Home garden assessment report: System niches, production and marketing constraints and intensification barriers in the Ethiopian highlands

Tilahun Amede and Mulugeta Taye

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Through action research and development partnerships, will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Livestock Research Institute (in the Ethiopian Highlands) and the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa). The International Food Policy Research Institute leads an associated project on monitoring, evaluation, and impact assessment.

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Summary

The Africa RISING project has been currently engaged in several agricultural intensification programs in the Ethiopian highland areas including Sinana, Maichew, and Debre Berhan. In these areas, because of the interest to develop sustainable intensification strategies, and the interest to establish a deeper knowledge on the potential of integrating highland vegetables and fruit crops, this study was conducted with the following objectives:

- Conducting participatory assessment and survey on socioeconomic and biophysical characteristics of the sites adoption and marketing of high value vegetables and fruits up on collecting relevant information through formal surveys, community group discussions and key informants
- Identifying various landscape and farm niches where these high value crops could be grown during the dry season, considering water points, theft and management option
- Identifying and suggesting best fitting commodity and high value product for each Africa RISING district

The study was conducted in 2014 growing season, in Oromia, Tigray and Amhara regions. Assessment and survey was conducted at Ilu Sanbitu and Selka kebeles in Sinana; Emba Hasti and Tsibet in Maichew; and Gosh Bado and Gudo Beret kebeles in Basona Worena.

Our field study revealed the following:

1. The crop-livestock systems of the Ethiopian highlands are predominantly cereal-based, with vegetable and fruits being recent introductions to the system. The home gardens and valley-bottom irrigable lands are the major niches of production to date. We have seen the potential of using soil bunds, eye-brows and within farm ditches as potential niches, particularly where livestock movement is restricted through byelaws, as was the case in Gudo Beret. Women-led farmers preferably grow vegetables around homesteads while men-led household in irrigable fields, particularly during the dry season. Other farm niches are rarely exploited. Livestock roaming, theft, easy accessibility for availing labour and access to water as the major determinants of decision making about niches.
2. Access to surface irrigation water (springs, rivers) has become a major incentive for growing vegetables and fruits. Farmer's rarely exploited the use of shallow wells, even in valley bottoms, areas where the water table is close to the surface. Some communities have started to use rainwater harvesting (collected from flood, micro and macro catchments and roofs) as the major source for water for growing vegetables and fruit crops in many areas. For instance, in Gosh Bado kebele at the villages Denjan (Workjur) and Talak Amba (Kombel) water harvesting has been used for the last two years. The water harvesting practice at Workjur in particular could be taken as a good lesson for other Africa RISING villages.

3. There is an increasing inclusion of vegetables in the diets of the rural community, which is expanding local market opportunities. Most farmers sell their produce at farm gate prices to local traders, who take the assembled produce to bigger towns in Alamata, Debre Birhan and Shashemene. There was no organized market strategy or collective marketing in any of the sites. The small volumes did not also attract large traders, who could offer better prices.
4. There is an increasing production of diverse vegetables, including onions, cabbage, potato lettuce, swiss chard, carrot, beetroot, onion, garlic in the different kebeles. However, there is a need to capitalize on a few key vegetables and fruits, responding to local and national markets. For instance specialization and value addition to the highly demanded 'Ensosila' in Mehoni for adornment, particular for women, is a major opportunity. The major market disincentive is not only low volume but also product quality and post-harvest handling, which could seriously affect prices. Although the current market seems to be fair for farmers, there is a concern of market failure if there is an increasing production of the same types of vegetables in all the sites arriving at similar times. Fruit production is very rare, and is mainly a recent introduction of apples.
5. There is a need to train farmers in building and managing diffused light stores to prolong the storage life of the seed tubers, up to 5-8 months. Understanding the value chain linking production, with quality control, the package system, value addition (for instance on potato chips) and collective marketing is another entry point for system change. Mapping marketing spots could help a lot.
6. Pests and diseases are already undermining the returns of horticultural investments. An alarming build up has already threatened most schemes, including on garlic, potato and fruits like apple and mango. Disease incidence was much more apparent in irrigated fields than in rainfed homestead fields. The major reason is that the same field is used for growing the same vegetable or related species year-in year-out, which helped to build up the stock. This was apparent in some of the sites (e.g. Mehoni), where farmers are thinking of abandoning the production of onions and garlic due to high incidence of powdery mildew, rust and purple blotch. This calls for an integrated pest and disease management, particularly in irrigated fields, whereby clean seed, crop rotation, uprooting of infested plants, careful management of farm implements and pesticides are used complementarily
7. Lack of organized seed systems for vegetables and fruits is another major constraint. The viability of seed is an essential factor for the success of vegetable growers. In the surveyed areas, particularly, at Senbitu and Selka kebeles farmers suffer from poor quality seed. Farmers are forced to purchase from the surrounding local shops for cheaper prices at the expense of quality. The BoA has been instrumental in some sites, as it was the case in the Mehoni site.
8. The concern of quality, both in accessing quality planting materials but also availing quality produces, requires the support of skilled extensionists and NGOs. Currently, quality is not assessed in all of these villages. The good practice of CIP on potato in southern Ethiopia is repeatedly mentioned as a good example. Potato farmers need to get approval by the local inspection committee before selling their products to major traders, which has helped farmers to negotiate for better prices. The inspection committee may be established by bring people from various institutions and community representatives. The inspection policies could be established and enriched in consultation with the concerned offices including BoA and NGOs. Moreover, in all these areas, there is a need to benefit from local marketing cooperatives for attracting major traders, collective bargaining but also regulating quality.

Site-specific observations and recommendations

Ilu Sanbitu and Selka: Most Ilu Sanbitu vegetable and fruit crop growers have access to various water sources, including from river Shaya, springs and wells. Ilu Sanbitu is very ideal for expanding vegetables and fruit crops production for it has bigger farm size, average 3-4 ha/household, ideal topography (plain–gentle slope), and high opportunity for marketing. Most farmers grow vegetables at their homestead while some others at irrigable fields. Several farmers sell produces at the nearby small market (7-10 km) or by travelling to Robe (15-20 km). Sometimes farmers sell the produces to middlemen while the crops are still in the field or after harvesting it. Many traders sell vegetables they bought, particularly potato, up to Somalia boarder, Shashemene, and/or Addis Ababa. However, poor and seasonal roads in the area are major market disincentives for growing vegetables, which calls for attention of policy makers. On the hand, given the ideal climate and ample land, this kebele could be a major source of diverse highland fruits including: pears, peaches, plums, olives, almonds, and walnuts. As these crops have a new growing and bearing culture the farming community is seeking support from BoA or other NGOs' farming communities.

At Selka, planting takes place only during the main rain season as there are no other surface water sources during the dry months. Most vegetables are grown at homestead. The seed source and associated problems are similar to Ilu Sanbitu. Farmers sell vegetable produces by taking them to the small market located at the nearby area (10 km) or by travelling to Robe (40 km), or by selling it right at the farm before harvesting or after harvesting it. Traders collects the vegetables particularly potato to Shashemene market, Addis Ababa and to Somalia boarder.

Emba Hasti and Tsibet: At Emba Hasti, there is an ideal climate for growing vegetables and highland fruit crops though Tsibet site may concentrate on commodities adopted to high altitude and low temperature, e.g. onions and garlic. Water is available in both kebeles from springs and wells. Farmers use ponds as a water reservoir and are distributed to the surrounding farms through small furrows. Water shortage is not necessarily a constraint in these kebeles. The major constraint, however, in both kebeles is land size, which is 0.25-0.50 ha/household. They mostly get seeds from the BoA. A committee administers purchasing seeds for the farming community in both kebeles. There are indications that planting and after-planting practices in these kebeles are carried out properly in the kebeles thanks to the strong support of the extension system. Farmers sell their produces individually, mostly by taking it to Maichew. They also sell it to local traders at farm gate while the traders would sell it further at Maichew, or far away to Raya or Alamata.

Gosh Bado and Gudo Beret. Both Gosh Bado and Gudo Beret kebeles have diverse temperature gradients, from cool highland, to semi highland plateaus and lowland valley bottoms, which would allow farmer growing different kinds of vegetables and fruit crops. Encouraging farmers to specialize in seed tuber production in the cool highlands, by supplying starter seed and helping constructing DLS, could facilitate change in livelihoods. The low land area is suitable to grow tropical fruit crops. At Gosh Bado, some villages have perennial springs and wells while a few others do not. At the village Denjan, there are springs in its two sub villages: Shinet and Workgurteg. In other villages (Gosh Wet, Gosh Wuha, and Atse Wuha), surface water is available for irrigation. BoA and NGOs' including Adheno (a local NGO) and Africa RISING have been active at Gosh Bado and Gudo Beret. Temperate fruit crops like pear, plum, olive, walnut could be grown in addition to apple while crops like banana, avocado, mango could be grown in the valley bottoms.

Introduction

More than 85% of the Ethiopian population, residing in the rural area, is engaged in agricultural production as a major means of livelihood. Agriculture in general accounts half of the gross domestic product and 90 % of the exports. Smallholders are the backbone of the agricultural sector for they cultivate 95% of the cropped area and produce 90-95% of the cereals, pulses and oil seeds (Alemayhu, 2006). Most of the arable land is cropped to cereals (85%), followed by pulses (11%) while vegetables and fruit crops are rarely grown, particularly in the Ethiopian highlands (Alemayhu, 2006).

The terrain of Ethiopia is diverse ranging from very high point (4500 masl) in the North West to the lowest point at the afar depression (120mbsl) in the northeast. Most of the annual crops are grown between 1500-3000 masl, with rainfall amount receiving between 600 and 1300 mm rainfall/annum and an average temperature of 18-20 ^{o}C.

According to the Ministry of Agriculture/Ethiopia (MoA) over 23 different kinds of vegetables and 20 different kinds of fruit crops are reported to grow by small scale farmers in Ethiopia. Very few of them are exported by private growers to neighboring countries like Sudan, Djibouti, and Somalia. In many places in Ethiopia most vegetables and fruits grow in two ways in that the first one in the cereal crop based farming system, which staple food crops such as teff, barely, wheat, and sorghum are grown in outer most farm fields, whereas the second one in the perennial crop based farming (Tesfaye, 2005).

Water is available from various sources including rain, spring and wells, and has an enormous effect on the physiology and bearing performance of vegetables and fruits, particularly during flowering and fruit setting phases. In areas where surface water is scarce water harvesting is a very important strategy. It is designed to collect run off and ground water from area of surplus or where it is not used, store it and make it available, where and when there is a water shortage (Studen and Liniger, 2013).Water collected in this manner, and also from rain and other sources, upon storing it in a pond (Abiye, 1986) can be used to grow vegetable and fruit crops during dry season.

Temperature also considerably affects vegetables and fruit crops production. It has a considerable effect on the dormancy, growth, flower, fruit initiation and formation, particularly on temperate crops such as apple, plum, prim, olive, peach and others. In some cooler areas in Ethiopia such as Chencha, Adigrat, around Dessie, Holleta, Sinana, Maichew, and Debre Berhan farmers have been increasingly trying to grow apple. The most important factors to successful grow highland fruits is to have a deeper knowledge on the crop growth behavior, chilling requirement of varieties, rootstock-scion relation, and also understanding fruit bearing behaviors. Some farmers in the Africa RISING sites are successful with the planting of apple while others not. The major reasons for not being successful, among others, was limited knowledge on the chilling requirement of the cultivars.

Currently BoA, and several NGOs are making an effort to expand the highland crop territory and use the potential for the benefit of the community. The Africa RISING project has been engaged in several programs in the Ethiopian highland areas including Butajira, Sinana, Maichew, and Debre Berhan. In these areas information about vegetables and fruit crops production across the value chain is very much limited and, therefore, this study was carried out with the following objectives:

- Conducting participatory assessment and survey on socioeconomic and biophysical characteristics of the sites, adoption and marketing of high value vegetables and fruits up on collecting relevant information through formal surveys, community group discussions and key informants;

- Identifying various landscape and farm niches where these high value crops could be grown during the dry season, considering water points, theft and management option

- Identifying and suggesting best fitting commodity and high value product for each Africa RISING district

Methodology

Research sites

The study was conducted in three regions in Ethiopia: Sinana, Maichew and Debre Birhan in the 2014 cropping season.

In Bale, the survey was conducted in Sinana woreda, which lies 430 km south east of Addis Ababa. Sinana is situated at an altitude 2200-2600 masl with an average minimum and maximum temperature of 9^{o}C and 21^{o}C, respectively, and with an average rainfall ranging between 750 and 1000 mm/annum. The soil type of Sinana district is mainly pellic vertisol, euricniosols, and chromic luvisoils. Sinana consists 20 kebeles, and of these, the study was carried out at Ilu Sanbitu and Selka kebeles. Ilu Sanbitu is about 12 km from the town Robe while Selka is about 40 km from Robe.

The survey in Tigray region was conducted in two kebeles namely Emba Hasti and Tsibet kebeles at Mehoni woreda, Maichew zone. Mehoni is a highland area situated at an average altitude of 2850 masl, with a peak height of 3935 masl at Tsibet. The woreda has a minimum and maximum average temperature of 12^{o}C and 18^{0}C, respectively, and rainfall ranging between 600-800 mm/annum. The number of household in the woreda is 20465 and of this 14050 are men and 6465 are women. The woreda consists 18 kebeles. The soil type is diverse but, in general, the woreda's soil comprises black soil 18%, red 7%, sand 7%, brown 25%, and loam 43%. The research sites Emba Hasti is about 8 km while Tsibet 20 km from Maichew town.

The survey in Debre Berhan was carried out at two kebeles in Basona Worena woreda, namely, Gosh Bado and Gudo Beret. The woreda consists of several other kebeles which most of its terrain are mountainous and sloppy. It has a cool climate, T^{o}C: 14-18; altitude 2500-3500 masl; moderate climate 18-20 ^{o}C, with an altitude of 1500-2500 masl. The soil type in the woreda varies depending on the landscape position, which includes vertisols, nitosols, and cambisols.

Research design and sampling

In all research sites we have identified representative gender groups, but also irrigators and non-irrigators, except at Selka site. At Selka, as there was no surface irrigation source, it was not possible to stratify the selected samples into irrigation and non-irrigation users. Twenty-seven samples at Ilu Sanbitu and twenty-three at Selka (Table 1), which is about 50% of the total vegetables and fruit crops growers, were interviewed. The total vegetable and fruit growers recorded by the development agents of the respective kebeles were about 50-60 in number. The number of samples at Emba Hasti and Tsibet were 28 and 24, respectively, while at Gosh Bado and Gudo Beret were each 26 in number (Table 1).The number of samples for most of the strata in each kebele is not uniform for there was a variation in number between men and women irrigation and non-irrigation users (Table 1), and also, in some it was not possible to get the expected respondents. Going house to house but also calling them at FRC, and to closer sites made the interview to the vegetables and fruit growers.

Table 1. Number of sample respondents

	Irrigation		Non irrigation	
	Men	Women	Men	Women
Sinana				
Ilu Sanbitu	10	7	5	5
Selka	-	-	14	9
Maichew				
Emba_Hasti	18	4	4	2
Tsibet	14	5	5	0
Debre Berhan				
Gosh Bado	12	7	0	7
Gudo Beret	8	14	3	1

*At Selka samples were taken only from non-irrigation users as they do not plant during dry season because of water problem.

Data collection

Information in all kebeles was gathered using questionnaire and interviews, and secondary information from different offices and libraries. The questionnaire consisted several questions including on climate and drought incidences, land use land cover change, the history of cultivating vegetables and fruits and their major constraints including access to input, source of planting materials, farmers future plan, institutions involved in production, market opportunities, means of livelihood of the community, land holding and means of storing and processing the products.

Also, information was gathered using checklist from different key informants: farmers group, women group, elders, office of each research site, Sinana woreda irrigation authority, Universities (Robe University, Debre Berhan University), Faji temperate fruits and related products development Debre Berhan/Ethiopia, and Debre Berhan Research center. Data were collected with the help of development agents of the respective research kebele, instructors from Robe University, and Maichew ETVT College, and Debre Berhan Research center.

Major findings

Socio economic and Biophysical characteristics

The results below captured the agroecological and socioeconomic characteristics, the major constraints affecting production and marketing of vegetables and fruits but also identified potential commodities for each kebele and the landscape and farm niches. In addition, salient points emerged from discussion with the farmers, women, and elder groups, and also with different governmental and non-governmental organizations are incorporated

Sinana

Ilu Sanbitu

Land use: Most farmers own relatively large farm size, and started to grow different vegetables including potato, head cabbage, swischard, lettuce, and onion. Men-led farmers own an average of 17500 sq meter total land, and of this, about 16950 sq meters (96.85%) are cultivated (Table 2). From the total cultivated land about 3205.56 sq meters (18.91%) are used for vegetables production and about 178 sq meter (1.04%) for fruit crops (apple) production (Table 2). There were also men and women led farmers who do not use irrigation in this kebele (Table 2). The men cultivate 36000 sq meter (91.14%), from the total land of 39500 sq meters, of which about 4000 sq meters are used for vegetables growing (Table 2). The women led also cultivated 40000 sq meter (95.24%) from a total land of about 42000 sq meter, of which about 4500 (11.25%) are used for vegetables production and 260 sq meter (0.61%) for fruit production (Table2).

Vegetable and fruit production is relatively a new practice in this kebele. According to the development agent of BoA, the number of vegetables and fruit producers in this kebele is about sixty households.

Table 2. Average total land holding, cultivated land, and vegetables and fruit crops land by irrigation and non irrigation users at Ilu Sanbitu, Sinana

Characters	Irrigation				Non irrigation			
	Men		Women		Men		Women	
	Land size ($m^{2)}$	Percentage (%)	Land size ($m^{2)}$	Percentage (%)	Land size ($m^{2)}$	Percentage (%)	Land size (m^2)	Percentage (%)
Average total land holding	17500		28571.42		39500	36000	42000	
Average cultivated land	16950	96.85	28571.42	100	36000	91.14	40000	95.24
Average land for vegetable growing	3205.56	18.9	3571.43	12.5	4000	11.1	4500	11.25
Average land size for fruit crops production	177.78	1.04	12.85	0.04	0	0	260	0.61
Irrigated land	1944.4	11.47	2142.86	7.50	0	0	No	No

Water sources: River Shaya is the main source for irrigating the crops in this kebele. One could easily develop shallow wells with the water table not deeper than 4-5 meters. The kebele has enough water, and most of the vegetable growers have their own well. Vegetables in this area are produced two to three times in a year.

Major Vegetable constraints: Several vegetable crops including potato, onion, garlic, carrot, beetroot, head cabbage, kale, lettuce, and swischard are grown twice or thrice per year in this kebele, with three to four types planted per season. In general potato, head cabbage, onion and garlic make good money in this kebele. There seems to be experience in growing vegetables and fruits in this region. Both men and women farmers planting vegetables in a row with recommended spacing, and also by applying the necessary cultural practices like weeding and others as needed. Also, farmers practice crop rotation by planting different crops at different times with a purpose to overcome insect pests and disease causing organisms.

The major problem with the vegetable production in this kebele is the absence of viable and genuine seed, and also red ants on potato. Theft and livestock intervention, however, are not major problems in this kebele.

Fruit crops growing and the constraints: Growing fruits is a recent practice, mainly supplied by ILRI. Apple fruit was introduced into the farming community of this village just one year ago. Five to twenty grafted apples of different cultivars were distributed at each homestead and were planted with a spacing of 2m by 2m. The apple height by the time the farm was visited was between 1.25-1.50 meters. After a year from now the plant will be ready for flowering and fruiting. In order to flower and bear fruit, however, most of the varieties require low temperature of about 3-8^{o}C for several days. This chilling hour is essential in order to break the bud dormancy and activate the flower, and fruit production. Most commercial apple varieties require 1200+300 chilling unit, defined as hours needed at optimum chilling temperature between 3-8^{o}C for many cultivars. Most apple cultivars are very specific with their requirements. As many growers disregard the chilling requirement they are not successful with apple production. According to Abiye Astatke, the manager "Fagi temperate fruits and related products development/Ethiopia" knowledge on the chilling requirement of the different cultivars is essential in order to bear optimum fruit production from apple plant.

Reducing the number of flowers and fruits through regular thinning practices until each plant retains about 200 fruits is also a widely used practice on apple.

Ilu Sanbitu is an ideal kebele for growing many highland fruit crops as land is not a constraint. In addition to apple, lots of temperate fruit crops including pear, peach, plum, olive, almond, walnut can be grown.

Access to inputs: Farmers have some form of information on new technologies in relation to cultivation practices, population density, use and methods of application of different fertilizers, and application of different chemicals for each vegetable crop. They, however, indicated that they cannot keep the harvest longer as they do not have vegetables store or DLS for their potato seed tuber. Concerning the support they receive, the farmers group indicated that the contribution made by both BoA and Africa RISING was important, but, are not yet very much pleased with the vegetable production practices as it is labour intensive and costly.

Farmers purchase and use all inputs including fertilizer, and insecticide/fungicide from the market with a very high price. They buy for instance, an insecticide "highway" with 1600.00 birr/0.5, a

fungicide redox with 480.00 birr /0.5 , hundred kg urea with birr 1390.00 and DAP with about 1600 birr. They said this is very expensive for them, and seeking interventions to minimize these costs.

Sources of planting materials: Farmers are purchasing seeds from different sources. Over 85% of men and 98% of women irrigation respondents indicated that they purchase vegetables seed for planting from local market and about 14% of the men respondents indicated that they get seeds from NGO. Also, 58% of men and 90% of women non-irrigation users buy seeds from the local market and a few get from NGOs.

Farmers also the risk of buying seeds from the local market, as most of the seeds are not clean and very poor in their germination. This is a serious issue for many concerned ones for there is not any well-established regulatory system, at least for horticultural crops. There is a need to develop a strategy to be looked at how inspection could be regularly made with the traders and also with the users.

Concerning potato, because farmers do not have seed tuber store like DLS which keeps the seed tubers longer they sell all the tubers they harvest cheap at harvest and buy other tubers at the time of planting in much higher prices, amounting to 1000.00 birr per 100 kg. Constructing DLS on collective or individual basis is helpful to retain the seed tuber younger and longer.

Vegetables and fruit crops growing sites: Several vegetable crops and apple are grown in many areas in this kebele. About 80% men and 76% women led irrigation users produce some type of vegetables and fruits at homestead. Also those without irrigation access grow vegetables at homestead during the rainy season. About 20% and 25% of men and women irrigation users, respectively, also produce vegetables on irrigable land in the main field. Growing vegetables and fruits in the homestead may give some opportunity for closer supervision but also limits the production and income because of relatively small land size. As land and water are not major limiting production factors in these area farmers should be encouraged to produce more by planting in a wider area. Both men and women groups also indicated that their family members would like to eat more diverse vegetable. The involvement of BoA and several NGOs' contribute a great deal for they encourage farmers in many ways to produce more vegetables and use them as a source of food and income.

Market opportunities: The access to water from Shaya River, spring and well during the dry period has benefitted Ilu Sanbitu's farmers to produce more vegetables at least twice in a year. As indicated on the value chain in Figure 1, Ilu Sanbitus' farmers sell the vegetable produces on the nearby small market or village (7-10 km) on Saturday each week (senbete market) or by travelling to Robe (15-20 km). They also sometimes sell for traders at the farm mostly when they are occupied with some other business, or when they are in short of money to cover long travel costs. The traders take the vegetables further south to Robe and/or Senbete market to Somalia boarder or to Shashemene supplying Addis Ababa. Farmers often sell their produces without information on market prices. Establishing a market information system about prices and the market situations could be very beneficial for farmers. Unlike other regions, we did not encounter middlemen in Ilu Sanbitu and vegetables are sold simply on agreement basis between the seller and the buyer.

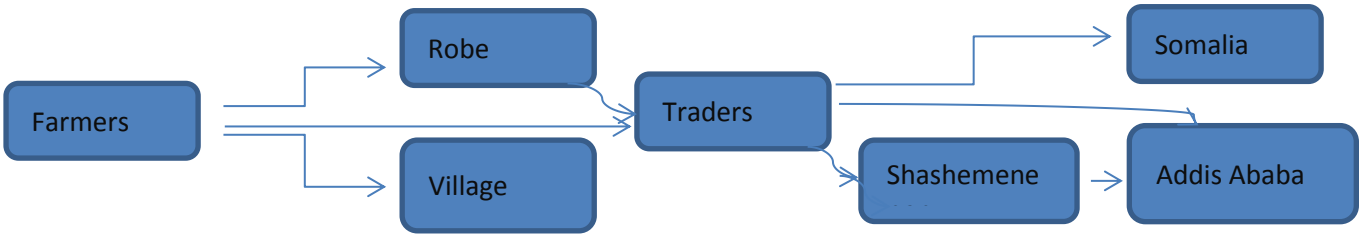

Figure 1. Value chain of vegetables produced at Ilu Senbitu

Also, concerning responsibilities, the involvement of women in vegetables production is very high as the man were commonly busy with other jobs. During discussion with the women group they also indicated that women in most households are responsible for selling vegetables as well. The women groups were to diversify their fruit crops production as a source of income but also to diversify their household nutrition.

Selka

Land use: The average total land size owned by a household is up to 50000 sq meter (Table 3), with most land being a cropland. However, the land size allotted for vegetables and fruits by men was very small, which is about 846 sq meter (1.69) %, and 7.77 sq meter (0.016 %), while land that allocated by women-led household for vegetables and fruits was 197.14 sq meter (0.44%), and 14.29 sq meter (0.031), respectively (Table 3).

Moreover, the number of vegetable growers was very few in number in this kebele. According to the development agent, the number at of vegetable producers is about fifty.

Table 3. Average total land holding, cultivated land, and vegetables and fruit crops land by men and women house holders Selka, Sinana

Characters	Non Irrigation			
	Men		Women	
	Land size ($m^{2)}$	Percentage (%)	Land size ($m^{2)}$	Percentage (%)
Average total land holding	50000		46921.43	
Average cultivated land	50000	100	44957.19	95.81
Average land for vegetable growing	845.56	1.69	197.14	0.44
Average land size for fruit crops production	7.77	0.016	14.285	0.031

Water sources: There is no surface water source at Selka in all of its sub villages. The water depth in this area is relatively deep, reaching more than 20 meters, which requires external support to develop the wells. There is a possibility of diverting the river Tagona, which is flowing through the nearby watersheds. According to the Irrigation Authority of Sinana woreda there is a program to start water harvesting establishment in the kebele in the coming few years. As most land are gentle slope and very much convenient rainwater harvesting could be employed for growing vegetables and fruit crops during the dry season.

Vegetable crops growing and their constraints: Some household in this kebele grows potato, cabbage, onion, lettuce, and swischard, mainly during the main rain season. Of this, potato, head cabbage and onion have a lot of demand and make good money for the growers. The problem with the production of vegetables during the rainy season is the land size. Both men and women in this kebele carry out growing vegetables, but the involvement of women at homestead is by far more than the male.

Constraints

- Farmers in the kebele are in short of quality seeds and are also suffering from red ant on potato. Theft and livestock intervention, however, are not major problems.

- Market problem particularly for potato is seen as a major constraint. Because many growers are planting it as the rain advents and also harvests nearly at the same time, as a result many sell with a lower price.

Fruit crops growing and the constraints: As there is no surface water source, most farmers did not grow fruit crops. Very few, however have planted very few number of apple (up to five) seedlings. During the dry season farmers water the seedlings from what they use for drinking. However, there is a high potential in this area for growing different kinds of fruit crops if shallow well development or water harvesting is practiced. Apple, pear, peach, plum, olive, almond, walnut could be grown.

Access to inputs: Farmers purchase fertilizer, seeds and insecticide/fungicide from the market with a very high price. These inputs are basically very costly to an ordinary farmer. Unless the situation is very forcing, farmers do not opt to apply chemicals on their plant.

Sources of planting materials: Nearly all men and women farmers groups indicated that they use seeds, which they purchased, from shops. Seeds purchased from these shops often were inferior quality and were very poor in their germination. To overcome this problem, BoA needs to work with traders to make quality seed available at kebele shops.

Vegetables and fruit crops growing sites: Farmers grow and produce different kinds of vegetables during the main rainy season. About 90% of both men and women farmers grow lettuce, head cabbage carrot and many others at homestead, close to their home mainly for the purpose of using empty space and easy handling. Most farmers are currently interested with the production of vegetables for they realized that it is a good source of food and income.

Market opportunities: Farmers produce and sell vegetables in this kebele following the same value chain indicated on Figure 1. They travel twice per week to the small market located in the nearby area (10 km) or travel to Robe (40 km) in order to sell their vegetables. Farmers also sell directly to the buyers at farm gate prices. Most take for instance potato to Shashemene and or further to Addis Ababa.

Institutional support: BoA supports farmers through organizing and coordinating the activities while Africa RISING at Robe encouraged supported farmers through providing technical assistance, demonstrating new technologies and making available potato seed tuber and apple seedlings to the farmers.

Mahoney/ Maichew

Emba Hasti

Land use: The total household of the kebele is 1402, of this 362 are men and 640 are women. The average landholding varies between 0.25-0.50 ha. The average land holding size is 40625 sq meter.

The average total land size by men led irrigation user at household level is 3888 sq meter (Table 4). From this, a farmer cultivate nearly 86 % of the total land, of which 6.53 % is used for growing vegetables, and a small proportion which amounts to 2.79 % is used for fruit crops (Table 4). The irrigated land size in this kebele is about 687.5sq meter (20.63% of the cultivated land). Several women also grow vegetables and fruit crops in this kebele. The land size for growing vegetables in this kebele per household is about 331sq meter (8.151%), fruit crop 25 sq meter (0.615%) (Table 4). Women also grow different vegetables and fruit crops without irrigation. There are no fruit crops, however, grown by the samples women-led farmers but about 367.5 sq meter (16.57%) of their cultivated land is used for growing vegetables.

Table 4. Average total land holding, cultivated land, and vegetables and fruit crops land by irrigation and non-irrigation users at Emba Hasti, Maichew

Characters	Irrigation				Non irrigation			
	Men		Women		Men		Women	
	Land size (m^2)	Percentage (%)	Land size (m^2)	Percentage (%)	Land size (m^2)	Percentage (%)	Land size (m^2)	Percentage (%)
Average total land holding	3888.89		4062.5		3225		2187.5	
Average cultivated land	333.33	85.71	4962.5	100	2600	80.6	2187.5	100
Average land for vegetable growing	551.11	16.53	331.25	8.15	192.5	7.40	362.5	16.57
Average land size for fruit crops production	93.06	2.79	25	0.615	25	0.96	No fruit	
Irrigated land	6897.5	20.63	868.75	21.38				

Water sources: Most of the farming communities at Emba Hasti access water from rain, spring and shallow wells. The spring water is available in many farms and well water by some farmers at household. During the dry season most farmers are dependent on springs for their drinking water and also for their vegetables. The water is pumped (photo 1a) and placed in a container (photo 1b) and from where it is distributed through channels. According to BoA woreda, farmers use both traditional furrows and modern diversions. The farmers themselves make the traditional river diversion while the modern diversion was well built and cemented by the government, which is managed by a water father. The farming community receives water turn by turn in groups. Each group has up to 20 members, and takes more than 20 days each to irrigate get their turn. Farmers irrigate day and night. Some indicated that getting enough water is difficult because of the high number of users. Some farmers have established private ponds and used it for their own demands, but also rent for their neighbours.


Photo 1(a and b) water pump and pond at Emba Hasti

Vegetables growing and the constraints: Farmers grow different kinds of vegetables in this kebele. Vegetables like potato, onion, garlic, carrot, and beetroot; leafy vegetables including head cabbage, lettuce, swischard and tomato are grown. Very few people grow tomato. Farmers in this kebele also practice intercropping by planting small sized vegetables between rows. For instance, farmers use the row space between carrots for planting small vegetables like lettuce. Also, they use the farm boarder for planting cabbage and other vegetables. This is a common practice in this area as part of the effort to use every piece of empty space to grow crops.

The dominant cash crop in the locality is 'Ensosila', which is used by women as a cosmotic plant. Farmers also use " Ensosila" field for planting other vegetables while the roots are there. They plant lettuce, swischard and other leafy vegetables carefully between the rows or right on the "Ensosila" root. They do this when they do not harvest the ""Ensosila" mainly due to market reasons. Concerning the general growing practices, farmers have received training and advice from development agents and non-governmental organizations (e.g. Africa RISING), which have helped them considerably to produce different vegetables.

Constraints: Market price of fertilizer, insecticide and fungicide is very high and is a major problem for many farmers. Farmers indicated that high price of urea fertilizer which is about 1147.00 birr /100 kg and DAP about 1500 birr/100 kg, is very high, and unaffordable. Also, pesticide and fungicide are very expensive, hence are very much reserved from applying them on their vegetables.

During discussion with the women, elder and farming group, land shortage was mentioned as the major problem, where the average land per household was 0.25-0.50 ha.

Fruit crops growing and the constraints: Most farmers have planted small number (up to ten) of apple fruits at homestead per household. They planted them with a spacing of 2m by 2m and were with a height of 1.25-1.50 meters by the time they were visited. As indicated at Ilu Sanbitu in order to flower and bear fruit apple requires low temperature of about 3-8^{o}C for several days. This chilling hour is essential to bloom flowers and bear fruit. Most commercial apple varieties require 1200+300 chilling unit, defined as hours at optimum chilling temperature between 3-8^{o}C. Most apple varieties are very specific with their requirements. In addition to this, fruit thinning is another important practice in apple farm, which farmers have to practice. Removing flowers and fruits and determining number of fruits per inflorescence is a common practice. Two hundred fruits per plant is optimum for a five old single plant. As some farmers own more land area, they can grow other temperate fruit crops, which may include apple, pear, peach, plum, olive, almond, and walnut.

Access to inputs: Accessing input at Emba Hasti is relatively well chained and organized. All the concerned government offices are involved in making available the needed input to farmers. The BoA office at the regional and woreda levels is very much engaged with farmers. They avail inputs such as fertilizers and chemicals in a better-organized mode than the other regions as indicated in photo 1.

Sources of planting materials: Unlike other sites, seed is not a serious problem in this kebele. About 68% of men irrigation user, and each 50% of women irrigation and non-irrigation users indicated that they buy seed from BoA while the remaining respondents purchase vegetable seeds from the local market. Farmers groups indicated that whenever they buy from the market, the planting materials are very weak in their germination, less pure and costly.

There is a strong linkage between district BoA, Input authorities, Union and individual farmers are also connected from top to bottom and from bottom to top. The woreda BoA and farmers Unions exchange information on the availability of seeds and other input. The Union is any input he wants without even being the member of the Union. Most of the vegetable seeds were therefore bought from Unions.

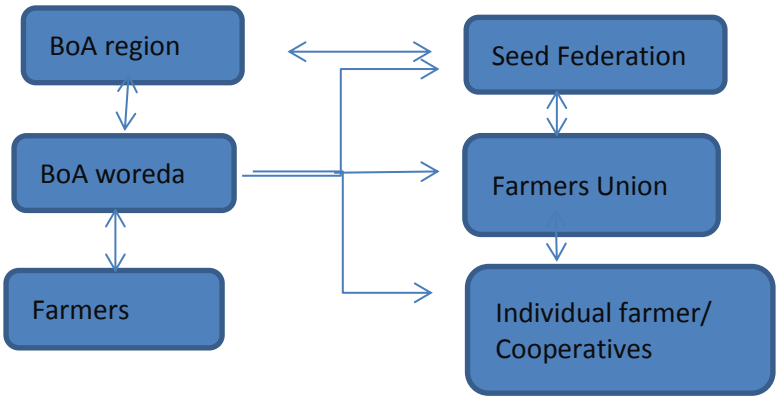

Figure 2: Linkage among different offices in order to purchase seeds at Emba Hasti

Vegetables and fruit crops growing sites: Most men (55.11%) and women-led irrigation users (65%), and also all women and about 75% of the men non-irrigation respondents indicated that they grow vegetables at their homesteads. Very few number of both men and women led irrigation users also grow on farm borders, and valley bottoms. About 35 % of men and 5% women use irrigable areas for vegetable production. Growing vegetables at homestead allowed farmers' day-to-day follow up but also use the fertile spots of their farm around. The small land size per household is a major constraint, which has limited the expansion a greater extent.

Market opportunities: The market opportunity for vegetables is very high at Emba Hasti. The vegetable marketing passes through various market chains as indicated on Figure 3. Farmers sell their produce by transporting it to Maichew, which is about 10 km from their village but also to Raya or to Alamata and Mekele. Sometimes they sell it by calling traders to their villages. In these situations, there is no involvement of middlemen.

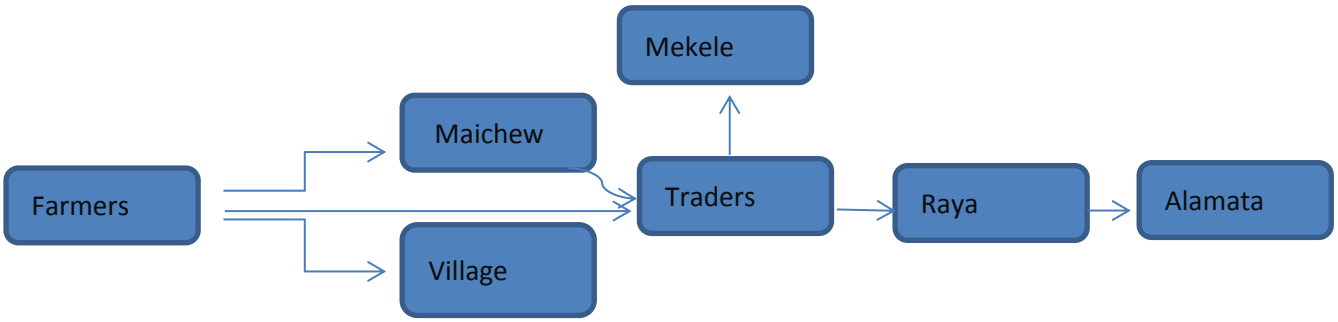

Figure 3: Value chain of vegetables produced at Emba Hasti

Farmers grow different vegetables and earn more money when they grew it with irrigation as compared to without irrigation i.e. during the rainy season (Table 5). They also use both standard scale and subjective measurement (e.g hand holds) for selling some of their produces (Table 5)

During our last visit to the sites, most farmers have not yet harvested apples as most of them are only one year old from the time of transplanting. There are, however, other few farmers who established apples some four to five years earlier than the recent one. One could collect up to 200 apple fruits /tree and sells up to 40 birr per kg. Farmers also take care of their cattle, from destroying the apple trees through cut and carry system and controlled grazing.

Table 5 Price of some vegetables when produced during the rainy season and using irrigation

Vegetables	Without irrigation/Rain	Irrigation
Potato	400-500 birr/100 kg	450-600 birr/100 kg
Cabbage	4-8 birr/ medium head (3kg)	15 birr/ medium head (3 kg)
Swischard	5 birr/ hand hold	7-8 birr/hand hold
Lettuce	5 birr/ hand hold	5.00 birr/ hand hold
Carrot	300 birr/100 kg	400 birr/100 kg
Beet root	300 birr/100 kg	500-550 birr/100 kg

Farmers often decided on the price of their produces suggesting that they have a strong bargaining power over traders. Moreover, nearly all respondents indicated that they would like to continue working on vegetable production as they are becoming major sources of income and as a source of food.

Institutional support: BoA and Africa RISING supported farmers to produce some vegetables and fruit crops in the year. Farmers indicated that BoA encouraged them by giving planting materials, organizing and training them to produce more high value produces. Africa RISING has been encouraged them through different programs including by supplying potato seed tubers and apple seedlings.

Questions on potato DLS and other means of vegetables storage were asked but farmers responded that they do not store the seed tubers or other vegetables. Thanks to the relatively cold climate potato seed tuber could be kept for about two-three months depending on the variety. After keeping it for a certain weeks it should be sold before it sprouts, or be stored in diffused light store (DLS) in order to arrest its sprout growth. Constructing DLS on group or individual basis might be helpful in order to store the seed tuber, at least for about eight months.

Tsibet

Land use: Tsibet is a highland located with a peak height of 3935 masl from the seal level. It is about 20 km from the town of Maichew. It receives rainfall twice in a year in which the first one is between mid-June-September, and the second one between March and April. The average landholding varies between 0.25-0.50 ha. The total household of the kebele is 1147, of this 885 are men and 262 are women.

There are both irrigation and non-irrigation users. The average total land held by men led irrigation farmer at household level is 3705 sq meter, of which 3333 sq meter (91.35%.) is used for growing different crops (Table 6). The land which is in use by men led household for growing vegetables is about 694 sq meter (20.56%), while for fruit crops is about 297 sq meter (8.78%) (Table 6). The irrigable area in this kebele is about 1366.6 sq meter, which is about 40.37% of the total cultivated land (Table 6). Also, the average land held by the men non irrigation users is about 4000 sq meter, of this about 3500 sq meter (87.5%) is used for growing different crops. From the total cultivated area, the vegetable crops are grown on an area of about 469 sq meter, which is about 13.49% of the cultivated land, while the fruit crops are on 8.4 square meter which is very small in size taking 0.24 % of the cultivated land size (Table 6).

Table 6.Average total land holding, cultivated land, and vegetables and fruit crops land by irrigation and non-irrigation users at Tsibet, Maichew

Characters	Irrigation				Non irrigation			
	Men		Women		Men		Women	
	Land size ($m^{2)}$	Percentage (%)	Land size ($m^{2)}$	Percentage (%)	Land size ($m^{2)}$	Percentage (%)	Land size(m^2)	Percentage (%)
Average total land holding	3705		3333		4000		-	-
Average cultivated land	3383	91.3	3333	100	3500	87.5	--	-
Average land for vegetable growing	94.469	20.1	1016.67	30.56	469	13.4	-	-
Average land size for fruit crops production	297.14	8.78	16.67	0.5	8.4	0.24	-	-
Irrigated land	1366	40.37	1458.33	43.75				

Water sources: According to BoA office, the community in this kebele have access to different water sources, including rainwater, springs, and shallow wells. Most farmers are dependent on springs for their drink and also for irrigating their vegetables, particularly during the dry season. Similar to Emba Hasti, irrigation water distribution among water users is highly organized and administered by a water committee. Each member irrigates its farm on turn-by-turn basis in which case the number of turning days depending on the number of members and the amount of water available. The turn for irrigation might be once in every twenty days, even more. The relatively longer time to irrigate could be a problem in many households. Some farmers informed us that they could water their farm using small containers.

Vegetable crops growing and constraints: Different vegetables crops have been growing in the area for a long period of time. For instance, shallot has been growing in the area for the last 40-50 years, while lettuce and swischard for the last 25-30 years. Areas close to the peak of Tsibet is cold and identifying high value crops for this locality might be helpful. The failure of formation of head of cabbage and the failure of tuber from the stolon of potato for instance might be due to the effect of very low temperature. Avoiding planting head cabbage in this area and also identifying the cold tolerant potato cultivar that suits to this area might be helpful. Crops like garlic and onion, however, do well in this area.

Like Emba Hasti at Tsibet vegetables are planted both in a row and Intercropping between rows of other plants but also planting along the farmer border is practiced. Because insect pests and diseases are rarely occurring owing to low temperature, they do not also apply chemicals on vegetables. The experience they have for years and the advice they get from development agents and NGOs helped them considerably to produce different vegetables.

Fruit crops growing and the constraints: Like at Emba Hasti most farmers have planted small number of apple fruits at homestead per household. They planted the seedlings they received from Africa RISING with a spacing of 2m by 2m and make regular follow up. In addition to Chilling, fruit thinning is becoming another important practice, which farmers have to focus in apple production. Removing flowers and fruits and determining number of fruits per inflorescence as per the variety is an important point to look at. Two hundred fruits per plant is optimum for a single plant, and take about 5-6 months to mature. As there are some farmers with a bigger area they can grow other temperate fruit like pear, peach, plum, olive, almond, and walnut

Access to inputs: Accessing input in the kebele is well chained and organized as indicated at Emba Hasti (photo 1). The sources are multiple and relatively better organized consisting various groups including BoA and Unions. Seed is available for anyone who wants to buy from the Union.

Source of planting materials: About 44% of men irrigation users, and 67% and 40% women irrigation and non-irrigation users, respectively, indicated that they buy seeds from BoA, while about 20 % obtained it from NGO. The remaining 17-40% men and women irrigation and non-irrigation users purchase seeds from the local market. Purchasing seeds from unknown source is commonly risky because of quality issues.

Vegetables and fruit crops growing sites: In this kebele, about 25 % men irrigation users, and 86% men non-irrigation users grow their vegetables at homestead, and some 4-10% men and women irrigation users, and men non-irrigation users grow at the farm borders. But, about 56% men irrigation and 93% women irrigation users grow at irrigable land. The interest is enormous to grow vegetables and fruit at homestead and also at irrigable area. Because of limited land size, farmers are trying to use all potential niches including planting at the farm borders, using intercropping, and planting on plots occupied by “ensosila”.

Market opportunities: Farmers produce vegetables twice in a year for food at home and also as a source of income. Although the return seems to be good, farmers travel more than 20-30 km, twice a week to Maichew markets. Those selling at farm gate, sell to traders, who would take it further to Raya. During the transaction middlemen rarely involves.

Institutional support: Similar to Emba Hasti**,** BoA and Africa RISING helped farmers to produce vegetables and fruits. They support them in different forms including providing technical assistance, supplying input, and training and also providing planting materials like apple and potato seed tuber.

Gudo Beret/Debre Berhan

Gosh Bado

Land use: Gosh Bado is a mountainous landscape with an average altitude of 2761 masl. The soil type is dominantly vertisol and nitosol. The average landholding is 0.50-0.75 ha. Total area of the kebele is about 6800 ha, of this land, 1680 ha is for cultivation, 265 ha for grazing, 137 ha for forest, 155 ha for bush land. The climatic zone comprises highland (dega) (17%), semi highland (woinadega) (80%) and lowland (kola) (3 %). The total household number is about 1800, but those that are organized under development group is 1124, of which 950 are men and 174 women. Cultivation in this kebele is cereal dominant (50%).

Gosh Bado kebele consists five villages: Gosh Wet, Gosh Wuha, Atse Wuha, Talak Amba and Denjan. Of this, Africa RISING is currently active at Talak Amba and Denjan villages (workgur sub village). Sub villages of Talak Amba are: Kombel, Gogamba, Kertie, Zer, Gosh Bado no 1, Gosh Bado no 2, Woira, Betekristian Amba, Aredo and Sembogel, while sub villages of Denjan are Shinet, Workgurteg and Workgur.

At Talak Amba cereal crops: teff, wheat, barley, legume: faba bean, pea, grass pea, lentil, chickpea, fenugreek; spices such as rosemary and basil; and several vegetables including potato, garlic, shallot, carrot, beet root, kale, swischard, lettuce; and fruit crops such as apple are growing. In the valley bottoms at Denjan, most of the crops that grow at Talk Amba grow. They also grow additional crops including sorghum, maize and oil crop such as saff flower; and coffee.

The average total land size of the men-led irrigation users is 3950 sq meter, of this the total cultivated land is 3156.25 sq meter, which is nearly 80% of the total land (Table 7). Land for growing vegetables is about 360.83 (11.41%) and for fruit crops is about 71.8 sq meter (2.27%) (Table 8). The irrigable land in this farming land is about 562 sq meter, 17.3%). Women-led groups also grow different crops using irrigation on a total land size of 1000 sq meter. The total irrigated land owned by women-led households is about 1000 sq meter, which is 18.33% of the cultivated land.

The women-led non irrigation users possesses a total land size of about 3928 sq meter, of this about 3214 sq meter (81.8%) are used for growing different crops. The land size of vegetables is about 192 sq meter (6%) and fruit crops about 102.14 sq meter (3.17%) at household level (Table 7).

Table 7. Average total landholding, cultivated land, and vegetables and fruit crops land by irrigation and non-irrigation users at Gosh Bado, Debre Berhan

Characters	Irrigation				Non irrigation			
	Men		Women		Men		Women	
	Land size ($M^{2)}$	Percentage (%)	Land size ($m^{2)}$	Percentage (%)	Land size ($m^{2)}$	Percentage (%)	Land size(^{2})	Percentage (%)
Average total land holding	3950		1000		5625		3928.51	
Average cultivated land	315.25	79.9	7500	75	4053.6	72.06	3214.3	81.8
Average land for vegetable growing	860.83	11.4	500	6.67	646	15.94	192.8	6
Average land size for fruit crops production	71.8	2.27	500	6.67	102.88	2.54	102.14	3.17
Irrigated land	562.03	17.3	1000	13.33	50	1.23	0.107	0.003

Water sources: Farmers use springs and wells as major sources of water during the dry season. Springs are available at the sub village Shinet and Workgurteg of the village Denjan, and also at the villages of Gosh Wet, Gosh Wuha, and Atse Wuha. There is no surface water source, however, at Workjur sub village of Denjan, and at all sub villages of Talak Amba: Kombel, Gogamba, Kertie, Zer, Gosh Bado no 1, Gosh Bado no 2, Woira, Betekristian Amba, Aredo and Sembogel. In Workjur of Denjan, and at Kombel of Talak Amba rainwater harvested in a pond during the rainy time is used for growing vegetables, apples and other crops during the dry period. This is an important practices, which could be practiced elsewhere in villages where there is no surface water sources.

Photo 2: Water harvesting at Workjur of Denjan village, Gosh Bado kebele

Vegetables growing and constraints: The kebele consists villages with various altitudes and microclimates, which created opportunity to grow diverse crops. At Talak Amba and Denjan (workjur) where the Africa RISING is active, vegetables including potato, onion, garlic, carrot, beetroot, kale, lettuce, swischard and tomato are growing. In this kebele, garlic, onion, beetroot,

shallot and carrot were produced more with irrigation than non-irrigation (Table 8). The yield obtained was also much higher with irrigation than without irrigation. Because cereals and legumes occupied most of the areas during the rainy season, the amount of land allotted for vegetables was small (Table 8). Potato also makes good money during both seasons in relation with the area it possessed.

Table 8. Production and income of some vegetable crops grown with irrigation and without irrigation at Gosh Bado kebele, Debre Berhan

	With irrigation					Without irrigation (rain)			
Vegetables	Yield (qt/ha)	Price (birr/kg)	Total area (ha)	Prod'n (qt)	Total income (birr)	Price (birr/kg)	Total area (ha)	Prod'n (qt)	Total income (birr)
Potato	256	5	4	1024	512000	8	3	768	614400
Garlic	130	24	7	910	2184000	35	2	260	910000
Shallot	50	12	13	650	780000	16	2	100	160000
Onion	150	10	10	1500	1500000	14	1	150	210000
Carrot	190	3	14	2260	678000	6	3	570	171000
Beet root	230	5	5	1150	575000		3	690	207000

*Data on crops yield, price, and area of the year 2013/2014

Constraints: Several factors are affecting the vegetable production, which the following are the major ones

- Seeds are serious problem in this kebele for they are not available by the time farmers want to buy them. Seeds, which they buy from the shop, often are very poor in their germination and also are very costly.

- Small land size /household (0.50-0.75 ha) is another major problem in the kebele.

Fruit crops growing and constraints: Due to the diverse microclimates, apple from highland crop; banana, and "kasmir" from tropical and subtropical fruits are grown. Africa RISING supplied several cultivars of Apple to farmers, which were planted mainly in homesteads with a spacing of 2m by 2m. As the growing environment is very ideal for lots of temperate fruits, which include pear, peach, plum, olive, almond, walnut can be grown.

Access to input planting materials: Farmers often buy seeds, fertilizer, and chemicals from kebele shop with a reasonable price, which was availed by BoA. However, farmers were commonly forced to purchase from the local market with much higher prices. About 42% of men irrigation users and very few women non-irrigation users purchase from BoA. But, also about 21 % of men irrigation users and 44 % women non-irrigation users purchase from local market.

Vegetables and fruit crops growing sites: About 79% men irrigation users, and 45% men and 42 % women non-irrigation users grow their vegetables at their homestead, while the others indicated that they grow on irrigable land. Most grow at homestead for it is easy for their day-to-day supervision, and also to use the limited space they have.

Market opportunities: Variety of vegetables and fruit crops are grown due to the variable microclimates in the kebele. Vegetable in particular follow the ma sell it right on the farm, before it

is harvested or after harvesting it. In general, middlemen are rarely involved during the selling and buying processes.

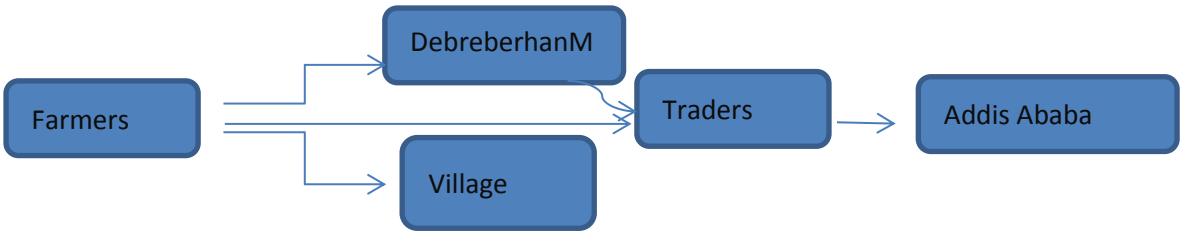

Figure 4: Value chain of vegetables produced at Gosh **Bado**

Institutional support: BoA, and NGOs' such as Adheno and Africa RISING helped farmers to produce vegetables and fruits. Adheno has been distributing several vegetables seeds and apples for several years now. Africa RISING also did the same last year. Both institutions encouraged farmers through providing technical assistance, supplying input, and training and also providing planting materials like apple and potato seed tuber.

Gudo Beret

Land use: Gudo Beret is located at an average altitude of 3081 masl, with an average temperature of 6-20^{0}C, and average rainfall amount 950-1200 mm/annum. The soil type of the kebele is nitosol (17%) and Cambisol (83%). Total area of the kebele is about 5010 ha, of this 2497 ha is used for cultivation, 923 ha for grazing, 24 ha for forest. It is dominantly cool highland (3758 ha), 22% moderate climate (1102 ha), and 3% hot climate (150 ha). In all villages, cereal is dominant (50%), followed by legume (35%); and vegetables (10%) and fruit crops (5%). The average landholding is 0.50-0.75 ha. Several vegetables including potato, garlic, shallot, carrot, beet root, kale, swischard, lettuce and fruits: apple are growing. The household of the kebele is 1062, of this, male is 830 and female 232.

The average total land size of the male led household irrigation users at Gudo Beret is 11406 sq meter, of this, the average cultivated land is 9687.5 which is nearly 85% of the total land size (Table 9). Vegetables in this kebele are grown on about 775 (8%) of the cultivated land and fruit crops on about 317.5 sq meter (3.28%).The irrigable land in this farming area is about 847.35 (8.75%) (Table 9).

Woman led who use irrigation also owned a total land size of 13571sq meter, of which they cultivate and grow crops on a total land size of 10625 sq meter, which is 78.37% of the cultivated land (Table 9). Vegetables at Gudo Beret are grown on 667.85 sq meter (6.28% of the cultivated land) at household level, and fruit crops on 293.2 sq meter, (2.76 %). The irrigated land owned by woman in this kebele is high reaching 1089.29 sq meter, which is 10.25 % of the cultivated land (Table 9). The land used for vegetables from the cultivated land is 283.5sq meter (6.96%), and fruit crops about 133.33 sq meter (17.02%) (Table 9).

The women headed non-irrigation users own a total land size of 7500 sq meter per household, and all for growing crops. The area for vegetables is 100 sq meter per household, which is 1.34% of the cultivated land.

Table 9. Average total land holding, cultivated land, and vegetables and fruit crops land by irrigation and non-irrigation users at Gudo Beret/ Debre Berhan

Characters	Irrigation				Non irrigation			
	Men		Women		Men		Women	
	Land size ($m^{2)}$	Percentage (%)	Land size ($m^{)}$	Percentage (%)	Land size ($m^{2)}$	Percentage (%)	Land size(m^2)	Percentage (%)
Average total land holding	11406		135.4271		1466		7500	
Average cultivated land	9687.5	84.94	10625	78.3	11250	79.4	7500	100
Average land for vegetable growing	775	8	667.85	6.28	783.33	6.96	100	1.33
Average land size for fruit crops production	317.5	3.28	293.2	2.76	133.33	17.02	100	1.33
Irrigated land	847.75	8.75	1089.29	10.25	41`6.67	53.19	-	--

Water source and production: At Gudo Beret village both springs and rivers are available while at Lai Mush only springs are available. At Guinea Beret, however, there is no surface water source and is currently difficult to grow vegetables and fruit during the dry season. In the other villages, Tach Mush Urage and Woldab Ager there are spring.. At Tach Mush village , with semi highland climate (woinadega), there are three springs: Beteskian Ambaminch (71 household users), Shollaminch (22 household users), Tach mush deldy (32 household users) while at Woldeabager village there is one spring, Arada bomba wuha (18 household users).

Vegetables crops growing and constraints: ***S***everal vegetables, which include potato, onion, garlic, carrot, beetroot, kale, lettuce, swischard, tomato are grown in this kebele. Farmers use more or less the same land size to grow vegetables during both dry and rainy seasons, but relatively more land is used for potato with irrigation (Table 10). Garlic and potato are much preferred vegetables and have good market.

Table 10. Production and income of some vegetable crops grown with irrigation and without irrigation at Gudo Beret kebele, Debre Berhan

	Irrigation					Without irrigation			
Vegetables	Yield (qt/ha)	Price (birr/kg)	Total area (ha)	Prod'n (qt)	Total income (birr)	Price (birr/kg)	Total area (ha)	Prod'n (qt)	Total income
Potato	256	4	23.5	6016	2406400	4	35	8960	313600
Garlic	130	10	4.5	585	585000	10	5	650	650000
Shallot	120	7	3.2	384	268800	7	1	120	84000
Carrot	65	6	3	195	117000	6	3	195	117000
Beet root	90	5	0.25	225	112500	5	3	270	135000
Head cabbage	65	5	1.5	97.5	48750	5	-	-	
Kale	65	5.6	2	130	728	5.6	3	195	109200
Swischard	85	6	0.25	21.25	127.5	6	3	195	117000

*Data on crops yield, price, and area of the year 2013/2014 was collected from the Bureau of Agriculture, Gudo Beret kebele

Constraints: The constraints indicated at Gosh Bado also holds true in this kebele. Source of seeds and land shortage, which is 0.25-0.50 ha/household are the major constraints.

Fruit crops growing and the constraints: Apple from highland crop; banana, and "kasmir" from tropical and subtropical fruits are growing well in this kebele. As that of Gosh Bado, lots of temperate fruits, which include pear, peach, plum, olive, almond, walnut and other tropical fruits like banana can be grown.

Access to input and planting materials: BoA is responsible for availing seeds, chemicals, fertilizers and other inputs. About 37.5% of male irrigation users and all women and male non-irrigation users purchase from BoA. But, also the male irrigation users get about 25 % from his neighbor and the same amount from NGO. Those that are purchasing from the market are not happy with the quality of seeds for they are unclean and with poor germination.

Vegetables and fruit crops growing sites: About 78% male and woman irrigation users, and all male and women non-irrigation users raise their vegetables and fruits at homestead. Some male and women (59 and 64%, respectively) grow in irrigable area. In general, many farmers are interested to continue growing vegetables and fruit crops production as source of food and income.

Market opportunities: The market opportunity for vegetables and fruits is very high in this kebele because of enormous possibilities to grow different fruit crops under different agro-ecological conditions. Both temperate and tropical fruit crops can be grown. Currently farmers sell their produce in nearby small markets, but also they take to Debre Berhan town, 30 km from Gudo Beret.

Institutional support: BoA, and NGO's including Africa RISING made considerable contributions for the production of vegetables and fruits through providing technical assistance, supplying input, training and also providing planting materials like apple and supplying potato seed tuber.

Major pests and diseases of horticultural crops

Pests and diseases are already undermining the returns of horticultural investments. An alarming build has already threatened most schemes up of pest and diseases, including on garlic, potato and fruits like apple and mango. Disease incidence was much more apparent in irrigated fields than rainfed homestead fields. The major reason is that the same field is used for growing the same vegetable or related species year-in year-out, which helped to build up the stock. This was apparent in some of the sites (e.g. Mehoni), where farmers are thinking of abandoning the production of onions and garlic due to high incidence of powdery mildew, rust and purple blotch. Bekele (1985) also reported that both are major diseases of onion and shallot, which could cause a significant decrease in yield and quality. Treating young plants with Ridomile (2-5 kg ha-1) is considered effective to minimize yield losses.

Despite the increasing demand for potato tubers across the sites, potato late blight remained to be a serious constraint. The disease incidence is the highest when the crop is grown during the main rainy seasons. However, there are multiple strategies developed by Holeta Research centre that could be used to minimize yield losses. Gebremedhin etal, (2006) indicated that there are varietal differences in resistance to the disease. In cool highland environments variety Genet was the best variety followed by Menagesha. Moreover, most farmers preferred Genet because of its tuber color, tuber size and vegetative growth habit while others preferred Menagesha because of its tolerates to other adverse conditions like other diseases and hail damage. Another strategy was to educate farmers using farmers' field school approaches to implement integrated disease management interventions, which combines chemical, agronomic and physical control of the disease. Management of clean seed, including through DLS is one effective strategy that has been proven to work across regions.

Apple trees are prone to several pests and diseases depending on different local conditions. It is Severe infestations could cause a 100% yield loss or even kill the whole plant. Apple fruit share common diseases across the different sites, particularly in those trees older than two years. The most important diseases occur in these areas are predominantly apple scab, powdery mildew, and Leaf spots.

Our observations calls for an integrated pest and disease management in these districts, particularly in irrigated fields, whereby clean seed, crop rotation, uprooting of infested plants, careful management of farm implements and pesticides are used complementarily. The ratio of break crops (food legumes including beans, chick peas or annual forage legumes) in the cropping pattern should be at least 20%. We also recommend for the Woreda experts to identify innovative farmers along with the farmers groups within each irrigation schemes, organize exchange visits to successful schemes, facilitate farmer to farmer exchange and organize training events where they capture good practices through pictures, videos, posters. The site coordinators should also develop competitive incentive mechanisms for promoting farmer innovation, including small financial rewards.

Best fitting commodities

Sinana

Ilu Sanbitu

Vegetables: Ilu Sanbitu is very ideal for growing different kinds of vegetables and highland fruit crops. Its temperature that ranges between 9-21^{o}C is very much optimum for most of vegetables including potato (17-23^{o}C), Allium species: onion, shallot, garlic (9-25^{o}C), cabbage family, lettuce, swischard (15-20^{o}C) , and carrot and beet root (14-25^{o}C).In this kebele, there is a high market on potato, head cabbage, onion and garlic (Table 11) than others, and famers may need to produce more of these.

Fruit crops: Different highland fruit crops including apple, peach, plum, olive, almond, walnut and other nuts can grow in this kebele (Table 11). However, apple, pear, plum, olive could better grown in this area because they have different varieties that could fit to different temperature regimes, and also make very good market. However, knowing their cultural practices including the grafting practice, root–scion relation, which varies depending on the variety, and type of fruit crops is necessary. Selection of varieties particularly in relation to the place where it is going to be established is essential. On temperate fruit crops knowledge on the variety requirement particularly on chilling requirement is mandatory. Planting alone is not enough. For instance pear, olive has varieties that require lower than -30 ^{o}C to break its dormancy and growing this crop in the place where there is no such low temperature at least for a certain number of days is not worthy.

Selka

Vegetables: At Selka, because it does not have water source during the dry season vegetable planting takes place during the main rain season. Selka in general is very ideal for growing different vegetables because it has an ideal temperature of 9-25^{o}C. Several vegetables are grown in this kebele but much more desired is for head cabbage and onion because they do not perish soon after harvesting and also give sometime until they win good market.

Fruit crops: Selka is without a water source. If water harvesting is practiced several fruit crops may be grown. Selecting dry tolerant varieties can be taken as a strategy in this area. However, apple, pear, plum can make better establishment and also make good income in this kebele.

Mahoney/ Maichew

Emba Hasti

Vegetables*:* Potato, garlic, onion, and several others indicated on (Table11) grow in this kebele both during rainy season and dry season using irrigation. Emba Hasti's average temperature (12-18^{o}C) is very ideal for growing most vegetables and highland fruit crops. Potato, onion, head cabbage make very good income in this area.

Fruit crops*:* Like Sanbitu there is no water shortage in this kebele and different fruit crops including apple, peach, plum, olive, almond, walnut and other nut can be grown (Table 11). The problem mentioned on the kind of varieties and also on the chilling requirement at Sanbitu also holds true here. In general knowing the kind of cultivar that is going to be established is very important. Apple, pear, plum , olive can be successfully grown and bear fruit if appropriate varieties that meet the surrounding chilling is planted. Information on such issue is obtained only from the variety source.

Tsibet

Vegetables: Similar to Emba Hasti several vegetables are growing in this kebele (Table 11). The latitude of this kebele reach 3400 masl and above, and the temperature reduce as one gets closer to

the peak. Garlic and onion best fits to this area. Some of the vegetables for instance head cabbage fails to make head, while potato seems to stay longer, leaf gets shrinked and smaller.

Fruit crops: types of fruit crops suggested in this kebele are similar to Emba Hasti. Because there is also low temperature at the top of Tsibet it seems very ideal for more olive to grow in this area.

Basona Worena/Debre Berhan

Gosh Bado

Vegetables: At Gosh Bado several vegetables including potato, onion, garlic and several others indicated on Table 11 are growing. The average temperature (6-20^{o}C) is very ideal for growing most of the vegetables and highland fruit crops. Potato, onion, garlic, carrot are preferred as they have a very good market in this area. Particularly carrot in this kebele is widely grown and has a very good market.

Fruit crops: Apple, peach, plum, olive, almond, walnut and other cool climate crops can be grown in this area. But, growing apple, pear, plum, olive and walnut is worthy for they can make a better income. Its being closer to the capital city is also an advantage for there are many international communities very much used to different fruits. It is, however, important to note that growing temperate fruit crops require a special attention on flowering and fruiting time and in general its growth. Therefore, knowing source of the variety, yield, and disease resistance is essential.

Because there are some low lands in this kebele, banana and avocado can better grow and make good market.

Gudo Beret

Vegetables: The temperature of this kebele which ranges between 9-22^{o}C is very ideal for growing most of the vegetable crops including potato, onion, garlic, carrot (Table 11) and also fruit crops such as apple, olive, pear and others. Potato and garlic are doing very good and preferred in the market

Fruit crops: Similar to Gosh Bado apple, peach, plum, olive, almond, walnut and other cool climate crops can be grown in this kebele (Table 11). But, growing apple, pear, olive is worthy for they can make a better income in this area. Also, knowing the chilling requirement, yield, and disease resistance of the different varieties is very essential.

As there are some low lands in this kebele, like Gosh Bado banana and avocado can better grow and make good market.

Table 11.Vegetables and best fitting commodities in different areas of Sinana, Maichew, and Debre Berhan

		Vegetables		Fruit crops	
Zone/Woreda	Kebele	Kinds currently growing	Best fitting commodity	Kinds of potential fruits	Best fitting commodity
Sinana	Ilu Sanbitu	potato, onion, garlic, carrot, beet root, head cabbage, kale, lettuce, swischard, shallot	potato, head cabbage, onion and garlic	apple, pear, peach,plum, olive, almond, walnut	apple,pearolive,plum
	Selka	potato, head cabbage, onion, lettuce,shallot	onion, head cabbage	apple, pear, peach,plum, Olive, almond,walnu	*apple, pear,plum
Mahoney/Maichew	Emba Hasti	potato, onion garlic, carrot,beet root, head cabbage, swischard, lettuce	potato, onion, head cabbage,	Pear, peach,plum, Olive, almond,walnut	apple, pear,plum,olive
	Tsibet	potato, onion garlic, carrot, beet root, head cabbage, swischard, lettuce	onion,garlic	Pear, peach,plum, Olive, almond,walnut	apple, pear, plum,olive
Gudo Beret/Debre Berhan	Gosh Bado	potato,onion, garlic,carrot, beet root, kale, lettuce, swischard, tomato	potato, garlic,onion,carrot	Pear, peach,plum, Olive, almond,walnut	apple, pear, plum,olive, walnut in highland ---------- banana, avocado in hotland
	Gudo Beret	potato,onion, garlic,carrot, beet root, kale, lettuce,swischard, tomato	potato, garlic	Pear, peach,plum, Olive, almond,walnut	apple, pear, olive in highland banana, avocado in lowland

***** There is no surface water source at Selka other than rain, which is in the main rainy season

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