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Evaluation of farmers' knowledge on the rare Abyssinian pea (*Pisum sativum* var. *abyssinicum*) landraces of Ethiopia

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Abstract. *G*ebreegziabher *BG, Tsegay BA. 2018. Evaluation of farmers' knowledge on the rare Abyssinian pea (*Pisum sativum *var.* abyssinicum*) landraces of Ethiopia. Biodiversitas 19: 1851-1865.* Abyssinian pea (*Pisum sativum var. abyssinicum* A. Braun) is a rare and problematic taxon requiring evaluation of present farmers' local knowledge. Cross-sectional data were collected from 444 respondents and analyzed using SPSS software. Descriptive statistics was used; one way ANOVA for significance test of variance and Exhaustive CHAID growth method for predictions. Prediction results showed that the crop requires about two good rains, Nitisol soils and about 21-30 kg ha^{-1}seeding rate. The flowering to maturity time ranges 1½ to 2½ months depending on the agroecology (highland or lowland), with a yield of about 300-400 kg ha^{-1}on average. The crop distribution is currently limited to three to four districts and sown after other crops are harvested. Major factors hindering its distribution are agro-ecological suitability, lack of intervention and preference of high yielding pea varieties. The crops' inferiority in yield and pest susceptibility is the main reason for less extensive awareness on the crop. Though inferior in yield and susceptible to pest, farmers still prefer to grow the crop because of its marketability for local exchange and consumption. The core production problems currently remarked by farmers are expensive price of the seed to buy and small land holding.

Keywords: Agronomic descriptors, indigenous knowledge, seeding rate, soil type, yield

INTRODUCTION

Abyssinian pea **(***Pisum sativum* var. *abyssinicum* A.Braun), is one among the pulse field crops grown in Ethiopia (CBD 2009). Local farmers have a great belief to express the crop's special taste, marketability, and earliness (Personal communication). Researchers are critically studying it and yet not fully attain factors and genes responsible for the delightful taste, the early flowering and maturity of the crop (Yemane and Skjelvåg 2003; Weeden 2007; Weller et al. 2012; Smýkal et al. 2015; Rubenach et al. 2017). Farmers in Ethiopia appreciate it in different ways; "urban stew", "stew for recipient of hospitality" and "chicken stew of the poor" for its delightful taste. On the other way, it is named as "seed of the well-off", for its marketability and unavailability for the poor. Regarding to its earliness, Abyssinian pea is named as "fetnoderash" (early maturing) referring to its short life cycle. As the studies made so far about the crop are slighter, there is lack of local yield gap estimation method developed to maximize the Abyssinian pea yields (Ittersuma et al. 2013).This is a major problem, particularly to the undeveloped countries like Ethiopia facing challenges to achieve potential yield (Affholder et al. 2013), especially when viewed in the global climate change scenario.

As the crop is less known outside of the tropical and subtropical belts of Africa (Mikić and Mihailović 2014), it is becoming herbarium specimen. It is a germplasm accession included in the 6096 pulse accessions of Ethiopia (CBD 2009). This requires evaluation of the stakeholders' indigenous knowledge so as to re-establish the prospect of food legumes together with the ecological insight to the agricultural system (Tomich et al. 2011). Besides, loss of diversity in farmers' field crops is decreasing and lacks the expected evidences of the threats in the available literatures (FAO 2010). Moreover, a study from Mikić et al. (2013) indicated the narrow distribution of Abyssinian pea that brought a narrow genetic variation with long inherent partial or complete tolerance adaptions for biotic and abiotic stresses particularly of salt (Tsegay and Gebreslassie 2014). Therefore, the aim of the study was mainly to evaluate farmers' knowledge on current trend, agronomic practices and production of the crop so as to lay basis for forthcoming studies on intensification. We believe that this would help in addressing issues of sustainable growth of the crop and obtaining optimum yield in order to tackle the challenges of population growth, food security, and climate change and resource conservation.

MATERIALS AND METHODS

Description of the study areas

The study was conducted in Northeast Ethiopia in Amhara and Tigray regions (Figure 1). It was piloted in six districts that proportionated into three districts per region based on agro-ecology. Each district was well-adjusted into three kebeles (small administrative units of a district existing in Table 2) which represent different agro-ecology. The districts have different geographical and climatic features (Table 1).

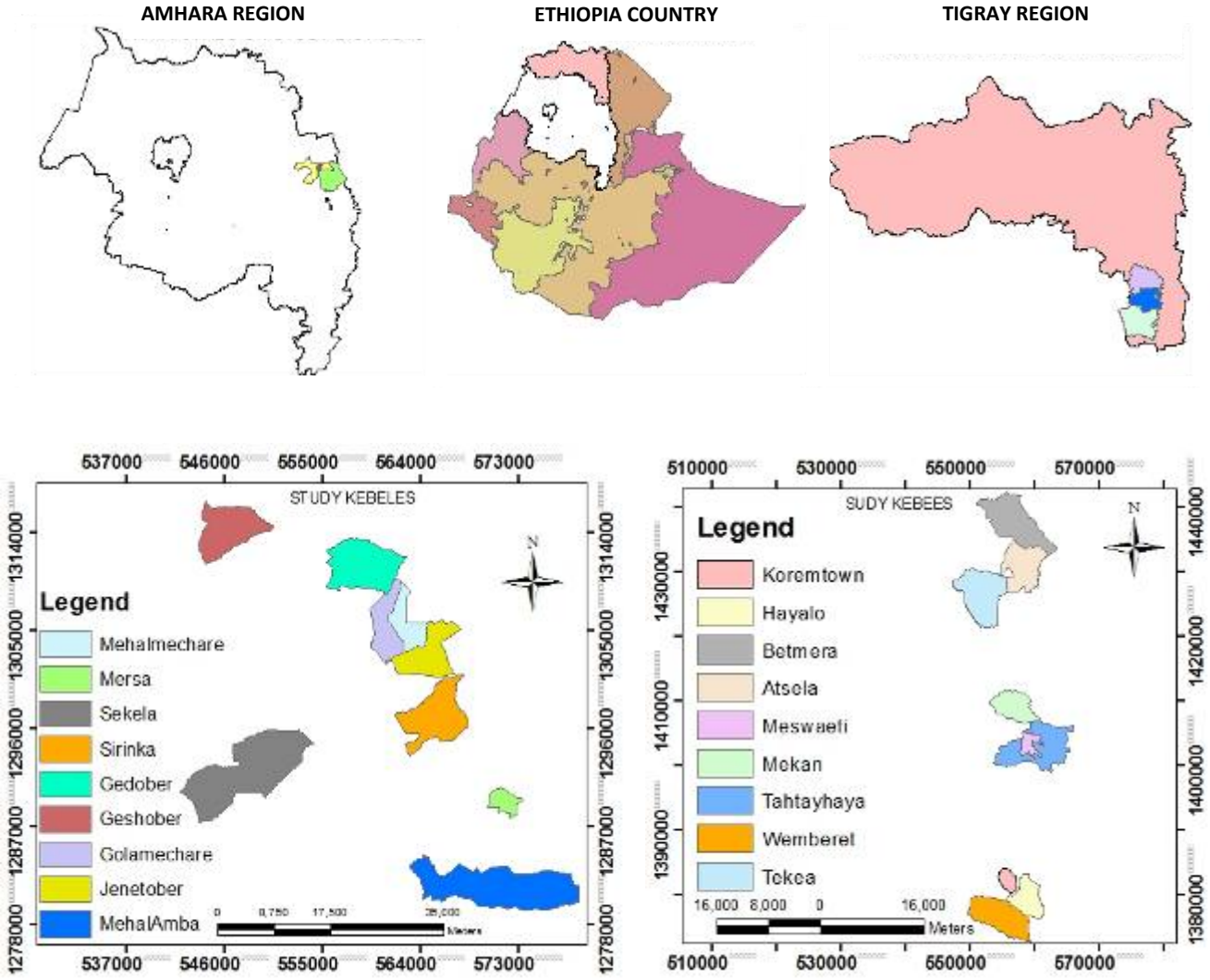

Figure 1. Map of Ethiopia showing location of the study areas within Amhara and Tigray regional states

Description of study areas

Gubalafto and Habru are situated in east plain possessing high potential agricultural value chain and beneficial from the varying topography with suitable climate and agro-ecology for crop production (Save the Children 2013). In Woldia, the study was conducted in kebeles within a radius of 10-15 km. Ofla and Amba-Alaje districts are mostly highland agro-ecological districts (Abrha and Simhadri 2015). They have normally sufficient rainfall and suitable temperatures for rainfed agriculture as indicated in Table 1.

Crop production areas in Ethiopia are shaped by the agro-ecological variability (Hurni 1998; Warner et al. 2015). The study districts from north Wollo are mainly characterized by production of stable crops such as sorghum, maize, teff, chickpea, and coffee and the districts from south Tigray (Table 1) produce stable crops namely wheat, barely, teff, chickpea and maize (Warner et al. 2015, personal observation). All regions produce Abyssinian pea though at different rates.

Table 1. Geographical and climatic features of the study areas

Sampling regions	Districts	Altitude (m asl.)	Mean annual rainfall (mm)	T (°C)
Amhara	Gubalafto	1379-3200	990-1030	21-25 (a)
	Woldia	2112-2218	600-820	10-20 (b)
	Habru	700-3500	300-876	21-32 (c, d)
Tigray	Ofla	2432-2450	350-1200	20-26 (e)
	Endamehoni	1600-3960	600-1000	9-18 (f)
	Amba-Alaje	2445-2480	580-845	14-22 (h)

Note: T^{O} (°C): temperature in degree Celsius, (a) Mengistie and Kidane (2016), (b) Svein and Adal (2002), (c) Damtew (2006), (d) Mekonnen et al. (2014), (e) Admasu et al. (2011), (f) Ebrahim et al. (2015), (g) Gebrewahd et al. (2017).

Data collection design

Cross-sectional data collection design was employed as this is better and more effective for obtaining information about the current status or the immediate past (Kahn 2000; Mengistie and Kidane 2016) of this icon crop (Abyssinian Pea). Personal interviews with oral verbal stimuli were presented and replied by way of oral verbal responses in the first steps of this study. This is in order to collect information that helps to understand the research topic better through information interchanged between the individuals. Pilot study tested questionnaires consisting of series of printed multiple choice questions, to be marked by the informants were distributed and collected. Observations (on residence, market and field) were ended for seed colors, pests and soil conservations (Figures 2 and 5), and focus group discussion with farmers who have the current growing experience of the crop for the last three years were used. Data were collected in 2017 using local language of informants that latter translated to English.

Sample size determination

Districts were selected purposely based on the current production potential of the crop and the climatic and geographic (altitudinal) differences of the districts (Table 1). Moreover, recommendations from agricultural and rural development experts were used.

A total of 6228 Abyssinian pea producer farmers of the six districts found from the pilot survey were proportioned into the representative kebeles using the formula of Yamane (1967). Additionally, a total of 82 agricultural experts with crop specializations from two Agricultural Research Centers (ARCs) were proportioned into their respective districts.

Table 2. Sex of respondents involved in study by districts and kebeles

Study regions	Districts	Kebeles	Male (N)	Female (N)	Total (N)
Amhara	Gubalafto	Sekela	12	10	22
		Geshober	14	8	22
		Gedober	18	4	22
	Woldia	Mehalmechare	13	9	22
		Jenetober	14	8	22
		Gola-mechare	17	5	22
	Habru	Sirinka	18	4	22
		Mersa	20	2	22
		Mehalamba	18	4	22
Tigray	Ofla	Korem-suburb	22	0	22
		Wenberet	15	7	22
		Hayalo	18	4	22
	Endamehoni	Meswati	20	2	22
		Tahtayhaya	18	4	22
		Mekan	20	2	22
	Amba-Alaje	Tekia	17	5	22
		Atsela	20	2	22
Both regions	ASARCs	Betmara	18	4	22
		Alamata-Sirinka	48	0	48
Total			356	88	444

Note: Kebeles (Singular Kebele) are small administrative units of Ethiopia, ASARCs: Alamata and Sirinka Agricultural Research Centers. N: number of respondents.

$$n = \frac{N}{1+N\,(e)^2}$$ (Yamane 1967)

Where, n: the number of required samples of respondents for the districts and ARCs (sample size); N: total farmers of the districts (population size) and Agricultural Experts; e: confidence level (0.05 (95%) level of precision. Accordingly, 396 farmers and 48 agricultural experts respectively with a total of 444 sample respondents were taken (Table 2).

Data analysis

Descriptive statistics, one way ANOVA, and Exhaustive CHAID growth method were used for socioeconomic data analysis, significance test of variance, and prediction of yield and yield related agronomic descriptors, respectively, based on agroecologies using SPSS v.20 computer software to evaluate farmers' knowledge on Abyssinian pea.

RESULTS AND DISCUSSION

Socioeconomic features of respondents

The impact of the different population sectors to the crop diversity, cultivation and production varies among the communal and agro-ecological areas. A great variation was observed on sex of respondents among districts and kebeles; in some of the areas, females take no part. This is particularly observed in Tigray region,Ofla district where 59 (13.3%) of the respondents were men and Korem-suburb kebele where 22 (100%) of them were men. Women living in Amhara region, Gubalfto and Woldia districts are equally concerned as men (Table 2). Therefore, the current study showed gender gap persistence in the crop diversity, cultivation and production knowledge similar to the case stated by Kahn et al. (2000) in the US states where women gaps remain in society's understand of the relation between income inequality, health and agriculture. Similar idea was stated by World Bank 2015 where hitherto women farmers are consistently found to be less productive than male farmers. The study is also consistent with the indication of Blau and Kahn (2000) declaring women as a group tend to work fewer weeks per year and hours per week than men. But this contradictes with the traditional property rights of gender-crop roles within rural societies (FAO 2012). Health wise, this contributes to the nutrition related diseases that affect pregnant and lactating women as stated by FAO (2015).

Most of the respondents were within the age groups of 44-56, 137 (30.8%) of the total participants followed by 31-43, 97 (22%). The knowledge about the crop is less in the potential young respondents (age group 18-30) though the crop is said worth marketable, provide job seeking for trading and income source for local exchange. The informant household family size was 4-5, 145 (32.7%) similar to average size of households by region of an atlas series of Ethiopia (CSA 2013). About 200 (45%) of them cannot read and write and about 64 (14.4%) have education below high school (Table 3). Hence, the production of the

crop is still through traditional means with little literacy and numeracy skills. This is alike the finding of Save the Children (2013).

Survey of indigenous knowledge on Abyssinian pea and factors affecting it

One way ANOVA between groups was used (Tables 4 and 6) to explore the knowledge of respondents based on districts of different agro-ecologies (Table 1) . The results of the one-way between groups analysis of variance with post-hoc tests, example for familiarity to the crop are presented as [F (2, 424): 2.2, p: .002]. Values are presented in percentages and leading questions are nominated as descriptors. Familiarity with the crop, duration, areas of distribution, and reasons for irregular occurrence and less knowledge about the crop and the likes were evaluated. There was a statistically significant difference (at the $p<0.05$) among districts and agro-ecologies for the descriptors [F (2, 424): 2.2, p: .002; F (2, 424): 1.8, p: .019; F (2, 424): 4.8, p: .000; F (2, 424): 2.4, p: . 001, F (2, 424): 1.8, p: .026; F (2, 424): 3.0, p: .000; F (2, 424): 3.4, p: .000; F (2, 424): 1.46, p: 0.054; and F (2,424): 2.7, P: 0.029], respectively.

Respondents from highland areas of both regions knew Abyssinian pea very well even their cultivation practice is not much as such as their familiarity. Possibly due to less cultivation practice in the agro-ecologies, there are some respondents who do not know the crop in the midland and lowland areas of Amhara and lowlands of Tigray regions, respectively. Descriptors for duration of knowledge about Abyssinian pea from the two regions are presented in Table 5. Most of the respondents knew the crop for the last thirty years ago actually even Abyssinian pea is a primitive landrace that displays traits usually associated with initial steps in the domestication process (Weeden 2007). It has domesticated some 4000-5000 years ago in the now Northern highlands of Ethiopia. Edwards et al. (2007) also describe Abyssinian pea as one among the crops with high genetic diversity in Ethiopia because of its origin. The crop cultivation practice has a long history in Tigray region study sites, where farmers had growing for the last thirteen years ago across all agro-ecological areas. This indicates that, familiarity is with the oldest age in Tigray region.

Table 3. Respondents' age group, family size, marital status, and educational background

Age group of respondents	Name of districts and Agricultural Institutes							
	Gubalafto	Habru	Ofla	Woldia	Endamehoni	Amba-alaje	ARARCs	Total
18-30	12 (2.7)	17 (3.8)	15 (3.4)	11 (2.5)	5 (1.1)	8 (1.8)	8 (1.8)	76 (17.1)
31-43	10 (2.3)	21 (4.7)	11 (2.5)	11 (2.5)	20 (4.5)	18 (4.1)	6 (1.4)	97 (22.0)
44-56	20 (4.5)	15 (3.4)	20 (4.5)	17 (3.8)	18 (4.1)	25 (5.6)	22 (4.9)	137 (30.8)
57-69	6 (3.6)	8 (1.8)	13 (2.9)	15 (3.4)	13 (2.9)	6 (1.4)	6 (1.4)	77 (17.3)
70 and >70	8 (1.8)	5 (1.1)	7 (1.6)	12 (2.7)	10 (2.3)	9 (2.0)	6 (1.4)	57 (12.8)
Total	66 *	66*	66*	66*	66*	66*	48**	444 (100)
Family size								
1	2 (0.5)	1 (0.2)	4 (0.9)	0 (0)	0 (0)	0 (0)	2 (0.5)	9 (2.0)
2-3	31 (6.9)	19 (4.3)	16 (3.6)	16 (3.6)	21 (4.7)	12 (2.7)	14 (3.2)	129 (29.0)
4-5	15 (3.4)	30 (6.7)	19 (4.3)	25 (5.6)	19 (4.3)	23 (5.2)	14 (3.2)	145 (32.7)
6-7	16 (3.6)	9 (2.0)	17 (3.8)	18 (4.1)	18 (4.1)	22 (4.9)	0 (0)	100 (22.5)
8-9	2 (0.5)	6 (1.4)	9 (2.0)	5 (1.1)	8 (1.8)	4 (0.9)	16 (3.6)	50 (11.3)
>9	0 (0)	1 (0.2)	1 (0.2)	2 (0.5)	1 (0.2)	4 (0.9)	0 (0)	11 (2.5)
Total	66*	66*	66*	66*	66*	66*	48**	444 (100)
Marital status								
Married	51 (11.4)	54 (12.2)	52 (11.7)	60 (13.5)	60 (13.5)	46 (10.4)	38 (8.6)	361 (81.3)
Single	6 (1.4)	3 (0.6)	4 (0.9)	3 (0.6)	4 (0.9)	18 (4.1)	8 (1.8)	46 (10.4)
Divorced	6 (1.4)	9 (2.0)	4 (0.9)	3 (0.6)	1 (0.2)	2 (0.5)	2 (0.5)	27 (6.1)
Widowed	3 (0.6)	0 (0)	4 (0.9)	0 (0)	1 (0.2)	0 (0)	0 (0)	8 (1.8)
Others	0 (0)	0 (0)	2 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.5)
Total	66*	66*	66*	66*	66*	66*	48**	444 (100)
Education background of the respondents								
Cannot read and write	32 (7.2)	33 (7.4)	25 (5.6)	35 (7.8)	43 (9.7)	32 (7.2)	0 (0)	200 (45.0)
Read and write (1-4)	12 (2.7)	10 (2.3)	11 (2.4)	15 (3.4)	1 (0.2)	15 (3.4)	0 (0)	64 (14.4)
Elementary School (5-8)	6 (1.4)	9 (2.0)	4 (0.9)	7 (1.6)	11 (2.4)	9 (2.0)	0 (0)	46 (10.3)
Secondary School (9-10)	2 (0.5)	1 (0.2)	6 (1.4)	2 (0.5)	0 (0)	1 (0.2)	0 (0)	12 (2.7)
Certificate and above	8 (1.8)	8 (1.8)	13 (2.9)	7 (1.6)	7 (1.6)	7 (1.6)	48 (10.8)	98 (22.1)
Religious and adult	6 (1.4)	5 (1.1)	7 (1.6)	0 (0)	2 (0.5)	2 (0.5)	0 (0)	22 (5.0)
Science and religious	0 (0)	0 (0)	(0)	(0)	2 (0.5)	0 (0)	0 (0)	2 (0.5)
Total	66*	66*	66*	66*	66*	66*	48**	444 (100)

Note: the values within parentheses are percentages. *Indicates the percentage (14.9%) of the total sixty six respondents per district. ** Indicates the percentage (10.8%) of the total forty eight agricultural experts from two ASARCs.

Table 4. ANOVA for knowledge about current distribution and reasons for limitation of the crop

Descriptors	Source of variation	Sum of squares	df	Mean square	F	Sig.
Knowledge about Abyssinian pea	Between Groups	1.393	19	.073	2.216	.002
	Within Groups	14.030	424	.033		
	Total	15.423	443			
Duration of familiarity with Abyssinian pea	Between Groups	91.023	19	4.791	1.815	.019
	Within Groups	1119.417	424	2.640		
	Total	1210.439	443			
Abyssinian pea availability in the study districts	Between Groups	135.709	19	7.143	4.772	.000
	Within Groups	634.568	424	1.497		
	Total	770.277	443			
Reasons for Abyssinian pea limitation in sporadic areas	Between Groups	157.372	19	8.283	2.399	.001
	Within Groups	1463.727	424	3.452		
	Total	1621.099	443			
Reasons for Abyssinian pea's less known	Between Groups	159.684	19	8.404	1.750	.026
	Within Groups	2036.091	424	4.802		
	Total	2195.775	443			
Production status of Abyssinian pea	Between Groups	4.707	19	.248	2.983	.000
	Within Groups	35.212	424	.083		
	Total	39.919	443			
If the production of Abyssinian pea decreasing, reasons for reduction	Between Groups	551.756	19	29.040	3.368	.000
	Within Groups	3656.053	424	8.623		
	Total	4207.809	443			
Intervention by agricultural extensions	Between Groups	1.696	19	.089	1.595	.054
	Within Groups	23.727	424	.056		
	Total	25.423	443			
Type/s of intervention	Between Groups	16.860	19	.887	1.731	.029
	Within Groups	217.417	424	.513		
	Total	234.277	443			

Respondents from highland areas of both regions recognized that Abyssinian pea is currently available in about four districts of their neighborhoods. In the midland and lowland agro-ecologies, the crop availability is limited to three districts of the two regions. This showed the sporadic distribution of the crop comparable to the claims of Yemane and Skjelvåg (2003) and Mikić et al. (2013). The main reason for limitation in distribution of the crop is its agroecology preference particularly in the highlands that is not restructured with food system of Ethiopia. This finding matches with the works by Wart et al. (2013) and Gliessman (2016). Lack of intervention for expansion and preference of high yielding other pea varieties in Amhara region districts and the soil type and moisture requirements in the midland and lowland areas of Tigray districts affects the crops distribution. The crops' inferiority in yield and pest susceptibility before people consume it is the main reason for less consideration of farmers about the crop cultivation in all agro-ecologies of Tigray region. Cultural bias against peasant crops and lack of expansion by extension experts to other areas is the reason participants said the crop got least attention in reverse of its importance in the highland and midland areas of Amhara region. Similar to the idea of National Research Council (2008) stating cultural bias against peasant crops is an ultimate calamity because plants that poor people grow are the very type well-suited to feeding the hungriest and most vulnerable sections of society. Now it is grown ordinarily as solitary planting. The crop production result showed that the crop is intensely decreasing and becoming rare. The main cause for reduction at small farmers scale of the crop is expensive price to buy the seed and small land holding of farmers. According to this result, there is no noticeable intervention started (Table 5).

Farmers' agronomic descriptors and use value knowledge on Abyssinian pea

A one-way ANOVA was conducted to explore the knowledge on agronomic performances and use values of Abyssinian pea. There was a statistically significant difference (at $p < 0.05$) for the descriptors across the agro-ecologies as shown in Table 6 [F (2, 424): 2.3, p: .002; F (2, 424): 3.9, p: .000; F (2, 424): 2.0, p: .007; F (2, 424): 11.7, p: .000; F (2, 424): 3.4, p: .000; F (2, 424): 3.3, p: .000; F (2, 424): 10.1, p: .000; F (2, 424): 5.0, p: .000; F (2, 424): 6.0, p: .000; F (2, 424): 5.1, p: .000; F (2, 424): 1.8, p: .025; and F (2, 424): 2.2, p: .003; F (2, 424): 5.0, p: .000; F (2, 424): 6.0, p: .000; F (2, 424): 5.1, p: .000; F (2, 424): 1.8, p: .025; F (2, 424): 2.2, p: .003; F (2, 424): 3.0, p: .000; and F (2, 424): 3.4, p: .000], respectively.

Table 5. Knowledge about current distribution and reasons for limitation of Abyssinian pea in the study area

Descriptors	Tigray			Amhara		
	Highland (N: 74)	Midland (N: 82)	Lowland (N: 66)	Highland (N: 66)	Midland (N: 90)	Lowland (N: 66)
Do know Abyssinian pea?						
Yes	100.0	100.0	92.7	100.0	91.1	97.0
No	0.0	0.0	7.3	0.0	8.9	3.0
%within districts	100	100	100	100	100	100
How long do you know the crop (Duration in years)						
<10yrs ago	2.7	0.0	2.4	0.0	0.0	3.0
10yrs ago	20.3	13.6	9.8	21.2	16.7	12.1
20 yrs ago	16.2	30.3	18.3	16.7	26.7	15.2
30 yrs ago	31.1	40.9	52.4	16.7	26.7	21.2
40 yrs ago	14.9	9.1	12.2	6.1	6.7	13.6
50 yrs ago	9.5	1.5	1.2	15.2	11.1	13.6
60 yrs ago	5.4	4.5	2.4	18.2	7.8	15.2
≥60 yrs ago	0.0	0.0	0.0	6.1	0.0	6.1
I don't know	0.0	0.0	1.0	0.0	4.0	0.0
%within districts	100	100	100	100	100	100
In how many of the the study districts do you know Abyssinian pea availability currently (Distribution knowledge)						
I don't know	0.0	0.0	1.2	0.0	4.0	16.2
1-2 districts	4.5	19.7	7.3	34.8	10.0	19.7
3 districts	14.9	27.3	29.3	25.8	34.4	33.3
4 districts	31.1	22.7	30.5	19.7	17.8	28.8
5 districts	25.7	18.2	15.9	10.6	11.1	12.1
≥6 districts	23.0	12.1	15.9	9.1	22.2	6.1
%within districts	100	100	100	100	100	100
Reasons for irregular pattern in distribution of the crop						
G1	8.1	3.0	2.4	6.1	8.9	4.5
G2	9.5	0.0	4.9	9.1	8.9	12.1
G3	0.0	0.0	7.3	6.1	10.0	15.2
G4	6.8	24.2	25.6	6.1	7.8	13.6
G5	10.8	9.1	12.2	10.6	20.0	21.2
G6	56.8	53.0	39.0	48.5	37.8	22.7
G7	0.0	3.0	0.0	3.0	0.0	0.0
G8	2.7	0.0	3.7	6.1	0.0	10.6
G9	4.7	7.6	3.7	4.5	2.2	0.0
G10	0.0	0.0	1.2	0.0	4.4	0.0
%within districts	100	100	100	100	100	100
Reasons for why the crop got slight attention by participants						
G1*	1.4	6.1	11.0	6.1	13.3	25.8
G2*	2.7	0.0	0.0	0.0	2.2	2.7
G3*	27.8	36.4	23.2	42.4	27.8	19.7
G4*	60.8	43.9	45.1	28.8	18.9	22.7
G5*	0.0	0.0	0.0	3.0	0.0	0.0
G6*	0.0	0.0	1.5	0.0	0.0	1.2
G7*	0.0	4.5	2.4	6.1	7.8	1.5
G8*	20.3	9.1	13.4	13.6	23.3	27.3
G9*	0.0	0.0	3.7	0.0	6.7	1.5
%within districts	100	100	100	100	100	100

Note: G1: soil type requirement, G2: moisture requirement, G3: cultural bias against peasant crops, G4: both soil type and moisture requirements, G5: lack of intervention for the crop expansion and preference of other high yielding varieties, G6: Agro-ecological preferences, G7: combined requirement of soil type, sunlight and moisture, G8: small landholding of farmers and climatic condition susceptibility, G9: susceptibility to pest and birds of the crop, G10: I don't know the reason. G1*: inferiority of this displaced crop by new pea varieties, G2*: misclassification of the crop, G3*: cultural bias against peasant crops and lack of expansion by extension experts to other areas of the crop, G4*: inferiority in yield and pest susceptibility of the crop, G5*: cost effectiveness of the crop, G6*: disappearing in the writing of travellers for scientific communication of the crop, G7*: both cultural bias and inferiority in yield, G8*: Agro-ecological requirements hindering further adaptation of the crop, and G9*: if other specify. N: Number of respondents

Majority of the respondents (of both regions) in the present study cultivate Abyssinian pea keeping the seasonal rainfall. Farmers from Gubalafto highland areas grow Abyssinian pea completely depending on the long rainy season. However, in Tigray region particularly in the lowlands of Endamehoni and midland areas of Amba-Alaje there are irrigation based Abyssinian pea cultivation starting's. Abyssinian pea thrives better in Nitisols in all agro-ecologies in general and in Leptosols in the highland and midland areas of Tigray region in particular, respectively. Sowing time was evaluated to understand the growing seasons and to improve the crop harvest as growing seasons define geographical areas suitable for crops (HarvestChoice 2010). Majority of the respondents in lowland, midland and highland areas of Amhara sow Abyssinian pea the in March and May months (during belg season) after other crops like teff are harvested followed by the long rainy season. Farmers in the Ofla highland areas sow the crop starting from July the half up to August the first with a single plough. The sowing time of the crop in the midland and lowland areas of Tigray is both during belg season and the long rainy season, although very few respondents experienced different sowing times (Table 7).

Respondents were also enquired the seeding rate for Abyssinian pea they used during sowing. Majority of the respondents use a seeding rate of 21-30 kg ha^{-1} even it varies enormously within the agro-ecologies. The variation may be due to planting date, soil type, relative humidity, temperature and the like factors the agro-ecologies possess. Still the seeding rate of the crop is below the seeding rate stated by Winch (2006) for early variety, with small seed that is planted in good time on infertile soil in a dry region may need a seeding rate of about 50 kg ha^{-1}. The crop start flowering one month after planting but florescence best in one month and fifteen days after planting in all the agro-ecologies (Table 7) viewing its early flowering phenotypic traits. This may be probably due to the crop ELF3 gene, a key prehistoric adaptation to shorter growing seasons stated by Rubenach et al. (2017) for some pea varieties. According to the respondents data the crop matures at $2^{1/2}$ months in average. The maximum yield farmers obtain from the 21-30 kg ha^{-1} is 300 kg ha^{-1} that can be enhanced to 400 kg ha^{-1} at the seeding rate of 41-50 kg ha^{-1} (Figure 10).

Table 6. ANOVA for agronomic performances descriptors of Abyssinian pea

Agronomic descriptors	Source of variation	Sum of squares	df	Mean Square	F	Sig.
Abyssinian pea dependency on rain or using other means	Between Groups	6.858	19	.361	2.294	.002
	Within Groups	66.727	424	.157		
	Total	73.586	443			
Abyssinian pea soil preference	Between Groups	345.896	19	18.205	3.900	.000
	Within Groups	1979.402	424	4.668		
	Total	2325.297	443			
Habit of using Abyssinian pea in intercropping and crop rotation	Between Groups	3.488	19	.184	2.023	.007
	Within Groups	38.485	424	.091		
	Total	41.973	443			
Crops intercropped or rotated with Abyssinian pea	Between Groups	807.477	19	42.499	11.650	.000
	Within Groups	1546.758	424	3.648		
	Total	2354.234	443			
Abyssinian pea sowing time (seasons)	Between Groups	241.356	19	12.703	7.404	.000
	Within Groups	727.455	424	1.716		
	Total	968.811	443			
Abyssinian pea's land ploughing number including the final sowing time	Between Groups	23.634	19	1.244	3.307	.000
	Within Groups	159.508	424	.376		
	Total	183.142	443			
Abyssinian pea rainfall requirement starting from sowing to maturity	Between Groups	52.100	19	2.742	10.060	.000
	Within Groups	115.576	424	.273		
	Total	167.676	443			
Seeding rate (Kg/ha)	Between Groups	128.927	19	6.786	4.943	.000
	Within Groups	582.053	424	1.373		
	Total	710.980	443			
Abyssinian pea flowering time (Number of months)	Between Groups	170.863	19	8.993	5.984	.000
	Within Groups	637.144	424	1.503		
	Total	808.007	443			
Time of maturity (months)	Between Groups	70.312	19	3.701	5.138	.000
	Within Groups	305.364	424	.720		
	Total	375.676	443			
Abyssinian pea yield in (100 Kg/ha)	Between Groups	53.996	19	2.842	1.763	.025
	Within Groups	683.644	424	1.612		
	Total	737.640	443			
Abyssinian pea conservation practice started	Between Groups	1.039	19	.055	2.181	.003
	Within Groups	10.636	424	.025		
	Total	11.676	443			
Abyssinian pea use related traits	Between Groups	105.837	19	5.570	2.764	.000
	Within Groups	854.386	424	2.015		
	Total	960.223	443			
Abyssinian pea part/s used for forage	Between Groups	505.395	19	26.600	25.353	000
	Within Groups	444.848	424	1.049		
	Total	950.243	443			
Animals Abyssinian pea straw preference compared to other peas	Between Groups	144.698	19	7.616	7.624	000
	Within Groups	423.545	424	.999		
	Total	568.243	443			
Browser animals prefer Abyssinian pea straw better	Between Groups	709.775	19	37.357	11.234	000
	Within Groups	1409.871	424	3.325		
	Total	2119.646	443			
Abyssinian pea medicinal values	Between Groups	71.770	19	3.777	7.991	000
	Within Groups	200.417	424	.473		
	Total	272.187	443			
Parts used for disease cure	Between Groups	693.293	19	36.489	6.100	000
	Within Groups	2536.455	424	5.982		
	Total	3229.748	443			
Rate of Abyssinian pea usability	Between Groups	64.973	19	3.420	7.436	000
	Within Groups	195.000	424	.460		
	Total	259.973	443			
Way of using Abyssinian pea	Between Groups	39.873	19	2.099	2.843	000
	Within Groups	312.962	424	.738		
	Total	352.836	443			
Abyssinian pea storage mechanism	Between Groups	241.724	19	12.722	5.559	000
	Within Groups	970.303	424	2.288		
	Total	1212.027	443			

Table 7. Knowledge about agronomic performances descriptors of Abyssinian pea

Descriptors	Tigray			Amhara		
	Highland (N: 74)	Midland (N: 82)	Lowland (N: 66)	Highland (N: 66)	Midland (N: 90)	Lowland (N: 66)
Is cultivation of Abyssinian pea dependent on seasonal rain?						
Yes	79.7	80.3	79.3	100	85.6	97.0
No	17.6	19.7	19.5	0.0	8.9	3.0
I don't know	2.7	0.0	1.2	0.0	5.6	0.0
%within districts	100	100	100	100	100	100
Soil type preference of Abyssinian pea						
Vertisol	18.9	19.7	14.6	4.5	21.1	9.1
Nitisols	25.7	36.4	36.6	65.2	32.2	42.4
Lithic leptosols	5.4	0.0	4.9	0.0	2.2	10.6
Cambisols	8.1	1.5	4.9	1.5	2.2	3.0
Leptosols	31.1	40.9	36.6	16.7	25.6	25.8
Regosols	5.4	1.5	1.2	0.0	13.3	4.5
all soil types	5.4	0.0	1.2	12.1	0.0	4.5
I don't know	0.0	0.0	0.0	0.0	3.3	0.0
%within districts	100	100	100	100	100	100
Sowing time of Abyssinian pea						
Long rainy season (June-August)	28.4	28.8	12.2	40.9	30.0	25.8
After crops harvest (belg) e.g Teff	16.2	0.0	9.8	54.5	37.8	57.6
Both during belg and June-August	2.7	48.5	58.5	0.0	15.6	13.6
Late (July half-first August)	52.7	22.7	18.3	4.5	12.2	3.0
If other specify	0.0	0.0	1.2	0.0	4.4	0.0
%within districts	100	100	100	100	100	100
The numbers of plough of land for Abyssinian pea cultivation						
I don't know	0.0	0.0	1.1	0.0	4.4	0.0
One time	70.3	72.7	59.8	65.1	70.0	63.6
Two times	25.7	21.2	29.3	25.8	15.6	30.3
Three to four times	4.1	6.1	9.8	9.1	10.0	6.1
%within districts	100	100	100	100	100	100
Seeding rate respondents experiencing						
10-15 kg ha^{-1}	9.5	25.8	3.7	3.0	3.3	0.0
15-20 kg ha^{-1}	12.2	3.0	17.1	9.1	13.3	6.1
21-30 kg ha^{-1}	41.9	19.7	39.0	40.9	33.3	40.9
31-40 kg ha^{-1}	25.7	18.2	13.4	37.9	21.1	28.8
41-50 kg ha^{-1}	10.8	25.8	23.2	9.1	21.1	19.7
60-70 kg ha^{-1}	0.0	7.6	2.4	0.0	3.3	1.5
I don't know	0.0	0.0	1.2	0.0	4.4	3.0
%within districts	100	100	100	100	100	100
The time required for flowering						
1 month	24.3	24.2	11.0	0.0	4.4	4.5
1 month & 15 days	59.5	56.1	52.4	83.3	73.3	45.5
2 months&15 days	2.7	7.6	20.7	0.0	7.8	18.2
2 months	13.5	6.1	11.0	15.2	10.0	25.8
40 days	0.0	6.1	3.7	1.5	0.0	6.1
If other specify	0.0	0.0	1.2	0.0	4.4	0.0
% within districts	100	100	100	100	100	100
Abyssinian pea maturity time						
2 months	23.0	21.2	20.7	48.5	22.2	51.5
2 months&15 days	31.5	56.1	34.1	48.5	57.8	27.3
3 months	39.2	19.7	39.0	3.0	13.3	21.2
3months &15 days	0.0	3.0	4.9	0.0	0.0	0.0
≤49 days	2.7	0.0	0.0	0.0	2.2	0.0
If other specify	0.0	0.0	1.2	0.0	4.4	0.0
%within districts	100	100	100	100	100	100
Yield in (100 kg ha^{-1})						
200 kg ha^{-1}	16.2	6.1	8.5	9.1	7.8	3.0
300 kg ha^{-1}	43.2	48.5	41.5	45.5	37.8	47.0
400 kg ha^{-1}	25.7	27.3	29.3	30.3	35.6	31.8
500 kg ha^{-1}	12.2	18.2	15.9	12.1	17.8	12.1
600 kg ha^{-1}	2.7	0.0	3.7	3.0	0.0	6.1
If other specify	0.0	0.0	1.2	0.0	0.0	0.0
I don't know	0.0	0.0	0.0	0.0	1.1	0.0
%within districts	100	100	100	100	100	100

Figure 2. Seed size, color (A-F), and resistance (D-F) to pea weevil (*Bruchus Pisorum* L.) differences of Abyssinian pea landraces where creamy seeds are bored more by pea weevil larvae feed on the seed during storage (F)

The price of Abyssinian pea (53 Ethiopian birr per kilogram) was more than twice better than the price of common pea (24 birr) during the market survey time in all the agro-ecologies nearby markets analogous to the assertion by Yemane and Skjelvåg (2003). Besides, delicious tastes followed by expensive seed price are the best use value related descriptors that come to the mind of Ethiopian farmers when asked about Abyssinian pea landraces. Beyond the forage value for donkeys and horses > cattle > sheep and goats), respectively (Table S1), 90.9% of the interviewed farmers from Tahtay-haya (Figure 1 and Table 2), the lowland area from Endamehoni districts claimed the medicinal value of the crop straw as the best cure of their animals' neck wounding by bat during the rainy season. It is also given as food for patients prescribed not eating some foods because of stomach ulcer in the highland areas of Tigray and all the agro-ecologies of Amhara region. The crop is currently fairly usable and mainly for earning income for local exchange of other staple crops, the very type well-suited to feeding the hungriest vulnerable farmers as it grows earlier. From the different storage mechanisms, the most common respondents practicing is dressing seeds using chemicals particularly of malathion after harvest and before storage (Table S2) in all the agro-ecologies to protect from pea weevil (Figure 2.D and 2.F). During consumption the chemically dressed seeds are washed very well.

Morphological and physiological variations among the Abyssinian pea landraces

Differences in seed's size, seed coat color and resistance to the pea seed weevil of the crop farmers' landraces were observed during the study time (Figure 2). This could be due to the variance in their adaptation and interaction to different environments. This is similar to the finding of Teshome (2015) on pea genotypes. Studies from Elzebroek and Wind (2008) and Pavek (2012) confirm the difference used as selection criteria of the various types of peas available by breeders. Pea seeds difference in resistance to pea weevil larvae boring is due to difference in color (Figure 2.F; Teshome 2015**)** and nutritional content (Winch 2006).

The Abyssinian pea (English) is locally named Dekoko (Tigrigna), Agerie Ater (Amharic) correspondingly. The English and Amharic terms describe its origin and the Tigrigna term defines its small seeds.The first ranked morphological descriptors most farmers used for selection of Abyssinian pea from other local peas were earliness > grain coverage (germination rate) > seedling vigor > leaf greenness > plant height (short and vigorous) > pods per plant > branches per plant > seeds per pod (Figure 3).

Abyssinian pea yield and yield related traits prediction using Exhaustive CHAID growth method

The respondents from each district define each descriptor according to their knowledge. Therefore, the independent (predictor) variable that has the strongest interaction with the dependent variable for each agroecology should better be chosen using Exhaustive CHAID growing method. Exhaustive CHAID examines all possible splits for each predictor by merging categories of each predictor if they are not significantly different with respect to the dependent variable. The green ones in the tree diagrams (Figures 4, 6, 7, 8, 9 and 10) indicate the predicted categories having strongest interaction with the descriptors determining the yield and yield related factors of the crop.

Prediction 1. Soil type preference of the crop

Abyssinian pea thrives better in Nitisol soil followed by Leptosol and Vertisol soils (Figure 4), respectively. Farmers from Amba-Alaje and Endamehoni areas grow the crop in Leptosols. The existence of more than half of all Nitisols in tropical Africa; in the highlands (>1000 m asl.) and 12.5% of the Ethiopia highlands where field pea is dominant pulse (IUSS Working Group WRB 2015; Keneni et al. 2013) give an impression of the crop adaption for this soil. Abyssinian pea has excellent root protuberance in Nitisol soils (Figure 5.A). Farmers traditionally conserve soil using different mechanism. A new and unfamiliar soil conservation practices using USAID white sacks (Figure 5.B-D) were observed during the study time.

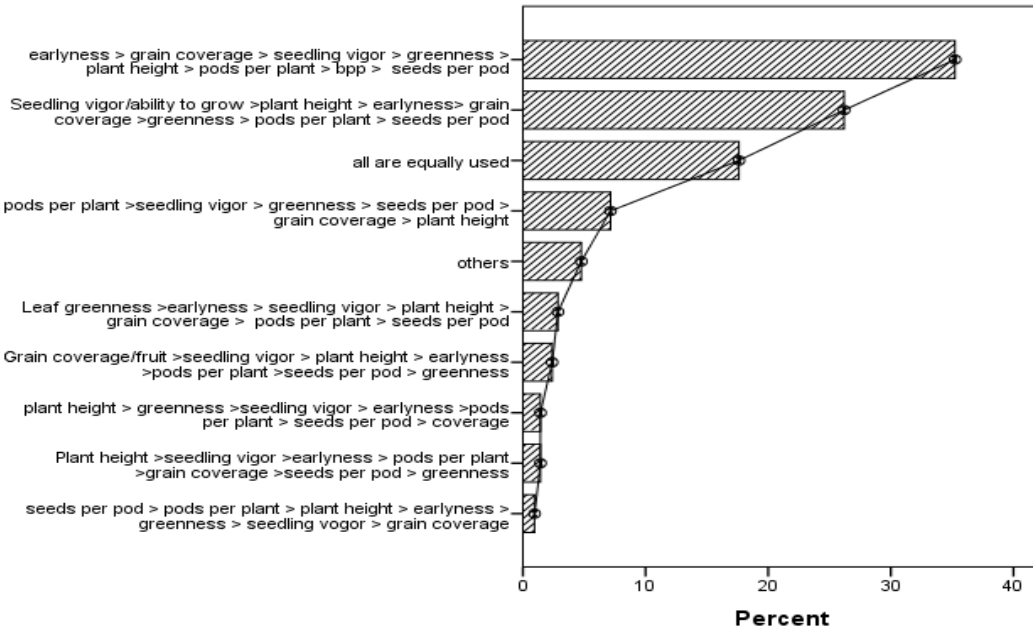

Figure 3. Farmer's morphological selection criteria of Abyssinian pea from other local peas. bpp: branches per plant

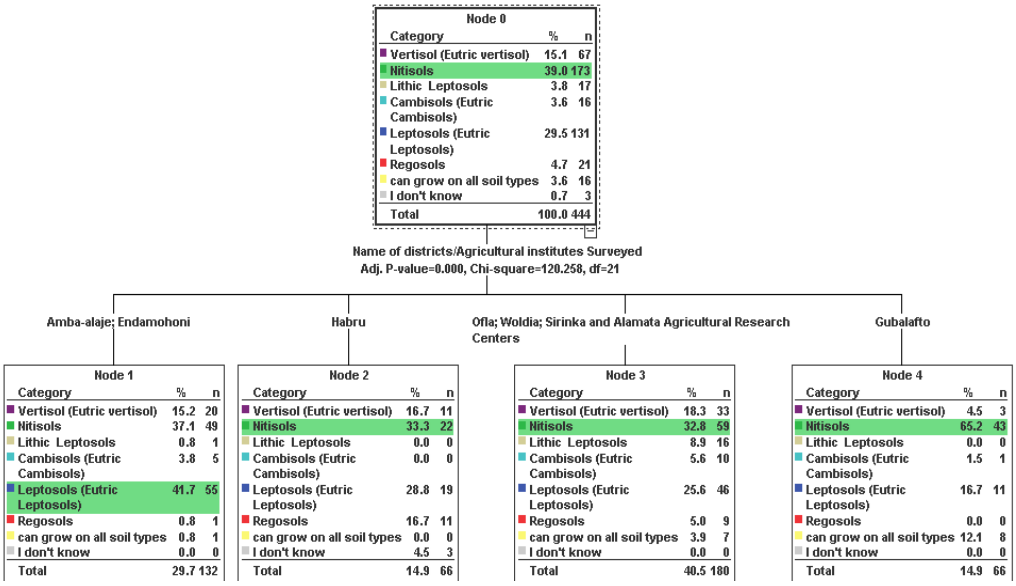

Figure 4. Tree diagram of Abyssinian pea soil type preference (Risk estimate: 0.597, SE: 0.023)

Figure 5. A. The direct physical effect of the soil type on the Abyssinian pea excellent root protuberance efficieny grown in Nitisol soil in Gedober kebele, North Wollo (Photo by BG, October 2017); B-D. Traditional soil conservation practices using USAID white sacks in Mekan kebele, Endamehoni district, South Tigray, where (B). Sunken white sack for soil conservation, (C). Side view of the sunken white sack, and (D). Soil protecting ability of white sack (Photo by BG. March 2017)

Prediction 2. Rainfall requirement of the crop

Abyssinian pea can perform good yield with about two good rain in all soil types and agroecologies (Figure 6). This is mostly common to highland areas that have higher humidity because peas have the ability to benefit from some rain at flowering and seed set with 70% relative humidity (Winch 2006).

Prediction 3. Seeding rate of the crop

Results from the tree diagram showed respondents knowledge as significant predictor of Abyssinian pea seeding rate. The overall category showed that, the common seeding rate (kg ha^{-1}) is 21-30 kg ha^{-1}, followed by 31-40 kg $ha^{-1}$and 41-50 kg ha^{-1}, respectively. The overall significant predictor does not represent all districts as blanket, because they have different agro-ecologies like altitude (Table 1 and Hurni 1998). In Ethiopia the best altitudes for pea ranges 1500-2200 m asl. with rainfall less than 600 mm, and 2200-2300 m asl. with rainfall more than 600 mm per year (Winch 2006). Respondents from Amba-Alaje midland district and ASARCs experience a seeding rate of 41-50 kg ha^{-1}. Of the districts in this category, 36% articulated this seeding rate (Figure 7), lesser than the typical seeding rate for smaller seeded pea varieties (Winch 2006).

The forecaster seeding rate for Endamehoni and Woldia lowland areas, and Habru is 21-30 kg ha^{-1}, where 86% of the respondents shared. Moreover, the seeding rate for the highland areas of Ofla and Gubalafto is 21-30 kg ha^{-1}, followed by 31-40 kg ha^{-1} (Figure 7). This is comparable to Pavek (2012) who revealed seeding rates vary with cultivar, soil type, seed size, climate, disease pressure and seeding method for *Pisum sativum*.

Prediction 4. Flowering time of the crop

It is predicted that, Abyssinian pea require about one month and fifteen days for flowering (Figure 8). This is particularly common for farmers' landraces from Gubalafto where about 55 (83.3%), Habru and ASARCs about 85 (74.6%), Amba-Alaje and Ofla about 74 (56.1%), respectively. For Endamehoni and Woldia lowland agro-ecologies, this is not the significant predictor where about 61 (46.2%) of the total 132 informants approved. This is similar to the findings of Weeden (2007), Weller et al. (2012) and Rubenach et al. (2017) stating Abyssinian pea flower in short days.

Prediction 5. Maturity time of the crop

Abyssinian pea matures in about two months and fifteen days (Figure 9) earlier (Weller et al. 2012; Rubenach et al. 2017). Early maturing helps peas for better seed set during dry season (Winch 2006). This is similar to the growth period for green seed or pods, even there is variation depending on farmers' cultivar, climatic conditions, and planting date of the agro-ecologies (Winch 2006).

Prediction 6. Yield (100 kg ha^{-1}) of the Crop

Yield per hectare of Abyssinian pea was predicted. The overall category indicated, the common yield in kilograms per hectare (100 kg ha^{-1}) for Abyssinian pea is 300 kg ha^{-1} for most districts. Still the production is below the good average yield compared to green peas pods which is 6.5-7 MT ha^{-1} (Winch 2006). This could be because of the small seed rate. Better seed rates can yield up to about 400 kg ha^{-1} of Abyssinian pea (Figure 10). This seeks urgent intervention to fill yield gap (Ittersuma et al. 2013). Little productions were observed during the study period in some sporadic areas of Endamehoni lowlands, and Ofla and Gubalafto high land areas which are belg season productive districts (Hurni 1998; Abrha and Simhadri 2015).

In conclusion, the results showed that, Abyssinian pea productivity is socioeconomically influenced by gender, family size, age, education, small landholding, and expensive price for poor of the seed. Abyssinian pea production was observed to be higher by men and educated respondents. The knowledge on agronomic descriptors like soil preferences, rainfall requirement, seed rate, flowering time, maturity period and yield and affecting factors like the reasons for limitation of the crop on some sporadic areas varies across agro-ecologies. Morphological and physiological variations among the landraces' seeds were observed. Currently, the crop productivity is highly decreasing because of combination of expensive price to purchase for poor farmers and their small land holdings. Evaluated predictors like the crop rain fall requirement, soil type preference, seed rate, flowering and maturity time, and yield showed that the landraces adapted differently to the agro-ecologies. Therefore, improve farmers' educational status and awareness on agronomic descriptors would enhance the production of the crop.

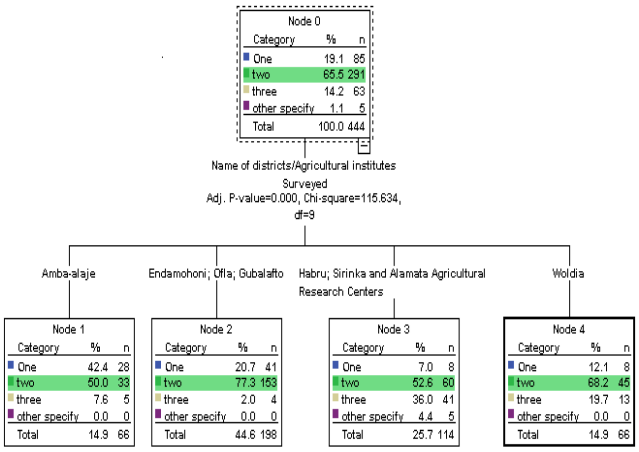

Figure 6. Abyssinian pea rainfall requirement created using the Exhaustive CHAID growth method (Risk estimate: 0.035, SE: 0.023).

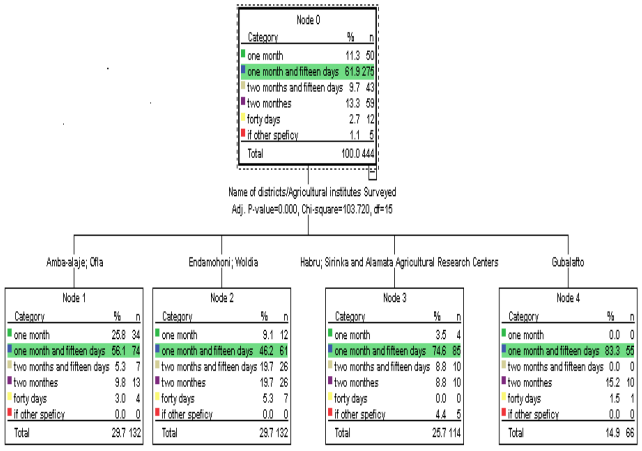

Figure 8. Abyssinian pea flowering time (Risk estimate: 0.060, SE: 0.003)

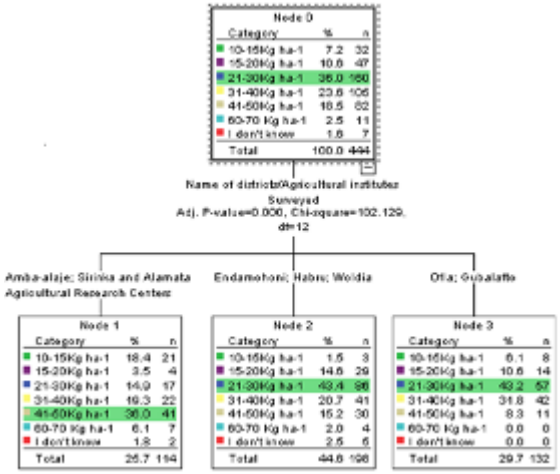

Figure 7. Abyssinian pea seeding rate (kg ha-1) with (Risk estimate: 0.059, SE: 0.002).

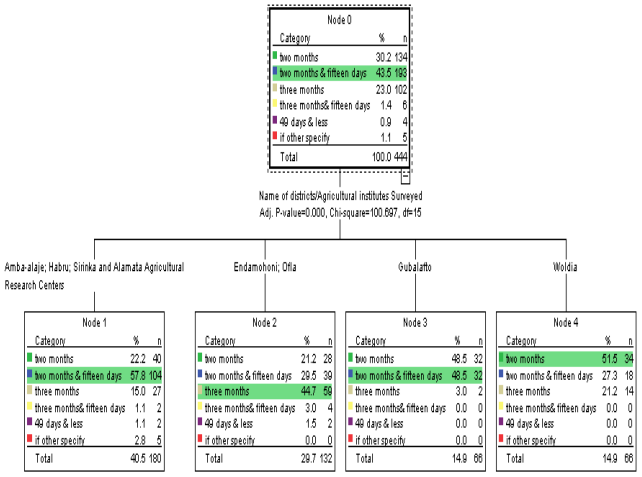

Figure 9. Abyssinian pea maturity time (Risk estimate: 0.060, SE: 0.005)

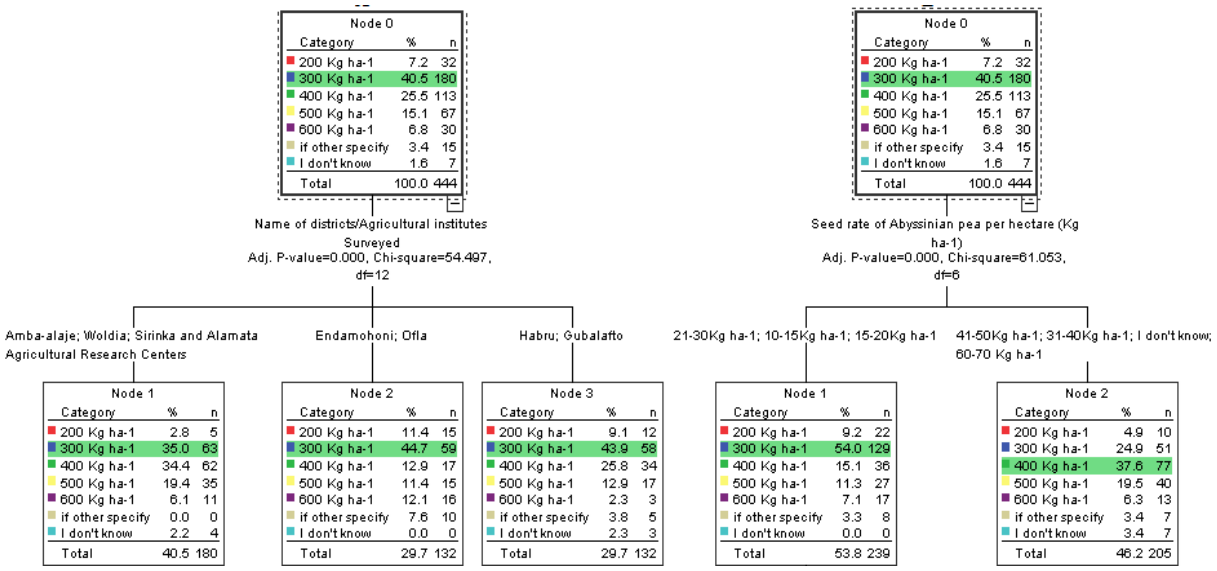

Figure 10. Abyssinian pea yield (kg ha^{-1}) as affected by agroecology (*left*) and seed rates (*right*)

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Table S1. Use and use related traits of Abyssinian pea

Descriptors	Tigray			Amhara		
	Highland (N: 74)	Midland (N: 82)	Lowland (N: 66)	Highland (N: 66)	Midland (N: 90)	Lowland (N: 66)
Market value of Abyssinian pea compared to white pea and common field pea						
Better	100.0	100.0	98.8	100.0	95.6	97.0
Less	0.0	0.0	0.0	0.0	0.0	0.0
I don't know	0.0	0.0	1.2	0.0	4.4	3.0
%within districts	100	100	100	100	100	100
Use related and unique traits of the crop respondents know						
G1UR	33.8	22.7	35.4	27.3	38.9	30.3
G2UR	16.2	15.2	26.8	16.7	17.8	15.2
G3UR	2.7	13.6	7.3	13.6	8.9	7.6
G4UR	39.2	43.9	26.8	39.4	27.8	42.4
G5UR	5.4	1.5	1.2	3.0	1.1	0.0
G6UR	2.7	1.5	1.2	0.0	2.2	4.5
Others	0.0	1.5	1.2	0.0	3.3	0.0
%within districts	100	100	100	100	100	100
Part/s of Abyssinian pea commonly utilized as source of food						
Only seed	18.9	22.7	26.8	28.8	58.9	65.2
Seed & mature	81.1	74.2	72.0	71.2	36.7	31.8
Only the matured	0.0	0.0	0.0	0.0	0.0	3.0
If other specify	0.0	3.0	1.2	0.0	4.4	0.0
%within districts	100	100	100	100	100	100
Part/s of Abyssinian pea commonly utilized as source of forage						
Mature>seed>straw	1.4	19.7	1.2	3.0	2.2	1.5
Straw > mature	1.4	51.5	34.1	9.1	21.1	6.1
Mature >straw	20.3	7.6	20.7	0.0	4.4	1.5
Only mature	58.1	12.1	12.2	54.5	28.9	39.7
Only straw	10.8	9.1	22.0	18.2	31.1	48.5
%within districts	100	100	100	100	100	100
Browser animals Abyssinian pea straw preferences rank						
G1BAP	0.0	0.0	2.0	0.0	0.0	0.0
G2BAP	8.1	0.0	0.0	0.0	0.0	0.0
G3BAP	50.0	24.2	37.8	37.9	33.3	21.2
G4BAP	0.0	60.6	22.0	0.0	12.2	12.2
G5BAP	0.0	0.0	1.2	3.0	1.1	7.6
G6BAP	0.0	0.0	0.0	6.1	0.0	0.0
G7BAP	23.0	7.6	13.4	27.3	13.3	47.0
G8BAP	18.9	1.5	13.4	25.8	17.8	10.6
%within districts	100	100	100	100	100	100

Note: G1UR: Seed expensive price > good taste > low yield, G2UR: good yield > Seed expensive price > good taste, G3UR: good biomass > seed expensive price >good taste, G4UR: good taste > seed expensive price > good biomass, G5UR: straw quality > medicinal value >good biomass, G6UR: earliness > expensive price > good taste >good yield. G1BAP: cattle's > sheep and goats > donkeys and horses, G2BAP: sheep and goats > cattle's > donkeys and horses, G3BAP: donkeys and horses > cattle's > sheep and goats, G4BAP: donkeys and horses > sheep and goats >cattle's, G5BAP: sheep and goats >donkeys and horses > cattle's, G6BAP: cattle's > donkeys and horses > sheep and goats, G7BAP: donkeys and horses > cattle, G8BAP: I don't know. N: number of respondents

Table S2. Current usability, medicinal value and storage mechanisms of Abyssinian pea

Descriptors	Tigray			Amhara		
	Highland (N: 74)	**Midland (N: 82)**	**Lowland (N: 66)**	**Highland (N: 66)**	**Midland (N: 90)**	**Lowland (N: 66)**
Current usability rate of Abyssinian pea by respondents						
Very usable	10.8	1.5	4.9	6.1	13.3	4.5
Most usable	4.1	4.5	12.2	1.5	20.0	15.2
Fairly usable	73.0	86.4	46.3	62.8	56.7	72.7
Unusable	12.2	7.6	35.4	24.4	5.6	7.6
I don't know	0.0	0.0	1.2	0.0	4.4	0.0
%within districts	100	100	100	100	100	100
For what purpose farmers are cultivating Abyssinian pea (Abyssinian pea ways of using)						
Consumption	18.9	34.4	37.8	16.7	34.4	16.7
Earning income	60.8	43.9	32.9	63.6	38.9	47.0
For both	12.2	9.1	8.5	18.2	20.0	31.8
Not growing	8.1	10.6	20.7	1.5	6.7	4.5
%within districts	100	100	100	100	100	100
Does Abyssinian pea have medicinal values?						
yes	70.3	28.8	53.7	68.2	58.9	57.6
No	21.6	23.2	60.6	30.3	27.8	33.3
I don't know	8.1	10.6	23.3	1.5	13.3	9.1
%within districts	100	100	100	100	100	100
Part/s used as medicinal values of Abyssinian pea and for what disease						
Seed/stomach ulcer	70.3	25.8	14.6	68.2	54.4	45.5
Straw/night bird	0.0	43.9	63.6	0.0	4.4	6.1
Leaf/michi	0.0	0.0	0.0	0.0	4.0	6.1
Others	0.0	2.3	0.0	6.0	7.8	13.6
I don't know	29.7	39.0	10.8	31.8	36.6	42.5
%within districts	100	100	100	100	100	100
Storage mechanisms farmers used for Abyssinian pea						
G1SMA	0.0	6.1	6.1	0.0	2.2	0.0
G2SMA	1.4	6.1	0.0	0.0	3.3	0.0
G3SMA	59.5	71.2	45.1	81.8	63.3	48.5
G4SMA	5.4	0.0	13.4	1.5	0.0	0.0
G5SMA	8.1	13.6	12.2	15.2	22.2	43.9
G6SMA	8.1	0.0	4.9	0.0	0.0	0.0
G7SMA	0.0	0.0	2.4	0.0	0.0	0.0
G8SMA	17.5	3.0	15.9	1.5	8.9	7.6
%within districts	100	100	100	100	100	100

Note: G1SMA: drying very well the storage material and storage material selection, G2SMA: changing of the storage materials per two weeks, G3SMA: dressing seeds prior to storage using chemicals such as malathion, G4SMA: by mixing with pest less susceptible crops like teff, G5SMA: dressing chemicals for weevils and using traps for rodents, G7SMA: Both drying well the storage materials and dressing seeds using chemicals, G8SMA: use trap and cat for rodents. N: number of respondents