Shade Trees in Organic Coffee Production

Dechasa Jiru

Research Report No 56

Ethiopian Agricultural Research Organization
Acknowledgements

I appreciate the collaboration and assistance of Yiheyis, Alemstay, Alemayehu, and the driver, MoA staff at Jima and Seka, Yohanis Tilahun in statistical analysis and my family who are always by my side. I am grateful to Abebe Kirub, for his continuous encouragement and help. I am indebted to EARO Information and Communications Department staff, for all the assistance in the final production of this publication. Abera Tola, OXFAM America, for the initiation, and all others whose names have not been listed in this document are greatly acknowledged. I am also indebted to Dr Taddesse Woldemariam for his technical inputs. Last but not list I thank the farmers at Seka and near Agaro who contributed a lot for the development of this document.
Introduction

Coffee originated in the highland forest areas of Southwest Ethiopia. It is the nucleus of the Ethiopian economy accounting 60% of the country’s export. About 1.2 million coffee farmers with their 15 million households directly or indirectly depend on coffee for their livelihoods (Oxfam International 2002). At a national level, coffee production system is classified into three: forest coffee, cottage coffee and plantation coffee (Meseret 2002). On the other hand, Demel (1999) divided the system into four: forest coffee, semi-forest coffee, garden coffee (which had previously been called cottage coffee) and plantation coffee.

Forest coffee, in contrast to home garden coffee, is collected from natural forests where chemical inputs like herbicide, pesticide, fungicide and inorganic fertilizers are not used as agricultural inputs. Much of the coffee produced in Ethiopia is from forest coffee. According to Demel (1999) the total area under coffee production is 0.4 million hectares; 95 % of the total production comes from
subsistence farmers who have neither the capacity nor the access to use agricultural inputs.

The focus of this survey was on potential shad tree species for intercropping at home garden level in Seka Chekorsa based on farmers' interview.

Yield and quality were the most important points that the farmers were interviewed for and the focus areas of this study in relation to shade tree intercropping. According to Wondimu et al. (2002), factors that determine coffee quality are numerous, involving humans and nature. Altitude, duration and intensity of precipitation, soil type, PH and color, genetic origin, geographical location of the producing region, agricultural practice, chemical and pesticide application, harvesting method and timing, processing technique, drying, grading, packing, transporting, all contribute to either the exaltation or deterioration of coffee quality. Yilma (2002), shares some of these problems, under a general classification as coffee ecology, rainfall, temperature and altitude. They agree that organic coffee is a quality coffee under optimum environmental conditions.
In the face of current coffee market crisis, producing organic coffee is an alternative since it has high market price. There has been a long time traditional knowledge in growing and managing the plant around Jima. The study area at which this paper is based is a multi-storey home garden in Seka Chekorsa where organic coffee has a major economic and social importance. Naturally, coffee is grown under forest shade and it is known to be shade loving. Accordingly, the objective of this study was to identify potential shade tree species that have the highest complementary production relation in yield and quality
Methodology

The survey was conducted at Seka Chokorsa, which is located 30 km south and west of Jima, near Agaro. Information on the uses of shade trees for coffee shading was collected based on the complementary advantages of the shade trees in production and quality. This information, which is based on multi-storey home garden, was the perspective of farmers who keep on planting coffee trees under shade trees.

Key informants who practiced home garden coffee for a long time were grouped and interviewed based on the criteria on which they select the tree as a shade tree. The criteria used were appropriateness as a shade tree, its role in nutrient input, role in soil conservation, role in coffee quality (taste), and production sustainability and environmental impact.

Farmers identified the factors, which they considered as main. Other factors were combined factors that contribute to coffee production and
quality. The main factors used in traditional coffee shade tree selection criteria were cumulative factors of the detailed or interrelated factors. For example, under the main factor shade, reduced light, high temperature and wind were some of the detailed factors. Shade has also impacts on soil conservation since the shade tree leaves slow down the flow speed of water and thereby increase infiltration. Low canopy height casts more shade under the main factor shade; the same character allows leaves to fall and accumulate near the stump of the shade tree.
Results and Discussion

According to the farmers interviewed there are several tree species used for coffee shading. The most suitable ones are, according to the farmers, *Acacia species* and *Albizia gummifera*.

Farmers expressed that the structural growth habit, phenology and functional relation of the plant with the environment made the two plants (*Acacia* sp. and *Albizia gummifera*) be opted and superiorly ranked to the other tree species in production cycles of coffee.

Among coffee shade trees, *Cordia africana* was the fourth choice of farmers in the survey area. However, the tree was the most abundant one. Farmers keep the tree for its high timber value.

The following major factors, as a function of quality and quantity, were considered in evaluating the coffee shade tree species in the farmers’ fields.
Height
Height of both species is suitable to coffee compared to height of other tree species like *Albizia schemperiana*, which is very tall and its drips from its canopy causes severe erosion and mechanical damage to the plant.

Spread
Circular and dome-shaped, umbrella like, irregularity low trees are preferred canopy shapes in shade trees.

Density
Based on farmers’ information, the canopy of *Acacia* species, with optimum density, casts enough shade while allowing enough light to pass through with uniform porosity of the canopy. Thus, it casts optimum amount of shade uniformly (Table 1).
Table 1. Comparative light intensity under canopies and in the open area (by camera light meter)

<table>
<thead>
<tr>
<th>North</th>
<th>N5</th>
<th>N4</th>
<th>N3</th>
<th>N2</th>
<th>N1</th>
<th>Shade tree trunk position</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>5000</td>
<td>3750</td>
<td>2500</td>
<td>2250</td>
<td>1750</td>
<td>0</td>
<td>1125</td>
<td>1750</td>
<td>2500</td>
<td>3750</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1000</td>
<td>750</td>
<td>500</td>
<td>450</td>
<td>350</td>
<td>0</td>
<td>225</td>
<td>350</td>
<td>500</td>
<td>750</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>East</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E1</td>
<td>W1</td>
<td>W2</td>
<td>W3</td>
<td>W4</td>
<td>W5</td>
<td>West</td>
</tr>
<tr>
<td>Total</td>
<td>5000</td>
<td>3750</td>
<td>2500</td>
<td>1750</td>
<td>1240</td>
<td>0</td>
<td>1625</td>
<td>2000</td>
<td>2500</td>
<td>3750</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1000</td>
<td>750</td>
<td>500</td>
<td>350</td>
<td>248</td>
<td>0</td>
<td>325</td>
<td>400</td>
<td>500</td>
<td>750</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>
The farmers said that its feathery leaves obstruct strong light and pass the required amount of light. The spread of the branches and shape are naturally designed with a shape of an umbrella.

**Leaf Shed Time and Sustainability**

*Acacia* spp retains more leaves and provides better shade in dry season than *Albizia gummifera*. However, *A. gummifera* completely shades leaves and thus relatively increases nutrient input. Both species harbors nitrogen-fixing bacteria; thus, N input is high. Since any plant accumulates the most important elements in its leaves, shedding serves the function of recycling these nutrients. Thus, phosphorous and other major and minor elements can be supplied to coffee like the natural coffee that has been supplied with all required elements for many years naturally. Generally, they contribute to sustainable production.
Leaf Shed Supply
Being deciduous and facultative deciduous, there is a continuous nutrient input to the soil. Both species recycle nutrients in the form of litter every year. This means nutrients are continuously supplied to the soil

Quality
Coffee beans around Jima produce heavy-bodied cup with winy aftertaste. Based on farmers’ group interview, coffee collected from under the shade litter of Albizia gummiifera and Acacia spp. is of the best quality to any other shade tree species. Coffee berry that falls on the ground under the shade where the leaf mulch exists has the highest quality even if it is collected after a long stay on the ground. On the contrary, coffee collected from under shade of Croton macrostachyus exhibited the lowest or rejected quality even for domestic consumption. Other species enable production of intermediate quality coffee according to farmers’ information.
Labor Efficiency
Coffee berry collected from the ground after shedding under the two species prolongs the harvesting time and thereby helps large amount of work to be performed by a small family labor. It avoids the renting of labor that would highly affect the farmers' income. Thus, use of the shade trees is economically sound in coffee marketing.

Role of the Roots
**Distribution and function of lateral roots**
Lateral roots are shallow and spread about the stump in a circular fashion in the soil. Their distribution tends to assume the spread of the canopy. The understorey coffee plant gets better chance of coming in contact with nitrogen rich roots of the shade tree.

Role in soil conservation
Uniform distribution of the shaded area and shallow depth of the roots ensures physical soil conservation. Optimum level of canopy porosity, due to the feathery leaves (Fig. 1), reduces raindrop particle size and strong solar energy consequently allows undergrowth vegetation and conserves the soil.
Fig 1. Feathery leaves of the *A. gummifera* and *Acacia* spp.
Influence of Trees on the Environment

Temperature stabilization
Under the canopy, extreme temperature is naturally trimmed, and this keeps the plant in a narrow comfort temperature range compared to open.

Rain interception or Infiltration
The feathery leaves of the two species have more intercepting roles due to increased surface area. On the one hand, excess moisture is intercepted and evaporated, on the other; infiltration is improved creating favorable condition for coffee growth.

Moisture balance
Under the shade, high organic matter improves soil moisture and reduces evaporation. Porosity is improved due to improved soil structure and presence of the roots in the soil system.

Overall influence of shade in coffee production
Shade has effect on coffee environment and production (Table 2) in farmers' farming practice. Under the shade, over bearing of coffee berry is limited to the optimum capacity and thus keep the
crop healthy and sustainable in production compared to open.

Table 2. Relative appropriateness as a function of quality and quantity of coffee product

<table>
<thead>
<tr>
<th>Function</th>
<th>Species</th>
<th>&lt;Acacia species&gt;</th>
<th>&lt;Albezia gummifera&gt;</th>
<th>&lt;Croton macrostachyus&gt;</th>
<th>&lt;Cordia africana&gt;</th>
<th>&lt;Meltia ferruginea&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shade</td>
<td>5.0</td>
<td>5.0</td>
<td>3.8</td>
<td>3.8</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Nutrient input</td>
<td>4.0</td>
<td>5.0</td>
<td>3.8</td>
<td>3.4</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Soil conservation</td>
<td>4.8</td>
<td>5.0</td>
<td>4.0</td>
<td>2.8</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>Coffee quality (taste)</td>
<td>5.0</td>
<td>4.6</td>
<td>0.0</td>
<td>2.8</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Sustainability and environmental impact</td>
<td>4.8</td>
<td>4.6</td>
<td>3.2</td>
<td>3.2</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>

Note: 5=Excellent, 4=Very Good 3=Good, 2=Satisfactory 1=no effect, 0=Bad

The role of coffee shade tree has been compared using Duncan’s Multiple Range Test. Difference coffee shade trees have significant effect on coffee yield and quality (p<0.0001). (Table 3)

Table 3. Role of different coffee shade tree species on coffee yield and quality

<table>
<thead>
<tr>
<th>Shade trees</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;Albizia gummifera&gt;</td>
<td>4.8400a</td>
</tr>
<tr>
<td>&lt;Acacia species&gt;</td>
<td>4.7200a</td>
</tr>
<tr>
<td>&lt;Meltia ferruginia&gt;</td>
<td>3.4800b</td>
</tr>
<tr>
<td>&lt;Croton macrostachyus&gt;</td>
<td>2.9600c</td>
</tr>
<tr>
<td>&lt;Cordia africana&gt;</td>
<td>2.9600c</td>
</tr>
</tbody>
</table>
The result showed that both *A. Gummifera* and *Acacia* spp. are the best coffee shade tree species for a better quantity and quality coffee production around Jima. Statistical tests agree with farmers' ranking except for *C. macrostachyus* and *C. africana*, which have been given low status of the same level. However, even if farmers mean ranking was the same for both species, they completely rejected *C. macrostachyus* for its negative effect on coffee quality.
Conclusion

In multi-storey and hoe culture planting practices, shade trees like *Acacia* species are left to grow naturally. Such management system allows the perennial plant to flower and to serve as shade. Yilma (2002) agrees that shade trees sustain production by preserving coffee environment, maintaining and conserving soil fertility and moisture, regulating extreme temperature; moderating flower induction and fruiting to avoid overbearing and dieback and improving coffee quality. He listed the appropriate shade tree species as *Acacia* spp. *Albizia gummifera* *Melltia ferruginia* and *Sesbania*. This order is also in agreement with farmers' ranking. He further noted that shade and altitude slow down bean maturation, thus create favorable condition for improvement in organoleptic quality. The same paper reveals that influence of shade in organoleptic quality (cup quality) has greater effect on bitterness of coffee. In the mid and lowlands, shade has a positive influence in the quality of animal production;
animals and plants that are provided with shade can yield to a quality product due to stabilization of the environment and normalization of physiological activities.

References


