



Farmers' Performance on Hybrid and Pure Line Coffee Varieties in Jimma Zone, Southwestern Ethiopia

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ABSTRACT

Even though farmers have a very huge indigenous knowledge on coffee variety selection, but most of them do not know about their incentives and constraints that govern decisions concerning about attributes that affect their interest to opt for the technology because assessment on their felt need about coffee varietal attributes was not widely used by research, that can lead to satisfy their economic and non-economic/cultural concerns. In view of this, the present study was conducted with the objective of executing "to analyze the response of farmers about the performance of the released hybrid coffee varieties and pure line coffee selections in three Districts of Jimma Zone" using the methodology of purposive selection by administering semi Structured household level questionnaires on 45 HHH farmers in three Districts of Jimma zone: Goma, Mana and Seka-chekorsa, to obtain information on their performance, production and quality constraints, farmers in the surrounding have an area coverage of land for hybrid and pure line 0.39 and 0.72 hectare for an average family size of 7.04 per house hold head respectively, 89% uses an intercrop planting pattern at the beginning of establishment for both. FYM application for hybrid coffee reaches to the maximum of 5.8t/ha leads the variety to give an average of 5.68q/ha of clean coffee which is equal to the national average (6q/ha) and having 37% yield advantage than the pure line (3.55q/ha) of that specific District. Accordingly, 91%, 87% and 90% of the respondent replied growth nature of hybrid is faster, open canopy and early maturing, while 46.7, 26.7 and 26.6 percent replied phenotypic quality of hybrid coffee has better performance than pure line by its fruit size, weight, and color respectively and 87% replied production pattern of hybrid coffee become increasing for the last five years. 89% utilizes cultural raised bed for drying process for both varieties to maintain the quality. With having market accessibility and information by far better in 53.3%, 4.4% and 42.3% at farm gate, two kilometer village glut, five to fifteen kilometer and 37.8, 33.3, 20, 6.7 2.2% of market information from radio, coffee traders, DA's, TV and mobile phone to sale their products, respectively. Despite hybrid coffee management is tedious, needs more labor, sterility nature of the seed and no price discrimination, all the respondent (100%) income increased and their life style were changed after they plant hybrid coffee variety and resulted farmers in the survey (study) area prefer hybrid coffee variety than pure line selections.

Keywords: Preference, Phenotypic Quality, Maturity, Intercropping, Shade, Yield, FYM, Performance, House Hold Head

1. INTRODUCTION

Coffee (*Coffea arabica* L.) is a non-alcoholic stimulant beverage crop that belongs to the family Rubiaceae and genus coffea, *Coffea arabica* ($2n = 4x = 44$). It is the only species naturally growing in Ethiopia (Anthony *et al.* 2001; Yigzaw, 2005). Accounting for 80 per cent of the world coffee market and 70 per cent of production, the crop is cultivated in most parts of the tropics (Taddese *et al.*, 1998). According to Anthony *et al.* (2001) Ethiopia is the important source of genetic resources for the world coffee industry and it is the only center of origin and diversity for Arabica coffee. With total area coverage of 600,000 hectares, 44 percent of domestic

consumption and 35 percent of the total export earnings, it is also the defining feature for the National culture and the major source of foreign currency for Ethiopia (Anthony *et al*, 2001; Mayne *et al* ., 2002; Alemayehu *et al.*, 2008; FAO/WFP, 2008).

Apart from this opportunity, however, Ethiopian coffee genetic resource is under threat nowadays, mostly due to deforestation of its natural habitat for timber and food crop production, establishment and expansion of modern plantation and illegal and legal settlements (Bayetta, 2001; Wolde Mariam *et al.*, 2002). Likewise, coffee growers in the country are confronted with production constraints such as lack of improved pure line and hybrid varieties, and inability to exactly identify farmers' responses that satisfy their de facto concerns and thereby failure to harmonize their felt needs of *varietal* attributes towards satisfying their economic and non-economic concerns.

There is a profound relationship among farmers' concerns; their working environment and *varietal* preference which require matching variety attributes with farmers' concerns among the available choice set and use decisions. The survival of a variety is contingent on its capacity to supply the variety attributes which receive more weight by the farm household. Likewise, the choice set of farmers indicated that some farmers give most priority to yield, others to yield stability and still others to marketability (Edilegnaw, 2003).

Even though farmers' involvement in selecting genotypes is very crucial for effective and wide adoption of varieties, lack of identifying their *varietal* preferences and how they rank their concerns in trade-off against *varietal* attributes is the day's critical researchable gap in developing countries (Bellon, 1996).

Having these points in mind, this paper examines farmers' preferences for coffee varieties; and identify their response on yield, quality, price, growth nature, tolerance to disease, weed infestation, and other farmers' intentions in the study areas towards incorporation of their felt needs and preferences in future breeding program.

2. Research Methodology

2.1. Description of the study area

Gomma District

It is located 397 km Southwest of Addis Ababa and about 50 km west of Jimma town (ORG, 2003). Its area is 1,230.2 km² (ARDO, 2008). The annual rainfall varies between 800- 2000 mm, while the mean minimum and maximum annual temperatures vary between 7°C-12°C and 25°C-30°C, respectively (ARDO, 2008). Based on 15 years weather data obtained from Gomma District, the average annual rainfall is 1524 mm. Altitudinal range is between 1387-2870 m. a.s.l (IPMS, 2007). Its soil types are Eutric Vertisols, Humic Alfisols and Humic Nitosols. Nitosols are the most abundant covering about 90% of the District, which is dark reddish brown in color, slightly acidic and suitable for coffee production (IPMS, 2007). Agro-ecologically, divided into 8% high land (Dega), 88 %, intermediate high land (Weyina Dega) and 4% low land (Kolla) (IPMS, 2007).

Manna District

Located at 20 km west of Jimma town. Having the total area of 478.98 km² (47,898 ha) of which 12% is highland, 65% intermediate highland and 23% lowland with altitudinal ranges between 1470–2610 m. a.s.l. The mean minimum and maximum temperatures are 13.00C and 24.80C, respectively (ARDO, 2008). Based on long term (15 years) weather data obtained from the nearby JARC meteorological station, the average annual rainfall is 1523 mm. Distric Nitosols

and Orthic Acrisols are the dominant soil types with slightly acidic PH, which is suitable for coffee production found in this District (ORG, 2003).

Seka Chekorsa

Altitude ranges 1580 to 2560 meters above sea level; perennial rivers include the Abono, Anja, Gulufa and Meti. A survey of the land in this District showed that 45.3% is arable or cultivable (44.9% was under annual crops), 6.1% pasture, 25.8% forest, and the remaining 22.8% is considered swampy, degraded or otherwise unusable. Coffee is an important cash crop for this District; over 50 square kilometers are planted with this crop.

2.2. Method of data Collection

A diagnostic survey were carried out in respective locations in January 2012. During this period, informal discussion was held with farmers, frontline extension personnel, subject matter specialists and governmental offices to obtain prior-informed consents, and identify villages that can take part in the diagnostic surveys. For this purpose, semi-structured and open ended questioners were conducted to evaluate the current and potential status of improved coffee varieties i.e. hybrid and pure-line.

The diagnostic survey was conducted in 6 PAs in late January by involving different development agents, key informants from research center, farmers, and different stake holders. Secondary data were collected from sources such as: research papers, personal contact, websites and journals. To check the relevance of the choices, questions about local conditions, farmers' expectations, and level of understanding, the questionnaires were pre-tested on a focus group of 18 farmers (3 from each kebeles). The pre-test results were discussed with the enumerators and necessary changes were made accordingly. The interview schedules were administered by trained development agents and pre-testing was duly made to rectify if questions were fit to collect the intended information. Then data explored from the informal surveys were triangulated with formal ones to capture insights of why actors are doing what they formulate. Data on performance or cultural practices, demographic issues and trend of production, price, cost, and yield were collected through semi structured interview schedule, key informant, and FGD to satisfy pre-determined objectives

2.3. Farmers' Sampling for quantitative study

The overall study was relied on a multi-stage mixed sampling technique. In the first stage sampling Jimma Zone was purposively selected for proximity and its geographic nature, since Jimma Zone was the first ever area where hybrid coffee was dispatched and popularized in the Nation (Girma *et al.*, 2008). Similarly, at the second stage three Districts namely: Goma, Mana and Seka-chekorsa were selected with the same technique above i.e., purposive selection. This was because, these Districts were the only locations where both pure-line and hybrid coffee were planted in the Zone. Finally, on the third stage, a total of six Kebeles were selected from these Districts with the same techniques.

Then based on secondary data (sampling frames) collected from JARC and respective Kebele administrations, a total of 45 farmers (20, 14 and 11 from Mana, Seka-Chekorsa and Goma District respectively) were purposively selected. The number was limited as because only of these much numbers of farmers who participated in scheme during the first batch hybrid coffee dispatching/1998. Thus all selected farmers do own both pure line selections and hybrid coffee varieties, and hence all these farmers were involve in the study (Table, 1).

2.4. Focus Group Discussions and Key Informants

In order to capture the socio-economic context of the households, three focus group discussions were held with knowledgeable people (elders, youth, and women farmers and responsible persons from different institutions),

based on pre-determined checklists. i.e. collection of pertinent data until attainments of theoretical saturation (Haggblade and Gamser 1994; Heisman, 1995). The data from these discussions were triangulated with the quantitative ones.

2.5. Method of data analysis

Descriptive statistics (frequency, percentage, modal group) were used to analyze data for the study. A statistically significant association for analysis was tested at 0.1 probability level. Before analysis, initially the raw data were re coded and entered into computer software program called SPSS (SPSS version 17); and Microsoft Excel 2007 database system to make pertinent mathematical computations and inferences, accordingly. Data collected from FGD and key informant disclosures were transcribed through Microsoft excel 2007 to compute common themes.

2.6. Descriptive analysis

Descriptive statistics (mean, percentage modal group) have been employed to analyze the preference and response of farmers in the performance of hybrid coffee Variety.

Table.1. Sample distribution of the respondent

Hybrid coffee variety and Pure selections producers	Mana District		Goma District		Seka-Chekorsa District		Total
	Doyobikila KA	Haro KA	Bulbulo KA	Kesoiti KA	Kofe KA	Kechema KA	
	6	14	3	8	7	7	45

Source: District agricultural office, Kebele administrative, October 2019

Table 2. Demographic characteristics and access to services of farmers in three

Indicator	Mana (N=20)		Goma (N=11)		Seka-Chokorsa (N=14)		Total		f value
	Mean	STD	Mean	STD	Mean	STD	Mean	STD	
Demographic factors									
Age of HH	50.35	5.92	43.46	3.45	50.35	4.18	48.05	4.52	0.044**
Family size	6.4	5.92	6.36	3.32	8.36	4.18	7.04	4.47	0.049**
Education	6.3	5.89	5.2	2.83	4.80	3.93	5.43	4.23	0.034**
Experience in farming									
Pure line	15.8	6.38	15.36	3.32	20.93	4.18	17.36	4.61	0.051*
Hybrid	5.45	5.92	5.64	3.32	5.43	4.18	5.51	4.47	0.019**

3. Result and Discussion

3.1. Demographic characteristics

The statistical test for homogeneity (F-test), which was run to compare means of continuous variable among Districts designated a significant difference of 5 percent probability level on experience of farming, family size, extension service and marketing to total hybrid coffee yield. Likewise a significant difference of 10 percent probability level was reported for area coverage with total hybrid coffee yield. The overall outcome indicated households have accessed the resources and brought positive effect on coffee production and due to having the total literacy rate of 97.8 percent, the result depicted (with the mean of 4.33 having) better educational

entitlement in the study areas. This outcome is by far more than two times than the National Average i.e. 35.5 (Ethiopian Media, 2012) with an implication to augmenting volume of improved coffee production in the study areas, having positive and highly significant value at five percent significance level, regarding larger family size (7.04) has positively affected the supply of coffee production with significance level of 5 percent probability level and thereby the impact for better participation in markets. Thus household heads with large family size have performed well in both hybrid and pure line coffee production albeit large labor requirement (Table.2), farm experience of 7 to 18 years is witnessed by 71 percent of pure line coffee producers having positive and significant value at ten percent significant level but for that of hybrids it was limited to only six years for almost all respondents (98percent) having positive and significant value at five percent significant level on those three Districts ,this result indicated that those farmers with best experience (6 to 18 years) were better familiarized and they were thereby competent to evaluate and rationally explain the performance of different improved coffee varieties than younger farmers with very few years farming experience (Table 2)

***Significant at 1 percent ** Significant at 5 percent * Significant at 10 percent,

On the other way of observations almost all (98%) of the respondents were male while 91.2% were 15-65 years old that include the productive mid (30-64) age in the study area. Furthermore, 2.2 percent of respondents had no formal education (illiterate), It means that having of different forms of formal education attained by respondents will assist in management of *Coffea Arabica* farms, while 95.6 percent of the respondents have a family size of 6-8 persons and all the respondent (100%) are married and engaged more in coffee field maintenance. The modal category of the respondents' farming experience in coffee was 1-6 years for hybrid and 13-18 years for pure line indicating that most respondents had long years of growing *Coffea Arabica* which might likely assist in better handling of the crop (Table 3).

Table 3: Modal group of Socio-economic characteristics of respondents

Characteristics	Frequency	Percentage	Modal Group
Sex			
Male	44	98	Male
	01	2	
Female			
HH age			
<15	0	0	
15 to 65	41	91.2	15 to 65
>65	4	8.8	
Marital status			
Married	45	100	Married
	0	0	
Single			
Education			
Illiterate	1	2.2	
Read and write	12	26.7	
1 up	15	33.3	1 to 6

to 6			
7 up to 8	14	31.1	
>12	3	6.7	
Family size			
6-8	43	95.6	6 to 8
>8	2	4.4	
Farm experience			
For hybrid coffee variety			
1-6	44	98	1 to 6
7-12	1	2	
13-18	0	0	
pure line coffee selections			
1-6	1	2	
7-12	4	8.8	
13-18	28	62.2	13 to 18
19-30	12	27	

The result also showed a dependency ratio of 0.89 as a way of life in the study area; which is above to National average i.e. 0.81 (World Bank, 2010). The result indicated that, out of 100 working persons, 89 were found to be economically inactive in the study area (Table 4); implying that most of them unable to support income generation in nationwide. Thus family labor endowments have negatively affected participation in the coffee production, given labor-intensive nature during coffee peak time.

Table 4: Average household size and dependency ratio

District	Non-working members	Working members	Dependency ratio(mean)
Mana	60	68	0.88
Goma	30	34	0.88
Seka-chekorsa	56	61	0.92
Total	146	163	0.89

3.2. Managements and physiological factors

According to the result showed average land holding for hybrid coffee variety and pure line coffee selection is 0.39 and 0.72 hectare respectively. Less land allocations for hybrid coffee production is because the limited amount of planting material required from Jimma Agricultural Research Center (personal contact from JARC)

and that of pure line selections was principally based on the capacity of the household head which assisted for better participation in coffee production and their will to support diversification of coffee idol in South-western Ethiopia. Having the planting pattern 89% of farmers intercrop annual crops into their coffee rows like Soya beans (41.8%); Phaseolus beans (32.7) while the coffee is still young canopy allows enough light between raw other crops such as avocado and banana are also commonly intercropped and a weeding activities on both hybrid and pure line coffee producers have been using cultural methods to control ... weeds, while none of them were applying herbicides. Those cultural methods under use include: digging with forked hoes (30%), frequent slashing/four times in a year (60%) and use of mulch (10%). Regarding FYM, almost all farmers in the study area don't have knowledge about the recommended fertilizers application rate for both organic and inorganic fertilizers. The respondents have portrayed that, they have been applying inorganic fertilizers before years i.e., during the first phase of CIP which is 30 years back and during the first dispatch of the hybrid coffees by JARC which is 7 years back. The respondents have also depicted that, their rate of FYM application was too low for both the hybrids and pure line. Conversely the application rate was a slightly more up to (5.75, 5.67, 4.47t/ha at Mana, Goma and seka respectively) for hybrids than pure lines which is better application than the current countries application system but amount of FYM applied for pure line at seka is even lower than the current application of our country (Fig.2).

The study result also shows Wanza (*Cordial africana*), Birbira (*Milletia ferrugenia.*), Grawa (*Vernonia spp.*) are identified as conventional coffee shade trees in the study area. Because these shade trees are economically insignificant and too important so that largely experienced by the farming household in the District because 55.6 percent of the respondent uses moderate shade intensity (30-60percent) popular for both coffee farming. The opportunity assisted better for 37percent yield advantage on hybrid than pure lines (Table:6). The rest (30% and 14.4%) of the respondent use light and heavy shade like avocado which were crucial to bring additional revenue and as they are doing well in sub-optimal conditions i.e., good yield with low management due shade tree. Congruently those farmers in the study area have their own shade tree choice and gave priorities based on its manageable height, weed suppression as well as having moderate light intensity (Table 5). Also 98 ,58 and 87 percent of the respondents, disclosed that hybrid coffee needs more space (because of its spreading growth habit), posses a flexible stem nature and were capable to bear crops earlier at least by one year than pure line as fly crop. Similarly its flowers bloom prior than pure lines every year which makes the desire of framers higher to acquire the material than pure-lines at younger stage, respectively.

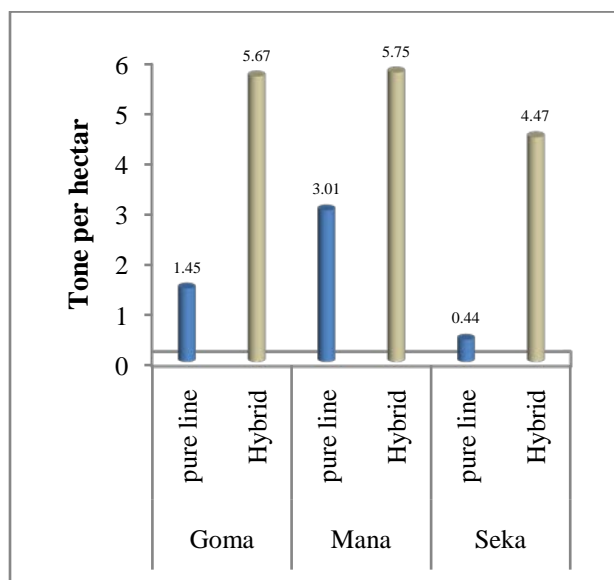


Fig.3. Last five-year farmyard manure used (tone per hectare)

Name of the shade tree			Rank
Amharic	Scientific	Oromiffa	
Sesa	<i>Albizia schimperiana</i>	Ambebesa, Muka-arba, Sesa, Vungo,	1 st
	<i>A. gummifera</i>	Gorbe	
Birbira	<i>Milletia ferruginea</i>	Sotellu, Ingidicha, Asra	2 nd
Wanza	<i>Cordia Africana</i>		3 rd
Grawa	<i>Vernonia amygdalina</i>	Aebicha	4 th
Avocado	<i>Persea Americana</i>	Abokado	5 th
Enset, koba	<i>Enset ventricosum</i>	Worke, Wese, Koba	6 th

Table 5. List of significant coffee shade trees intercropped with coffee in the study areas

3.3. Production, and Productivity

Result showed that, even though the yield of hybrid coffee on those three Districts by far lower than the expected amount (18q/ha on farmers condition), 99% of farmers replied the productivity of hybrid coffee varieties was increasing in the last five years due to spreading canopy nature to suppress weed and increasing number of branches per tree and it gave an average amount of 5.67 q/ha clean coffee under farmers condition having 37% yield advantage than the pure line coffee selections of that specific area, which is almost equal to the national average 5-6q/ha (Table 6)

Table 6. Yield advantage of hybrids over pure online in three Districts

*as reported by JARC (2008)

Variety	Mana
Hybrid	8.05
Pure line	4.61
Yield advantage	42.73
National yield advantage	

3.4. Harvesting and bean physical appearance of hybrid coffee

Survey result indicated that 46.7, 26.7 and 26.6 percent of the respondent replied hybrid coffee has better performance than pure line in respect of its fruit size, weight, and color (Fig 3), and in response to its early maturing nature, about 90 percent of hybrid coffee cherries ripe earlier than pure lines. In concent to this line, 99 percent of the producers conduct harvesting by selective peaking at main harvesting time (october to the begning of december but may flactute due to the avaiability of eratic rain fall) based on its maturity index (from yellow to slightly red color). Thus harvesting usually commences imediately when the cherries showed red color. And 89 percent of the respondent utilized raised bed for drying coffee which in turn assisted

for maintaining the quality of both hybrid and pure line coffee after harvesting, due this practice 84% of the respondent reported that there is no quality problem on their both coffee varieties. On the contrary the preference of some farmers' for hybrid than that of the pure line coffee is becoming critically lower due the F1 did not pass to the next generation and it requires large labor for management than that of pure line and therefore influenced not only the decision to adopt but also the level of the adoption too, because 68% of the respondent used both family and hired labor as the principal source and followed by family labor for hybrid, which accounted for about 32 percent of labor allotment for pure line coffee production only.

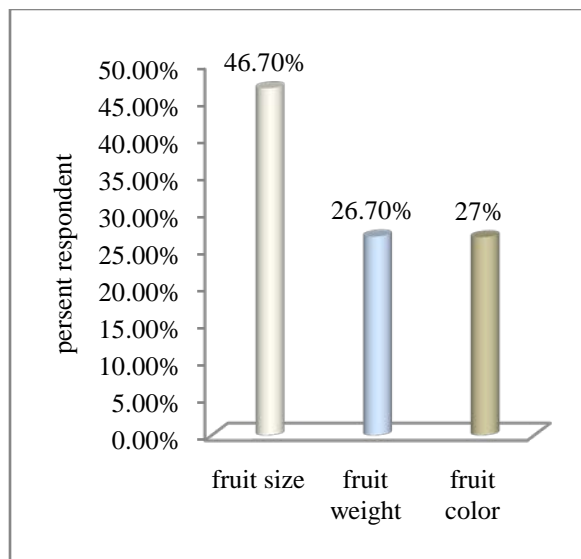
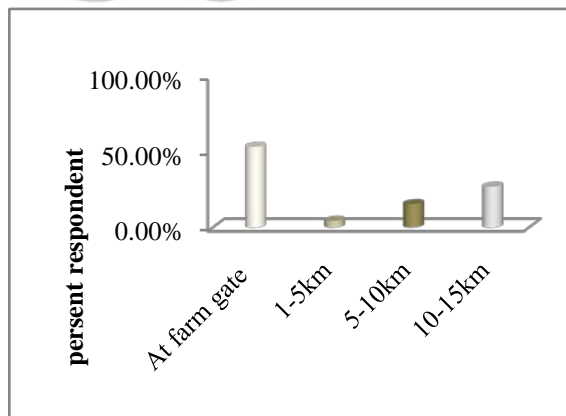


Fig 3. Farmers' response on Quality of hybrid coffee as compared to pure line

3.5. Accessibility to market and market information

The study revealed that the infrastructure in Jimma Zone is generally satisfactory and it is comparatively close to contiguous coffee markets. These in turn assisted farmers to cut off their transport cost augment their market supplies and increase coffee production in the study area. This becomes true that some farmers explained the road is conducive to sell large proportion of coffee at farm gate (53.3 percent) followed by vending at two kilometer village market (4.4 percent). on the other hand rest 42.3 percent of the product was sold at a distance of five to fifteen kilometer with having market information from radio, coffee traders, DA's, TV and mobile by 37.8, 33.3, 20, 6.7 and 2.2 percent respectively for both hybrid and pure lines. So that the overall research result highlighted closer markets and up-to-date information have assisted farmers to plant coffee by in large amount since they are not much forced to transport their produce to distant markets third party information where they sell at loss or extra cost(Fig4&5).



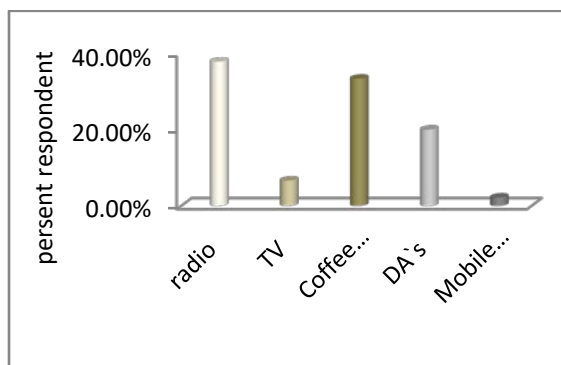


Fig.4&5. Distance and accessibility to market to sale coffee Source of market information

3 Conclusion

Variety development through hybridization has resulted in the release of three hybrid varieties namely Aba-buna for low altitude, Melko-CH2 and Gawe for mid altitude, which can produce 15 to 24 quintals per hectare clean coffee under optimum condition. This can provide an advantage of 18-41 percent yield increase over the pure line selections (Bertrand *et al.*, 2019).

According to this study on the performance of these varieties farmers with best experience (6 to 18 years) were better familiarized and they were thereby competent to evaluate and rationally explain the performance of different improved coffee varieties than the younger's having an average land for hybrid coffee variety and pure line coffee selection is 0.39 and 0.72 hectare respectively which is by far less than the national average for coffee. Accordingly 89% of the respondent incorporated annual crops on both coffee rows at younger stage and their FYM application rate was a slightly more up to (5.75, 5.67, 4.47t/ha at Mana, Goma & seka respectively) for hybrids than pure lines (except in seka District) it was better application than the current countries recommendation, 5.5t/ha. Type and intensity of shade trees Wanza (*Cordia africana*), Birbira (*Milletia ferruginea*), Grawa (*Vernonia spp.*) are identified as conventional coffee shade tree in the study area having 55.6 % of the respondent use moderate of shade intensity(30-60%) popular for both coffee farming. The opportunity assisted for better yield (37%) advantage on hybrid than pure line coffee that were resistant to CBD(*Colletotrichum coffeae*) and Rust(*Hemelia vastatrix*), while the hybrid one were totally susceptible for Ascochyta disease (*Ascochyta blight*). While 98, 58 and 87 percent of the respondents disclosed that hybrid coffee needs more space (because of its spreading growth habit), possess a flexible stem nature and bear crops earlier at least by one year than pure line at younger stage, respectively and yield of those hybrid coffee on those three Districts by far lower than the expected amount, 18q/ha on farmers condition, Behailu *et al.*, 2008. But it gave an average amount of 5.67 q/ha under farmers condition having 37% yield advantage than the pure line coffee selections of that specific area, which is almost equal to the national average 5-6q/ha so that 99% the farmers replied the productivity of hybrid coffee varieties was increasing in the last five years due to spreading canopy nature to suppress weed and increasing number of branches per tree with better phenotypic quality such as fruit size, weight and color by percentage of 46.7, 26.7 and 26.6 than the pure line respectively.

The overall performance indicates: both varieties were highly scored for disease tolerance. Other criteria that were high scored were high yield, growth nature and weed control. Hybrids were scored excellent in high yield, fast growth nature, disease tolerance and no binalism nature with the exceptional phenotypic quality. The least preferred criterion was easy marketability, shade intensity and type. Based on the above mentioned criteria used hybrid were preferred well by the farmers compared to the pure lines. Even though about 87 percent of the farmers have indicated the price trend of coffee kept on dwindling across time due to world market price fluctuation, while 89 percent of the respondents replied there is no price discrimination for both type of coffee at all, with intermingling these aforementioned prices condition some farmers for hybrid that of the pure line coffee is becoming critically lower due the F1 did not pass to the next generation and it requires large labor for management than that of pure line and therefore influenced not only the decision to adopt but also the level of adoption. But having this condition, finally coffee farmers income, life style and money saving trends of almost all farmers (92 percent) has been improved and therefore built their capacity to send their children to school due to the increment of total production per house hold.

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