

# **Creating New Markets via Smallholder Irrigation: The Case of Irrigation-led Smallholder Commercialization in Lume District, Ethiopia**

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# 1. Background

Following the 2008 global food crises, the agricultural development agenda has gained renewed international attention. Though this observed price instability reflects largely short-term disequilibria between supply and demand, many - especially major food importing countries - consider it an indicator of a new era that is characterised by much more unstable food prices on the international markets (Galtier, 2009). Consequently, investors from these countries were encouraged to lease farm lands in relatively land and water abundant countries in Africa and other parts of the developing world.

The price instability witnessed in 2007-2008 has shaken the confidence of major food importing countries and led them to consider outsourcing agricultural investment as a solution. Multilateral donors like the World Bank and FAO<sup>1</sup> pointed out that one opportunity for finding sustainable solutions to the problem might lie in supporting Africa and potentially countries such as Brazil or selected Central and South-east Asian countries to become global players in world agricultural trade. Along with the promotion of appropriate technologies for small farmers and the particular crops they grow<sup>2</sup> both aimed at helping to raise the productivity and competitiveness of African agriculture, commercialization of small family-based agriculture is also considered key to stimulating agricultural growth in Africa and to averting future global food crises.

The commercialization of African small family farms in particular and raising their competitiveness especially at international level is, however, not without controversy. Two points are at the centre of the disagreement. First, there is a view promoted by scholars like Paul Collier that small-scale farming in Africa is not capable of meeting the challenges of contemporary agricultural development<sup>3</sup>, hence is not able to take part in the global value chain. On the other hand, there is a growing body of evidence (e.g. Sharp et al, 2008) that small farmers, even in "subsistence-oriented" areas, are as entrepreneurial as any other group of people when they find opportunities that suit their conditions<sup>4</sup>.

Success stories generated from such case studies, however, face difficulties informing highly-debated issues and attracting patronage mainly because findings from such studies mostly rely on data generated from small village-level surveys where drivers and conditions for successful commercialization are partly associated with some village-specific factors<sup>5</sup>. Though this argument is partly true, what is important is to analyse and put in proper context implications generated from such village-level studies so that lessons on issues – such as the conditions under which small farms can commercialise, and the encouragement required from policy, can be drawn.

## 2. Objectives

Following the foregoing discussions, and based on household-level surveys conducted in four villages in central Ethiopia where government intervenes to enhance the commercialization of small farms, the study tries to generate insights that improve our understanding of ways in which small scale farming may become commercialised, and the prospects and challenges for

further commercialization. The study also looks at other factors that drive the commercialization process and how these vary vis-à-vis key household characteristics and objectives like food security. As commercialisation of agriculture is identified in Ethiopia as a means to reduce poverty among small farmers, the study also looks at some key outcomes of the intervention that indicate the effect of commercialization interventions on poverty and the incomes of participant farm households.

In general, the key issues this work addresses include:

- How commercialization schemes affect household food security: Does the intervention improve or worsen food security? Does household priority to achieve food security affect their participation in initiatives to commercialise smallholder farming?
- How the ability to bear risk (measured in terms of initial access to assets) relates to commercialization or farmers capacity to take up opportunities for commercialization; and
- The degree to which the intervention resolves potential failures in factor and product markets.

By answering these questions the study tries to assess the implications of the scheme for those with little or no land and food insecure households and in order to identify the forces that drive and strengthen the commercialization process.

## 3. The study area and the commercialization scheme

### 3.1. Background on the programme

The Ethiopian government (see MOFED, 2005) revised its rural development strategy five years ago. This revision has given agricultural commercialisation a central place in the country's second Poverty Reduction Strategy Paper (PRSP). The PRSP aims to rebalance earlier 'food self-sufficiency first' strategy into a broader approach that recognises the need for integrating smallholder agriculture into markets in particular and the commercialization of agriculture in general. Following this change in the government rural development policy, many rural districts revised their agricultural development and intervention strategies. The case this study investigates is a programme implemented by the Lume district agricultural office.

The district agricultural development office introduced irrigation-supported production of perishable horticultural crops like onions, tomatoes and green peppers which are primarily produced for markets, into the predominantly grain-dominated cropping systems of the district. The programme began in 2005 with interventions in two kebele community associations, then two more kebele associations were added in 2006, and another three kebele associations in 2007. In 2009, four more kebele associations were incorporated.

The programme builds small irrigation structures that run across different villages and supports randomly selected farm households to irrigate part of their farm land. Owing to shortage of water, authorities allow beneficiary households to irrigate only part of their farm land, with a maximum limit of a quarter of their land-holding. Apart from this investment in low-cost irrigation structures, the programme provides technical advice on

improving the efficiency of water use as well as agro-economic recommendations on the production of the new vegetable crops. It also monitors the use of water and enforces household limits on water use to land earmarked by the district office for irrigation.

By promoting high value, relatively labour intensive vegetable crops, the programme tried to integrate small farmers into markets and raise their cash income. Out of the total 35 rural kebele associations<sup>6</sup> in Lume district, the programme is currently implemented only in 11 villages. Even in these intervention villages only 10 to 30% of farmers have the opportunity - through random selection - to take part in the programme. Other than the promise to grow only vegetable crops on the land they earmarked for irrigation, participant households have no obligations and do not have to pay the services they get from the programme.

### 3.2. The study area

Lume district is located in the central part of the country in East Shoa Zone of Oromiya Region. The district is located in the highlands (1,500 – 2,300 meters above sea level) and receives adequate rainfall. It is very near to major national and regional markets and highways that connect the country to ports in the neighbouring countries. This proximity to urban centres (Addis Abeba, Nazareth and Debre Zeit/Bishoftu) and major road networks create market opportunities. Emerging demand for vegetables in the nearby cities also offers a huge potential for the expansion of cash crop production and intensification of existing cropland.

The predominant occupation of the study population is sedentary mixed farming which depends heavily on

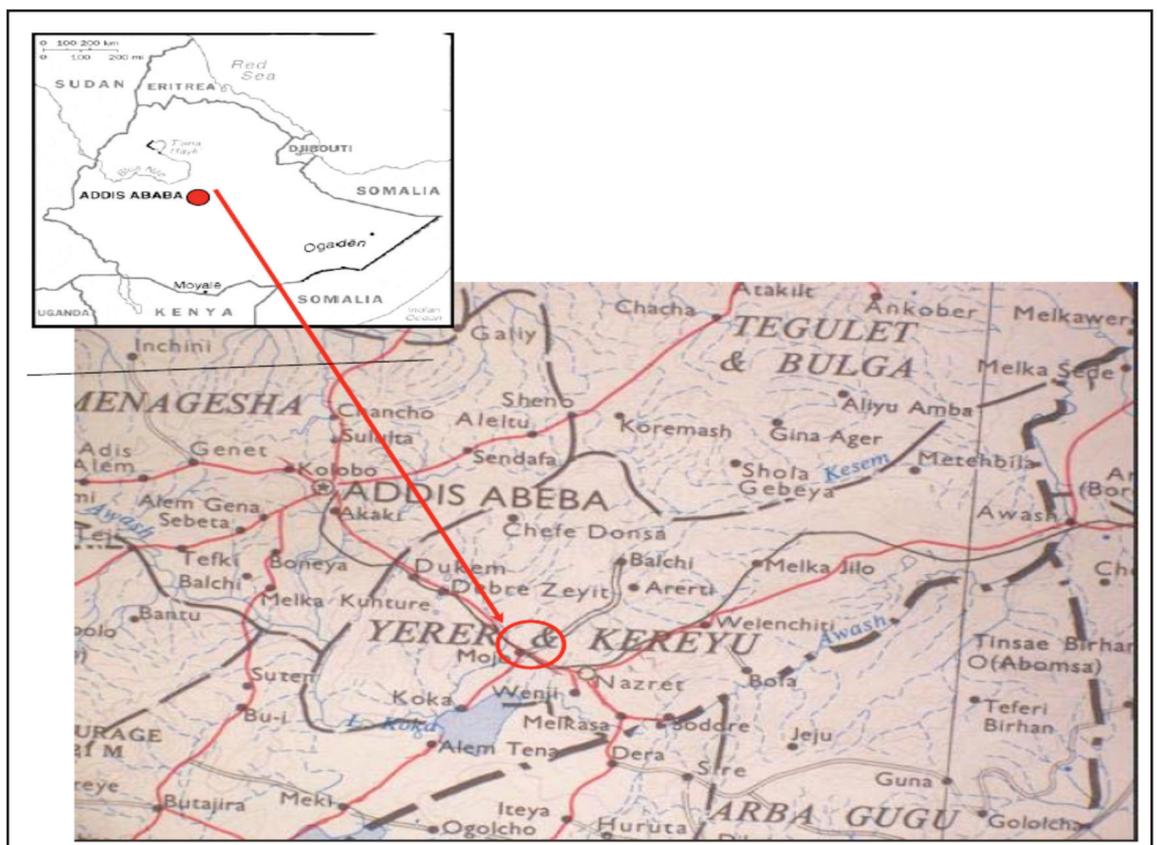
the use of chemical fertilizers. Today more than 90% of households use chemical fertilizers (Fikru, 2008). Agriculture is mainly rain-fed, but water harvesting and small scale irrigation technologies have been practiced for the production of high-value vegetables.

Farmers own on average about 2.3 hectares (ha) of farm land which is far higher than the national average of about one hectare, however the young and poor experience acute land shortage. Grazing land has dwindled due to population pressure and led farmers to keep only essential animals.

The major source of livelihood in the area is cultivation of different annual crops (tef, wheat, maize and barley), fruit and vegetables, and livestock raising (cattle, sheep, and goat). Tef and vegetables (mainly onion, tomatoes and green pepper) are the main cash crops, while tef and wheat are the major subsistence crops. Farmers in the district are also engaged in various non-farm activities alongside farming. These include waged labour (mainly in emerging large private flower farms), trade, pottery, sale of local liquors, and quarrying of stones, gravel and river sand. Fishery is also practiced on Lake Tute which is found in the woreda (district) (Fikru, 2008).

Results from group discussion indicate that non-farm business activities contribute on average about 22 % of total income, while wage and salary and other income sources were estimated to contribute for 14 % and 8 % of total income on average, which implies that the share of income from farming is a bit less than 60% . Though diversification into non-farm livelihoods is important, the study by Fikru (2008) indicates that at the time the study was conducted, diversification into high value, high return activities was virtually absent and diversification

Figure 1. Location map of the study area



**Table 1. Sample farm households based on their wealth / landholding status**

Wealth Status	Participants	Non-participants	Total
Poor (cultivate <2 ha)	20 (25 %)	23 (29 %)	43
Medium (2 – 4 ha)	30 (38 %)	29 (36 %)	59
Better off (> 4 ha)	30 (37 %)	28 (35 %)	58
Total (N)	80	80	160

was limited to petty trade and family level small-scale activities.

## 4. Methodology

The study uses a structured household questionnaire and qualitative methods that include focus group discussions and key informant interviews for data collection. As it intends to examine households' behaviour and how this behaviour responds to the commercialization scheme, the study uses the household as its unit of analysis.

A two stage stratified random sampling method was adopted for the selection of sample households for the survey which includes 160 farm households residing in four intervention villages<sup>7</sup>. First, farm households in selected villages were stratified by their status in the commercialization programme (i.e. their participation) – as participants and non-participants. This is followed by stratification of farm households into three groups – poor, medium, and better-off – based on their wealth status. Farm size is used as a proxy for households' wealth status as discussion with community members during the scoping study revealed that farm size is the major indicator of wealth<sup>8</sup>.

As the study seeks to analyse the behaviour of different households vis-à-vis their wealth status, it was necessary to draw samples following the method of proportionate stratified random sampling where a quota is allocated to the three strata in proportion to their size. Subsequently, sample households were selected randomly from each wealth strata until the quota (defined as ratio of the number of farmers in each subgroup / strata over the total sample size) was filled. The same procedure was used to select non-participant households living in the intervention villages<sup>9</sup>.

For the focus group discussion four groups were formed: participant households, non-participant households, youth, and women, representing different segments of the community. Each group consisted of five to eight persons and effort was made to include household members from different backgrounds. Key

informant interviews were conducted with representatives of district agricultural offices, local traders and heads of cooperative associations.

As part of data processing, quantitative data collected through the household survey was sorted and coded, followed by data cleaning and entry. The analysis was conducted primarily using descriptive statistical procedures like frequency distributions and cross tabulations which provides analytical information about a variable of interest, e.g. changes in the commercialization status of farmers and on the relationship between two or more variables of interest which helps, for instance, in exploring the possible causes of disparity in accessing and benefiting from the new interventions among different farm household groups (defined in terms of farm size or food security).

## 5. Results

The study shows that diversification into horticultural crops is one potential avenue for commercialization of small farmers while helping participant farm households to improve their income given diminishing land / labour ratio. The study also generates empirical evidence and insights that can enrich the debates and arguments on the commercialization of small family farms.

### 5.1. Characteristics of the study population

The majority of sample farm households were male-headed, although the share of females is significantly higher among non-participant group than the participant group. It is not clear whether this low participation of female-headed households in the commercialization initiatives is the consequence of their multiple responsibilities – household and farming - or whether it is because of gender-related barriers or biases<sup>10</sup>. Similarly, illiteracy and incidence of migration are higher among non-participant farm households.

Differences between the two groups in cultivated land, household size, and age of household head were found statistically insignificant. The likelihood of migration and

### Box 1: Gender and commercialization

A Pearson chi-square coefficient was computed to look the relationship between gender and participation in the commercialization scheme. If there is no relationship between gender and participation, which are both categorical variables, one expects an equal number (proportion) of choices to participate (or not) between female- and male-headed households.

On null hypothesis that participation in the commercialization scheme is independent of gender, a  $\chi^2$  value (1) of 3.94 and Pr = 0.047 indicates that participation in the commercialization scheme is not independent of the sex of the household head, keeping other factors constant. A revisit of the study population might be necessary to reveal why male-headed households were preferentially treated in the selection process where participation was reportedly the result of random selection.

diversification of livelihood into non-farm activities, however, appear to be significantly higher among non-participant farm households. Survey data indicates that the likelihood of participation and duration of off-farm employment by farm households not engaged in the commercialization scheme exceeded that of participant households by a ratio of 2 to 1.

The aforementioned differences between participant and non-participants could be attributed to mere chance. There might, however, also be a selection bias whereby literate and male-headed households get better chance of participation. The lack of statistically significant difference in landholding, however, could be an indication that there was no selection bias, as having more assets might indicate a higher degree of interest for commercialization than other factors, such as literacy.

### 5.1.1. Land and land market

An overwhelming majority of the Ethiopian people depend on land for their livelihood. The ownership of land, however, rests on the state. Farmers are endowed with user rights and the right to transfer land through inheritance. Farmers also have the right to rent out up to half of the land under his/her holding. The regional government proclamation, however, further complicates the transferability of land rights. For instance, it limits the lease period to three years for traditional farming (and 15 years for mechanised farming) and requires the leaser to be a permanent resident of the area.

Despite such policy constraints, land rental markets operate actively and provide ample opportunities for farmers in the study area to rent land, expand their farming area and engage in the production of high value cash crops. About 86% of participant farmers rented on average about 1.2 ha of farm land. Similarly, about 60%

of non-participant farmers reported that they rented others' land, while another 20% of non-participant farm households rented out part of their farm land<sup>11</sup>.

Compared to non-participant farmers, farmers engaged in the commercialization scheme engage more in land rental markets, though the transactions are conducted among farmers who own similar sized farms, indicating the egalitarian distribution of farm land in the study areas. This might also be the reason for lack of statistically significant differences in farm size between participant and non-participant farmers, illustrating the fact that both relatively small and large farmers had equal chance in taking part in the commercialization scheme.

Though the cause-effect relationship might run in both ways, participant farmers who rent someone else's land were also found to employ non-family labour and rarely participated in off-farm activities. On the other hand, the reverse was found true of non-participant farmers who rent farm land. The lowest participation in both farm and non-farm labour markets, however, was found among non-participant farmers who rented out their land either to participant or other non-participant farmers (Table 3).

### 5.2 . Smallholders' responsiveness to the commercialization scheme

Responsiveness to the commercialization scheme is measured in terms of changes in value of crops sold compared to the pre-intervention period and differences in cash income between participant and non-participant farmers. The analysis, however, holds true if the assumption of insignificant selection bias is correct, implying that pre-intervention differences in the degree of commercialization has no role in explaining post-inter-

**Table 2. Key socio-economic profile of the study population**

Demographic and social characteristics	Participants		Non-participants		T-value/ Pearson chi2(1)
	Mean	Median	Mean	Median	
Age (year)	40 (12)	40	42 (13)	45	1.00
Sex (% of male headed households)	98	-	90	-	3.94**
Household size	6.8 (3.6)	6	6.5 (2.6)	7.0	0.34
Illiteracy among heads (%)	15	-	27	-	3.38*
Migration					
- % households having members migrated	29	--	39	--	2.82*
- Number of persons migrated (No./hh)	2.2 (1.2)	2.0	2.0 (1.2)	2.0	--
Asset and economy					
Cultivated land (ha)	3.5 (2.2)	3.0	3.0 (1.9)	2.5	1.43
Participation in off-farm activities (% of HHs having one or more member working off-farm)	24%	-	45%	-	8.67***
Number of days worked off-farm	45	-	90	-	2.14**
N	80		80		

\*, \*\* and \*\*\* indicates statistical significance at 10%, 5% and 1% respectively. For continuous variables like age t-test was conducted. For categorical variables like sex and literacy, the Pearson chi2 (1) value indicates the result of a chi-square test performed to see if two variables (e.g. sex versus participation in the commercialization scheme) are independent.

Note: Figures in parenthesis are standard deviations.

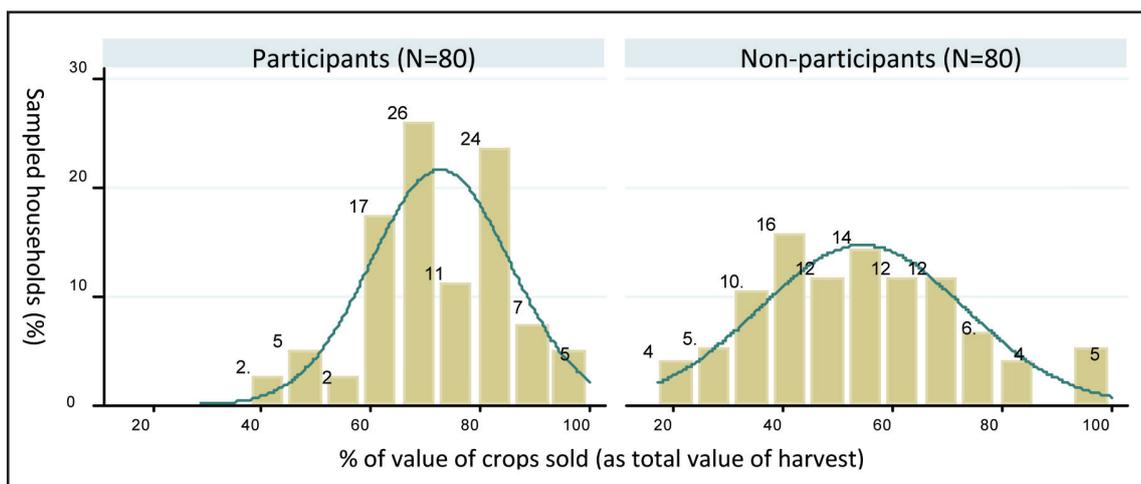
Source: computed from household survey (2009).

**Table 3. Farm land and participation in land market**

	Participants	Non-participants	t-value
Owned land (ha)	2.3 ha	2.2 ha	0.18
Cultivated land (ha)	3.5 ha	3.0 ha	1.43
Number of plots per farm	7	5	--
Number of rented-in plots per farm	2	1	--
<b>2. Participation in land market</b>			
<b>2.1 Participation as tenant</b>			
- Owned farm land (ha)	2.2 ha	1.9 ha	0.16
- Households rented-in land	69 (86%)	45 (60%)	--
- Average size of rented-in land	1.7 ha	1.4 ha	0.46
- Participation in off-farm activities (% yes)	23%	51%	3.12***
- % hired farm labour	83%	50%	1.77*
<b>2.2 Participation as landlord</b>			
- Owned farm land (ha)	--	2.1 ha	--
- Households rented-out land	0	16 (20%)	--
- Average size of rented-out land	0	0.61 ha	--
- Participation in off-farm activities (% yes)	--	18%	--
- % hired farm labour	--	29%	--

\*, \*\* and \*\*\* indicates statistical significance at 10%, 5% and 1% respectively.

Source: computed from household survey (2009).

**Figure 2. Commercialization status of sample farm households during the survey year**

Source: computed from household survey (2009)

vention difference. Similarly, factors other than participation are assumed to affect both groups similarly.

### 5.2.1. Comparison of participant versus non-participant farm households

The introduction of vegetable crop production led to a significant improvement in the commercialization of smallholders in the study area. The new crops (onion, tomato and green pepper) became the major source of cash income, and crops like tef, which was the major cash crop before the intervention, became more of a subsistence crop. The cash cropped area also expanded, both in absolute terms and relative to land allocated to staple food crops.

As shown in Figure 2 participant farm households responded well to the initiatives and operated at higher level of commercialization<sup>12</sup>, though the distribution is highly skewed, especially compared to non-participant

farm households. About one-third of non-participant farmers operate at a low level of commercialization<sup>13</sup>, while the corresponding figure among participant farm households is only 2%. Similarly, the percentage of farm households operating at a high degree of commercialization<sup>14</sup> was 54% of participant farmers and only 30% of non-participant farmers.

In general, Figure 2 shows that most participant farmers operate at a higher degree of commercialization than their non-participant counterparts. It also reflects the positive impact of targeted public investment in creating an enabling environment for commercialization of small farmers, though the study did not control for the effect of other factors such as the distinctive features of the study area including better proximity to roads and markets.

**Table 4. Changes in cash cropped area among participant farm households Before-after comparison**

Commercialization status Figure in brackets indicate proportion of farm land allocated to cash crops, both new and old cash crops	Changes in commercialization status		
	Before	After	Change (%)
Very low (25% or less)+	0	3	--
Low (26% to 50%)	37	24	-35%
Medium (51% to 74%)	35	45	28%
High (75% or more)	8	9	12%
N	80	80	

Source: computed from household survey (2009)

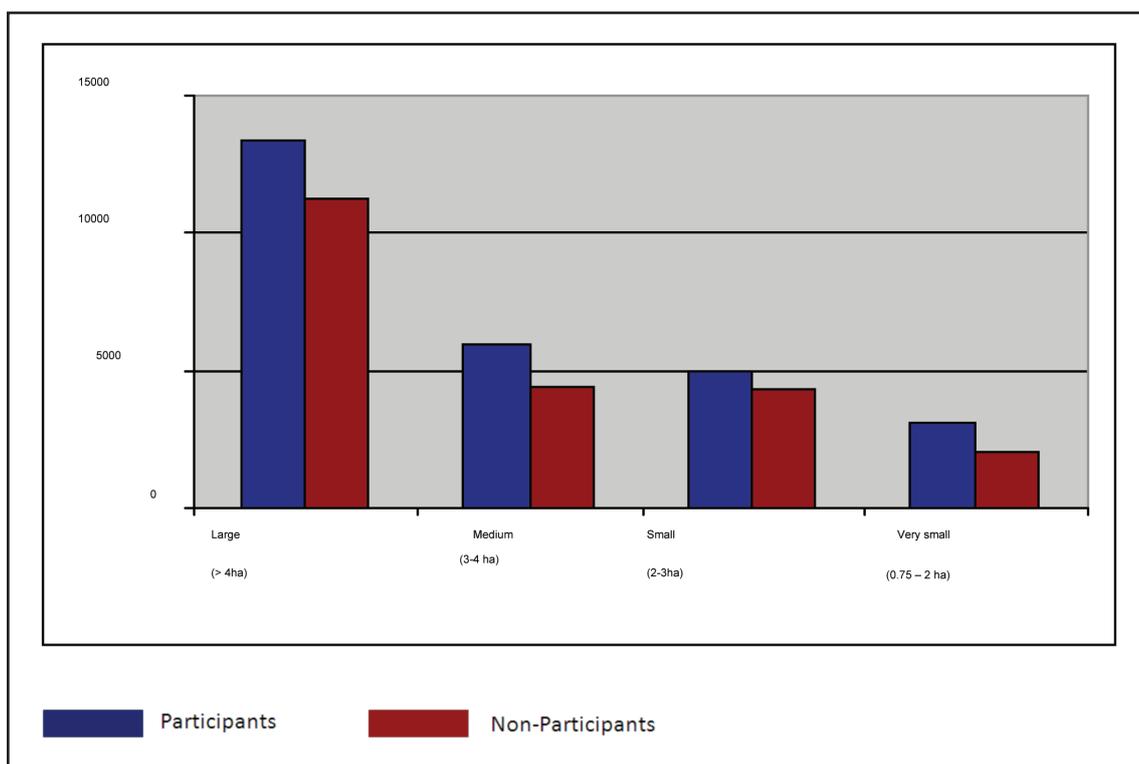
**Table 5. Average crop area in sample villages (during the survey year)**

	Villages				
	Ejersa Jero	Arifeta Jegola	Shera-dibandiba	Biyo-bisk	F-value
Year village joined the programme	2006	2007	2008	2008	--
Crop area allocated to new vegetable crops (ha)	0.44	0.34	0.22	0.24	3.78***
Cash income (Birr/farm)	21,681	24,195	7,473	12,096	8.71***
Share of new crops in farm cash income (%)	66	69	52	56	0.66
Total cultivated land (ha)	3.67	3.33	2.18	3.22	89.7***
N	20	20	20	20	

\*\*\* indicates statistical significance at 1%.

Source: computed from household survey (2009).

**Figure 3. Household cash income (Birr/household)**



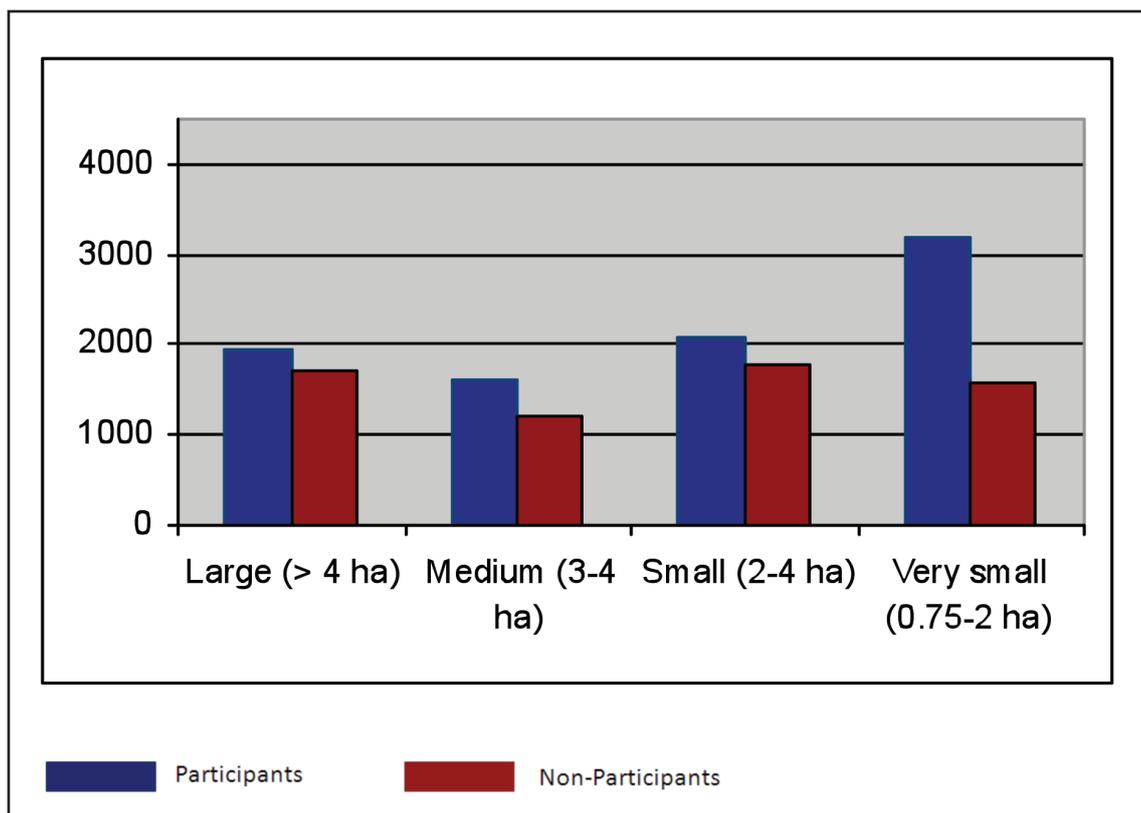
Source: computed from household survey (2009).

### 5.2.2. Responsiveness of participant farm households

The study shows that all participant farmers respond positively to the intervention as both ctheash cropped

area and the number of cash crop growers increased after the intervention. As shown in Table 4, about 14% of farm land allocated for the production of staple food crops in pre-intervention period, for instance, turned into

Figure 4. Household cash income (Birr/hectare)



Source: computed from household survey (2009).

cash crops production. Similarly, the proportion of farmers that allocated half or more of their land to cash crops<sup>15</sup> increased by about 23% and reached 68% after they took part in the commercialization scheme.

In addition to its positive impact on commercialization, the programme, through its positive impact on employment and productivity, helped to counteract the negative effect of the diminishing trend of land / labour ratio.

However, without further investment on existing or new irrigation infrastructures, the programme seems to lose its momentum as farmers' capacity to expand their production of the new horticultural cash crops (onion, tomato and green pepper) has declined because of shortage of irrigation water and increased competition for its use especially in recent years when more and more

Table 6. Participation in output and input markets among different farmers

Landholding and indicators of commercialization	Wealth status/land holding			F-value	
	Poor (cultivate < 2 ha)	Medium (2 - 4 ha)	Better off (> 4 ha)		
Farm size (own land (ha))++	1.13 (0.64)	3.11 (0.58)	5.8 (1.4)	167.4***	
Area allocated to high-value cash crops	Ha	0.36	0.70	1.02	2.95**
	% share	32%	22%	18%	
Indicators of commercialization					
Crop sold (kg/household)	1,291 (898)	1,394 (1,885)	3,544 (7,412)	2.66*	
Cash income from new cash crops	5,327 (4,178)	7,192 (10,964)	13,721 (24,944)	2.54*	
Fertilizer use – kg/farm	110 (59)	189 (172)	571 (1,467)	2.98*	
Hired labour – person-days/farm	53 (50)	65 (64)	104 (99)	3.74**	
Other farm expenses (Birr/farm)	1,283 (1,344)	1,179 (1,182)	2,772 (3,013)	3.26**	
N	43	14	16	74	

\*\*\*, \*\* and \* indicates statistical significance at 1%, 5% and 10% respectively.

Figures in parenthesis indicate standard deviations.

++ As the question is to analyse how farmers asset prior to their intervention affects their participation in the scheme, the number of farm households in the respective groups is different to the one seen in Table 1 which classified the same households into the same three groups but based on cultivated land during the survey year (i.e. post-intervention period).

## Box 2. More land means higher commercialization.

The commercialization process in the study area is primarily the result of public investment. As reflected by its positive role both among participant and non-participant farmers, farm size is also a key driving force of the commercialization process. Though relatively large farms are better suited for commercialization initiatives in absolute terms, small farms generate more cash income per unit of farm area, indicating that large farms face problems maintaining their marginal productivity while they expand their cash cropped area.

farmers were connected to the existing irrigation infrastructure.

As shown in Table 5, farm cash income varies directly with the size of farm land allocated to the new vegetable cash crops which also correlates positively to the total farm size. The new vegetables contributed to over 60% of cash income of the average participant farmer, though they accounted for not more than 10% of farm size.

### 5.3. Farm asset and commercialization

Asset-rich farmers are expected to engage more in commercialization initiatives. The study tried to look at how different sized farms responded to the commercialization initiative. Although access to irrigation water seems critical, especially for relatively large farms, farm size was taken as a proxy for risk that might push the poor to subsistence-oriented production. To assess the relationship between farm asset and commercialization, sample farm households were classified into four groups for the first analysis which include both participant and non-participant farm households and into three groups for the next which focuses exclusively on participant farm households<sup>16</sup> and their landholding prior to their participation in the commercialization scheme.

As indicated in Figure 3, the likelihood of generating cash income improves consistently as the size of farm increases. Large farms (both participants and non-participants) in general and especially those who cultivate above 5 ha of land generate substantially larger cash income. The income effects of shifts from subsistence to commercial crop production, however, widen as the size of farm declines. Keeping in mind any pre-intervention difference, small farms generated 57% more cash income than their counterparts who did not take part in the programme<sup>17</sup>. The difference between the two groups narrowed to 33% as the scale of operation grows to over 3 ha and further to 18% when the size of farm reaches 5 ha.

The above analysis, however, reveals only part of the story on the positive relationship between farm size and commercialization as an inverse relationship between the intensity of commercialization<sup>18</sup> and the size of cultivated land<sup>19</sup> was observed. As shown in Figure 3, farmers with the smallest land holdings, for instance, earn Birr 3,185 from a hectare of farm land which exceeds by over 63% the cash earned from the same 1 ha but managed by relatively land-rich farmers (this difference is statistically significant at 10%).

### 5.4. Asset and participation in the commercialization scheme

The study shows that even though the smallest farms<sup>20</sup> respond positively to outside interventions that aim to enhance the integration of their farm into markets, differences in asset holdings are likely to be a big determinant

of who responds better to incentives for commercialization. Ascertaining the existence of an association between farm households' assets and the degree of their participation in the scheme is important to measuring how effectively the programme targets poor farmers, although causality can run in both directions<sup>21</sup>.

Farm size influences household responsiveness to the commercialization scheme positively and significantly. Land allocated to the new high-value cash crops increased as the size of farm land increases (Table 4). Farmers with large farm size allocated three times more land to new cash crops when compared to small farmers; and by about 30% when compared with farmers with land holdings between 2 and 4 ha<sup>22</sup>. Similarly, farm cash income rises gradually when land holdings increases. Empirical evidence from other studies, such as Heltberg's 2001 study of smallholder farmers in Mozambique, also indicates capital accumulation as an important stimulus to commercialisation (see Poulton & Leavy, 2008).

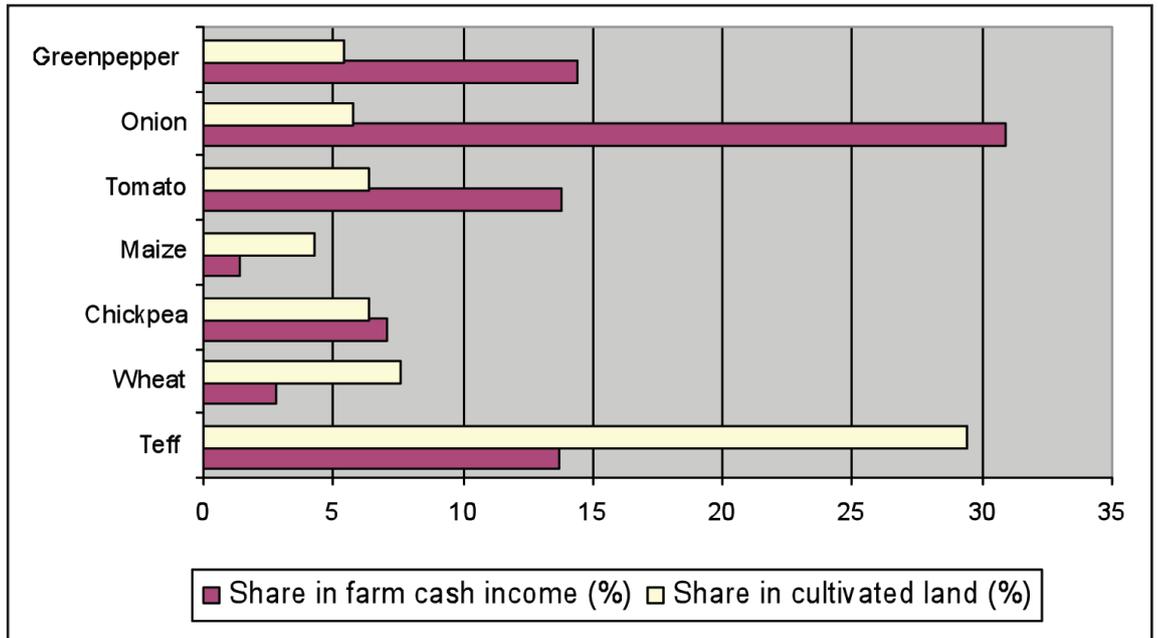
Similar to the effect on participation in the output markets, farm households' use of purchased farm inputs that include the use non-family (hired) labour and fertilizer rises as their farm size increases. This positive association between farm size and commercialization, however, is valid as long as the unit of analysis remains at household level (i.e. farm level). Small farmers were found to apply more purchased inputs on a hectare of farm land than larger farmers who operate at relatively higher level of commercialization<sup>23</sup>. As small farmers were found to allocate a greater share of their land to cash crops, the result reflects again the positive effect of commercialization on the use of purchased inputs.

### 5.5. Commercialization, diversification and specialization

The commercialization scheme leads to the diversification of the farming system. Over 90% of participant farmers changed their cropping pattern, though nearly all farmers continue to grow food crops and, in most cases, they tried to meet their own food needs from own production<sup>24</sup>. Tef and wheat continue to be the most popular crops. Onions and tomatoes, however, took the position of maize and barley as the third and fourth most frequently grown crops.

The effect of the intervention, however, was marked more in the changing role of crops. Tef turned from a commercial to subsistence crop. As a cash and also a food crop, tef brought on average about 60% of the cash income prior to the intervention. Its share, however, declined to 13% after the intervention. Similarly, the share of wheat and haricot beans in generating cash declined from 14% and 10%, respectively, to less than 5%. In contrast, new crops like onion and tomato contribute about two-thirds of household cash income and become the most important commercial crops.

Figure 5. The changing role of crops among participant farmers



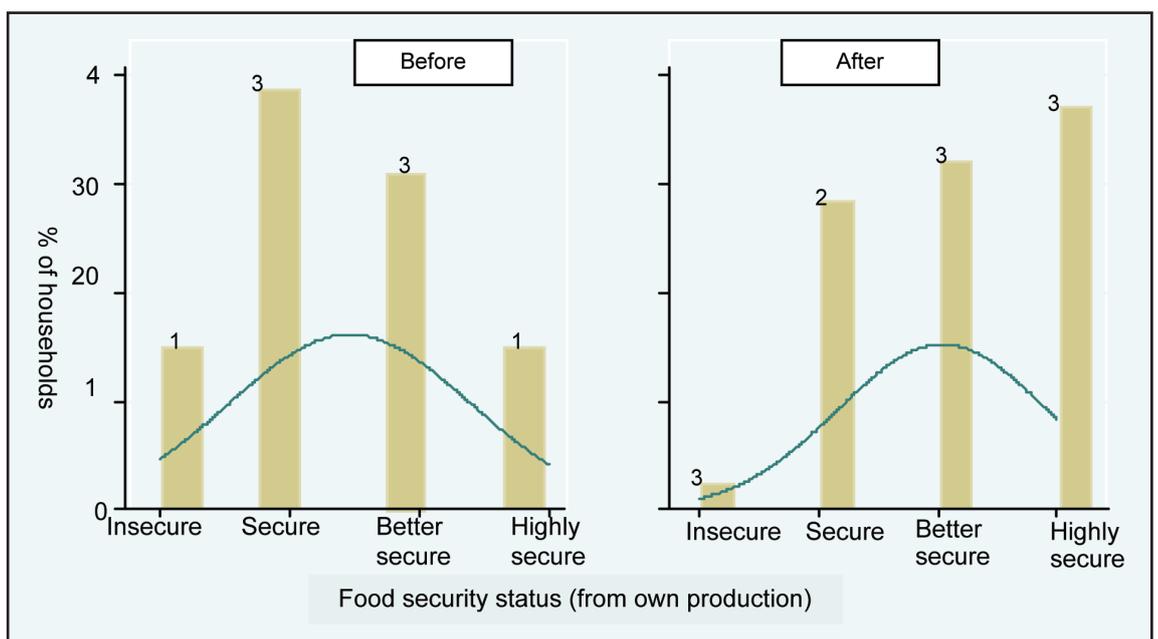
Source: computed from household survey (2009)

While enhancing the commercialization and diversification of small farmers, the initiative does not compromise households' food security objectives. Both expansion of crop land and improved productivity have contributed to this improvement in food security of participant farm households, even if the most reliable option, especially for farmers to join the programme in the future, is to enhance the productivity of food crops. The result is generally in line with a growing body of evidence throughout sub-Saharan Africa that argues for the pursuit of a food security strategy based on diversi-

fication of smallholder agriculture into high-valued cash crops (Jayne, 1994).

As commercialization and diversification emerged simultaneously, the finding indicates that commercialization doesn't necessarily mean specialization especially among smallholders working in uncertain market environments and at the early stages of the commercialization process. On the other hand, the co-emergence of commercialization and diversification indicates that smallholder agricultural commercialization may not yield the expected gains from specialisation and economies

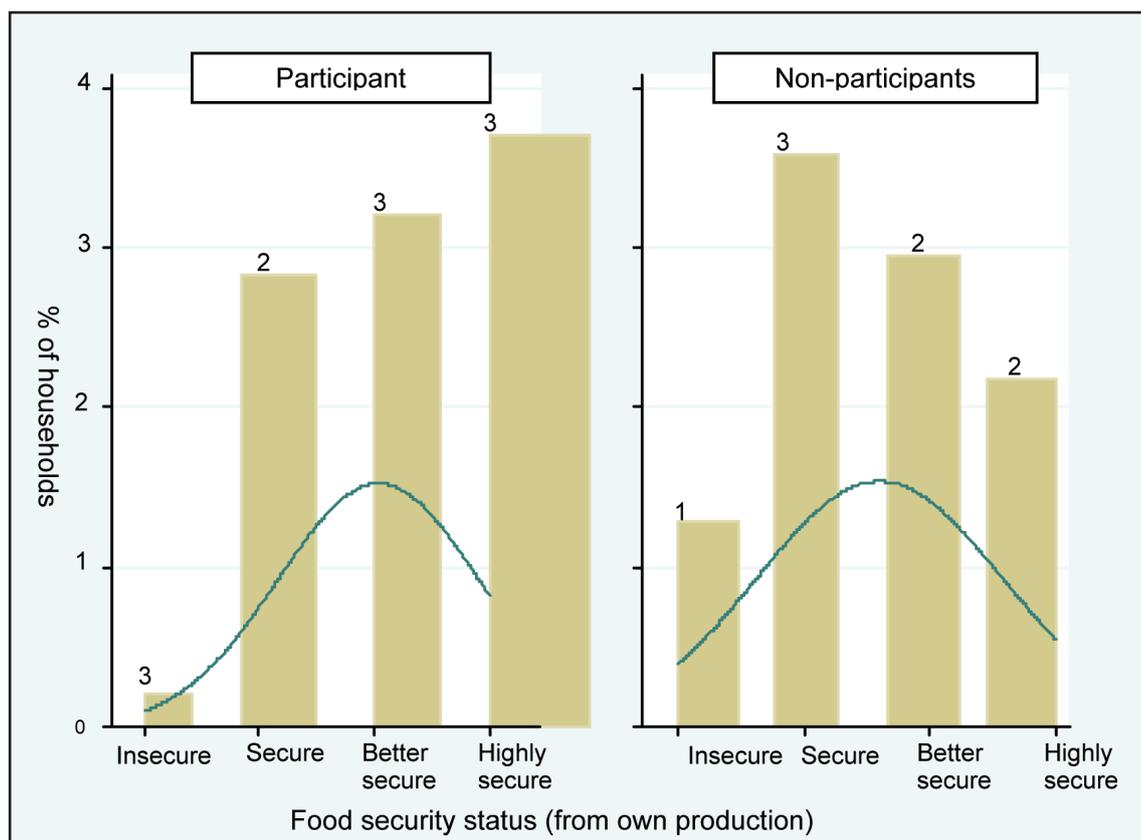
Figure 6. Changes in food security status among participant farm households (%)



Pearson  $\chi^2(3) = 25.0833$  Pr = 0.008

Source: computed from household survey (2009)

Figure 7. Status of food self-sufficiency among participants and non-participant households (%)



Source: computed from household survey (2009)

of scale, especially at the early stages of commercialization.

The reluctance of small farmers to compromise their food security has an important policy implication, particularly if the commercialization programme intends to extend its activity among net grain purchasing households. In general, it might be worth looking at the reliability of local food markets or food supply as part of any future plan for expansion of the commercialization programme.

### 5.6. Commercialization and Food security

Although the question of how the food security status of farm households has changed while they engage in cash crop production activities is interesting, the question of how the need to achieve household food security affects the extent of their participation in commercialization scheme is more interesting.

#### 5.6.1. Participants self-assessment on their food security

As shown in Figure 6, about 15% of participant households reported that the amount of food they produced

prior to entering the commercialization scheme was not sufficient to feed the household for a year, compared with only 3% after the intervention. Similarly, the proportion of households that classified themselves as highly food secure<sup>25</sup> increased from 15% to 37% after the intervention. These differences are statistically significant ( $p = 0.008$ ). This positive effect on household food security is, as discussed earlier, the effect of both increase in acreage allocated to food crops (although this is also true among non-participant farmers) and productivity improvement in food crop production<sup>26</sup>.

Survey data also shows a wide gap in food security between participant and non-participant farm households in favour of the prior group. Only 3% of participant farmers, for instance, reported that they are food insecure, compared with about 13% of non-participant households. Similarly, close to 70% engaged in the commercialization scheme described themselves as highly secure against 50% of non-participant households. These associations are statistically significant ( $p = 0.023$ ). Although the intervention has contributed to significant improvement in the food security status of participant households, it is difficult to attribute the wide gap between

Crop land utilization	Before	After	t-value
Total cultivated land (ha)	2.27	3.53(+55%)	7.46***
- Food crops area (ha)	0.98	1.54 (+57%)	3.83***
- Cash crop area (traditional/old) (ha)	1.29	1.50 (+16%)	3.56***
- New cash crops area (ha)	--	0.50	--

\*\*\* indicates significance at 1% level and figures in parenthesis are %age changes.

Source: computed from household survey (2009).

**Table 8. Cropland allocation by degree of food security**

	Participation		Food security status				F-value
			Food insecure	Secure	Better secure	Highly secure	
Total cultivated land	Participant		1.6 (1.9)	3.1 (2.3)	3.5 (2.1)	4.0 (2.2)	1.20
	Non-participant		1.4 (0.8)	2.7 (1.2)	3.0 (1.3)	4.4 (2.7)	12.9***
% of land allocated to cash crops (both new and traditional cash crops) <sup>29</sup>	Participant	before	46 (11)	56 (15)	60 (10)	68 (15)	5.79***
		after	42 (13)	46 (9)	57 (11)	66 (16)	11.95***
	Non-participant		29 (22)	43 (16)	59 (16)	69 (17)	12.9***

\*\*\*, \*\* and \* indicates statistical significance at 1%, 5% and 10% respectively.

Figures in parenthesis indicate standard deviations.

Source: computed from household survey (2009)

the two groups to the intervention alone as the analysis fails to control for the effect of households' status pre-intervention<sup>27</sup>.

### 5.6.2. Evidence from household survey

Participant farmers did not reallocate their food crop land to either traditional or new high-value cash crops as they adopted new high-value horticultural cash crops. Contrary to what was anticipated, they expanded both their cash and food crops area. After the intervention, total cultivated land expanded on average by 55% to 3.53 ha<sup>28</sup>, and, as shown in Table 7, over 44% of this land went to the production of staple food crops, while 16% and 40% allocated to the production of 'traditional' and the new high value cash crops respectively.

Whether it shows a 'food-first' strategy of farmers or not, the trend indicates the behaviour of small semi-subsistence farm households in trying to ensure their food security while they diversified their farm into cash crop production. Evidence from other studies (e.g. Von Braun and Kennedy, 1994) also shows that households which invest in cash crops rarely sacrifice their food security.

However, the result does not necessarily imply that success in producing more for the market helps to increase food security, the finding indicates that there is every reason to expect such kind of multipliers that reinforce the complementarity than the competing effect of expanding production of cash crops on food production.

Though some specific characteristics of the study area, such as increasing the chance of renting land have played a role, the multiplier effect is also associated with the nature of cash crops introduced. As smallholders expand into vegetable crops only marginally, the expansion led to a significant improvement of their cash income. This allowed households to use traditional cash crops such as tef increasingly as a food crop, which in addition has positive nutritional outcomes. By promoting high value and relatively labour intensive vegetable crops, the intervention also helps to generate further employment to the growing labour forces.

### 5.7. Food security and the extent of participation in commercialization

Table 8 examines the dynamics of cash and food crops and indicates that food security status consistently

increased as the proportion of farm land allocated to cash crops increased. Both participant and non-participant farmers allocated more land to cash crops as their food security status improved. Controlling for differences in farm assets and location (villages where sample households reside), the proportion of farm land allocated to cash crops is 42% higher among highly food secure households compared to food insecure households. The result suggests that, ceteris paribus, the viability of interest for producing cash crops become less and less when household food self-sufficiency status declined. Alternatively, it indicates the difficulty in promoting cash crops among food insecure households and /or in food insecure areas.

Despite the expansion of cash crop areas in absolute terms, the percentage share of the area used for cash crop cultivation declined in post-intervention period. As indicated in Table 8, cropland allocated to cash crops declined by 10% and 4% among just-food secure and food insecure households, respectively, post-intervention. Similarly, the proportion of cash cropped area declined by up to 3% among better food secure households<sup>30</sup>.

In general, smallholders' priority to achieve their food self-sufficiency has important implications for the extent of their participation in commercialization schemes. This has strong implications especially if commercialization initiatives focused on high value but traditional cash and food crops like tef which, unlike vegetables, generate far less cash income per unit farm area.

### 5.8. Commercialization and farm productivity

Commercialization programmes in poor communities in general and among net grain-purchasing households in particular should not overlook the role of enhancing productivity of grain crops. Consequently, the study tried to ascertain how the two variables (commercialization and productivity) relate with each other, ceteris paribus.

Survey data shows that land productivity in the production of food grains is higher among households engaged in the production of new cash crops like onion and tomatoes. The productivity of the two most important food crops - tef and wheat - is higher for participating farmers than non-participants by 56% and 48%, respectively, keeping in mind any pre-intervention difference between the two groups<sup>32</sup>. This positive relationship,

**Table 9. Gross margin (land productivity) of old and new crops (Birr/ha) <sup>31</sup>**

Crop	Participants	Non-participants	t-value
Old, largely cash crops			
Tef	16,833 (16,607)	10,781 (3,018)	5.45***
Wheat	11,220 (6,509)	7,581 (3,124)	4.87***
Chickpeas	13,483 (4,774)	14,028 (5,713)	0.61
Lentils	14,041 (5,314)	17,528 (9,213)	1.87*
New cash crops			
Onion	49,729 (16,084)	-	-
Tomato	31,043 (25,742)	-	-
Green pepper	32,384 (17,696)	-	-
Other crops (largely staples)	9,802 (6,101)	6,901 (4,687)	1.92*

\*\*\*, \*\* and \* indicates statistical significance at 1%, 5% and 10% respectively.

Figures in parenthesis indicate standard deviations.

Source: computed from household survey (2009).

however, did not prevail in production of pulses like chickpeas and lentils, where the difference in productivity shifts slightly to non-participant farm households.

Intensification of food crop production seems to contribute to this improved performance of participant farmers. As shown in Table 9, farmers growing new cash crops invest more in their food production, particularly tef and wheat. They applied more fertilizers, improved seeds and used more hired labour on a hectare of cropland than their counterparts who did not take part in the programme. The use of purchased seeds and fertilizer rose by over 50% and reached 138 kg and 421 kg, respectively, per household; while pesticides application doubled after they took part in the commercialization scheme. Most importantly, the change in the number of users and expenditure for rented farm equipment and water pumps is more notable – it has increased over three times. In general, the evidence shows that commercialisation on the input side also proceeds in tandem with the degree of participation in output markets, and this might attribute for improved productivity.

Survey data also shows that the new cash crops contributed a considerable share of the observed increase in the use of purchased farm inputs. The new cash crops, for example, accounted for 39%, 37%, 87% and 23% of the use of improved seeds, fertilizers, pesticides and rented equipments, respectively, while occupying only about 15% of cultivated land. Though under certain circumstances the direction of causality might run the other way, the study shows the positive household-level synergies between commercialization and use of productivity-augmenting inputs.

### 5.9. Factor markets and commercialization

As in the case of input markets, a similar effect can be observed in smallholders' participation in factor markets. Compared to the pre-intervention period, participant farm households, for instance, hired about 60% more labour, though the size of farm cultivated also increased by equal proportion. However, the fact that about 60% of the hired labour was employed on new cash crops which are cultivated on only 15% of farm land indicates

**Table 10. The commercialization process and changes in the use of purchased inputs**

	Before-After comparison			Comparison of participants versus non-participants		
	Before	After	t-value	Participants	Non-participants	t-value
Improved seeds						
- Users (%)	53	54	0.19	54	53	0.15
- Application rate - all crops (kg/farm)	89	138	2.42**	138	101	1.11
Fertilizer						
- Users (%)	99	100	--	100	97	--
- Application rate (kg/farm)	277	421	8.79***	421	340	2.19**
Pesticide						
- Users (%)	91	98	2.53**	98	89	2.49**
- Application rate (litre/farm)	2.07	4.16	6.69***	4.16	1.86	3.91***
Expenditure for farm equipments/pumps etc.						
- Users (%)	18	55	4.18***	55	11	4.48***
- Expenditure (Birr/farm)	680	1016	2.97**	1016	730	1.05

**Table 11. Impact of commercialization on participation in factor markets**

	Participant farmers			Comparison of participants versus non-participants		
	Before	After	t-value	Participants	Non-participants	t-value
Labour market						
- Farm labour						
- Participation (%)	53	54	--	54	53	--
- Labour hired (man-days/farm)	89	139	2.42**	139	98	1.11
- Share of new crop (%)	--	58%	--	58%	--	--
- Non-farm labour						
- Participation (%)	16	23	1.51	23	46	3.01**
Land rental market						
- Participation as - tenant (%)	-- <sup>35</sup>	--	--	86	43	3.68***
- landlord (%)	--	--	--	0	15	3.20**
- Size rented-in (ha/household)	--	--	--	0.84	0.61	1.82*
- Share of new crops (%)	--	--	--	29%	--	--
Credit market						
Participation (%)	80	85	0.84	85	78	0.06
Average loan (Birr/household)	700	1000		1000	1080	0.84
Average interest rate (%)	8.61	9.94	3.74***	9.94	8.47	0.95
Major lender			0.46			
Cooperatives (%)						
Micro-credit/NGO	52	45		45	62	
Government	36	42	-	42	32	
Local money lenders	2	0	-	0	3	
	10	13	-	13	3	
			-			

the positive role of these crops in stimulating local labour market.

The effect of the commercialization programme on local labour markets might go beyond agriculture to non-agricultural activities. Survey data indicates that employment in non-farm activities indeed increased slightly after the intervention. What emerged noticeably is, however, the wide gap in non-farm employment between participant and non-participant farm households (23% versus 46%, respectively). In general, the commercialization scheme might help in stimulating non-farm employment especially for non-participant farm households<sup>34</sup>.

Demand for credit measured as the incidence of borrowing changes only slightly, the average loan size, however, increased significantly by over 40% in the post-intervention period. Survey data also shows a slight change in the structure of credit suppliers. Over 60% of non-participant farm households got their credit from cooperatives. After a fall by more than 14% from the pre-intervention period, the share of cooperatives as supplier of credit was only 45% among participant farmers, though the average loan size increased by about 43% from Birr 700 to 1,000 per household.

On the other hand, about 13% of participant farm households borrowed from local money-lenders (who provide loans at higher interest rate), compared to only 3% among non-participants. The decline in the role of cooperatives as source of credit among participant farmers, along the relative importance of the private sources (local money lenders), indicates a growing and healthy appetite for future borrowing. It might also mean that the cooperatives cannot lend to all and force some

to get their loans from more expensive money lenders – so it might point to a constrained capital market.

### 5.10. Markets and the commercialization initiative

Although the survey did not generate detailed information required to analyse transaction costs and the nature of risks involved in the value chain, it tries to learn whether farmers face new kinds of marketing problems once they have started to grow the new perishable horticultural crops.

Survey data and response from focus group discussions indicate no evidence to suggest lack of demand for their new products or low or reduced bargaining capacity. Thanks to better access to major roads and nearby cities, farmers sell a third of their produce on-farm, which indicates high demand for vegetables in nearby cities. The data also indicate that the farmers did not face new marketing problems that affect their interest for the new cash crops.

The future also seems conducive as emerging demand for vegetables in the nearby cities and food stores offers a huge potential for further expansion of production and intensification of existing cropland. Farmer participation in new but more competitive markets (including direct delivery to nearby stores) also depends on other requirements to meet the quality, size, and delivery standards, and other transaction costs that have raised the cost of entry even more.

In general, farmers' potential to attain the full advantages of the new intervention and their location are improved if they form marketing cooperatives which allow them to supply directly to nearby stores<sup>36</sup> and help

**Table 12. Farm households opinion on markets**

	Participant households	
	Before the intervention	After the intervention (for the cash crops)
Did you find a buyer for your products		
Yes, always	6	5
Yes, sometimes	35	25
No	59	70
Did you know (reasonably estimate) what price the market offer for your products - % reported yes	76	84
Who determines the price for your products		
Seller (I)	4	3
Buyers	42	47
The market (Negotiated price)	54	50
Where you sell your products		
on farm	1	30
village market	72	43
district market	27	26
In other market places, including Addis	0	1
	73	78

Source: computed from survey data.

them to get higher share of consumer prices. This is especially important as close to half of the farmers surveyed reported that they are price-takers and have no power to determine the price for their product.

Such direct participation in the value chain might also help small farmers to learn and acquire skills needed for engaging in contract farming that, though much beneficial, is more demanding in terms of quality and food safety. Evidence from elsewhere<sup>37</sup> also shows the positive role of farmers' organizations and the need for technical and capacity support for smallholders to catch –up with the growing and changing demand in their surrounding areas and beyond.

## 6. Conclusion and recommendation

Survey data shows that participant farmers responded well to the commercialization scheme. Cash crop area was expanded among all farmers, albeit at different degree. The new vegetables (onion, tomato and green pepper) become the major source of cash income while crops like tef, which was the major cash crop before the intervention, became more of a subsistence crop.

The commercialization process did not displace staple food crops and, consequently, helps for further diversification of agriculture in the study area. The result, therefore, implies that commercialization among smallholders in this particular location does not necessarily mean specialization.

The fact that the level of commercialization consistently increased with the size of the farm indicates the positive role of capital accumulation in the form of farm land, all else being equal, in fuelling the commercialization process. This, however, does not necessarily indicate that there is a par-relationship between the two. On the contrary, smaller farmers who allocated a larger proportion of their farm land to cash crops generated more

cash income per hectare of farm land. The finding implies the positive role that both the size of farm and the intensity (or the percentage share) of cash cropped area have in stimulating the commercialization process. In general, the programme needs to continue its focus on both relatively land-poor and land-rich farmers, but needs to deal with the constraints that hold back the latter to expanding the proportion of land they allocate to cash crops, while helping the former to raise the level of commercialization through consolidating their tiny farms that will help to improve their scale of economies.

Although the income and food effects of shifting from subsistence to commercial crop production are likely to be time and place specific, as a review of cash cropping schemes indicate (see Von Brown, 1994), the expansion of cash crops does not necessarily lead to a displacement of food crops nor compromise the food security status of small farmers. On the other hand, although the direction of causality has not been examined adequately, the study found that the commercialization scheme helps stimulate local factor markets with its positive effect on the use of purchased farm inputs.

Overall, the study shows the success of this irrigation-led smallholder commercialization initiative, while the positive impact of this proactive public support might depend partly on the location of the study area. First, the study area is located along major roads and close to major and growing urban markets, thus its location helps create sufficient demand for the new vegetables. Second, recent expansion in large private investment in the study area helped to expand local land markets as poor farmers have opportunities to rent out their land and work as wage-labourers on nearby large farms and at other establishments.

Any attempts to replicate the success of this scheme should therefore not overlook the distinctive features of the study area. On the other hand, in view of rapid growth of supermarkets, changing consumers' demands and the associated stiff competition from other suppliers, any

commercialization scheme among small farmers should go beyond technical support to organizational support in order to improve their economies of scale and direct participation in value chains thus facilitating conditions for future contract farming arrangements with nearby growing food groceries and supermarkets.

## End Notes

<sup>1</sup> See a recent study published jointly by the World Bank and FAO, titled 'Awakening Africa's Sleeping Giant – Prospects for Commercial Agriculture in the Guinea Savannah Zone and Beyond' and the series of debate also entitled Awakening Africa's Sleeping Agricultural Giant and hosted by Reuter.

<sup>2</sup> This is a key justification for major initiatives such as Alliance for a Green Revolution in Africa (AGRA).

<sup>3</sup> See Foreign Affairs of Nov/Dec 2008 and a recent online discussion by the IDS-hosted Future Agricultures Consortium).

<sup>4</sup> Entrepreneurship (of small farmers) alone is, however, not sufficient in linking smallholders to international markets

<sup>5</sup> See findings from Heltberg and Tarp (2002) which suggests that differences in area-based characteristics (especially risk and technology) are more influential in the commercialization process than differences in how the poor and non-poor respond to incentives.

<sup>6</sup> On average about 3,000 farm households reside in each kebele.

<sup>7</sup> Though pre-interview scoping study indicates relatively small diversity in the population, the sample size was decided mainly based on resource availability.

<sup>8</sup> Discussion with community members (during the scoping study) revealed that a household is considered poor in the community if it exhibits the following characteristics: landlessness, lack of oxen and seed and if household members earn their living by casual labour or are hired on other peoples farm. On the other hand, a household with land and oxen tilling its own or contracted land is considered to belong to the medium wealth group. A rich household possesses significant assets other than land, is involved in trading and /or participates in other non-farm activities. Such households are also expected to have significant savings in the bank and to provide to their children with a decent education.

<sup>9</sup> As participation in the commercialization programme is determined solely by random selection, pre-intervention differences between the two groups were assumed to be insignificant hence, non-participant farm households were expected to serve as a control group.

<sup>10</sup> If the latter is the case, it is important to redesign the programme to provide equal opportunities for female-headed households.

<sup>11</sup> More farmers might engage in land rental markets as landlords, but various restrictions on land markets (e.g. restriction that limit the size of land to be rented out) might discourage them to reveal this.

<sup>12</sup> Commercialization is measured as value of crops sold as a percentage of total value of harvest.

<sup>13</sup> Low level of commercialization indicates marketing 40% or less than their output - measured in value term.

<sup>14</sup> Defined as farmers who marketed 60% to 80% of the harvested output.

<sup>15</sup> This includes both traditional and new cash crops that are associated with the introduction of irrigation scheme.

<sup>16</sup> Though there are various technical guidelines to classify farmers based on their farm sizes, the study adopts the classification of farms that the government uses in its annual agricultural sample surveys so that a review of characteristics and policy implications drawn

from this study will be comparable with other studies conducted based on the national statistical systems.

<sup>17</sup> This is statistically significant difference ( $t=1.91$  and significant at 10% level).

<sup>18</sup> Intensity of commercialization is measured as cash income earned per hectare of cultivated land.

<sup>19</sup> In proportion to the total landholding, small farmers also allocate more land to cash crops (small farmers allocate on average about 32% of their land to new cash crops while this figure is only 18% among large farmers).

<sup>20</sup> The positive effect could partly be explained by the location of the study area where better access to nearby cities and major roads could help to minimize the risk of growing a particular cash crop (in this case perishable horticultural crops but with a stable market) which is relatively more important to smaller farmers.

<sup>21</sup> The study limits itself to this two-way analysis, though small farmers' decision to take part in the scheme or the extent of their participation may be made in light of many different factors which need a rigorous regression analysis. Or else, in place of regression, farmers' responses to the question of why they participated might reveal the range of factors behind their participation in the scheme.

<sup>22</sup> Though in proportion to the total landholding, small farmers allocate more land to cash crops.

<sup>23</sup> The correlation coefficient which measures both the nature and extent of the relationship between two or more variables also indicates a negative association between the intensity of fertilizer ( $r=-0.20$ ), improved seeds ( $r=-0.19$ ) and hired labour ( $r=-0.31$ ) uses and the degree of commercialization of farm households.

<sup>24</sup> Shortage of irrigation water also explains why more land was not converted from production of food crops to production of the new vegetable crop.

<sup>25</sup> A household is considered food insecure if its own production of grain could not feed the household for a year. Similarly, if own production of food could feed the household for 12 to 18 months, from 18 to 24 months or more than 24 months households were considered as food secure, better secure and highly secure, respectively.

<sup>26</sup> Food security is here defined as comprising own food production, not purchased food.

<sup>27</sup> Lack of data on pre-intervention food security status of non-participant households impedes to carry out a dynamic comparison of the food security status of participant and non-participant farm households.

<sup>28</sup> Most of the land comes from renting from farmers who abandon part or all of their farm to work as labourer in large commercial farms (in animal fattening, high value crops, and flowers) and various small industries expanding in recent years in the study and nearby areas.

<sup>29</sup> The survey didn't ask non-participants about their land allocation in the pre-intervention period, so it was not possible to know the changes in their cropping pattern and compare it with the corresponding changes among participant farmers.

<sup>30</sup> The difference between the percentage of cropland allocated to cash crops and 100 % gives the proportion of crop land allocated to production of largely staple food crops.

<sup>31</sup> This might be because new high-value cash crops unlike traditional cash crops, help to generate more

cash income per unit farm area reducing the incentive to expand cash crop area; alternatively shortage of irrigation water might constrain the expansion of cash crop area.

<sup>32</sup> It is also important to note the potential two-way effect in productivity and commercialization.

<sup>33</sup> To keep out the effect of market, a constant (average) price is used in computing the gross margin. Difference in land productivity, hence, implies only physical yield difference among different farmers.

<sup>34</sup> Because of limitation in the design of the survey (lack of data on non-participants in pre-intervention period), it was not possible to conduct before-after comparison for non-participant farm households help to answer this question more explicitly.

<sup>35</sup> Data were not available.

<sup>36</sup> It is assumed that a parallel effort will be taken to relieve existing constraints on the production side.

<sup>37</sup> Like the South Africa's Agricultural Black Empowerment (AgriBEE) Policy which enables smallholder farmers to supply up to 30% of the nearby store's demand for fresh produce (see Poulton and Levy, 2008)

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## Annex

**Table A 1: Land productivity among participant farm households operated at different level of commercialization) (Birr/ ha**

	Degree of commercialization				F-value
	Very low	Low	Medium	High	
Tef	12,313 (14,620)	12,304 (12,114)	11,003 (5,165)	14,590 (3,875)	0.28
Wheat	8,981 (4,905)	9,120 (3,582)	10,549 (7,510)	13,769 (6,068)	1.17
chick peas	12,107 (4,976)	17,141 (1,737)	13,778 (5,202)	11,136 (4,584)	1.80
Lentils	12,453 (4,335)	18,620 (5,267)	13,449 (4,344)	14896	0.92
Onion	46,366 (17,197)	49,418 (25,464)	41,537 (22,259)	39,385 (46,279)	0.42
Tomato	53,311 (27,547)	49,225 (21,033)	54,302 (60,261)	35,917 (21,761)	0.22
Green pepper	21,981 (17,236)	30,546 (20,148)	24,511 (21,011)	--	0.41
N	16	22	36	7	

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