FARMER-IDENTIFIED INDIGENOUS FRUIT TREE WITH SUITABLE ATTRIBUTES FOR THE SEMI-ARID NORTHERN PROVINCE OF SOUTH AFRICA

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ABSTRACT

The study describes different research techniques used to gather useful information to assist smallholder farmers in making important decisions on the identification and selection of an indigenous fruit tree for domestication and commercialisation. The study demonstrates how action research brings together farmer-researcher actors into rural development in an interaction designed to address and find a solution to a problem as identified by farmers. In the end an indigenous technology/product is selected, that fits well into smallholder farming systems. The indigenous fruit tree, Mmupudu (Mimusops zeyheri; English = Transvaal red milkwood; Afrikaans = Moepel) was top - ranked as having favourable environmental, economic and nutritional attributes for conditions under which rural communities in the semiarid Northern Province of South Africa live.

1. INTRODUCTION

Most rural communities in the Republic of South Africa's Northern Province were historically settled on shallow soils with steep slopes and the annual rainfall averaging 450 mm (range 300 - 620 mm). Most of this rainfall occurs as heavy thunderstorms, which exacerbates the soil erosion problems (Anon, 1999a). Inhabitants of rural areas experience untold suffering from excruciating levels of abject poverty and malnutrition. Due to the scarcity of irrigation water in the semiarid rural areas, it is uneconomical to cultivate exotic crops, which are inherently sensitive to water stress. Commercial husbandry of exotic crops under irrigation on one percent of the arable land of the province, are an exclusive produce for lucrative processing and export markets (Anon, 1999b).

Exotic crop systems in the rural communities of the Northern Province collapsed due to their unadaptability to marginal soils and water stress. Large tracts of land that were deforested for these projects are degraded at alarming rates (Anim, 1999:340). Farmers in the province are not ignorant of erosion problems, because

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their village streets, crop fields and grazing camps are affected, as attested to by their incessant quest to know how soil erosion can be managed. The answers are not obvious. However, acclimatised indigenous plant species may ameliorate some of the erosion problems by minimising land denudation, which may in turn reduce the velocity of water.

World-wide, great efforts to improve and domesticate indigenous plants as alternative crops are underway (Gardner, 1991:1 - 5). Advantages of indigenous plant species over exotic species are that they are already acclimatised to local conditions. Therefore, these plants have a better chance of enhancing more sustainable agro-systems, combating land degradation and conserving the natural plant heritage. Domesticating and commercialising genetically sustainable plant species with environmental, nutritive and economic values in rural communities is an urgent challenge to farmers, scientists, developmental agencies and environmentalists.

The Northern Province is home to a diversity of indigenous plants, used for centuries by Nguni tribes as food, medicines, insect repellents, rituals, animal feeds and aesthetic fulfilment. However, with the advent of exotic plants, indigenous plants that were genetically acclimatised to marginal environmental conditions of the province were reduced to the status of declared weeds, concomitant with progressive extermination programs. A classical example is the spiny prickly pear (*Opuntia stricta*), for which cochineal insects were introduced from India for extermination (Van der Merwe, 1931:11). However, in recent years there has been a paradigm shift in attitudes of viewing all indigenous plant species as obnoxious invader plant species. This view is attested to by the renaissance of various interest groups that are evaluating benefits accorded by indigenous plant species in the province. The objectives of this study are three-fold: (1) to use farmer knowledge to identify and select an indigenous fruit tree that can be top - rated for its edible qualities, (2) to evaluate the economic potential of the selected fruit tree, and (3) to review the potential nutritive values of the selected fruit tree and its potential sustainability under marginal environmental conditions.

2. METHODOLOGY OF THE STUDY

The study was initiated in March 1997 as a collaborative effort between the Northern Province African Farmers' Union (NOPAFU), an organisation representing the interests of smallholder farmers, and the extension officers of the province. The three phases of the study were conducted by employing a Delphi group technique and telephonic surveys. In a Delphi technique, people with exceptional knowledge about a given subject area, in this case being farmers, are

involved in repeated questioning and feedback using written questionnaires, until a consensus is reached on the subject (McCaslin & Tibezinda, 1997:41).

2.1 First phase of the study

A multistage sampling technique was used to select the participants in five regions of the province, namely: Central, Lowveld, Northern, Southern and Western Regions. Fifty randomly selected farmers per region participated in fruit identification (n = 250). The extension agents administered an identification form which requested farmers to list all edible indigenous fruit trees occurring within their region. The return rate of the identification forms was 100% in all regions except the Western Region which had a return rate of 73% due to internal transport problems.

Seven fruit trees which had at least 50% nominations were listed at the top of the questionnaire using the local names (Appendix A). One hundred and fifty randomly selected farmers per region participated in the ranking of the fruits (n = 750). Farmers selected in rank order the three most important indigenous fruit trees based on edible qualities of fruits in fresh and / or beverage forms.

2.2 Second phase of the study

Mmupudu (*Mimusops zeyheri)* was top - ranked as the most important indigenous fruit tree. The economic potential of this fruit tree was determined through a marketing survey outside the rural communities in the Southern and Central Regions in October 1997. Mmupudu fruits were harvested from Sterkspoort and Chuenespoort mountain ranges and wrapped in 500 g plastic packages. The four targeted towns were Lebowakgomo, Nebo, Pietersburg and Practiseer. Extension agents identified 11 marketing stations within each town, and the randomly selected five stations used for marketing purposes were:

- magistrate court,
- police station,
- shopping mall,
- taxi rank, and
- filling station.

A street vendor at each station was given 10 fruit packages at 08h00 to sell for R3.00 each, along with an advertisement board of “Mmupudu fruits for sale”. The following day at 10h00, extension officers collected the sale returns.

2.3 Third phase of the study

The availability and cost of Mmupudu seedlings were determined through telephonic quotation surveys at nine indigenous nurseries in Northern and Mpumalanga Provinces during December 1997. When the seedlings were not available, nurserymen were indirectly asked to explain why they were not keeping Mmupudu seedlings in their indigenous nurseries, as our previous surveys with indigenous gardeners showed that the demand for Mmupudu seedlings was high. In order to have more insight into the propagation problems of Mmupudu, nurserymen were asked to provide reasons why the seedlings that they have or could get for us "from elsewhere" were so expensive.

3. DATA ANALYSIS

Data for all three phases were analysed using descriptive statistics, with nominated fruit trees being ranked from the first to the third order (Hoshmand, 1988:16). Unless otherwise stated, the popularity of the trees was identified through weighting the nominated frequencies to derive the weighted totals. Weighted totals are defined as the sum of the nominated frequencies in the 1st, 2nd and 3rd rank orders multiplied by rank weights 3, 2 and 1, respectively (Hoshmand, 1988:16).

4. RESULTS AND DISCUSSION

4.1 Identification of known edible wild fruit trees

Seven fruit trees that had at least 50% nominations are as alphabetically listed: Mmilo (*Vangueria infausta;* English = Wild medlar; Afrikaans = Grootmispel), Mmola (*Parinari curatellifolia*; Mobola plum; Grysappel), Mmupudu (*Mimusops zeyheri, Transvaal Red Milkwood; Moepel*), Mokongono (*Garcinia livingstoni*; African mangosteen; Laeveldse geelmelkhout), Morotologa (*Ximenia caffra*; Large sourplum; Grootsuurpruim), Morula (*Sclerocarya birrea;* , and Motoro (*Opuntia spp.*). All these fruits have fruits in summer, except Mmupudu which has fruits in mid-spring, when vitamin C, which it supplies in large quantities, is in scarce supply. Motoro has the largest fruits, followed by Morula; whereas fruits of the other listed trees are more - or - less of the same size. Also, fruits of exotic spineless cultivars of Motoro are commercially available, suggesting their high nominations; whereas Morula is a common beverage. Reasons for the high nominations of other listed fruit trees were not obvious.

4.2 Identification of the most popular wild fruit tree

In fresh form, Mmupudu, Mmola and Morula were ranked as the1st, 2nd and 3rd, respectively (Table 1). On the other hand, in beverage form, Morula occupied both position one and two.

Table 1: Importance ranking in edible forms of three indigenous fruit trees by smallholder farmers

Fruit	Edible form	Frequency and % nominations			Weighted totals	Weighted percen-tages
		1st most important	2nd most important	3rd most important		
Mmupudu	**Fresh**	121 (80.1%)[y]	13 (14.0%)	18 (12.1%)	407[z]	51.6%
	Beverage	0 (0%)	2 (2.8%)	0 (0%)	4	1.0%
Morula	**Fresh**	11 (7.3%)	27 (29.0%)	93 (62.4%)	180	22.8%
	Beverage	89 (100%)	56 (78.8%)	1 (12.5%)	380	91.1%
Mmola	**Fresh**	19 (12.7%)	53 (57.0%)	38 (25.5%)	201	25.5%
	Beverage	0 (0%)	13 (18.3%)	7 (87.5%)	33	7.9%
TOTAL	**Fresh**	**151**	**93**	**149**	**788**	
	Beverage	**89**	**71**	**8**	**417**	

[y] *% nomination = frequency/total x 100 = 121/151 x 100 = 80.1%.*

[z] *Weighted total = (121)3 + (13)2 + (18) = 407, i.e. weighted totals is equal to the sum of the number of nominations in the 1st, 2nd and 3rd rank order multiplied by rank weight 3, 2 and 1, respectively.*

In fresh form, 95.3% of farmers participating in the study, top - rated Mmupudu, with 63.1% rating Mmola second. In fresh form, Mmupudu, Mmola and Morula were rated as the 1st most important, 2nd most important and 3rd most important by 80.1%, 57.0% and 62.4% farmers, respectively. Also, the weighted percentages reflected that Mmupudu was perceived by 51.6% farmers as being more important in edible fresh form than in beverage form. In beverage form, Morula was rated as the 1st and 2nd most important by 100% and 78.8% farmers, respectively; whereas Mmola was rated third by 87.5% farmers. Morula was perceived as being much more important in beverage than in fresh form.

4.3 Availability of young Mmupudu trees

Farmers in all regions felt that there was great need for the domestication and commercialisation of Mmupudu trees "because these fruit trees were scarce in nature" as apposed to Morula. Farmers did not consider Mmupudu as being placed under taboo in their cultures to domesticate. During phase three, lack of nursery stock, information on cultivation technology and uncertainty about the marketability of Mmupudu were cited as constraints for not planting this fruit tree in home gardens or fields by 93.7%, 82.2% and 5.3% farmers, respectively. The demand for Mmupudu seedlings in all five regions is summarised in Table 2.

Farmers who were keen on purchasing and planting seedlings in their home gardens or fields averaged 92.5% (range 87.3 - 98.0%) for Mmupudu and 64.4% (range 50 - 76.0%) for Mmola; whereas those who would neither purchase nor plant Morula averaged 97.7% (range 95.3 - 99.3%) across the regions.

Robust lateral root systems, which invariably result into the cracking of houses or which obscure cultural practices in fields, along with leaf abscission in winter which is a nuisance for routine diurnal sweeping within the household yard, were among the stronger reasons farmers were reluctant to purchase and plant Morula seedlings. Also, 51.6% farmers (range 49.5 - 66.2%) indicated that Morula trees were still abundant in nature to meet the beverage requirements of the communities within their regions. Interestingly, 83.3% farmers (range79.4 - 93%) indicated that 1.3 ha (range 0.1 - 3.0 ha) could soon be made available in their home gardens or fields for the cultivation of Mmupudu.

4.4 Marketing potential of the Mmupudu fruit

Mmupudu has the potential of enhancing food security in rural areas in two ways: (1) with its familiarity within the rural communities, the fruit has the potential for alleviating vitamin C deficiencies, particularly as the fruits occur in mid-spring when vitamin C in rural areas is in short supply; and (2) with its familiarity in urban

communities, the fruit has the potential of improving the economic status of rural communities through sales of fruits. In our survey, 97% of the fruit packages were sold, demonstrating the familiarity and marketability of the fruit (Table 3).

The marketing of seedlings is another possible revenue generating source. In the surveyed nurseries seedlings were available in one-third of the nurseries; whereas in the remaining nurseries nurserymen were prepared to get seedlings

Table 2: Demand for purchasing and planting seedlings of three indigenous fruit trees by smallholder farmers

Variable measured	Frequencies of demand for seedlings per region (n = 150)										Total freq. per fruit	% freq. per fruit
	Central		Lowveld		Northern		Southern		Western			
	Freq.	% freq.[z]	Freq.	% freq.	Freq.	% freq.	Freq.	% freq.	Freq.	% freq.		
Mmupudu												
Yes	147	98.0%	131	87.3%	135	90.0%	144	96.0%	137	91.3%	694	92.5%
No	3	2.0%	13	8.7%	12	8.0%	6	4.0%	13	8.7%	47	6.3%
Undecided	0	0%	6	4%	3	2.0%	0	0%	0	0%	9	1.2%
Mmola												
Yes	75	50.0%	105	70%	93	62.0%	96	64.0%	114	76.0%	483	64.4%
No	45	30.0%	35	23.3%	8	5.3%	20	13.0%	32	21.3%	140	18.7%
Undecided	30	20.0%	10	6.7%	49	32.7%	34	23.0%	4	2.7%	127	16.9%
Morula												
Yes	0	0%	1	0.7%	0	0%	3	2.0%	0	0%	4	0.5%
No	145	96.7%	149	99.3%	149	99.3%	147	98.0%	143	95.3%	733	97.7%
Undecided	5	3.3%	0	0%	1	0.7%	0	0%	7	4.7%	13	1.7%

% frequency per fruit = (Total registered frequencies/n x 5) x100

Table 3: Sale returns of Mmupudu fruits from five stations per market (n = 50)

Market	Packages sold @ R3.00 per 500 g package per station[x]					Total sold per market	% sold per market[y]
	1	2	3	4	5		
Lebowakgomo	10	10	8	10	10	48	96%
Nebo	10	8	10	10	9	47	94%
Practiseer	10	10	10	10	10	50	100%
Pietersburg	10	10	9	10	10	49	98%
Total sold per station	40	38	37	40	39	194	97%
% sold per station	100%	95%	92.5%	100%	97.5%	-	-

[x]*Station: 1 = magistrate court, 2 = police station, 3 = shopping mall, 4 = bus/taxi rank, and 5 = filling station.*
[Y] *% sold per market = (Total sold per market/n) x 100.*
[X] *% sold per station = (Total sold per station/40) x 100.*

for us "from elsewhere". Nurseries without seedlings cited either "sold out", "propagation" or "slow growth rates" as reasons for not having seedlings. Seedlings were available at an average price of R22.00 (range R18.00 - R35.00), depending on the length of the plant. In May 2000, Kanniedood Nursery in Naboomspruit was selling 0.1 m and 1.1 m long seedlings at R21.00 and R79.00, respectively. The nurserymen indicated that the seedlings were expensive because they were difficult to raise due to their slow growth rates or cited high demands for the plant as an aesthetic evergreen plant. Also, they indicated that to by - pass slow growth rates of seedlings, seedlings had to be "hunted" on dense mountainous hillsides, dug, planted in small plastic bags and then tendered for several years before reaching marketable sizes. Producing commercial seedlings using the latter technique is not recommended because the seedlings are almost always infected with rhizosphere pathogens, such as nematodes, bacteria and fungi.

5. OTHER ATTRIBUTES OF THE INDIGENOUS FRUIT TREE - MMUPUDU

Literature was reviewed to determine the distribution of Mmupudu in Africa, and to determine its nutritive value and natural habitat, in order to evaluate the suitability of the tree in ameliorating the malnutrition problems and its adaptability to marginal environmental conditions of the rural districts of the Northern Province.

5.1 Nutritive potential benefits

Compared with most indigenous and certain exotic fruits, Mmupudu fruits are not astringent - an important quality for fresh fruits. Also, compared with all exotic and indigenous fruit trees, Mmupudu fruits have the highest vitamin C content, ranging from 50 to 80 milligram per gram fresh fruit (Venter & Venter, 1996:234). Guava, an exotic fruit which had been rated as having the highest vitamin C content, has 20 milligram vitamin C per gram fresh fruit.

5.2 Ecological potential benefits

The distribution of Mmupudu starts from Tanzania in the north to KwaZulu - Natal in the south (Venter & Venter, 1996:234). The natural habitat of this tree in the Northern Province includes mountainous cliffs, rocky hillsides and tributary fringes, which are inherently marginal in soil depth, total available moisture and light intensity. Due to inherently marginal conditions in its natural habitat, Mmupudu evolved a non - aggressive lateral root system, hairy young shoots, dark green glossy leaves and a dense crown (Venter & Venter, 1996:234), which are important adaptation attributes. Mmupudu is also believed to be genetically adapted to growing under low and high light intensities, although the mechanism involved remains unknown.

Initial greenhouse observations in our studies suggested that Mmupudu has lower rates of crown growth when compared to those of root growth. The slower crown growth when compared to the faster root growth is a common physiological investment factor associated with drought - tolerant plant species (Krieg, 1983:382). Thus, Mmupudu appears to possess unique attributes for drought tolerance and adaptation to marginal environments, which are dominant in locations where most of the rural communities were historically settled. The non - aggressive lateral root systems and its evergreen characteristics make this plant a suitable candidate for use in home gardens and public amenities and institutions such as parks, golf courses, schools, hospitals and churches, where it will promote the rural and urban greening policies. Also, its evergreen crown and slow growth rates, make it an ideal street tree, requiring minimal cultural practices.

6. CONCLUSIONS

Ninety-five percent smallholder farmers in the Northern Province top - rated Mmupudu as the most suitable indigenous tree for domestication and commercialisation. The evergreen and drought - tolerant Mmupudu trees are adapted to conditions that prevail in most rural areas. Compared to most

commercial exotic fruits that are grown in the province, Mmupudu fruits contain the highest vitamin C content per gram fresh fruit. Thus, this fruit would alleviate vitamin C malnutrition among the rural communities. A number of farmers were willing to purchase and plant Mmupudu seedlings in their home gardens or fields. Fruit marketing surveys outside the rural areas showed that fruits of this tree were marketable in urban areas. Sufficient indicators suggest that Mmupudu has enormous economic, nutritional and environmental benefits for the rural communities of the Northern Province through sales of seedlings and / or fruits, serving as source for vitamin C and combating land degradation. However, further research is still necessary to establish the sustainability of Mmupudu tree as a commercial fruit tree. Topics that should be considered include:

- mass propagation of seedlings through asexual techniques,
- genetic characterisation of Mmupudu within the province,
- soil, nutrient and climatic requirements,
- phyllosphere and rhizosphere pests,
- productivity,
- post-harvest physiology,
- nutritive value of fruits,
- economic benefits of fruits and seedlings, and
- increasing fruit size.

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ANNEXURE A: Survey form for the selection of top - rated indigenous fruit trees

Region:_____

Village:_____

A. Important indigenous fruit trees in your region: 1. Mmilo (*Vangueria infausta*), **2.** Mmola (*Parinari curatellifolia*), **3.** Mmupudu (*Mimusops zeyheri*), **4.** Mokongono (*Garcinia livingstoni*), **5.** Morotologa (*Ximenia caffra*), **6.** Morula (*Sclerocarya birrea*), **7.** Motoro (*Opuntia spp.*).

B. Question: Among the listed fruits in A above, which three fruits are the most important to you when eaten in fresh form? (Write the corresponding number of the fruit in the provided space).
a. 1st most important: /____/ b. 2nd most important: /____/ c. 3rd most important: /____/

C. Question: Among the listed fruits in A above, which three fruits are the most important to you when eaten in beverage form? (Write the corresponding number of the fruit in the provided space).
a. 1st most important: /____/ b. 2nd most important: /____/ c. 3rd most important: /____/

D: Question: Would you be willing to buy and plant seedlings in your home garden or field for the fruit tree you listed as (Make an X near your answer):
a. 1st most important in B above? Yes: /_____/ No: /____/ Don't know: /____/
b. 2nd most important in B above? Yes: /____/ No: /____/ Don't know: /____/
c. 1st most important in C above? Yes: /____/ No: /____/ Don't know: /____/
d. 2nd most important in C above? Yes: /____/ No: /____/ Don't know: /____/

For your 1st most important fruit in (a) if you made an X at No., give reasons why you are not prepared to buy and plant your top rated fruit tree (**If your answer is YES, do not give reasons, but go to E below**).
1. _____
2. _____
3. _____

For your 1st most important fruit in (c) if you made an X at No., give reasons why you are not prepared to buy and plant your top rated beverage fruit tree (**If your answer is YES, do not give reasons, but go to E below**).
1. _____
2. _____
3. _____

E: Question: Why are you not planting your 1st most important fruit tree in D (a) above? Put an X near your reason (Remember, it is allowed to cross more than one reason).
a. It is taboo in my culture to plant this tree: /____/
b. Lack of information on cultivation: /____/
c. Lack of nursery stock: /____/
d. No need because these fruit trees are many in nature: /____/
e. No information on whether people will buy its fruits: /____/
f. Other reasons (Please write it down): _____
_____

F: Question: How many hectares of your own land would you be willing to use for planting your most important fruit tree in D (a) above in your (a) Home garden: /____/ Ha; (b) Field: /____/ Ha.

Your ID:_____ Your signature: _____