The homegarden agroforestry system of Bukoba district, North-Western Tanzania. 2. Constraints to farm productivity

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Key words: homegarden, Musa spp., Coffea canephora, farm productivity

Abstract. A questionnaire survey was conducted among 72 randomly selected households in Bukoba district, Tanzania from August to November 1991. The objective of the study was to identify the major constraints to increased productivity in homegardens and farmers response to these constraints. Declining of homegarden productivity seems to have been influenced by the gradual decline of soil fertility mainly as a result of decrease in cattle population, the serious outbreak of banana weevils, nematodes and later Panama disease, fragmentation of homegardens due to population growth and lack of cash. As a result, homegardens can no longer subsist farm families for the most part of the year. The actual decline in banana yield is 66% over the last 20 years. Incomes are too low to support modest investment to improve productivity in homegardens. Farmers' responses to these problems have been out-migration, a shift towards cultivation of root crops, planting of beer banana and decrease in homegarden management intensity. These responses however are likely to offer only short term and partial solutions.

Introduction

Homegardens are widely distributed throughout the world and have been extensively documented [Soemarwoto, 1987; Fernandes et al., 1984]. Characteristically homegardens are largely for subsistence and they represent a risk-spreading farming system [Oduol and Aluma, 1990]. Homegarden agroforestry was already well established in Bukoba in the late 19th century [Hyden, 1969]. The cultivation of homegardens has since been the dominant agricultural system in the district. The most important food crop in this system is banana (Musa spp.), while the most important cash crop is coffee (Coffea robusta). Various constraints afflicting the homegarden farming system in Bukoba have attracted attention of researchers of various backgrounds and are widely documented [Friedrich, 1968; Milne, 1938; Smith, 1987; Tibaijuka, 1984]. Poor soils has always been pointed out as a major constraint [Milne, 1938; Moberg, 1972; Kabwoto, 1976; Mkamba, 1986].

Banana pests became serious in the seventies and are reputed to have caused a tremendous loss of yield of banana [Tibaijuka, 1984; Maruku, 1980]. Population pressures and fragmentation of homegardens has led to uneco-
nomically small farms and caused out-migration [Royal Tropical Institute, 1989; Smith, 1987].

Materials and methods

Two wards, namely Karabagaine and Maruku in Kyamtwara division were selected for the study. Three villages from each ward were selected at random. In Karabagaine ward the villages selected were; Nsisha, Kangabusharo and Kiziri, whereas in Maruku ward Kasho, Nyabukazi and Bujogero villages were selected. A list of households for each village was obtained from the respective village government offices. Twelve households per village were randomly selected for the survey. A preliminary draft of the questionnaire was pre-tested on fifteen households in July 1991. The household survey was conducted from mid-August to early November 1991.

Secondary data was obtained from informal interviews with researchers at Maruku Agricultural Research Institute, village extension workers in the study area, subject matter specialists at Bukoba District Agricultural Office, and the representative of the Tanzania/Netherlands Farming Systems Project at Bukoba. In addition, literature on the study area was obtained through publications and unpublished reports available at Maruku and at the National Agricultural Library, Sokone University of Agriculture (SUA), Morogoro.

Qualitative data were analysed by statistical measures of central tendency (means, median), statistical measures of dispersion (range, standard deviation) and percentages.

Quantitative data were analysed by the use of linear regression. Both simple and multiple linear regression models were used to predict the relationship between homegarden productivity (dependent variable) and its predictor variables. Regression models were designed as follows:

Simple linear regression:  
\[ Y = a + b x_1; \quad Y = a + b x_2; \quad Y = a + b x_3; \quad Y = a + b x_4. \]

Multiple linear regression:  
\[ Y = a + b x_1 + b x_2 + b x_3 + b x_4 + e, \]

where

- \( Y \) = homegarden productivity (for banana and/or coffee)
- \( x_1 \) = amount of hired labour (number of labourers hired per year)
- \( x_2 \) = homegarden size (hectares)
- \( x_3 \) = household size (number of people per household)
- \( x_4 \) = cattle number (hence manure)

A one-way analysis of variance (ANOVA) was used to analyse the reported data on present and past yield levels of banana. Only the banana crop yield could be subjected to ANOVA because farmers were able to recall previous yields. The analysis was designed to test the difference between the two means. The zero hypothesis was that the current yield level was equal to the yield level in the 1960s, while the alternative hypothesis stated that the two yield levels were different.

Productivity of homegardens

The study revealed that an average kg of coffee, 105 bunches of banana, cassava, taro, yams, and other minor into per hectare basis, a one hectare 135 kg of coffee, 175 bunches of Homegardens in which cattle manure the mean yield per hectare was 320 272 kg of beans. Since cattle manure percentage of farmers, average output not applied were taken as the most.

It was found that the average be bunches per hectare per year whereas. This represents a 66% decline in pr 20 years.

A one way analysis of variance significant difference between the and the mean yield of the same (c 0.0000).

According to Schuler (1984) th equivalent (M.E.), i.e. one adult p obtain this daily calorie requirem banana per day (1 kg of banana pi family reported in this study and a elderly, a family of 5.22 persons i annual banana requirement for the f per year equivalent to about 204 bunches per hectare is therefore not alone income generation.

A study by Moody (1970) indica was 3,363.3 kg/ha/year, and coffee assumed to weigh 15 kg [Acland, 1 garden was 224 bunches per year.

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The above analysis agrees with gardens has significantly declined constraints. Banana is the staple ad district. Under present situation o few households will be able to sult

In this study only about 20% homegardens could sustain them feeling was that there is a shift to crops which are cultivated on th gardens. Increased dependency on
Productivity of homegardens

The study revealed that an average homegarden of 0.6 ha produces about 81 kg of coffee, 105 bunches of banana and 120 kg of beans per year. Data for cassava, taro, yams, and other minor crops could not be obtained. If converted into per hectare basis, a one hectare homegarden would therefore produce 135 kg of coffee, 175 bunches of banana and 200 kg of beans per year. Homegardens in which cattle manure is applied were found more productive, the mean yield per hectare was 320 bunches of banana, 264 kg of coffee and 272 kg of beans. Since cattle manure application is limited to only a small percentage of farmers, average output from homegardens in which manure is not applied were taken as the most representative.

It was found that the average banana output in the past (1960s) was 514 bunches per hectare per year whereas at present the mean yield is 175 bunches. This represents a 66% decline in production of banana over a period of about 20 years.

A one way analysis of variance (ANOVA) revealed that there is a highly significant difference between the mean yield of banana some 20 years ago and the mean yield of the same crop at present (calculated F value = 52; p = 0.0000).

According to Schuler (1984) the daily calorie requirements of one man equivalent (M.E.), i.e. one adult person (15–55 years), is 2500 calories. To obtain this daily calorie requirement, an adult person has to eat 2.1 kg of banana per day (1 kg of banana provides 1200 calories). Taking an average family reported in this study and assuming that because of children and the elderly, a family of 5.22 persons is equal to 4 man equivalents (M.E.), the annual banana requirement for the family is 4 × 2.1 × 365 = 3066 kg of banana per year equivalent to about 204 bunches. The present production of 175 bunches per hectare is therefore not sufficient for family subsistence needs let alone income generation.

A study by Moody (1970) indicates that banana production in Bukoba then was 3,363.3 kg/ha/year, and coffee was 235 kg/ha/year. If a banana bunch is assumed to weigh 15 kg [Acland, 1971]; then the yield per hectare of a homegarden was 224 bunches per year. Even though the 1970 study was done on a smaller sample (n = 23), the decrease in crop yields is evident.

The above analysis agrees with the hypothesis that production in homegardens has significantly declined over the last two decades due to various constraints. Banana is the staple and the most cherished food crop in Bukoba district. Under present situation of declining homegarden productivity very few households will be able to subsist on their homegardens in the long run.

In this study only about 20% of respondent households felt that their homegardens could sustain them for most part of the year but the general feeling was that there is a shift towards other food crops, particularly root crops which are cultivated on the grasslands and on the edges of homegardens. Increased dependency on root crop will lead to short fallow period
in the grassland and consequently to poor yield and probably land degradation. It will also lead to decrease in grazing land.

A simple linear regression of homegarden productivity with each of four predictor variables (size of homegarden, heads of cattle per household, hired labour, size of the household) showed that cattle keeping accounts for 71.2% of the variation in banana production and 84.8% of the variation in coffee production (Table 1). This confirms that cattle keeping and hence manure, is a necessary input in homegardens and that homegardens in which manure is applied are more productive than those without manure. Other variables were found to account for a smaller percentage of variation except hired labour which accounted for 65.6% of variation in coffee production but accounted for a mere 39.2% of the variation in banana production. A multiple linear regression showed that the four predictor variables accounted for 71.7% and 86.1% of the variation in banana and coffee production respectively. Results of both simple and multiple linear regression are summarised in Table 1.

**Table 1. Homegarden productivity as a function of four predictor variables.**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Predictor</th>
<th>$R^2$ (%)</th>
<th>t-ratio$^a$</th>
<th>$p^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
<td>Hired labour</td>
<td>39.2</td>
<td>6.84**</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Homegarden size</td>
<td>7.7</td>
<td>2.62*</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>Household size</td>
<td>0.0</td>
<td>0.79</td>
<td>0.432</td>
</tr>
<tr>
<td></td>
<td>Cattle number</td>
<td>71.2</td>
<td>13.30**</td>
<td>0.000</td>
</tr>
<tr>
<td>Coffee</td>
<td>Hired labour</td>
<td>65.6</td>
<td>11.68**</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Homegarden size</td>
<td>1.9</td>
<td>1.54</td>
<td>0.127</td>
</tr>
<tr>
<td></td>
<td>Household size</td>
<td>1.7</td>
<td>1.48</td>
<td>0.143</td>
</tr>
<tr>
<td></td>
<td>Cattle number</td>
<td>84.8</td>
<td>19.95**</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Table 2. Constraints underlying production.**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
<td>Banana weevil</td>
</tr>
<tr>
<td></td>
<td>Nematodes</td>
</tr>
<tr>
<td></td>
<td>Land scarcity</td>
</tr>
<tr>
<td></td>
<td>Labour scarcity</td>
</tr>
<tr>
<td></td>
<td>Lack of manure</td>
</tr>
<tr>
<td></td>
<td>Poor soil fertility</td>
</tr>
<tr>
<td></td>
<td>Panama disease</td>
</tr>
<tr>
<td>Coffee</td>
<td>Pests/diseases$^a$</td>
</tr>
<tr>
<td></td>
<td>Low producer price</td>
</tr>
<tr>
<td></td>
<td>Lack of inputs$^b$</td>
</tr>
<tr>
<td></td>
<td>Land scarcity</td>
</tr>
<tr>
<td></td>
<td>Labour scarcity</td>
</tr>
<tr>
<td>Cattle$^c$</td>
<td>Diseases$^a$</td>
</tr>
<tr>
<td></td>
<td>Lack of vet.serviced</td>
</tr>
<tr>
<td></td>
<td>Lack of labour</td>
</tr>
</tbody>
</table>

$^a$ Output of a t-test on the zero hypothesis that the regression coefficient is zero, that is, that the predictor has no impact on the output of bananas and coffee, respectively.

$^b$ Significant at 95%.

$^c$ Significant at 99%.

**Constraints underlying production.**

Critical constraints limiting production mainly the two principal crops (Banana and Coffee) as summarised in Table 2.

**Banana**

It is clear from Table 2 that banana growers face most pressing problem of banana weevil (C. destructor), which attacks banana plants by feeding and weaken the plants. Fruit quality falls down unless it is promptly yellowish.

Old farmers attributed the outbreak of the sunflower crop (Helianthus annuus) to the banana weevil. They claimed that the weevils were part of the natural life cycle and thus resisted. As a result, the weevil population increased and caused serious crop damage.

Banana weevil is seldom a severe pest in managed farms [Acland, 1971], and neglected farms. The serious in the mid 1970s could be attrit.
and probably land degradation.

Productivity with each of four cattle per household, hired keeping accounts for 71.2% of the variation in coffee growing and hence manure, is gardens in which manure is analogous. Other variables were variation except hired labour production but accounted production. A multiple linear is accounted for 71.7% and production respectively. Results summarised in Table 1.

<table>
<thead>
<tr>
<th>t-ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.84**</td>
<td>0.000</td>
</tr>
<tr>
<td>2.62*</td>
<td>0.011</td>
</tr>
<tr>
<td>0.79</td>
<td>0.432</td>
</tr>
<tr>
<td>15.39*</td>
<td>0.000</td>
</tr>
<tr>
<td>11.68**</td>
<td>0.000</td>
</tr>
<tr>
<td>1.54</td>
<td>0.127</td>
</tr>
<tr>
<td>1.48</td>
<td>0.143</td>
</tr>
<tr>
<td>19.95**</td>
<td>0.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>t-ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.90</td>
<td>0.372</td>
</tr>
<tr>
<td>1.76</td>
<td>0.082</td>
</tr>
<tr>
<td>0.05</td>
<td>0.957</td>
</tr>
<tr>
<td>8.41**</td>
<td>0.000</td>
</tr>
<tr>
<td>2.75**</td>
<td>0.000</td>
</tr>
<tr>
<td>-0.16</td>
<td>0.869</td>
</tr>
<tr>
<td>0.85</td>
<td>0.398</td>
</tr>
<tr>
<td>10.13**</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The coefficient is zero, that is, that coffee, respectively.

**Constraints underlying productivity in homegardens**

Critical constraints limiting productivity in homegardens were found to affect mainly the two principal crops (banana and coffee) and the livestock component (cattle) as summarised in Table 2.

**Banana**

It is clear from Table 2 that banana weevil is perceived by the farmers as the most pressing problem of banana production in Bukoba district. Weevils damage banana plants by feeding on the banana stem, they tunnel the stems and weaken the plants. Fruit quality is reduced, and the banana stool eventually falls down unless it is propped.

Old farmers attributed the outbreak of banana weevil to the introduction of the sunflower crop (*Helianthus annuus*) during the British colonial period. They claimed that the weevils were first seen on sunflowers. Sunflower adoption was thus resisted and it is not grown in Bukoba today. It may be of great interest to researchers to validate or invalidate the farmers' claim.

Banana weevil is seldom a serious problem on fertile soils and in well managed farms [Acland, 1971]. It is however, a serious threat on infertile and neglected farms. The serious outbreak of banana weevil in Bukoba district in the mid 1970s could be attributed to the gradual decline of soil fertility.

**Table 2.** Constraints underlying productivity in homegardens. Frequency of mention in a questionnaire survey.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Constraint</th>
<th>Frequency (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
<td>Banana weevil</td>
<td>88</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Nematodes</td>
<td>31</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Land scarcity</td>
<td>64</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Labour scarcity</td>
<td>47</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Lack of manure</td>
<td>71</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Poor soil fertility</td>
<td>82</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Panama disease</td>
<td>72</td>
<td>52</td>
</tr>
<tr>
<td>Coffee</td>
<td>Peats/diseases&lt;sup&gt;a&lt;/sup&gt;</td>
<td>29</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Low producer prices</td>
<td>53</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Lack of inputs&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Land scarcity</td>
<td>69</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Labour scarcity</td>
<td>50</td>
<td>36</td>
</tr>
<tr>
<td>Cattle</td>
<td>Diseases&lt;sup&gt;c&lt;/sup&gt;</td>
<td>38</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Lack of vet.services</td>
<td>67</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Lack of labour</td>
<td>42</td>
<td>5</td>
</tr>
</tbody>
</table>

<sup>a</sup> Unspecified.

<sup>b</sup> Includes sprayers and chemical inputs.

<sup>c</sup> The respondents included only those who had cattle.
over the years after the rinderpest epidemic. The same explanation might be
given for the outbreak of nematodes.

Nematodes, though equally devastating, were not considered as a problem
by majority of farmers. This is probably due to the fact that nematodes are
microscopic, it is therefore difficult for farmers to point out nematodes (which
they have never seen) as a threat to the banana crop. It is also possible that
farmers can not differentiate crop damage due to nematodes from that caused
by weevils. Nematodes destroy the banana crop through the root system. They
burrow, feed and reproduce inside the roots, eventually the corm rots away.
Like in weevil damage, banana plants damaged by nematodes usually fall
down unless propped.

Panama disease caused by Fusarium oxysporum f. sp. cubense was reported
to be a relatively new problem but fast spreading in Bukoba district. Whereas
cooking banana have considerable resistance, beer banana especially Jamaica
sweet is very susceptible to Panama disease [Valmayor, 1990]. Panama disease
destroys the crop by attacking the leaves which eventually dry.

Lack of manure and poor soil fertility are closely related. Farmers also
perceive low soil fertility as a major constraint in both coffee and banana
production (Table 2). Low soil fertility in Bukoba district is partly due to the
soil parent material. Permanent cropping, lack of constant replenishment
of soil nutrients through manuring and leaching due to heavy rains also
contributed to low fertility.

Coffee

The major problems of coffee were found to be scarcity of land, low producer
prices and scarcity of labour. The fact that Tanzanian farmers are usually
paid unrealistically low producer prices is well known and it has been widely
documented [Lele, 1984; Coulson, 1982]. As a result of being underpaid,
farmers have no incentive to invest in coffee production. Visual assessment
of most sample homegards during the survey indicated that coffee trees
were bushy and old. Tibajjuka [1984] observed a similar trend and reported
that about 30% of coffee trees are too old to be productive. The logical implica-
tion is that the coffee output in Bukoba is either stagnant or declining. Most
of the respondents claimed that the coffee production in homegardens is
declining. The coffee industry in Bukoba district has faced booms and depres-
sions over the last century. Farmers respond to increases in price by producing
more coffee and vice-versa [Smith, 1987, 1989]. In the 1991 crop buying
season farmers were paid 50 shillings per kilogram of dried, unhulled coffee
which is only 10% of the world market price. Under the present state of the
economy of Tanzania, annual earnings from coffee cannot subsist an average
household for a month. In this case farmers find no incentive to produce more
coffee.

Scarcity of land as a constraint to coffee production in Bukoba may be
explained by continued fragmentation of homegardens due to population
pressure and the decline in prod-
such a situation the basic priority
for the household.

Only about 30% of the respet
factors to coffee production. Gen
from few pest and disease attack

Cattle

Table 2 shows that respondents
lack of veterinary services, prev
Only three out of twelve cattle
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loss (30%), high sterility among
common constraints to cattle kee
lence of these constraints may a
low. Improving veterinary service
Except for manure, the productiv
A milking cow produced, on a
respondents asserted that the pri
milk or meat.

Farmers’ responses to constra

Farmer’s response to a host of
tivity varied greatly depending
disposal. However, no respond
to improve homegarden product

Pest and disease control

With respect to banana, 68% of
of pest control, mainly trapping
with village extension workers a
prescribed by extension agents
banana pseudo stems and cover
were not doing anything substas
for panama disease or nematode

Out-migration

Out-migration has been a way
of Bukoba district over the dec
The same explanation might be not considered as a problem the fact that nematodes are point out nematodes (which crop. It is also possible that nematodes from that caused through the root system. They eventually the corn rots away, killed by nematodes usually fall

Con f. sp. cubense was reported in Bukoba district. Whereas for banana especially Jamaica ayor, 1990]. Panama disease is closely related. Farmers also in both coffee and banana a district is partly due to the of constant replenishment ing due to heavy rains also

Acracy of land, low producers are usually own and it has been widely result of being underpaid, production. Visual assessment indicated that coffee trees similar trend and report productive. The logical impli- stagnant or declining. Most luction in homegardens is as faced booms and depress- seases in price by producing . In the 1991 crop buying n of dried, unhulled coffee under the present state of the e cannot exist an average incentive to produce more

luction in Bukoba may be gardens due to population pressure and the decline in production of banana for food in the district. In such a situation the basic priority of a farm family is to produce enough food for the household.

Only about 30% of the respondents cited pests and disease as limiting factors to coffee production. Generally Coffea canephora var. robusta suffers from few pest and disease attacks [Acland, 1971].

Cattle

Table 2 shows that respondents felt that the most pressing constraints were lack of veterinary services, prevalence of cattle disease and lack of labour. Only three out of twelve cattle keeping farmers reported to have a regular contact with livestock and veterinary extension staff. Previous studies have indicated that long calving interval (approximately 25.5 months), high weaning loss (30%), high sterility among cows and poor husbandry of cattle are also common constraints to cattle keeping in Bukoba [Friedrich, 1968]. The prevalence of these constraints may explain why cattle population has remained low. Improving veterinary services could reduce the problem of cattle diseases. Except for manure, the productivity of cattle in the study area was very small. A milking cow produced, on average, half a litre per day. Cattle keeping respondents asserted that the prime motive for keeping cattle is manure, not milk or meat.

Farmers’ responses to constraints

Farmer’s response to a host of constraints underlying homegarden produc- tivity varied greatly depending on the resource endowments at his or her disposal. However, no respondent reported to be taking any serious measures to improve homegarden productivity.

Pest and disease control

With respect to banana, 68% of the respondents practised cultural methods of pest control, mainly trapping the weevil. Only about 10% were in contact with village extension workers and these were trying weevil control measures prescribed by extension agents. These measures were chopping up of old banana pseudo stems and covering the corns with earth. The remaining 22% were not doing anything substantial to control weevils. No control measures for Panama disease or nematodes were mentioned by the farmers.

Out-migration

Out-migration has been a way of life for people in densely populated parts of Bukoba district over the decades [Royal Tropical Institute, 1989; Smith,
1987]. Under current situation of land shortage and decline in homegarden productivity, people have been migrating to other parts of the district, particularly the south-western part (Katerelo and Rubale divisions) and also other parts of Kagera region, particularly Karagwe district where there is still some room for expansion and where banana weevil and nematode infestation is minimal. The other destination of migrants is the urban centres of Tanzania, this is particularly common among the youth. It is highly debatable if out-migration is a panacea for the problems confronting farmers in Bukoba district. Whereas migration to urban areas directly affects farm labour supply, migration to other rural areas within the region amounts to exporting problems to new areas. First, migrants take young banana stools with them to plant in new plots and in so doing they unconsciously spread crop diseases, banana weevils and nematodes. Second, the supply of arable land is limited. With increasing population, the land is increasingly becoming scarce. This will lead to cultivation of marginal land which is infertile and more prone to degradation.

Growing of beer banana

The growing of beer banana as a response particularly to the onslaught of banana weevil in Bukoba district has been prompted partly by the fact that beer banana is less susceptible to weevil damage. Beer banana is also grown as an alternative to coffee as cash crop. This supports the results of this survey, which indicates that sale of banana beer and beer banana has become an important source of household income. Beer banana varieties are unfortunately susceptible to Panama disease. Planting of beer banana may therefore not be a viable solution. Moreover, since beer banana is normally not eaten, food supply at household level is likely to be severely affected by increasingly planting beer banana in homegardens.

Dependency on root crops

The destruction of cooking banana by weevils and nematodes has resulted in shortage of the most cherished food in Bukoba and therefore more dependency on minor crops (cassava, yams, taro, and sweet potatoes). Since cultivation of these crops is traditionally a woman’s responsibility, over-dependence on root crops and grains will mean more workload to women. Since cultivation of root crops dictates a high degree of crop rotation and/or long fallow periods, it is unlikely that the shift to root crops can be successful in Bukoba.

Neglect of homegardens

Because of the need to have alternative sources of livelihood and also due to migration an increasing number of homegardens are being neglected.

Neglected homegardens are beseeged. The constraints underlying prod
Fig. 1. The cause and effect model

Conclusion

Productivity of the homegarden last couple of decades. The reas

Acknowledgements

Comments from Professor A. J an earlier draft have been extre
Neglected homegardens are breeding places for banana weevil and nematodes. The constraints underlying productivity in homegardens can be summarised in a cause and effect model as shown in Fig. 1.

![Cause and effect model of reduced productivity in homegardens of Bukoba](image)

**Fig. 1.** The cause and effect model of reduced productivity in homegardens of Bukoba.

### Conclusion

Productivity of the homegardens in Bukoba has dropped drastically over the last couple of decades. The reasons for the decline in productivity are complex, and somewhat interrelated, but the overall most important reason seems to be lack of animal manure. So far, no sufficient steps have been taken to halt this negative trend and restore the homegardens as a sustainable production system.

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Hill agroforestry systems

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Key words: Sikkim, Manalay, watershed, nutrients, merits, constraints

Abstract. In the Manalay watershed of Sikkim, there has been a loss of land for the community. The agricultural and animal husbandry besides growing land, and the population grew. The farms mainly focus on altitudes cultivation of cereals and cash crops. This paper presents data on the linkages among tree-crop-animal systems. The high and crop combinations are fixed, mostly with cow dung and recycling of by-products. The system is the poorest section of the society. Limited to most agricultural zone, depletion of soil quality and heavy rainfall during need to be improved through research.

1. Introduction

Land-use systems in the Himalayan region, horticulture, agroforestry are interdependent and play a critical role. Most of the farming systems are rain-fed and depend on rainfall. Oberholzer, Misra and Raja (1991) and Shah, 1982; Sharma, 1980 and Ramakrishnan, 1981) and by the farmers to meet their daily needs. There are a number of excellent studies on the subject. The system is based on a watershed of 80% is engaged in agriculture, the inventory of the crops, trees at the watershed; (ii) analyse the kinds of crops; (iii) record fuel...