Successes with Value Chain

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Transforming the Traditional Potato Production through Improved Technologies in the Central Highlands of Ethiopia

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Introduction

Potato (*Slanum. tuberosum* L.) is believed to be introduced to Ethiopia in the 19th century by a German botanist named Schimper (Horton 1987; Pankrest 1964). Since then, potato production in this country has been limited to homestead as a garden crop. Its expansion was gradual at the early stages. Many reasons have contributed to its slow adaptation. The narrow genetic base of the early introductions, traditional view towards potato as a poor man's food, and lack of skill of production had effectively hindered its wider cultivation. A steady rise in production occurred at the end of the 19th century during which there was a long famine in Ethiopia.

Since that time potato became a very important garden crop in many parts of Ethiopia. In the mid 1970s, it was estimated that the total potato acreage was 30,000 ha, with an average yield of about 5 tons per ha. Due to the growing importance of the crop, a national potato research program was launched in 1975. Since the inception of the program, a large number of germplasm was introduced and improvement work undertaken. Cultivated land to potato grew to about 50,000 ha in the mid 1980s as a result of introduction of improved varieties and development of appropriate cultural practices through research. The present area under cultivation is estimated at more than 160,000 ha with a national average yield of below 9 tons per ha. On-farm research results, on the other hand, show that farmers can get an average yield of 24 tons per ha using improved technolc gies.

There are natural, economic, technical and institutional constraints that limit production of potato in Ethiopia. Drought, lack of irrigation water, and high disease and insect pressure are some of the major natural limitations. Some of the other limitations include poor credit system, price fluctuations, poor marketing infrastructure, lack of quality (disease free) seed tubers, high yielding varieties, poor agronomic techniques, inefficient marketing and transportation system, internal quarantine problems, lack of consumers' awareness, poor linkage between partners and inadequate number of trained staff.

Considerable progress has been made in relation to development of varieties, agronomic and seed production techniques, and integrated pest management (IPM) for major diseases and insect pests in different agro-ecological zones of the country since the establishment of the national potato research program.

Technology transfer work has been undertaken in the central highlands of Ethiopia since 1988. Participatory approaches, such as on-farm variety adaptation trials, training and informal seed production were employed in the technology development and dissemination process. Reported here are impacts of this work on the lives and livelihoods of participating farmers in scaling up and scaling out improved potato technologies.

Technology Development

As stated earlier, potato production technologies were developed in collaboration with different partners. The technologies developed included high yielding and widely adapted varieties with tolerance to late blight (*Phytophthora infestans*), improved agronomic practices, disease and pest management, post harvest handling, utilization, and seed tuber production techniques.

A total of 17 high yielding (22-47 tons per ha) varieties adapted to altitudinal and rainfall ranges of 1700-2800 m above sea level and approximately 560-1500 mm, respectively, were developed. Improved agronomic practices such as use of good quality seed, time of planting, plant population, fertilizer rate, depth of planting, ridging, harvesting techniques, storage and crop rotation have also been developed. Establishment of an IPM program against major diseases such as late blight and bacterial wilt (*Ralstonia solanacearum*) has made it possible to

grow potato in the main rainy season. Various partners were involved in the scaling up and scaling out process (Table 1).

Table 1. Partners and their roles in the scaling up and scaling out process

Institution	Role
EIAR	Developing R4D strategy
	Budget and personnel allocation
	Demonstration and popularization capacity building
MOARD	Collaboration in dissemination of technologies and feedback
CIP, PRAPACE	Source for germplasm
	Financial support
	Technical backstopping
IFAD, AHI	Financial support
	Technical backstopping
SHDI, World Vision	Collaboration in implementing projects
	Collaboration in technology dissemination
	Financial support for training farmers and DAs

The Scaling up Process

The problem of conventional research and the current extension system has been its linear top-down approach in generating and transferring technology with little or no involvement of farmers and without proper consideration of their priorities and capacities. Adoption and impact of potato technologies through transfer efforts that followed the traditional model were very slow and not profound. This has resulted in a shift of emphasis towards participatory approaches. Effective participation is essential for the development of site-specific technologies that address farmers' felt needs. Improving the exchange of ideas and information among farmers, researchers and extension staff is believed to improve the technology development process for farmers, especially those in complex, diverse and marginal environments with limited resources. In our present approach, farmers were encouraged to participate in the process of evaluation and selection of technologies that suit their conditions. Thus, a participatory potato technology development and dissemination process has been undertaken in the central highlands of Ethiopia since 1998. The methods used to disseminate the available technologies included farmer field school (FFS) farmer's research group (FRG), on-farm variety adaptation trials, informal seed production and training.

On-farm variety adaptation trials of released varieties and selected clones from advanced breeding trials were conducted under variable farmers'

Table 3. Technologies evaluated and number of farmers involved indifferent weredas through the FFS-FRG approach

Wereda	Technology	PR approach	No. participating farmers
	IDM-LB	FFS+ FRG	25+15
	Post harvest	FFS	75
Jeldu	INM	FFS+ FRG	50+15
	IDM-LB	FFS+ FRG	24+15
	Post harvest	FRG	15
Dendi	INM	FFS+FRG	25+/15
	IDM-LB	FFS+ FRG	25+15
Degem	INM	FFS+ FRG	25+15
	IDM-LB	FFS+ FRG	25+15
Wolmera	INM	FRG	15
	Post harvest	FFS	25
	INM	FFS+ FRG	25+15
Alemaya	Post harvest	FRG	15

In the first round of FFS, there were dropouts of some farmers from membership in some FFSs due to various reasons. The most important reasons reported were:

- Expectation for material inputs than knowledge from the research;
- Bad experience with previous producers cooperatives;
- Lack of interest to come to the school every week feeling that the work is time consuming; and
- Fear that the FFS approach may not be applicable to their local condition.

On-farm Variety Adaptation Trials

The results obtained from the two years at Meta Robie showed that yield of released varieties ranged between 25 and to 28 tons per ha. It is also observed that even the tuber yield of the susceptible check (AL-624) could be improved to a reasonable yield with a single Ridomil MZ® spray at a rate of 2 kg per ha. These results indicated that the improved varieties could give higher tuber yields during the main season where most farmers cannot grow potato using their own local varieties because of the devastating effect of late blight (Table 4).

Farmers' evaluation of the varieties for quality revealed that attributes such as appearance, taste and texture were the most important parameters used to compare varieties/clones. Based on these criteria, the varieties 'Tolcha', 'Menagesha' and 'Wechecha' were ranked highest for acceptance.

Training

Training was given to farmers at each location on field selection techniques for disease-free seed, optimum tuber size, and construction and use of DLS to ensure improved and quality seed tuber production under farmers' conditions. A total of 2,165 farmers were trained during the period from 2002 to 2004. Of these 535 women were trained on potato food preparation, 61 development agents on potato production and management and 1,569 farmers on potato production and late blight management.

Impact of the Potato Technology

A quick participatory rural appraisal (PRA) survey was conducted in 2003 to collect qualitative information on how potato production technologies were used by the participating farmers in Degem (North Shewa zone) and in Jeldu and Dendi *weredas* of West Shewa zone. Following the PRA survey, a structured questionnaire was designed to quantify some of the most important parameters. Taking into consideration of resource availability, homogeneity of the strata, and the population size in each stratum, the total sample size of the farmers was 302 (151 from Jeldu, 118 from Dendi and 33 from Degem). All the farmers covered in this study were participants in one of the outreach programs of Holetta Research Center (demonstration, adaptation trial, informal seed production or FFS).

Farmers obtained considerable economic benefits and impacts in their lives and livelihoods from the use of improved potato production technologies. The farmers themselves identified the impact indicators as livelihoods, asset ownership and economic status.

Impacts on asset ownership

One of the most important impact areas observed from the use of improved potato production technologies was in asset ownership. The two most important assets of the farmers are livestock and land. According to the findings, 75, 64, 52 and 43 percent of the overall farmers who brought impact have purchased oxen, cows, heifers and bulls, respectively, by using the income derived from the sale of improved potato (Table 4).

Table 4: Percentages of farmers reporting improved asset accumulation due to adoption of improved potato production package in western and northern Shewa zones in 2003.

Impact areas	*Wereda*			
	Jeldu	Dendi	Degem	Average
Purchased oxen	79	75	71	75
Purchased cows	65	60	63	64
Purchased heifers	48	80	50	52
Purchased bulls	46	40	42	43
Purchased sheep	68	100	70	74
Purchased donkeys	28	50	58	46
Purchased horses	71	83	11	52
Purchased chicken	63	86	57	63
Cultivated more land	43	71	41	46

The other most important asset of the farmers is land. As the farmers gain more economic benefits, they tend to increase cultivated land by using different mechanisms. As the results indicate, the proportion of landless farmers (71 percent) in Dendi wereda before the introduction of potato production technologies has decreased to 29 percent after the use of the technologies. This indicates that 42 percent of the farmers have started cultivating their land either through sharecropping or through contracting. The proportion of the overall farmers who used to cultivate 1.25 to 2.00 ha of land (4 percent) has increased to 15 percent after the use of potato production technologies.

Impacts on economic benefits

The farmers obtained considerable economic benefits from the use of improved potato production package. According to the marginal analysis, the marginal rate of return was 1109 percent. In other words, farmers obtained an average of birr 11.09 for every birr they invested on improved potato technologies. These impacts were realized within three to four years.

Impacts on livelihoods

In addition to asset ownership, impacts were observed on changes in livelihoods of the participant farmers after the use of potato production technologies. About 71 percent of the farmers in Jeldu and 39 percent in Degem *weredas* have constructed new corrugated iron roofed houses using the income derived from the use of improved potato technologies. Moreover, 69 percent of the overall farmers have increased the number of houses owned as compared to the condition before the introduction of the technologies.

The most important impact of improved potato varieties was improvements in food security at the household levels. The farmers emphasized that they did not face food shortages throughout the year since the introduction of improved potato varieties. Potato fills the critical food shortage they face before harvesting cereal crops.

The results also indicate that 71 percent of the farmers have enrolled their children in school because of more economic benefits accrued from the use of improved potato technologies. Debt settlement, increased input use and employment of hired labor are some of the additional benefits from the package (Table 5).

Table 5: Percentages of farmers reporting improvements in their livelihoods due adoption of improved potato production package in three weredas of West and North Shewa in 2003

Impact areas	Wereda			
	Jeldu	Dendi	Degem	Average
Use of corrugated sheets for construction of house	71	-	39	51
Increased number of houses	65	80	70	69
Improved household food security	55	100	97	88
Debt settlement	22	86	25	33
Increased input use	48	89	48	55
Increased use of hired labor	28	75	46	41
Enrolled more children in school	62	88	76	71
Improved fulfillment of school requirements	57	86	83	73
Better clothed family members	74	100	87	87
Increased cash savings	13	75	43	34
Constructed new DLS	78	88	77	79
Upgrading existing DLS	17	67	5	15
Improved household expenditure	76	95	90	86
Improved access to health services	54	91	79	72
Improved maintenance of residence	48	33	68	58

Main Factors for Success

- Availability of improved production technologies;
- Increased awareness created through training and use of the media;
- Availability of favorable growing conditions to the potato crop in many parts of Ethiopia;
- Favorable policy environment;
- Suitability of potato as an alternative to traditional crops;
- Increased market opportunities; and
- Improved co.laboration with partners in the technology development and transfer process.

Lessons Learnt

- Participatory approach is a good means of speedy technology transfer;
- Farmer-based seed production can be an important source of good quality potato seed where there is no formal seed production system;
- Strategic intervention is required in site selection and specialization of seed producers to sustain a viable seed system;
- Experience gained from this out reach program can be used as a model to further scaling out the package into other potato growing areas; and
- Some farmers were hesitant to work as a group while some others did not follow the recommendations.

Challenges

- How to scale out this technology package to a wider group of beneficiaries for more impacts; and
- How to establish a mechanism to control seed quality in the informal seed system

The Way Forward

Efforts made so far in developing, popularizing and scaling up and scaling out improved potato production packages have made significant changes in the lives and livelihoods of farmers who have adopted the technologies. However, it should be noted that the areas currently benefiting from these technologies are very small in size compared to the potential that is available for potato production in Ethiopia. Therefore, there is a strong need to scale out these technologies to other major potato producing regions of the country through:

- Strengthening collaboration among partners;
- Providing access to market information;
- Capacity building for farmers and researchers alike;
- Establishing sustainable seed scheme; and
- Continuous technical backstopping by providing more options of better varieties and updating management practices