Report: Creating Wealth with Seed Potatoes in Ethiopia (FIGG/39)

Prepared for the Common Fund for Commodities

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Project name	Wealth creation through integrated development of potato production (WCPP)
Date	2008-2012
Financial	Estimated total cost: US$3.86m Finance from CFC: US$2.05m (grant), of which US$0.5m provided from the contribution of the OPEC Fund to CFC. Counterpart Contribution: US$1.81m (of which US$0.51m provided by CIP and US$1.30m by public and private sector collaborating Institutions)
Project funder	Common Fund for Commodities (CFC)
Project implementers	In the evaluated areas: CIP, EIAR and Holetta research centre
Evaluating agency	Royal Tropical Institute, Amsterdam (KIT)
Evaluation date	April 2014
Country	Evaluation carried out in Ethiopia (project also undertaken out in Kenya & Uganda)
Geographical areas	West Shewa, South West Shew, Guragie and Tigray zones
Project objectives	1. To increase the availability of high quality potato seed at affordable prices; 2. To improve farmers' knowledge of crop husbandry and access to high quality seed, leading to improved yields and increased income and food security; 3. And to improve market linkages and communication between potato value chain stakeholders, leading to increased income

Introduction

The project "Wealth creation through integrated development of potato production" (WCPP) was aimed at addressing constraints faced by potato producers in Ethiopia, and in doing so improving the wealth and livelihoods of potato producers[1]. The project ran from 2008-2012.

The project was funded by the Common Fund for Commodities (CFC) and implemented by the International Potato Centre (CIP), who partnered with the Ethiopian Institute of Agricultural Research (EIAR), Holetta Agricultural Research Center of EIAR, Ministry of Agriculture and Solagrow PLC (a private seed potato producing company). The project was in West Shewa Zone (Cheleya and Tikur- Inchini woreda[2]), South West Shewa (Wonchi woreda), Guragie zone (Gumer and Geta woreda), and Tigray Zone (Atsbi woreda).

[1] The project was actually carried out in 3 countries, Kenya, Uganda and Ethiopia, however this evaluation concerns only Ethiopia.

[2] Woreda (districts) (Amharic: ወረዳ?) are the third-level administrative divisions of Ethiopia. They are composed of a number of wards (kebele) or neighborhood associations, which are the smallest unit of local government in Ethiopia.

The Royal Tropical Institute (KIT) in Amsterdam, was commissioned to carry out an independent evaluation of the project to measure change and document lessons from the intervention. This was carried out in April 2014.

Background to the potato sector in Ethiopia

Improvements in the potato production system can be a pathway out of poverty in Sub Saharan Africa, including Ethiopia. It is an excellent smallholder farmer crop in the highlands, with a short cropping cycle, potential for large yield per hectare, and serves as both a cash and food security crop. In Ethiopia potato production can fill a gap in food supply during the 'hungry months' of October to December before the grain crops are being harvested [3].

Potato is a high yielding tuber crop with a short cropping cycle of about 3-4 months. This, coupled with high potential yield of about 40 t/ha, makes the potato a suitable crop for places where land is limited and labour is abundant (FAO, 2008) such as in Ethiopia. The highlands also offer favourable climatic and edaphic (soil) conditions. Furthermore, it is one of the crops with the highest growth rates in the country as a result of growing markets, especially in urban areas, as eating habits change (Tesfaye et al., 2010).

However, The potato sub-sector in Ethiopia is relatively undeveloped and is faced with low productivity of less than 10 t/ha. There is potential for yields of 35 t/ha, which are being attained by progressive farmers using quality seed potato of improved varieties coupled with improved management practices, under the same rain-fed conditions.

Constraints include a shortage of good quality seed tubers (Kinyua et al., 2001) and a lack of adaptable and disease resistant varieties (Olanya et al., 2001; Berga et al., 2005;). Diseases and poor seed quality are intertwined such that frequent recycling of seeds leads to build up of disease leading to disease multiplication (Wang'ombe 2008). Some diseases such as BW are both soil and seed borne which spreads rapidly through seed recycling. Sub-optimal production practices are another constraint (Gebremedhin et. al., 2008) as is poor soil fertility, which is closely related to poor management but also to small land plots making crop rotation a problem. Diseases such as Late Blight and Bacterial Wilt (BW) are a challenge which farmers should meet through good production practices, crop rotation

[3] This background sub-section draws on and summarizes much work from other project documents including: International Potato Center CIP. (2013).Wealth Creation through Integrated Development of the Potato Production and Marketing Sector in Kenya, Uganda, and Ethiopia, Final Report.

and fungicides. Ethiopia also faces are fairly weak public extension system. Most farmers lack proper storage facilities (Diffuse Light Storage) for seed and cold storage (non-electric with traditional materials) for ware. Storage determines the sprouting of seed potatoes and the shelf life of harvested ware potatoes. Furthermore road infrastructure is relatively poor (though improving) and there is limited opportunities for processing and value addition at present. Marketing systems are inefficient, characterized by ad-hoc sales and farmers cite price instability and poor prices as major challenges.

Project goal and objectives

The WCPP project sought to address such constraints faced by potato producers in Ethiopia and in doing so improve the wealth and livelihoods of smallholder potato producers through the integrated development of the seed and ware potato production and marketing chains.

There were three main project objectives:

- Increase the availability of high quality seed at affordable prices;
- Improve farmers' knowledge of crop husbandry and access to high quality seed, leading to improved yields and increased income and food security
- improve market linkages and communication between potato value chain stakeholders, leading to increased income

There was a further objective to translate project results into national potato sector development plans and sharing project lessons with international partners. This report is an input into that process.

To achieve this, the following specific tasks were undertaken

- Training seed and ware potato farmers in all aspects of potato production, marketing, and utilization
- Increasing production of quality seed through the use of improved conventional methods and aeroponics (a new method for rapid MT multiplication) at Holetta research centre
- Promoting seed technologies to farmers for their own seed supply in particular through the small seed plot technique and positive selection
- Promoting seed storage technologies to farmers and cooperatives, notably the diffused light store (DFS)
- Linking seed and ware potato farmers and their cooperatives to markets
- Strengthening farmers' negotiating skills through increased knowledge and access to information

Other activities involved encouraging value chain interactions among producers, buyers, credit facilities, and other stakeholders and working towards a national potato development plan.

Research Methodology

The Royal Tropical Institute, Amsterdam (KIT) was asked by CFC to conduct a rapid and cost effective assessment of the WCPP project in April 2014. The fieldwork was conducted in three woreda (districts) over a period of only eight days in April 2014. The evaluation was conducted one and a half years after project completion, allowing sufficient time for impact. The methodology was designed based on a limited budget and a desire to for both learning and accountability.

The project was implemented in six woreda in Ethiopia and three were selected for this research; Gumer, Geta, and Wonchi. The sampling of these woreda was purposive, determined by logistic considerations given the size and spread of the country and such a rapid assessment. The methodology was designed by Roger Bymolt at KIT, who enlisted the support of a local consultant from Fair and Sustainable Ethiopia (F&S BD Service PLC) in Addis Ababa who organized a team of seven enumerators.

The methodology was designed to take a mixed methods approach, in order to best identify and measure changes that could be attributed to the intervention, and to draw out recommendations and learning for future scaling up or a phase 2. The mixed methods approach involved:

- Quantitative surveys (190 respondents)
- Focus groups based on the PADev method[4] (4 locations, 30 respondents each)
- Interviews (key informants, Holetta, CIP)
- Literature review and review of project documents including an earlier evaluation

Quantitative surveys: Surveys with individual farmers took around 45 minutes and were administered using digital tablets running Open Data Kit (ODK). A control group was not used, as the time and resources available would not have allowed for a big enough sample for this to be meaningful. A baseline database for these Woreda was also not available. To account for this, the baseline was reconstructed using recall data from the respondents.

Focus groups: The focus groups were designed to complement the survey design and was based on a selection of PADev tools. In particular, participants were asked to

[4] See www.padev.nl

a) Identify any/all other agricultural projects that had come to the area in the past 10 years, for which any of the findings could be alternatively attributed
b) Identify and describe all of the changes that have occurred between when the project began and today, and to give reasons why the change had occurred (e.g. the project or any other reasons)
c) Identify and describe any/all events that may have had an impact on their livelihoods (eg extreme weather, conflicts etc)
d) Identify and rank the most important challenges participants faced before the start of the project, and to repeat for challenges faced now.
e) Engage in a participatory budgeting exercise to help determine typical costs of production and returns from potato ware and seed production.

A group of older potato farmers during a break in the focus group discussions

Interviews: A limited number of interviews were conducted with CIP and with Holetta project staff.

Literature review: A thorough review was conducted of project documents including an earlier evaluation study across Kenya, Uganda and Ethiopia[5]

It is important to note that all of these methods were deliberately designed to triangulate in order to describe well a picture of the project outputs, outcomes and impact, and to both measure and explain the changes that respondents experienced, and beneficiaries perception of those changes.

As a side note, several challenges were experienced during such a short fieldwork period. Ethiopian Customs officers temporarily held the digital tablet devices before a payment of duty, there was an unfortunate death in a research village leading to a delay, and Sunday market affects all villages in the Woreda. Nevertheless the research was successful at collecting all necessary data on time.

Research findings and analysis

Agricultural projects in the research area

From the focus group discussions it was found that none of the research areas had been served by any other agricultural project in the past 10 years than the WCPP project, and certainly by no other potato project[6]. To be clear, no other potato related training had been delivered before, during or after the WCPP project. Very few farmers

[5] International Potato Center CIP. (2013).Wealth Creation through Integrated Development of the Potato Production and Marketing Sector in Kenya, Uganda, and Ethiopia, Final Report.

[6] Participants referred to the project variously as the Holetta project (Holetta staff delivered trainings) or the CFC project (CFC was branded on the DFS stores).

were even organized in groups or cooperatives before the project implementation staff helped to organized them.

This finding gives confidence that many of the changes described in this report can be *directly* attributed to the WCPP project. To highlight this point, one group comprising much older farmers said that they could not recall ever in their history receiving a project other than the WCPP project funded by CFC (Gumer, Burdena Dember).

Challenges of potato farmers – then and now

As part of the focus group exercises, participants were asked what their biggest challenges were 'then' (before the project, 5 years ago) and to rank these. This exercise helped to identify the relevance of the intervention to the area. Following this, participants were then asked to identify and rank their biggest challenges 'now'.

The following table shows the most frequently mentioned challenges, and those ranked as the biggest challenges[7]. The challenge ranking points show those challenges most highly and frequently ranked.

Challenges 5 years ago

Figure 1 Challenges 5 years ago

Challenge type	Total ranking points	Number of groups citing
Potato varieties	35	4
Land shortages	32	4
Potato knowledge	25	3
Low income	24	3
Food security	21	3
Productivity	14	2
Inputs	13	2
Other crop dependence	11	2
Soil	5	1
Drinking water	5	1
Employment	5	1

Potato varieties (4 groups) – All groups cited a dependence on local varieties as the biggest challenge 5 years ago. These were low yielding, and improved varieties had never been introduced to the area before.

Land shortages (4 groups)- Land shortages were reported as a major challenge by all groups as plots had been subdivided into small parcels. Farmers had on average around 1 hectare of land.

Potato knowledge (3 groups) – Participants said they didn't know then that their land can produce the yields they experience now. Farmers lacked knowledge and followed traditional practices for all crops, without ever receiving agricultural training of any kind. This particularly applied to seed potatoes.

Low income (3 groups) – Income from agricultural production was low. Most farmers were dependent on enset[8] and few had cash crops to sell at the market. The majority of farm production was used for household consumption. Participants said they often didn't send children to school, couldn't afford oxen, and could not improve their houses.

Food insecurity (3 groups) – Most households suffered from food insecurity for at least a few months of the year. December was previously the best month because barley and faba bean is harvested then. Respondents said that in the lean months they often harvested and consumed their enset, reducing their food security further.

Productivity (2 groups) – yields were said to be low for potatoes but also for all other crops. This was partly due to exhausted lands, and also a lack of fertilizer.

Inputs (2 groups) – Few people used fertilizer, there was low availability and little income to invest.

Other crop dependence (2 groups) – There was dependency on enset production, which was the main cash crop and was not high value

Lack of employment opportunities (1 groups) – People left the rural areas for the nearby townships hoping to make some small income. The rural economy was regarded as depressed.

Environmental Degradation (1 group) – High soil erosion of the land, removing top soil

Challenges now

[7] To compile the challenges mentioned, each challenge received 5 ranking points each time it was mentioned, and a further ranking point for each step up the rank between 1 and 5. Hence, if a challenge was ranked by participants of a focus group as 5th it was given 6 points (5 for being mentioned + 1 for being fifth). If a challenge was ranked 1st it was awarded 10 points (5+5).

[8] Enset (sometimes spelt Ensete), is one of the two genera in the banana family, Musaceae, and includes the false banana or enset, an economically important food crop in Ethiopia.

Figure 2 Challenges now

Row Labels	Sum of Ranking points	Number of groups citing
Marketing	46	4
Inputs	26	4
Storage	24	4
Potato varieties	24	3
Productivity	18	2
Farm tools	10	1
Industry	8	1
Training	7	1
Soil	7	1

Inputs (4 groups) – Participants now reported using fertilizer on their seed plots and so fertilizer prices became a bigger issue than when it was not used. Now all 4 groups even cited fungicide costs and availability as they learned from the project how it can be used to control diseases.

Marketing (4 groups) – A new challenge that has arisen is marketing – farmers are now grappling with price variations through and across seasons and that fact that the more farmers that turn to growing improved potato seed, the more supply and hence lower prices. Farmers are also becoming interested in growing and marketing ware, and see marketing of ware as an emerging challenge for seed growers also, as these farmers buy their seed.

Potato Varieties (3 groups) – The challenge for many farmers now is to source new basic seed (first generation). Farmer cooperatives have not begun to do this. Individual farmers say that the cost is too high and difficult to source. Farmers say they are willing to pay 350 birr or thereabouts – around the price that they are selling their own seed for. The latest variety desired by farmers is Belete.

Productivity (2 groups) – Farmers cite the declining productivity of the seed through the generations as a challenge, though farmers did demonstrate their understanding of declining productivity.

Storage (4 groups) – Farmers have seen the value of DLS seed potato storage through the project. Many of the cooperatives were able to replicate the demonstration DLS building many more (up to 100), although one cooperative only build 3 more. A new storage challenge is ware potato storage to keep potatoes cool and prolong the period they can market these, so they are not selling in a glut for low prices. This would help smooth the market.

Farm tools (1 group) - In need of improved farm tools- using hand tools now, taking time and labour and difficult to dig the ground and shallow for potatoes. Shortage of land for feeding cattle; Ox driven or horse driven tools desired, and small tractors, hand driven tractors; (across country need more farm tools, would buy if available said) If available can buy as a group

Training (1 group) – Since the project finished, there is a lack of training for new groups

Soil (1 group) – One group had their soil tested and it was found that there is soil acidity, so farmers need to buy lime for the soil.

Industry (1 group) – One group believed that the presence of potato processing industry would help drive demand for potatoes and their seed potatoes. There is some concern that if there are not enough buyers of potatoes then prices will fall.

A farmer demonstrates the basic tools being used to break the land

Challenges – before the project and after

Figure 3 Difference between challenges now and 5 years ago (ranking points)

	Rank score: 5 years ago	Rank score: Now	Change
Potato varieties	35	24	-11
Land shortages	32	0	-32
Potato knowledge	25	0	-25
Low income	24	0	-24
Food security	21	0	-21
Productivity	14	18	4
Inputs	13	26	13
Other crop dependence	11	0	-11
Soil	5	7	2
Drinking water	5	0	-5
Employment	5	0	-5
Storage	0	24	24
Marketing	0	46	46
Industry	0	8	8
Training	0	7	7
Farm tools	0	10	10

Several differences can be seen between farmers' challenges 5 years ago and today. **Potato varieties** have become less of a challenge, and at the start of the project this challenge was completely alleviated. However, with seed not being renewed, and the generation of seed now being around generation 5, farmers understand that new basic seed is needed. The desired seed is 'Belete'. **Land shortages** are no longer cited as a challenge because, while sizes haven't changed, farmers have seen that small plots of seed potatoes can have high yields and good profit when well managed. Similarly **potato knowledge** is no longer a challenge, which can be fully attributed to the project (p.14). **Low income** has ceased to be a challenge as the introduction of seed potatoes through the project is said to have been a very profitable and even revitalised rural economies. **Food security** issues have likewise ceased to be a challenge as the introduction of potatoes has been successful not only as a cash crop (from which food can be bought), but to help with household food security before the grain harvests are ready (p.9).

However, **productivity** has returned as a serious challenge. When farmers received clean basic seed from the project, yields were reportedly high, but with each generation the seed quality deteriorates further. Farmers understand this, but few farmers or cooperatives have replenished their seed either due to cost, availability, or lack of coordination between themselves to buy from the research center. **Input** costs have become an issue as farmer have seen and understood the importance of correct fertilizer use, and that fungicides are important for controlling difficult diseases that can dramatically reduce yields or spread to infect whole crops.

There is now much less **dependence on other crops**, particularly enset, because of the success of the WCPP project. **Soil** quality remains a minor issue. **Employment** is less of an issue because profits are being made from potato.

However, **storage** for ware potatoes has become a challenge as farmers seek to sell their ware potatoes outside of the glut harvest period and need appropriate technology to store for several months. **Marketing** has become the biggest challenge, as before farmers were not marketing seed (or quantities of ware) and are growing concerned about supply/demand dynamics with the changes in the sector and its effect on prices, and also the dependence on the MoA to link cooperatives with formal buyers (especially NGOs). Development of a potato processing **industry** would be one way to take up the additional supply. Some new potato groups are starting up after seeing the benefits of potato farming on project beneficiaries and they require **training** to maintain quality of the seed in the area. Quality **farm tools** – both hand tools and ox drawn ploughs – are apparently relatively difficult to access, so there is an opportunity here too.

Household characteristics

190 surveys were carried out across the three districts of Gumer, Geta, and Wonchi. Most surveys were conducted with the heads of households, who were usually the ones organised in groups, and who were project beneficiaries. The characteristic of household heads usually being men meant that only 17% of the sample were women – slightly below the expected 20% of women who were targeted to be involved in the project, and who were often widows. The average age of the male respondents was 45, and 38 for the women, with a dependency ratio of 2.33, and a household average of 6.44 members. Household labour availability is not thought to be a big issue for farmers in the research area as land holdings are small (p.9).

Figure 4 Respondent demographics - gender and household heads

Head of household	Men	Women	Total
Yes	151	22	173
No	7	10	17
Total	158	32	190

Figure 5 Household demographics - family size

Average hh members	6.44
Male adults over 60	0.14
Female adults over 60	0.24
Male adults 18 59	1.58
Female adults 18 59	1.51
Male children 0 17	1.53
Female children 0 17	1.39
Dependency ratio	2.33

Food security

Figure 6: Average number months households consuming 3, 2, or 1 meals per day

	3 meals	2 meals	1 meal
5 years ago	3.91	6.64	1.45
Now	7.59	4.24	0.16

The WCPP project was found to have had a major impact on food security. 5 years ago respondents reported that their households had 3 meals a day for an average of 3.9 months of the year, which has improved to 7.59 months of the year with 3 meals a day. Even more significantly, respondents reported that 5 years ago there were an average of 1.5 months per year where households had only one meal per day. Now, virtually all beneficiary households have at least 2 meals per day every month of the year (Figure 6).

The fact that there have been no other food security or agricultural projects in the research area over this time points to a clear contribution that the WCPP project has made on food security. Indeed, respondents themselves directly attributed changes in their food security situation to the project, and not to any other reason. This is because potato is a food crop as well as a cash crop for farmers. Potato is a short season crop and is able to be harvested before the grain crop is ready, bridging the former hungry season, even for those producing relatively little on very small plots of land. This trend of increased food security was observed across all three of the woreda research areas.

The data from Figure 6 can be converted to show the number of meals each household member consumed per per year[9]. 5 years ago, each household member consumed 805 meals per year, an average of 2.2 meals per day. Last season this increased to 955 meals per year, an average of 2.6 meals per day - a 19% increase. However, the most important thing is that the number of households enduring a hungry season[10] (1 to 2 months) where they have to get by on only one meal per day has fallen to virtually zero.

Land assets

Farmers were found to own about 1.2 hectares[11] of land on average, and it was rare for a farmer to have more than 2 hectares. All three woreda claim to face the challenge of land shortages, due to subdivision and bequeathing land to sons.

Land - Ware potatoes

5 years ago, those who grew ware potatoes did so on an average of 0.41 hectares. Last season this had risen to 0.74 hectares, an increase of 80%. Most farmers (83%) owned their biggest plot. Most respondents only had the one ware potato field, although 30% had a second field. For those with more than one ware potato plot, 21% leased their second field, while 11% borrowed it.

Figure 7 Average size of ware plots (hectares)

Ware field size 5 years ago	Ware field size now
0.45	0.77

Figure 8 Ownership status of biggest ware potato field last season

Status	Percent
Owned	83%
Leased	13%
Borrowed	4%

Land – seed potatoes

The average size of seed plots is relatively small – less than half a hectare last season (37% of the average total land size). Virtually no farmers had dedicated seed plots before the project began. It might be reasonably asked why farmers don't dedicate more land to seed potatoes given its potential profitability. There are several reasons: farmers choose to continue to grow other crops for household consumption (diversification); enset is grown by many and the crop takes 5-10 years to mature for harvest, so farmers do not want to pull it up; farmers need to rotate their seed plots to prevent the build-up of diseases in the soil; and land supply is scarce making it difficult to expand production by leasing.

[9] Meals per month x 30.41 days per month

[10] The hungry season is typically August to October when enset and barley stocks are low

[11] Total land size data is from the baseline survey. The reliability of data collected for total land size was found to be questionable on review.

Figure 9 Average size of seed plots (hectares)

Woreda	Plot size last season
Geta	0.33
Gumer	0.41
Wonchi	0.64
Total	0.45

Productive assets

Very few farmers are mechanized. Most farm using hand tools, and 64% say that they own and animal plough, while 56% said they own an ox or other cattle. Virtually all farmers depend on the rains, with very few irrigating through lakes, streams or boreholes (15%)

Figure 10 Irrigation sources

Rain	Lakes/ streams	Borehole	Water pan	Water tank
100%	9%	5%	0%	1%

Income sources

Farmers have a wide variety of income sources. Last season the most common were ware potato, enset, barley, seed potatoes, faba bean, dairy, sheep and wheat. However enset has historically been the dominant source of income (and food security). 5 years ago 65% of respondents said that enset was the main source of income. However, since the WCPP project has come, seed potatoes (24%) and ware potatoes (16%) have rivalled enset as the most important source of income. This is significant because enset is described by respondents as a rather poor cash crop option, but the best that was previously available. The success of the project has been such that in a relatively short time, 40% of respondents now count potato as their main source of income; a ten-fold increase.

Figure 11 Sources of income last season

	Count	Percentage
Ware potatoes	181	95%
Enset	172	91%
Barley	168	88%
Seed potatoes	164	86%
Faba bean	136	72%
Dairy	127	67%
Sheep	116	61%
Wheat	100	53%
Chicken	92	48%
Field pea	88	46%
Vegetables	77	41%
Eggs	60	32%
Other cattle	58	31%
Farm labour temp	34	18%
Other agric	31	16%
Own business	28	15%
Other livestock	21	11%

Figure 12 Biggest income source last season and five years ago

	Last season	5 years ago
Enset	49%	65%
Seed Potatoes	24%	-
Ware potatoes	16%	4%
Own business	4%	6%
Barley	3%	7%
Wheat	1%	3%

Potato production

Cooperative formation

89% percent of respondents said that they were in a potato farmer group, and most (85%) described this group as a formalized cooperative. It is important to add that most of these groups and cooperatives didn't exist prior to the project, which played a catalysing role. To be included in the project farmers needed to organise into groups and to individually have a minimum of 0.25 hectares and to build a Diffused Light Store (DFS) (p.16).

Members reported that they contributed land, labour, or both to the cooperative, and cooperative members that grew seed potatoes together as well as individuals on their own land. The cooperative would pay out members when the crop was sold based on members contributions, with a set price put on the land leased from cooperative members, and for labour contributions.

Such a collective farming arrangement is a methodological challenge to determine with certainty each members contribution.

> *"CFC organised us In 2008 with 26 members in first group, 20 male, 6 female; There are now about 36 groups formed from the 18 Kabele in the Woreda. The groups from this area formed an cooperative 'Enget BeSira' with 120 members (100Male) and 20Female) and was legally registered. The cooperative setup a committee of 5 members that quality among producer members and ensures crop rotation is done. MoA and Holetta work with us to check our practices and offer advice". (Gumer Burdena Dember)*

The survey checked which farmers which farmers independently grew and marketed ware and seed potatoes (Figure 13)

Figure 13 Number of respondents growing and marketing seed and ware potatoes

	Ware grown	Ware marketed	Seed grown	Seed marketed
Count	182	152	101	125
Percent	96%	80%	53%	66%

Farmers reported that, on average, they had been growing potatoes for only 6.5 years. More significantly, 144 of 182 ware farmers (78%) have been growing for 5 years or less, inspired to begin growing potatoes by the project starting. Approximately half of the farmers surveyed manage to have 2 potato growing seasons per year – the main season (Meher) and a short rainy season (Belg). However the Belg season is shorter and less reliable and usually requires supplementary irrigation[12].

Varieties - Ware

The 38 farmers who were growing potatoes before the project began were typically using varieties that were not improved, and/or varieties that had been recycled through countless generations. 69% were using non-improved varieties such as Key Dinich and were largely growing for home consumption or small scale marketing at local markets. Only about 13% of respondents said that they were using the improved varieites of Gudene and Jalene 5 years ago, with the majority growing Key Dinich or another local variety. (Note, farmers often grow more than one variety in a single season).

Last season however, virtually all farmers reported growing the improved varieties Jalene or Gudene (some continued planting a little of their own local varieties). The change in the number of farmers now using the improved varieties of Gudene and Jalene was clearly attributed to the project by focus group participants.

Figure 14 Ware potato varieties planted 5 years ago and now

	5 years ago	Now
Jalene	8%	59%
Gudene	5%	87%
Guasa	5%	1%
Gera	3%	1%
Key dinch	35%	16%
Aba minememe	0%	1%
Other local	68%	10%
	N=37	N=182

*Does not add up to 100% because farmers frequently plant more than one variety

Varieties - Seed

Prior to the project no farmers were growing seed potatoes specifically in separate plots, with the intention to market these. Rather, those few farmers who grew local ware varieties saved their small potatoes and replanted these as seed the next season. As one focus group said:

> *"Quite a few people were growing ware potatoes in their backyards before the project, but this was for home consumption and not enough sell. Now, this has changed and we have become potato seed producers". (Wonchi-fitewato)*

Now, 101 of the sampled 190 farmers reported growing seed potatoes in their own seed plots, separate from their ware potatoes or other crops. Further, most other respondents reported contributing labour and/or land to the common cooperative seed plots. Virtually all of these farmers are growing Jalene or Gudene as seed. Very few have managed to source a new improved variety, Belette, which is much in demand in the past year.

> *"Before we were only using local varieties but through the project we received improved varieties. We were even buying local seed varieties at a higher price sometimes. Now we can buy the improved varieties with higher yield and our income problem has been solved" (Gumer Esen and Andagezu)*

[12] See Gildemacher, P. (2012) *Innovation in Seed Potato Systems in Eastern Africa*. Royal Tropical Institute. p.32

Figure 15 Seed varieties last season

Gudene	Jalene	Other local	Guasa	Keydinch	Gera
81%	41%	8%	4%	4%	2%

Yields - ware potatoes

Potato yields have significantly improved over the course of the project. Exact measurements of the change are difficult to make because they rely on farmers' a) accurate estimation of field sizes b) accurate estimation of yields c) accurate enumerator questioning so that farmers to not combine or confuse seed and ware yields. These challenges in data collection during a rapid assessment mean that the following yield changes should be treated as indicative. After outliers had been removed from the analysis, an increase in yield in the region of 80% was found. Substantial increases in ware potato yield were found in all of the woreda, giving some confidence to this interpretation of the data.

Figure 16 Reported ware potato yields (tonnes/hectare)

	5 year ago average	Recent season average
Geta	8.17	13.94
Gumer	8.92	19
Wonchi	9.6	13.74
Total	8.8	15.82

* Outliers were filtered out, and determined as those cases outside the realistic ranges of 2-40 tonnes/hectare.

Respondents were asked for all the reasons that could be attributed to this positive change and several were given (see Figure 17). The most common reasons were improved use of fertilizer, new seed varieties, improved cultivation practices and improved use of fungicides and insecticides. Better rainfall was also a reason given, ranked 6th highest. However, when asked what the main reason was, 41% cited the training and extension provided through the project, and 35% cited the improved seed varieties supplied through the project (Figure 18).

What this means is that while it is always difficult to attribute all of a change in yield to a project, the new knowledge on cultivation practices and improved seed that the project provided are clearly perceived by respondents as the major drivers of yield change in ware potato production.

Of those who experienced a challenging season last season, the overwhelming reason was too much rainfall, causing late blight.

Figure 17 Perceived reasons for improved ware potato yield

Reason	Percentage
Improved use of fertilizer	59%
New Seed varieties	59%
Improved cultivation practices	55%
Improved use of Fungicides /insecticides	51%
Improved use of clean seed	39%
Better rainfall	31%
Increased use of labour	29%
Less disease	23%
Use of farm animals	17%
Improved access to credit	14%
Improved irrigation	5%
Other	2%
Use of machinery	0%

Figure 18 Main reason for improvement in ware potato yield

Training /extension advice on improved cultivation practices	Use of improved seed varieties	Improved use of fertilizer	Use of clean seed
41%	35%	16%	6%

N=112

Yield – seed potatoes

As discussed previously, seed potatoes were not grown professionally on separate plots until the project began. The average reported seed potato yield was around 16 tonnes per hectare, similar to the ware potato yield. (However, this may be a low estimate as these figures are derived from a calculation of farmer estimates of land * yield). Figures quoted in the focus group discussions on yield ranged between 22 and 30 tonnes per hectare (Figure 37).

Figure 19 Average Seed yield in recent seasons (tonnes/hectare)

Woreda	Average yield /hectare
Geta	15.40
Gumer	17.81
Wonchi	13.50
Total	15.79

As might be expected, the reasons given for the improvements of seed potato yields are very similar to those of ware potatoes. Again, fertilizer/insecticide/fungicide use, better seed varieties, and better cultivation practices were all cited as reasons. When asked for the main reason, again respondents reported that the training and extension that the project

provided was the biggest reason, followed by the improved seed varieties they were able to access. Respondents clearly attributed a substantial part of the change in yield to the project.

Figure 20 Reasons for improved seed yield

Reason	Percentage
Better fertilizer	93%
Better seed varieties	82%
Better insecticide fungicide	80%
Better cultivation practices	75%
Better clean seed	57%
Better rainfall	53%
Better more labour	46%
Better disease	32%
Better farm animals	21%
Better credit	13%
Better other	8%
Better irrigation	7%
Better machinery	1%

Figure 21 Main reason given for change in seed yield

Main reason	Percent
Training /extension advice on cultivation practices	34%
Use of improved seed varieties	34%
Improved use of fertilizer	25%
Use of clean seed	5%
Better rainfall / climate	1%
Increased labour	1%

N=95

Renewing seed

Farmers must refresh their seed stocks with new basic seed and flush out older generations of seed after about three seasons. For many farmers and cooperatives, they are now overdue to refresh their seed stock. Figure 22 shows that for 58% of farmers have not refreshed their seed stock for 4 seasons or longer. Discussions in focus groups found that in practice virtually no farmers had purchased new basic seed from Holetta research centre or another company. When farmer reported buying new seed this was usually in the form of improved varieties but which was already several generations old. Farmers demonstrated good knowledge of seed quality and deterioration, which they learned through the project. They know they must refresh their seed soon, and report that it has been affecting their yields for several seasons already. However, cooperatives appear to be not organized sufficiently so as to approach research centres or private companies and buy this new seed and begin multiplying basic seed within their membership. Another challenge would be for the cooperative to help farmers access it by transporting tonnes of seed several hundred kilometres to the farmers.

It should be noted that farmers did report being willing to pay for this seed. However they would like to buy for somewhere in the region of 600birr/quintal (they sell their own seed in the region of 300-400birr/quintal). However new basic seed (early generation) often sells for up to 1500 birr per quintal.

Farmers understand that not refreshing their seed is lowering their yields – they have seen the results themselves. What they seem less aware of is that this is a reputational issue too. The potato farming areas that the project has worked with have developed a reputation with certain institutional buyers looking to buy quality seed. If farmers and cooperatives the project areas fail to refresh their seed soon, they could suffer reputational damage that would lose them their hard-to-find formal buyers who would move to other areas.

Figure 22 Number of years since clean seed purchased

Year	1	2	3	4	5	6	8
Percentage	4%	7%	30%	18%	35%	4%	1%

N=96

Crop rotation

Crop rotation is important for soil quality and reducing a build-up of diseases and pests such as bacterial wilt and nematodes. Potatoes should not be grown on same land 2 seasons in a row and should not return to the same plots for at least 3 more cycles[13]. In focus group discussions farmers demonstrated an understanding of this. However, the survey data shows that only 51% of respondents rotate after a single season. It is somewhat concerning that just over 20% of farmers continue growing potatoes on the same plot for 3 or more seasons. So while their appears to be knowledge of the importance of rotation, the very small land sizes of the areas make this a particular challenge.

[13] Lung'aho, Lemaga, Nyongesa, Gildemacher, Kinyae, Demo, Kabira. (2007). Commercial Seed Production in Eastern and Central Kenya. Kenya Agricultural Research Institute. p.9

Figure 23 Number of seasons growing potatoes on a plot before rotating

Number of seasons	Percentage
1	51%
2	29%
3	17%
4	2%
5	2%

Training

Training and capacity building for farmers was a major component of the project, given that many had little prior experience in potato farming, and especially in seed potato production.

The project began by helping farmers to form groups and manage groups, write a constitution for the group to function and to assign leadership roles. After some time, many of these groups came together to form and register small cooperatives.

Training began by Holetta taking one 'model' farmer from each area and bringing them to the Holetta research centre to gain first hand insight on what clean seed is and what improved varieties constitute. Those farmers then returned to their groups and reported back, which was soon followed by Holetta researchers and staff who delivered a series of practical on site trainings.

In most cases, training was given only to cooperative members, who were usually the heads of their respective households. The gender split was roughly 4/5 men and 1/5 women, reflecting somewhat the traditional household roles in the community. The project asked for at least 1/5 women in each cooperative, which usually comprised widows. In the cooperatives, at least one woman held a leadership role on the committee, such as treasurer or secretary. Only in rare cases did the wife of a household head attend the training alongside her husband, as this would have made the size of the training groups a little too large to be manageable. Instead, all trainees were instructed to pass on their acquired knowledge to the other household members and labourers working on their farms. Whether this was done well, or not, was not able to be verified in this rapid assessment, however farmers clearly showed an understanding that it was in their interest to do so, as poor practices can negatively impact the yield or affect losses.

Before receiving an initial supply of clean seed, farmer first received training on what clean seed actually is, how to plant it, how to use various inputs for productivity increases. Those who received trainings had to be members of the cooperative, and to make training sessions manageable, only one member per household attended. These farmers were then to pass on this new knowledge and skills to household and hired labourers.

> *"CFC helped us with group formation, introduced new varieties, and gave us training on agronomic practices. We learned about storage, harvesting, and planting. In fact everything we know [about potatoes] we learned through CFC" (Gumer, Burdena Dember group).*

The penetration of training was quite high – 74% of respondents who declared that they had received training through the project. 26% said they had received no training whatsoever. Some caution needs to be taken here, because respondents sometimes do not declare training as being received if they perceive it more as extension services, or training by lead farmers. It was confirmed across all sites that this knowledge did not exist prior to the CFC intervention.

Of those who had received some training, the most frequently cited types were fertilizer application, cultivation (twice doing ridging and weeding), land preparation, storage, harvesting, pesticide use and crop rotation, seed and seed varieties, group formation and marketing (Figure 24). As part of the training on planting practices, farmers learned how to mitigate the occurrence of diseases such as Late Blight and Bacterial Wilt. Training involved knowledge of rotation, handling and storage practices, as well as application of fungicides. An interesting training component reported in focus groups by all respondents was that women of cooperative member households were given training on how to cook potatoes. 12 different recipes were introduced for local dishes. This likely contributed to local acceptance of potato in the area and consumption of the crop. Storage of seed potatoes is another training component delivered and is discussed later in the 'Storage' section (p.16).

This shows the impressive range of trainings that the project covered, particularly on the production side, to bring farmers up from a low base to become knowledge and professionalized farmers. Furthermore, after harvesting farmers were trained on handling and quality control[14], where small tubers were separated out for cattle fodder, large tubers were consumed in the household or perhaps marketed, and it was only those 'medium' sized tubers of 25-55mm that were suitable as seed potatoes.

[14] This subject was not asked in the household survey

Figure 24 Frequency of types of training received

Training type	Count	Percentage
Fertilizer application	139	99%
Cultivation	138	98%
Land preparation	137	97%
Storage	130	92%
Harvesting	126	89%
Pesticides /weeding	123	87%
Crop rotation	107	76%
Varieties	103	73%
Seed	94	67%
Groups	95	67%
Marketing	83	59%
Record keeping	64	45%
Watering	42	30%
Other	6	4%

N=139

Not only were large numbers of farmers trained in a wide variety of topics, but the quality of the training received was perceived to have been either 'good' or 'very good' in 86% of the cases of trained respondents. In fact, nearly half said the training had been 'very good', which is a credit to Holetta research institute, who carried out the trainings.

Figure 25 Perception on the quality of trainings

Perception	Percentage
Poor	3%
Average	11%
Good	38%
Very good	48%

N=147

Through the training farmers perceive that their knowledge has increased substantially. This is true for all of the knowledge topics asked about - production methods, soil management, seed, diseases and storage. It was consistently found that about 70-80% of farmers rated their knowledge before the project as either 'very poor' or 'poor'. After the project, 80% or more farmers rated their knowledge in these subjects as either 'good' or 'very good'. This again indicated both the very low base that these potato farmers started from and that the project has done an excellent job in building their capacity in a relatively short amount of time.

Figure 26 Changes in farmers knowledge between 5 years ago and now

		Very poor	Poor	Ave	Good	Very good
Production methods	5 years ago	54%	16%	14%	12%	4%
	Now	2%	2%	16%	26%	55%
soil manage-ment	5 years ago	49%	19%	14%	15%	3%
	Now	2%	1%	19%	29%	50%
Seed	5 years ago	53%	24%	8%	12%	2%
	Now	3%	3%	16%	27%	51%
Diseases	5 years ago	58%	21%	7%	14%	1%
	Now	2%	4%	13%	32%	50%
Storage	5 years ago	56%	21%	7%	13%	3%
	Now	3%	2%	16%	24%	55%

Of course, it is well and good to deliver training that is well received, but the real test is whether or not the training had any impact. An impressive 61% of trained respondents said that the training had a 'high impact' on yield, while a further 35% percent described the impact as 'moderate'. Only 4% described the impact of the training as low impact (3%) or no impact (1%). This is supported by the finding that yield of ware potatoes has increased by roughly 80% since the project began (Figure 16) and that respondents perceive the biggest reason for this to be the training and extension that the project provided (Figure 18).

Figure 27 Perception of impact of training on yield

Perception	Percentage
no impact	1%
low impact	3%
moderate impact	35%
high impact	61%

N=147

Training has also contributed to changes in production methods of farmers. This includes very large increases (200-300%) in the number use farmers using fertilizers, insecticides and fungicides, as well as oxen (73%). Of course these changes are also influenced by changes income allowing farmers to invest, among other factors. But the point is that the training has encouraged farmers to make those investments.

Figure 28 Changes in potato production methods

	5 years ago	Now	change	change %
Planting using DAP fertilizer	58	186	128	221%
Planting urea fertilizer	43	183	140	326%
Top dressing	51	184	133	261%
Insecticide	26	95	69	265%
Fungicides	24	103	79	329%
Tractor use	1	2	1	-
Oxen use	77	133	56	73%

Record keeping among farmers is still very low, with only 12% saying that they keep detailed records, and 67% keeping no records at all. While 45% of trained respondents said that they had received training in record keeping, it is clear that this is one training type which has not had penetration. Record keeping is often found to be weak among small scale farmers farming various commodities in Sub Saharan Africa[15], so this finding is not surprising. It simply shows that work needs to be done here if farmers are to plan properly and manage their farms as a business.

Figure 29 Percentage of farmers keeping records

Records kept	Percentage
No records	67%
Basic records	20%
Detailed records	12%

N=190

Training delivery

Initially, Holetta research centre was the only institution that provided trainings to the farmers though the project, particularly on the introduction of improved seed varieties. By the end of the project, government extension was collaborating with the Holetta research centre to contribute their knowledge on subjects such as soil conservation and management, and have provided some ongoing support to farmers. The role of NGOs, and private companies were not significant at any stage in the research areas. It should also be noted that the cooperatives have been a platform for informal self-learning and knowledge sharing and is very likely to have contributed to production improvements following the initial trainings. This is probably helped by the closeness of the communities, the relatively small size of the cooperatives, and the fact that cooperatives also farm some seed plots together. Overall, the training appears to have been delivered very well, were

[15] This is a finding from more than one dozen similar studies conducted by the author across various food commodities and countries. Contact the author for details on these.

Seed potatoes stored inside DLS storage

certainly well appreciated and appear to have a strong impact on yields. However, in such a rapid assessment the reliance on self-reporting by farmers of their changed practices makes it difficult to determine how correctly farmers adhere to the training without direct observation. In the near future, follow up extension and training would be recommended to correct and further normalise these improved practices.

Storage

A further component of the training was storage. Holetta trained farmers on how to construct a diffused light storage facility (DLS) by building a demonstration store with farmers at each cooperative. The project paid for the iron sheet roofing for the demonstration store, while farmers contributed Eucalyptus from their lands for the walls and flooring. This model store was then replicated by farmers using their own investments of time and materials. Most of the DLS stores are cooperatives stores, with very few individuals having their own. This makes sense due to the expensive of construction.

5 years ago, farmers reported a range of different storage types, none of which are optimal for seed storage even under local conditions. These included leaving potatoes in the ground or covered in the field which often resulted in them being eaten by wild animals, rotting, or inflicted with diseases. Seed was also stored in the house, either covered or uncovered but usually in piles. Piling seed in this way can result in damage to the tubers, and also the dark storage conditions retard the sprouting of seed before planting.

Following training and the construction of demonstration Diffused Light Stores in the project, now 52% of respondents reported storing their seed in DFS stores. After sorting and grading the seed, only 'medium' sized tubers of 25-55mm are stored as seed potatoes.

In all Woreda, farmer cooperatives successfully replicated the project demonstration stores, which were observed by the research team at all sites. Frequently the demonstration store was seen surrounded by several other stores which the cooperative members had built themselves and put their own investments into, typically for the iron sheet roofs. It is difficult to say how many DLS have been constructed because the research team were only a few kebele[16] were able to be visited in each woreda. In one focus groups it was reported that 145 DLS had been built in a kabele based on project demonstration store, while others reported dozens. Exact numbers are not verifiable, but it is clear that the idea of building demonstration stores with local materials and with available local skills and technologies has resulted in replication and spread of the technology.

> *"Before the project seed was left in the ground and was been eaten by wild animals, or was rotting, inflicted with diseases. That was a big problem in the area. We had a lesson on Diffused Light Storage (DLS). Now we are sorting and grading and selling the good, medium sized seed. CFC assisted us with one store made of iron sheets and now there are more than 145 DLS in this kabele. The smallest DLS have 40 iron sheets and biggest 60 sheets; The technology has spread even to farmers not involved in the project originally" (Gumer Burdena Dember).*

Figure 30 Storage methods 5 years ago and now

	5 years ago	Now
Dark store	13%	5%
Store with light	2%	13%
DFS	4%	52%
Uncovered house	15%	14%
Covered house	22%	17%
Stored in the Ground	28%	9%
Covered field	7%	8%
In bags	0%	1%
Other	11%	1%
	n=46	n=190

*5 years ago statistics only for those farmers growing potatoes for 5 years or more for reliability

** Does not add up to 100% because farmers might store seed in more than one place

Cooperative committee members were trained by Holetta to check members' stocks being put into cooperative storage and to record this information on their own data sheets. A process was set up to accept or reject members' seed into group stores for group marketing. This was a self-check mechanism to ensure and maintain the quality of seed stock for buyers. This is an important aspect for the reputation of the cooperative and the area as reputable seed sellers.

One gap in farmers knowledge of storage technology is how to store ware potatoes using locally available materials. Farmers have only received training on seed potatoes. However, storing ware potatoes is a different proposition. Farmers want to store harvested ware potatoes in order to prolong their shelf life so that they can be sold after the market glut that occurs around harvest times, and when the oversupply causes prices to drop considerably. This technology would seem to be important to even out the ware supply in the market, and would probably encourage more farmers to take up ware potato production, which in turn would lead to more demand for quality seed from seed growers.

Marketing

Seed

In the focus group discussions, farmers explained that NGOs are the biggest buyers of seed from seed cooperatives. At present, the Ministry of Agriculture (MoA) of the Woreda plays an important role in facilitating trade between the cooperative and buyers such as World Vision, CRS, GIZ, AGP and others, without taking a cut on the sale. The buyer deals with the cooperative rather than individual farmers. The cooperatives' chairman, secretary, treasurer and board facilitate the sale. Cooperative records are kept of these deals and were viewed by the research team at the cooperative offices. When cooperative seed stocks are low, individuals can also sell improved seed (which has been quality approved by the cooperative) through the cooperative with a levy of 10birr per quintal collected by the cooperative.

[16] A kebele (Amharic: ቀበሌ, qäbäle, "neighbourhood") is the smallest administrative unit of Ethiopia similar to a ward, a neighbourhood or a localized and delimited group of people. It is part of a woreda, or district, itself usually part of a Zone, which in turn are grouped into one of the Regions based on ethno-linguistic communities (or kililoch) that comprise the Federal Democratic Republic of Ethiopia. Each kebele consists of at least five hundred families, or the equivalent of 3,500 to 4,000 persons. There is at least one in every town with more than 2,000 population.

CFC demonstration DLS (right) surrounded by stores replicated by farmers at their own cost

Figure 31 presents the data from the surveys, which paints a picture of individual farmers marketing their seed to several types of buyer. (Note, the figures for 'cooperative', 'government organisation', and 'NGOs' can probably be combined (~60%) as this likely represents the process described above of farmers selling to NGOs through cooperatives as brokered by MoA. However, care should be exercised here because of the risk of some double counting).

Figure 31 Ware marketing

	5 years ago	Now
Village market	80%	68%
District market	30%	35%
Small traders	43%	61%
Big traders	13%	18%
Farmers direct	45%	38%
NGOs	1%	1%
Government organisation	0%	3%
Companies	0%	1%
Cooperative	8%	13%
Other	31%	5%
	N=83	N=190

Figure 32 Seed marketing

	5 years ago	Now
Village market	-	46%
District market	-	35%
Small traders	-	60%
Big traders	-	23%
Farmers direct	-	49%
NGOs	-	7%
Government organisation	-	19%
Companies	-	2%
Cooperative	-	34%
Other	-	2%
	-	N=123

In the focus group discussions, common prices for seed potatoes ranged between 300 and 700 birr per quintal (100kg) in recent seasons, with the common price being around 400 birr per quintal. The survey data found that last season prices averaged around 310 birr per quintal.

Farmers identified seed marketing as a growing problem, as there are now an increased number of farmers growing seed potatoes. There are several contributing reasons for this, among them increased supply of seed to the market, dampening prices, and also possibly lower seed quality (seed has been recycled for several generations often without being refreshed and old seed flushed out).

Figure 33 Average prices for ware and seed / quintal (birr)

	Ware	Seed
5 years ago	287	-
Last season	255	312

Ware

Ware potatoes receive lower prices than seed potatoes, and the price ranges between a high of 300 birr per quintal and 100 birr, with 180 being the common price cited in focus group discussions. Farmers expressed a preference for selling ware potatoes through traders rather than at the district markets because there is no transport cost to the farmers and little needed in the way of coordination. However, recognising that traders buy in bulk and cover transport costs, farmers said they found it difficult to say what a 'good' price should be when negotiating with traders, suggesting a lack of information. Different traders come and buy in different years, rather than developing long term relationships with certain farmers or areas. In some cases traders are known from the area, and in some cases are not known and may come from far away, even selling on potatoes to Somaliland. As in the case of seed potatoes, many farmers reported marketing to more than buyer type last season.

Gender

The majority of the survey participants were males, because they were most often identified as the head of the household and hence brought into the project. Focus group discussions corroborated that more males engage in potato cultivation than females and are engaged in more production activities (confirmed by female focus group participants). This has implications on decision making, regarding what, where and how to cultivate, and on how income generated should be used.

The project required that at least 20% of cooperatives members should be women. At least one woman also held a leadership position in each of the cooperatives visited. This was found to be achieved in the cooperatives visited within the research area, but no more than 20%. Women involved in the cooperative tended to be widows or unmarried. As the men were usually the head of the household and are traditionally intensively involved in potato production and other agriculture, the project largely worked within these structures, with men directly engaging in training more than women through their cooperative membership. Men were then required to disseminate this training to other household labourers and hired labourers. While it is was not possible in this research to judge whether or not this happened, or how well, it stands to reason that it is in the interests of the household head to do so, as this is a pathway to improved production levels benefiting the household.

In general, men were reported to be more involved in the heavy work of land preparation and ploughing with oxen. Women are more likely to contribute their family labour to planting and harvesting, where they collect the potatoes behind the oxen driven by men.

It should also be noted that (widowed) women tended to own smaller plots of land, so are not making such large profits as other beneficiaries with ware potatoes (Figure 34). However, women did have about the same amount of land under seed potatoes as men.

Figure 34 Gender -average size of land used for ware potatoes (hectares)

	Men	Women	Total
Land size (average h)	0.63	0.4	0.6
Count	N=142	N=26	

Figure 35 Gender -average size of land used for seed potatoes (hectares)

	Men	Women	Total
Land size (average h)	0.59	0.57	0.59
Count	N=90	N=10	

One training that was specifically targeted to women was cooking. Before, women said they only knew about boiling potatoes, but have now been trained in twelve recipes. While this might seem as small detail, this was reported to be quite important to the acceptance of potato in the community. It might be hoped that this component of the project will help with sustainability because potatoes can be grown both as a cash crop and for household consumption.

Livelihood impact

The CFC WCPP project is clearly perceived by beneficiary farmers to have had a substantial impact on their livelihoods and also on the wider community, through revitalized rural economies. Furthermore the project has had an impact on the chain level, where the potato sub sector has been considerably strengthened by greater availability of improved seed.

> *"Everything we know we learned through CFC" (Gumer Burdena Dember)*

Before the project few farmers grew potatoes, and those who did so grew mainly for household consumption. The

project introduced changes in farmer knowledge and skills related to both ware and seed potato farming, which can be directly attributed to the project. This led to improved potato farming practices which resulted in higher yields (p.12), fewer losses (p.16), higher quality seed produce (p.14), and commericialisation of produce (p.17). For beneficiary farmers, this translated into substantially higher incomes from seed potatoes than they were earning before with other traditional crops such as enset, or barley, wheat, beans and peas.

Cost, revenue and profit

> *"Most of our income is from potato - potato kick-started everything here. With the money we earned from potato, we invested in other enterprises and crops. There was very little in the way of cash crops before the CFC project. The most common was some small profit from enset. Some people with land made money leasing land to others, others worked as hired labour at about 5 birr /day". (Gumer Burdena Dember).*

The significant income generated from potatoes (Figure 36, Figure 37) was used in many different ways. Farmers most frequently cited purchasing corrugated iron sheets for their houses as the first investment when they began making money from potatoes. Other commonly recalled purchases were mobile phones, radio, and TVs and several connected their houses with electricity. Households spoke of being now able to afford school fees, whereas before this was a serious struggle for most households. Income from potatoes enabled farmers to invest in oxen, dairy cattle, horses, sheep, and other small livestock.

Some farmers are now investing in leasing more land for potatoes, although this is limited and severely constrained by low land availability and relatively high populations density in these rural areas. Farmers did not invest in mechanisation, however some did buy more oxen or a plough. More significantly, it is clear farmers are now seriously investing their production through purchases of fertilizer, seed and other inputs. These production changes are believed to be major drivers of changes in yield and income (p.12). Investments in production capacity appear to be helping farmers move into a more financially sustainable farming cycle. It should be noted, that beneficiary farmers also reported improvements in yields of other crops as an outcome of the WCPP project. This was because they now applied better practices to their other crops too, such as fertilizer use, and crop rotation.

The increased economic activity in the project areas was reported in focus groups to have even led to some few farmers with larger lands opening small stores, or becoming small traders to gain further income. (This was not able to be verified).

Seed beneficiaries

Figure 36 and Figure 37 show the costs, revenue and profit that can be derived from growing 1 hectare of seed potatoes. This figures were obtained during the focus group discussions of these groups – one in each woreda[17]. A median value was used by the researcher from 3 focus groups[18] where cost/revenue/profit data was gathered in order to represent a 'normal' scenario. Opportunity costs for household labour were included in the calculation (ie all labour was priced). It was found that costs amounted to approximately 43795 Birr per hectare. Total revenue (marketable seed produce * price) was calculated at 104000 Birr. This leaves farmers with an approximate profit of 60205 Birr per hectare (US$ 3204, EUR 2416).

Seed potato farmers had an average of 0.45 hectares under potato seed last season (Figure 9), meaning that an 'average' farmer made 27092 Birr from seed potatoes per 0.45 hectares last season (USD$1380, EUR1016). Furthermore, roughly half of the respondents were growing potatoes two seasons per year (long 'Meher' rains and shorter 'Belg' rains), meaning that their annualised income from seed potatoes could be up to double this figure in a good 'short' season.

Of course, we need to account for the value of the crop that seed potatoes are replacing on the same land – typically enset, barley, wheat and faba bean. This study is too limited in scope to estimate the marginal return based on the replacement value of seed potato over these other crops. However, in focus group discussions, farmers stressed that potatoes are by far their most profitable crop, and it would not be a stretch to suggest that the marginal return is at least 50% of the figures cited above per season.

Ware beneficiaries

Beneficiary ware farmers are now also receiving more income from their ware potatoes, as a result of better quality seed and better production practices. Ware prices were often quoted at 150-200 Birr per quintal, and we use the figure here of 180 Birr per quintal. The estimated yield for ware potatoes before the project was 8.8 tonnes per hectare and now is 15.8 tonnes per hectare – an improvement of 7 tonnes per hectare. This amounts to an *additional* 12600 birr per hectare than before the project. Those growing potatoes had on average 0.77 hectares,

[17] The price, yield and multiplication rates from the focus group discussions are not quite the same as the data from the quantitative survey for each woreda. However, because this data was carefully probed by the KIT researcher in the focus groups as 'normal' situations it has been used here. The quantitative data however had a considerably greater range with quite some outliers which could be caused by either poor individual farmer estimates of their land size and yield or enumerator error.

[18] Data was not able to be obtained for the Geta woreda focus group due to time constraints

meaning a typical ware beneficiary farmer is now generating 9702 Birr more per season. After accounting for extra input costs such as additional labour, fertilizers and fungicides, this would amount to roughly an *additional* 6000 Birr more per season (US$305, EUR224)

Ware non-beneficiaries

Of course, farmers who were *non*-beneficiaries also stood to benefit from the project, as the beneficiary farmers have produced improved seed which they can use on their potato farms. It is difficult to estimate how much improved seed alone can add to yields, however one expert estimate[19] put this at 25% for the first year the seed is bought and a further 17% when it is recycled by the ware grower the second season. Taking the baseline yield figure of 8.8 tonnes (above), this means an approximate improvement of 2.2 tonnes per hectare in the first year for non-beneficiary farmers using improved seed produced by beneficiary farmers, translating to an *additional* 3300-4400 birr more per hectare per season.

[19] Peter Gildemacher PHD.

Figure 36 Seed potato farmers costs per hectare

	Gumer- Esen and Andagezu	Wonchi - Weldo Telfam	Gumer - Burdena Dember	Median
Costs				
Land leasing (one season, June to October)	8000	1500	8000	8000
Land breaking - 1st break	3200	280	3500	3200
Land breaking – 2nd break	4800	280	3500	3500
Land breaking – 3rd break	3200	280	400	3200*
Land breaking – 4th break	-	-	400	
Seed (20 quintal, 2 tonnes)	10000	12000	8000	10000
Cultivation (weeding, ridging) - 1st time	2400	800	1500	1500
Cultivation (weeding, ridging) - 2nd time	2000	800	2500	2000
Planting	3200	680	1500	1500
Fungicides	1100	800	800	800
Urea	3536	2175	2130	2175
DAP	2800	3120	3472	3120
Harvesting	4400	1360	2800	2800
Transportation (field to DLS)	2000	1100	3000	2000
Total	50636	25175	41502	43795

* Researcher value used as median value thought to be too low[20]

[20] **Gumer- Esen and Andagezu:** Land leasing: one season, June to October; Land breaking 1st break: 80 man days * 40 birr /day by hand; Land breaking 2nd break: 120 man days * 40 birr /day by hand; Land breaking 3rd break: 80 man days * 40 birr /day by hand; Seed: 2 quintal (2 tonnes) of sprouted seed at 500 birr/quintal; Cultivation (weeding, ridging) 1st time: 60 man days *40 birr/day; Cultivation (weeding, ridging) 2nd time: 50 man days * 40 birr/day; Planting: 80 man days*40 birr/day; Fungicides: 2kg at 550birr/kg; Urea fertilizer: 4x 50kg bags at 884 birr/50 kg; DAP fertilizer: 4x 50kg bags at 700 birr/50 kg; Harvesting and transportation combined: 160 man days * 40 birr/day;

Wonchi - Weldo Telfam: Land leasing: one season, June to October; Land breaking 1st break: 1 day with 4 pair ox and 4 men (1 pair ox = 50birr/day, 1 man 20 birr/day); Land breaking 2nd break: 1 day with 4 pair ox and 4 men (1 pair ox = 50birr/day, 1 man 20 birr/day); Land breaking 3rd break: 1 day with 4 pair ox and 4 men (1 pair ox = 50birr/day, 1 man 20 birr/day); Seed: 2 quintal (2 tonnes) of sprouted seed at 600 birr/quintal; Cultivation (weeding, ridging) 1st time: 40 man days *20 birr/day; Cultivation (weeding, ridging) 2nd time: 40 man days *20 birr/day; Planting: 4 pair oxen (50birr each pair), 4 person with oxen (20birr each), 20 people behind planting and covering (20birr each); Fungicides: 2kg at 400birr/kg; Urea fertilizer: 3x 50kg bags at 725 birr/50 kg; DAP fertilizer: 4x 50kg bags at 780 birr/50 kg; Harvesting: 8 pairs of Oxen (1 pair ox=50 birr/day) and 8 men (1 oxman=20birr/day), behind each pair of ox is 5 people collecting (40 collectors) (1 person is 20 birr - same labour cost for a man and woman); Transportation: From field to DLS by donkey cart, 5birr/quintal;

Gumer - Burdena Dember: Land leasing: one season, June to October; Land breaking 1st break: 70 man days * 50 birr /day; Land breaking 2nd break: 70 man days * 50 birr /day; Land breaking 3rd break: 4 pair of ox (each ox 50/day) with hand labour (50/day);

Figure 37 Seed potato farmers revenue and profit per hectare

Revenue	Gumer-Esen and Andagezu	Wonchi - Weldo Telfam	Gumer - Burdena Dember	Median
Marketable Yield - quintal / hectare	260	220	300	260
Price/quintal (100kg bag)	400	400	300	400
Multiplication rates	13	11	15	
Total revenue (marketable yield*price)	104000	88000	90000	104000
Profit (Birr)	**53364**	**62825**	**48498**	**60205**
US	2718	3200	2470	3204
EUR	1999	2353	1817	2416

Displacement

In all focus groups it was reported that 5 years ago, before the project, there were few employment opportunities, that local economies were seriously depressed economically, and that it was very common for households to send one or more members to work seasonally in the nearest towns to earn money through petty trading or services. This had negative impacts, such as on household cohesion, hardships and risk of violence in the towns, and risks of exploitation. It was also suggested that this kind of migration brought back 'diseases'[21]. Focus group participants in all areas reported that the WCPP project has revitalised the economies of local communities and stopped, or even reversed, outward migration. Essentially this is because beneficiaries believe that now there are better prospects in the area, and says their households have significantly more money now because of potatoes. This is of course very difficult to verify, however all respondents stressed this change in displacement, and all of them identified this change unprompted by the research team. This gives some confidence in the strength of this finding.

Spinoff to non-beneficiaries

Revitalisation of local economies can be seen to have had a spinoff benefit to non-beneficiary farmers in the project area (e.g. through increased economic activity). This was not able to be measured in such a rapid assessment so the extent to which non-beneficiaries may also have benefited is not accurately known. Another way that non-beneficiaries are expected to have benefited is through farmers buying better quality potato seed from the beneficiary farmers and their cooperatives. In this way, non-beneficiaries should also be realising higher yields and income because of the better seed. Furthermore, there could be expected to be some spinoff to non-beneficiary farmers as they come to learn from and replicate at least some of the production practices adopted by beneficiary farmers. This indirect impact would be very difficult to measure even in an extensive research. However, as discussed above, just by improving non-beneficiary farmers access to improved seed from beneficiary farmers can raise their ware potato yield by 25% in the first year alone.

Household Food Security

As discussed earlier (p.9), the WCPP project had a major impact on food security for virtually all beneficiary households. The WCPP project was found to have had a major impact on food security. 5 years ago respondents reported that their households had 3 meals a day for an average of 3.9 months of the year. Now beneficiaries report having 3 meals a day 7.59 months of the year. Before the project respondents reported on average 1.5 months of the year where the household had only one meal per day, whereas now virtually all respondent households have at least 2 meals per day for every month of the year. Because potato is a short season crop, beneficiary farmers no longer experience a hungry season as they used to before the grain harvest.

Conclusion and Recommendations

The CFC project 'Wealth creation through integrated development of potato production' has clearly brought a wide range of positive livelihood changes for potato farmers in the highlands of Ethiopia. It has brought new potato related knowledge and technologies, helped to organise farmers, and has significantly improved food security and household incomes. The project was well targeted and well implemented and applied a strategy which, rather than focussing on one or two production issues, took a systematic approach to transforming the seed and ware potato value chains. Overall, the project can certainly be regarded as a success story.

Nevertheless, there are of course aspects which the project funders, implementers and other actors should be aware of to ensure the sustainability of these gains. While the project has now wound up, there is a good opportunity for CFC or another donor to invest in a phase 2, to build on the gains

Land breaking 4th break: 4 pair of ox (each ox 50/day) with hand labour (50/day); Seed: 2 quintal (2 tonnes) of sprouted seed at 400 birr/quintal; Cultivation (weeding, ridging) 1st time: 30 people at 50 birr /day; Cultivation (weeding, ridging) 2nd time: 50 people at 50 birr/day; Planting: 30 people at 50 birr /day; Fungicides: 400birr /kg, 2kg; Urea fertilizer: 3x 50kg bags at 710 birr/50 kg; DAP fertilizer: 4x 50kg bags at 568 birr/50 kg; Harvesting: 8 pair of ox (50 birr each pair ox), 50 birr/person w ox, total 8 people with the ox. Collecting 40 people (5 behind each ox), at 50 birr; Transportation: 300 quintal average yield *10birr per quintal by cart;

[21] Possibly AIDS, this was not probed on

made and take the sector to the next level. The following are recommendations are offered:

- Project trainings have successfully built farmer capacity and professionalized seed production. It is recommended for this to be built on in other areas, as there remains a big demand for improved seed throughout Ethiopia. Furthermore, it would be wise to continue supporting project beneficiary farmer groups with, say, annual training follow-ups to ensure best practices become normalized by all farmers.
- The capacity of farmer cooperatives has been built to a good level in a short time – some better than others. However, it should be kept in mind that these cooperatives are still relatively nascent and can be expected to require a degree of ongoing support to carry out business operations and support their farmers. Up until recently they have enjoyed the support of the project, and the energy of new farmers coming into the potato sub-sector for the first time. However, it is in the next phase of a cooperative's development that governance challenges can arise due to changing expectations of members, changes in leadership, changes in market conditions, or poor environmental conditions.
- Marketing was highlighted by farmers themselves as their biggest challenge now. Prices have begun to fall as supply increases, and farmers have expressed a concern about how they can best access new markets. At the moment, some feel dependent on the brokering role that the woreda MoA plays to bring NGOs and other formal buyers to them. This assistance from the MoA is certainly appreciated, however cooperatives and individual farmers feel they need to reach new markets – either more ware farmers in the area or linking with buyers further away. With the new road highway networks observed being built in the vicinity of the research areas, this would seem to be a real opportunity.
- The DLS storage for seed is perceived to have been a big success. However, now seed and ware growers are interested in locally appropriate technologies for ware storage too (i.e. not electricity dependent). This is an issue for enabling ware farmers to prolong the period in which they can store and market ware potatoes, outside of the glut that occurs around harvest time. This is relevant to seed potato growers too, because they often also grow ware. Furthermore, seed producers believe that if ware potato growing is more profitable then more farmers will grow ware, resulting in higher demand for their seed.
- Financial literacy is an issue for farmers – very few are keeping records, despite them reporting that they have had training. This makes it difficult for them to judge the levels of investment that they should make on inputs, and what the return on investment would likely be from yield gains. In focus group discussions no farmer actually knew their costs or *how much* they were profiting, although it was widely believed that they were profiting a lot.
- The need for investment in clean basic seed (generation 1) is probably the biggest and most urgent challenge to the sustainability of seed potato production by beneficiary farmers. Virtually no farmers have flushed out and refreshed their seed stocks since the project began. So while seed production and storage practices are good, the inevitable degeneration of the improved seed varieties is catching up with farmers. Yields are decreasing, resulting in reduced profits. Furthermore, there is a reputational issue at stake – project beneficiary farmers and their cooperatives are currently perceived by formal buyers such as NGOs as having desirably high quality seed. Unless farmers buy new basic seed to improve the quality of their harvested seed, they can expect to lose these hard to find formal buyers. The issue here is two-fold:
    - First, farmers said that new basic seed from Holetta (either 'Gudene', 'Jalene' or the favoured 'Belette') costs roughly 3-4 times what they currently sell their own multiplied seed for. Farmers have expressed that they would happily pay around 600 birr per quintal, but the reality of market prices for basic seed are putting off farmers. Nevertheless, while this is expensive for farmers, the participatory budgeting exercises done during this evaluation show that even if farmers buy new seed at these prices, they will still comfortably return a profit that same season, with costs offset by the higher yields of new seed. Furthermore, farmers will of course benefit through higher yields in the following 3 seasons of multiplication. Assuming a cost of 1200-1500 birr per quintal (100kg) for new basic seed, and that farmers use 20 quintal per hectare (2 tonnes), this amounts to 24000-30000 birr in increased costs per hectare when renewing their stocks.

    - Second, access is an issue. Farmers and their cooperatives feel far away from Holetta and seed companies, both geographically and relationship wise. Potato seed is bulky and therefore difficult and expensive to transport. A seed distribution marketing arrangement between Holetta and potato seed cooperatives would be interesting to look into. Farmers also feel that they do not know who to approach to access new clean basic seed, and how to negotiate such a deal. Therefore, it would be wise to strengthen the linkages between farmer cooperatives and Holetta and/or companies to improve access to basic seed. For example, farmers expressed interest in a revolving seed fund. After all, beneficiary farmers are now playing an important role in the chain, multiplying improved seed in numbers, on a scale that Holetta and companies cannot do on their own.
- Finally, there would appear to be an emerging opportunity for investment in a medium-large potato processor in the sector, as there is in Kenya. The demand already exists and is currently met through imports. Consumption of potato chips (French fries) in East Africa is rapidly increasing due to urbanisation, the proliferation of fast-food restaurants, growing tourism, and a significant change in eating habits among both high- and low-income groups in urban areas. It is understood that there is no such company operating in Ethiopia at present. Such an enterprise has been calculated as being profitable in other research[22]. It would also help to absorb increases in ware potato supply to the market, as more farmers look to grow potatoes and realise higher yields from the use of improved seed and better ware production practices. Beneficiary farmers would be excellent candidates to supply such an enterprise through an outgrower arrangement.

[22] Haverkort, A., Koesveld, F., Schepers, H., Wijnands, J., Wustman, R., Zhang, Z. (2012) Potato prospects for Ethiopia: On the road to value addition. Wageningen UR. Available at http://edepot.wur.nl/244969

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