
 195 (household members above 65 years = 0.75 AEQ; 18–65 years = 1.0 AEQ; 14–18 years = 0.75 AEQ; 7–14
 196 years = 0.5 AEQ, below 7 years = 0.25 AEQ).

197 Source: Household Survey.

198 Analysis of the contribution of indigenous fruits towards reduction of vulnerability
199 focuses on Takawira Resettlement area since the households living here depend more heavily
200 on indigenous fruit during times of crisis (Mithöfer and Waibel, 2003).

201

202 **4. Results and discussion**

203 The poverty line extrapolated from Alwang et al. (2002) is at 4600 ZWD per adult
204 equivalent and year⁴. The average household income in Takawira is above the poverty line.
205 However, 25% of the households of Takawira were below the poverty line during the research
206 period. The estimate of the poverty headcount based on consumption data is at 48% for the
207 rural areas and nationally at 35% for 1995 (Alwang et al., 2002). In Takawira, the households
208 below the poverty threshold derived an average annual income of 2700 ZWD per adult
209 equivalent. In comparison, Campbell et al. (2002) estimate that 71% of their households were
210 below the “food poverty line” (28000 ZWD per household), which covers basic nutritional
211 needs, and 90% were below the “consumption poverty line” (45000 ZWD per household)⁵,
212 the latter also covering some allowances for housing, clothing, education, health and
213 transport.

214 Seasonality of income generating activities implies that poverty as well as vulnerability
215 to poverty fluctuates in the course of the year. Vulnerability is high during the period from
216 August to January, when agricultural production requires the most inputs and does not yet
217 provide sufficient income. Depending on the harvest of the staple crop (maize) the critical
218 period when households are most vulnerable starts in September if the maize harvest was low

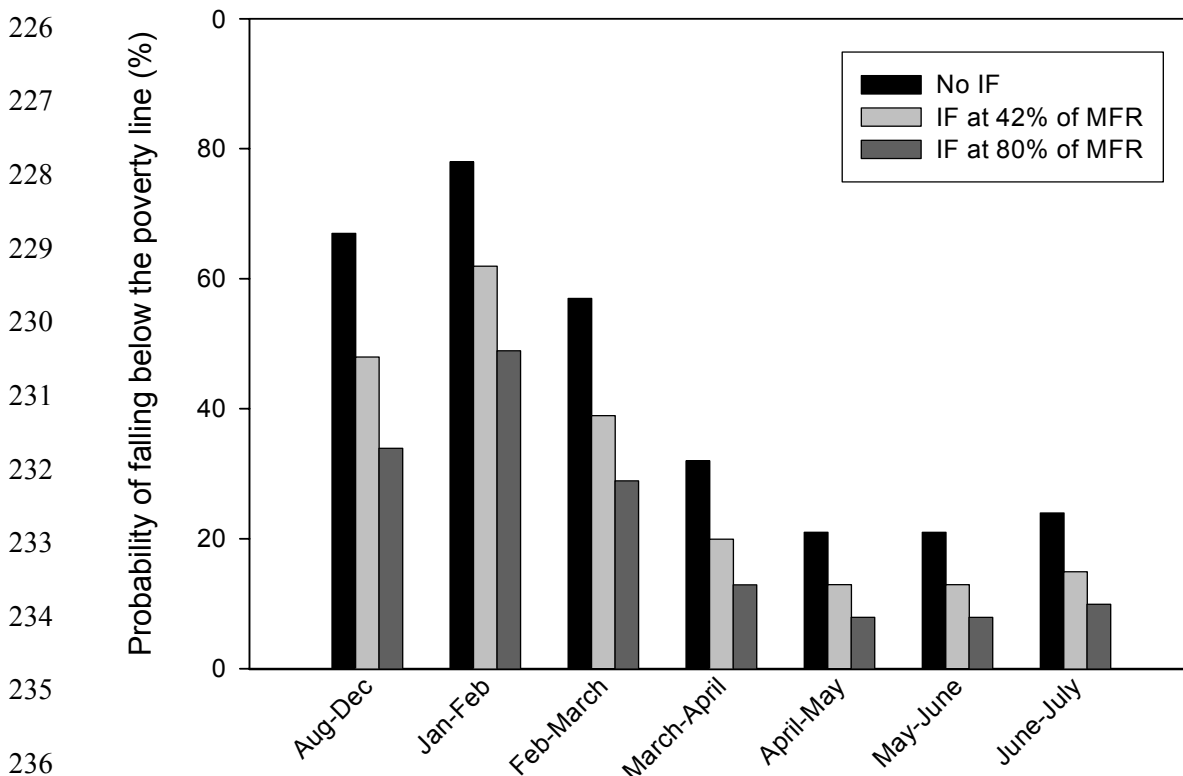
⁴ 24000 ZWD per average household size of Takawira. Alwang et al. (2002) estimate a national minimum food needs poverty line for 1990 based on data of the Central Bureau of Statistics. This threshold was extrapolated to 1999 using the average annual growth rate of the food price index.

⁵ In 1999 Zimbabwean dollars (Campbell et al., 2002). Both measures of poverty were defined specifically for their survey.

219 whereas in years with normal maize crop, the grain lasts up to the next harvest. During the
 220 critical period 80% of interviewed households of Takawira derived an income below
 221 minimum food needs.

222 Figure 2 shows that availability of indigenous fruits reduces the probability of falling
 223 below the poverty line. As expected, the higher the share of indigenous fruits towards
 224 minimum food requirements, the lower vulnerability to income poverty is.

225



237 Fig. 2. Probability of falling below the poverty line, Takawira Resettlement Area (%)*.

238 * MFR = minimum food requirements, IF = indigenous fruits.

239 Source: Simulation results based on household survey data.

240

241 Overall, vulnerability to poverty is high in the resettlement area and also fluctuates
 242 strongly during the year. The impact of IF with respect to reducing the probability to fall
 243 below the poverty line is considerable. Depending on their availability, they can reduce
 244 vulnerability to poverty by up to 33% during the critical period of the year.

245 The overall likelihood that a household will fall below the poverty line at least during
246 one period of the year is high. With no surplus from the previous cropping season, the
247 likelihood to experience at least one period of poverty is higher. It ranges from 99% to 85% in
248 Takawira; the more IF can contribute to MFR, the lower it is. Rather than stating the number
249 of vulnerable households, which would include an arbitrarily set threshold under which
250 households are considered vulnerable, these figures describe the risk of becoming poor.
251 Campbell et al. (2002) show for the south of Zimbabwe that wealthy households receive more
252 remittances than poor households and that poor households depend to a larger extent on
253 woodland products. The link between wealth and indigenous fruit use is captured in the model
254 indirectly, namely by the resource stock the year of analysis starts with, the amount of
255 remittances and other income received by the household, which all influence the extent of IF
256 collection.

257 Since the household income in one season is derived from various sources, the
258 sensitivity of the household income towards each of its components is assessed for the critical
259 period, August to December. The sensitivity analysis is carried out for scenarios with
260 indigenous fruit tree use. For this purpose, simulation data are further analysed by linear
261 regression for the critical period. The functional form underlying the regression is given by
262 equation 2⁶. The sensitivity analysis uses the standardised beta coefficients as a measure of
263 the impact of a standard deviation change in each income component on the household
264 income.

265

266

⁶ As expected, the regression model results in a R-square of 1.

266 Table 1

267 Sensitivity of household income to changes of income by source

	Standardised Beta Coefficient
Remittances	0.450
Off-farm activities	0.127
Horticulture	0.183
Agriculture	0.698
Livestock	0.554
Exotic fruit trees	0.044
Indigenous fruit trees	0.188
Loan	0.169
HH consumption & expenditure (incl. school fees)	0.000

268

269 Income from agriculture, livestock and remittances ranks highest in influence on
270 household income. In comparison, the impact of IF availability is smaller. Harvesting of non-
271 timber forest products is a subsistence strategy of households; it provides additional income to
272 households earning the bulk of their income from agriculture or off-farm sources as findings
273 of Ruiz-Perez et al. (2004) show for lightly managed forests.

274

275 **5. Conclusions**

276 Vulnerability to food poverty in Zimbabwe is high and fluctuates strongly during the
277 year. Portfolios of income generating activities in Zimbabwe consist of a variety of different
278 activities and vary amongst farmers and areas. These activities follow seasonal patterns and
279 their extent in terms of demand for input varies in the course of the year. By combining
280 activities farmers smoothen income fluctuations.

281 Wild foods like indigenous fruits reduce vulnerability. In the research area, the
282 probability of falling below the poverty threshold is at 70% during the critical food insecure
283 season when agricultural crops are planted if no indigenous fruits are available and about 30%
284 during maize harvesting time. If indigenous fruit area available, they reduce vulnerability by
285 about one third during the critical period. However, vulnerability to poverty cannot be
286 eliminated by indigenous fruit use due to their limited availability. However, the trees
287 contribute one risk-coping strategy, which can be further complemented by other strategies,
288 during the agricultural off season and thus provide a cushioning effect to annually occurring
289 poverty and hunger in August to December.

290 Since IF use is a low entry barrier activity during the time of need, measures should be
291 taken to assure availability of indigenous fruit trees, e.g. through on-farm conservation.
292 Adding value to the fruits may be another area to enhance rural incomes at the times of need.

293

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