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Measurement of knowledge of farmers on chickpea demonstration at Adola Rede District, Guji Zone, Oromia Regional State, Ethiopia

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Chickpea production in Guji Zone is not known by farmers due to absence of improved seed and lack of knowledge on chickpea production. Thus, this study was instigated to demonstrate new varieties of chickpea to local farmers aligned to measure farmers' knowledge on chickpea production. In order to measure farmers' knowledge on chickpea the issue of capacity building such as trainings, field visit, exchange visit and field days were organized to capacitate farmers' knowledge on chickpea demonstrated varieties. 36 items test were prepared on chickpea production and administrated to 24 farmers who were participants during the demonstration of chickpea on their land. Items contains yes or no, true or false and explain types. Each correct answer was given '1' score while wrong answer was awarded '0' mark. Finally, 15 knowledge items test were selected based on the difficulty index which ranges from 45 to 92, discrimination index above 0.20 and the point bi-serial correlation coefficient significant at 0.1%, 0.05 and 0.001% level for final knowledge test. The reliability of the knowledge test was measured by split-half method and reliability coefficient (r=0.969) which indicates that this knowledge test is quite reliable. The result of this study revealed that majority of farmers (83.33%) owned moderate level of knowledge on chickpea production. This indicated that demonstration of chickpea at Adola Rede increased the knowledge of farmers. Farmers Training Center established in each Kebele should be functioned to increase farmers' knowledge on chickpea production.

Key Words: Knowledge, Reliability, Item Analysis, Chickpea, Demonstration

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) occupies an important position amongst the pulse crops grown in Ethiopia because of its multiple functions. It is a key component of the daily diet, and thus important protein source for Ethiopian households who cannot afford animal products. Chickpea cultivation produces straw that is used as livestock feed (Jane *et al.,* 2017; Shiferaw and Teklewold, 2007). This straw is mainly used when there is drought and green fodder is unavailable for livestock feeding.

Another attractive feature of chickpea is its ability to fix atmospheric nitrogen in symbiosis with rhizobia, contributing directly to grain protein and reducing the

need for N fertilizer for subsequent crops. It thereby has great potential to improve soil N status (Tena *et al.,* 2016 and is an ideal candidate for intensification of the tef monoculture that is common in Ethiopia. It is often grown after wheat and tef are harvested on vertisols using residual moisture which extends the cropping season from September to December. As a result, growing chickpea allows the farmers to produce extra crop on the same land (Endalkachew *et al.,* 2018).

Chickpea is a less labor-intensive crop and its production demands low external inputs compared to cereals. In Ethiopia chickpea grain is widely used in different forms as green vegetable (green immature seed), “Kollo” (soaked and roasted) and “nifro” (boiled seeds) and “wot” (sauces) made up of “shiro” (powdered seeds) (Dejene and Kelbessa, 2018).

The average seed yield of chickpea in Ethiopia is 1.91 tons/ha. The total land coverage and yield of chickpea in Ethiopia are estimated to be 225607.53 hectares and 444145.93 tons, respectively (CSA, 2017). The crop has a great economic merit in Ethiopia providing a cheap source of protein for human diet and animal feed, and as a source of alternative cash income to the farmers and foreign currency to the country (Megersa *et al*., 2018, Bereket and Abdirazak, 2018).

Despite its nutritional value, high economic importance, the national average yield of chickpea is still lower (1.97 t/ha; CSA, 2017) than its potential of up to 5 t/ha on experimental stations (Fiker, 2016). Chickpea yields are limited by factors such as pests, diseases, drought and yield improvement requires compatible resilient varieties adapted to different agro-ecological zones (Megersa *et al*., 2018). The low yield of chickpea in Ethiopia was due to various production constraints including: low yield potential of landraces, lack of superior varieties, their susceptibility to biotic and a biotic stresses and poor cultural practices are some the serious constraints in chickpea production (Goa, 2014).

Production of chickpea have not been yet under production in the potential areas of Guji zone (Deresa *et al.,* 2018). The production of chickpea in Adola Rede district of Guji Zone is not known by farmers. Thus, we proposed new varieties (Dalota and Habru) to the farmers by demonstrating on the area of 100m^2. After adaptation of varieties demonstration is needed to create awareness and publicize further adoption of varieties. This kind of demonstration is important in facilitating the knowledge transfer of the use and application of improved varieties from researchers to farmers. Knowledge transfer is expected from every development activities which is likely to be maintained and sustained by farmers themselves. To implement this research activity we gave two times training on the recommended packages of chickpea production in the area. We also gave exchange visit and field days in order to capacitate the knowledge of farmers on the chickpea production. Thus, to see the impact of these trainings, exchange visit and field days this activity was initiated to measure the level of knowledge of farmers on the new demonstration of chickpea production.

RESEARCH METHODOLOGY

Description of study area

Adola Rede is 470 KM away from the Addis Ababa to the South. The activity was conducted on two Kebeles (Gobicha and Dole) where demonstration of chickpea was conducted in 2017 and 2018 cropping season. Adola district has diverse agro-ecology which is suitable for production of different crops. Major crops produced in the area includes maize, tef, haricot bean, chat, coffee and the others. The black soil characteristics of the area make it potential for production of chickpea.

Development of knowledge test

Development of items

Items regarding chickpea production were developed by Bore Agricultural Extension Researchers. 36 items were prepared based on uncertainty, simplicity and representativeness. English and English (1961) defined knowledge as a body of understood information possessed by an individual or by a culture. Knowledge is totality of understood information possessed by an individual. A knowledge test has been defined by Bloom *et al.* (1955) as a test which refers to those behavior and test situation which emphasized the remembering by the recall of ideas, material or phenomena. For this study knowledge was operationalized as the amount of information owned, understood and applied by farmers in chickpea production.

Item analysis

The item analysis was done on the lines of technique used by Jha and Singh (1970) which yielded three kinds of information; index of item difficulty, index of item discrimination and index of item validity. The index of item difficulty indicated the extent to which an item was difficult to understand while the index of item discrimination was to find out whether an item really discriminated a well-informed farmer from a poorly informed one. The index of item validity provided the information on how well an item measured or discriminated in agreement with rest of the test.

Sample Size

The 36 items were administered to 24 farmers. Items contains yes or no, true or false and explain types. Each correct answer was given '1' score while wrong answer was awarded '0' mark. Thus total score secured by all individual farmers on 36 items for correct answers was the knowledge score on chickpea production. The scores obtained by 24 farmers were arranged in descending order and divided into six groups (4 farmers in each group). The groups were named as G1, G2, G3, G4, G5 and G6. The range of score obtained by the respondents of six groups were described in Table 1.

For the purpose of item analysis, the middle two groups G3 and G4 were eliminated keeping four extreme groups with high and low scores. The data related to the correct response for all the items in respect of these four groups were tabulated for calculating the difficulty and discrimination indices. Selection of items for final format of the knowledge test was done based on the following criteria:

I) Item difficulty index-P

The index of item difficulty was worked out as the percentage of the respondents answering an item correctly. The assumption in this item index of difficulty was that the difficulty is linearly related to the level of farmer's knowledge about chickpea production. When a farmer answers an item, it was assured that the item was less difficult than his/her ability to cope with it. It was calculated by following formula:

$$pi = \frac{ni}{Ni} \text{x} 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where, pi= Difficulty index in percentage of the i^{th} item, ni = Number of respondents giving correct answer to i^{th} item, Ni = Total number of respondents to whom the i^{th} item was administered *i.e.* in the present case. An example of calculation of Difficulty Index (Pi) of item no. 24 was presented below:

$$\boldsymbol{p24 = \frac{ni}{Ni} \text{x} 100 = p24 = \frac{20}{24} \text{x} 100 = 83.33}$$

Note:
1) Range of **P** values for final selection of the item was 45 to 92 percent.
2) The **P** values for all items were listed in Table 3.

II) Calculation of discrimination index:

Item discrimination index indicates the ability of the item to differentiate the well informed farmers from the poorly informed ones. The $E^{1/3}$ formula was used in the present study for calculating the discrimination index. The formula used was as follows:

$$\mathbf{E^{1/3} = \frac{(S1+S2) - (S5+S6)}{N/3}} \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where, S1, S2, S5 and S6 are frequencies of correct answer in the group of G1, G2, G5 and G6, respectively. N= Total number of farmers in the item analysis. Example. Discrimination index of item 24 was calculated below

$$\mathbf{E^{1/3} = \frac{(4+4) - (3+2)}{24/3} = 0.375 \approx 0.38}$$

Note:

1) Discrimination index **($E^{1/3}$)** above 0.20 was considered for final selection of the item
2) The **$E^{1/3}$** values for all items were listed in Table 3.

III) Point bi-serial correlation:

The main aim of calculating point bi-serial correlation was to work out the internal consistency of items that is the relationship of total scores to a dichotomized answer to any given item. In a way, validity power of item was computed by correlation of individual item of whole test. Point bi-serial correlation for each of item to preliminary knowledge test was calculated:

$$\boldsymbol{r_{pbis} = \frac{Mp - Mq}{SD} \, x \sqrt{P.Q}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Where, $\boldsymbol{r_{pbis}}$ = Point bi-serial correlation, Mp = Mean of the total scores of the respondents who answered the item correctly, Mq = Mean of total scores of respondents who answered item incorrectly, SD = Standard deviation of entire sample, P = Proportion of respondents giving correct answer to item, Q = Proportion of respondents giving incorrect answer to item. For example, let's apply the formula for *rpbis* to the data for Item 24 in Table 3 (which we would expect to correlate with the total scores), Mean of the total scores of the farmers who answered the item correctly was 30.38; Mean of total scores of farmers who answered item incorrectly was 25.33; the standard deviation was 4.57; the proportion of farmers answering correctly was 0.81 and the proportion answering incorrectly was 0.19.

P = 395 [Summation of the scores obtained by 13 farmers passing the item (giving correct answer of item no. 24)]. **Mp** = 395/13= 30.38 (mean score). **Proportion of P** = number of farmers giving correct answers/total number of farmers = 13/16= 0.81

Table 1: Range of scores knowledge of chickpea obtained by the farmers

Group number	G1	G2	G3	G4	G5	G6
Score range	34-35	33	31-32	29-30	26-28	20-25
Number of farmers	4	4	4	4	4	4

Table 2. Reliability test on the knowledge test

Correlations			
		Odd	Even
Odd	Pearson Correlation	1	.969**
	Sig. (2-tailed)		.000
	N	18	18
Even	Pearson Correlation	.969**	1
	Sig. (2-tailed)	.000	
	N	18	18

**. Correlation is significant at the 0.01 level (2-tailed).

Q = 76 [Summation of the scores obtained by 3 farmers not passing the item (giving wrong answer of item no. 24)]. **Mq**= 76/3= 25.33. **Proportion of Q** = 3/16= 0.19. The proportion passing and failing for item 24 was 0.81 and 0.19 respectively.

When we apply $r_{pbis} = \frac{Mp-Mq}{SD}\ x\ \sqrt{P.Q}$ for item 24, we obtained

$\boldsymbol{r_{pbis\ 24}} = \frac{\mathbf{30.38-25.33}}{\mathbf{4.57}}\ \boldsymbol{x}\ \sqrt{0.81x0.19}$ **=** 0.43

The calculated point bi-serial correlation was tested with (n-2) degree of freedom

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad \text{..... (4)}$$

Where t = the t-value of correlation, r = point bi-serial correlation coefficient, n = number of farmers. The t-value of item 24, r_{pbis24}, n = number of farmers (n = 24-2=22) would be

$t = \frac{0.43\sqrt{22}}{\sqrt{1-0.43^2}}$= 2.23.

Since t-calculated (2.23) was greater than t-tabulated (2.07) at degree freedom of 22, it was significant at 0.05 level of probability. This meant that item 24 appears to be widely understood to the farmers out in the same way as the total scores understood by the farmers (Table 3). In this sense, the point bi-serial correlation coefficient indicated that item 24 discriminates well among the farmers in this group (in terms of the way the overall test discriminates). The correlation between item 33 and the total scores was a negative value of -0.04, and this item appears to be widely understood to the farmers out opposite to the way that the total scores understood by the farmers. In other words, the point bi-serial correlation coefficient shows that item 33 discriminates in a different way from the total scores at least for the farmers in this group. The correlation between item 34 and the total scores was zero and item 34 did not appear to be understood by all the farmers in the same way as the total scores. This means item 34 was not discriminating at all among the farmers in this particular group because there was no variation in their answers (see Table 3).

IV) Reliability of knowledge test:

Split-half method was employed to calculate the reliability coefficient value as split-half method is conceived as best of the methods for measuring test reliability and the main advantage is that all data for computing reliability are obtained upon one occasion which helped to eliminate the variations brought about by differences between the two testing situations (Garret, 2007).

V) Validity of knowledge test:

The validity of knowledge test was established through content validity. All possible care was taken in incorporation of the statements covering all aspects on full packages of chickpea production. All the statements were subjected to item difficulty, discrimination index and point bi-serial correlation before selection of the final statements. Hence it was logical to assume that the test satisfies representation as well as sensible method of test construction, the criteria for contest validity.

Method of Data collection and analysis

Face to face interview was employed to collect the data. The collected data were inserted to Microsoft excel and it was analyzed by SPSS version 20.

Table 3. Difficulty index, discrimination index and point bi-serial correlation of farmers on chickpea production

Item no	Frequencies of correct answers in four extreme groups				Total frequencies of correct answers (G1+…+G6)	Difficulty index-P (% of respondents giving the correct answers)	Discrimination index ($E^{1/3}$)	Point bi-serial correlation (r_{pbis})	t
	G1	G2	G5	G6					
1	4	3	3	3	21	87.5	0.13	0.26	1.27
2	4	4	4	3	23	95.83	0.13	0.13	0.61
3	4	3	3	3	18	75	0.13	0.19	0.91
4	4	4	4	3	23	95.83	0	0.13	0.61
5	4	4	2	1	18	75	0.63	0.34	1.69*
6	4	4	3	3	21	87.5	0.25	0.36	1.81*
7	4	4	4	2	22	91.67	0.25	0.56	3.17***
8	4	4	3	4	20	83.33	0.13	0.07	0.32
9	4	3	4	3	22	91.67	0	0.07	0.32
10	4	4	3	4	23	95.83	0.13	0.14	0.66
11	4	4	3	3	21	87.5	0.13	0.28	1.37
12	4	3	4	3	23	95.83	0.13	0.5	2.7*
13	4	4	2	0	15	62.5	0.63	0.63	3.81***
14	3	4	2	2	18	75	0.5	0.56	3.17***
15	4	4	4	3	23	95.83	0.13	0.22	1.06
16	4	4	2	2	20	83.33	0.5	0.64	3.81***
17	4	4	4	3	23	95.83	0.13	0.27	1.32
18	4	4	3	1	16	66.67	0.25	0.63	3.81***
19	3	3	2	2	19	79.17	0.38	0.42	2.17**
20	3	4	1	1	17	70.83	0.75	0.78	5.85***
21	4	4	4	1	20	83.33	0.38	0.72	4.87***
22	4	4	3	2	20	83.33	0.25	0.37	1.87*
23	3	4	4	3	22	91.67	0.13	0.25	1.21
24	4	4	3	2	20	83.33	0.38	0.43	2.23**
25	4	4	3	4	21	87.5	0.13	0.19	0.91
26	4	4	0	2	11	45.83	0.5	0.29	1.42*
27	3	3	2	3	19	79.17	0.38	0.36	1.81*
28	4	4	2	3	20	83.33	0.38	0.29	1.42*
29	4	4	4	4	24	100	0	0	0
30	4	4	2	1	14	58.33	0.38	0.03	0.14
31	4	2	2	1	11	45.83	0.38	0.44	2.3**
32	4	2	4	4	24	100	0	0	0
33	4	4	0	1	3	12.5	0	-0.04	0.19
34	0	1	4	4	24	100	0	0	0
35	4	4	4	4	24	100	0	0	0
36	4	4	4	4	24	100	0	0	0

*, ** and *** significant at 0.1, 0.05 and 0.001 respectively. There was a significant difference (t at different level) between the criterion scores of farmers who got the item correct and those who got it wrong. This meant that the right farmer got the item correctly. Thus, the item could be accepted as a valid discriminator between high or clever and low or weak farmers. In addition the item could be used to predict the overall performance of a farmers in the test.

RESULTS AND DISCUSSION

Reliability of knowledge test

In this method, 36 items were divided into two equal halves with odd numbered in one half and even number in the other. The scores of odd and even numbered items were ordered from lower to higher. Items were administered to 24 farmers. Thus, two sets of knowledge score were obtained. Then, co-efficient of correlation

Table 4. Categorization of respondents on the basis of their knowledge level (n = 24)

Knowledge categories	Mean score of range	Frequency	Percent
Low	Less than 24.87	3	12.5%
Moderate	24.87 up to 34.01	20	83.33%
High	Above 34.01	1	4.17%

between two sets of scores was computed and observed to be highly significant at 0.01 level (r value = 0.969) which indicates that the knowledge test is highly reliable (Table 2). Therefore, this test had high internal consistency for measuring knowledge of farmers on chickpea production.

Knowledge level of farmers on chickpea production

The items having difficulty index between 45-92, discrimination index above 0.20 and the point bi-serial correlation significant at 0.1%, 0.05 and 0.001% level were finally selected for final knowledge test. Based on these criteria, 15 items become the knowledge test of chickpea production. Therefore, the item number 5, 6, 7, 13, 14, 16, 18, 19,20,21,22,24,26,28 and 31 were selected based on their respective difficulty index, discrimination index and point bi-serial correlation significant (Table 3).

Categorization of farmers' knowledge on chickpea production

The mean and standard deviation of all the farmers' scores were computed for classifying the knowledge level in different categories. Based on the mean knowledge score and standard deviation three levels of knowledge of chickpea farmers were categorized under low, medium and high. The categorization was done according Meena *et al.* (2007): Low knowledge level = Less than (Mean knowledge – Standard Deviation), Medium knowledge level = From (Mean knowledge $\pm$ Standard Deviation) and High knowledge level = Above (Mean knowledge + Standard Deviation). Table 4 showed that majority of farmers (83.33%) owned moderate level of knowledge on chickpea production.

CONCLUSION AND RECOMMENDATION

Farmers have their own experienced knowledge on their farming activities. But they may lack knowledge when new technologies introduced to them. Knowledge is important for the increment of production and productivity of chickpea farmers. Different trainings and field days were organized each year to increase the knowledge of farmer on the technologies but there is no standard process of testing the knowledge of chickpea farmers. However, this study developed item test that measures the knowledge of chickpea producing farmers. It was observed that items constructed to test the knowledge of chickpea farmers were highly stable and dependable for measurement of knowledge of chickpea producing farmers. In addition, the findings of this item analysis revealed that majority of respondents owned moderate level of knowledge on demonstration of chickpea production. This indicated that demonstration of chickpea at Adola Rede increased the knowledge of farmers. There is a chance for the improvement of farmers' knowledge on chickpea production. Farmers Training Center established in each Kebele should be functioned to increase farmers' knowledge on chickpea production.

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Appendix-I. Knowledge of farmers on demonstration of chickpea production

I. Please say Yes or No

1. Chickpea is well adapted to your area.
2. Did you know how to plant chickpea?
3. Zero tillering is good for chickpea planting.
4. Chickpea planting is easy.
5. Raw planting of chickpea is difficult.
6. Chickpea is only used for household consumption.
7. Did you know chickpea production?
8. Chickpea is sown during early September month.
9. Chemical is not needed for chickpea production.
10. Sowing should done after land ploughed for three to four times.
11. Do you know that you should not enter the field after spraying chemical?
12. Can you show chickpea sowing to other farmers?

II. Say true or false

13. All chickpea varieties are matured at the same time.
14. Chickpea is used for soil fertility.
15. Fertilizer is not needed for chickpea production.
16. Chickpea did not select soil characteristics.
17. Entering chickpea farm during flowering did not affect the chickpea production.
18. Weeding during flowering did not affect the chickpea production.
19. Chickpea straw is used as feed.
20. Chickpea should be harvested as soon as it matured to avoid shattering.
21. Hand weeding is needed for chickpea production.
22. Hoeing is not needed for chickpea.
23. Chemical is applied after weeding is done.

III. Answer the following questions

24. Name two chickpea varieties
25. What is the seed rate of chickpea for one hectare?
26. What is the recommended spacing for the sowing of chickpea between rows?
27. What is the recommended spacing for sowing of chickpea between plants?
28. What is the recommended depth for planting of chickpea?
29. Which fertilizer is needed for chickpea production?
30. What is the recommended fertilizer rate for chickpea production for one hectare?
31. Name one chemical used to control pod borer
32. At what stage chemical is applied?
33. What rate of chemical is recommended for one hectare?
34. What are cautions needed in order to use chemical on chickpea?
35. How you thresh your chickpea?
36. How you can store your chickpea?

Appendix II. Abbreviations

CSA Central Statistical Agency
KM Kilo Meter
P Item difficulty index
$E^{1/3}$ Discrimination Index
R_{pbis} Point Bi-serial correlation
SPSS Statistical Package for Social Sciences