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Comparative Study of Seedlings Production in Traditional and Modern Nurseries in Khartoum State Localities

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Abstract

The study was carried out in Khartoum state at the level of itslocalitiesin order to assess, compare problems face seedlings production in traditional and modern nurseries. Main objectives are to put on table recommendations to balance supply and demands of plant seedlings to fulfill needs. The study targeted related stakeholders, in various aspects of plant nurseries. The methodology conducted through questionnaires by a split across stakeholder survey and focus groups formats to answer questions related to the objectives. It employed analysis of current and past archival reports, documents, interview with key stakeholders and personnel, official authorities, in Khartoum state municipalities. The results show nurseries areas are in range of 20-35 metre square present 98.9% and significant differences ($p > 0.05$) in respondents for area for establish traditional and modern nurseries(Table 1). Significant differences manifest by respondents in both nurseries seedlings production capacities that show a significant difference ($p < 0.05$) in seedlings production by respondents (57.8%) in traditional nurseries comparable to (100%) modern nurseries(Table 2). Seasons of seedlings production showed significant differences ($p<0.05$) by respondents in summer (100%) in modern and (6.7%) in traditional nurseries. The traditional nurseries gave a low value (17.8%) comparable to high percentage (54.4%) in modern nurseries in autumn and winter.Significant differences ($p < 0.05$) were shown by respondents in number of permanent workers in traditional nurseries (37.8%) comparable to (100%) in modern nurseries. Significant differences ($p < 0.05$) between respondents' frequencies employment in tradition and modern seedlings production nurseries (72.2%) and (15 .8%) respectively (Table 4). It is recommended to develop nurseries, regulations and requirements to be taxes free.

Keywords: Planttradition, modern nurseries, nursery development, seedlings production.

Introduction

Generally in nurseries seedling production is a major expense of a forestation, and production of good quantity of seedlings with feasible cost can contribute in mass productionof seedlings. Seedlings produced through traditional or modern technologies, each has its advantages and disadvantages. However agricultural production systems across most of dry regions of the world of which African ones are faced by multiple range of biophysical, socioeconomic and political constraints. Ultimately the regions suffer from vicious cycle of low productivity, low levels of investment, and land degradation. The main causes are encountered in conflicts, harsh climatic conditions such as low and unreliable rainfall, frequent droughts, fragile ecosystem that resulted in low and declined land productivity (Salaheldin, 2006). Recently forest and land degradation is worldwide crisis that requires multiple approaches to mitigate as well as the anticipated effects of climate change (Halme*et al*. 2013; Laestadius*et al*. 2015; Sabogal*et al*. 2015; Stanturf*et al*. 2014a; 2014b), in Sudan however the forest cover has been estimated to be 10% of Sudan area(FNC, 2017). As the world population increased, needs for food crops products, shrubs, trees for plantations, restoration and sustainable use of land, all are becoming more urgent. Consequently emerge sudden increase in demand for commercial, food crop plants, medicinal and spiritual purpose, seeds, nursery seedlings of trees, shrubs of high quality and yield to fulfill needs of various agriculture plantations (Gregorio *et al.*, 2015; Harrison *et al*., 2008; Keirungi and Fabricius, 2005). There are several types of nurseries identified; private, community, or research and training and commercial ones (Munjuga*et al*., 2013).The permanent nurseries traditional or modern, large or small are pond on their objectives such as; number of seedling required or raised annually or seasonally for various plantations programmes. Moreover in nurseries foresters and horticulturists can afford to provide growing condition to raise healthy and vigorous plants. Recently nurseries types described as, retail nurseries that sell seedlings to public; wholesale nurseries sell seedlings to stakeholders, commercial gardeners and; private nurseries supplement needs of institutions and private states. Generally whatever is grown in nursery for out planting is called Nursery stock. Moreover nurseries supply seedlings plants for landscape, agriculture and farming programmes and biodiversity conservation(Joel and Vincent, 2016).

Objective of the study: Therefore the study objectives were conducted to investigate, assess and comparesome various components that affect practices positively or negatively quantitative and qualitative seedlings production between traditional and modern nurseries in Khartoum state Localities.

Materials and Methods

Sampling and data collection

Sample size: Sample size was determined according to assessment of the average numbers of nurseries available at the localities of Khartoum State, institutions and private ones. The sample size was 5% (East Nile 110, Khartoum 140, and Um Badh 12, Jabal Awlia 85, and Karrary 95 nurseries) taken from the total study samples of working nurseries 1770 according to Khartoum state localities.

Primary Data

Information and data were collected through visits, meetings and questionnaire to collect

available information and data on seedlings production packages in tradition and modern nurseries. The visits covered selected nurseries included, traditional and modern ones at Soba Al-Hela district, production nurseries at Al-Greif farms, Al-Nakhil tissue Culture Company at Shmabat; Qassem Education nurseries at Shambat, University of Sudan Shambat and CTC greenhouses nurseries. The total number of questionnaire was 90 made according to 5% of the total nurseries in localities. It was distributed to targeted stakeholders covering nursery working gender, education levels and occupations. Other questions concerned different components required for seedlings production, establish, tools, associate accessories, in puts for seedlings production qualitative and quantitative. In addition to the components that make adverse effect on seedlings growth performances, production cost and revenue.

Secondary data

The sources of the secondary data included past studies, literature review, official documents and reports, research findings, reviewed scientific journals, websites, and all that form baseline information and data probably strengthening the study. The institutions included; Research Centres nurseries, National Forest Corporation Nurseries in Khartoum state. Nurseries of Khartoum state, Al Nakheil Tissue culture Centre at Shambat, Forest and gum Arabic Research Centre Tissue culture laboratory, private sectors included companies of CTC (Central Trading Company) and Zadna; all above represent traditional and modern nurseries.

Interviews and Visits

A personal interview with Khartoum State Manager of forest was held on 8/7/2017. The interview form covers the technical factors within the management system, its relationship to production, the extent of impact, relationship between production and management. The other form was delivered to Agricultural engineer dealing with dialogue of technical factors and the impact on seedlings production. Official interview with Agriculture administration Units in various Khartoum state localities, Department of forest in Almoqran of Khartoum state with the administrator of nursery. The head engineer of technicians and a direct dialogue covered all matters related to nursery seedlings production problems and obstacles. The visit to the forests and gum Arabic research Centre at Soba was conducted on August/2017; to traditional nursery and scientifically for researchers and students to conduct research and learning. Third visit was to Zadna Company that applies modern methods for production of horticulture seedlings specifically Date palm. The interview was held with the agricultural engineers in Department of plant technology and viability. Some information were related to production from the Food Centre and plant cultivation within the tissue culture laboratory; and for the tools related to seedlings production from incubator to greenhouse and outside environment, The visit to CTC company made with the Director General and official interview with the technical and administrative side engineer; concerned seedlings production inside the greenhouses. The visit to the Sudanese Standards and Meteorology Corporation was aimed to collect information about the seedlings specifications and standard measures. Little information was obtained from the agricultural section official e-library archiving.

Data analysis

The data were subjected to analysis of variance (ANOVA) to assess the various

parameters and expressed at 95 per cent confidence level. Data was analyzed with the statistical software SPSS (Version 16.0) for Windows. Contingency table and X^2 Cross-tabulated results including statistical significance testing and Pearson correlation analyses were performed to assess the interrelation of the factors. The frequency and percentage of variables were presented.

Results and Discussion

Nurseries area

From the visits, meetings and questionnaire with agriculture administration unit's authorities in Khartoum state, the area of nurseries given to people seem to be similar in most localities. The nurseries areas are in range of 20-35 metre square distributed present 98.9%. Table (1) shows significant differences ($p > 0.05$) in area groups by respondents where the available space for establish traditional and modern nurseries were between 20and 55 metres square. Significant difference ($p<0.05$) were manifested by respondents in modern nurseries areas that gave (1.1%) comparable with (98.9%) in traditional nurseries. The slight significant difference in area of traditional nurseries probably related with the conditions of laws ratified by state localities, that area do not exceed 35 metres. However there might be variations in nurseries areas according to design of different shapes and sizes and purpose of seedlings production. Similarlythe site of modern nursery with equal proportions indicates that the area is acceptable but not best suited for modern nursery hence seedlings production profit of small scale nursery per annum and rate of return need to be evaluated. Functional nurseries areas however described and agreed by Dewayne and Sarah (2013) may include the entrance, nursery office, sales area, propagation area, production area, media preparation and storage area, receiving and shipping areas, service storage area for equipments, maintenance, employee facilities, etc. Nevertheless the main dominant components affected the output per unit area of seedlings production cost probably may be land and other ones.

Table 1 Official area categories (metres) for establish of traditional and modern nurseries in Khartoum state localities.

Nursery type	Respondents percentages in brackets				Total
	Areas categories (m^2)				
	0.0	20 – 35	36 – 45	46 55	
Traditional	(1.1)	(98.9)	(0.0)	(0.0)	90
Modern	(0.0)	(98.9)	(15.8)	(63.2)	19
Total	1.0	93.0	3.0	12.0	109
Significance	**	**	***	***	

***high significant; **significant; NS= No significance

Seedlings production capacity

No significant difference according to answers in both nurseries regarding seedlings production capacities except capacity of (3000-6000seedlings per year) whereas; a significant difference ($p< 0.05$) existed in seedlings production by respondents (57.8%) in traditional nurseries comparable to (100%) in modern nurseries indicating high production of seedlings (Table 2). The increasing in seedlings production in modern nursery probably associated with adoption of modern technologies, availability of production requires and facilities comparable to tradition nursery that was supported by

Wilkinson and. Landis (2009). Moreover production seasons in modern nursery site, the length of the year of either produceall under specific controlled growth condition contrarily to traditional nursery.However a significant difference ($p< 0.05$) exists by respondents between the two types of nurseries in producing less than 6000 seedlings per year. Hence it is concluded that traditional nurseries were unable to take advantage of economy of large-scale seedlings production and this leads to the assumption that; most if not all the nurseries distributed by Khartoum state localities are small retail or resale nurseries.

Table 2 Seedlings Production Capacity/year of Tradition and Modern Nurseriesin Khartoum State Localities

Nursery type	Respondent percentages in brackets						
	0	3000 –6000	6001 –9000	9001 –1200	1201-more	MD	Total
Traditional	(1.1)	(57.8)	(4.4)	(15.6)	(4.4)	(16.7)	90
Modern	(0)	(100)	(0)	(0)	(0)	(0)	19
Total	1	71	4	14	4	15	109
Sigmificance	N.S	**	N.S	N.S	N.S	N.S	

***high significant; **significant; NS= No significance

Seasonality and Seedlings Production

In table (3) the respondents showed significant differences ($p< 0.05$) in summer seedling comparable to other ones whereas; the production of seedlings was (100%) in modern nurseries compared with (6.7%) in traditional nursery. The traditional nurseries gave a low value (17.8%) whereas; modern nursery gave a high one (54.4%) in autumn and winter. This probably attributed to introduction of mechanisms that controlling climatic factors such as temperatures (Hatfield *et al*., 2011); protection from direct winds and new irrigation methods (Ballui*et al*., 2017) were available in modern nursery that are not available in traditional nursery. Hence it was confirmed that the period required by seedlings to reach a growth stage suitable for transplanting varies and depends on plant species and climate conditions. Significant differences were existed when comparing seasonal seedlings production where in modern nursery gave (100%) responses that do not affected in all seasons comparable with traditional nursery where (43.3%) responses showed that seedlings production was affected with season's factors and length of year (Table 3).The conclusion was based on the findings that confirmed advantages of establishing modern nurseries as production of seedlings are a developing operations and commercial transplant production in highly specialized nurseries is a worldwide trend.

Table 3 Seedlings production and seasons in tradition and modern in Khartoum state localities

Nursery type	Respondents percentages in brackets									Total
	Summer			Autumn		Winter		All seasons		
	Yes	No	MS	Yes	No	Yes	No	Yes	No	
Traditional	(6.7)	(64.4)	26	(17.8)	(82.2)	(54.4)	(54.6)	(43.3)	(56.7)	90
Modern	(100)	(0)	(0)	(100)	(0)	(100)	(0)	(100)	(0)	19
Total	25	58	26	35	74	68	41	58	51	109
Significance	***	***	**	***	***	***	***	***	***	

***high significant; **significant; NS= No significance

Manpower

Significant differences ($p< 0.05$) were showed by respondents in number of permanent workers in traditional nurseries that gave (37.8%) comparable to (100%) in modern nurseries. This means that workers in modern nurseries must be permanent where the work needs skilled labours and employee, agriculture engineers and technicians for management and production process. Significant differences were obtained by respondents in temporal workers numbers in both types of nurseries. Significant difference was manifested by the respondents in the number of temporal workers in traditional and modern nurseries that gave (87.8%) and (2.2%) respectively. It was clear that work in tradition nurseries depend on temporal workers with few numbers comparable to modern nurseries that depends on permanent manpower (Table 4). However many of the operations at modern nursery were carried out by machines, even though temporal labour wages are expensive but necessary component of any nursery operation to carry out specific jobs.

Table 4 Temporal and permanent labours in tradition and modern nurseries in Khartoum state Localities

Respondents percentages in brackets							
Labours category							
Nursery Type	permanent labours		temporal labours				Total
	0	1 -3	0	1-3	4-6	6-more	
Traditional	(37.8)	(62.2)	(6.7)	(87.8)	(2.2)	(3.3)	90
Modern	(100)	(0)	(100)	(0)	(0)	(0)	19
Total	53	56	25	79	2	3	109
Significance	***	***	***	***	***	***	

***high significant; **significant; NS= No significance

Seedling production methods

No significant differences ($p> 0.05$) were accounted by the respondents regarding seedlings production methods in both traditional and modern nurseries (Table 5). In both nurseries all methods of seedlings production were used, seed sowing, and vegetative propagation types, explants cuttings, grafting and layering.However significant differences ($p< 0.05$) were showed by respondents in using vegetative propagation and seed methods. Probably as being argued by (Hatfield *et al*., 2011), the observed differences were been attributed to differences in the two nurseries facilities where modern nursery, is more equipped and prepared with additional tools to perform the vegetative methods comparable to traditional nursery.

In modern nursery sowing seeds method is used successfully and probably due to prevailing of climatic conditions, conservation of physiological factors compared to traditional nursery that lacks such advantages. Therefore through the nurseries it is possible to make available planting material of plant species demand; seed sources, seeds of some species exhibit low viability and trees with high economic valuehence propagation of such species using seeds is not easy for seedlings production.Similarly Ali and El Tigani (2015) work on *Acacia senegal* propagation confirm that, in absence of comprehensive information on propagation techniques tradition, modern practices as tissue culture were combined to produce more, rare and valuable plant species seedlings.

Table 5 Seedling production methods in traditional and modern nurseries in Khartoum state localities

Nursery Type	Respondents percentages in brackets						
	Seeds		Propagation		Seeds and Propagation		Total
	Yes	No	Yes	No	Yes	No	
Traditional	(77.8)	(21.1)	(8.9)	(91.1)	(28.9)	(71.1)	90
Modern	(63.2)	(36.8)	(21.1)	(78.9)	(52.6)	(47.4)	19
Total	83	26	12	97	36	73	109
Significance	N.S	N.S	N.S	N.S	N-S	N.S	

***high significant; **significant; NS= No significance

Seedlings Production

Therearesignificant differences (p< 0.05) between respondents' percentages of employment in tradition and modern nurseries (72.2%) and (15.8%) respectively (Table 6).Thisdifference probably related to the problem of employment in traditional nurseries that more depend on permanent and temporary workers in additionthe high wages. No significant differences (p>0.05) between categories of respondents (23.3%) in traditional nurseries comparable (5.3%) in modern ones. However there are observed unjustified differences showed by taxation that makes a problem for owners of nurseries. Although much of the agricultural inputs are exempted from taxes but there are symbolic fees applied in some localitiesandsomeother onesencourage establishing ofseedlings production nurseries as in Um-Badah and JabalAwlialocalities.

Respondents answers showed no significant differences (p> 0.05) between problem performed bywater which gave (85.6%) in traditional nursery comparable to (100%) in modern nursery (Table 6). However the observed difference probably attributed to whole dependence in traditional nurseries on irrigation by traditionally ordinary pipes and water flow system. Hence the number of seedlings irrigated was less than 500 per day and little water is required. The irrigation system by the pipes flow and floatation system comparable to the need of reservoirs to storage water, (91.1%) respondents in traditional nurseries respond that does not need reservoirs. Similarly in modern nurseries water is not considered a production problem in essence modern nursery reliance on water reservoirs for modern irrigation systems. HoweverPandiyaraj, *et al*.,2017; Nerida*et al*.,2016) argued that modern irrigation systems requires concrete, cement or gravel floors beds and some may add recycling system for water and fertilizers application.

In seedlings production by vegetative propagation methods no significant differences (p> 0.05) were showed by respondents concern problem of climate in seedlings production that gave (82.2%) in traditional nurseries comparable to (89.5%) in modern ones. This is probably due to the control system of climate factors in modern nursery that provide a more controlled environment hence production of seedlings in all seasons whereas; seedlings production in traditional nursery with shade or screen (Nerida*et al*.,2016) was affected by the climate however; the choice of most suitable seasons for production were winter and autumn minimize the difference.

Table 6 Seedlings production problems in traditional and modern nurseries in Khartoum state localities

	Respondents percentages in brackets								
	Seedlings production problems								
Nursery type	Employment		Taxes		Waters		Climate		Total
	Yes	No	Yes	No	Yes	No	Yes	No	
Traditional	(72.2)	(27.8)	(23.3)	(76.7)	(14.4)	(85.60	(17.8)	(82.2)	90
Modern	(15.8)	(84.2)	(5.3)	(94.7)	(0)	(100)	(10.5)	(89.5)	19
Total	68	41	22	87	13	96	18	91	109
Significance	***	***	NS	N .S	N.S	N.S	N.S	N.S	

Continued table 6

Nursery type							Total
	High cost		input production		Other		
	No	Yes	No	Yes	No	Yes	
Traditional	(82.2)	(25.6)	(61.5)	(38.9)	(61.1)	(20)	90
Modern	(89.5)	(73.7)	(26.3)	(47.4)	(52.6)	(5.3)	19
Total	91	37	72	44	65	19	109
Significance	N.S	***	***	N.S	N.S	N.S	

***high significant; **significant; NS= No significance

Conclusion

- The study revealed that due to the ongoing economic restructuring and market liberalization in the region, most of the few surviving central nurseries today have lowseedling production and hence are unable to meet demand.
- The motive and target of a private business enterprise is to make as much profit as possible while public enterprise has the ultimate motive of catering for welfare of masses.
- In the absence of rigorousvaluation of the longer-term effects of both types of nurseries in building natural, human andsocial capitals, it appears that both have a role to play in meeting local demand for seedlings productions.
- Most plants growers do not have access to good quality certified disease free plant materials of true to type varieties as a result of which production, productivity and quality of produce suffers heavily.
- Most of the dependence is on unregulated private sector nurseries in most of the states which lacks modern infrastructure such as green house, mist chamber, efficient nursery tools and gadgets, implements and machinery.
- There are several private nurseries operating in the Khartoum state playing important role in multiplication of planting material of horticulture plants and many follow traditional methods and lack adequate infrastructure and sell plant material of unknown pedigree.
- There are several constraints in systems of plant propagation and seedlings production such as unavailability of standardized measures of seedlings, root stocks and non-maintenance of healthy stocks of elite varieties are worth mentioning.

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دراسه مقارنية لإنتاج الشتول في المشاتل التقليدية والحديثة بمحليات ولاية الخرطوم

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المستخلص

أجريت الدراسة في ولاية الخرطوم علي مستوي المحليات لتقييم و تحديد مشاكل إنتاج الشتول في المشاتل التقليدية و الحديثة. بالإضافة إلى الوصول لتوصيات التي تساعد في الإمداد بإنتاج الشتول لمقابلة الإحتياجات المختلفة. إستهدفت الدراسة القطاع الخاص و الحكومي و المختصين في زراعه الأنسجه النباتيه تم إستخدام الإستبيان للإجابة على الأسئلة الموجهه للمختصين، الموظفيين،أصحاب المشاتل الخاصة ...الخ.جمعت الدراسة نوعان من المعلومات الأوليه. مقابلات شخصيه مع مسئولي الهيئه القوميه للغابات، هيئه البحوث الزراعيه، الشركات الخاصه التي تعمل في مجال زراعه الانسجه والبيوت المحميه (سي تي سي.شركه زادنا) بعض المشاتل التقليديه في المحليات.أما المعلومات الثانويه جمعت من الدراسات السابقه أهم النتائج المتحصل عليها من التحليل. أن مساحة المشاتل الكلية تتوزع في مساحة تتراوح بين 20 – 35م2 حيث أن نسبة المشاتل التقليدية تمثل 98.9 أظهرت الدراسة فروق معنوية في المساحة المتوفرة لتأسيس المشاتل التقليدية و الحديثة حيث تراوحت بين 20 – 55 متر2. وتوجد فروق معنوية في السعة الانتاجيه خلال السنة بين المشاتل التقليدية و الحديثة حيث بلغت النسبة

57% للمشاتل التقليدية و 100% للمشاتل الحديثه.أوضحت الدراسة فروق معنوية في انتاج الشتول في موسم الصيف بين المشاتل الحديثة (100%) و التقليدية (6.7%). أظهرت المشاتل التقليدية أقل قيمة (17.8%) مقارنة بالمشاتل الحديثة (54.4%) في موسمي الخريف و الشتاء. هناك فروق معنوية في عدد العمالة الدائمة و المؤقتة في المشاتل التقليدية (37.8%) مقارنة بالمشاتل الحديثة حيث بلغت النسبة (100%). أيضا أظهرت الدراسة فروق معنوية فيما يخص طريقة العمل في المشاتل التقليدية و الحديثة و توصى الدراسة بالعمل على تطوير المشاتل و اللوائح الخاصة بتسهيل و توفير وسائل إنتاج الشتول فى محليات ولاية الخرطوم.