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Informal Trees Germplasm Dealers and Their Germplasm Source to Ensure Role of Trees in Climate Change Mitigation in Case of Arsi Zone, Ethiopia

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Abstract
Nurseries demands for trees germplasm remains unfulfilled and supplying quality trees germplasm were inconsiderate of informal trees germplasm dealers. It could worsen the quality of seedlings and their trees. This study was aimed to identify and describe the informal trees germplasm dealers and their germplasm sources. Thus total of ten nurseries were observed and 56 respondents were selected and interviewed**.** The analysis of variance was used for analysis. From total number majority of germplasm suppliers were General agro-dealers and farmers. The trees germplasm supply were the major source of income for licensed forest experts. Seed and vegetative propagative were types of planting material supplied to nurseries. Majority of tree seed were supplied by General agro-dealers while vegetative propagative were by Investors. The highest amount of tree seeds were supplied for fodder (28.4%) and watershed management (22.5%) whereas vegetative propagative were for fruit (85.1%). The main suppliers and source of tree germplasm for different uses was different. For example, majority of fruit seed and vegetative propagate were supplied by investors and licensed forest experts. The leading source of fruit and timber trees seeds were farmland and planted forest respectively. Right agro ecology, easy accessibility, secure source and cheap price were highly considered in selection of trees germplasm source. Germplasm quality were not of high priority to most of the informal germplasm dealers when procuring germplasm due to scarcity of high quality source, and low attention of many and awareness of few dealers to select high quality source. Awareness creation for informal trees germplasm dealers and facilitating the establishment of trees germplasm orchards are very important for quality trees germplasm supply.
Keywords: Informal germplasm dealers, Seed source, Vegetative propagative

1. INTRODUCTION

1.1. Background of the study

Reproductive material, planting material or germplasm; seed and cuttings or grafts, are the most precious resources for nurseries since almost all trees and shrubs grow from them (Walelign, 2008). Nursery acquire tree germplasm from informal and formal germplasm dealers/suppliers. The nursery self-collection is the system by which locally available seed is collected by nursery workers themselves while others informal suppliers could be any other traditional private supply system. The formal tree germplasm dealers are those from which nurseries obtain seed of relatively good in provenance (Dedefo, *et al*., 2016). The trees germplasm dealers and source could determines the quantity, quality and cost of tree germplasm (Cromwell, *et al*., 1993).

Collecting germplasm from high quality mother tree may mean that the farmer plants better seedling then the growth and survival of out planted trees could be superior. Seedling raised from high quality germplasm would minimizes cost of seedling production, grow faster and normally with little or no infection by diseases and pests, hardness of plant tissue, uniformity in seedling shape and size and quality trees (Mbora, *et al*.,2009 and Garrity, *et al*., 2010). A good quality tree then gives quality output or services in plantation (Gregorio, *et al*.,2005 and Villar-Salvador, *et al*.,2006). Good plantations raised from good quality seedling can often be used as seed sources as well. Thus it is better to produce a few good quality seedlings than many poor ones to optimize the best use of labor and land resources (Walelign, 2008; Berhe, *et al*., 2010 and Shafiqul-Islam, 2011).

Production of quality tree seedling is very important to maintain forest and diversify agricultural product, and to achieve every plantation activities or else it could result in serious ecological and socio-economic problems (Shafiqul-Islam, 2011). Because utilization of the forest for construction, fuel wood, charcoal production, cultivation, overgrazing and exploitation without replacement could be exacerbated when poor quality seedlings have been failed to survive in plantation site (Lemenih and Kassa, 2011a). The farmers need for trees seedlings remains unsatisfied because of inadequate supply or poor quality seedling. The formal trees germplasm supply was less than nurseries demand in Ethiopia (Derero, 2012). Dedefo, *et al*. (2016) also reported that highest amount (87%) of trees germplasm of low quality were being supplied to nurseries of Oromia regional state by informal trees germplasm dealers. If poor quality of tree seed is sown, it worsens the quality of seedlings and their trees. In addition to this, there is a research gap at study area on ongoing information on informal trees germplasm dealers and their seed source towards quality tree seedling production. Thus this study was to identify and describe the Informal trees germplasm dealers and their germplasm in Arsi zone, Oromia region, Ethiopia. For every successful trees plantation to happen, it is very important to have good germplasm

and seedling quality (Dedefo, *et al*, 2016).

2. MATERIALS AND METHODS

2.1. Description of study area

The Informal germplasm dealers' survey was conducted in four districts of Arsi Administrative Zone, Oromia regional state. It is located at 175km to south eastern of Addis Ababa, the capital city, of Ethiopia. Its elevation ranges from 1600 to 3800 m a.s.l., with mean annual temperature ranging from 11 to 27 °C. Its mean annual rainfall ranges from 200 to 2400 mm with Brown, Red and black soil types in decreasing order of their proportion (MOA 2007). Geographically it is located at latitude of 7˚10'15" - 8˚42'23" N and longitude of 38˚41'9" - 40˚43'44" E (Figure 1).

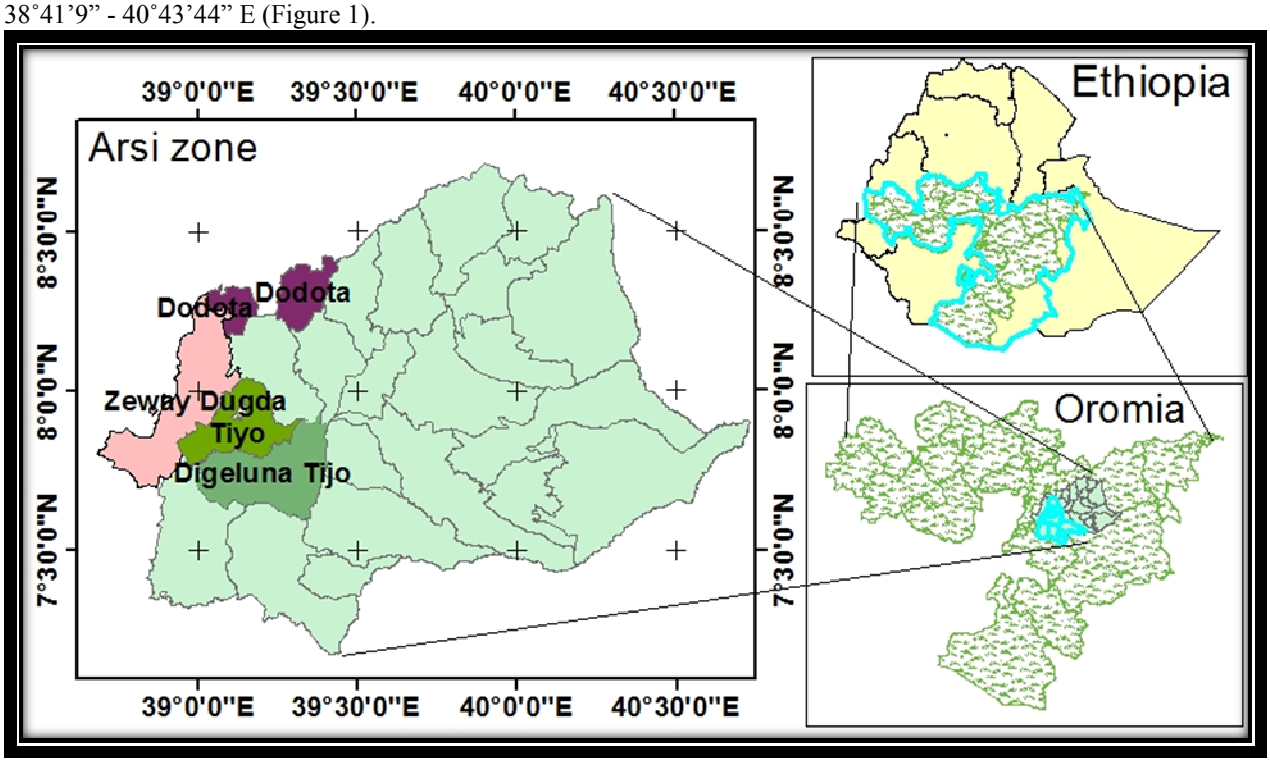

Figure 2: Map of study area drown by using GIS (Arcmap-vesion-10.3)

2.2. Sampling Techniques

Two districts from each of two traditional agro-ecological zones were selected as representative based on the secondary information acquired on germplasm supply system in Arsi Zone. Two districts selected from Dega were Digelu Tijo and Tiyo districts and those of two from dry weyna-dega area were Dodota and Zuway Dugda districts. Dega areas have an elevation from 1900 to 3800 m a.s.l., with mean annual temperature ranging from 11 to 21 °C. Its mean annual rainfall ranges from 900 to 2400 mm. Whereas, the Dry weyna areas are located at elevation from 1600 to 1900 m a.s.l., with mean annual temperature ranging from 20 to 27 °C. Its mean annual rainfall ranges from 200 to 1200 mm (MOA 2007). A total of ten nurseries were seen: five nurseries from each of the Dega and the Dry weyna dage areas.

The respondents targeted for interviews included the people with direct and indirect involvement in informal germplasm supply including: dealers, nursery sta (owners, foremen or employees) in the ten nurseries, forestry experts at zone and districts level as well as development agents of natural resources at Kebele level (the lowest administrative unit in Ethiopia) where selected nurseries found. A list of all informal trees germplasm dealers, those had been supplying germplasm of at least three tree species within the selected districts in consecutive three years before the study was conducted, were obtained from the districts' Agricultural offices. The listed germplasm dealers were then classified into five groups based on their status (specialization and dealing kinship), namely: farmers, any investors, general agro-dealers (GAD), licensed forest experts (LFE) and government expert. Farmer are those suppliers' collects and supply trees germplasm to nurseries or any other germplasm dealers. Investors are the juice seller who supply its germplasm to nurseries as well. General agro-dealers are those supply trees germplasm to nurseries besides crops seed to farmers. Licensed forest experts are those first collects and/or purchases germplasm from farmers then supply them to nurseries. Unlike other germplasm suppliers the Gov't experts are those working in government office and purchases germplasm from farmers then supply them to nurseries informally. They are termed informal because they are traditionally

organized and managed, flexible and dynamic, local or regional in scope, and undocumented (Mbora and Lillesø, 2007 and Gill, *et al*.,2013).

The purposive and random sampling techniques were applied to select respondents. Since each of the ten identified nurseries had a single foreman, they all were selected for interview. Similarly, since the nurseries were located in ten di erent kebeles, a natural resources development agent (DA) from each kebele was included in the survey. In addition, two forestry or a natural resource management expert from each of the four districts and two additional expert working at Zone level were included in the list. Furthermore, one respondents from the existing nursery employees were added randomly. Additional sixteen informal germplasm dealers were also included in the survey. Eventually, a total of 56 respondents were identified: 40 of them were experts and operators in nurseries, and 16 of them from other informal trees germplasm dealers (table 1).

Table 1: Selected districts and respondents

No		Respondents and of selected districts					
		Dega		Dry weyna dega			
		Z/Dugda	Dodota	D/Tijo	Tiyo	Other	Total
	Respondents & nurseries	No	No	No	No	No	No
A	Nursery selected	3	2	3	2		10
B	Nursery experts						
1	Zone experts					2	2
2	District experts	2	2	2	2		8
3	Das	3	2	3	2		10
4	Nursery Operator	3	2	3	2		10
5	Nursery Forman	3	2	3	2		10
	Sub total experts.	11	8	11	8	2	40
C	Germplasm dealers						
1	Farmers			1	1	2	4
2	Investors		1		2		2
2	GAD	1	1	2			6
3	LFE				1	2	2
5	Gov't Expert			1	1		2
	Sub total dealers	1	2	4	5	4	16
	Overall respondents	12	10	15	2	6	56

2.3. Method of data collection

2.3.1. Primary data collection

Prepared questionnaire were used for undertaking the primary data collection. The questionnaire was focused on the informal trees germplasm dealers' characteristics and germplasm source. The questionnaires were tested and revised as appropriate before the final administration. The primary data were collected though observation and interview. Initially observation of currently available tree species being supplied, equipment and number of nurseries in each districts were seen in order to get existing the information about germplasm tag, germplasm management methods and overall informal germplasm dealers' status. For this case total of ten nurseries site were visited. Secondly, selected informal tree germplasm dealers, nursery foreman and employees, DA and experts (table 1) were interviewed on information about overall germplasm source in general. Hence, totally 56 respondents were interviewed to capture information related to informal germplasm supply systems and their germplasm**.**

2.3.2. Secondary data collection

Secondary data was collected through review of past literature and extraction of data from records on informal germplasm supply systems in Arsi zone. These reviewed relevant sources were reports and unpublished documents concerning trees germplasm supply systems.

2.4. Data analysis

Data collected by interviews was analyzed using SPSS version 20 software (statistical package for social science). The ANOVA (analysis of variance) was used to see the response of explanatory variable to predictors at 5% level significance. Qualitative data was analyzed after interpretation and organization of the respondents' opining. The analyzed data was summarized in narrative form and presented in descriptive manner.

3. RESULTS

3.1. Informal trees germplasm suppliers/dealers

3.1.1. Types informal trees germplasm suppliers and their relation with supply

Five types of informal trees germplasm suppliers in Arsi administration zone were identified. Out of the surveyed informal tree germplasm suppliers, more than half were General agro-dealers (37.5%) and farmers (25%). Similarly Kinuthia, *et al*. (2012) also realized that nursery workers and casual laborers of Ethiopia were involved in seed collection and paid in cash. Based on their planting material, two types of germplasm were supplied to Arsi zone named; seed and vegetative propagative. From total supply, majority (78.5%) of tree seed were supplied by General agro-dealers while most (77.3%) of vegetative propagate were supplied by Investors (table 2). Two relation of informal tree germplasm dealers with their trees germplasm supply were recorded: the dealers, whose germplasm supply were their major source of income and the one for whom it was additional source of income. All informal germplasm dealers whose trees germplasm supply are their main source of income were licensed forest experts (50%) and General agro-dealers (33.3%). Whereas germplasm supply are their additional source of income for other. In line to this finding Derero (2012) identified that the informal seed dealers in Ethiopia were contributed 68% of trees germplasm supplied to nurseries. Dedefo, *et al*. (2016) also reported that nurseries in Oromia regional state were obtained a few seed of relatively good in provenance from formal seed system.

Table 2: Role of germplasm suppliers for informal trees germplasm dealers

Category of informal tree germplasm dealers	number of informal germplasm dealers		Relation of tree germplasm suppliers			
			germplasm supply as major income		germplasm supply as extra income	
	No	%	No	%	No	%
Farmers	4	25	0	0	4	100
Investors	2	12.5	0	0	2	100
General agro-dealers	6	37.5	2	33.3	4	66.7
licensed forest experts	2	12.5	1	50	1	50
NRM experts in Gov't office	2	12.5	0	0	2	100
Total	16		3	18.8	13	81.2

3.1.2. Types of germplasm and reason of their production

According to respondents, based on uses of their products, five benefits (figure 2) of supplied trees germplasm were prominent in Arsi zone. Similar classification of trees seed in to purposes of their production in case of Oromia regional state were also reported by Dedefo, *et al*. (2016). Out of those germplasm supply; the highest amount of tree seeds were supplied for fodder (28.4%) and watershed management (22.5%). The highest amount of tree vegetative propagative were supplied for fruit (85.1%) and watershed management (8.9%). In line to this finding Kinuthia, *et al*. (2012) was showed that the national demands for fruit tree germplasm can be much higher than the current supply in Ethiopia.

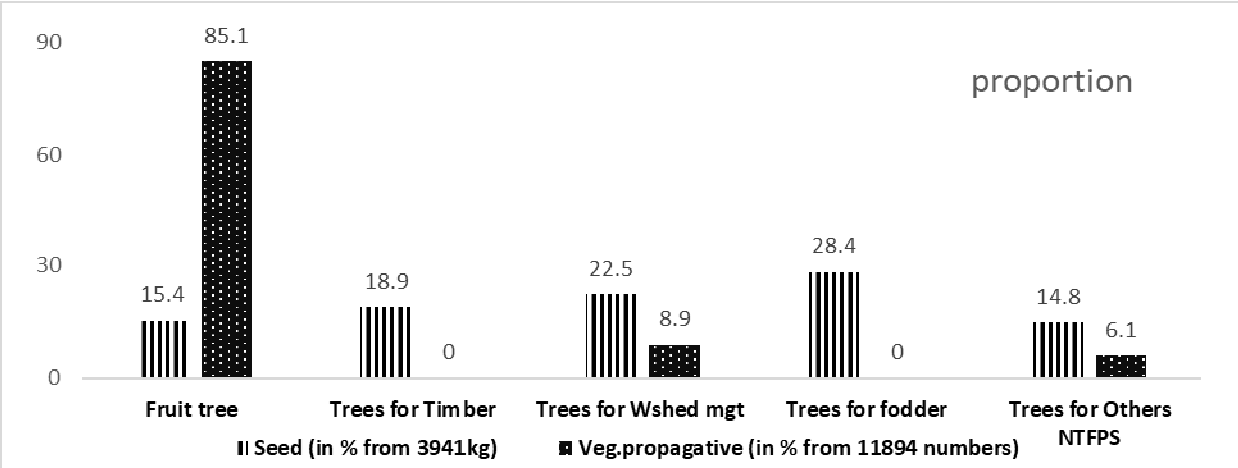

Figure 3: Types of germplasm and their uses

3.1.4. Types of germplasm supplied by Informal trees germplasm dealers

Concerning types trees and their germplasm dealers; majority of fruit trees seed was supplied by investors (66.3%) and licensed forest experts (27.1%). Majority of timber trees seed was supplied by farmers (56%) and General agro-dealers (37%). Majority of trees seed for watershed management was supplied by licensed forest experts (63%) and General agro-dealers (26%). Majority of trees seed for fodder was supplied by General agro-dealers (53%) and licensed forest experts (31%). Majority of trees seed for NTFPS was supplied by licensed

forest experts (50.9%) and General agro-dealers (49.1%). In case of Vegetative propagative all of planting material for fruit, watershed management and NTFPS were supplied by licensed forest experts, farmer and General agro-dealers respectively (table 4). The planting material (germplasm) in this finding concise with others study conducted in Africa (Mbora and Lillesø 2007; Mbora, *et al*,. 2009 and Dedefo, *et al*., 2016)

Table 3: Contribution of informally trees germplasm dealers in relation to uses of their trees

Types of germplasm		Farmers		Investors		General agro-dealers		licensed forest experts		Gov't expert	
	Category	No	%	No	%	No	%	No	%	No	%
Seed (n=3941 in kg)	Fruit tree (n=606 kg)	40	6.6	402	66.3	0	0	164	27.1	0	0
	Trees for Timber (n=744)	417	56	0	0	275	37	0	0	52	7
	Trees for Wshed mgt (n=888)	0	0	0	0	231	26	559	63	98	11
	Trees for fodder (n=1120)	0	0	0	0	594	53	347	31	179	16
	Trees for Others NTFPS (n=583)	0	0	0	0	286	49.1	297	50.9	0	0
	Total seed (n=3941)	457	11.6	402	10.2	1386	35.2	1367	34.7	329	8.3
Veg.propagative (n=11894 in no)	Fruit tree (n=10120)	0	0	0	0	0	0	10120	100	0	0
	Trees for Wshed mgt (n=1053)	1053	100	0	0	0	0	0	0	0	0
	Trees for Others NTFPS (n=721)	0	0	0	0	721	100	0	0	0	0
	Total	1053	8.9	0	0	721	6.1	10120	85.1	0	0

3.2. Sources of germplasm and the main reason for procuring

3.2.1. Mapping trees germplasm follow direction to Arsi zone

Out of nine regional state of Ethiopia, more than half (52%) of tree germplasm, supplied to Arsi zone by informal germplasm dealers, were obtained from southern nation and nationality region. Whereas 39% and 9% of them where obtained from Oromia and 9% from Amara region respectively (figure 3). Even though highest proportion of forest coverage of the country is in Oromia region it has not been used as germplasm source. However, out of nine regional state, the highest coverage (35.86%) of forests in the Ethiopia are found in Oromia region (Farm Africa, 2015).

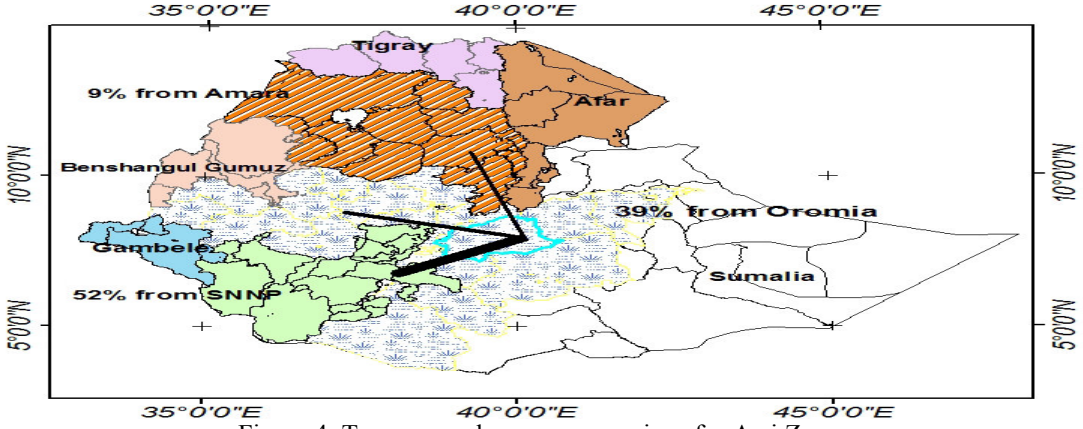

Figure 4: Trees germplasm source regions for Arsi Zone

3.2.2. Sources of trees germplasm

As shown in table 5, four sources of trees germplasm were reported by informal trees germplasm dealers. Almost all fruit and NTFPS trees seed were collected from farmland and Planted forest. The main source of timber trees seed were planted forest (56.3%) and natural forest (31.2%). The main source of trees seed for watershed management were any tree stand (43.8%) and natural forest (37.5%). And that of trees seed for fodder were any tree stand (62.5%) and planted forest (31.3%). The main source of vegetative propagative for fruit, watershed management and NTFPS were Farmland (100%), Natural forest (56.3%) and any tree stand (100%) respectively. In line to this similar classification of trees seed sources' were described by Mbora, *et al*. (2009). Similarly the study conducted in Ethiopia by Kinuthia, *et al*., (2012) also reported the local collection takes place in natural forests, farm lands, someone woodlots, streets, religious institute, the government and NGO nurseries and research centers. Gaur, *et al*., (2010) also reported that trees grown by germplasm from good source and supply

system would be healthy, grow vigorously and deliver products of high quality.

Table 4: Sources of trees germplasm

Category of germplasm		Source of Germplasm (n=16)							
		Any tree stand		Planted forest		Natural forest		Farmland	
	Purposes of production	No.	%	No.	%	No.	%	No.	%
Seed	Fruit tree	0	0	0	0	0	0	16	100
	Timber tree	2	12.5	9	56.3	5	31.2	0	0
	Wshed mgt trees	7	43.8	3	18.7	6	37.5	0	0
	Trees for fodder	10	62.5	5	31.3	1	6.2	0	0
	Trees of NTFPS	0	0	16	100	0	0	0	0
	Total	19		33		12		16	
Vegetative propagative	Fruit tree (10120 in no.)	0	0	0	0	0	0	16	100
	Trees for Wshed mgt (1053 in no.)	7	43.7	0	0	9	56.3	0	0
	Trees for Others NTFPS (721 in no.)	16	100	0	0	0	0	0	0
	Total					9			

3.2.3. The main reason for procuring trees germplasm from existing sources

The source of trees germplasm could determines the quality and cost of out planted tree seedling. The main reason for selecting the source of trees germplasm could be more than list. However informal trees germplasm dealers considered eight criteria of trees germplasm source selection (table 6). Right agro ecological zone (AEZ), easy access and secure source were fully (100%) considered, and Cheap price/free (87.5%) was highly considered in selection of germplasm sources to collect trees germplasm from. while well pollinated tree was no considered. This indicate that the genetic and physiological quality of trees germplasm, were not of high priority to most of the informal germplasm dealers when procuring germplasm. The experts attributed this mainly to low concern of many and awareness of few informal trees germplasm dealers to collects germplasm of high quality, and scarcity of high quality source. This finding concise with that of Mbora, *et al*,. (2009) and Dedefo, *et al*. (2016).

Table 5: Criteria of germplasm supplier to select the source of trees germplasm

		G. dealers (n = 16)		N. operators (n = 40)		Total (n = 56)	
Reasons	Category of reasons	No.	%	No.	%	No.	%
Main reason for collecting from such germplasm sources	At right AEZ	16	100	40	100	56	100
	Well pollinated tree	1	6.3	1	2.5	2	3.6
	Appropriate no.of M.tree	3	18.8	5	12.5	8	14.3
	Performed good mother tree	11	68.8	40	100	51	91.1
	Easy access	16	100	40	100	56	100
	Only available	14	87.5	33	82.5	47	83.9
	Secure source	16	100	40	100	56	100
	Cheap price	16	100	33	82.5	49	87.5

4. Conclusion and Recommendation

Based on their planting material two types of germplasm, seed and vegetative propagate, were supplied to nurseries by five types of informal germplasm dealers. Majority of tree seed were supplied by General agro-dealers whereas majority of Vegetative propagative were supplied by Investors. From total number majority of informal germplasm suppliers were General agro-dealers and farmers. Trees germplasm supply were the main source of income for majority of licensed forest experts. The highest amount of tree seeds were supplied for fodder (28.4%) and Watershed management (22.5%). And that of vegetative propagative were supplied for fruit (85.1.%) and Watershed management (8.9%). Majority of fruit trees seed was supplied by investors (66.3%). Majority of timber, watershed management, fodder and NTFPS trees seed was supplied by farmers (56%), licensed forest experts (63%), General agro-dealers (53%) and licensed forest experts (50.9%) respectively. All vegetative propagative for fruit, watershed management and NTFPS were supplied by licensed forest experts, farmer and General agro-dealers respectively. The source of seed for all fruit and NTFPS trees were farmland and Planted forest. The main source of seed for timber and watershed management trees were planted forest (56.3%) and any tree stand (43.8%) respectively. It was also any tree stand (62.5%) for fodder trees seed. The main source of vegetative propagative for fruit, watershed management and NTFPS were Farmland (100%), Natural forest (56.3%) and any tree stand (100%) respectively. Right agro ecology (100%), easy accessibility (100%), secure source (100%) and cheap price (87.%) were highly considered in selection of germplasm source.

Whereas germplasm quality were not of high primacy to most of the informal germplasm dealers when procuring trees germplasm mainly due to scarcity of high quality source. In order to strengthen the informal germplasm dealers' contribution in trees germplasm supply, wider and better awareness creation to them on selection of trees germplasm source is vital. Facilitating the establishment of trees germplasm orchards at suitable area to harvest high quality trees germplasm is also quit important.

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