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THE COMPARISON OF THE ESSENTIAL OILS OF THE FLOWERS OF ENDOD (*PHYTOLACCA DODECANDRA*)

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ABSTRACT

The volatile oils of the flowers of Phytolacca dodecandra collected from West Shewa Zone Ginchi Woreda and East Wollega Zone Ebantu Woreda, Ethiopia have been examined separately using GC-MS. The essential oils were extracted by hydro-distillation from the flowers of P. dodecandra and analyzed using Gas chromatography-Mass spectroscopy (GC-MS). The major components of essential oils from Ginchi were cyclooctasulphur (34.01%), trans-nerolidol (15.44%), cis- mono(2-ethylhexyl) phthalate (12.59%) β-phenylethanol (11.93%), benzyl alcohol (9.30%), and from Ebantu and eucarvone (26.56%), α-isophoron(15.46%), 2,4-ditert-butylphenyl-5-hydroxypentanoate (11.30%), diacetamide (7.24%). Variation in chemical composition and percentage of volatile components of the flowers oil of the plant from both sites might be due to the difference in soil type and climatic conditions.

Key Words: Phytolacca dodecandra, Essential oil, Phytolacaceae, flowers, Endod

INTRODUCTION

An ethnobotanical study conducted on different medicinal plants of Ethiopia including *Phytolacca dodecandra* (Endod) which indicated that Ethiopians have used traditional medicines for many centuries and the use of which has become an integral part of different cultures in the country (Fisseha Mesfin *et al*., 2009; Gidey Yirga,2010; Tilahun Teklehaymanot and Mitutse Giday, 2007).

Phytolacca dodecandra (Endod), is a semi-succulent straggling or scrambling shrub about 10 m height or more. It belongs to family *Phytolacaceae* which includes about 16 genera and 100 species. The genus *Phytolacca* contains about 35 species in tropical and subtropical regions (Hedberg *et al*., 2000).

The plant is distributed in east, west, central, and southern Africa and parts of South America and Asia (Dalziel, 1936). In Ethiopia, the species is naturally found at altitudes ranging between 1600-3000 m above sea level (Wolde-Yohannes, 1983).

Endod is the local name for *Phytolacca dodecandra* or soapberry, a full shrub closely related to the American pokeweed (*Phytolacca americana*).

Endod has often glabrous but less commonly pubescent leaves and racemes, short pedunculate racemes with several flowers and bluntly star-shaped berries (Polhill, 1971).

The berries of endod constitute various triterpenoid saponins, which possess potent and useful biological properties including detergent, molluscicidal (Aklilu, 1965, 1970; Parkhurstet *et al*., 1974; Aklilu *et al*., 1991), spermicidal (Stolzenberg and Parkhurst, 1976), insecticidal, and fungicidal properties (Dawit and Solomon, 1994). The most scientifically studied use of endod is its molluscicidal property; it kills the intermediate host snails that harbor schistosomes that cause the disease Schistosomiasis or Bilharzia. In contrast to all other currently available molluscicides, endod berries have also dual purposes: it is used as soap for washing clothes and as molluscicide for killing schistosome transmitting snails. The use of Endod for schistosomiasis control is considered cheaper, environmentally safe, biodegradable, more readily available plant molluscicide than the currently available synthetic chemicals (Kloos and McCullough, 1983; Lambert *et al*., 1991; Molgaard *et al*., 2000). Although the flowers of Endod contain essential oils, to the best of our knowledge, there was no previous report on the analysis of the essential oils of the flowers part of Endod.

Nowadays, the plant products have a wide range of applications in perfume and cosmotic industry, in food technology, in aroma and pharmaceutical industry. These wide applications of the plant products initiated us to investigate the constituents in the flowers of *P. dodecandra* from the two sites in Ethiopia, using Gas Chromatography-Mass spectrometry.

MATERIALS AND METHODS

Plant Material

The flowers of *P.dodecandra* were collected from two different places in Ethiopia namely, Ebantu Woreda, East Wollega, Oromiya Region, and Ginchi West Shewa, Oromiya Region during flowering in November, 2009. The botanical specimen was identified and deposited at Haramaya University, Herbarium; Center, Ethioipia. The flowers were collected in plastic bags and then exposed to room temperature for drying for five days.

Isolation of the Essential Oils

The ground and air dried flowers (90.0 g) of *P.dodecandra*, collected from Ebantu site, were placed in a round bottom flask fitted with Clevenger-type apparatus and a glass condenser and hydro-distilled for 3 hrs at atmospheric pressure. After the hydro-distillation, the essential oils were separated by separatory funnel using chloroform (ACS grade of U.K.) and were dried over anhydrous sodium sulphate (Na_2SO_4). The obtained yield was (0.032 g, 0.032%). Similarly, the ground and air dried flower (90.0 g) of *P. dodecandra* collected from Ginchi site, was also hydro-distilled for 3 hrs at atmospheric pressure, separated and dried. This yielded essential oils (0.39 g, 0.39%). The oils were then sealed in glass vials and stored in fridge until GC/MS analysis (Anonymous, 1996).

Gas Chromatography-Mass Spectrometry (GC-MS)

The specifications of GC-MS for analysis of essential oils are Agilent 19091S-433 MSD equipped with a HP-5MS 5% Phenyl Methyl Siloxane of capillary column (30 m x 0 .25 mm x 0.25 µm). The oven temperature was programmed

from 40-240^{o}C at a rate of 3^{o}C/min and it was held at 40^{o}C for 2 min and at 240^{o}C for 5 min. Injector temperature was at 250^{o}C and transfer temperature was at 260^{o}C. The carrier gas was helium flowing with the flow rate of 1.5 ml/min with a linear velocity of 31.5 cm/s, the split ratio was 1/60 with ionization energy of 70eV at scanning time of 1 s and the mass range was 40-500 amu. The constituents were identified by processing of the raw GC-MS data with ChemStation G1701CA software and comparing with NIST and from retention times and mass spectra of standard compounds. Relative amounts of detected compounds were calculated based on the peak areas of the total ion chromatograms (Faridahanim, *et al*., 2007).

RESULTS AND DISCUSSION

The essential oils of the flowers of *P. dodecandra* from Ginchi Woreda and Ebantu were obtained by hydro-distillation and analyzed by GC-MS shown in fig 1 and 2. The major constituents of the essential oil of the flowers of P.dodecandra from Ginchi were benzyl alcohol (9.30%), β-phenylethanol (11.93%), cis-*trans*-nerolidol (15.44%), cyclooctasulphur (34.01%), mono (2-ethylhexyl) phthalate (12.59%) as shown in table 1. Similarly the essential oils from that of Ebantu has diacetamide (7.24%), α-isophoron(15.46%), eucarvone (26.56%), 2,4-ditert-butyl phenyl-5-hydroxypentanoate (11.30%) (see Table 2) as major constituents. The percentages of the yielded constituents from both sites were different; that is 0.032% for Ebantu and 0.39% for Ginchi sites. This variation might be because of environmental difference, the variation of safety when the flowers were collected, the fertility of the soil, temperature of the area and other different factors.

When these essential oils from both places were analyzed by GC-MS, compounds with different percentage were identified after processing of the raw data by GC-MS with ChemStation G1701CA software and by comparison of those spectral data with those of NIST library and their MS spectral data with standard compounds. Relative amounts of detected compounds were calculated based on the peak areas of the total ion chromatograms.

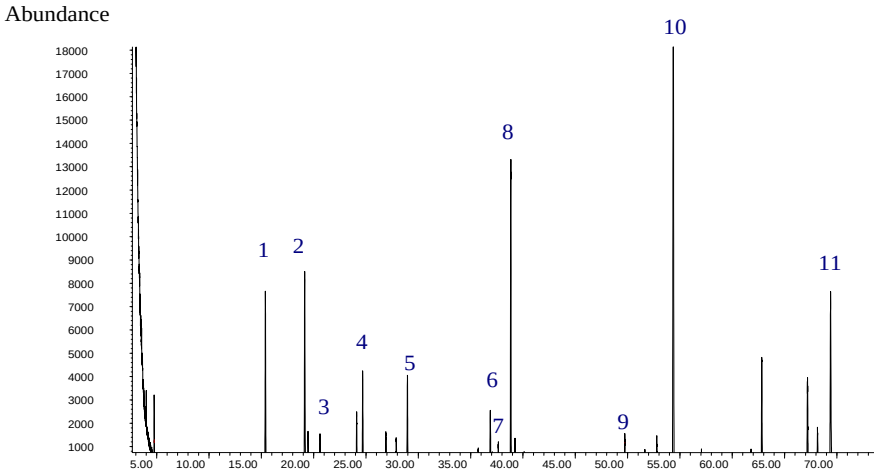

Figure 1: Gas Chromatogram of the hydro-distilled oil of the flowers of *P. dodecandra* from Ginchi

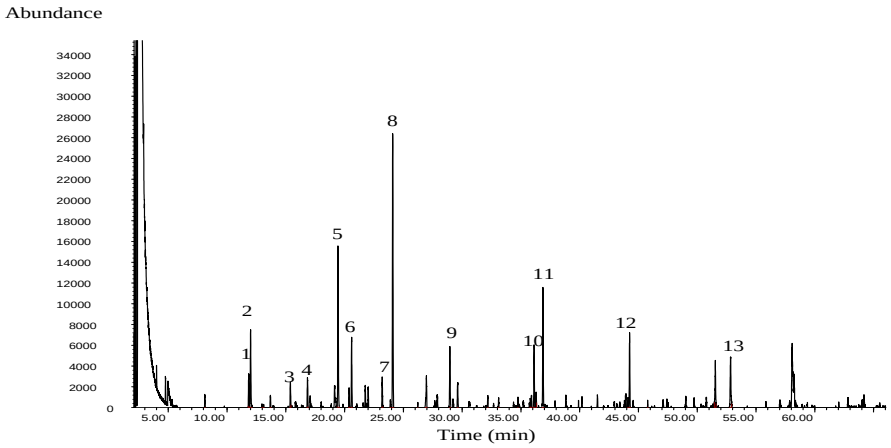

Figure 2: Gas Chromatogram of the hydro-distilled oil of the flowers of *P. dodecandra* from Ebantu

Table 1 shows eleven components with their retention time, Kovats Index and percentage composition of essential oil from Ginchi site. The table shows the presence of five major components namely, cyclooctasulphur (34.01%), *cis-trans*-nerolidol (15.44%), mono (2-ethylhexyl) phthalate (12.59%), β-phenylethanol (11.93%), and benzyl alcohol (9.30%), while six of them γ-phenylpropanol (4.97%), peonol (4.68%), 2,4-ditert-butylphenyl-5-hydroxypentanoate (3.12%), α-isophoron (1.94%), 2,5-dimethyl-3-4-hexanediol (1.26%), 3-amino-2-cyclohexanone (0.75%), were noted to be relatively the minor constituents. The identity of the major component (cyclooctasulphur) needs to be confirmed by running GC of a standard sample. However due to a difficulty of obtaining the standard sample, we were not able to confirm it for the time being.

Table 1: Chemical composition of the hydro-distilled oil of the flowers of *P.dodecandra* from Ginchi

Peak No.	RT min	KI Lit	KI	%Com.	Compounds
1	15.389	1036	1010	9.30	benzyl alcohol*
2	19.148	-	1136	11.93	β-phenylethanol*
3	19.466	1097	1088	1.94	α –isophoron
4	24.687	1235	1207	4.97	γ –phenylpropanol
5	28.961	1437	1438	4.68	peonol
6	36.898	-	2255	3.12	2,4-ditert-butylphenyl-5-hydroxy pentanoate
7	37.068	-	1106	0.75	3-amino-2-cyclohexenone
8	38.836	1564	1550	15.44	cis,trans-nerolidol*
9	52.784	-	1013	1.26	2,5-dimethyl-3,4-hexanediol
10	54.373	-	1845	34.01	cyclooctasulphur* ?
11	69.395	-	2162	12.59	mono(2-ethylhexyl) phthalate*

***** Major components of the oils

Table 2 shows the thirteen components with their retention time, Kovats Index and percentage composition in the essential oils from Ebantu site. Four of the components eucaryone (26.56%), α-isophoron (15.46%), 2,4-ditert-butylphenyl-5-hydroxypentanoate (11.30%) and diacetamide (7.24%) were the major constituents of the essential oils, whereas nine of them *n*-decanoic acid (6.24%), eicosane (6.22%),4-oxoisophorone (6.11%), *o*-(trimethylsilyl) phenol (5.53%), 2-ethylhexylester (5.27%), benzaldehyde (2.84%), acetophenone (2.65%), (*E*)-2-ethoxyethenylacetate (2.41%), benzylalcohol (2.15%) were found to be relatively minor constituents.

Table 2: Chemical composition of the hydro-distilled oil of the flowers of P. *dodecandra* from Ebantu.

Peak No.	RT min	KI lit	KI	% Com.	Compounds
1	11.835	965	965	2.84	benzaldehyde
2	12.021	-	955	7.24	diacetamide*
3	15.388	1036	1010	2.15	benzyl alcohol
4	16.845	-	1037	2.65	acetophenone
5	19.455	1097	1088	15.46	α-isophoron*
6	20.594	1268	1108	6.11	4-oxoisophorone
7	23.204	-	869	2.41	(*E*)-2-ethoxyethenylacetate
8	24.115	-	1343	26.56	eucarvone *
9	28.950	978	1058	5.53	*o*-(trimethyl silyl) phenol
10	36.130	-	1972	5.27	Sulfurous acid,2-ethylhexyl ester
11	36.893	-	2255	11.30	2,4-ditert-butylphenyl-5-hydroxypentanoate*
12	44.248	2000	2000	6.22	Eicosane
13	52.858	-	1473	6.24	*n*-decanoic acid

***** Major components of the oils

As shown in Tables 1 and 2, most of the essential oil constituents of the flowers from both sites were different and only a few of them were similar. The similar components of essential oils in both sites were benzyl alcohol, α-isophoron, 2,4-ditert-butylphenyl-5-hydroxypentanoate. The benzyl alcohol with kovats Index of 1010 and 9.30% composition is major for Ginchi site and minor for Ebantu site while α-isophoron with kovats Index 1088, 15.46% composition and 2,4-ditert-butylphenyl-5-hydroxypentanoate kovats Index 2255, 11.30% composition were major for Ebantu site and α-isophoron (1.94%) and 2,4-ditert-butylphenyl-5-hydroxypentanoate (3.12%) were minor in Ginchi.

One of the most important perfume ingredients made from benzene is 2-phenylethanol. As benzyl alcohol and bezaldehyde are benzene derivatives they may also be used as ingredients of perfume. *cis*, *trans*-nerolidol identified as components of essential oils of flowers of Endod is an oxygenated terpenoids. The terpenoids form the largest group of natural odorants, so it is only to be expected that they also form the largest group of modern fragrance ingredients. Thousands of different terpenoid structures occur in perfume ingredients, both natural and synthetic. As far as perfume materials are concerned, the most important members of the terpenoid family are the oxygenated monoterpenoids (Pybus and Courtney, 2006).

CONCLUSION

Even though several bioactive compounds were previously isolated and characterized from berries of Endod, there has been a research gap till date on volatile constituents of oils from flowers of Endod. Volatile components from plants are mainly used in aromatherapy, in perfumery as insect repellants and others. Based on the geographical location and soil type and seasons of the year components and their percentage composition of volatile components of Endod may vary. In this study, flowers of Endod were collected from two sites.

From the flowers of this plant, the essential oils were extracted by using hydro-distillation; from these oils, the major components of the essential oils were analyzed using GC/MS. The major essential oils identified were benzyl alcohol (9.30%), β-phenylethanol (11.93%), cis, trans-nerolidol (15.44%), cyclooctasulphur (34.01%), mono (2-ethylhexyl) phthalate (12.59%) from Ginchi site and diacetamide (7.24%), α-isophoron(15.46%), eucarvone (26.56%) and 2,4-ditert-butyl phenyl-5-hydroxypentanoate (11.30%) from Ebantu. Variation in chemical composition and percentage of volatile components of the flowers oil of the plant from both sites might be due to the difference in soil type and climatic conditions. In the further, bioactivity tests and comparative studies on volatile components of oils this part of the plant from different regions is recommended.

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MEETING MIDDLE LEVEL MANPOWER TO LABOR MARKET NEEDS: OPPORTUNITIES AND CHALLENGES FOR TVET INSTITUTIONS

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ABSTRACT

The purpose of this study was to examine the extent to which TVET institutions identify and use market opportunities and the major challenges they face in matching manpower supply to the demand for the skilled workforce in the labor market. To meet the purpose of the study, the researcher used quantitative survey research method supported by qualitative data. The participants of the study were 45 members of TVET management (process owners), 45 department heads, and 73 TVET graduates (employed and unemployed), 9 TVET principals, 3 Micro and Small enterprise office heads, 12 employers and 9 TVET heads from 6 districts and 3 administrative zones. Questionnaires and semi-structured interviews were employed to solicit data from key informants in the study setting. Data were analyzed through qualitative and quantitative analysis methods. The study results showed that TVET institutions were found weak in spotting actual skill needs in the labor market, implementing cooperative training and involving stakeholders in matching competences to labor market needs. Generally, TVET institutions do not effectively utilize job opportunities currently available in their respective areas. Hence, the researcher recommends the importance of strengthening network and partnership program between TVET institutions and stakeholders in areas of job placement, work attachments, advice on courses, part-time teaching staff and financial assistance.

Key terms: Labor market, Middle level Manpower, TVET Institutions, Demand, Supply

INTRODUCTION

Technical and vocational education and training refers to the deliberate interventions of bringing about learning which would make people more productive in designated areas of economic activity (ILO, 2001). According to UNESCO (2002) the major objective of technical and vocational education and training is to supply qualified workforce ranging from lower to middle skill levels. To achieve this objective, TVET providers should develop the capacity to produce trainees with skills and knowledge of the competitive requirement and institutional mechanisms that will ensure the establishment of excellence of instruction and development of employment-linked competencies among graduates (UNESCO, 2003).

Various Scholars and organizations have identified the role of TVET for development, among these ILO (2001), specified the role of TVET as an instrument that creates new employment opportunities and income-generating activities in the formal and informal sectors of the economy. Moreover, it is extremely well-positioned to contribute to global development, participation and interaction.

However, according to MoE (2007) the task of matching supply of skilled manpower to the demand in the labour market is so challenging, and factors hindering its implementation are also multidimensional and abundant. In this regard , the data obtained from Oromia Education Bureau (2005) between in the academic years 2002-2005 depicted that 16,046 TVET trainees graduated and out of those graduates only 2,737 (17.05%) got employment opportunities in government, private, cooperatives and as self-employees.

Among these the most employed graduates were those who graduated in the area of construction, Electricity and Electronic technologies. Nevertheless, in the same fiscal year, there were more than 2,468 private investment projects, which were assumed to create 131,988 permanent and 594,630 temporary job opportunities for middle level TVET graduates and other unemployed citizens in Oromia Regional State (Oromia Investment Profile, 2005). This indicates that TVET institutions are unable to use the opportunities existing in their environment.

Recently, the study made by Oromia Regional TVET Agency (2009) also confirmed the mismatch in supply and demand of middle level skilled manpower in the region. According to the agency, the rate of responsiveness of TVET programmes to regional private investment sector is less than 40%. In the same way, tracer study result which was conducted in Arsi Administrative Zone in September 2010 in six TVET institutions, showed that out of 722 TVET graduates of 2009/10, only 128 (17%) of them got employment opportunity (self-employed, organized in cooperatives & employed in private & government firms).

A similar study, conducted by Adama TVET College, revealed that out of 2,596 TVET graduates of 2008-2009/10 in different levels, only 610 (23.5%) graduates got job opportunities. This problem is also true in the case of East Shoa Zone TVET Department. The analysis of the document showed that, out of 845 TVET graduates of 2009/10 only 298 (35.3%) were employed in different sectors, organized in cooperatives and as self-employee.

From the above data, the effectiveness of training being offered is already under question. Because, as stated by Middleton et al. (1993) basically the effectiveness of the training depends on the extent to which trained workers use their skills in employment. Besides, a rise in the unemployment rate reflects not a growing scarcity of jobs but rather a change in the expected costs and benefits of looking for and accepting employment (Heyne, 1991).

Hence, the purpose of this study was to investigate the extent to which TVET institutions identify and use market opportunities and the major challenges they face in matching manpower supply to the demand for the skilled workforce in the labor market. Therefore, in light of the above statements, the study tried to get appropriate answers to the following basic questions:

1. What measures were taken by TVET institutions to endorse employment oriented vocational and technical training?
2. What opportunities are in place to maximize the employment rate of TVET graduates?
3. What challenges do TVET institutions face to respond to the competence needs and qualification requirements in the labor market?

MATERIALS AND METHODS

The methodological approach used in this study was quantitative survey research method supported by qualitative data. To make the study manageable, purposive sampling technique was used to select nine TVET institutions which were established before the implementation of Ethiopian National TVET Strategy of 2008 and which are found in Adama, Arsi and East Shoa administrative zones of Oromia Regional State were included in the study.

Moreover, by using snowball sampling techniques 51 employed and 22 unemployed a total of 73 (32.3%) TVET graduates of the same level (Level-3) and fields of training (Construction, Electricity and Automotive Technology) were included in the study. Furthermore, by using simple random sampling techniques 45 process owners and 45 department heads were included in the study. In addition, 9 TVET principals, 3 TVET heads, 12 employers of TVET graduates and 3 heads of Micro and Small Enterprises were purposely selected as sample respondents.

For this purpose, questionnaires and semi-structured interview were mainly employed to solicit information from the group. In addition, various reports and documents in TVET institutions were reviewed and used as secondary source of data. To do this, the researcher used three years of data (2008-2011). Finally, the raw data collected through a quantitative approach were tallied, tabulated, and analyzed by using means and standard deviations. Moreover, data collected through the semi- structured interview and open-ended questionnaire were analyzed by reviewing common ideas reflected and key points related to the objectives of the research.

RESULTS AND DISCUSSIONS

Matching Competences to Labor Market Needs

TVET quality is a very vast issue and requires a broad spectrum of actions. In this regard, process owners and department heads were asked to evaluate actions taken by TVET institutions for effective utilization of labor market opportunities in promoting employment oriented TVET program using a five point scale ranging from very low (1) to very high (5).

Table 1: Current Institutional Practices (N=90)

No.	Items	Mean	SD
1.1	Industrial experience of teachers were improved	2.76	.73
1.2	Cooperative training was conducted	1.74	.86
1.3	Pilot test was performed before large scale implementation	1.92	1.44
1.4	Tracer study was conducted	1.38	.63
1.5	Government sector plans were used as input for designing training programs	1.67	1.09

One of the distinguishing characteristics of technical/vocational education is its linkage with industries and companies. In this regard, UNESCO (1973) noted that a vocational teacher should have industrial or comparable experience. Concomitant with this, item 1.1 was posed to informants with the intention to identify actions taken by TVET institutions to improve the industrial experience of trainers. Accordingly, more than average of the informants indicated that TVET institutions try to improve the industrial experience of teachers with mean average 2.76.

Item 1.2 of Table I deals with the cooperative training. According to MoE (2007:6) cooperative training makes trainees acquire the necessary

practical skills reducing the existing skill gap and meeting the challenges of constant change in markets and technologies. In this regard, a question was posed to TVET principals and department heads and the overwhelming majority of them responded negatively (mean = 1.74). This may be due to the less emphasis given by the TVET institutions to the importance of cooperative training and unwillingness of owners of firms to accept trainees.

Evidently, the interviews held with the employers and TVET officials also confirmed the unsuccessfulness of cooperative training program among seven TVET institutions. The reasons given by owners of industries were the dissimilarity of training material, fear of wastage of production materials and safety reasons. However, two factories, namely: Wonji Sugar Estate and Wonji Paper Factory currently have started cooperative training with Wonji TVET institution. Similarly, Nazareth Tractor Factory and MOENCO Toyota Garage, Trans-Ethiopia, Tekur Abay and Bekelcha Transport Industries, Telecommunication and Ethiopians Electric Light Corporations have started cooperative training with Adama TVET College.

Informants were also asked three other questions which focused on tracer study, pilot testing of new programs before large scale implementation and using government sector plans as input for designing training programs. As it is indicated in Table 1 item 1.3, 1.4 and 1.5, almost all TVET institutions were weak in conducting tracer study, pilot testing and using government sector plans as input to adjust their training program (mean average less than 2.00). From this we can deduct that, it is not unwise to infer the fragile nature of TVET institutions in supplying manpower needed in the labor market.

Stakeholders Involvement in TVET System

TVET is considered as an important element in human resource development with the general objective of equipping learners with adequate knowledge and skills for life and the labor market (UNESCO, 2002). To achieve this intended objective and to make TVET system employment oriented, demand-driven and responsive to the economic development of the country, the concerned stakeholders should participate in planning, programme implementation and monitoring and evaluation of the TVET activities carried out in the training institutions (NICHE, 2010). In this regard, process owners and department heads were asked 8 questions about the role played by the stakeholders to make TVET graduates competent and effectively utilize the job opportunities available in the world of work especially in their firms.

Table 2: Major areas of Stakeholders Involvement (N= 90)

	Items	Mean	SD
2.1	Supervise the implementation of the program	2.33	.67
2.2	Providing career guidance service	2.26	.90
2.3	financing training program	1.25	.43
2.4	Providing training facilities	1.38	.48
2.5	Monitoring training quality standards	2.61	.95
2.6	Involving in training of trainers	1.36	.48
2.7	Providing information that help to adjust the TVET curriculum	3.11	.91
2.8	Paying pocket money for the trainees	1.07	.27

As it can be seen from Table 2, process owners and department heads agreed that stakeholders

moderately participate in monitoring training quality standards and in providing information that help to adjust the TVET curriculum with mean average 2.61 and 3.11 respectively. However, the participation of stakeholders is low in supervising the implementation of TVET program and in providing vocational and guidance service for trainees (mean between 2.00-2.50).

Moreover, as it was clearly indicated in Table 2 there was almost no active participation of stakeholders in financing training program through contributing resources, providing training facilities, training of trainers, and paying pocket money for the trainees. The interview responses also confirmed the findings.

In general, this result is inconsistent with the contentions of Osborne and Geebler (1992) findings which was supported by UNESCO (2003) that declared the importance of participating stakeholders in TVET system, especially, in identifying training needs, establishing and monitoring training standards, harmonizing activities, supervising manpower demand and supply and evaluating the training system in terms of efficiency and effectiveness.

Job Opportunities Currently Available in the Study Area

The vocational education and training system in Ethiopia is seen as a key supplier of the skilled workforce required to sustain the growing economy (MoE, 2008). A question was presented to all groups of informants to specify job opportunities currently available in Adama and surrounding towns. Through structured interview and open ended responses, informants stated that jobs related to wood work, automotive, maintenance service, metal and electricity are available in the labour market. However, repairing electronic materials and automotive related works are only available for few graduates who are able to compete with workers already in the labour market. Furthermore, informants added other types of jobs currently available in the labour market. Some of the jobs are: textile and garment, food processing, and road construction (cobblestone).

Specifically, MSE office heads showed that cafeteria, hair dressing, ICT and other businesses are also available jobs for graduates who have the need to establish their own firms or to be organized in MSE. Moreover, according to Adama town investment office 2011 final report, since 2007/8, 463 different types of industries have been established in Adama town and created job opportunities for 21,649 citizens out of whom 6.10% are TVET graduates. In addition, to implement the five year developmental and transformation plan, government sectors have a great desire and plan to get skilled manpower from TVET institutions.

Major Challenges and Issues Faced by TVET Institutions

Management members (process owners), TVET graduates, and department heads were given criteria to assess major challenges facing TVET institutions in meeting labor market needs.

As it is seen from the data obtained in Table 3 above item 3.1, the training facilities (training machines, hand tools, and teaching aids) in relation to the number of students are inadequate.

An interview response of seven TVET principals, two TVET zone and five District heads also revealed

that the training facilities of TVET institutions are far below what has been stipulated by the 2008 Ethiopian TVET strata.

Table 3: Within the School factors (N=163)

	Items	Mean	SD
3.1	Lack of training facilities	4.34	.694
3.2	Low supply of consumable raw materials for practical training	4.15	.799
3.3	Trainers lack of industrial experience	3.34	1.146
3.4	The training equipment available in TVET institutions are less relevant to local situation	3.98	0.936
3.5	Difficulty in securing appropriate financing for implementation of anticipated framework	3.41	1.131
3.6	Problem of predicting the number of graduates required from vocational training institutes in terms of occupational categories	3.60	0.607

On top of this, other facilities such as: computers, books, reference materials, journals, and textbooks are still insufficient and this has aggravated the problem.

Shortage of consumable raw materials for training also affected the training process. Furthermore, informants declared that the training machines in the workshop are less relevant to the local situation and the technologies used in the environment. In their responses to the open ended questions, the respondents stated that the training machines in the workshops are partially operated by the trainers and trainees and they are less relevant to the content of the module. According to the majority of TVET principals the other major barriers which badly affected the training system are: cost of TVET programs, inadequacy of training budget and insignificant financial support from different funding agencies. This reality calls for some mechanisms like income generating to reduce the burden of government in spending on TVET and restrain budgetary constraints.

Informants were also asked about industrial experience of trainers. As one can see from Table III item 3.3, trainers' lack of industrial experience may be among critical constraints that handicapped trainers' efforts. The mean value 3.34 clearly indicates the prevalence of the problem. The other problems which encountered TVET institutions were low competence of management in measuring actual skill needs in the labor market and difficulty of predicting the number of graduates required from vocational training institutes in terms of occupational categories.

Table 4: Out of the school factors (N= 163)

	Items	Mean	SD
4.1	Mismatch between employable skills and TVET curriculum	4.27	0.816
4.2	Lack of capital for self employment	4.00	0.785
4.3	Technological change	4.06	0.916
4.4	Challenge of getting relevant raw materials for training	4.22	0.916

As shown in Table IV above, informants were asked to answer the extent to which external factors affect TVET institutions in matching competences to labor market needs. According to the finding of this study, the external challenges facing TVET institutions in supplying middle level manpower needed in the labor market are: mismatch between employable skills and TVET curriculum (mean= 4.27), lack of capital for self employment (mean=4.00), technological changes

(mean=4.06) and inadequacy of raw materials for the process of training (mean=4.22). In general, weak coordination and lack of willingness of concerned bodies to participate in TVET system and the impact of technology and economy affected TVET institutions not to utilize market opportunities in reducing the rate of graduate unemployment.

CONCLUSION

The study result shows that various kinds of job opportunities are available for TVET graduates in Adama, Arsi and East Shoa administrative Zones. However, the effective utilization of market opportunities in Adama and surrounding towns are affected by the low capacity of TVET institutions to cater their training program for actual skill needs of the labor market and weak involvement of stakeholders. In addition, fragile implementation of cooperative training, lack of adequate and reliable labor market information, absence of tracer study result, inadequacy of training facilities and budget, change in technologies are other challenges facing TVET institutions in meeting middle level manpower needed in the labor market.

To overcome challenges and to utilize market opportunities effectively, TVET institutions need to rely on strengthening labor market information system at institutional level. Moreover, network and partnership program between TVET institutions and stakeholders need to be fostered in areas of job placement, work attachments, advice on courses, and donation of equipment, part-time teaching and financial assistance. Furthermore, to utilize learning facilities such as experienced industrial experts, to reduce expenditures of laboratory equipment and to make trainees familiar with jobs in labor market, TVET institutions need to strengthen cooperative training with enterprises.

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A CAUSAL ANALYSIS MODEL OF SUPPLY CHAIN FACTORS IMPACTING OPERATIONS EFFICIENCY

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ABSTRACT

With the ever-increasing trend in customer expectations for better product and services, operations efficiency has been a concern for industries. The key strategy to improve operations efficiency (OE) lies in managing supply chain (SC) efficiently. There are many factors which are critical for a successful supply chain management (SCM). The causal relationship between the factors largely influences operations decision. Thus, there arises a challenge on how to establish causal relationship between factors. To resolve this, in this research we propose a Decision Making Trial and Evaluation Laboratory (DEMATEL) method since the current approaches are based on human judgments which are not simple to estimate. The application of the proposed method is illustrated in the airport operations context involving survey of practitioners and experts. Data were analyzed using MATLAB program. Findings reveal that in order to enhance OE decision makers need to consider the most important SC factors, the factors in the cause groups, and their influence level upon other factors. The study provides insight to decision makers on how to establish the cause effect relationship of factors quantitatively and convert into a visual structure map leading to a better operations decision.

Key words: Operations efficiency, SCM, Airport operations, Causal relationship, DEMATEL

INTRODUCTION

Industries are facing tremendous challenges in today's changing business environment due to ever-increasing trend in customer expectations for better product and services. The key to address these challenges lies in the strategies followed and capability developed. SCM capability is one of such capabilities that are required to enhance OE.

SCM is the process of integrating a network of intra- and inter-organizations activities and key business processes to improve the flow of goods, services, finances, and/or information from suppliers to end customers (Chow *et al*., 2008). Excellent theoretical insights are found in literature on manufacturing and service industries unfolding operations and financial benefits realized through SCM (Lai and Cheng, 2003). There is an increasing interest on implementing efficient SCM strategies in many industries (Li *et al*., 2006).

Airport industry as a service system requires multiple organizations and their relationship to successfully carry out its daily operations that can be achieved through SCM. Some key critical factors reported in the literature for successful SCM implementation are

management commitment and information sharing (Tummala *et al*., 2006), infrastructure and technology (Fawcett *et al*., 2011), know-how (Chow *et al*., 2008), performance monitoring (Chan *et al*., 2006), and process improvement (Li *et al*., 2006). Industries have to prioritize implementation of the factors based on the influence of each factor over another factor and their importance to the operations. While the causal relationship among the factors largely influences implementation decisions, establishing causal relationship among factors is a challenge to decisions makers. To resolve this, decision makers use their judgments which are not simple to estimate. Moreover, sufficient analysis of the relationship among the SC factors is not well addressed in literature.

The purpose of the present study is three fold. First, to identify SC factors reported in literature those affect airport operations. Second, to examine the relationships among these factors and the influence levels of each factor over other factors as well as their priorities applying DEMATEL method. Finally, to develop a structural model of the relationship to enable decision makers to take a better operations decision.

This paper is organized as follows: Section 2 explains the study framework and outlines the steps of DEMATEL method. Section 3, results and discussion of findings are presented. In section 4, conclusion of the study is presented.

Infrastructure (F2), Technology (F3), and Information sharing (F4), Know-how (F5), Performance monitoring (F6), and Process improvement (F7).

The study analyzes the causal relationship among these factors and finds the impact level of each factor over other factors. The DEMATEL method is used to achieve this because it is a practical method for visualizing the structure of complex causal relationships with matrices and graphs (Warfield, 1976). The method has been used in different areas of research and practices, such as in SCM (Amiria *et al*., 2011), safety management (Liou *et al.*, 2008), auto industry (Wu and Tsai, 2011), service quality (Tseng, 2009), and technology (Lee *et al*., 2010).

This study uses practitioners and experts survey/interview to collect data. Seven practitioners from one of the Indian airports and three experts from academia who have operations and SCM expertise, designated by P_1 to P_{10} are participated in the study conducted from March 2011 to April 2011. Each practitioner and expert was asked to indicate the degree of which he/she believes factor *i* affects factor *j*. The pair-wise comparisons to evaluate the influence and direction between two factors were denoted by a_{ij} and given an integer score 0 to 4 ranging from “no influence” to “very high influence" respectively.

In applying DEMATEL method first, causal relation diagrams which capture the relationships between the seven factors are developed.

MATERIALS AND METHODS

Seven SC factors that an airport should possess for enhanced airport operations are identified from the literature. These are Management commitment (F1),

Based on this, an initial direct-relation matrix, a *n x n* matrix A for each of the causal relation diagrams is generated. The matrix A= [a_{ij}] shows the degree of direct impact each factor *i* exerts on each factor *j*. Following this, the initial direct-relation matrix for n matrices is obtained using the equation:

$$A_n = P_1 + P_2 + \ldots + P_n \quad (1)$$

Then, the normalized initial direct-relation matrix N is computed by the following equation:

$$N = A_n * \frac{1}{max_{1 \le i \le 7} \sum_{j=1}^{7} aij} \quad (i, j = 1, 7..) \quad (2)$$

Next, the total-relation matrix (T) is calculated by accumulating the normalized initial direct-relation matrix N as follows, where *I* is identity matrix.

$$T = N (I - N)^{-1} \quad (3)$$

Using equation (4) to (6), the sum of rows (D_i) and the sum of columns (R_j) are calculated from T for each factor and a causal relation diagram is developed to explain the structural relation among the factors.

$$T = [t_{i,j}]_{n \times n} \quad (i, j = 1, 2, ..., n) \quad (4)$$

$$R_j = \sum_{i=1}^{n} t_{ij} \quad (6)$$

Factors	*F1*	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*
F1	0	0	0	1	0	0	1
F2	0	0	1	0	0	0	0
F3	0	0	0	1	0	0	0
F4	0	0	0	0	0	1	1
F5	1	0	0	1	0	0	0
F6	0	0	0	0	0	0	1
F7	0	0	0	0	0	0	0

$$D_i = \sum_{j=1}^{n} t_{ij} \quad (5)$$

Computing (D_i - R_j) gives the factor's category into a cause group (D_i - R_j > 0) and effect group (D_i - R_j < 0). The causal relationship diagram which provides insight for making decisions can be mapped using the dataset of (D_i + R_j, D_i – R_j). By means of this diagram and the position of factors, a decision maker can identify whether a factor is a cause or an effect and how it is affected or affect others.

RESULTS AND DISCUSSION

Ten causal relationship diagrams have been developed by the ten practitioners and experts following the guidelines proposed by Sterman (2000). Since there are seven factors, ten 7 x 7 direct-relation matrices were formulated for the ten causal relation diagrams. The initial direct-relation for the causal relationship diagram developed by one of the practitioners (P_1) is given in table 1. Each number in the matrix (a_{ij}=1) shows that there is a positive relationship between the two factors (*i* and *j*).

Table 1: The initial direct-relation matrix developed by P_1

MATLAB program is used to compute the relationship matrices and the degree of influence of factors. Accordingly, the relative importance each of

the factors or the strength of influence both dispatched and received is determined by ($D_i + R_j$).

Similarly, nine causal relationship diagrams have been developed by the remaining nine practitioners and experts and their corresponding initial direct-relation matrix were formulated accordingly. The initial direct-relation matrix determined by accumulating the ten matrices of the ten diagrams using equation (1) is shown in table 2.

Table 2: The initial direct-relation matrix for SC factors

Factors	*F1*	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*
F1	0	1	2	3	2	2	3
F2	1	0	4	3	3	2	2
F3	1	3	0	4	2	1	4
F4	0	0	1	0	2	3	3
F5	4	0	1	3	0	3	4
F6	2	0	0	1	3	0	4
F7	1	1	0	3	0	1	0

The initial direct-relation matrix given in table 2 is normalized using equation (2) and results are reported in table 3. The total-relation matrix is calculated from table 3 using formula (3).

Table 3: The normalized direct-relation matrix for SC factors

Factors	*F1*	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*
F1	0.000	0.209	0.417	0.626	0.417	0.417	0.626
F2	0.209	0.000	0.834	0.626	0.626	0.417	0.417
F3	0.209	0.626	0.000	0.834	0.417	0.209	0.834
F4	0.000	0.000	0.209	0.000	0.417	0.626	0.626
F5	0.834	0.000	0.209	0.626	0.000	0.626	0.834
F6	0.417	0.000	0.000	0.209	0.626	0.000	0.834
F7	0.209	0.209	0.000	0.626	0.000	0.209	0.000

The key decision factors and relationships can be obtained from the total-relation matrix. The D_i and R_j are also calculated as shown in table 4.

Table 4: The total-relation matrix for SC factors

Factors	*F1*	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*	$\boldsymbol{D_i}$
F1	0	0.0008	0.0016	0.0025	0.0016	0.0017	0.0025	**0.0107**
F2	0.0008	0	0.0033	0.0025	0.0025	0.0017	0.0017	**0.0125**
F3	0.0008	0.0025	0	0.0033	0.0017	0.0008	0.0033	**0.0124**
F4	0	0	0.0008	0	0.0016	0.0025	0.0025	**0.0074**
F5	0.0033	0	0.0008	0.0025	0	0.0025	0.0033	**0.0124**
F6	0.0016	0	0	0.0008	0.0025	0	0.0033	**0.0082**
F7	0.0008	0.0008	0	0.0025	0	0.0008	0	**0.0049**

R_j	**0.0073**	**0.0041**	**0.0065**	**0.0141**	**0.0099**	**0.0100**	**0.0166**

The relative importance the factor has ($D_i + R_j$) and the factor relation ($D_i - R_j$), i.e, the net effect the factor contributes to the system are calculated using equation (4) to (6) and the results are reported in table 5.

Table 5: The degree of influence of SC factors

	F1	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*
$D_i + R_j$	0.0180	0.0166	0.0189	0.0215	0.0223	0.0182	0.0215
$D_i - R_j$	0.0034	0.0084	0.0059	-0.0067	0.0025	-0.0018	-0.0117

Using ($D_i - R_j$) values, we identified the cause group ($D_i - R_j > 0$) & an effect group ($D_i - R_j < 0$). This relationship is transformed by the proposed DEMATEL method and mapped in figure 2.

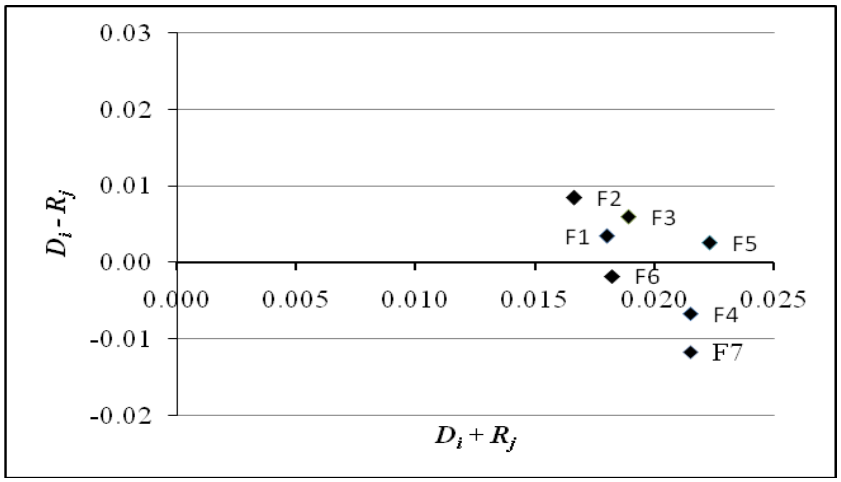

Figure 2: The causal diagram

Using the T values given in table 4, the interdependencies among the identified cause and effect group factors and their strengths are illustrated in figure 3.

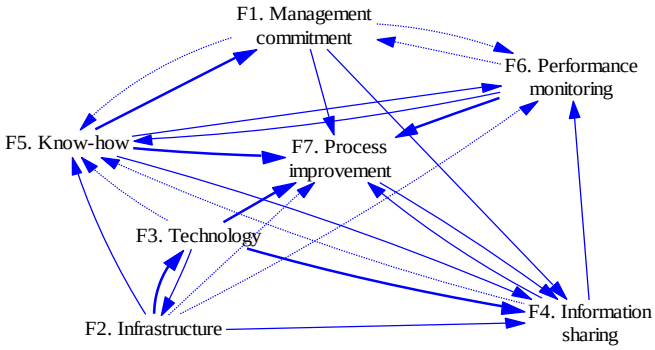

Figure 3: Interdependencies among SC factors

We have established a threshold to group the T values and represented with different lines for ease of understanding. The thresholds are $T_{ij} > 0.3$ (*higher influence*, thicker lines), $0.25 \leq T_{ij} < 0.3$ (*high influence*, thin lines), $0.15 \leq T_{ij} < 0.25$ (*medium influence*, dotted lines) and $T_{ij} < 0.1$ (*low influence*). To reduce the complexity of the figure, low influence factors are omitted. Factors with several arrows mean that each factor shows a frequent interactive relation with other factors.

Based on the results, valuable insight and several implications can be generated for decision makers in the airport operations.

1. Referring to $(D_i + R_j)$ values in table 5, among the seven factors, F5 and F4 are the most critical factors by numerical figures (0.0223 and 0.0215, respectively) to be taken into account. This finding matches with the finding exhibited in figure 3 that these factors are with the highest number of interactive arrows indicating their strength and influence on other factors. Prioritizing of these factors follows F5>F4>F7>F3>F6>F1>F2. Hence, the key to airport OE is building SCM know-how (Chow *et al.*, 2008) followed by Information sharing.
2. The findings from figure 2 indicates that four factors: F1, F2, F3 and F5 are defined as cause factors, while the other three, F4, F6, and F7 are in the effect group. The cause factors dispatch the influence to other factors more than they receive whereas, effect factors receive the influence from other factors more than they dispatch. Recognizing the difference between cause and effect factors help decision makers take proper operations decisions (Amiria *et al*., 2011).
3. The decision makers have to concentrate on improving the cause factors as these are influencing factors having positive impact to get high performances in terms of effect factors. In other words, the effect factors: F4, F6, and F7 can be improved through management commitment, availability of infrastructure, implementing technology, and building know-how through training and development. Ultimately, this enhances the OE.

CONCLUSION

Enhancing OE is a must for the success of industries which is affected by many issues such as effective management of the SC. This context is very critical

for airport industry because of the dynamic and complex nature of the airport business environment. In order to facilitate decision making on implementation of the SC factors leading to enhanced OE, airports are required to understand the causal relationship among the factors.

In this paper, we have investigated the complex relationship between factors impacting airport OE quantitatively and developed a structural model of the relationship using the proposed DEMATEL method since the current approaches are based on human judgments which are not simple to estimate. The proposed approach can be modified as required for analyzing operations and SCM issues of other industries. The results reveal that SCM know-how is the most important factor as well as a cause factor to enhance OE. Further, airport industries need to pay more attention to the identified four cause factors to drive performance in the effect factors and achieve operational success. This understanding could help practitioners in their effort for successful SC process implementation.

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ECONOMIC EFFICIENCY OF EXPORT–ORIENTED CATTLE-FATTENING FARMS IN EAST SHEWA ZONE: THE CASE OF ADAMA CITY AND ITS SURROUNDINGS

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ABSTRACT

This study was undertaken to measure the economic efficiency of export–oriented cattle-fattening farms in Adama city and its surroundings and to identify their determinants. Technical, allocative and economic efficiencies were estimated by a non-parametric Data Envelopment Analysis (DEA) method and the identification of their determinants using Tobit model. The study result showed the existence of substantial inefficiencies in production as well as efficiency differentials among the farms. The mean technical, allocative and economic efficiencies were found to be 88%, 62% and 55%, respectively. An econometric analysis based on Tobit model indicated that length of fattening period had significant negative impact on all efficiency scores, whereas training and schooling had significant positive impact on allocative and economic efficiencies. Farm head's year of experience on cattle-fattening, extension contact and off farm income had significant positive impact on technical efficiency. Experience sharing program, year of experience and feeding frequency has significant positive impact on economic efficiency. Policy measures aimed at developing better farm-level training programs focusing on the fattening period, feeding

and management record keeping; enhancing farms' access to information, and marketing systems are recommendations drawn from the study to increase productive efficiency of cattle fattening farms in the study area.

Key words: DEA, Tobit Analysis, Cattle- Fattening Farms, Technical, Allocative, Economic, Efficiencies.

INTRODUCTION

Like most Sub-Saharan African countries, Ethiopian economy is heavily reliant on agriculture and allied economic activities. This is because agriculture adds 47% to the total GDP, provides livelihood to more than 80% of the population, constitutes nearly 90% of the nation's total export and makes most of the exchange earnings to the economy (CSA, 2007). When we take the livestock subsector, Ethiopia ranks first in Africa and tenth in the world with respect to livestock population. It is estimated at around 35 million tropical livestock units (TLU), which includes 30 million heads of cattle, 42 million heads of sheep and goats, about 7 million equines, one million camels, over 53 million chickens, 10 million bee colonies, and 40 thousand ton annual harvestable fish (Azage *et al*., 2009) in the country. Livestock production contributes an estimated 16 % to the total GDP and over 40 % to the agricultural GDP (Diao *et al*., 2007), 15% of export earnings and 30% of agricultural employment (Staal *et al.*, 2008). The sub-sector is the second major source of foreign currency

through export of live animals, hides and skins (ILRI, 2003). The sector also employs about one-third of the country's rural population (ILRI, 2003). The recent economic policy of the government of Ethiopia under Growth and Transformation Plan (MEDaF, 2011) places a great emphasis on commercialization of agriculture, diversification of production and exports, and private sector investment in order to move farmers beyond subsistence farming to small-scale market-oriented agriculture. Nevertheless, the agricultural service delivery system in general and livestock service in particular which were implemented in the past did not lead to the envisaged commercialization of agricultural producers. Hence, with the process of commercialization of the country's subsistence-oriented production systems to more productive and market-oriented production systems, the agricultural support service has to be transformed and should become responsive and innovative.

On the other hand, despite the fact that agriculture is primarily a rural based activity in Ethiopia, the phenomenon of urban and peri-urban agriculture (UPA) is also becoming evident. There is large population of agricultural producers with in urban and peri-urban areas. Now a days, market oriented livestock production systems are one of UPA emerging and dominating most urban centers in the country, varying in kinds and levels. The systems involve the production, processing and marketing of milk and milk products, animal breeding and cattle fattening farm productions. Addis Ababa and Bushoftu cities and their surroundings are one of the areas that exhibit market oriented dairy production. Adama city and its surrounding towns are also well known by its cattle fattening farms as a major market –oriented, especially export -oriented livestock production activity. Thus given the current and previous governments' economic policies that aim at improving farm productivity; productivity and market performance of market oriented livestock production with export potential, detailed and systematic empirical studies on the production efficiency of market oriented livestock production in Ethiopia are scarce or non-existent, particularly of export-oriented. Accordingly this research has been conducted to assess farm level technical, allocative and economic efficiencies of export-oriented cattle-fattening farms and its confounding factors in Adama city and its surroundings.

MATERIALS AND METHODS

The data used for this study were collected both from primary and secondary sources. The primary data were collected from heads of sample farms through formal farm survey using structured questionnaire;interviews ,field observations & focus groups discussion and finally triangulated to each other. The content of the questionnaire was mainly emphasized on personal characteristics of farmers, farm characteristics, and access to institutions. Before embarking on the actual survey, a pre-test of the questionnaire was conducted in order to identify difficult or unwanted questions, to see the reaction of the respondents to the questions, and to check the appropriateness of the questionnaire.

To generate primary data for the research a two stage cluster random sampling technique was used to select a sample of respondents. First, a total list of export-oriented cattle-fattening farms was obtained after stratifying them into two groups, namely, urban, and peri-urban feedlots. Secondly, a list of` the sample

respondent of cattle-fattening farms who has bulls in their feedlots during the survey period was prepared randomly from both lists. Accordingly the total sample size for the study was 62 cattle-fattening farms that are selected randomly from a total population of 95 cattle-fattening farms in the study area, which has bulls in their feedlots during the survey period.

For data analysis, descriptive method, which included frequency distributions, maximum, minimum, percentages, measures of central tendencies and measures of dispersion of the sample units, were used to describe some important characteristics of the sampled farms; a mathematical (linear) programming method called DEA was used to estimate efficiency of production and an econometric method called Tobit was used to identify factors affecting the efficiency of production.

The Model

The models used in the study were a two-stage approach involving DEA and Tobit models. In this approach, a DEA problem were solved in the first stage using General Algebraic Modelling System (GAMS) and at the second stage, the efficiency scores from the first stage were regressed upon different explanatory variables using Tobit model. Hence, under DEA frontier, we used the model specified by equation (1) and solved the same linear programming problem (Charnes *et al*., 1978) for the i^{th} farm or for each $DMUs_i$, i = 1, 2,..., n; and obtain the technical efficiency (TE_i) score ϕ for each of the n DMUs in the sample.

$$\begin{aligned} &\min_{\phi,\lambda} \phi \\ s.t \quad &-y_i + Y\lambda \geq 0 \\ &\phi x_i - X\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad (1)$$

Like wise, in order to derive a measure of total economic efficiency (EE) index, the model specified by equation (2) were used and solved the same input-based cost minimization DEA model.

$$\begin{aligned} &\min_{x_i^*,\lambda} w_i^t x^*_i \\ s.t \quad &-y_i + Y\lambda \geq 0 \\ &x^*_i - X\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad (2)$$

Then the total or overall economic efficiency (EE_i) index for the i^{th} firm is computed as the ratio of the minimum cost to the observed cost given input prices and CRS technology (Coelli *et al*., 2005), given by equation :

$$EEi = \frac{w_i^t x_i^*}{w_i^t x_i} \qquad (3)$$

Allocative efficiency (AE_i) of the i^{th} firm is then the ratio of economic efficiency and technical efficiency of the i^{th} firm. For the inefficiency factors the Tobit Model (Tobin, 1958), was specified as:

$$E_i^* = \sum_{j=1}^{n} \beta_j x_j + \eta_i$$
$$E_i = \begin{cases} 1 & if \ E_i^* \geq 1 \\ E_i^* & if \ E_i^* < 1 \end{cases} \qquad (4)$$

Where i refers to the i-th farm in the sample; x_j represents various farm-specific variables; β_j are parameters to be estimated; η_i is the error term and $\eta_i \sim N(0, \sigma_\eta^2)$; E_i is an efficiency measure representing technical or allocative or economic

efficiency and E_i^* is the latent variable, with $E\left[E_i^* \middle| x_i\right] = x_i\beta$.

Description of the Model Variables

Input-output variables for DEA Models

Output Variable: - Yield or the output variable(y) in the production function for this study is a yield per farm which is defined as the actual quantity of the output (the total sum of live weight of all bulls in the feedlot) produced per farm during the survey period, measured in kilograms.

Production Inputs for DEA Model:-The quantity and qualities of the inputs and technical skills of the farmer to use the inputs properly determines production or efficiency of the farm producers. Thus**,** for this study, six inputs such as Labor(in hours), Number of Bulls(in head), Total Quantity of Concentrate Feed (quintal), Total Quantity of Roughage Feed (quintal), Length of Fattening Periods(in days), Costs of Veterinary and Medicine (in Birr) were specified as production inputs and were used in the production functions (equations).

Variables for Tobit Model

The dependent variable for the Tobit Model: Are the technical, allocative and economic efficiency estimates derived from DEA frontier models in the production functions.

Independent variables for inefficiency factors: After economic efficiencies are estimated for each farm, sources of inefficiency differential among farm, besides input constraints, were estimated using efficiency scores as dependent variable, using Tobit analysis. For this purpose twelve explanatory variables were used for inefficiency model for this study, and were categorized in three groups as follows:

Demographic factors: These include personal characteristics of farm head such as age, education and cattle fatting farm experience of the farm heads.

Socioeconomic factors*:* These are farm characteristics such as farm size (number of bulls), length of fattening period, daily feeding frequency, off/non-farm employment and existing management record.

Institutional factors: These include access to institutions such as, use of credit, extension service, training of the farm head on cattle-fattening farm and their participation on experience sharing programs**.**

RESULTS AND DISCUSSION

Descriptive statistics were used to analyze primary data. Accordingly the summery of descriptive analysis of the output and input variables used in the non-parametric DEA models and of the explanatory variables used in Tobit model are presented below.

Descriptive Results

Descriptive Analysis of the Output and Input Variables for the DEA Models

As can be observed from Table 1 below, the Descriptive statistics result showed that the sample cattle-fattening farms produced 72.9 tons of live

weight, on average. The minimum was 17.2 tons and the maximum was 220 tons.

Table 1: Descriptive statistics of the output and input variables used in the DEA model

Variables	Mean	Std. dev.	Min	Max
Output				
Live weight (kg)	72921.98	44651.72	17166.00	220350.00
Inputs				
Number of bulls (head)	195.02	118.14	50.00	600.00
Labor (man-day-hrs)	3376.26	2689.45	528.00	14400.00
Fattening period (days)	66.73	33.45	15.00	150.00
Total concentrate feed (quintals)	1291.05	943.17	117.00	3900.00
Total roughage feed (quintals)	758.84	613.01	104.00	2625.00
Costs of veterinary and medicine (birr)	4427.32	3658.44	1000.00	18000.00

To reach the present level of production, cattle-fattening farms used approximately 3376 labour hours, 205 tons of total feed, of which 129.1 tons is concentrate (by-product) feed and 75.9 tons is roughage feed on average. In addition to these inputs, farms expenses 4427 birr for veterinary and medical costs on average during the fattening period. The sampled farms kept their bulls on average for 67 days in the feedlots. The average feed intake per animal during the fattening period was 1051.12 kg, with concentrate feed 662 kg and roughages 389.11 kg.

Daily feed intake per animal during the fattening period was 15.75kg with concentrate feed 9.92 kg and roughages of 5.83 kg. The farms were obtained a bull weighing a live weight of 373.92 kg on average during the fattening period. Thus the farmers were producing on average above the country's minimum requirement of live weight of bulls to export from the country during the fattening period; as the live weight average is 373.92 kg in the study area while the minimum national value to export from a country is 325 kg.

Descriptive Analysis for Explanatory Variables Used In Tobit Model

As can be observed from table 2, for the sampled farms, the average age of the farm heads at the time of the survey was 42 years with the minimum and maximum 22 and 65 years, respectively. Furthermore, when we see the age of the farm heads in age range; 2 (3.2%) of them are less than 31 years old, 30 (48.4%) of them are in between 31-40 age, 25 (40.3%) of them are between age of 41-55, and only 5 (8.1) of them are more than 56 years old. This indicates most of the producers are young. When we see the year of farm head experience of the sampled farms on cattle-fattening farm or/and similar activities**,** the sampled respondent farm heads had an average of 7.65 years of farm experiences that ranges from 1 year to 18 years of farm experience.

Table 2: Summary of descriptive statistics of explanatory variables used in Tobit model

Variables	Continuous variables				Dummy variables	
	Mean	Std. Dev.	Min	Max	Percentage of farmers with dummy = 1	percentage of farmers with dummy = 0
Schooling (Years)	7.68	4.78	0	16	-	-
Age (Years)	42.35	8.91	22	65	-	-
Farm Experience (Years)	7.65	4.42	1	18	-	-
Farm Size (No. Of Bulls	195.02	118.14	50	600	-	-
Fattening Period (Days)	66.73	33.45	15	150	-	-
Extension Contact (Number)	1.60	1.20	0	4	-	-
Credit Amount (Birr)	365806.5	547496.7	0	3000000	-	-
Feeding Frequency (No. Of Times)	2.10	0.30	-	-		
Access To Training (Yes/No)	0.61	0.49	-	-	61	39
Experience Sharing (Yes/No)	0.29	0.46	-	-	29	71
Management Records (Yes/No)	0.77	0.42	-	-	77	23
Off/Non-Farm (Yes/No)	0.47	0.50	-	-	47	53

Demographic characteristics

As shown table 3 above, majority of the sample respondents, that is 53 (85.5%) had attended at least elementary school education out of which 11 (17.7%) had completed primary education, 1-6; 29 (46.8%)

Table 3: Educational level of the sample respondents

Education level	Frequency	Percentage
Illiterate	9	14.5
Primary	11	17.7
Secondary	29	46.8
Diploma	8	12.9
BA/BSC	5	8.10

completed junior and secondary education, 7-12; 8 (12.9%) had graduated with diploma or certificate and 5 (8.10%) had B.A/B.Sc degree qualification. Meanwhile, 9 (14.5%) of the sampled producers were illiterate.

Socio economic characteristics

Only about 29 (47%) of the sampled farm head reported to earn off/non-farm income from non-cattle fattening farm activities.

About 48 (77.4%) the sampled farm had management records. Regarding feeding frequency, the majority of them, that is, 56(90.3%) farmers feed their bulls twice per day and only 6(9.7%) of the farmers reported that they feed their cattle three times daily.

Institutional characteristics

A total of 47(75.8%) of the sampled farms reported contact with extension agents but have very few contacts with extension services in a month, only (1.6 times on average, or 1-4 times per month). Exactly half of the sampled farms had access to credit of which 25(40.3%) used formal credit institutions, while 6(9.7%) have used informal credit sources either from relatives, friends or local money lenders. Credit use averaged approximately 365806.5 birr per farm. About 38(61.3%) of the sampled producers have access to training on cattle-fattening farm

system and 18 (29%) of them have obtained experience sharing out of Ethiopia.

DEA and Econometric Model Results

A. Technical efficiency analysis:-

The results derived from DEA models as shown in table 4 indicated that technical efficiency indices differed substantially among farms, ranging from 0.34 to 1.00 with 19 fully efficient farms out of the 62 sampled farms with an average efficiency score of 0.88.

Table 4: Distribution of technical, allocative and economic efficiencies of sample farms (n = 62)

Efficiency (%)	Frequency			Percentage		
	TE	AE	EE	TE	AE	EE
0 – 10	0	0	0	0	0	0
11 – 20	0	0	1	0	0	1.6
21 – 30	0	0	2	0	0	3.2
31 -40	1	4	4	1.6	6.5	6.5
41 -50	0	3	13	0	4.8	21.0
51 -60	0	17	24	0	27.4	38.7
61 -70	2	29	14	3.2	46.8	22.6
71 -80	10	8	3	16.1	12.8	4.8
81 -90	20	0	0	32.3	0	0
91-100	29	1	1	46.8	1.6	1.6
Total	62	62	62	100	100	100
Mean	88	62	55	-	-	-
Std. Deviation	12.038	10.978	13.353	-	-	-
Minimum	34	31	20	-	-	-
Maximum	100	100	100	-	-	-

An average efficiency score of 0.88 implies that if the average farm in the sample was to achieve the technical efficiency level of its most efficient counterpart, then the average farm could realize a 12 % input reduction. A similar calculation for the most technically inefficient farm revealed input saving of 66 %. Though the maximum and the minimum technical efficiency scores differed considerably, the modal technical efficiency class is 0.91-1.00, representing 46.8 of the sample producers indicating that the highest number of farmers had technical efficiencies between 0.90 – 1.00. Of the sample farms, 79% had a higher technical efficiency scores than the mean technical efficiency. This implies that the farms are fairly technically efficient.

B. Allocatve efficiency analysis

The estimated allocate efficiencies differed substantially among the farms ranging between 0.31 and 1.00 with the mean allocative efficiency of 0.62.

This implies that if the average farm in the sample was to achieve allocative efficiency level of its most efficient counterpart, then the average farm could realize 38 % cost saving. A similar calculation for the most allocatively inefficient farm revealed cost saving of 69 %. The frequency of occurrence of the estimated allocative efficiencies in deciles ranges indicate that a clustering of allocative efficiencies in

the region of 0.61-0.70 efficiencies range representing 46.8 % of the respondents.

C. Economic efficiency analysis:-

The combined effect of technical and allocative efficiency results showed that the average economic efficiency level for the sample farms is 0.55, with a lowest of 0.20 and a highest of 1.00. This indicated the existence of substantial economic inefficiencies of production in the study area. However, low economic efficiency scores revealed that there was a considerable room to increase agricultural output without additional inputs, given the existing technology. If these farms operated at full efficiency levels, they could reduce, on average, their costs of production by 45 % and still produce the same level of output.

Tobit Estimates:

Analysis of Determinants of Efficiency

Econometric Analysis

The Tobit results (Table 5) showed that, except credit amount and length of the fattening period, all explanatory variables had a positive relationship with technical efficiencies Tobit analysis was used to explain efficiency differentials among the sampled farms. Before undertaking Tobit Model estimation and making an econometric analysis, the explanatory variables were checked for their multicollinearity using different batteries of tests. To test existence of multicollinearity in the hypothesized explanatory variables, VIF and TOL was computed. The results showed that the entire explanatory variables had no serious multicollinearity problem. Furthermore, for hetroscedasticty test, we used a hetroscedasticy robust method; robust standard errors are often reported in applied cross-sectional work, especially when there is heteroskedasticity problem (Jeffrey, 2002). Finally, Tobit estimation was conducted by STATA.

Table 5: Factors affecting efficiency of exported-oriented cattle fattening farms in the study area

Variables	**TE**		**AE**		**EE**	
	Coefficient (std error)	Marginal effect	Coefficient (std error)	Marginal effect	Coefficient (std error)	Marginal effect
Intercept	0.656(0.198)***	0.919	0.535(0.125) ***	0.617	0.316(0.137)***	0.552
Agefh	0.002(0.002)	0.002	0.001(0.001)	0.001	0.001(.002)	0.002
Crtamount	-1.020(4.56) **	-1.02	-7.510(2.84) ***	-7.51	-1.280(3.12) ***	-1.28
Expsharing	-0.008(0.052)	-0.009	0.037(0.032)	0.038	0.057(0.035)*	0.057
Feedingfrqu	0.039(0.063)	0.039	0.054 (0.041)	0.054	0.087(0.045) **	0.088
Yexpr	0.008(0.004)*	0.008	0.001(0.003)	0.001	0.005(0.003)*	0.006
Flength	-0.001(0.000)***	-0.002	-0.001(0.0004)***	-0.002	-0.001(0.0004)***	-0.002
Mgtrecords	0.033(0.052)	0.033	-0.045(0.033)	-0.045	-0.032(.037)	-0.033
Farmsiz	0.0001(0.0002)	0.0001	0.0001(0.0001)	0.0001	0.0001(0.0001)	0.0002
Off-farm	0.087(0.048)***	0.087	-0.002(0.029)	-0.002	0.034(.032)	0.034
Schooling	0.004(0.005)	0.005	0.006(0.003)**	0.006	0.007(0.003)**	0.007
Training	0.038(0.041)	0.039	0.042(0.026)*	0.043	0.061(0.029)**	0.062
Extcontactm	0.024(0.016)*	0.025	-0.015(0.009)	-0.015	0.008(.011)	-0.009

Sigma	0.127 (.015)	-	0.086(0.008)	-	0.094(0.008)	-
LR χ^2 (12)	28.10 ***	-	31.46***	-	43.80***	-
Log likelihood	14.625	-	61.708	-	55.960	-

****** significant at 1% level; **significant at 5% level;* significant at 10% level.***

The significant positive relationship of off/non-farm income with technical efficiency might be explained by the fact that off/non-farm employment may absorb under-employed labour resources, improve the experience and human capital of the farm operator and bring additional income that could be used for funding farm activities, thus leading to a positive relationship with technical efficiency. Most of contacts with extension services were associated with greater technical efficiency. Thus extension visits were found to positively and significantly affect technical efficiency for this study. Similar results were reported by Kaliba, A.R and C.R Engle, (2006). Schooling is positively and significantly related to allocative and economic efficiencies, which confirms with previous studies by Coelli *et al.* (2002), and this result may be explained by the fact that education is expected to make farm head less conservative and more receptive to new technology and innovation, which will consequently lead to higher efficiencies. Moreover, this result may be explained by the better education level of the sampled farm head as about 86 % of the sampled farm head have at least completed primary education thus resulted in positive efficiency relations.

Feeding frequency is positively and significantly related to economic efficiency, which indicated that farms with higher feeding frequency were more economically efficient than farms with lower feeding frequency, as expected. Similar results were reported from previous studies (Ceyhan and Hazneci, 2010 and Ghorbani *et al*., 2009).

Another outcome of the Tobit model was the significant effect of credit use on economic efficiency. Although 31 (50%) of the sampled farms had access to credit from either formal or informal credit sources, credit use showed unexpected negative sign on technical, allocative and economic efficiencies level significantly. As a result, farms using more credit were more inefficient. This may be due to shortage of working capital, due to high input costs and low returns on outputs, together with high credit costs, the Moral Hazard problem of credit and 'fungibility of loan' (or loan diversion).

Training had significant positive impact on allocative and economic efficiencies. Similar results were reported from previous studies (Ceyhan and Hazneci, 2010). The result verifies the importance of capacity building and technical assistance for agriculture entrepreneurs and producers to improve production efficiency.

Farm experience in cattle-fattening had a significant positive impact on technical and economic efficiencies. This is because most of the sampled farm heads were experienced farmers (with average 7.65 years of cattle fatting farm experience) and as most of farms are own operated, daily works of farms were done by themselves, and thus resulted in a positive influence on technical and economic efficiencies among the farms. The result was in line with the findings of Mbanasor and Kalu (2008).

Experience sharing program was found to significantly and positively affect economic

efficiency as hypothesized. The positive relationship of experience sharing activity with efficiency magnifies the role of experience sharing program as one capacity building programmes in addition to training and extension service as technology adoption can be acquired through observation also. In fact, 18 (29%) of the sampled farmers have obtained experience sharing programs out of Ethiopia to some African and Meddle East countries.

Length of fattening period was found to be significantly and negatively affect all efficiencies. This result is in line with Ghorbani *et al*. (2009). The negative relationship of length of fattening period with all efficiencies may be is due to the extended period of fattening period length as few of the sampled farms kept their bulls for more than three months, which in tern resulted in loss of live weight of bulls, loss of the standard quality of beef for export and incurs to more unnecessary feed costs and thus resulted in the negative relationships with all efficiencies.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study evaluated economic efficiency of export-oriented cattle fattening farms in Adama city and its surroundings and identified their determinants, using DEA and Tobit Models respectively. Using a detailed survey, data were collected in the production year of 2010 from June to July, form 62 sampled cattle fattening farms and measures of technical, allocative and economic efficiencies were obtained. The results indicated that the mean technical, allocative and economic efficiencies were 88%, 62% and 55%, respectively. This indicated the existence of a substantial allocative and economic inefficiencies as well as variations in efficiency levels among farms. DEA results showed that the excess cost owing to inefficiency of the sample farms in the study areas was, on average, 45% and was mainly due to allocative inefficiency. Tobit result showed that length of the fattening period and credit amount had significant impacts on all efficiency scores, whereas training and schooling had significant impact on allocative and economic efficiencies. Extension contact, Farm head year of experience and off/non-farm income had a significant impact on technical efficiency. Farm head year of experience, Experience sharing and feeding frequency had a significant impact on economic efficiencies.

Recommendations

Policy implications of this analysis are that efficiency estimates indicate both the distribution of the farms' efficiency and its institutional and socioeconomic determinants. An analysis of the determinants' relative efficiency indicates which aspects of the farms' human and physical resources must be targeted by public investments to improve farm efficiency. That means the identification of those factors contributing to efficiency differentials among farms might help to formulate better policy for intervention. Result from inefficiency differentials suggests that policy-makers should focus on these institutional and socio-economic factors influencing efficiency of production. They should focus on enhancing farms' access to information via better extension services, marketing systems and encouraging management record keepings. Capacity building and technical assistance for agriculture producers is important to improve production efficiency. Thus training, agricultural extension and other capacity building programs for farms should be provided to improve the economic efficiency of

individual farms up to at least the level of the best cattle-fattening farms. Hence training focusing on the fattening period, feeding and management record keepings are the major recommendation drown from the study to enhance production efficiency of cattle fattening farms in the study area.

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A COMPARATIVE STUDY OF OCCUPATIONAL ROLE STRESSORS AMONG ACADEMIC OFFICERS OF PRIVATE AND PUBLIC HIGHER EDUCATIONAL INSTITUTIONS IN OROMIA REGIONAL STATE OF ETHIOPIA

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ABSTRACT

This study aimed to examine occupational role stressors among academic officers of public and private higher educational institutions in Oromia Regional State of Ethiopia. To address this, a total of 251 academic officers were selected using random sampling techniques from higher educational institutions in the state. Data were collected from participants using a questionnaire focusing on Occupational role Stress questionnaire. The findings of the study indicated that there were significant mean differences in all role stressors (i.e., role overload, role insufficiency, role ambiguity & role boundary) between public and private educational institutions, in which the mean scores for academic officers of public institutions were higher than that of private institutions. Based on the findings of the study some recommendations were suggested.

Key words: Academic officers, role stressors, public & private higher educational institutions

INTRODUCTION

In the pursuit for organizational excellence, managers of all types of organizations are forced to work under highly stressful circumstances. In those situations, managers are likely to undergo reduced psychological well-being. Stressfulness of their working conditions may induce stress-related health problems. According to Shanfa, et al. (1998), regardless of the types of organizations, managers tend to experience more stress from every source of pressure than their subordinates. They appeared to suffer from mental strains and anxiety as they have to face various organizational problems (Pestonjee, 1999; Assadi, 2003).

In this regard, job related stress among managers has been acknowledged as reaching an epidemic level (Francis, 2007, Lindorff, 1994).

Differences in the experiences of work stress were also highlighted between public and private sectors. For instance, in South Australia; public sector

workers have more stress claims than private sector workers; the average duration and cost per claim is higher than for the public sector (Dollard, 2001). private enterprises than those in state-owned enterprises.

With regard to their incidences, studies revealed that heavy demands are stressful when they exist simultaneously with restricted control over one's own life situations (Karasek and Theorell, 1990). People may experience stress and dissatisfaction when the role expectations embedded in one of their work roles differ, or contradict with other their work roles. Besides, one may hold many roles at the same time, but the benefits from those roles decrease when the number of roles becomes too high. It could also be harder and more burdensome for managers in a hectic working environment to handle multiple tasks which may lead to role stress (Nordenmark, 2004; Spector, 2008). In such situations, there could be a possibility of high risk of mental strains, which in turn increases the risk of psychological illness.

Studies have also established the relationships between role stressors and the feeling of strains associated with various psychological and physiological reactions (Fogarty, et al. 2000; Peiro, Gonzalez-Roma, et al. 2001; Posig & Kickul, 2003; Osipow, 1998; Fako, 2010, Idris, 2011). In those cases, role stressors (viz., role overload, role ambiguity, role boundary and role insufficiency) are likely threaten managers' capability to accomplish assigned tasks.

Moreover, studies noted that role overload creates strain because of the pressure to do more work, having a heavy workload that interferes with work quality, and the feeling of not being able to finish a Besides, Lu, et al. (2009) have also pointed out that managers were encountered higher levels of occupational stressors and psychological strain in given task within a specified period of time (Conley & Woosley, 2000; Greenberg, 1999; Fako, 2010). In the case of role ambiguity, individuals experience strain when they consistently do not have a clear picture about their work objectives, their co-workers' and supervisor's expectations of them, and the scope and responsibilities of their jobs (Spector, 2008; Conner & Douglas, 2005; Fako, 2010; Idris, 2011).

Role boundary also occurs when individuals are required to play two or more role requirements that work against each other which create expectations that may be hard to reconcile (Spector, 2008; Conner & Douglas, 2005; Rizzo, et al. 1970) and role insufficiency measures the extent to which the individual's training, education, skills, and experience are appropriate to job requirements (Osipow, 1998).

As per the existing studies, there have been growing evidences that higher education no longer provide the stress free working conditions (Winefield et al, 2003; Barkhuizen and Rothmann, 2008). Occupational stress levels among academic staff of higher education are generally found to be high (Michailidis, 2008; Catano, et al. 2007; Barkhuizen and Rothmann, 2008; Biron, et al. 2008), alarmingly widespread and increasing across the globe (Gillespie et al, 2001).

However, most of what have been known about stress among higher education employees are based on studies conducted in the United States, Great Britain, Australia, Canada and New Zealand and other developed countries (Adeyemo & Ogunyemi, 2005; Thorsen, 1996; Tytherleigh et al, 2005) all cited in

Fako (2010). In fact, studies on stress in higher educational institutions have also been done in Africa (Nhundu, 1999; Ofoegbu and Nwadiani, 2006) in Fako (2010) and (2011). More specifically, such studies did not cover stress related to academic staffs that are in charge of office duties be it in public or private higher educational institutions. Apparently, academic staff members with office duties in addition to teaching and research activities seem to be more stressed than those with academic duties alone. Because, alike other managers in any organization, academic officers in higher educational institutions are also expected to perform managerial functions/ administrative issues.

Moreover, sandwiched between administration and instruction, academic officers are required to manage the frequently competing priorities, interests, agendas, and other matters of concern regardless of the types of institutions (public and private) of Oromia Regional State of Ethiopia. In this regard, the responsibilities of complex and challenging positions tend generate stress as they are expected to respond to demands that generate even more stress. Hence, to the best knowledge of the researcher, no studies have also been found that examined the extent to which academic officers of public and private higher educational institutions are confronted with role problems in Oromia Regional State of Ethiopia. Therefore, it is felt necessary to address the perceived role problems among academic officers of public and private higher educational institutions in the State.

Hence, the objective the study was to examine occupational role stressors among academic officers of public and private of higher educational institutions in Oromia Regional State of Ethiopia. Based on this, the researcher devised the following research questions to attain this objective.

Research Questions

- Is there a significant difference in role overload between academic officers of public and private higher educational institutions?
- Is there a significant difference in role insufficiency between academic officers of public and private higher educational institutions?
- Is there a significant difference in role ambiguity between academic officers of public and private higher educational institutions?
- Is there a significant difference in role boundary between academic officers of public and private higher educational institutions?

Significance of the Study

The results of study will benefit stakeholders in higher educational institutions (e.g., mangers, experts, supervisors, researchers, policy makers) to understand role stressors and their corresponding effects on academic staff who have been holding office duties in addition to teaching and research activities in public and private higher educational institutions. In general, the results of this study are expected to contribute to the existing body of knowledge and also help to narrow down the gap of information with respect to occupational stress in public and private higher educational institutions.

Population, Subjects, and Sampling techniques

The target population of the study were academic officers of public and private higher educational institutions in Oromia Regional State of Ethiopia. The study was delimited to Oromia Regional State due to limited resources of the researcher for data

collection. The academic officers are academic staff with office duties in addition to teaching and research activities in their respective departments. These included department heads, deans, vice deans, registrars, research and publication officers, student deans, guidance and counselling officers, and other officers who have been in charge of office responsibilities.

Participants were selected using multistage sampling techniques from five public higher educational institutions (viz.; Adama, Wollega, Jimma, Haramaya and Madda Wolabu Universities) and from accredited seven private higher educational institutions (Kuyera Adventist College; Rift Valley, Africa Beza, Royal, Admas, and Central university colleges and Unity University-Adama branch) for the study. List of academic officers and relevant information was obtained from the department of human resource development of each higher educational institution under the study. A total of 251 academic officers were selected for the study and their demographic characteristics are presented in Table 1.

Table1: Demographic Characteristics of Participants

Demographic characteristics	Groups	Sub-characteristics	Freq.	%	Min.	Max.	Mean	Std. Deviation
Age(in years)			-	-	21	60	33.53	9.20
Gender	Public	Male	143	57				
		Female	11	4				
		Total		61				
	Private	Male	93	37				
		Female	4	2				
		Total		39				
	Total		251	100				
Experience(in years)			-	-	1	35	10.73	8.85
Educational status	Public	Graduate	34	13				
		Post graduate	105	42				
		PhD	15	6				
		Total		61				
	Private	Graduate	82	33				
		Post graduate	15	6				
		PhD	-	-				
		Total		39				
	Total		251	100				

Tools of Data Collection

Occupational Stress Inventory- Revised (OSI-R) (Osipow, 1998) was used to collect data. Because, OSI-R theoretical model of stress hypothesizing that stressors originating in the work environment influence how individuals perceive their work roles; that when work stressors interact with stress-inducing work roles, personal or psychological strain results. This questionnaire has three components to measure the three domains: Occupational Role Stress, Personal Strain, and Personal Resource for Coping. Since this study deals only with role stressors the first component of the inventory was used (Osipow, 1998).

Moreover, according to Osipow (1998), the first component of the questionnaire has six subscales viz., role overload, role insufficiency, role ambiguity role boundary, responsibility and physical

environment. Of these, the first four subscales, viz., role overload, role insufficiency, role ambiguity and role boundary were used to collect data on role stressors in this study. Each of subscales composed of five- point Likert scale items. A high subscale score depicts greater level of role stressor.

Table 2: Results of alpha coefficients for internal consistency of scales used

Scales	Reported values of Alpha coefficient(r =)	Alpha coefficient in this study (r =)
Role Overload (RO)	0.78	.86
Role Insufficiency (RI)	0.85	.77
Role Ambiguity (RA)	0.79	.75
Role Boundary (RB)	0.72	.82

Furthermore, reliability of OSI-R was also determined by internal consistency analyses. Alpha coefficient for internal consistency of each scale is greater than 0.7 as shown in Table 2 which is acceptable (George and Mallery, 2003).

Data Analysis

Descriptive statistics such as mean & standard deviation were employed to describe general characteristics of the data. An independent-samples t-test was used to compare the mean differences in occupational role stressors (i.e., role overload, role insufficiency, and role ambiguity and role boundary) for public and private higher educational institutions.

RESULTS AND DISCUSSION

Test for Assumptions

Before running the analysis, the underling assumption for t-test was assessed. With regard to normality, it was recommended that the violation of this assumption should not cause any major problems with large enough sample sizes, for instance, when sample sizes greater than 30 subjects (Gravetter & Wallnau, 2000).

In addition to suggestion, the distribution of scores for each group was also checked using histograms obtained on SPSS Version 13 and did not violate any of the underlined assumptions. In all cases, the assumptions were maintained as required. Moreover, level of significance was assumed to be 1% ($\alpha = .01$) in this study.

Table3: Results of mean differences for public and private higher educational institutions on occupational role stressors

Types of institutions	Mean	Std. Deviation	Mean Difference	Sig.
Public	3.381	.463		.01
Private	3.111	.514	.053[1]	
Public	2.999	.438		.007
Private	2.863	.487	.0498[2]	
Public	2.853	.530		.001
Private	2.593	.649	.063[3]	
Public	3.355	.526		.002
Private	3.179	.462	.055[4]	

1= role overload, 2= role insufficiency, 3= role ambiguity, 4= role boundary

As can be seen in Table 3 above, there was significant difference in mean scores of role overload between public institutions (*M*=3.381, *SD*=.463) and private institutions (*M*=3.111, *SD*=.514; ***t* (310) = 5.129**, *p*=.01). The result disclosed that the mean score of role overload for public institutions was higher than that of private institutions. Further analysis of significant mean difference per item revealed that doing too many different tasks in too little time, performing tasks on their job out of their experience or qualification, scarcity of resources they need to get their job done, working under tight time deadlines and doing more work than it is reasonable appeared to be major factors for role overload among academic officers of public than private institutions.

Significant difference in mean scores of role insufficiency was observed between public institutions (*M*=2.999, *SD*=.438) and private institutions (*M*=2.863, *SD*=.487; ***t* (310) =2.735**, *p*<.01). This result also indicated that mean score in role insufficiency for academic officers in public institutions was higher than mean scores of those in private institutions. Moreover, based on significant mean difference per item, career progress is not what hoped it would be, being pessimistic about their job, unable to satisfy their needs for success and recognition in their job and unable to learn new skills in their work were found to be causes for role insufficiency among academic officers in public than private institutions. It happened due to the fact that most skilled, experienced and educated academic officers in private institutions are believed to come from public institutions for better payment and other facilities.

As can be seen in Table 3, there was significant difference in mean scores role ambiguity between public institutions (*M*=2.853 *SD*=.530) and private institutions (*M*=2.593, *SD*=.649; ***t* (310) = 4.138**, *p*<.01). It is also observed that the mean score in role ambiguity for academic officers in public institutions was higher than those academic officers in private institutions. Similarly, significant mean difference per item also showed that lack of getting useful feedback from their supervisor about their performance, being uncertain about what they are supposed to accomplish in their work, lack of setting priority with several tasks and confusion between what their supervisors ask & really want were more pronounced factors among academic officers in public than private institutions.

Significant difference in mean scores of role boundary was observed between public institutions (*M*=3.355 *SD*=.526) and private institutions (*M*=3.179, *SD*=.462; ***t* (310) =3.188**, *p*<.01). From the result, it was evident that mean score in role boundary for academic officers in public institutions was higher than those academic officers in private institutions. Besides, from significant mean difference per item, confusion between what their institutions expect them to do and what they think is right, supervisors' conflicting ideas about what they should be doing and frequent disagreement with individuals from other work units or departments appeared to be causes of role boundary among academic officers in public than private institutions. The present findings with regard to role stressors are inconsistent with the studies by Lu, et al. (2009), Dollard (2001 and Widerszal-Bazyl, et al. (2000).

CONCLUSION & RECOMMENDATION

From discussion made above, it can be concluded that there were significant differences in all occupational role stressors (i.e., role overload, role insufficiency, role ambiguity & role boundary) of academic officers between public and private higher educational institutions in Oromia Regional State of Ethiopia, in which the mean scores for academic officers of public institutions were found higher than that of private institutions.

On the basis of findings, it is recommended that office duties, responsibilities and accountabilities should be clearly defined in accordance with academic officers' teaching and research activities. Besides, academic officers should also be encouraged to plan and prioritise activities related to teaching, research and administration.

To clarify their doubts, reduce incompetence and confusion while performing their office duties, on the job training is also recommended, accompanied by techniques of motivating, recognizing, and rewarding good managerial practices. Moreover, further study is also recommended to investigate effects of occupational role stressors among academic officers of public and private higher educational institutions.

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