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Potatoes and livelihoods in Chencha, southern Ethiopia

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ABSTRACT

Potato is highly productive crop and can provide a cheap and nutritionally-rich staple food. Its potential as a cash generator and source of food is much under-utilized in many emerging economies. In this paper we study the impact of an intervention that introduced improved potato technologies in Chencha, Ethiopia on the livelihoods of smallholder farmers. We collected information through in-depth interviews in order to explore possible pathways of impact on farmers' livelihoods; and used this information as the basis for designing a household survey. The results show changes in agronomic practices and consumption; these changes were most pronounced among wealthy farmers who participated in the intervention. Farmers used the additional income from potato in different ways: wealthier farmers improved their houses and increased their livestock, whereas poor farmers mainly invested in furniture, cooking utensils, tools and in developing small businesses like selling and buying cereals, milk and weaving products in the local markets. Some wealthy farmers, who did not participate in the project, also derived some indirect benefits from the intervention. This underscores: i) interventions that promote uniform farming technologies in themselves are not always sufficient to improve the livelihoods of poor farmers, and ii) the need to broaden the scope of interventions so as to take into account the resources available to farmers in different wealth categories, and the diversity of strategies that they employ for improving their livelihoods. Our approach allows to understand and describe the different developmental effects of a single technological intervention on the different aspects of farmers' livelihoods.

1. Introduction

Despite long-term efforts to increase agricultural productivity in Ethiopia the country remains a net importer of food in order to meet domestic demand. Increasing population pressure, diminishing farm sizes, the depletion of soil organic matter and soil nutrients, soil erosion, highly variable rainfall, and underdeveloped food-producing resources that are heavily reliant on low-input farming practices are undermining the efforts to increase agricultural productivity (Winer, 1989; Asefa, 2003; Negatu, 2008; Bogale, 2012). Eighty-five per cent of the country's population depends on farming for a living and much emphasis is placed on technology-led initiatives as a means of reducing food insecurity (Araya et al., 2010; Beyene, 2008; Bogale, 2012). The promotions of improved potato varieties and of new production practices for smallholder-farming systems are central elements of attempts to improve potato productivity (Tesfaye et al., 2013).

The discussion around the role and potential of potato in Ethiopia is dominated by four central assumptions:

- potato is an integral part of smallholder farming systems in the highlands as it has been grown and consumed for about a century;
- potato has a short cropping cycle, is highly productive and can be harvested before cereal crops mature;
- potato is not at risk of international price fluctuations unlike major cereal crops, as it is mostly traded in local and national markets; and
- the potential of potato as a cash and food crop is greatly underutilized (Scott et al., 2000; Sen et al., 2010; Woldegiorgis et al., 2015).

The contribution of potato to households' food consumption has recently received much attention. For instance, the United Nations declared 2008 as "The International Year of the Potato", drawing global attention to the important role of this nutritious plant (Food and Agriculture Organization of the United Nations (FAO), 2008). Many see potato as having a crucial role in guaranteeing household food consumption due to the fact that it is not that much affected by the global fluctuations in food prices; hence inflation is lower than for cereals that are more globally traded (Scott et al., 2000; Woldegiorgis et al., 2015;

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Food and Agriculture Organization of the United Nations (FAO), 2008; Cromme et al., 2010). However, the potential of potato as a tool for stimulating agrarian change depends upon improving potato production and productivity, through the adoption of high quality seed potato, good management practices, proper post-harvest handling and the availability of suitable storage facilities (Demo et al., 2015).

This paper explores the initial effects of a project intervention that recently started to promote improved, high-yielding and disease-tolerant potato varieties and improved production practices in Chencha *wereda*[1], southern Ethiopia. It provides an example of an intervention that claims to have potential of improving the livelihoods of smallholder farmers. In analysing the effects of this intervention we asked the following questions:

- What changes have occurred in households' farming practices since the start of the intervention?
- What differences have these changes made to households' livelihoods?
- Do such changes and differences apply equally to farmers in different wealth categories?

Impact evaluation is a much criticized practice. Most impact evaluations do ignore the differentiated impact that technologies can have because of the different causal pathways for the effect of technologies on people's livelihood and how these play out in different contexts and across different type of households (Pawson and Tilley, 2004; Dietz and Zanen, 2009; De Janvry et al., 2011). In addition, assessment methods and variables chosen can lead to biases and overlook valuable impacts (Crane et al., 2016). In response to some of these criticisms, we started out with exploratory interviews in order to capture the views and experiences of the farmers who had been the target of the project. We used the insights from these interviews to define the impact areas to cover in the survey and support the results with qualitative information.

1.1. Background: the study site and project intervention

The Chencha *wereda* is located in the Gamo Gofa Zone of the Southern Nations, Nationalities, and Peoples Region, Ethiopia. Farmers in the *wereda* of Chencha grow a range of crops, including potato, enset, wheat, barley and kale, and raise livestock (cow, ox and sheep). The bimodal rainfall includes a *Belg* (the short rainy season from March to May) and a *Meher* (the long rainy season from June to October) season and allows two potato planting seasons (Mazengia et al., 2015).

The non-governmental organization Vita, based in Ireland and active in Eastern Africa, is engaged in different development activities to enhance families' food, energy and water security and to support the efforts to build sustainable livelihoods. The introduction of improved potato technologies – improved quality of seed potatoes, and improved agronomic field and storage practices – is core to Vita's agricultural development programme in southern Ethiopia. It had a potato project that in 2013 disseminated tuber seed of the new potato variety Gudene among 360 farmers, 260 ware producers and 100 seed producers. Ware and seed producers received 250 kg and 625 kg of seed potatoes, respectively. The conditions to become seed potato producers included: a farmer had to be known to be diligent and had to own at least 1.5 ha of land (which is large in the Chencha context). Farmers who could not fulfill these conditions were taken as ware potato producers. Farmers were also trained in the class room and on the field about improved potato production practices: the application of synthetic fertilizers, land preparation, ridge planting, weeding, disease management, harvesting and storage. The training was provided on group basis. During the training, the extension workers advised to plough at least three times to get a fine soil for planting and to plant medium-sized seed tubers. Planting new potato varieties on ridges rather than in flat soils was also part of the training. To manage the soil fertility and potato diseases, proper doses of synthetic fertilizers (200 kg/ha DAP and 100 kg/ha Urea) and crop protection chemicals were recommended, respectively. To minimize post-harvest losses, farmers were advised to harvest all their potatoes at once and store the seed and ware potatoes in improved storage facilities. The project also supported the construction of ware and seed potatoes storage facilities, for which farmers had to supply the local materials. Vita extension workers randomly selected 24 ware potato producers out of 260 to build ware potato storages. The 24 ware producers were selected randomly. All of the seed producers constructed Diffused Light Storages (DLS)

The extension approach implemented in this locality in the specific years was the "progressive farmer strategy". Wealthy and medium wealthy farmers had first-hand access to new potato varieties, and production and storage technologies. This strategy is built on the assumption that once the progressive farmers shift to new production practices, the practice will be copied by less progressive farmers. It was intended that this intervention would: i) make quality potato seed more widely available in the area; ii) improve potato productivity at the level of the individual farms and the participating communities; iii) reduce the duration of the 'hungry period', and; iv) increase household incomes. The assumption was that the benefits derived from this intervention would be powerful enough to improve the livelihoods of farmers in Chencha.

2. Materials and methods

2.1. Data collection and analysis

In Chencha, 33 out of the 45 kebeles are with suitable potato production conditions, where climate is relatively cool, soils are relatively fertile, and land holdings relatively large. Vita's intervention was conducted in 10 of these 33 *kebeles*. We carried out research in four of the intervention *kebeles*: Yoyera, Gendo Gembella, Losha, and Laka. These four *kebeles*, together, represented the distribution of agro-ecological conditions of intervention *kebeles*. The data were collected in two parts: first a series of exploratory interviews, followed later by a larger-scale survey. The exploratory interviews were conducted in February-March 2015 with 20 farmers whom we selected from the list of farmers who had received materials and training from Vita on potato seed production. We selected farmers with different wealth status. The interviews explored four main areas: potato cropping practices prior to the intervention; the amounts harvested and uses to which they were put; the support provided by the intervention; and improvements attributable to the intervention. These interviews were used to define the indicators of the effects of the intervention at a household level. The first-named author conducted the interviews in Amharic, which were audio-recorded and transcribed into English. A translator supported the interviews when the respondents do not know Amharic.

In April 2015, we randomly sampled 140 farmers who had participated in the project and 64 farmers who had not. We used lists of names of those who did and did not participate in the project, as registered by the administration of each *kebele*. Participants had direct access to the materials and training provided by the project, while non-participants only had indirect access, if at all. Enumerators used a questionnaire to collect information from the sample of farmers. The questionnaire focused mainly on the changes following the project intervention: change in potato production practices and livelihoods of the farmers. To categorize the surveyed households by wealth status, we convened focus groups and discussions in the four *kebeles*, in each of which a sample of 7–10 community members participated. To differentiate between relatively wealthy, medium-wealthy and poor farmers, participants identified the following key criteria: size of land holding; number of livestock; house structure (floor area and construction

[1] A *wereda* is the administrative unit immediately above a *kebele,* the smallest administrative unit.

materials) and number and age of enset (*Ensete ventricosum*) plants. Farmers, who were categorized by local people as relatively wealthy, for example, had more than 1 ha of land, 3–4 oxen, several cows and sheep, at least five houses with corrugated sheets and more than 300 enset trees (for details, see Tadesse et al., 2016). On this basis the participating group contained 27 wealthy, 92 medium-wealthy and 21 poor farmers (circa 20%, 65% and 15%, respectively) and the non-participating group 21 wealthy, 25 medium-wealthy and 18 poor farmers (circa 33%, 39% and 28%, respectively).

We used descriptive statistics to process the household survey data. Log-linear analysis (χ^2) was used to test the association between participation in the intervention, farmers' wealth category and changes in households' livelihoods. Odds ratio was computed to determine the effect of participation in the intervention on the livelihoods for the three wealth categories using the SPSS version 22® (Field, 2009). To triangulate these results we occasionally use respondents' quotes from the in-depth interviews.

3. Results

3.1. Changes in production practices

Wealthy farmers were more likely to adopt more new production practices (six out of seven) than medium-wealthy (who adopted five practices) and poor ones (three). This applied among both participant and non-participant farmers (Figs. 1–3), although those in direct receipts of the improved varieties and production practices adopted significantly more new production practices (Table 1). Medium-wealthy farmers, who participated in the project, adopted the new production practices almost as often as wealthy farmers, except for fertiliser application. Poor farmers adopted fewer of the new production practices: new varieties, tilling and triple weeding being the most widely adopted. Some poor farmers who did not participate in the project (5 out of 18) did adopt the new varieties and production practices of tilling and weeding more frequently. Those we interviewed said that local market and farmers in the neighbourhood were the sources for the new varieties. They have learned the new production practices from farmers in the neighborhood, mainly as a result of being hired to do these jobs. Wealthy non-participant farmers who adopted some of the new production practices (57%) said that they learned by observing what others were doing.

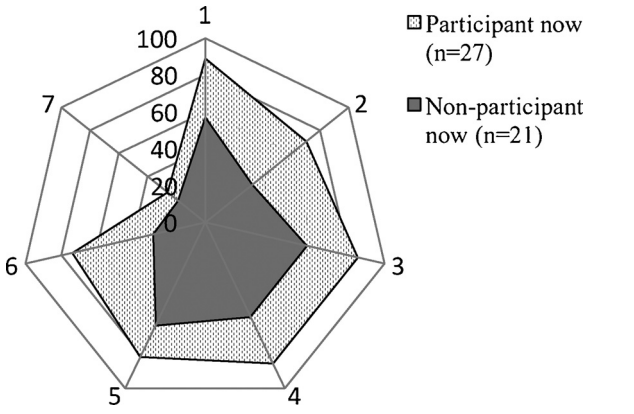

Fig. 1. Adoption of improved varieties and agronomic practices among wealthy farmers (%).
Log-linear analysis (χ^2): wealthy participant vs non-participant: 1 = 6.35*; 2 = 6.52*; 3 = 4.70*; 4 = 4.70*; 5 = 2.29; 6 = 9.85**; 7 = 0.316.
1 = improved potato varieties; 2 = synthetic fertilizers only; 3 = planting in ridges; 4 = tilling three times; 5 = weeding three times; 6 = improved seed storage; 7 = improved ware storage.
*,** and *** indicate significant effects at $p < 0.05$, $p < 0.01$, $p < 0.001$, respectively.

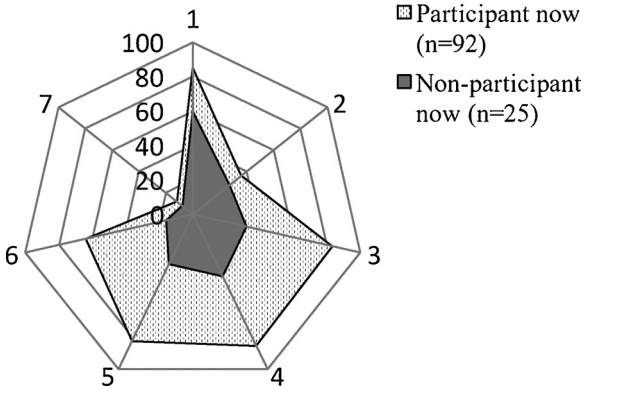

Fig. 2. Adoption of improved varieties and agronomic practices among medium-wealthy farmers (%).
Log-linear analysis (χ^2): medium-wealthy participant vs non-participant: 1 = 7.40**; 2 = 0.74; 3 = 24.86***; 4 = 21.14***; 5 = 3.38***; 6 = 18.32***; 7 = 1.00.
1 = improved potato varieties; 2 = synthetic fertilizers only; 3 = planting in ridges; 4 = tilling three times; 5 = weeding three times; 6 = improved seed storage; 7 = improved ware storage.
*,** and *** indicate significant effects at $p < 0.05$, $p < 0.01$, $p < 0.001$, respectively.

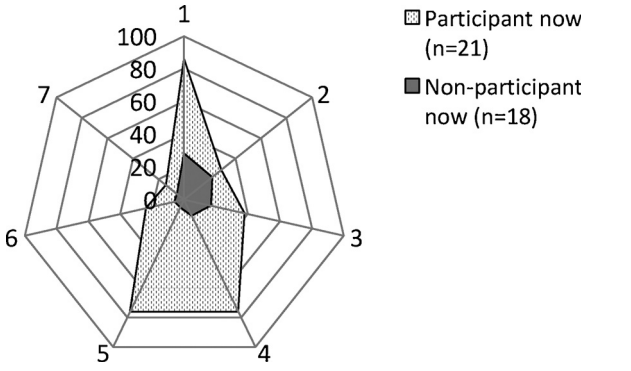

Fig. 3. Adoption of improved varieties and agronomic practices among poor farmers (%).
Log-linear analysis (χ^2): poor participant vs non-participant: 1 = 13.44***; 2 = 0.20; 3 = 2.19; 4 = 16.51***; 5 = 19.66***; 6 = 2.48; 7 = 0.803.
1 = improved potato varieties; 2 = synthetic fertilizers only; 3 = planting in ridges; 4 = tilling three times; 5 = weeding three times; 6 = improved seed storage; 7 = improved ware storage.
*,** and *** indicate significant effects at $p < 0.05$, $p < 0.01$, $p < 0.001$, respectively.

Table 1
The effect of participating in the intervention on potato production practices for the three wealth categories.

Production practices	Odd ratios		
	Wealthy (n = 48)	Medium (n = 117)	Poor (n = 39)
Improved varieties	6.00	3.71	15.60
Synthetic fertilizers	4.75	n/a[#]	n/a
Planting in ridges	4.31	10.09	n/a
Tilling three times	4.31	8.36	25.6
Weeding three times	n/a	9.38	54.40
Seed storage	7.14	9.39	n/a
Ware storage	n/a	n/a	n/a

[#] Not applicable as the association is not significant.

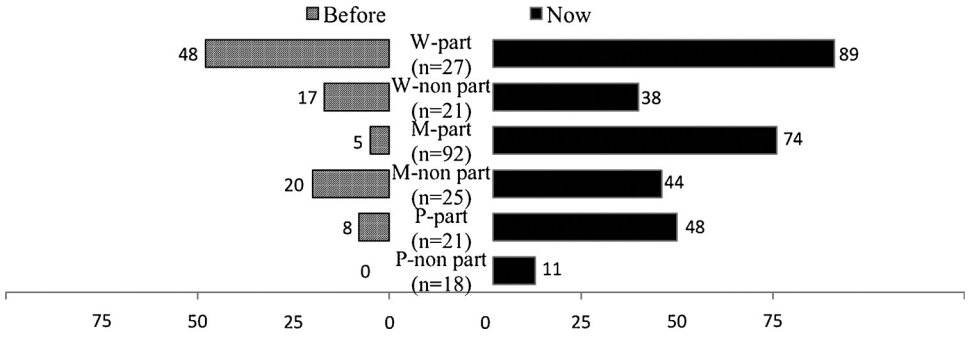

Fig. 4. Farmers commercializing part of their potato harvest (%).
Wealthy - $\chi^2 = 13.71^{**}$, Odd ratio (OR) = 13.0; Medium - $\chi^2 = 8.02^{**}$, OR = 3.61; Poor - $\chi^2 = 6.06^{*}$, OR = 7.27.

3.2. Increased commercialization

Before the intervention, 79% of participating farmers said that they only produced for home consumption (Fig. 4). After the intervention, only 26% produced solely for home consumption and 74% were selling seed or ware potatoes in the local markets. Non-participant farmers mainly grew potato solely for domestic consumption; although there was also a shift here towards greater commercialization after the intervention (just 7% sold potatoes before the intervention and 27% afterwards). None of the respondents grew potato solely for cash (Fig. 4). The shift towards partial commercialization because of participation in the intervention was more pronounced among wealthy farmers (13.71) than medium-wealthy and poor farmers (3.61 and 7.27, respectively) (Fig. 4). Farmers said that the shift towards commercialization was due to higher yields resulting from use of the new variety and production practices and receiving good prices for the new improved varieties of potato (both as ware and seed). Around half of the wealthy farmers (13 out of 27) were selling some potato on local markets before the project, and they substantially increased the volume of potato they supplied to the local market, from an average of 338 kg to 1546 kg. One of the wealthy participating farmers, said: "I grew enset (*Enset ventricosum*), wheat and potato as sources of food and cash, while other crops such as barley and haricot bean produced for home consumption because I do not have surplus produce to sell. I produced apple mainly as a cash source. Selling such a big volume of seed potato (1350 kg) and earning 5400 Birr (1€ = 25Birr) is a new experience for me. Now, next to apple, potato has become an important means of income for my family."

3.3. Changes in livelihoods

The adoption of improved potato production technologies and increases in yields and incomes enabled many farmers to develop their financial and material assets. Among participating farmers, the average amount of seed and ware potato sold per year increased from 0.33 to 1.20 tonnes as a result of the intervention and among non-participating farmers it increased from 0.25 to 0.61 tonnes. As a result, the average income from potato almost doubled among participant farmers (range 600 to 5000 Ethiopian Birr, 1 Ethiopian Birr = 0.04 Euro), and among non-participant farmers it increased by almost one third (range 350 to 3400 Birr). Farmers in different wealth categories invested the cash earned from potato in different ways. Many wealthy and medium-wealthy farmers constructed new houses with corrugated iron. The cash from potato helped them to buy fabricated construction materials such as corrugated iron sheet and nail. They used to live in their traditional bamboo or grass rooves. Participating farmers in the two upper wealth groups were twelve times more likely to do this than their non-participating counterparts (Table 2). Similarly, these two groups of participating farmers were six times more likely than non-participants to increase their livestock. Wealthy farmers mostly acquired oxen or cows while medium-wealthy farmers mainly increased the number of sheep. Poor farmers adopted other strategies, mainly buying new household equipment or investing in small businesses: selling (and buying) cereals, weaving products and milk products in the local markets and did so five and six times more (respectively) than their non-participant counterparts. The household equipment consisted of mainly furniture and cooking utensils and tools, and the small businesses involved selling (and buying) cereals, weaving products and milk products in the local markets.

Table 2
The effect of participating in the intervention on assets, by wealth category (%).

Asset	Wealthy		Medium	
	Participant (n = 27)	Non-participant (n = 21)	Participant (n = 92)	Non-participant (n = 21)
House construction	56	10	52	8
Log-linear (χ^2)	10.94***		15.67***	
Odds ratio	11.88		12.55	
Livestock	41	10	33	12
Log-linear (χ^2)	5.82*		4.12*	
Odds ratio	6.53		3.55	
Asset	Medium		Poor	
	Participant (n = 92)	Non-participant (n = 25)	Participant (n = 21)	Non-participant (n = 18)
Small business	20	24	43	11
Log-linear (χ^2)	0.23		4.82	
Odds ratio	n/a[#]		6.00	
Household equipment	24	20	62	22
Log-linear (χ^2)	0.17		6.20*	
Odds ratio	n/a[#]		5.69	

[#] Not applicable as the association was not significant.

Not all income from potato was used for building tangible assets. The type of asset accumulation partially depended on the amount of cash gained from potato and household priorities. More than half of farmers (12 out of 21), who sold a relatively large amount of potatoes, prioritized sending their children to private college or paying back loans they had taken from other farmers. A medium-wealthy farmer stated that "The cash from potato enables me to pay one term college fees for my two children. When they graduate they will have independent lives. In the future, they might be able to support me." However, in some cases, the improved potato technology had a negative impact on assets. A number of medium-wealthy (13%) and poor (33%) participant farmers were forced to make additional expenses or to sell assets after their investment in seed and/or fertilizer failed to turn into a good potato harvest. A poor farmer explained her experience as follows: "I planted 250 kg of seed potato as per the training I received. I purchased and applied fertilizers, although I am not used to

doing so for potato. In the first two months, the crop was very promising. In the last month, however, majority of the crop wilted. It was a big loss for me".

3.4. Changes in duration of availability of food

Many farmers did not produce sufficient food to last them all year round. During the *Belg* season, there is food shortage from April to May. Farmers across wealth categories mentioned that by May they had often exhausted their home-produced supplies. In the *Meher* season, the food shortage starts in September and lasts until mid-November, with October to mid-November being the critical months. This is the time when the crops in the fields are not ready to harvest; the food from the previous *Meher* harvest is fully-depleted and very little remains from the *Belg* harvest. During these periods households make major adjustments in their food balance: reducing the number of meals per day, cutting back on quantities consumed per meal, and using less-favoured crops. For the majority of farmers, potatoes matured in June to July during the shorter (*Belg*) rainy season and in December to January in the longer *Meher*. One of the changes associated with improved potato production was to extend the potato consumption period by an average of 2.3 months. The extension ranged from 3.4 extra months for the wealthier participant farmers to 10 extra days for the poor non-participant farmers.

Before the project intervention in 2012, in May, when potato reserves from the *Meher* harvest were depleted most households consumed not-fully grown enset (*Enset ventricosum*). Most farmers prefer maize to not-fully grown enset, but do not produce maize themselves and have to purchase it from local markets. After the project intervention, a high percentage of participant farmers, across all wealth classes, increased their maize consumption. There was also cut back on the consumption of not-fully grown enset among participant farmers, across all wealth classes (Figs. 5, 6 and Table 3). This was because the income earned from the new potato technology and (in the case of poor farmers) petty trading enabled farmers to purchase the maize they required.

Before the intervention, during September to mid-November, *Tsegurame Dinich* (*Plectranthus edulis)* and potato were the main staples of household food consumption. After the project intervention, some wealthy farmers consumed less *Tsegurame Dinich* (as they planted less), and all wealth categories increased their consumption of new potato varieties, preferred to *Tsegurame Dinich*. Wealthy and medium-wealthy participant farmers significantly increased their potato consumption (Table 3). The farmers associated the increment in potato consumption mainly with increased yields, although improved ware storage technology was also a factor for a few farmers; 26% of wealthy participants and 12% of medium-wealthy participants.

4. Discussion

This study has analysed the effects of an intervention introducing improved potato varieties and production practices on the livelihoods of smallholder farmers. The effects of the intervention reported here are preliminary, as the period between the intervention (2013) and evaluation (2015) is short. Our findings show that, even after two years, diverse new potato production practices emerged, patterned by wealth categories. Wealthy and medium-wealthy farmers applied more new production practices than poorer farmers. This is in line with earlier findings by Dersseh et al. (2016). The fundamental factors for the highest adoption among relatively wealthy and medium wealthy farmers, for example, was better access to technologies and knowledge, and availability of labour, land and cash. In contrast, poor farmers could not adopt new varieties and production practices because the technology does not fit their socioeconomic condition; they are too poor and their farms are too small (Tadesse et al., 2017).

Wealthy farmers who applied more new production practices generated more income from the surplus potato they produced, and this enabled them to acquire new assets. However, a few medium-wealthy and almost a third of the poor farmers had to sell off some assets in order to purchase seed potato and synthetic fertilizers and to manage the crop. This might be because these farmers lacked sufficient capital to implement them. Bacterial wilt could further aggravate the crop loss. In the case we reported on, the spreading of bacterial wilt with the diffusion of contaminated potato seed beyond seed tuber producing areas has already been proven (Abdurahman et al., 2017). This emphasizes that improved potato production practices require improved access to information, training and inputs if they are to be successful (Hirpa et al., 2010; Limenih et al., 2013).

Our findings also suggest that farmers in different wealth categories take different strategies to improve their livelihoods. Using the additional income from the potato crop, wealthy and medium-wealthy farmers acquired assets that required a relatively large amount of cash and contributed to long-term livelihood enhancement. Poor farmers invested in small businesses to diversify their income sources. This is in line with others (Tesfaye et al., 2013) who found that improved potato technologies had more impacts among adopters with better farm resources. These findings reflect that, while agriculture remains a key driver of non-farm economic development, farming alone might not be a way to improve the livelihoods of poor farmers with very limited agricultural resources. Studies have also indicated that poorer farmers participate in non-farm activities as alternative sources of income in order to reduce their vulnerability (Reardon et al., 1992; Akaakohol and Aye, 2014). The effects on the livelihood of the farmers in this study cannot solely be attributed to the change in production practices. Pre-existing differences in key farm resources also play a role. We found that these differences clearly influence farmers' uptake of new practices and their choice of how to invest any additional income. This implies the need to broaden the scope of interventions and to take into

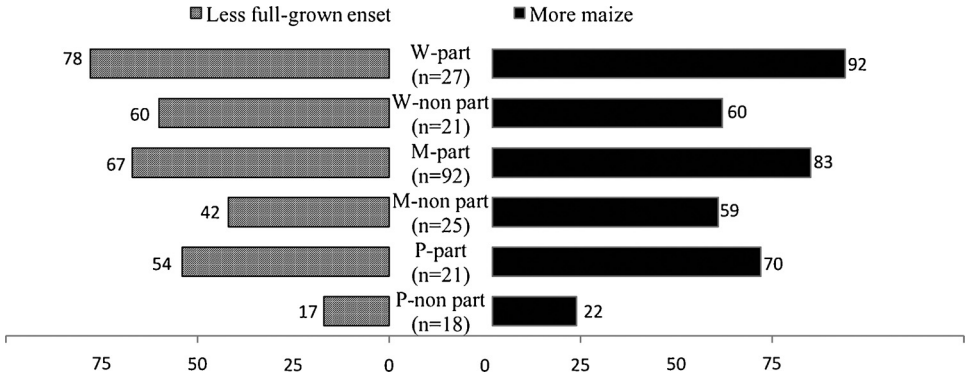

Fig. 5. Relative changes in crops consumed among participant and non-participant farmers by wealth class - May (%).

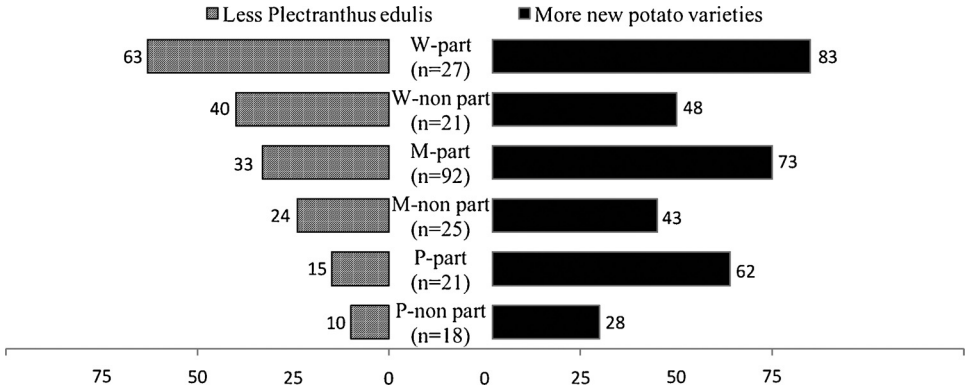

Fig. 6. Relative changes in crops consumed among participant and non-participant farmers by wealth class - September to mid-November (%).

Table 3
The effect of participating in the intervention on consumption patterns, by wealth category.

Attributes	Wealthy (n = 48)	Medium (n = 117)	Poor (n = 39)
Less consumption of immature grown enset			
Log-linear (χ^2)	3.42	5.40*	5.37*
Odds ratio	n/a#	2.80	5.73
More maize consumption			
Log-linear (χ^2)	6.74*	5.81*	9.39**
Odds ratio	8.28	3.39	8.27
More consumption of new potato varieties			
Log-linear (χ^2)	6.09*	7.35*	4.54
Odds ratio	5.29	3.58	n/a
Less consumption of *Plectranthus edulis*			
Log-linear (χ^2)	2.92	0.47	0.87
Odds ratio	n/a	n/a	n/a

Not applicable as the association is not significant.

consideration the diversity of resources available to farmers, which in turn influences how rural households attempt to improve their livelihoods.

The results from this study show that the intervention enabled farmers to adjust their consumption pattern over the season. They would eat more potatoes, especially after harvesting, and the additionally generated income allowed farmers to consume more maize and rely less on enset. Our findings also pointed to farmers reducing their daily consumption when food reserves declined. This means that food shortage may be felt over a longer period than what is measured by asking farmers when their food stores are empty or when they need to buy food.

Improved potatoes are thought to have the potential for breaking cycles of hunger as they can be harvested before cereal crops have matured (Woldegiorgis et al., 2015; Demo et al., 2015). Our findings indicate that this potential was not fully realized because there was a mismatch between the time for potato harvesting and the periods of food shortage. Farmers exhaust their home-produced supplies in the months of May, and October to Mid-November, whereas the improved potatoes matured from June to July and from December to January. Use of improved ware storage facilities, that could help farmers to stretch the availability of potato over a longer time period, was not a practice of farmers who did not receive the construction material. To improve the contribution of potato in filling the gap in food supply there is also a need for introducing and promoting very early maturing potato varieties while keeping a view on the nature of the crop and the agro-ecological conditions of the locality, such that their growth cycle matches with the hunger gap.

There were indirect benefits of the intervention to farmers who did not directly receive the seed of new varieties and training in improved production practices. These benefits were mostly concentrated among the wealthier farmers. For example, the proportion of wealthier farmers who applied improved production practices and improved their livelihood situation was higher than the proportion of medium-wealthy and poor farmers. Wealthier farmers increased the proportion of their income from potato more than poor farmers. The increase in consumption of maize and potato was also more among wealthier farmers. These findings illustrate that improved potato technologies were not equally accessible to, or easy to implement for, farmers in different wealth categories. Kassie et al. (2009) have noted that access to information and household endowments have a significant and positive impact on farmers' decisions to adopt, and benefit from, agricultural practices, such as conservation tillage, compost and chemical fertilizer.

5. Conclusions and implications

The introduction of new potato varieties and production practices has had a significant contribution to improving the livelihoods of farmers in the highlands of Chencha. However, these preliminary effects were not uniformly distributed among farmers in different wealth categories. In general, the wealthier farmers who received improved seed potatoes and production technologies benefited more than other farmers. They generated better income, acquired more assets and improved their food consumption. Poorer farmers were less able to translate the technology into long-term livelihood improvements. This could be because they lacked the complementary resources to benefit fully from the intervention. The results from this study show that the intervention enabled considerable adjustment in the type of crops consumed during food shortage seasons.

The main implication of this study is that while encouraging the adoption of new potato technologies may foster agricultural and economic development, such technological interventions do not necessarily guarantee that farmers in different wealth categories will benefit equally. This suggests the need for offering famers a range of technology options that fit different socio-economic contexts. Farmers in different wealth categories also had different strategies for improving their livelihoods. One should recognize the importance of these diverse strategies, especially those employed by poor farmers in order to build their productive resources and enhance their livelihoods. This could be done by integrating potato technology with other targeted farm and non-farm interventions. Finally, through our exploratory interviews we were aware of the need for wealth disaggregation in the measurement of impact of the potato technology and able to capture the different strategies and complex effects on consumption patterns. Our approach shows the importance of the wider context in order to better understand and describe the, often very different, developmental effects of a single technological intervention on the different aspects of farmers'

livelihoods.

Disclosure of statement

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