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# The contribution of coffee research for coffee seed development in Ethiopia

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In Ethiopia, despite the enormous wealth of genetic diversity the average national coffee yield remains low. This is largely attributed to the predominant use of traditional coffee varieties and husbandry practices. The Jimma Research Center (JRC) has released a total of 37 coffee varieties along with improved agronomic and processing techniques. However, the inadequate supply of high quality coffee seeds still remains a major barrier, mainly due to the absence of a formal coffee seed system in the country. The JRC had been and is still shouldering the huge task of producing and supplying coffee seeds and seedlings. The results depicted substantial variations among coffee varieties across seasons. A total of 17, 5641 kg of improved coffee seeds have been produced and dispatched to the various coffee growers in the country. The request for coffee seeds is increasing at an alarming rate with wider gaps between the demand and supply. The results of specialty coffee multiplication and distribution initiative depicted a 48% and 66% achievement for coffee seeds and seedlings, respectively. These were distributed to model famers, private investors and state farms. Further, twenty specialty coffee seed orchards were also established. Sustainable coffee seed system requires, among others, strengthening and supporting coffee research centers, small-scale farmers, private and state coffee farms. This paper is therefore an attempt to share experiences on the current status of coffee seed production and seed system in Ethiopia. It also presents the challenges, opportunities and future directions for effective and efficient coffee seed systems in the country.

**Keywords:** Coffee diversity; Coffee seed standards; Coffee varieties; Specialty coffee; Seed orchard; Technology transfer

## INTRODUCTION

Coffee is one of the most important commodities in the international agricultural trade, representing a significant source of income to several countries of Africa, Asia and Latin America. Despite its importance, the value of coffee exported from Africa, including Ethiopia has declined considerably over the years due to lack of sustainability and poor competitiveness of the sub-sector at the national and international market. For example, Africa's production fell by 18.5% and its share of world production fell accordingly and was down by 1.5% for the crop year 2008/09 and 2009/10. This is primarily ascribed to various problems, including inadequate access to improved production and processing technologies,

together with deficient services, poor market access and lack of incentives. The sub-sector is also constrained by the prevailing ineffective and inefficient policy frameworks that strongly affect the benefits obtained thereof (ICO, 2009).

Currently, Ethiopia is a leading arabica coffee producer in Africa, ranking the fifth largest Arabica coffee producer and tenth in coffee export worldwide. Its total coffee production and export respectively increased by 107% and 226% for the crop year 2009/10 and 2010/11 (ICO, 2011). In Ethiopia, coffee had been and still contributes to the Lion's share in its national economy being the leading source of foreign exchange earnings. Besides, the livelihood of a quarter of the Ethiopian population depends directly or indirectly on the different processes of production and marketing along the coffee value-chain (Girma et al., 2008). In Ethiopia, the overall land area devoted to coffee production due to new plantings is

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increasing and estimated to be 662,000 hectares, of which 496,000 hectares are estimated to be productive. The average annual production is amounting to about 350,000 t and productivity of about 0.71 t/ha (Alemayehu et al., 2008). Here, coffee is produced under four broad production systems, i.e. forest coffee (8-10%), semi-forest coffee (30-35%), cottage or garden coffee (50-57%) and modern coffee plantations (5%). Hence, more than 95% of the total volume of coffee produced in Ethiopia is contributed by the smallholders whose average holding size is less than one hectare with low average productivity ranging from 200 to 250 kg /ha (Workafes and Kassu, 2000). Ethiopian coffee is predominantly produced by small-scale farmers using traditional farming system and thus considered as organic by *de facto* and known for its superior quality. The low-input coffee production system with the occurrences of maximum biodiversity, environmental sustainability and ecological services (Taye, 2010) should deserve due attention and needs to be supported, among other, through smallholder certification and carbon trading. Nonetheless, all these immense opportunities have not yet been fully accredited and exploited, demanding for strong international collaborations in supporting national certifiers and sustainable global coffee initiatives for the development of the coffee sector and thus, maximize its decisive role in improving the livelihoods of the rural poor (Taye and Tesfaye, 2002).

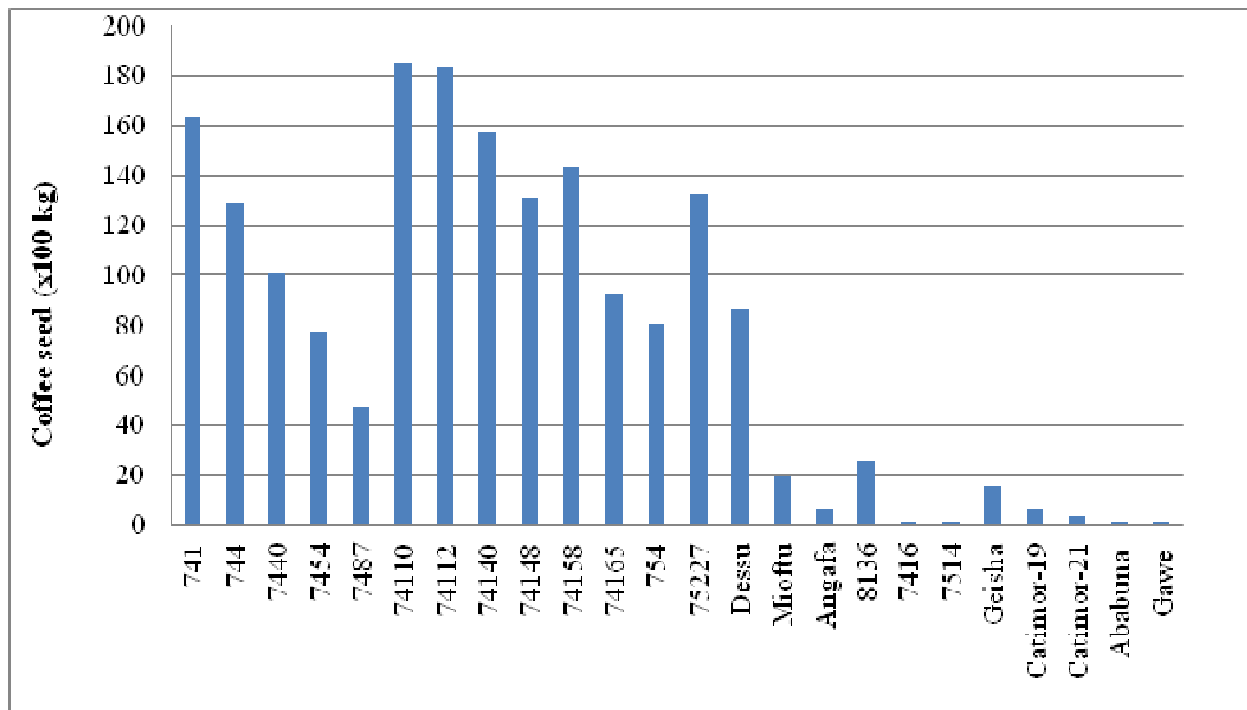
Despite the wealth of ecological and coffee diversities, the national average coffee yield level is low by the world standard. This could be attributed to several factors, including insufficient credit and input distribution mechanisms for coffee producing farmers, predominant use of unimproved local coffee landraces, as well as conventional husbandry and processing practices, which in turn seriously hampers the overall national coffee production and productivity of the smallholder coffee farmer in the country (Taye, 2010). In contrast, the released coffee varieties have high yield performances ranging from 1,200 to 2,600 kg/ha and 800 to 2,400 kg/ha at research plots and on-farm conditions, respectively. Moreover, the high yield levels of coffee are also recorded at the medium to large-scale farms owned by private investors and model farmers, as well as most of the state coffee farms, largely due to the use of recommended coffee varieties and improved field management practices (Bayeta et al., 1998). Hence, it is crucial to promote the recommended best coffee technologies at each geographical area and production zone. This requires, among others, strong stakeholder linkages at all levels and aggressively transfer the improved coffee varieties, improved agronomic practices, harvesting and post-harvest management technologies.

In Ethiopia, the current Government support for the production and export of market-oriented quality coffees, among others, contributed a lot to benefit from the encouraging premium coffee prices. This is really a

re-birth to the coffee sector, largely to improve the livelihood of the rural communities at the original birthplace of *Coffea arabica*. The nationally projected GTP targets in the coffee sub-sector demand, *inter alia*, empowering small scale coffee farmers and supporting private investors through dissemination of information and skills regarding improved production and processing technologies, together with adequate supply of inputs, including coffee seeds and fertilizers. It is thus high time for the meaningful transfer of the available improved technologies and best practices in managing the already existing coffee stands, on top of supporting the emerging commercial coffee plantations in the identified and potential coffee growth corridors in the country. However, except the limited attempts by the Jimma Research Center, there is no strong public or private institution that is authorized for the production, processing and supply of improved coffee seeds in Ethiopia (Admassu et al., 2008; Negusie et al., 2008). Above all, multiplication and distribution of the improved and suitable coffee varieties at each agro-ecology should deserve a prime attention of the stakeholders to promote sustainable and commercial coffee production, processing and marketing systems. This study offers a preliminary view on the need to strengthen the existing coffee seed systems and support the legal frameworks for the protection of coffee genetic resources and seed actors for sustainable coffee seed system in Ethiopia. This would enable effective distribution of improved coffee varieties as demanded and thus contribute to increased coffee production and productivity. The specific objectives are to share experiences on and describe the status of improved coffee seed production and supply in Ethiopia and highlights the prevailing challenges and opportunities. It also suggests some future interventions for establishment of sustainable and more efficient coffee seed system in the country.

## METHODOLOGY

This paper provides experiences on the seed system of coffee in Ethiopia and the status of improved coffee seeds multiplied and disseminated to the diverse stakeholders in the country. It is a culmination of work done on coffee seed production and distribution mainly by the Jimma Research Center, which holds the national mandate to coordinate coffee research in Ethiopia. The status of coffee seed production was analyzed for the released coffee varieties. From the annual requests for each variety and supplied by the Jimma Research Center, the gaps between the demand and supply was analyzed and compared over years. The experience on the constraints and opportunities for production and dissemination of improved coffee varieties is highlighted and future interventions for sustainable coffee seed system in the country are also suggested.



**Figure 1.** Multiplication and distribution of improved coffee seeds prepared from the released arabica coffee varieties by the JRC over 32 years (1997-2010)

## RESULTS

In Ethiopia, there is no formal system responsible for the production and supply of improved coffee seeds from the released and adaptable coffee varieties. As there is no public or private enterprise, all the burdens had been and is still left to the JRC. Thus, JRC is the only governmental institution that had taken the initiative of multiplying improved coffee seeds and seedlings of the nationally released CBD resistant varieties since 1987 and distributing all over the major coffee growing areas of the country. According to informal information, the contributions of farmers' coffee seed system in the major coffee growing areas of the Oromia and SNNP regional states is immense, though comprehensive results are inadequate and awaits investigations. The experiences accumulated so far regarding production and supply of improved coffee seeds and seedlings produced from the released pure-line and hybrid coffee varieties are separately presented as follows.

At research centers, coffee seeds are mainly produced from coffee seed orchards of the released and adaptable coffee varieties established and managed by the coffee technology multiplication unit, as well as from the varied experimental fields existing in the different centers. Accordingly, a total of 17,5641 kg of improved coffee seeds have been produced over the last three decades (1979-2010) and disseminated to different coffee growers in the country. The demand for improved coffee seeds

and seedlings is rapidly growing from time to time. According to the data analyzed between 1997 and 2010 crop years, the ever increasing annual request for coffee seed is coming from the various zonal agriculture bureaus, NGOs and private investors from all over the country. According to the analysis, the demand follows the order of the Illuababora (45%), Jimma (35%) zones, coffee plantation development enterprise (6%), Kafa (3.27%), West Wellega (3.15%), East Wellega (1.97%) and West Shoa (1.72%) zones. As a result, the highest demand (>90%) is from the Oromia regional state, followed by the SNNP (8.15%). In addition, JRC has also provided limited amount of coffee seed services to the other emerging and potential coffee producing areas of the Benshangul Gumuz, Tigray and Ahmara regional states for adaptation and expansion of new coffee farms.

With regard to coffee varieties, the top ten leading coffee varieties with high amount of seeds were supplied from 74110, 74112, 741, 74140, 74158, 75227, 74148, 744, 7440 and 74165 in that descending orders (Figure. 1). This is possibly attributed to variations among the released coffee varieties in their popularity, adaptability, preference and demand by users. The maximum values for the compact coffee varieties could be associated to the increasing requests, particularly from the Illuababora zones where they thrive best and have been collected. In contrast, some of the released coffee varieties are less demanded and calls for research to collect feedbacks on their drawbacks for improvements. The average annual results, however, depicted considerable variations from year to year, perhaps due to the

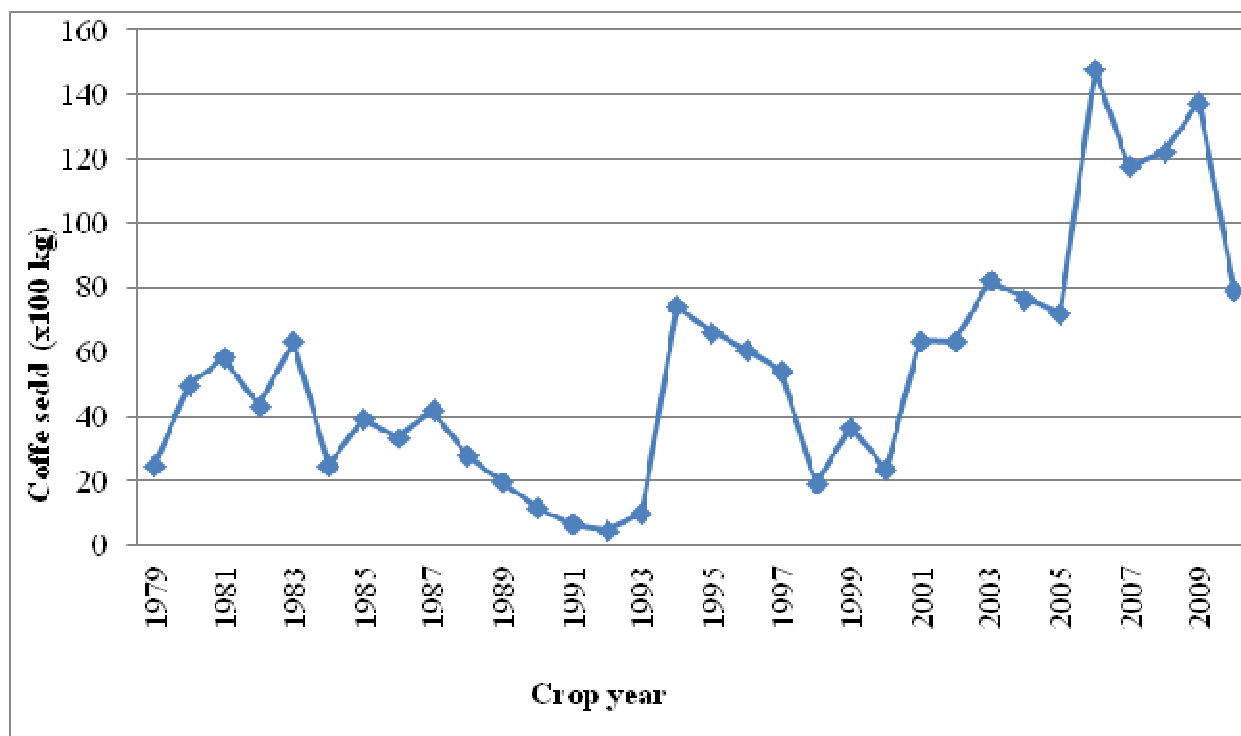


Figure 2. Annual patterns of improved coffee seed production by the JRC over the last three decades

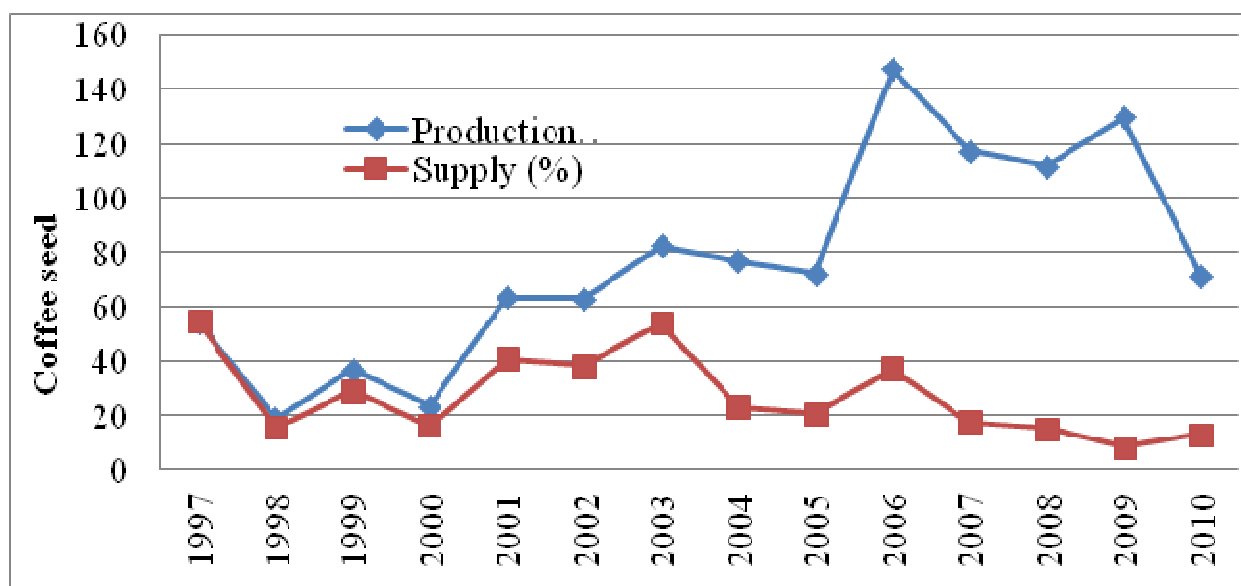


Figure 3. Trends of improved coffee seeds produced and supplied by the JRC

biennial nature of coffee trees, number of varieties involved and their land holding size, as well as the prevailing climatic and field management conditions. The results also depicted unstable coffee seed production and supply by the JRC. Accordingly, the maximum average capacity of coffee research centers had only reached as

high as 14,762 kg in the 2006 crop year (Figure. 2). The analyses also revealed that the demand surpasses with the increasing gaps over years (Figure. 3). The demand shares in most years is more than 80 %, indicating the untapped opportunities for the interested private and public insitutions to involve in the coffee seed business.

**Table 1.** Quantity of improved CBD resistant coffee seeds produced and supplied by private and state coffee farms in southwestern Ethiopia

Coffee farms	Annual Seed Production (kg)					
	2007/08	2008/09	2009/10	2010/11	Total	Mean
State Farms						
Limmu	12,000	12,300	13,725	6,200	44,225	8,845
Teppi	2,000	2,593	5,026	5,443	15,062	3,766
Private Farm						
Ethio-Agriceft	546	591	1,157	1,221	3,515	879
<b>Total</b>	<b>14,546</b>	<b>15,484</b>	<b>19,908</b>	<b>12,864</b>	<b>62,802</b>	<b>4,497</b>

The JRC can not meet the rapidly growing demand for improved coffee varieties in the country as described by Negusie et al., (2008). To circumvent the shortage of planting materials, the informal coffee seed system is also practiced by the varied private and public coffee farms in the major coffee producing regions of the country. This includes production of uncertified coffee seeds from the released and adaptable coffee varieties by small-scale farmers, private investors and state coffee farms, who produce and use for themselves, on top of transferring to other users in their vicinities. Among others, the big coffee state farms, namely, Limmu, Teppi and Bebeke of the coffee plantation development enterprise (CPDE) had produced and supplied a total of 59,287 kg of coffee seeds to different users between 1997 and 2000. They depend on the improved CBD resistant selections initially obtained from the JRC. Likewise, the recently established modern private coffee farm of Medroc Ethiopia, the Gemadro coffee farm of Agiceft Ethiopia, has also played a significant role in the production and supply of coffee seeds from the selected CBD resistant varieties (Table 1). The production from these large coffee farms is also augmented by the relatively smaller quantities of CBD resistant coffee seeds (1,000 to 2,000 kg) produced and supplied by some private coffee farms of smaller scales found in the southwestern parts of Ethiopia. The whole informal coffee seed sources prepare improved coffee seeds as per the requests they receive from the users ahead of time. This could be the main reason for the variations in the amount of coffee seeds distributed over crop years.

In Ethiopia, experiences show that smallholders had served as the major source of coffee seeds and seedlings for the informal farmer to farmer seed exchanges via the respective Wereda and Zonal bureaus of agriculture. For instance, in most coffee growing areas of the Oromia and SNNP regional states, it is not uncommon to find coffee farmers who are producing large volumes of coffee seeds to supply for the agricultural offices in their vicinities. Besides, they are also playing a great role in providing coffee seeds and seedlings to their fellow farmers around their localities,

thereby generating considerable income for their livelihood. Thus, the existing farmers' experience and knowledge of producing coffee seeds and seedling as a source of cash seems to be so cost-effective and affordable option for sustainable and efficient scaling-up of improved coffee technologies within the small-scale coffee producing communities. Hence, this practice could be strengthened and promoted to enhance the use of improved varieties within the smallholder coffee producing sector at least in the highly suitable coffee growing regions and districts of the country. However, in some cases, the variety and purity of the seeds and seedlings produced and supplied by individual coffee farmers may not be dependable as they are not so strict in providing the selected released coffee varieties. Due to the high opportunity costs, the farmers may include some coffee seeds and seedlings from disease susceptible local landraces they consider and prefer good. Hence, it is essential to establish farmers' coffee seed/seedling producers group with pertinent technical and practical training supports. This indicates that large-scale coffee farms have more experience than the other coffee seed sources. The technical and resource capacities of the large-scale coffee seed producers (state farms and private investors), as well as those of smallholders can help to trigger rapid expansion of improved coffee technologies and contribute a lot to boost coffee production and productivity in the country. This would be successful if their activities are technically supported through all rounded regular trainings as well as field inspection and certification schemes as it is true in the case of other cereal seed systems.

Since the past few years, the Ethiopian government had given a very serious attention for the expansion of the coffee plantations, which in turn entailed large scale multiplication and distribution of improved coffee seedlings. This can be witnessed from the ever increasing plan for the total coffee area coverage every year through expansion of new coffee plantations, accompanied with allocation of adequate budget, which in turn created a significant boost in the demand for improved coffee seeds all across the country. There are also

**Table 2.** Achievements of the specialty coffee multiplication and distribution plan (2009/2010)

Specialty coffee	Variety number	Amount of seed (kg)			Number of seedlings		
		Planned	Achieved	Percent	Planned	Achieved	%
Wellega	6	1,020	681	67	3,565,800	810,000	23
Harar	7	420	203	48	1,470,000	800,000	54
Sidama/Yirgacheffe	8	1,507	1,087	72	5,271,950	3,093,000	59
Limu	9	421.0	255	61	1,473,000	1,000,000	68
<b>Total</b>	<b>30</b>	<b>3,368</b>	<b>2,225</b>	<b>66</b>	<b>11,781,250</b>	<b>5,703,000</b>	<b>48</b>

small financial supports provided by some NGOs that have coffee components in their projects, which thus give assistances for the purchase of coffee seeds to be supplied to the smallholder farmers. In line with this, Alemayehu *et al.*, (2008) reported the considerable contributions made by the coffee improvement project of the European union (EU) that supported establishment and running of coffee nurseries in different parts of the country, viz. Oromia, SNNPRS, Gambella and Amhara regions, thereby enhancing expansion of new coffee plantations using CBD resistant coffee varieties, till the project phased out in December 2009.

To exploit these huge market opportunities, recently 11 pure-line specialty coffee varieties have been released for the different coffee growing areas of the country, i.e. 4 for Western and Kelem Wellega, 3 for Sidama/Yirgacheffe and 4 for West Hararghe (MoA, 2010). The latter Harargehe varieties were released in collaboration with the Mechara Agricultural Research Center of the Oromia Agricultural Research Institute. The Limmu, Harar, Wellega, Yirgacheffe and Sidama coffee types were known to have their peculiar typicity of winy, mocca, fruity, floral and spicy flavors, respectively. Cognizant of the encouraging world coffee markets, the JRC has taken the initiative for the multiplication and distribution of specialty coffee seedlings in 2009/2010 with the prime objective of plan is to establish coffee seed orchards that can be certified as future seed sources in the major coffee growing areas of the country. As a result of shared vision, proactive and strong commitments from individuals, groups and institutions involved, it was possible to attain a significant success within a short period of time and using the availed limited government budget. Accordingly, the accomplishments recorded thereof were as high as 66% and 48% from the targets of coffee seeds and seedlings, respectively (Table 2), largely due to the shortage of coffee seeds as compared to the yield estimations from the already established coffee trees at each site.

The multiplication of the Limmu coffee seedlings was carried out at the Jimma, Gera and Agaro research centers and accordingly, a total of 761,194 seedlings were distributed in seven weredas of the Jimma zone. A total of 718,362 seedlings were distributed to model coffee

farmers, while the remaining 42,832 were supplied to private investors, state coffee farms and public institutions. Likewise, about 262,062 Wellega/Gimbi specialty coffee seedlings were multiplied at the Haru and Mugi Research centers, from which 121,992 seedlings and 483 kg seeds were disseminated to 168 coffee users (coffee farmers and private investors) in Haru-Jitu, Gimbi, Laloasabi and Anfilo weredas of the West Wellega and Kelem Wellega zones. The highest amount coffee seedlings, amounting to a total of 3,043,000 were multiplied from the Sidama and Yirgacheffe specialty coffees at three research centers (Awada, Wondo Genet and Wenago) and seven government nursery sites. From these, 150,000 seedlings were dispatched to coffee farmers in Wondo Genet, Dale and Wenago weredas.

Coffee nurseries of the respective agricultural bureaus were selected and used to accomplish the targets in collaborations. Therefore, seven nursery sites were selected and used to multiply the Sidama/Yirgacheffe specialty coffee varieties. Similarly, the Harar specialty coffee seedlings were exclusively multiplied using the nursery sites at Mechara, Gelemsao, Boke and Mesela Weredas in West Haraghe Zone. So far, a total of 78,180 Harar specialty coffee seedlings were distributed to 178 coffee farmers. In all cases, about 10 % of the total specialty coffee seedlings were distributed to model farmers, private investors and state coffee farms who were selected by the respective district agricultural bureaus, based on their merits, and hence were trained then after about the desired precautions in the course of planting and subsequent after planting care of the seedlings within each of the targeted four coffee areas (Table 3). In some cases, to solve the shortage of nursery sites and time constraint, coffee seeds were distributed to the selected farmers and private farmers. Hence, a total of about 518 kg of coffee seeds of the Wellega and Sidama/Yirgacheffe varieties were supplied to model farmers and private investors identified by each wereda and are fully willing to do the work. On the other hand, about 90 % of the total seedlings are at nursery sites and were said to be ready for field transplanting in June 2011. These include seedlings from the Sidama and Yirgacheffe, Wellega and Harar coffee varieties.

**Table 3.** Stakeholders trained and distribution of specialty coffee seedlings (2009/2010-2010/2011)

Specialty coffee	Coffee farmers	Private investors	Development agents	Administrators	Total	Distributed 2009/10	Distributed 2010/11
Limu	644	2	107	35	788	761,194	0
Wellega	282	3	108	24	417	121,992	262,062
Harar	105	0	23	40	168	78,180	474,931
Sidama/Yirgacheffe	196	0	31	32	259	150,000	2,431,057
<b>Total</b>	<b>1,227</b>	<b>5</b>	<b>269</b>	<b>131</b>	<b>1,632</b>	<b>350,172</b>	<b>3,168,050</b>

**Table 4:** Coffee seed orchards established at research centers and adaptive sites

Specialty coffee	On-station	Adaptive site	Total
Limmu	3	5	8
Wellega	2	4	6
Hararghe	1	1	2
Sidama/Yirgacheffe	2	2	4
<b>Total</b>	<b>8</b>	<b>12</b>	<b>20</b>

**Table 5.** Amount of coffee seeds produced and distributed to the respective zonal agricultural bureaus and coffee research centers in the year 2010/2011

Coffee	No. of varieties	Qty of coffee seeds produced (kg)	Research center (10%)	Zone Agric. Office (90%)
Limmu	8	256	26	230
Wellega	5	88	9	79
Hararghe	6	286	0	286
Sidama/Yirgacheffe	8	898	90	808
<b>Total</b>	<b>27</b>	<b>1,528</b>	<b>125</b>	<b>1,403</b>

In the mean time, to backup the coffee seed orchards established by the smallholders, private investors and state coffee farms, a total of 20 coffee seed orchards were also established at the previous adaptive research sites to be managed by the respective research centers found nearby (Table 4). For instance, a total of 16,546 Limu specialty coffee seedlings were used to establish coffee seed orchards at the three reserach centers and four adaptive sites (Somodo, Haro, Yachi, Shegole and Babu). Subsequently, works had been started to establish a data base of the coffee fields occupied by each coffee variety, so as to lay the foundation for future follow ups and to make them potential sources of improved coffee seeds in the respective localities. However, this still demands proactive and strong collaborations between the stakeholders to act according to the signed memorandum of understanding, so as to realize the targeted objectives of identifying and

establishing coffee seed producers group, as well as to provide contionous technical support, undertake monitoring and evaluations on the performances of the seed orchards established at each locality. This in turn can facilitate certification schemes and ensure sustainable production and supply of high quality coffee seed standards that would generate premium prices to the producer. Similar to the specialty coffee work, this also requires strong collaborations among the actors at all levels (farmers, peasant administration, development agents, wereda and zonal experts and administrators). Moreover, in 2010/2011 a total of 1,512 kg coffee seeds were produced from the selected 27 coffee varieties and 90 % of these were shared to the respective agricultural zones (Table 5). Each zone is responsible to identify and distribute the coffee seeds to the potential districts to raise coffee seedlings and establish coffee stands. The remaining proportion was multiplied at the respective

research centers, specifically for refilling and establishment of additional coffee seed orchards at the respective coffee growing areas in the country.

### Conclusions and future directions

In Ethiopia, the little attempt made by the national coffee research centers could not satisfy the ever increasing demand for improved coffee seeds, largely due to its limited area of land holding, insufficient irrigation schemes, and ineffective seed quality monitoring and seed storage facilities. Unlike the case of other crops, there is no public and/or private coffee seed sector that is responsible to produce the required amount of coffee seeds and their supply to users, to enable cultivation of reliable coffee varieties at each locality. Besides, there is no a national coffee seed standard and certification scheme, requiring urgent actions at the various levels of the federal and regional institutes. The problems associated with lack of basic information on seed purity, viability (percent germination), vigor, and other aspects also deserve high priority to ensure production and supply of good quality coffee seeds from recommended coffee varieties that are adaptable to specific agro-ecological zones of the country. In addition, there should also be a capacity building programs for stakeholders involved in the coffee seed value-chain. This is because, production and supplying traceable coffee seeds and planting materials in perennial plants like coffee, and it is a long-term investment that requires strong collaborations among the national and international coffee actors.

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