SOCIETY OF EXTENSION EDUCATION

RESEARCH ARTICLE

Development of a Scale to Measure Tribal Farm Women's Knowledge on Fruit Production Practices in Arunachal Pradesh

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ABSTRACT

The knowledge test was developed to measure the knowledge of tribal farm women of Arunachal Pradesh regarding fruit production. After substantial literature review 60 items were selected covering all important aspects of fruit production. The prepared item was precisely examined and revised by a panel of experts in the field of horticulture and extension education. Some items were reframed based of the suggestions made by the experts. The 58 items were considered for initial testing for developing a knowledge scale and were put down for item analysis. The prepared test was administered to 90 tribal farm women of Upper Subansiri district of Arunachal Pradesh for pre-testing through personal interview method from September- October 2021. Scores of one (1) and zero (0) were given for correct and incorrect responses respectively. For item analysis, item difficulty index and item discrimination index were calculated. For establishing internal validity of the knowledge check, point biserial correlation coefficient (rpbis) was found. Test of reliability was determined by Spearman Brown formula. The final scale consisted of 35 items placed under six fruit production messages namely, land preparation and planting, inter-culture operations, nutrient management, management of pest and diseases, harvesting and post-harvesting.

Key words*: Knowledge; Fruit Production; Tribal farm women.*

Knowledge is an important component of human behavior that plays a crucial role in overall behavior of a person. The level of consistent knowledge of participants can be known every so often through an appropriate knowledge test (*Chatterjee et al. 2020*).

Fruit production is the thorough culture of perennial plants to produce fruits having economic importance. Arunachal Pradesh is blessed with vast available land resource, suitable agro-climatic conditions for the full-fledged growth and development of horticultural crops. It is said that the state is the sleeping giant of Indian Horticulture because much more is yet to be explored in harnessing the full potential of the state for Horticultural development. Tribal farm women of Arunachal Pradesh have been participating in several fruit production operations with men contributing to a significant role in their family income. Their main work includes cleaning, land preparation, planting, harvesting, sorting, grading etc. Despite this, their work is not given any sole importance. However, the tribal farm women have inadequate knowledge which brings challenges for them to access information about the various available farm tools and latest technologies, finances, training activities, etc. It is the need of the hour that tribal farm women get the opportunity too and get the same level of training, technology, wages, etc as their male counterparts. Moreover, research studies on knowledge of tribal farm women in fruit production activities are scanty. Realizing the importance of the above facts, a knowledge test was developed to assess the knowledge of tribal farm women engaged in fruit production. A knowledge scale was developed and standardized adopting the procedure followed by *Gohain and Sharma (2019), (Malakarar et. al. 2020)* and *(Muyal et al. 2022)*.

METHODOLOGY

In order to measure the knowledge of tribal farm women in fruit production, a standardized knowledge

test was prepared. The procedure in developing a knowledge test is shown below:

Collection of item: Based on substantial literature review, discussions with experts, academicians, and researcher's own experience on the subject items about fruit production were collected. Initially 60 items were identified. The items highlighted major areas of fruit production and were according to the understanding of the tribal farm women.

Jury opinion: The 60 items collected were sent to a panel of 8 experts in fruit production and extension to check the relevancy of the items in accessing the knowledge of tribal farm women about fruit production. The experts were given the liberty to modify any of the items. The content validity of the knowledge items were judged in terms of clarity/ ambiguity and relevancy hence, 57 items grouped under 6 fruit production practices namely; land preparation and planting, inter-culture operations, nutrient management, management of pest and diseases, harvesting and post-harvesting were selected after considering experts advice.

Administration of knowledge test: The prepared test of 58 items was administered to 90 tribal farm women of Upper Subansiri district of Arunachal Pradesh in the non-sampled area for pre-testing through personal interview method. Scores of one (1) and zero (0) were given for correct and incorrect responses respectively. All selected items were asked in statement format which were answered as "Yes" and "No". Therefore, there was a possibility of respondents scoring the maximum points for all correct answers and zero for all wrong answers. Thus, the range of obtainable score was 0-58. The total score obtained by respondents on all items was considered as the knowledge score of the respondents. Therefore, on the basis of respondents' knowledge score, they could be categorized as low, medium and high knowledge.

RESULTS AND DISCUSSION

Item analysis: Item analysis was carried out by finding the item difficulty index and item discrimination index. Item difficulty index tells how difficult is the item; while the item discrimination index reveals the extent to which an item discriminates the well-informed respondents to the respondents who are poorly informed. The scores obtained by 90 respondents were arranged in descending order. The respondents were divided into six equal groups – G1,

G2, G3, G4, G5 and G6 with fifteen (15) respondents in each group. The range of score obtained by the respondents of 6 groups is given in Table 1.

Table 1. Score range obtained by respondents

S.N.	Scores out of 57	Respondents
G1	50-22	15
G2	21-17	15
G3	16-13	15
G4	12-10	15
G5	9-7	15
G6	6-2	15

For the purpose of item analysis, the middle two groups namely G3 and G4 were eliminated retaining only the four terminal groups securing high scores (G1 and G2) and with low scores (G5 and G6).

Item difficulty index (P) : Item difficulty was determined by the percentage of individuals able to pass each item. In practice, if an item is to distinguish among individuals, it should not be so easy that all persons can pass it, nor should be difficult that none are able to pass it.

The index of item difficulty indicated the extent to which an item was difficult. The item difficulty as worked out in the present study was P *i.e.* the percentage of respondents answering an item correctly. In the present study, item with P values ranging from 20 to 80 only was considered for the final knowledge test. It was calculated by the formula given below: No. of respondent's answer correctly

$$P = \frac{\text{No. of respondents correct answer}}{\text{Total no. of respondents}} \times 100$$

To illustrate P of item no.2 in table 2, it was worked out in the following manner:

$$P = \frac{16}{90} \times 100 \qquad P = 17.77$$

Item discrimination index (E1/3) : The second criteria for item selection were the discrimination index indicated by E1/3 value for an item. The function of item discrimination index is to find out whether an item really discriminates a well-informed respondent from a poorly informed respondent. The formula used is as follows:

$$E1/3 = \frac{(S1 + S2) - (S5 + S6)}{N/3}$$

Where,

S1, S2, S5 and S6 = frequencies of correct answers in groups G1, G2, G5 and G6 respectively.

N = Total No. of respondents in the sample analysis.

In the present study, the items with E1/3 values ranging from 0.20 to 0.73were considered for the final selection for inclusion in the knowledge test.

To illustrate, E1/3 of item no.1 in Table 2, it was worked out in the following manner:

$$E1/3 = \frac{(12 + 2) - (2 + 0)}{90/3}$$

$$E1/3 = 0.40$$

Point biserial correlation (rpbs) : For establishing internal validity of the knowledge check, point biserial correlation coefficient (rpbs) was estimated since the items were scored simply as '1' if correct and '0' if incorrect. According to *Garrett (1979)* point biserial r assume that the variable, which has been classified into two categories, can be thought of as concentrated at two distinct points along a graduated scale. The point biserial correlation of item no. 2 in Table 2. is .724** It was calculated using IBM SPSS software version 21.

Eventually, thirty-five (35) items having significant biserial correlation significant at 0.01 and 0.05 level of probability were selected for the final knowledge check grouped under 6 sub-heads (land preparation and planting, inter- culture operations, nutrient management, management of pest and diseases, harvesting and on post- harvesting) as depicted in Table 3.

Testing the reliability of the knowledge check : Test of reliability was determined by using the following formula:

$$rtt = \frac{n}{n-1} \times \frac{\sigma^2 t}{\sigma^2 t} \, \rho q$$

Where

rtt = Reliability coefficient of the whole test

n= Number of items in the test

σt = the SD of the test score

p = the proportion of the group answering a test items correctly

q = (1-p) = the proportion of the group answering a test items correctly.

A split half reliability coefficient of the test was also calculated by using the Spearman Brown formula on on SPSS software version 21. The reliability coefficient of the whole test was estimated from the formula

$$rtt = 2rh/1+rh$$

Where,

rtt = reliability coefficient of the whole test

rh = reliability coefficient of the half test found experimentally

Both these coefficients provide an estimate of the internal consistency of the test and thus the dependability of the test scores. According to Garett (1979), "the method of rational equivalence is superior to the split half in certain theoretical aspects, but the actual difference in reliability coefficient found by the two methods is often negligible". The fact was apparent in the present case.

Validity of the scale : The content validity was measured by the extent to which the items included in the test represent the total universe of fruit production by the tribal farm women. The universe of the content was covered through intense literature review and through interviews with several horticulture experts and extension personnel. Hence, it was assumed that the scores obtained by administering the knowledge test measures what it was intended to be measured. Moreover, the validity of the test item was also tested by method of point biserial correlation coefficient (rp bis). The items with highly significant biserial correlation coefficients at 0.01 and 0.05 levels of probability indicated the validity of items in relation to the knowledge test designed to measure the knowledge of rural women. The knowledge check developed could serve the purpose for measuring knowledge of tribal women about fruit production.

The final scale (Table 3) consisted of 35 statements in a two-point continuum of 'Yes' and 'No' assigned with a score of 1 and 0 respectively. These statements thus, were finally administered to the tribal farm women in order to assess their knowledge level on fruit production technologies.

CONCLUSION

The tribal women in Arunachal Pradesh play an important role in fruit production activities and have gratuitously contributed to their traditional farm practices and activities. Tribal farm women are in urgent need of acquiring knowledge and skill in fruit production activities as studies in the particular field suggested that most farm women have inadequate knowledge in fruit production that makes them dependent on their male counterparts for latest information, latest technologies, finances, training activities, etc. It is necessary to check the knowledge gap of these women regarding different fruit production activities in order to understand the knowledge of individuals as it helps in the learning process. Hence, a knowledge test was constructed in the present study. A valid knowledge test helps us to

Table 2. Knowledge item about fruit production activities with item difficulty index, item discrimination index and point biserial coefficient (N=90)

Knowledge item	P	E1/3	rbis
Land preparation and planting			
All fruits require fertile soil with good water-holding capacity.	21.11	0.19	1
Pit size is dug approximately twice the diameter of the root system of the fruit plant.	17.77	0.40	0.724**
Filling of the pit should be done with a mixture of sand, soil and farm yard manure in the ratio (1: 1: 1)	28.88	0.53	0.467**
The ideal pH range for most fruit crops is 5.2-5.8.	11.11	0.13	0.176
Mandarin orange planting is done during April to June.	20	0.33	0.414**
Contour system of orchard layout is generally followed on the hills with undulated topography.	18	0.09	0.101
Planting distance in most varieties of kiwi (Golden spur, Red chief, McIntosh, Golden Delicious) and sweet orange (Blood Red, Hamlin, Pineapple, Jaffa, Valencia) is 5m x5m.	22.22	0.60	0.279*
Kiwi plants are mostly propagated vegetatively through cuttings and grafting.	14.44	0.10	0.077
A green manure crop is grown to improve the physical and chemical conditions of soil before planting operations are taken up.	21	0.40	0.472**
Correcting the soil site problems before planting by adding amendments, organic matter is done about a year before planting.	30	0.43	0.320*
Inter-culture operations			
Mulching ads humus to the soil and keeps soil structure and controls weed.	68.88	0.33	0.427**
Propping in banana is done to balance the bearing plant.	61.11	0.45	0.494**
Smudging of fruit tree is done to maximize the attack of pest.	20	0.26	0.336**
Thinning is done to improve fruit size, colour and quality at fruit harvest.	23.33	0.26	0.402**
Earthing up of fruit plants helps in better anchorage of the fruit crop.	16.66	0.07	0.176
Wrapping of fruit is a technique that extends the shelf life.	26.66	0.30	0.352**
De-suckering is one of the major management practices in banana plantation that determines the size of bunches.	15.55	0.07	0.176
The safest time to prune most fruit trees is after harvest in evergreen plant and during dormant season in deciduous plant.	16.66	0.16	0.021
Pruning has strong influence on fruitfulness of deciduous fruits like peach, grapes and ber, plum etc.	13.33	0.08	0.108
Drip irrigation is the best available technology for fruit crop growers in hilly areas.	24.44	0.40	0.300*
Nutrient management			
Soil testing prior to planting takes helps in proper recommendation of fertilizer for desired fruit crop.	26.66	0.53	0.468**
Soil fertility can be maintained by application of farm yard manure, lime, inorganic fertilizer.	36.66	0.53	0.600**
Micronutrient deficiencies are quite very commonly observed in many citrus orchards.	11.11	0.13	0.176
Nutritional deficiency, particularly of N and K may lead to irregular bearing in fruit trees.	16.66	0.40	0.434**
Heavy use of inorganic fertilizers may lead to soil deterioration.	18.88	0.43	0.288*
Well decomposed compost is better source of organic manure than fresh cow dung that is used in fruit crops.	21	0.32	0.316*
Vermicompost can be used as another source of organic manure for fruit trees.	21.11	0.56	0.538**
Adequate manuring of young and mature papaya tree is essential to maintain the growth and vigour of the tree.	18.55	0.18	0.135
In addition to the major nutrients like N, P, K, Ca, Mg and S, citrus requires micro-nutrients like Zn, Cu, Mn, Fe, B, Mo, etc.	15.55	0.03	0.110
Management of pest and diseases			
Copper and sulphur containing products can control fungal and bacterial diseases in fruit trees.	17.77	0.06	0.114
Insects like aphids, caterpillar, borer, mites, moths, slugs, and maggots can all destroy fruit trees.	23.33	0.56	0.327*
Copper and sulphur containing products can control fungal and bacterial diseases in fruit trees.	12.22	0.18	0.140
"Apple scab" is one of the most common and most serious diseases in apple trees.	18.88	0.10	0.049
Growing marigolds, Sudan grass, or certain mustards (oilseed rape) for a year or two before planting fruit plants can help control certain parasitic nematodes.	7.77	0.03	-0.136
Removal and burning of infected leaves, twigs, and fruit from the area prevent the source of infection.	21.11	0.43	0.461**
Using pheromone traps, yellow stick tapes, breeding sterile insects is a technique for pest control in some fruit trees.	18.88	0.43	0.367**
Extracts of neem, dhatura, Calotropis, Pongamia, Callophylum and custard apple seeds can control a wide range of insects, bacteria, and some diseases.	20	0.40	0.336*
Trunk borer is a very damaging insect pest of mandarin orange in Arunachal Pradesh.	15.55	0.33	0.387**

Harvesting

Pre-cooling of fruits is done to reduce the deterioration process of fruits.	25.55	0.70	0.421**
Apple, grapes, kiwi and sweet orange are harvested through handpicking.	18.88	0.06	0.043
The peak harvesting season of kiwi fruit starts from November to mid-December.	23.33	0.56	0.477**
Mandarin orange is harvested using ladder or fruit picker in order to prevent injury and loss of fruit crop.	26.66	0.46	0.614**
Most fruits are picked when ripe properly.	25.55	0.09	0.048
Pineapple is harvested when it turns yellow in colour.	26.66	0.05	0.039
Jack fruit matures towards the end of summer in July and is harvested by cutting the stalk end.	26.66	0.40	0.541**
The peak harvesting period for peach is mid-June to mid-July.	14.44	0.05	0.210
Banana is harvested when the fruit ridges changes from angular to round instead of drying leaving	23.33	0.50	0.434**
Absence of latex on scratching of fruits is an indication of maturity of mango and papaya.	26.66	0.36	0.269*

Post- Harvesting

Grading and sorting of fruits helps the grower to get better price as well as the consumer to get quality product with respect to price of the commodity.	21.77	0.46	0.319*
The shelf-life of guava fruit at room temperature is relatively short due to rapid development of fungal rots.	23.33	0.33	0.466**
Temperature plays a crucial role in the shelf life of fruit crop during the storage period.	22	0.26	0.336**
Kiwi fruit can be stored at 0 degree with a relative humidity of 90-95 percent for up to 6 months.	25.55	0.39	0.472**
De-handing is done in banana.	15.55	0.06	0.217
Wrapping the guava fruits in newspaper enhances the shelf life of fruits by 3 days.	7.77	0.03	0.087
Maximum storage life can be achieved by storing only undamaged produce at lower temperature tolerable by the fruit crop and at the Relative Humidity appropriate for the fruit crop.	19.11	0.17	0.117
To remove field heat and remain fruit in turgid condition, fruit should be harvested during morning time.	8.88	0.04	0.083
Edible coatings (waxes) are applied to apples to enhance shelf-life.	31.11	0.73	0.369**
Cleaning and sanitization of containers or bins used for transfer and storage of fruit is essential.	25.33	0.73	0.417**

**Significant at the 0.01 level (2-tailed); *Significant at the 0.05 level (2-tailed)

Table 3. The scale developed to measure the knowledge of tribal farm women on recommended fruit production technologies

Statements	Yes	No
Land preparation and Planting		
A green manure crop is to be grown to improve the physical and chemical conditions of soil before planting operations are taken up.		
Mandarin orange planting is to be done during April to June.		
Planting distance in most varieties of kiwi (*Golden spur, Red chief, McIntosh, Golden Delicious*) and sweet orange (*Blood Red, Hamlin, Pineapple, Jaffa, Valencia*), and Mandarin (Khasi Mandarin) is 5m x5m.		
Pit size is to be dug approximately twice the diameter of the root system of the fruit plant.		
Filling of the pit should be done with a mixture of sand, soil and farm yard manure in the ratio (1: 1: 1)		
Correcting the soil problems before planting by adding amendments, organic matter is to be done about a year before planting.		
Inter-culture operations		
Wrapping of fruit is a technique that extends the shelf life.		
Smudging of fruit tree is done to minimize the attack of pest.		
Drip irrigation is to be done for fruit crop growers in hilly areas.		
Thinning is to be done to improve fruit size, colour and quality at fruit harvest.		
Mulching adds humus to the soil and increase soil structure and controls weed.		
Propping in banana is to be done to support the bearing plant.		
Nutrient management		
Vermicompost can be used as another source of organic manure for fruit trees.		
Soil fertility can be maintained by application of farm yard manure, lime and inorganic fertilizers.		
Nutritional deficiency, particularly of N and K may lead to irregular bearing in fruit trees.		
Soil testing prior to planting helps in proper recommendation of fertilizer for desired fruit crop.		
Well decomposed compost is to be used as a better source of organic manure than fresh cow dung that is used in fruit crops.		

Heavy use of inorganic fertilizers may lead to soil deterioration.

Management of pest and diseases

Using pheromone traps, yellow stick traps, breeding sterile insects is a technique for pest control in some fruit trees.

Extracts of neem, dhatura, Calotropis, Pongamia, Callophylum and custard apple seeds can control a wide range of insects, bacteria, and some diseases.

Trunk borer is a very damaging insect pest of mandarin orange in Arunachal Pradesh.

Insects like aphids, caterpillar, borer, mites, moths, slugs, and maggots can all destroy fruit trees.

Removal and burning of infected leaves, twigs, and fruit from the area are to be done to prevent the source of infection.

Harvesting

Pre-cooling of fruits is done to reduce the deuteriation process of fruits

The peak harvesting season of kiwi fruit starts from November to mid-December.

Banana is to be harvested when leaves get dried instead of the fruit ridges changes from angular to round.

Jack fruit matures towards the end of summer in July and is harvested by cutting the stalk end.

Absence of latex on scratching of fruits is an indication of maturity of mango and papaya.

Mandarin orange is to be harvested using ladder or fruit picker in order to prevent injury and loss of fruit crop.

Post-harvesting

Edible coatings (waxes) are applied to apples to enhance shelf-life.

Kiwi fruit can be stored at 0 degree with a relative humidity of 90-95 per cent for up to 6 months.

Grading and sorting of fruits helps the grower to get better price as well as the consumer to get quality product with respect to price of the commodity.

The guava fruit cannot be kept for longer period in room temperature due to rapid development of fungal rots

Temperature plays a crucial role in the shelf life of fruit crop during the storage period.

Cleaning and sanitization of containers or bins used for transfer and storage of fruit is essential.

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analyze the accurate knowledge level of the individual *(Bharti and Sagar, 2022).* The knowledge test covered all the important aspect of fruit production (land preparation and planting, inter-culture operations, nutrient management, management of pest and diseases, harvesting and post-harvesting) as included in the present study. This test can be helpful for researchers and extension personnel to serve as a readymade reference for carrying out further studies in knowledge of fruit production and related areas.

CONFLICTS OF INTEREST

The authors have no conflict of interest.

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