Farming Systems Approach For Identifying R and D Options For Enhancing Income and Sustainability in Kafa-Sheka Zone of Ethiopia

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ABSTRACT

This study was conducted in Gimbo Woreda of Kafa-Sheka Zone (KSZ), Ethiopia with the aim to identify and analyse the farming systems and, analyse and prioritise research and development (R & D) options for enhancing income and sustainability of farming systems. The study area was classified for enhancing income and sustainability of farming systems. The study area was classfied into three zones namely, 'forest', 'transition' and 'deforested' zones based on the "scale of deforestation". Consequently four farming systems were identified. The study envisaged a movement of the farming systems towards on that is based on coffee, a high income generating tree crop that also protects the environment. In the light of constraints and opportunities several R and D options were identified and prioritised.

To meet the multiple objectives of poverty reduction, for security, competitiveness and sustainability on small farms, several researches (Norman, 1978, Byerekee *et al*, 1982, Shaner *et al*., Goldsworthy and de Vries, 1994) have suggested farming systems approach. This approach emphasize the need to view the farm situation as a whole and consider the stakeholder's perspective crucial for any development strategy. The Kafa-Shaka Zone (KSZ) of Ethiopia is known for its forest cover, forest product and spontaneously growing coffee and spices. However, the area covered by forest is decreasing, due to population pressure (including new settlements), expansion of crop production and commercial investment (e.g. tea and coffee estates). These practices seriously damage genetic diversity of flora and fauna living within the ecosystem (genetic erosion) and may threaten sustainability of the production system. Promotion of cereal based cropping system by new settler farmers has further affected the environmental sustainability. The rampant destruction of the forests was continuing in the area. As the livelihood of the farmers was directly or indirectly dependent on forest products, there was an urgent need to develop strategies that will promote sustainable exploitation of natural resources and raise income levels of farmers. The present paper therefore aims to identify and analyse the farming systems of Gimbo woreda of kafa-sheka zone and, analyse and prioritise research and development options, by integrating stakeholders' perspective, for increasing income and sustainability of farming systems in the study area.

METHODOLOGY

The study was conducted in *Gimbo woreda* (district) of the Kafa Sheka Zone (KSZ), Ethiopia. Most of KSZ is part of the South-Western Ethiopian high lands characterised by a rolloing plateau. An interdisciplinary team conducted the study and followed the agricultural research for development approach using participatory mathods and, integrating the perspective of all relevant stakeholders. The team's perception of the field study problem was presented to the stakeholders (research managers, researchers and development workers and farmers). Suggestions received from stakeholders helped the team to focus the study better. After a brief reconnaissancy survey of the study area, four *kebeles* (peasant associations) namely, Yebito, Baha, Tega-tega and Shombakecheb and two representative villages from each *kebele* were selected. The "scale of deforestation"

and altitude were the major criteria for selection of peasant associations (PA).

The farmers were interviewed both individually and in-groups in the selected villages with the help of a checklist. Involving the farmers developed various participatory tools like seasonal calenders, timeline and agro-ecosystem diagrams. A mid-term review workshop which drew participants from research, development departments, NGOs, donor agency and farmers, was organised. In the workshop preliminary farm typology was refined and premiliminary R & D options were identified. The identified research and development options were discussed and prioritised with farmers and other relevant stakeholders. The discussions with the stakeholders enabled the team to evolve for prioritising the options. The options were assessed for their contribution to economic efficiency, environment sustainability and social equity, and their probability of success. Assessment of the individual criterion was based on subjective information, which was expressed in a scale (in this case, 1 to 5). The options were prioritised based on the value of the final score collectively given by the team and stakeholders; higher the score of an option, higher the priority it gets. Main findings of the study were discussed with all the stakeholders in the final workshop. Hence in the process the relevant stakeholders including farmers were involved right from the stage of designing the project.

RESULTS AND DISCUSSION

The study area was classified into following zones based on the "scale of deforestation" that KSZ was witnessing. Further the farming systems were identified in each zone based on the production acticities and resource situation. Each farming system was considered as a recommendation domain for which one set of recommendation/option may be suggested.

Zones and farming systems

Forest zone: This has abundant forest cover with semi-domesticated coffee and spices. The soils were deep, fertile and reddish brown in colour. Besides collection of coffee and the spices, there are homestead plots with enset, bananas, maize and haricot beans. Bee keeping is an important activity. Main problems of farmers were damage of crops by wild animals and the coffee berry disease (CBD).

1.   Forest gathering/coffee-based farming system

Transition zone: The forest (with semi-domesticated coffee) has been depleted. The land area

under cereals was increasing, as the forest dwindles. The soil fertility was decreasing in the areas under cereals. Major crops besides coffee and *enset* were maize, *tef (Eragrotis tef)* and haricot beans. Main problems are CBD, damage to crops by monkeys and tryponosomiasis in animals.

1.   Forest gathering /coffee/cereal-farming system

2.   Enset/cereal-based farming system

Deforested zone: Arable fields with cereals such as maize, *tef*, barley, finger millet and sorghum have replaced the forest. The legume, haricot bean, faba-beans and peas are important. The soils generally have becomes less fertile. Disease in crops and livestock are prevalent. Scarcity of fuel wood is an emerging problem.

1.   Cereal-based farming system

In essence, coffee and the spices in the forest zone, coffee and cereals in the transition zone and cereals in the deforested areas dominated crop production. Farmers gathered different spices such as 'korarima' (*Aframomum conorima)*, 'timiz' (*Piper* spp) and coffee (*Coffee arabica* L) from the natural forest. The new settler farmers from the northern part of the country introduced the cultivation of cereal crops. However, nowadays, farmers exchange their indigenous knowledge and their livelihood much depends on small holding mixed cropping based on a range of food and cash crops. The high value cash crops such as coffee, spices, *enset* and fruits are highly suitable for local agro-ecological conditions and would be beneficial for sustainable natural resource management (NRM) and income enhancement. However, little efforts have been made to encourage the above crops in the area.

The primary objective of farmers was to ensure food security for the family. The farming was mostly subsistence type. Illiteracy and lack of awareness, resources, credit facilities, rural infrastructure and market have led to inappropriate use of available natural resources and also they were under utilized. As a result farmers' income was very low and poverty was rempant in the rural areas. The cause of concern was also the government casual approach to promote large investments in coffee and tea plantations. Investors were permitted to clear up large areas of the forest for coffee or tea plantation. Many of these investors were interested only in mining the forest not in developing coffee and tea farming. These activities might have negative consequences on the livelihood of farmers who depend on the forest for semi-cultivated coffee, spices and bee keeping.

Interactions between Sub-systems

Crop-livestock interations

The most important interactions was the use of animals for traction. Oxen were used for land preparation for all crops, and for weeding the thining in maize fields.The farmyard manure (FYM) was used on the plots around the homestead. FYM was not used in far away field because of difficulty in carrying it. Farmers in transition and deforested zones used crop residues to increase the fertility of their soil. The crop residues from *teff*, beans, maize were left in the field to be grazed on by livestock. Animals were dependent on common grazing lands for their feeding. Most of the common grazing lands on gentle slopes have been distributed for farming leaving the swamps as the main source of grazing for the animals. Swamps harbouring many parasites like-fluke exposed animals to diseases and parasites. The numbers of livestock especially sheep and goats have declined largely due to inadequate feed and increased disease incidence. Vaccination of livestock against disease such as rinderpest is said to take place regularly but farmers' access to veterinary services was very poor. *Forest and its uses.*

In forest and transition zones farmers collect wild coffee and spices from the forest. Farmers have access to the forest for firewood, timber for house construction and agricultural implements like plough the hoes. Moreover, the forest provided an opportunity for the farmers to be engaged in bee keeping. It provides a conductive habitat for wild animals like baboons, monkeys and warthogs. These animals caused considerable damage to crops and livestock.

Socio-economic interactions

Households' cash needs were met by selling wild coffee, honey, sheep, goat, chickens, eggs and milk products. Seed was the main input, which was either produced by the household itself or bought from either market or other farmers. Most farmers did not use chemical fertilisers, as it was expensive. Communal sharing of oxen and human labour was very common. Availability of credit was inadequate.

Natural Resource Management (NRM)

Farming activities have considerable influence on the management of natural resources. Farmers try to optimise the use of available resources, and in doing so they often unconsciously cause damage to the resource base. This does not in any way suggest irrationality on their part. The practices that enhanced the efforts to promote sustainable management of natural resources were: Application of farmyard manure (FYM) on crops; Crop rotations; Inter cropping; Incorporation of crop residues on ploughed fields; Ploughing along the controus; Land fallowing and Planting of tree and *enset* across slopes. All farmers ploughed their fields across the slopes, and some of them (about 40%) constructed a furrow along the slope to facilitate water drainage. Some farmers followed crop rotation and application of FYM as favourable practices.

Detrimental practices

On the other hand, there were farmers' practices that were at variance with the efforts to attain sustainable natural resource management. These include:

1. Shifting cultivation, 2. Mono-cropping,

3. Indiscriminate felling of trees, 4. Continuous cropping.

Farmers' practices represent an integration of their indigenous knowledge and coping strategies. Farmers were aware of these consequences but were oftern incapable or taking action because of resource constraints. Farmers need to be supported by research and extension agencies to understand the consequences of some of their practices.

Farmers were of the opinion that encouragement of coffee and other trees plantings, increasing productivity per unit area of land and general education of all on the need to keep the forest for the present and future generations would stem the tide of deforestation. The activities of investors should also be closely monitored.

Existing opportunities for enhancing income and sustainable NRM

Promotion of improved coffee planting

Coffee cultivation was the key to efforts to increase farm income and halt the environmental degradation taking place in Gimbo. Coffee was money, and households with forest plots from which they collect semi-domesticated coffee were relatively better off. Households with fields of improved coffee were even wealthier. Jima Agricultural Research Center mandated for coffee research, is close to the area. Coffee is planted under shade. Suitable shade trees could also enhance the bee-keeping activities of farmers.

Crop diversification

Opportunity for diversification focusing on improved coffee, taro, cassava (*Manihot esculenta*), *enset*, banana, sugarcane, mango, avocade, papaya, groundnut, linseed, soybeans, horse bean, ginger, turmeric and long peppers

existed.The level of cultivation (area and management) of these crops in the existing farming system was very low.

Crop residues as feed

Crop residues and other crop by-products were available for feeding livestock, which were not very commonly used as feed.

Bee keeping

The existing flora provides an excellent opportinity for bee keeping, which was also good for sustainable NRM and complementary for coffee cultivation. Bee keeping is the traditional occupation in rural*Gimbo*.

Options for income enhancement and sustainable NRM

This study envisaged a movement of the farming systems of KSZ towards one that is based on coffee. In the long run, tea many also become important. The intermediary forest/coffee/cereals system should become less important when coffee revenues give farmers enough cash and security to buy maize and *tef* grains for food from the market. Consequently, crop specialisation was envisaged. In the light of this vision, and the constraints and opportunities identified (with stakeholders' involvement) a total of twenty-seven research, development and R &D options were suggested. These options were screened again by involving all the relevant stakeholders including farmers. After screening, nine options/recommendations were selected which are discussed below.

Research options

1. Screening/on-farms testing of coffee, spices, enset and maize cultivars

Research has developed improved varieties of coffee and spices, which are now grown in many parts of Ethiopia. These need to be tested farmer conditions in KSZ as well. Maize and *enset* were predominant food crops in KSZ. Use of local varieties by the farmers and poor agronomic practices were among the main causes of low crop yields. High yielding varieties (HYVs) of maize have successfully been developed and introduced to other parts of the Ethiopia. There was thus need to conduct on-farm testing of these varieties for suitability and adaptability. The prospects for double cropping maize appeared to be bright, but need to be verified in light of the existing agronomic practices. *Enset* production is constrained by various diseases, some of which have not

yet been characterized. A disease surveillance to identify and ascertain the extent of severity is urgently required so that remedial actions could be taken.

2. On-farm evaluation of bare-root method of transplanting coffee seedlings

One of the main constraints faced by coffee farmers was lack of access to adequate improved coffee seedlings at affordable cost. Farmers seem to prefer bare-root method of transplanting coffee seedlings to the poly-bag as it cost almost one-tenth compared to seedling in poly-bag. However, there was need to evaluate the performance of bare-root coffee seedlings under farmers' conditions.This proposal could be integrated into the existing programme for promoting farmers to established coffee nurseries.

3. Evaluation of mud-hives as intermediate bee keeping technology

Bee keeping is a widespread activity among families in Gimbo woreda. Handling of traditional cylindrical log hive was cumbersome and difficult to inspect that resulted in low outpur of honey. Wooden frame beehives introduced in the past were expensive for most farmers to manage. The mud-beehive is considered an inermediate technology, which would be simple to construct and reduce the cost. The mud-hive creates excellent internal atmosphere for bee activities and uses less wood compared to other hives.

4. Study of weeds and soil fertility status

The climatic conditions of Gimbo Woreda favour the rapid growth of weeds. Farmers however, did not consider weeds as a major crop production constraint. Farmers again considered their soils inherenty fertile and therefore underlook little or no soil improvement practices. In the deforested zones, where continuous cropping or mono cropping of cereals with little or no nutrient replenishment was the norm, the fertility of the soils has been declining.

5. Study of indigenous bee practices and identification of bee flora

Farmers in this region have traditionally been practicing bee keeping the have accumulated a lot of experience and knowledge in it. Farmers used various indigenous methods to protect beehives from their enemies like ants. They were equally aware of the naturally growing trees, and shrubs, which were valuable sources of nectar. Most of these tree species and indigenous practices are not documented and therefore fast disappearing.

6.   *Evaluation and utilisation of multi-purpose trees*

Agro-ecology of the zone is suitable for coffee cultivation, bee keeping and horticulture. This calls for a need to evaluate alternative multi-purpose trees, which are useful for fodder, shading, fuel, soil fertility and bee keeping for their suitability, utilisation and acceptability.

7.   *Identification and evaluation of local fodder species*

Feed scarcity in dry season was a major constraints in livestock rearing. There were many naturally occurring fodder spices. Some of theem appeared to have very high nutritioal value especially those which were used by farmers for fattening sheep and goats. These fodder spices have not been properly identified and evaluated for their nutritive value.

Development options

8.   *Introduction of fruits trees into the farming systems*

Fruits trees such as avocado and mangoes that suit to the agro-climatic conditions have the adventage of being Eco-friendly. In spite of good potential, there fruits trees were poorly promoted into the farming systems in Gimbo.

Research and development option

9.   *Study of indigenous knowledge in enset production*

Enset was particularly important in the enset/cereal based farming system, where if contributed significantly to household income, besides being a staple food crop. In spite of this, there was no *enset* production manual for development agents (DAs).

Prioritizing options

Invariably more research and development options are identified than could be implemented with the available resources. To increase the efficiency of research the recommendations were therefore prioritised using the following criteria.

* Economic efficiency: economic surplus generated in terms of value of production

* Environmental sustainability: improved natural resource management

* Social equity: gender, number of farmers benefited

* Probability of success: chances of success of the project with available resources

Each criterion was given a weight, reflecting the importance attached to it. The weights were allotted in consultation with all major stakeholders. Economic efficiency and environmental sustainability were considered equally important and these were also given more weights than the other two criteria. Social equity and probability of success were also given equal weights. Then for each criterion some measurable indicators were identified in order to arrive at a score for each option.

Contribution to economic efficiency was estimated based on expected economic surplus generated by each project and then relatives scores were given. Environment sustainability was measured in terms of improved natural resource management like "number of hectares of erosion prone land that may be positively affected by the results of the project". Expected benefits of the project for male and female farmers, small and large farmers, and total number of farmers benefited were measured for social equity. Probability of success of the project was estimated based on availability of resources (technical and material) and willingness of the stakeholders to take up the project.

Research and development need

The options related to coffee, spices and bee keeping was more appropriate for forest and transition zones. The *enset* option was more relevant to the cereal zone but the farmers from foresst or transition zone would need to be involved because of their wealth of experience in *enset* production (Table 1). After prioritizing, the first two options viz., On-farm testing of coffee, spices, *enset* and maize varieties were developed into research proposals in consultation with the relevant stakeholders.

It emerged that many farmers received the package (maize and fertilizer) with the instructions and understanding of when and how to apply and, the costs of the package were also not affordable. Hence the farmers were not in a position to adopt the recommended technologies on account of resource constraints. Therefore need-based technologies were required which can fit in the resource restrictions of the farm family. The available technologies need to be assessed and evaluated under field conditions and refined accordingly. For instance, farmers plant bare root coffee seedlings taken from forest, however recommended poly-bag seedlings cost almost ten times, which most farmers were unable to afford. The implementation of the proposals thus demand the active involvement of farmers. The client-oriented research requires the selection of representative villages and farmers in the various zones and farm types. It is recommended that implementation of the proposals

includes the formation of farmer research groups, who would play active roles in farmer managed-farmer implemented on-farm trials.

Table 1. Research, Development and R&D options for Gimbo Wereda

Research and Development Options	Priority Rank	Time to effect
1. On-farm testing of varieties of coffee, spice, *enset* and maize	II	Short/ medium
2. On-farm evaluation of bare-foot method of transplanting coffee seedlings	I	Short/ medium
3. Evaluation of mud-hives as intermediate bee keeping technology	V	medium
4. Study of weeds and soil fertility status	IV	Short
5. Study of indigenous bee-keeping practices and identification of bee flora	V	Short
6. Evaluation and utilisation of multi-purpose trees	VI	Long
7. Identification and evaluation of local fodder species and forage legumes	VII	medium
8. Introduction of fruit trees into the farming systems	V	medium
9. Study of indigenous knowledge in *enset* production and development of extensio manual	III	Short

CONCLUSION

Coffee cultivation provides a uniques development strategy for KSZ for enhancing the incomes of farmers and also arresting the spate of deforestation. Analyzing farming systems by interdisciplinary team involving relevant stakeholders through participatory methods help in developing need based research and development programmes.

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