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Contents

Un Filtre à Sable Perforé à Alimentation Intermittente Pour L'épuration des Effluents D'huilerie de Palme: Cas de L'unité Industrielle de Toumanguié, Côte D'ivoire	226-238
<i>Lacina Coulibaly, Béatrice Assamoi Ama, Issiaka Savané and Yacouba Bado</i>	
Effect of Scaling on the Performance of the 4-Bit CPL Subtractor Circuit	239-248
<i>C. Senthilpari, Ajay Kumar Singh and K. Diwakar</i>	
The Input of Psychology in Methodological Considerations of Cross Cultural Marketing Research	249-254
<i>Christina Giannakopoulou, George Siomkos and Aikaterini Vassilikopoulou</i>	
Effect of Mathematical Games on Nigerian Students' Performance in Mathematics in Secondary Schools in Port Harcourt Metropolis	255-264
<i>Olubunmi M. Adaramola and Jane I. Alamina</i>	
Community Norms and Cultural Attitudes and Beliefs Factors Influencing Violence Against Women of Reproductive Age in Nigeria	265-273
<i>Thomas G. Adegoke and Oladeji, David</i>	
The Impact of Internet Banner Advertisements on University Students	274-290
<i>Muhammad Nawz Mahsud, Muhammad Ijaz Ahmed and Ishtiaq Ahmad Chaudhry</i>	
Mathematical Formulation of Poverty Index	291-296
<i>Chandra Putcha</i>	
U.S. and Japanese Electronic and Electrical Equipment Manufacturing Firms: A Comparison	297-301
<i>Ilhan Meric, Charles W. McCall and Gulser Meric</i>	
Groundwater Pollution in Africans Biggest Towns: Case of the Town of Abidjan (Côte D'ivoire)	302-316
<i>Ahoussi Kouassi Ernest, Soro Nagnin, Soro Gbombélé, Lasm Théophile Oga Marie Solange and Zade Sompohi Pacôme</i>	
Multi-Objective Planning of Distribution System with Distributed Generation	317-325
<i>Masoud Aliakbar Golkar, Shora Hosseinzadeh and Amin Hajizadeh</i>	
Reflection of US Policy Towards Pakistan in Pakistani Press	326-339
<i>Ishtiaq Ahmad Choudhry, Muhammad Nawaz Mahsud and Shajee Hasan</i>	
Storage and Cost Efficient Mining on an OLTP System using Schema Enhancement Method	340-342
<i>Mr. Syed Mubashir Hasan and Mr. Muhammad Imran Saeed</i>	

Statistical Approach on the Impact of the Activity of the Industrial Zone of Skikda on the Quality of the Waters of Saf-Saf Wadi (Skikda Algerian East Coasts) <i>L. Mézédjri, A. Tahar Ali and A.B. Djebbar</i>	343-347
Toxicokinetic Studies of Cadmium and Zinc in Goats Following Intratracheal and Intravenous Administration of Particulate Matter <i>E.A. Moses, J.C. Akan, V.O. Ogugbuaja and P.A. Onyeyili</i>	348-355
Trade Diversion and Trade Creation the Case of Turkey Establishing Customs Union with the European Union <i>Veysel Ulusoy and Ahmet Sözen</i>	356-361
Éfficacité Comparée de Deux Méthodes de Diagnostic Précoce de Gravidité Chez la Brebis Ouled Djellal <i>Abdelaziz Benyounes, Farida Lamrani, Jose Sulon, Ali Tahar and Jean-François Beckers</i>	362-373
Generic Architecture Based Agent for Context and Schema Mediation <i>Benharzallah Saber and Kazar Okba</i>	374-383
Photovoltaic-Stand-Alone Hydrogen System <i>R.Y. Tamakloe and K. Singh</i>	384-396
Operating Characteristics of Proton-Exchange-Membrane (PEM) Fuel Cells <i>R. Y. Tamakloe, K. Singh and Clovis A. Linkous</i>	397-405
Diversity of a Mosaic Ecosystem in the Surroundings of the Téné Classified Forest (Oumé), Western Center of Côte D'ivoire <i>N'guessan K. Edouard, Kouassi K. Edouard and Sangne Y. Charles</i>	406-418
Forecasting as a Strategic Decision-Making Tool: A Review and Discussion with Emphasis on Marketing Management <i>Cihat Polat</i>	419-442
Equation of Motion in Appearance Potential Spectra of Simple Metals <i>Omubo-Pepple V. B, Opara F. E, Ogbonda C and Pekene D.B</i>	443-447

Un Filtre à Sable Perforé à Alimentation Intermittente Pour L'épuration des Effluents D'huilerie de Palme: Cas de L'unité Industrielle de Toumanguié, Côte D'ivoire

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Abstract

Les capacités des filtres à sable perforés et non perforés à alimentation intermittente à épurer les effluents d'huilerie de palme ont été étudiées. Les sables grossiers à granulométrie uniforme (MGU) et à granulométrie variée (MGV) ont été utilisés comme massifs filtrants. Les influences de la température des effluents, de la charge appliquée et de la recirculation des filtrats dans les filtres sur leurs rendements épuratoires par rapport aux MES, DCO, NH_4^+ et du pH ont été étudiées. Les filtres perforés donnent globalement un meilleur rendement d'épuration des effluents (MES: 99.6%, DCO: 99.9% et absorbance: 99%) par rapport à ceux non perforés (MES: 95 %, DCO: 99.8% et absorbance: 97%) indépendamment du massif filtrant. Cependant, le massif MGV permet d'obtenir une bonne réduction des MES et de la DCO dans les filtrats par rapport au massif MGU. Quant au pH des filtrats, ils sont tous basiques ($7.7 \leq \text{pH} \leq 9$). La recirculation des filtrats permet de réduire d'avantage leur teneur en MES, DCO, NH_4^+ et augmente leurs pH.

Les résultats pertinents obtenus montrent que la filtration intermittente des effluents d'huilerie de palme dans un filtre perforé contenant un massif MGV est un bon procédé pour leur épuration.

Keywords: Filtration, intermittente, sable, épuration, effluent, palme

Abréviations

- EPHP**: Effluent de production d'huile de palme
PALMCI: Palmier de Côte d'Ivoire
MGV: Massif filtrant grossier à granulométrie variée
MGU: Massif filtrant grossier à granulométrie uniforme
P_{MGV}: Filtre perforé contenant le massif MGV
P_{MGU}: Filtre perforé contenant le massif MGU
NP_{MGV}: Filtre non perforé contenant le massif MGV
NP_{MGU}: Filtre non perforé contenant le massif MGU

Introduction

La protection de l'environnement contre les rejets industriels est une préoccupation mondiale (Fujie *et al.*, 2003; Otsuki *et al.*, 2004; von Braun *et al.*, 2002). Cependant, les pays en développement accusent un retard dans ce domaine, à cause de l'utilisation de procédés non adaptés aux réalités du terrain ou à leur coût élevé. En Côte d'Ivoire, la majorité des industries ne traitent pas leurs effluents avant leurs intégrations dans les milieux récepteurs (MECV, 1998). Cette situation contribue au déséquilibre des milieux récepteurs (lagune, rivières et fleuves), dont les impacts socioéconomiques et sanitaires sont considérables. Parmi les industries les plus polluantes, il y a les huileries de palmes (Oswal *et al.*, 2002). Le volume d'effluent généré par celles-ci est environ $0,8 \text{ m}^3 \text{ t}^{-1}$ de régimes usinés (Jacquemard *et al.*, 1995). La société palmier de Côte d'Ivoire (PALMCI) rejette environ $2\,720 \text{ m}^3$ d'effluent de production d'huile de palme (EPHP) par jour pour ses 10 unités de production d'huile de palme. Ces EPHP ont généralement un pH acide ($\text{pH} = 4 - 5$), contiennent 95-96% d'eau, 0.6-0.7% d'huile, 2-4% de solides y compris les matières en suspension (MES) et sont chaudes ($80 - 90^\circ\text{C}$) (Ahmad *et al.*, 2005). Leurs demande chimique en oxygène DCO, la demande biologique en oxygène (DBO) et les MES sont respectivement 25 g l^{-1} , 11 g l^{-1} et 15 g l^{-1} (Oswal, 2002).

Divers procédés de traitement (aérobie et anaérobie) des EPHP ont été expérimentés, mais la plupart d'entre eux connaissent des difficultés d'exploitation, à cause de leur exigence en main d'œuvre qualifiée et la consommation importante d'énergie. Par ailleurs, les matières grasses de ces EPHP sont un problème majeur pour leur gestion. Ces gras réduisent le transfert d'oxygène dans les procédés biologiques d'épuration ainsi que la sédimentation des boues (Chao et Yang, 1981). Au vu de ces difficultés, il apparaît urgent de rechercher des méthodes alternatives simples et robustes de traitement des EPHP. L'enlèvement des huiles de ces effluents par adsorption est une piste investiguée par diverses équipes de recherche (Ahmad *et al.*, 2005; Inagaki *et al.*, 2002). Cependant, les filtres à sable qui sont beaucoup utilisés dans la production d'eau potable et l'épuration d'effluents gras (Gnagne, 1996; Masschelein, 1996; Wotton, 2002) et qui pourraient constituer une alternative intéressante pour l'épuration des EPHP n'ont pas encore été explorés. Or, le mécanisme d'adsorption qui est dominant lors de l'enlèvement des matières grasses dans les procédés biologiques (Hsu *et al.*, 1983) est le mécanisme principal dans la filtration sur lit de sables (Gnagne, 1996; Rubenstein et Kohel, 1977). Gnagne (1996) a augmenté le rendement d'épuration des effluents d'abattoir jusqu'à 99% de DCO, 77.5% de NTK avec un filtre à sable présentant de petites perforations circulaires sur la face latérale dont le rôle était d'augmenter l'aération du lit. On pourrait augmenter la capacité épuratoire desdits filtres en améliorant l'aération du massif filtrant avec une grande ouverture latérale. Dans le cadre de sa nouvelle politique de protection de l'environnement contre ses EPHP, la PALMCI veut développer un filtre robuste moins onéreux et facile à mettre en œuvre.

L'objectif de cette étude est de développer un filtre à sable perforé latéralement à alimentation intermittente pour épurer les EPHP de PALMCI. La capacité épuratoire dudit filtre sera comparée à celle d'un filtre non perforé (témoin). Les influences de la nature du massif filtrant, de la charge hydraulique et de la température de l'EPHP sur la capacité épuratoire des filtres seront étudiées.

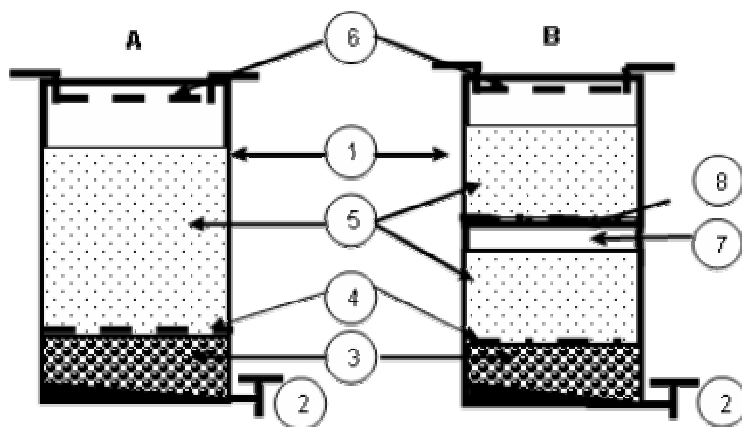
Matériel et méthode

L'expérience a été réalisée sur le site de production d'huile de palme de PALMCI à Toumanguié. Cette unité a une capacité de traitement de 45t/h de régime de palme avec un taux d'extraction d'huile de 22%. Par ailleurs, elle est située sur les rives de la rivière Toumanguié et rejette ses EPHP dans celle-ci.

Filtres

Quatre filtres à sable à alimentation intermittente dont deux non perforés (NP) et deux perforés (P) ont été utilisés (Figure 1). Ils sont de forme parallélépipédique ($L \times l \times h = 1 \times 0.5 \times 1$ m) et sont réalisés en acier (épaisseur = 0.5 cm). La différence entre le filtre NP et le filtre P se situe au niveau de la continuité du massif filtrant (0.7 m) dans le premier filtre cité et la discontinuité dudit massif (deux fois 0.35 m) dans le second filtre. Par ailleurs, le filtre NP a une seule surface d'aération (surface supérieure du filtre) et le filtre P en a trois dont la surface supérieure du filtre et les deux surfaces au niveau de la perforation. Ce dispositif d'aération optimise les phénomènes d'oxydation et de coagulation, ainsi que le refroidissement des effluents dans le filtre. Deux massifs filtrants d'origine marine ont été utilisés; le sable grossier à granulométrie uniforme ($m = 643.33 \mu\text{m}$, $CU = 1.82$) et MGU et MGV constitués de sable marin dénommé MGU et le sable grossier à granulométrie variée ($m = 593.33 \mu\text{m}$, $CU = 2.6$) dénommé MGV. Les quatre filtres développés sont deux filtres NP dont les massifs filtrants sont MGU (NP_{MGU} et P_{MGU}) et deux autres filtres dont les massifs filtrants sont MGV (NP_{MGV} et P_{MGV}).

Figure 1: Configuration et équipements des filtres. **A:** Filtre non perforé; **B:** Filtre perforé latéralement. (1): corps de réacteur; (2): robinet de drainage du filtrat; (3): gravier 15/25; (4): géotextile; (5): massif filtrant ($h = 0.7$ m); (6): tamis (porosité = 0.5 cm) de distribution des effluents sur la surface du filtre; (7): ouverture latérale symétrique sur les deux faces ($l \times h = 0.75 \times 0.1$ m); (8): grille perforée de soutien du sable.



Alimentation des réacteurs

La caractérisation de l'hydraulique des filtres a été faite avec de l'eau de forage prélevée sur le site. L'essai a consisté à appliquer 10 l de cette eau dans un tamis placé au dessus du lit pour assurer sa répartition homogène sur toute la surface du lit. L'essai d'épuration des EPHP a consisté à prélever ceux-ci dans le florentin de l'unité de production et à les appliquer sur le filtre de la même manière que dans l'essai hydraulique. L'étude de l'influence des charges a consisté à appliquer des volumes d'EPHP de 10, 20 et 40 litres. Quant à la détermination de l'influence de la température, celle-ci a consisté à appliquer 10 l d'EPHP ayant des températures de 26°C (température ambiante), 40°C et 50°C. La recirculation du filtrat d'un filtre a consisté à l'appliquer à nouveau sur le même filtre.

Analyse

La demande chimique en oxygène (DCO) a été analysée suivant la méthode 8000 de l'USEPA. Le NH_4^+ a été déterminé par la méthode spectrométrique au bleu d'indophénol selon la norme NF T90-015 (Solorzano, 1969). Le pH des échantillons a été mesuré à l'aide d'un pH-mètre Corning 240. Les MES ont été obtenues sur un échantillon décanté pendant une demi heure. Un volume de 10 ml de cet échantillon est porté dans un creuset préalablement pesé (M_1). L'ensemble est porté dans une étuve à 105°C pendant 2 heures. Après séchage, le creuset est refroidi à température ambiante dans un dessiccateur, pesé (M_2) et les MES ont été calculés suivant la relation (1):

$$\text{MES (mg/l)} = 100 \times (M_2 - M_1) \quad (1)$$

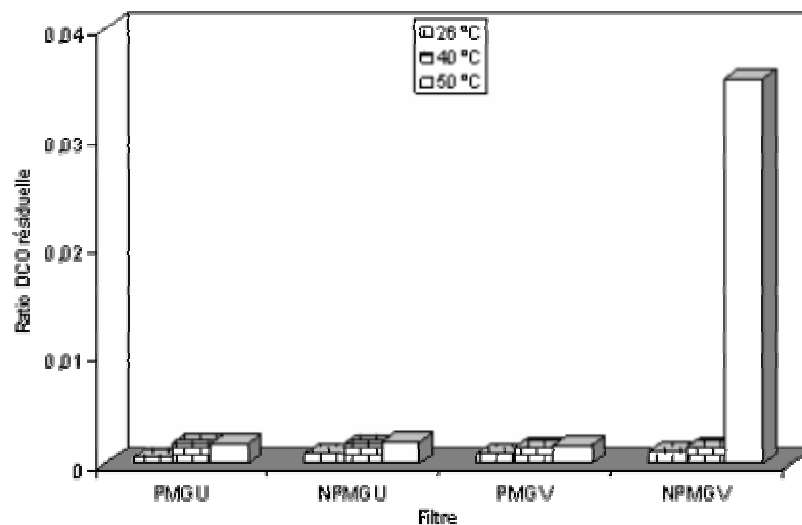
L'adsorption des huiles dans les filtres à sable a été évaluée en mesurant l'amplitude d'absorption de la lumière par les échantillons dans un spectrophotomètre entre 200 et 800 nm. Les amplitudes d'absorption des filtrats ont été comparées.

Le mode de gestion des filtres a consisté à suivre pendant une semaine l'effet des paramètres (charge, température et recyclage) sur les indicateurs de pollution des EPHP. Les valeurs présentées sont les moyennes d'une semaine d'expérience (7 valeurs). L'écart type par point n'a jamais excédé 1%.

Résultats et discussion

La caractérisation de l'hydraulique des filtres a permis de constater que l'écoulement de l'eau se fait suivant trois phases: latence, rapide et stationnaire. Les durées des phases de latence des filtres P_{MGU} , P_{MGV} , NP_{MGU} et NP_{MGV} sont respectivement 16, 33, 120 et 228 min. Quant aux vitesses d'écoulement d'eau dans la phase rapide, elles sont 7, 18.3, 42 et 137 l min⁻¹ respectivement pour les filtres NP_{MGV} , NP_{MGU} , P_{MGV} et P_{MGU} . Les vitesses d'écoulement des eaux dans les filtres perforés sont supérieures à celles des filtres non perforés. Ce résultat s'explique par le fait que dans les filtres non perforés, il existe une pression résiduelle d'air dans l'espace poral qui freine l'écoulement de l'eau par rapport aux filtres perforés. Cette pression est due à l'air piégé dans les pores entre le front de l'eau et la base du filtre. Les différences constatées entre les écoulements d'eaux dans les filtres P_{MGU} et P_{MGV} , ainsi qu'entre les filtres NP_{MGU} et NP_{MGV} , s'expliquent par la différence de la conductivité hydraulique entre les massifs MGU et MGV. En effet, l'écoulement de l'eau est plus rapide dans un sable grossier à granulométrie uniforme (MGU) par rapport au même type de sable à granulométrie varié (MGV). D'ailleurs, les durées de latence des filtres confirment cette hypothèse. La figure 2 présente l'influence de la température des EPHP sur le rendement épuratoire des filtres. L'augmentation de la température des EPHP de 26°C à 50°C entraîne une baisse de l'enlèvement de la DCO dans tous les filtres. L'enlèvement de la DCO dans les filtres était très important (99.9%) lorsque la température de l'EPHP était 26°C. Inversement le plus faible enlèvement de la DCO a été obtenu avec les EPHP à 50°C, notamment dans le filtre NP_{MGV} (96.4%). L'important enlèvement de la DCO dans les filtres pour les EPHP à 26°C par rapport à ceux à 40 et 50°C, s'explique par le fait qu'à la première température, la DCO est essentiellement sous la forme de matière grasse particulaire et sa rétention dans les filtres est facilitée par l'adsorption, la sédimentation et le tamisage (Rubenstein et Kohel, 1977). Par contre à 40 et 50°C, la matière grasse est encore liquide, ce qui est favorable à son infiltration dans le massif, d'où sa présence dans les filtrats et sa contribution dans l'augmentation de la DCO.

Figure 2: Effets de la température des effluents de production d'huile de palme (EHP) sur la teneur en DCO des filtrats des différents filtres.



Compte tenu de la meilleure performance des filtres à 26°C, le reste des expériences a été conduit à cette température. La Figure 3 présente l'influence des charges appliquées sur le rendement épuratoire de la DCO dans les différents filtres. Quelque soit la configuration du filtre ainsi que son massif filtrant, il y a une baisse du rendement d'enlèvement de la DCO de 99.9 à 86% parallèlement à l'augmentation de la charge de 10 à 40 l. Les filtres P_{MGV} et NP_{MGV} sont les plus sensibles à la charge de 40 l (86% d'enlèvement de la DCO). Par ailleurs, pour un massif filtrant donné, le rendement d'enlèvement de la DCO par le filtre perforé est supérieur à celui du filtre non perforé. Par contre, avec les charges 10 et 20 l, les rendements d'enlèvement de la DCO dans les filtres P_{MGU} et P_{MGV} sont les mêmes (99.8%). Cependant, avec la charge de 20 l, c'est le filtre NP_{MGV} qui donne un meilleur rendement d'enlèvement de la DCO (98.4%) par rapport au filtre NP_{MGU} (97%). L'augmentation de la concentration de la DCO dans les filtrats en parallèle avec celle de la charge appliquée, s'explique par l'occupation de tous les sites d'adsorption des matières grasses aux charges élevées. En effet, le massif filtrant ne dispose que d'une surface d'adsorption donnée, l'augmentation de la charge entraîne l'occupation complète de celle-ci par les polluants, le reste s'infiltre et se retrouve dans le filtrat (Duncan, 1988). La grande performance des filtres P_{MGV} et NP_{MGV} par rapport à aux filtres P_{MGU} et NP_{MGU} , s'explique par l'existence de pores de petits diamètres dans le massif MGV par rapport à ceux du massif MGU. Ceux-ci permettent la rétention d'un maximum de matière grasse, ce qui réduit la concentration de la DCO dans le filtrat (Rubenstein et Kohel, 1977). Par ailleurs, la faible vitesse d'écoulement de l'eau dans le massif MGV donne plus de chance aux mécanismes physico-chimiques de séparation (adsorption, tamisage, sédimentation) de se dérouler dans ledit massif. L'influence de la recirculation des filtrats dans les filtres est présentée dans la Figure 4. La recirculation permet de baisser la concentration de la DCO des filtrats (Figure 4A). Les filtres non perforés réduisent plus la concentration de la DCO des filtrats (22 et 40%) par rapport aux filtres perforés (0.2 et 11%). Ces résultats s'expliquent par le fait qu'au cours de la première filtration, les filtres perforés retiennent un maximum de DCO particulaire et ne laissent passer que de la matière grasse colloïdale. La recirculation du filtrat n'a donc pas un grand impact sur l'enlèvement de celles-ci. Par contre, dans les filtres non perforés, la baisse importante de la DCO des filtrats recirculés s'explique par une meilleure rétention des matières grasses par le massif filtrant, à cause de la réduction de la taille des pores par les premières matières adsorbées lors de la première application de l'EHP. La Figure 5 présente l'influence des charges appliquées sur le pH des filtrats. Le pH des filtrats est basique (7.7 à 9.3). Par ailleurs, le pH des filtrats augmente en parallèle avec les charges appliquées. Pour les charges 20 et 40 l, les pH des filtrats du filtre P_{MGU} sont supérieurs à ceux du filtre P_{MGV} . Par contre, avec la charge 10 l, les pH des filtrats du filtre P_{MGV} sont supérieurs à ceux du filtre P_{MGU} . Les pH des filtrats des filtres

perforés sont en général supérieurs à ceux des filtrats des filtres non perforés. La recirculation des filtrats permet d'augmenter leur pH sauf pour le NP_{MGU} (Figure 4B). L'augmentation du pH des filtrats par rapport à celui de l'EPHP s'explique par une adsorption des acides palmitiques dans les massifs filtrants. L'importante augmentation du pH des filtrats des filtres perforés par rapport à ceux des filtres non perforés s'explique par la meilleure adsorption des acides palmitiques dans les premiers filtres cités. Cette augmentation de l'adsorption des acides palmitiques serait due à la bonne aération du filtre perforé qui favorise la coagulation de la matière grasse, donc des acides et leur rétention dans ledit filtre. Quant à l'augmentation du pH des filtrats suite à leur recirculation, celle-ci s'explique par l'adsorption dans le massif filtrant des acides palmitiques résiduels. Par ailleurs, il faut signaler que la réduction de la porosité du massif filtrant suite à l'adsorption de la matière grasse des EPHP est favorable à la rétention de particules de petites tailles ou des produits non retenus lors de la première filtration. La Figure 6 présente l'influence de la charge d'EPHP appliquée sur les filtres sur leur capacité d'enlèvement des MES. Quelque soit la configuration du filtre ainsi que du massif filtrant utilisé, il y a une diminution du rendement d'enlèvement des MES avec l'augmentation de la charge. Cependant, les filtres non perforés sont plus sensibles à l'augmentation de la charge par rapport aux filtres perforés. Par ailleurs, le massif MG_V donne le meilleur enlèvement des MES indépendamment de la configuration des filtres. Les filtres perforés (Figure 6A) donnent un meilleurs rendement d'enlèvement des MES (96 à 99%) par rapport aux filtres non perforés (80 à 99%) (Figure 6B). Ces résultats sont en accord avec ceux de la DCO et s'expliquent par le fait que les MES des EPHP sont pour l'essentiel de la matière organique et sont comptabilisées dans la DCO. Donc toute augmentation de MES dans les filtrats a pour conséquence une augmentation de la DCO. L'influence de la charge sur la transparence des filtrats est présentée dans la Figure 7. On constate que l'augmentation de la charge de 10 à 20 l entraîne une dégradation de la transparence du filtrat qui varie en fonction de la configuration du filtre et de son massif filtrant. Les filtres perforés donnent un filtrat nettement plus claire par rapport aux non perforés qui donnent un filtrat jaune orangé à la charge de 20 l. Quant à l'enlèvement des huiles par les filtres, la Figure 8A montre que ce sont les acides palmitiques qui sont essentiellement contenus dans les EPHP (absorption à 280 nm). Ces acides sont plus enlevés par les filtres perforés par rapport à ceux non perforés. Par ailleurs, la recirculation n'a pas d'influence sur l'enlèvement des huiles par le filtre P_{MGV} dont le rendement reste constant à 99%. Par contre, avec le filtre NP_{MGV}, il y a une réduction de la concentration d'huile dans le filtrat (Figure 8B). Dans ce dernier filtre, la recirculation permet d'augmenter le rendement d'enlèvement des huiles de 97.81 à 97.85%. Ces résultats confirment l'hypothèse de l'adsorption supplémentaire des acides palmitiques dans les filtres NP_{MGV} évoquée dans le paragraphe sur la DCO et le pH.

Figure 3: Effets des charges appliquées d'effluents de production d'huile de palme (EHP) dans les filtres sur la concentration en DCO des filtrats.

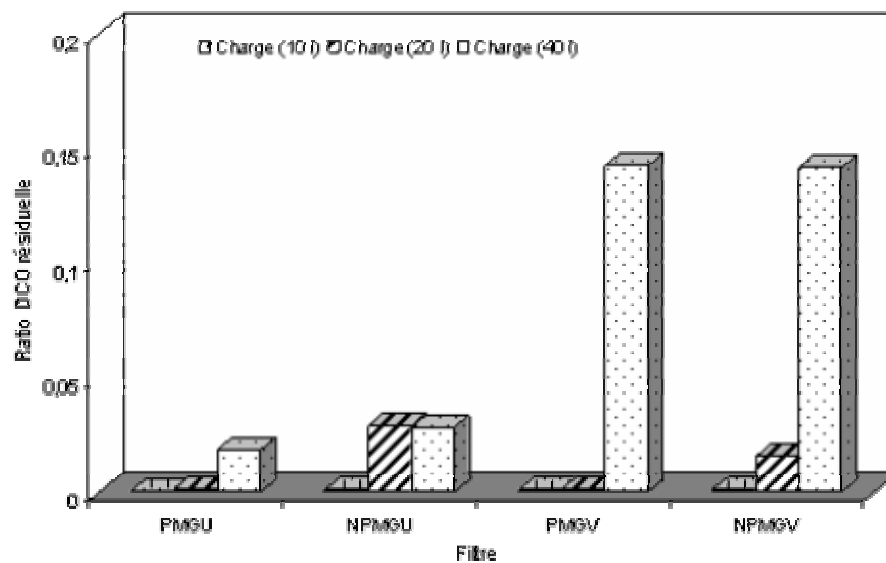


Figure 4: Effets de la recirculation des filtrats dans les filtres les concentrations et pH desdits filtrats.

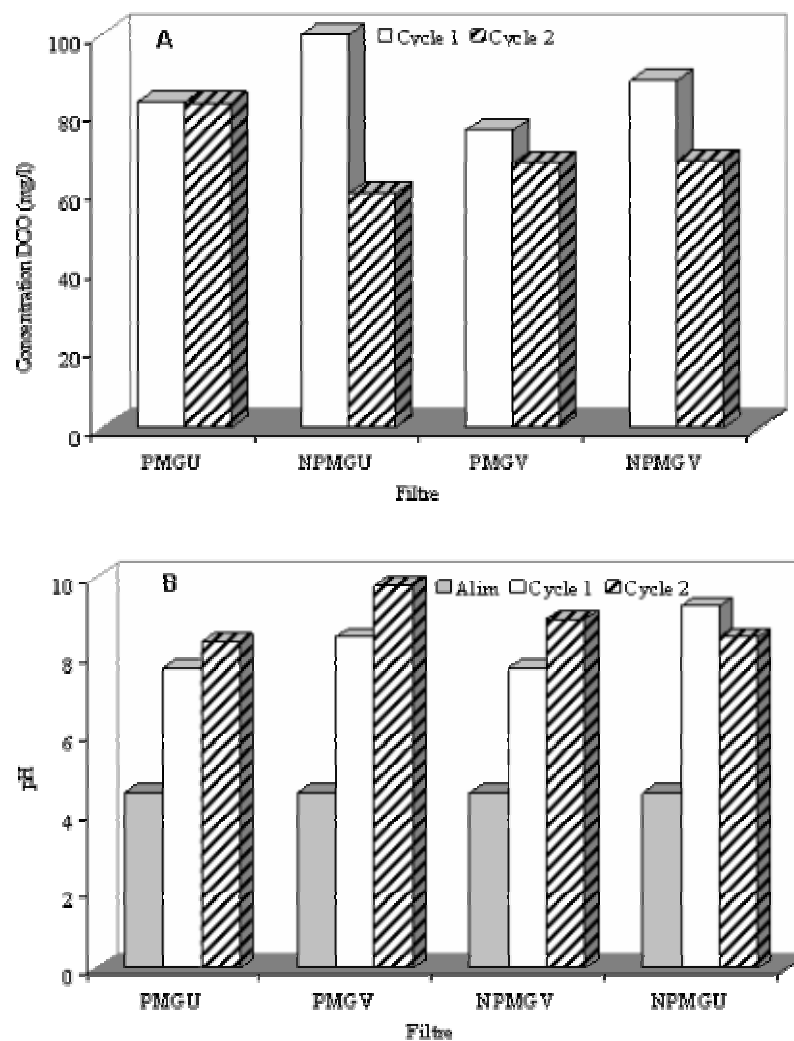


Figure 5: Effets des charges des effluents de production d'huile de palme (EHP) appliquées dans les filtres sur le pH des filtrats. **A:** Filtres perforés équipés avec les massifs MGU et MGV; **B:** Filtres non perforés équipés avec les massifs MGU et MGV.

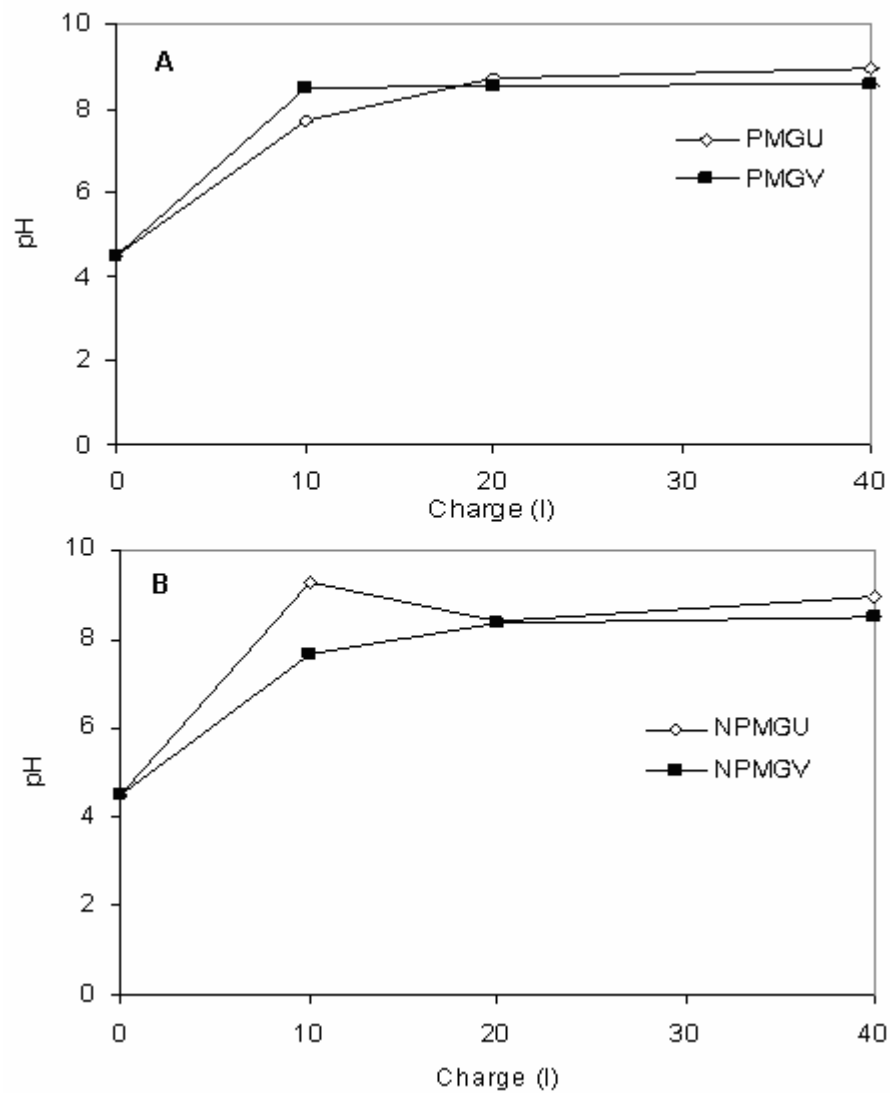


Figure 6: Effets des charges des effluents de production d'huile de palme (EHP) dans les filtres sur la concentration en MES des filtrats. A: Filtre perforé équipé avec les massif MGU et MG; B: Filtre non perforé équipé avec les massif MGU et MG.

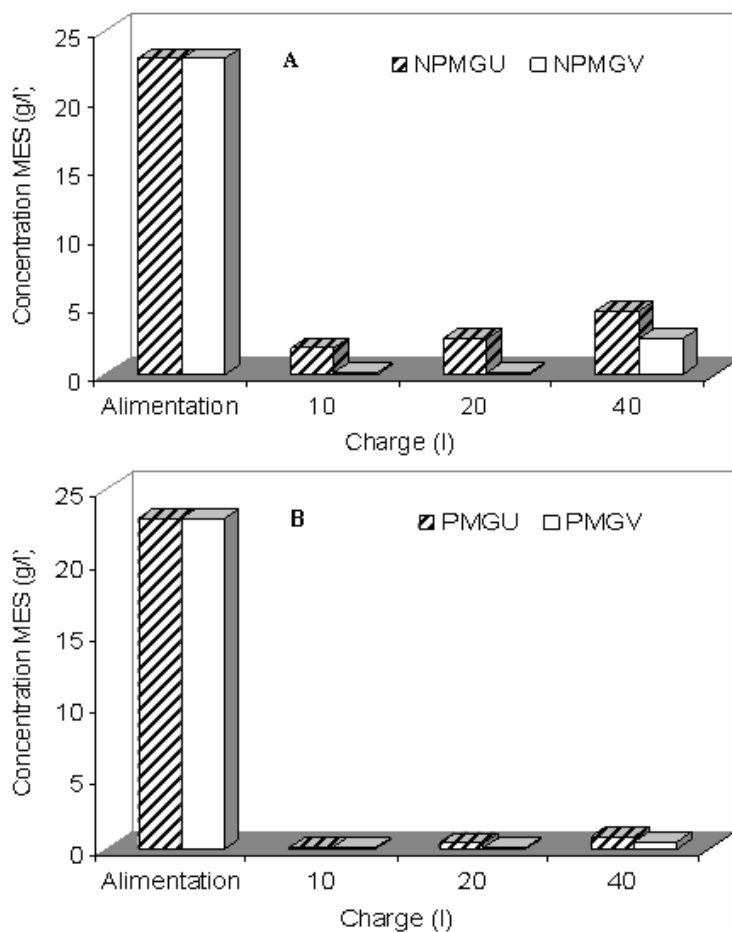


Figure 7: Effets de la charge appliquée d'effluents de production d'huile de palme (EHP) sur la transparence des filtrats des différents filtres.

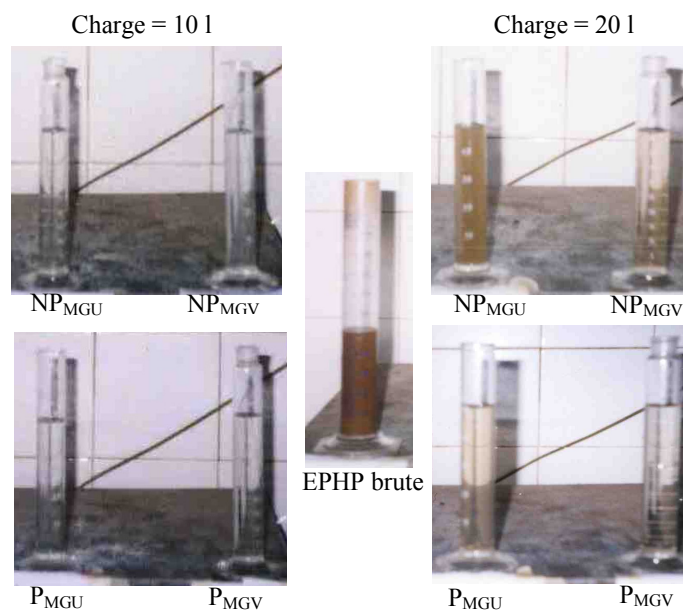
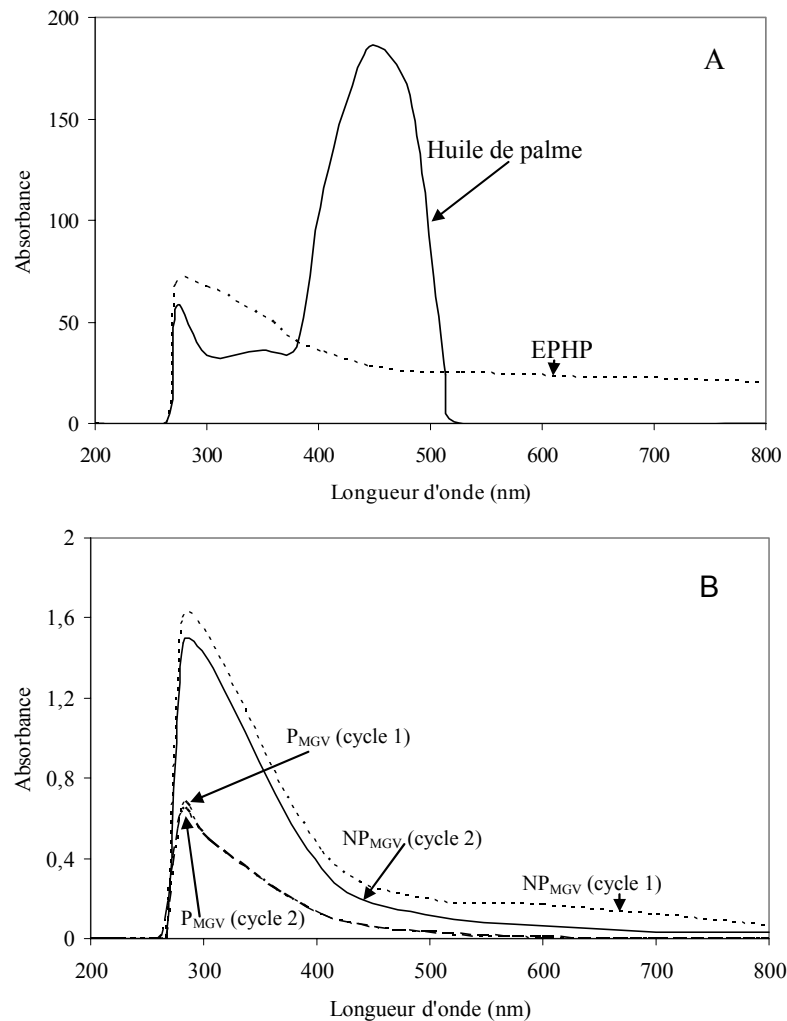
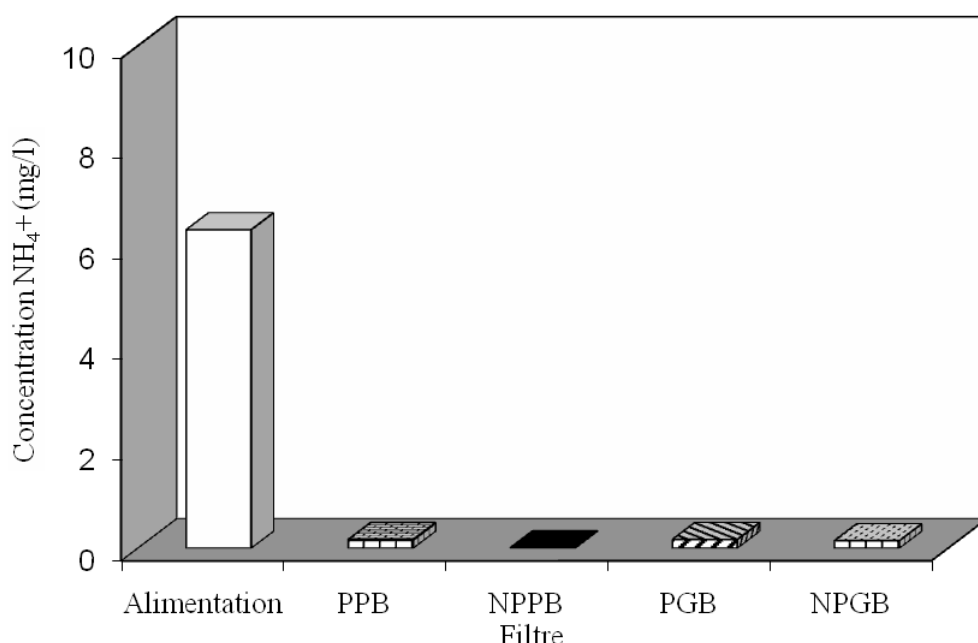


Figure 8: Absorption de la lumière par l'huile de palme et l'effluent brute de production d'huile de palme (EHP) (A) et les filtrats des filtres P_{MGV} et NP_{MGV} (B).



La Figure 9 présente la concentration d'ammonium (NH_4^+) dans les filtrats des filtres lorsque 10 l d'EHP étaient appliqués. Les filtres P_{MGV} et P_{MGU} (97 %) enlèvent moins le NH_4^+ par rapport aux filtres NP_{MGV} (98%) et NP_{MGU} (99.8 %). La faible concentration de NH_4^+ dans les filtrats pourrait s'expliquer d'une part par leur rétention dans le massif filtrant et d'autre part par leur volatilisation sous forme de NH_3 lorsque le pH du milieu devient basique (Chapman, 1992; Tchobanoglous, 2003). En effet, à pH 9 (pH des filtrats), la proportion de NH_3 peut atteindre les 50% à entre 15 et 30°C. La meilleure performance des filtres non perforés par rapport ceux perforés pourrait s'expliquer par le fait que NH_4^+ n'est pas contenu dans la matière grasse, par conséquent, l'aération du massif filtrant n'influence pas son adsorption.

Figure 9: Effets de la configuration des filtres et des massifs filtrants sur l'enlèvement du NH_4^+ dans les effluents de production d'huile de palme (EHP) par lesdits filtres à la charge 10 l.



Conclusion

Le rendement épuratoire des filtres concernant les paramètres MES, NH_4^+ et la DCO est très élevé (99%). Par ailleurs, le pH des filtrats est légèrement basiques et ne nécessite pas d'ajouts chimiques avant leur intégration dans l'environnement. Ces résultats sont influencés par la configuration du filtre (perforé ou non), la qualité du massif filtrant, la température de l'effluent appliquée ainsi que la recirculation des filtrats.

Globalement, ce sont les filtres perforés équipés avec le massif MGW qui ont donné les meilleurs rendements épuratoires des effluents de production d'huile de palme. Ce filtre ainsi que le massif MGW constituent donc un très bon système d'épuration des EHP. Pour son exploitation, la charge de 10 l d'un EHP à 26°C est conseillée, car celle-ci a permis d'obtenir dans ledit filtre des rendements d'épuration supérieurs à 97% pour chacun des paramètres de pollution analysés.

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Effect of Scaling on the Performance of the 4-Bit CPL Subtractor Circuit

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Abstract

This paper presents the effect of scaling on the performance a 4-bit CPL subtractor circuit, which is designed by multiplexing control input technique adder cell. The 4 bit subtractor circuit layout is generated by Microwind 3 VLSI CAD tools and scaling parameters are analyzed using BSIM model. The performance of 4 bit CPL subtractor circuit analyzed using device-scaling theory. This paper analyzed the effect of scaling on the overall circuit in terms of power dissipation, propagation delay and area of chip. The overall scaling effect is that gate area, propagation delay and power dissipation are decreased while the feature size is scaled down. We have compared our simulated results with published results and found a better performance in terms of power dissipation, propagation delay and area due to applying device scaling theory on multiplexing control input technique adder cell.

Keywords: Scaling, 4 bit subtractor, BSIM, Multiplexing control input technique adder cell.

I. Introduction

There is a close correlation between the peak power dissipation of digital circuits and reliability problems such as electro-migration and hot carrier induced device degradation. The methodologies, which are used to achieve low power consumption in digital systems, span wide range, from device/process level to algorithm level. The device characteristics, device geometries and interconnect properties are significant factors in lowering the power consumption. Circuit level measures such as the proper choice of circuit design styles, reduction of the voltage swing and clocking strategies can be used to reduce dissipation in the transistor level [1]. The submicron technology circuits are used for low power dissipation and high speed due to low scale grade interconnect layers [2]. The exponential growth in the importance of CMOS, in the last three decades, has been largely driven by technological innovations that have enabled a steady reduction in MOSFET dimensions. When the dimensions of a

MOSFET are scaled down, both the voltage level and the gate-oxide thickness must also be reduced. Since the electron thermal voltage, (kT/q) is a constant at room temperature, the ratio between the operating voltage and the thermal voltage inevitably shrinks. This leads to higher source to-drain leakage currents stemming from the thermal diffusion of electrons. At the same time, the gate oxide has been scaled to a thickness of only a few atomic layers, where quantum-mechanical tunneling gives rise to a sharp increase in gate leakage currents. The effects of these fundamental factors on CMOS scaling are quantified [3].

According to Mead and Conway [4], any dimension in the layout design can be expressed in terms of λ , called λ -design rule. According to the capability of silicon industry or to meet the specification of the circuit being designed, a value may be allocated to λ , prior to manufacture. If the CMOS scaling is given continuously it will yield miniaturization of the transistor. Smaller the transistors, faster in action, consumes less power, lower cost and more transistors can be packed on a chip and cost effective. Aggressive scaling of CPL devices in each technology generation has resulted in higher integration density and performance [2, 7]. The 4 bit subtractor circuit is analysed using device scaling technology. The scaling down of feature size generally leads to improved performance and it is, therefore important to understand the effect of scaling. The parameter is scaled for the VLSI fabrication technology is still in the process of evolution that is leading to smaller line widths, smaller feature size and higher package density on a chip. Generally, subtractor circuit used as signal propagation in the ALU which is transferring the signal without losses and only some researchers [5, 6] has given their attention on the subtractor circuit. In this paper, we have designed a 4 bit CPL subtractor with the help of multiplexing control input technique and studied the effect of constant field scaling on the overall circuit performance. We have first chosen the feature size and then decided the scaling whereas others have chosen the reverse manner. The 4 bit subtractor circuit layout is generated with the help of Microwind 3 VLSI CAD tools and device parameters are analyzed using BSIM model.

II. Cmos Scaling Theory

Advances in silicon ULSI technology has been historically made by scaling of the device dimensions. According to scaling theory, both lateral dimensions (i.e., lithographic feature sizes) and vertical dimensions (e.g., junction depths) should be reduced to increase the package density of devices while avoiding deleterious short-channel effects. The *International Technology Roadmap for Semiconductors* (ITRS) [6] provides a consensus scenario of how device parameters will scale for technology generation ranging from today's 130-nm technology to devices as small as 22 nm in the year 2016. The technology node parameter also called the technology generation represented the minimum lithographic image size in earlier generations of the Roadmap, now it refers to the DRAM half-pitch. This projected progress is even more remarkable when one notes that, for leading-edge microprocessor chips, the physical gate length is only 60% of the node parameter, and the effective channel length could be as little as half of the physical gate length. Thus, the Roadmap envisions devices having effective channel lengths well under 10 nm within the next 15 years. Furthermore, the recent historical rate of progress has been even faster than that predicted by the roadmaps or Moore's Law [7]. Each successive version of the ITRS Roadmap from 1994 to 2001 has been more aggressive than the previous one: New technologies nodes have been introduced more rapidly than expected.

The overall 4 bit subtractor circuit is analyzed in terms of total power dissipation, Delay and area by using simulation technique and scaled analysis (after scaled down) by using constant field model. The scaled down layout is simulated by Microwind 3 and analyzed using BSIM. Scaling depends on application, since different applications can tolerate different amounts of static leakage power. So that, there is no single end to scaling, but rather there are different optimum ends to scaling for different applications [7]. High power and high-performance circuits can accept much higher static leakage dissipation than portable battery-powered devices. The smaller chip also gives smaller die size increased yield and increased performance. The process of shrinking all geometrical dimensions and

voltages multiplying by a scaling factor is called device scaling, which is applied on multiplexing control input technique adder cell circuits [8].

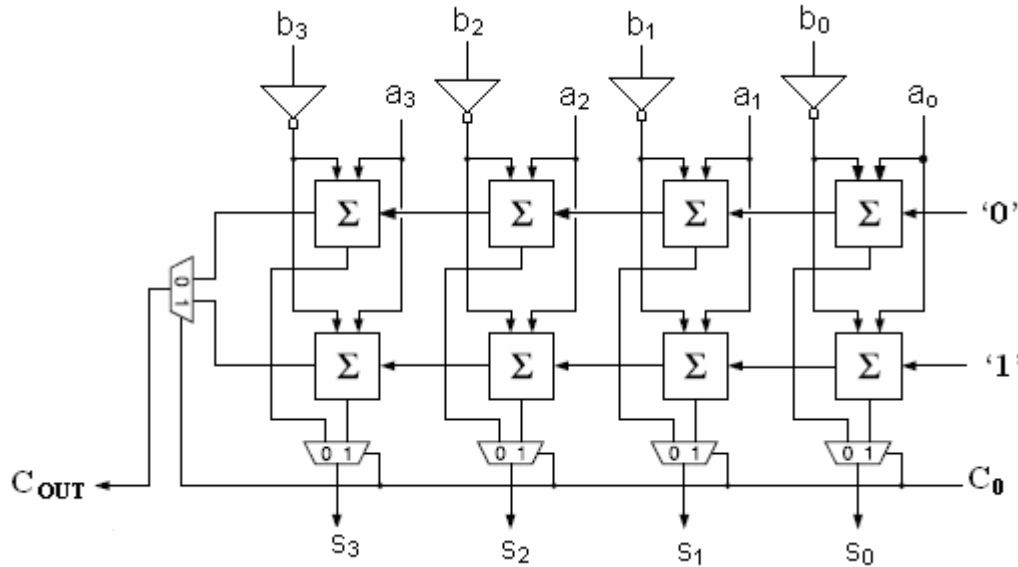
III. Architecute

The 4 bit subtractor circuit is designed by using multipliexing control input technique circuit, which is consists of NMOS and PMOS transistors. The scaling device theory applies on the NMOS and PMOS transistor, which is yielding the width and length of transistors scaled down. The threshold voltages reduced due to transistor length and width are scaled down. According to Hesham *et.al* [9], as feature sizes decrease to submicron supply voltage also decreases. For deep submicron channel lengths, the supply voltage can be in 0.5-1.2 volt range. Therefore, at these small channel lengths logic designers cannot be use NMOS pass transistor logic because of the threshold voltage is drops. At these small feature sizes, the logic families that use transmission gates with both NMOS and PMOS transistors operate correctly. When we are scaling the physical dimensions of the devices from one technology to another, the devices (transistors) are reduced in size and therefore, reducing the lengths of the local interconnect (wires) required to connect the transistors [6, 8]. According to ITRS, the table 1 is illustrates the supply voltage, scaling parameter and scaling factor is known feature size. Our proposed architecture is not varying/changing the supply voltage, but it is fixed to the given feature size.

Table 1: Illustrate Scaling Projection of Transistor Parameter

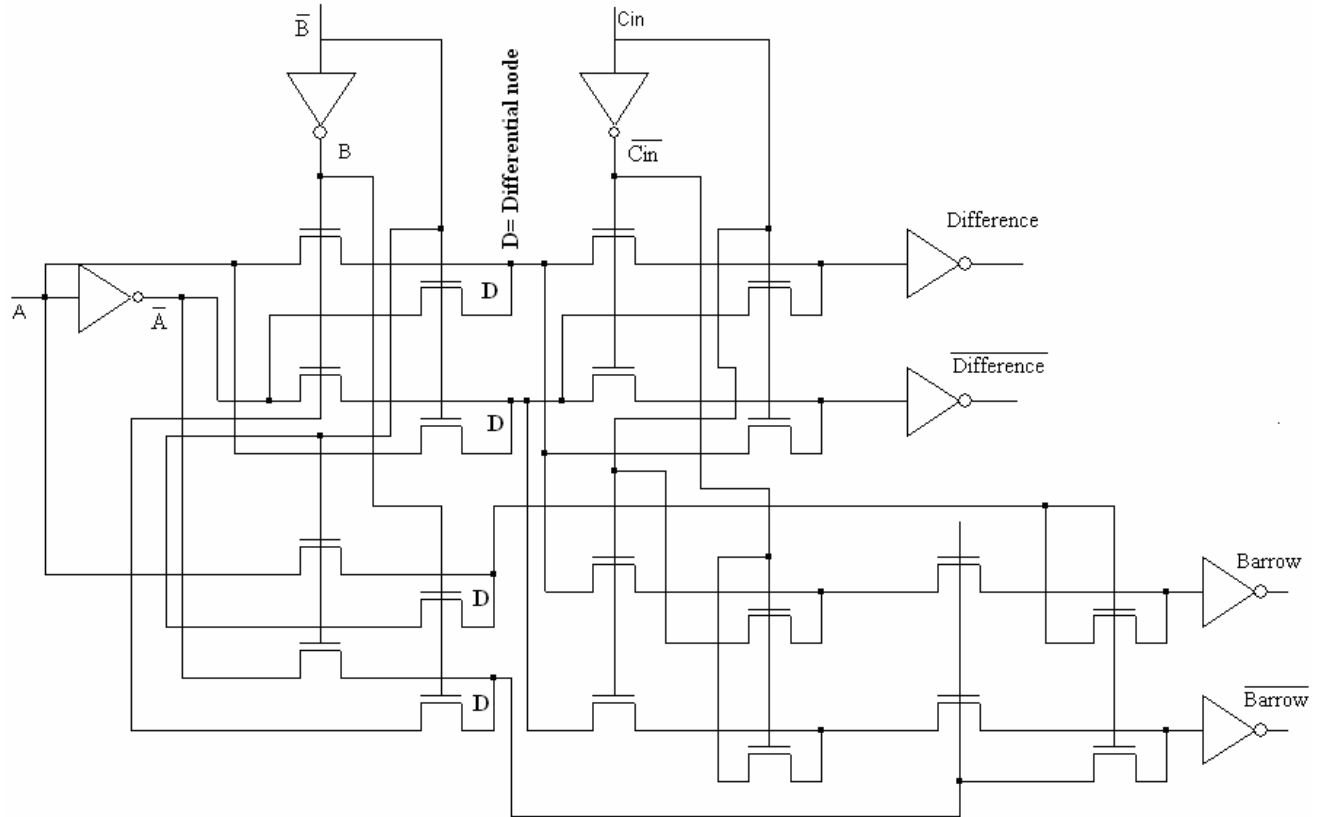
Generation (nm)	150	120	90	70	Scaling Factor
L_{GATE} [nm]	120	~90	~70	~50	x 0.8
V_{DD}	1.2	1	0.7	0.5	x 0.8
T_{OX} [nm]	1.6	1.28	1.024	0.81	x 0.8

The 4 bit subtractor block diagram is shown in Fig.1. To find the value (A-B), if we assume that the input A is greater than B, we can use only 2's complement method, which is clearly shown in Fig 1. In this method, 2's complement of B is to be added to A and the end around carry is to be ignored. All the bits of B is complemented to get 1's complement of B and then to the least significant bit B_0 is added with '1' to get '2's complement of B. the right most full adder adds A_0 , B_0 and '1'. The immediate left full adder circuits adds A_1 , B_1 , and C_0 and so on. The end carry is ignored. The results A-B is given by $D_N...D_1D_0$. A subtractor circuit will add 2's complement binary integers [10]. Whenever the result of an operation produces a number larger than 7 or smaller than -8, there is an overflow because these numbers cannot be represented in 4-bit 2's complement. Therefore, we will accomplish subtraction by simply adding the negative of the second number. The negative of B will be implemented using the 2's complement.

Figure 1: Block diagram of 4-bit Subtractor

The input A and complement B is fed into adder circuit, which is performing A-B. The subtractor circuit is simulated by the Microwind 3 CAD tool and the scaling parameters are measured by the BSIM MOS model, which is used to the accurate simulation results of submicron technology. BSIM is an industry standard for deep-submicron device simulation. A simplified version of this model is supported by the Microwind 3, and recommended to ultra-deep submicron technology simulation [11]. The generated layout of the 4 bit subtractor circuit is simulated using by different feature size such as: 120nm, 90nm, 70nm and 50nm respectively. First, the scaling device parameter calculated theoretically using standard formulae and then the scaling device parameter verified using simulated results of the 4 bit subtractor circuit [6]. A binary full subtractor circuit includes an exclusive OR gate operating upon minuend and subtrahend binary input signals. The difference output from the circuit is the borrow input signal or its inverse depending upon the output state of the exclusive OR gate. The borrow output of the circuit comprises either the borrow input or the subtrahend input, as determined by the output of the exclusive OR gate and by an operation (difference) specifying input signal. Our 4 bit subtractor circuit is designed by using CPL full adder technique. Actually our circuit is performing in the manner of $(A + (-B))$ method. The full adder circuit is designed using by multiplexing control input technique adder cell. This technique has two stages like as; differential node

stage and swing restoration node stage which is shown in Fig.2. In this Fig.2, the input A, $\bar{A}$, B and $\bar{B}$ fed as an input to the pass transistor and form a multiplexing control inputs. According to stage I (differential node) operation; we will get a result $A \oplus B$ of sum mode. This node is indicated as differential node D in Fig.2. The differential node is the output of the $A \oplus B$ and input of the restoration unit. In our subtractor design, the differential node $A \oplus B$, and C_i are fed through the multiplexing control input and form a XOR circuit for difference and XNOR for its complement. A logic circuit combines a plurality of pass-transistor logic trees and a multiple-input logic gate for receiving logic signals from the respective pass-transistor logic trees (differential node), and can express a complex logical operation while decreasing the number of stages in pass-transistor logic trees and improving operation speed. This node is called as a swing restoration node of the pass gate adder circuit. At this node we will get the output expression $A_i \oplus B_i \oplus C_i$ in sum node and complement of $A_i \oplus B_i \oplus C_i$ in sum complement node respectively. We can derive the other non-clocked pass gates depends upon connecting component after the restoration node. Similarly, we can derive the borrow and its complement.

Figure 2: Full subtractor circuit

VI. Scaling of 4-Bit Subtractor Circuit

Out of the various parameters available in the VLSI scaling process, the power dissipation, maximum operating frequency and total chip area play dominant role in 4 bit subtractor circuit while scaled down feature size. Each and every device parameter can be scaled down by constant field model. The scaling parameter is calculated using by constant field model. The scaling projection of transistor parameter and scaled down technologies are illustrated in the table 1. Initially, the transistor width and length values are calculated and the values are substituted in 4 bit subtractor circuit transistors. The new simulation results are obtained by scaling parameter and its values are calculated. When the scaled down the process parameter, succeeding generations of technology have denser, higher performance circuits without too much increase in power density. The limits of this scaling process are caused by various physical effects that do not scale properly, including quantum-mechanical tunneling, the discreteness of dopants, voltage-related effects such as sub threshold swing, built-in voltage and minimum logic voltage swing, and application-dependent power-dissipation limits. The average switching power dissipation is proportional to the square of the supply voltage (V_{DD}), and hence the scaled down V_{DD} will significantly reduce the power dissipation. The CPL circuits after applying scaling technique operate with low supply voltages (such as 1.2V- to 0.5V) and takes very low switching power but suffer from huge power dissipation. Further, it should be noted that with the advancement in fabrication (deep submicron and ultra-deep submicron) technology, the power dissipation is comparable to the switching power dissipation.

The 4-bit subtractor circuit is generated by DSCH2 and layout manufactured using Microwind 3 VLSI CAD tools. The layout window features a grid, scaled in lambda (λ) units. The lambda unit is fixed to half of the minimum available lithography of the technology [11]. The default technology is a CMOS 6 metal layer in 0.25 μ m technology, consequently lambda is 0.125 μ m. But this CPL subtractor circuit designed using deep submicron technologies such as 120nm, 90nm, 70nm and 50nm. The MOS

size (width and length of the channel situated at the intersection of the polysilicon gate and the diffusion) has a strong influence on the current. The safe way to design the circuit is to create a MOS device from the MOS generator palette. The programmable parameters are the MOS width, length, the number of gates in parallel and the type of devices (n-channel or p-channel). By default metal interconnects and contacts are added to the drain and source of the MOS. Some times if there is no interconnection of our design, we may add a supplementary metal 1 interconnect on the top of metal 1 for drain and source.

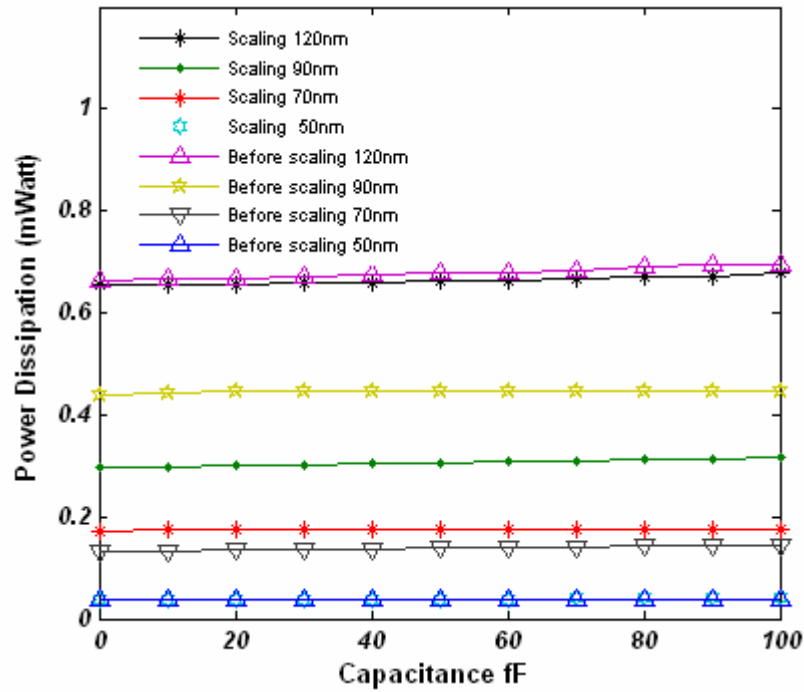
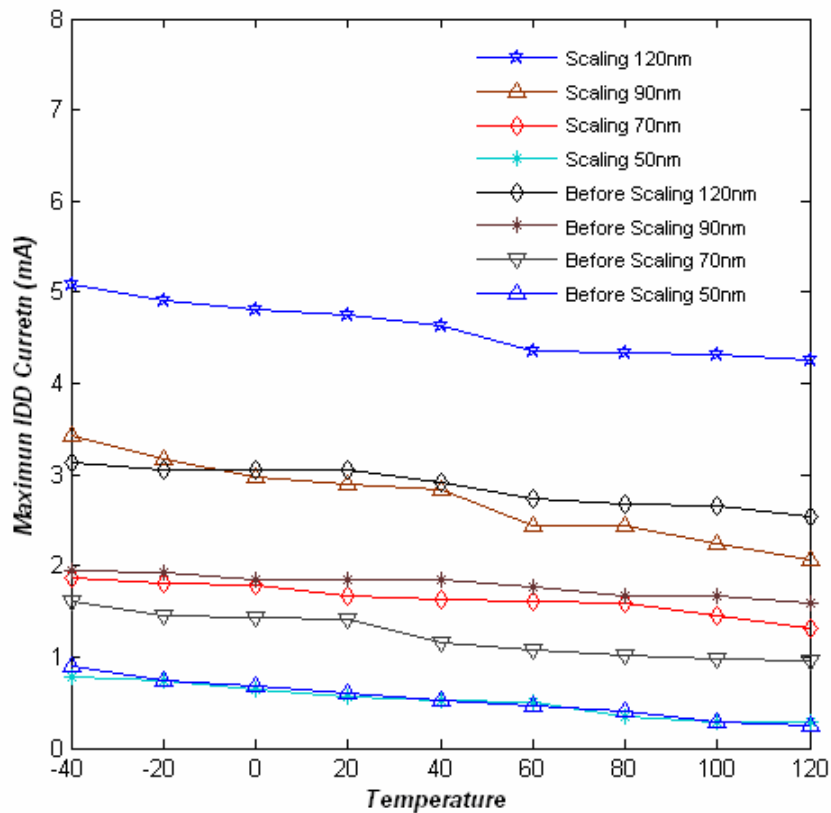
V. Simulation Results and Discussion

A subtractor can be constructed using the full adder blocks. This is done using a carry save adder approach. A carry save adder computes the sum of the least significant bit first, and then allows any carries to propagate to the next full adder. The sum of the first two bits is the least significant bit of the answer. The carry save subtractor operates in a similar manner, however the two's complement of the second input must be taken. This is done by inverting the second input and setting the carry in is logically '1' on the first full subtractor. The case used to simulate the carry save subtractor involves pushing all inputs from high to low. If the inputs are all high, the difference is zero thus the output would be all low. If the circuit is pushed from all high to all low, there will be a borrow across every full subtractor. The 4-bit subtractor circuit uses 308 transistors. In this paper we have analyzed our circuit by two different approaches.

Approach I: In this approach we have designed the circuit by using transistor (NMOS/PMOS) of different feature size like 120nm, 90nm, 70nm and 50nm. Then the designed circuits were simulated with help of Microwind 3 VLSI CAD tools in terms of power dissipation, delay and area. The simulated results are given in table 2. From the results, It is clear that as we are going for lower dimension transistor, the circuit performance, in terms of power dissipation and delay is improving and also area occupying by circuit on as the chip is lower.

Approach II: First we designed the circuit for 150nm transistor feature size and then applying the scaling theory as given in table 1 to scale down the circuit for 120nm, 90nm, 70nm and 50nm. In this approach we are recalculating the dimension of each transistor (NMOS/PMOS) and then generating the layout of the scaled circuit by Microwind 3 CAD tool, according to resize configuration. The scaled 4 bit subtractor circuit is again simulated with Microwind 3 in terms power dissipation, propagation delay and area. As we are scaling our 4 bit subtractor circuit, power dissipation falls drastically and there is linear decrease in propagation delay. Comparison between two approaches shows that power dissipation is reduced in between 5% to 64% whereas the circuit becomes faster after scaled down. The maximum reported improvement in propagation delay of circuit after scaling is about 94% and minimum percent improvement is 65%. Therefore we can say that the tremendous speed gain is achieved after applying the scaling device theory to our 4 bit subtractor circuit. Overall area is also reduced by around 6 % to 12 % after scaling.

The 4 bit subtractor circuit is gives constant power dissipation for increasing load capacitance. The load capacitance (C_L) versus total power dissipation of the 4 bit subtractor circuit is shown in Fig.3. The Load capacitance (C_L) is increased the power dissipation approximately constant for given V_{DD} . According to layout parameter analysis, our circuit power dissipation is high before scaled the circuit elements. After applying scaling theory on the elements, the total power dissipation is reduced according to their dimensions, which is clearly indicating in the Fig. 3. Gate delay is proportional to output capacitance (and driving resistance) [12]. Gate delay is approximately proportional to fan-out.

Figure 3: Capacitance versus total Power dissipation**Figure 4:** Temperature Versus Maximum I_{DD} current

Our designed adder cell based subtractor circuit is analyzed for Drain current effect for various temperatures. The temperature analysis made by using BSIM advanced layout design tools for various temperatures. The temperature versus maximum I_{DD} current graph is plotted, which is shown in Fig. 4, with help of standard feature size CMOS 120nm, CMOS 90nm, CMOS 70nm and CMOS 50nm and

scaled down feature sizes. The maximum I_{DD} is used to find out the transistor operation points. According to Donald A. Neaman *et.al* [13], when temperature increased, the current will be decreased. Any motion of free carriers in a semiconductor leads to a current. This motion can be caused by an electric field due to an externally applied voltage, since the carriers are charged particles. This carrier transport mechanism is due to the thermal energy and the associated random motion of the carriers. We will refer to this transport mechanism as carrier diffusion. The total drain current in a semiconductor equals the sum of the drift and the diffusion current. As one applies an electric field to a semiconductor, the electrostatic force causes the carriers to first accelerate and then reach a constant average velocity (v), due to collisions with impurities and lattice vibrations. The ratio of the velocity to the applied field is called the mobility. The velocity saturates at high electric fields reaching the saturation velocity. Additional scattering occurs when carriers flow at the surface of a semiconductor, resulting in a lower mobility due to surface or interface scattering mechanisms. Diffusion of carriers is obtained by creating a carrier density gradient. Such gradient can be obtained by varying the doping density in a semiconductor or by applying a thermal gradient. Both carrier transport mechanisms are related since the same particles and scattering mechanisms are involved. This leads to a relationship between the mobility and the diffusion constant called the Einstein relation. According to Fig. 4, our 4 bit Multiplexing control input technique adder based subtractor circuit is giving low current compared other existing circuits. So, our designed 4 bit subtractor circuits are used in low power and high speed mobile circuits, which will give withstand long hour's battery life.

We have compared the gate capacitance value and power dissipation of our scaled 4 bit subtractor circuit with David Duarte *et.al* [14] reported results for microprocessor system. Fig 5 shows the comparison result for gate capacitance and it is observed that the gate capacitance value decrease in our circuit than David Duarte *et.al* [14]. The maximum percentage improvement of 98.30 is observed when the circuit is scaled to 50nm. The average improvement is around 50%.

Table 2: The 4 bit subtractor circuit

Feature size	Simulation result (Before)			Scaling result (after applying scaling technique)			% improvement		
	Power (μ W)	delay	Area μ m ²	Power (μ W)	delay (ps)	Area μ m ²	Power	delay	Area
120nm	0.608	0.41ns	2664	0.29	28	2414	52.3	93.17	9.3
90nm	0.276	71ps	1845	0.10	25	1680	63.76	64.78	8.94
70nm	4.56	71ps	1770	4.32	18	1568	5.263	74.64	11.412
50nm	0.121	52ps	924	0.077	15	869	36.36	71.15	5.95

Figure 5: Comparison graph

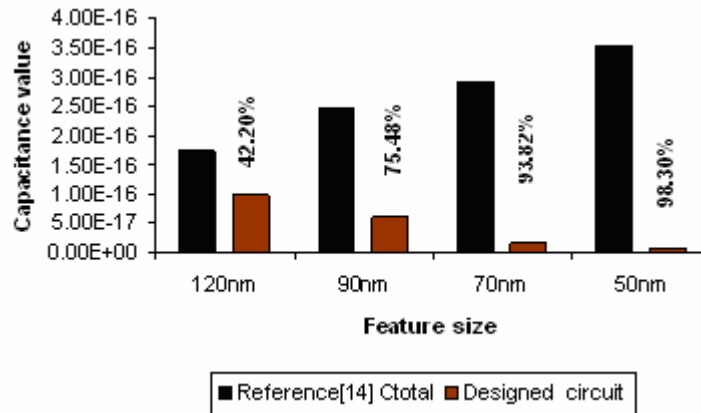


Table 3: Comparision Table

Feature size	4 bit Subtractor circuit Power Dissipation		Reference [14] Power Dissipation	
	P active Watt	P leakage Watt	P active Watt	P leakage Watt
120nm	2.6072×10^{-3}	1.3034×10^{-3}	21	2
90nm	1.131×10^{-3}	5.659×10^{-4}	25	4
70nm	3.016×10^{-4}	1.508×10^{-4}	28	9
50nm	7.8585×10^{-5}	3.9294×10^{-5}	35	28

Table 3 gives the comparison results in terms of static power and dynamic power of our circuit and David Duarte *et.al* [14]. Duarte *et.al* [14] has analyzed the power dissipation in microprocessor and reported the dissipation in terms of watt whereas in our circuit power dissipation is in milli watt. This again confirms the superiority of our circuit in terms of power dissipation and delay. This is possible due to our design approach of multiplexing control input technique adder cell and device scaling approach.

Conclusion

The 4-bit subtractor circuit is designed by using multiplexing control input technique adder cells and schematics verified by using DSCH2 CAD tool. The layout is generated using by Microwind 3 layout simulator and analyzed by BSIM analyzer. During the analysis we found that overall area acquired by the CPL 4-bit subtractor circuit has reduced tremendously after the scaling as well as due to input multiplexing method. This reduction in area saves lot of power consumption on the chip. This subtractor circuit is very much useful to signal transformations and signal compression of the ALU circuit. The ultimate aim of this paper is that the subtractor circuit must have lowest dissipation and also high speed which yields the compression of the signal without power losses and it would be sent with high speed.

Refereces

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The Input of Psychology in Methodological Considerations of Cross Cultural Marketing Research

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Abstract

This paper investigates the potential input of social psychology in cross cultural marketing research. More specifically, the study addresses the methodological considerations in designing the market research study, carrying out the study and interpreting the marketing research findings.

Introduction

In the era of global communications, during which the world is becoming one market place (i.e., global village), products have become global in nature and companies are increasingly trying to intervene in foreign markets all over the world (Mattelart, 1991). In light of the accruing business internationalism, development of cross-cultural marketing strategies is imperative. Cross-cultural marketing has been characterised as the extension of a company's home country's marketing strategy into the global marketplace (Roberts, 2001). As business internationalism globalization increases, companies should better utilize cross-cultural marketing research approaches (Young and Javalgi, 2007). Interestingly, cross-cultural marketing research has to compete with the integration of different cultures on a common global scale.

Psychologists, as well as marketing researchers often have tended to select persons who are conveniently available to be subjects in their experiments or informants in their empirical work. It would be, however, a mistake to assume that the findings from studies in Europe and North America can be applied on people from other parts of the world. That is why the study of cross-cultural psychology in marketing research may be useful to broaden corporate vision and deepen business insights by crossing the borders (Segall et al., 1990).

More specifically, cross-cultural research in psychology has been defined as "the explicit, systematic comparison of psychological variables under different cultural conditions in order to specify the antecedents and processes that mediate the emergence of behaviour differences" (Eckensberg, 1972, p. 100).

Cross-cultural research was primarily of interest to anthropologists up until the World War II, when experimental psychologists became interested in groups outside the urbanised and literate

samples of Europe and North America (Price-Williams, 1969). They wanted to investigate the generisability or variability of certain psychological characteristics. In other words, they wanted to "demonstrate the effect of culture or demonstrate that culture does not matter" (Strodtbeck, 1964, p. 224). This concerns such fundamental questions as the extent of biological dispositions of mankind and the extent of susceptibility to learning influences (Price-Williams, 1969).

In addition, psychologists wanted to examine causal relationships between certain ecological and societal factors and the variability in psychological processes in different cultures. It was, therefore, necessary to examine a vast array of possible factors, such as the physical environment, child-rearing techniques, degrees of literacy, and the organisation in social, economic and religious spheres (Price-Williams, 1969).

The progress of cross-cultural studies has been right across the gamut of psychology, from relatively 'molecular' aspects of behaviour, such as those involved in perceptual processes, to relatively 'molar' concepts of personalities and attitudes (Price-Williams, 1969). As a result, psychologists from all disciplines have started getting involved in this type of research.

Cross-cultural research involves a big variety of methodologies. There is the laboratory-type research, whose only difference from traditional laboratory experimentation lies in the fact that it is conducted in a different cultural context. There are observational studies where often these studies are made with the investigator stepping out of his country, indeed out of his library (field studies). Moreover, sometimes the basic data of which have been collected previously by other people are analysed together by third person(s) (documentary studies). Sometimes collaborators in many countries co-operate to attack the same problem (Price-Williams, 1969).

Designing a marketing research to produce unambiguous findings is not easy (Reynolds, 2000). It is difficult even when the study is done in the investigator's own society, where the marketing researcher knows the language, is knowledgeable about prevailing attitudes, is using measuring instruments of known reliability, and is able to detect subtle cues in the behaviour of the subject. The problems confronting cross-cultural psychologists are even more complicated (Segall et al., 1990); and these problems and difficulties of conducting research outside the traditional confines of one's own laboratory and one's own culture have attracted much attention.

All the methods that are often used in cross-cultural psychology can be applied in connection with the different marketing research goals. The use of each possible method presents its particular difficulties and requirements. Most methodological considerations, however, which are characteristic of cross-cultural research are relevant to all of them and are therefore going to be presented here without specific reference to a particular method (Duijker & Rokkan, 1954).

Designing the study

The marketing researcher has to take into consideration a number of difficulties adapted from psychology when designing a cross-cultural study. First of all, it is important to achieve equivalence of the phenomena under investigation. Berry and Dassen (1974) suggested three kinds of cross-cultural psychology equivalence: functional, conceptual and metric equivalence. Functional equivalence is necessary because classification and interpretation of behaviours may vary from culture to culture. Thus, it might be inappropriate to study the same behaviours in two or more different societies. One might in fact have to study different behaviours in order to study the same psychological phenomenon (Segall et al., 1990). One way to overcome this problem is by participant observation, employment of local people to serve as informed observers, and local test construction (Segall et al., 1990).

Moreover, different cultures may have different conceptual systems, so conceptual equivalence has to be met as well (Frijda & Jahoda, 1969). Sears (1961) argued that the meaning of research materials (stimuli, concepts, etc.) or of behaviour must be equivalent before comparison is possible. A number of attempts have been made to operationalise this requirement. The most common one is the use of forward and back translations of words, sentences and test items to demonstrate translation

equivalence (Brislin, Lonner, & Thorndike, 1973). Another approach to conceptual equivalence is semantic differential analysis (Osgood, 1965).

The final type of equivalence, the metric equivalence, exists when the psychometric properties of two (or more) sets of data from two (or more) cultural groups exhibit the same coherence or structure. It requires behavioural measurements to be structured in similar ways within groups before comparisons across groups are allowed (Berry, 1980).

Another very important consideration is how the researcher is going to measure a psychological process. This consideration is also applied to marketing research. In psychology, it has been accepted that the use of tasks and tests developed in one culture are not always appropriate in another culture, since there can be no such thing as a "culture-free" test. Instead the aim is said to devise "culture-fair" tests, which give no undue advantage to some groups. This could be achieved by constructing tests equally unfamiliar to all (impossible to do) or by devising culturally "appropriate" tests. In culturally appropriate tests a particular psychological dimension is assessed by means of a medium familiar to the members of each culture (Frijda & Jahoda, 1969). However, this assumes a very good knowledge of the culture you are studying and can, therefore, be difficult to implement.

Sampling is another problem common in psychological and marketing researches and particularly difficult in cross-cultural studies. Sampling takes place when the researcher chooses the cultures under investigation, when he selects his participants, when he selects the behaviour that he is going to study and the means he is going to use to assess it (as stated above) (Berry, 1980). What has attracted a lot of attention is the sample of individuals. The groups that the researcher is going to work with must, firstly, be comparable and also be different. The researcher wants the differences in some respects and the communalities in other respects, so he can investigate the hypothesised effect of some difference on people who are otherwise comparable (Segall et al., 1990).

Another aspect of sampling is representativeness. Sometimes, though, obtaining a representative sample can be difficult, time consuming and expensive. Consequently, there may well be subtle pressures on the investigator to recruit relatively accessible subjects. This happens at the expense of a representative sample. This is also apparent when the researcher uses a local informant. This is because it is usually the case that the informants are linguistically, educationally, or otherwise different from most people in their society. The researcher can end up again with a slightly distorted set of facts since some aspects of his research are based on unrepresentative sample - the informant or convenient sample (Segall et al., 1990).

Carrying out the study

In psychology, the interaction between the investigator and those whose behaviour he is investigating can threaten the validity of a study. Obviously, people in other societies will be very different from the investigator in many respects. Some intriguing methodological problems emerge from these differences in marketing research. For instance, there are likely to be serious impediments to communication, so serious that the subjects may misinterpret the task they are supposed to perform or the investigator may misinterpret the performance (Segall et al., 1990).

Cambell (1964) suggested a way that one can be sure that a difference across groups represents a "real" difference and not a case of miscommunication. He proposed to insert "comprehension check" items in the study. These "comprehension check" stimuli are stimuli which almost certainly will evoke no variation in response cross-culturally. Actual test items can be built upon the established communication of the task, and any observed cross-cultural variation can be taken as an indicator of valid behavioural differences (Cambell, 1964). Although this seems to be useful and plausible it is not always so easy to implement.

In addition to the possibility of miscommunication, one must also acknowledge the possibility of the subjects' misperceptions of the role and the status of the researcher. These misperceptions can affect their performance in any variety of unknown ways. They may say or do whatever they think they have to do in order to please, placate, or get away from the investigator (Segall et al., 1990). One way

to control the expectations, guesses or hypotheses on the part of the subject when coming into contact with the researcher, is by attempting to communicate one's aims, assimilating them to the most common spheres of education and medicine (Frijda & Jahoda, 1969).

Interpreting the findings

The complexity of the culture-variate situation renders interpretation hazardous. Alternative interpretations are often hard to exclude in marketing research. Attribution, for example, of some specific personality trait to some cultural group usually carries three connotations: supposed transsituational generality; relative immutability of the behaviour concerned when in new situations; and early origin during the life-cycle (Frijda & Jahoda, 1969). These assumptions, though, cannot be made unless they have been explicitly and systematically examined.

Too readily, behaviours are taken to be parts of a pattern, elements of some "cultural orientation", instead of specifically learned, isolated reaction tendencies. The unity of culture and culture-training should not, however, be overrated and taken as an axiom in interpretative efforts (Frijda & Jahoda, 1969). It is easy to be illegitimately drawn to the conclusion that if similarity among groups is found then some universal process is involved (Strodtbeck, 1969) but this should not be concluded unless it is supported by valid and reliable findings.

It has been argued that establishing that a culture has an effect on behaviour is a much easier task than establishing that culture does not matter. This is because it is difficult to distinguish between total failure in communication and total difference in perception (Strodtbeck, 1964). It is, therefore, the marketing researcher's responsibility to interpret the results in an appropriate way, while baring in mind all the methodological difficulties he encountered in his study.

Conclusion

Although there are certain products and markets, for which similar reactions could be identified across the globe, one may also find other sectors that differ considerably from country to country and from culture to culture. The majority of international marketing research "flops" are the apparent results of lack of cultural sensibility, a lack of recognition of certain attitudes and values that make a successful marketing mix in one country unpromising to another (Ricks, 1993). Obviously, meaningful cultural differences should lead into different marketing policies. The marketing researcher could adopt psychologists' considerations when designing cross-cultural marketing researches.

Cross-cultural psychology as well as cross-cultural marketing research seek to comprehend the systematic covariation between cultural and behavioural variables (Reynolds, 2000). Included within the term cultural are ecological and societal variables, and within the term behavioural are inferred variables. We should not forget that what we often call "human nature" is not only a reflection of human biological potential, but also a product of culture and two classes of formative experience, socialisation and enculturation (Segall et al., 1990). Together these account for both the uniformities and the diversities in the behaviour of human beings. Human behaviour must be viewed in the sociocultural context in which it occurs, if we are truly to understand it (Segall et al., 1990).

Traditionally, though, the cross-cultural study is one which Western industrial cultures are compared with pre-literate tribal ones. As regards the latter, however, it must be pointed out that there are hardly any cultures left that remain unaffected by Western ideas and technologies (Frijda & Jahoda, 1969). Most cultures have lost their traditional identity and have given in the pressures of the "more civilised people". This has a positive side: the methodological problems have become easier to overcome. Information, regular contact and easier accessibility have helped researchers to approach different cultures with more confidence. But, this has also had a negative impact on cross-cultural marketing research: in some respects, cross-cultural studies have lost their biggest advantage: the study of the unknown.

Moreover, cross-cultural marketing studies are associated with numerous methodological difficulties, some of which are often impossible to overcome. Although solutions have been suggested to most of the problems, the lack of time, funding, and accessibility often makes it difficult for these suggestions to be put into practice. This is by no means a good reason to abandon this very important type of research. Despite the fundamental and administrative difficulties associated with cross-cultural research, the rewards are significant and the move away from singular location studies to more comparative research is to be encouraged.

Finally, it must be noted that the more kinds of information available, the more sure we can be of our findings (Irvine & Carroll, 1980). This means that cross-cultural marketing studies often have to use more than one method of data collection; they have to be embraced by researcher; and cross-cultural and general experimental findings have to be integrated. This is the only way to ensure that cross-cultural marketing research conclusions are based on validated findings.

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Effect of Mathematical Games on Nigerian Students' Performance in Mathematics in Secondary Schools in Port Harcourt Metropolis

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Abstract

The study investigated the effect of mathematical games on Nigerian students' performance in mathematics in secondary schools in Port Harcourt.. The design of the study was Pretest, Posttest Control Group Design. A total of one hundred and eighty (180) JSS1 students were involved in the experimental study. This number was made up of Ninety (90) boys and Ninety (90) girls from three schools purposively chosen from the Co-educational Federal schools, State schools and Government Approved Private Schools in Port Harcourt metropolis, for a good representation of the schools. From these schools, subjects were randomly assigned to the experimental and control groups i.e 60 students from each school. Two instruments were used in data collection. One was the pretest, which was used to establish the pretest mean scores, standard deviation and variance of the two groups used for study. This formed the basis for comparison with the posttest. The posttest was a parallel or an equivalent test to the pretest, and was used to determine the difference in achievement of students exposed to mathematical games and those not. The two groups were taught at different lesson times in their respective schools. The statistical tools used for the study were Mean, Standard Deviation, Variance, non-independent t-test and Analysis of Variance (ANOVA). The results showed that the use of mathematical games was more effective than the use of traditional lecture method in teaching mathematics. From the findings recommendations on how to improve students' performance in mathematics were made. The implications of the findings were also considered.

Introduction and Background

Mathematics is made compulsory in primary and secondary schools all over the world because it helps the child to develop analytical, critical and evaluative thinking, as well as its importance in the study of other sciences and the development of nations. Abdulahi (1986): Aburime (2004): Jegede (2003). Most students usually loose interest in the study of mathematics and consequently perform poorly. Badru (2003). This is partly due to poor presentation of the image of mathematics to the students by the society (Obodo 1997). With the common slogan that "mathematics is a difficult subject", students may easily become reluctant learners of mathematics in schools.

Mathematical games have been used to teach mathematics and science in many countries. As quoted by Obioma (1992) Plato said Amusement and pleasure ought to be combined with instruction to make mathematics interesting. These things make a student useful to himself and more wide awake.

Mathematical games can be used to introduce concepts as a prelude to explicit teaching or practice skills or consolidate a concept. Educational games do lead to improved learning. Azuka (2001). Teachers still remain the key figure in changing the way mathematics is taught and learnt in schools. It is believed that teachers with appropriate mathematical background can develop many requisite skills for mastering the art of teaching mathematics.

The job description for teachers can be summarized by saying: Teachers must know the subject matter, they must know the students they are teaching, and above all, know how to teach the students artistically.

Purpose

The purpose of this study is to determine how effective the use of mathematical games would be on students' performance in mathematics. Specifically, however the study is set to determine:

- If there will be a significant difference in the performance of students taught using mathematical games and those taught with the traditional lecture method.

Research Questions

To guide the study, the following research questions were posed:

1. Is there any difference between the pretest scores and the posttest scores of students in the experimental group within each school?
2. Is there any difference between the pretest scores and the posttest scores of students in the control group within each school?
3. What is the difference in the performance of students in the experimental group and students in the control group in all the schools?
4. What is the difference in the performance of boys and girls in the experimental group in all the schools?

Hypotheses

The null hypotheses are: -

1. There is no significant difference between the students' pretest scores and posttest scores in the experimental group within each school.
2. There is no significant difference between the students' pretest scores and posttest scores in the control group within each school.
3. There is no significant difference in the performance of students in the experimental group and students in the control group in all the schools.
4. There is no significant difference between the performance of boys and girls in the experimental group in all the schools.

Review of Related Literature

Game theory as related to mathematics is a branch of mathematics that uses modeling of incentive structures. Game theorists study the predicted and actual behaviors of individuals in games as well as optimal strategies. In a research conducted in New Zealand in 1977 to popularize mathematics, games were devised for teaching. Diamond and Diamond (1992). Achievement is seen here as the level of performance exhibited by an individual. It is the extent to which a student is able to accomplish a task.

Anastasi (1982) viewed achievement as meaning the effects of relatively standardized sets of experiences. Hence academic achievement could be regarded as the level of proficiency and knowledge demonstrated by an individual after learning has occurred. It has to do with the use of mental effort or skill acquisition.

Teaching has been viewed by Obodo (1997) as one of the most important professions in the world and most rewarding. It is sad to note that studies carried out expose the fact that some mathematics teachers do not have the knowledge of modern curriculum which is indeed a prerequisite for effective teaching. Lassa (1976). To achieve the goals of mathematics curriculum, well qualified, trained and motivated teachers are needed.

Seegers and Boekaerts (1996) study shows that boys do better in mathematics achievement and participation. Forgasz, Leder and Gardner (1999) again supported this view of boys being better than girls in mathematics. Expressing a different view, Fennema and Leder (1990) as well as Becker (1991) observed that there is no justice in mathematics education, females are not learning and participating in mathematics at the same level as males. Byrnes, Hong and Xing (1997) reported that mathematics is sex-typed as a male domain.

In Nigeria, students achievement in secondary school mathematics has become a matter of great concern. Ale (2003): Aborisade (2001): Amazigo (2000). However, the issue of gender also needs to be faced squarely. Osakwe (1990) pointed out that girls have an edge over boys in verbal ability but boys tend to dominate in mathematics. Okeke (1997) calls for gender equity, especially in science, technology and Mathematics, Three Nigerian researchers, Ani, Esin and Iyang (2001) report that the level of women enrolment and graduation in STM (Science, Technology and Mathematics) disciplines is not encouraging, especially when compared to the males.

Methodology

Design

This is an experimental study with randomized groups, pretest – posttest design. The study involved two groups which allow the use of intact classes and easy control of the reactive effects of experimentation.

Randomized Groups Pretest – Posttest Design.

Groups	Pretest	Treatment	Post Test
Experimental	Y1	X	Y3
Control	Y2	-	Y4

The independent variables are the teaching methods i.e mathematical games for the experimental group and traditional method for the control group. The dependent variables are performance, while sex is an intervening variable.

Research Instrument

The test instruments were multiple choice type of teacher made achievement tests, carefully constructed using a lesson plan and a test blue print that was based on specific objectives of the lesson plan to ascertain validity. (Alamina,2001). Since the tests were teacher made achievement tests, item analysis was carried out to determine the difficulty and discrimination indices of the test items

The pretest consists of 20 items testing general knowledge of simple equations administered to the 2 groups of students used for the study. This test was used to establish the pretest mean scores, standard deviation and variance of the two groups used for the study. The experimental group was taught with mathematical games.

The pretest questions were administered to the two groups first, before teaching took place. This helped the researcher determine the equivalence of the groups. The experimental group was taught using the lesson plan prepared with mathematical games.

In the course of the teaching, "Card games" were given to the students to play and study with in groups of "five". After this, the posttest item consisting of twenty objective questions was administered. The control group was taught using traditional method without games.

The posttest consists of a 20-item test, based on simple equation. This was administered to the 2 groups used for the study. The scores obtained enabled the determination of any difference in the achievement of students exposed to mathematical games and those not. This posttest instrument was a parallel form of the pretest instrument. (i.e similar in content). According to Mehrens and Lehman (1973) two parallel tests can be used in order to reduce the memory effects of the students.

The reliability of the tests (pretest and posttest) were also computed using a pilot group of 40 students from the Federal Government Girls College, Abuloma – a subset of the population. Using Kuder – Richardson Estimates formula, the reliability of the pretest was estimated to be $r_{xx} = 0.9$ while the reliability of the posttest was estimated to be $r_{yy} = 0.8$. For the reliability of the whole test, Pearson Product Correlation Coefficient was $r_{\frac{1}{2}x\frac{1}{2}y} = 0.70$. Spearman Brown Prophecy Formula was applied as a correction factor and the reliability coefficient of 0.82 was obtained for the whole test. (Thorndike, 1971). From the obtained value one could predict that a person with a comparatively high score in the pretests would also score high in the posttest and vice versa all variables remaining constant.

Data Analysis

Descriptive statistics was used for research questions 1 to 4 and this involved computation of means standard deviation and variance of the scores.

For Hypotheses Testing, Inferential statistics was applied using Non-Independent t-test statistics for Ho1 and Ho2, also used was simple Analysis of variance (ANOVA) for Ho3, and Ho4.

Research Question i

Is there any difference between the pretest scores and posttest scores of students in the experimental group within each school?

Table 1: pretest/posttest means scores/standard deviation of students within each school

Experimental group	School 1	School 2	School 3
Pretest	$\bar{X} = 6.2$ SD = 2.5	$\bar{X} = 4.0$ SD = 1.8	$\bar{X} = 7.0$ SD = 3.5
Posttest	$\bar{X} = 10$ SD = 2.8	$\bar{X} = 8$ SD = 2.1	$\bar{X} = 11$ SD = 3.5
Diff. in means	4.2	4.0	4.0

The experimental group in school 1 had a pretest mean score ($\bar{X}$) of 6.2 and Standard deviation (SD) of 2.5 and post test mean score of 10 and standard deviation of 2.8. Difference in the mean score is 4.2.

The experimental group of school 2 had a pretest mean score ($\bar{X}$) of 4.0 and standard deviation (SD) of 1.8 and post test mean score of 8.0 and standard deviation of 2.1. The difference in the mean score is 4.0

The experimental group of school 3 had a pretest mean score ($\bar{X}$) of 7.0 and standard deviation (SD) of 3.5 and posttest mean score of 3.5. The difference in the mean score is 4.0. In each of the schools, using pretest means score as the basis of comparison there was an increase in the students' posttest scores.

Research Question ii

Is there any difference between the pretest scores and the posttest scores of students in the control group within each school?

Table 2: Pretest/posttest mean scores and standard deviation within each school

Control group B	School 1	School 2	School 3
Pretest	$\bar{X} = 5.5$ SD = 2.4	$\bar{X} = 5$ SD = 3	$\bar{X} = 5.1$ SD = 3.6
Post test	$\bar{X} = 8.0$ SD = 2.1	$\bar{X} = 5$ SD = 3.6	$\bar{X} = 10$ SD = 2.9
Diff. in means	2.5	0	4.9

The control group in school 1 had a pretest mean score of 5.5 and standard deviation of 2.4 and posttest mean score of 8.0 and standard deviation of 2.1. Difference between the means is 2.5. The control group in school 2 had a pretest mean score of 5 and standard deviation of 3 with a posttest mean score of 5 and standard deviation of 2.6. The control group in school 3 had a pretest mean score of 5.1, standard deviation of 3.6 and a posttest mean score of 10, standard deviation of 2.9. Difference between the means is 4.9.

Research Question iii

Is there any difference in the performance of students in the experimental group and student in the control group in all the schools?

Table 3: Posttest mean score and standard deviation for both group in all the schools?

Posttest	School 1	School 2	School 3
Experimental (A)	$\bar{X} = 10$ SD = 2.8	$\bar{X} = 8$ SD = 2.1	$\bar{X} = 11$ SD = 3.5
Control (B)	$\bar{X} = 8$ SD = 3.8	$\bar{X} = 5$ SD = 2.6	$\bar{X} = 9.7$ SD = 2.9
Diff. in means	2	3	1.3

The experimental group in school 1 had the posttest mean score as 10 and standard deviation of 2.10 while the control group had a mean score of 8 and standard deviation of 3.8. The difference between the mean was 2.

The experimental group in school 2 had the mean score as 8 and standard deviation of 2.1 while the control group had the mean score of 5 with standard deviation of 2.6. The difference between the means was 3. The experimental group in school 3 had the mean score of 11 and standard deviation of 3.5 while the control group had the mean score as 9.7 and standard deviation 2.9. The difference between the means was 1.3.

Research Question iv

Is there any difference in the performance of boys and girls in the experimental group in all the schools?

Table 4: Posttest mean score and standard deviation for boys and girls in the experimental group in all the schools?

Experimental Group	School 1 Post test	School 2 Posttest	School 3 Posttest	Total Mean
Boys	$\bar{X} = 9.1$ SD = 2.9	$\bar{X} = 7.7$ SD = 2.3	$\bar{X} = 11.2$ SD = 3.1	28.0
Girls	$\bar{X} = 10.2$ SD = 2.7	$\bar{X} = 8.2$ SD = 2	$\bar{X} = 10.1$ SD = 3.2	28.5

The boys in school 1 had the posttest mean score of 9.1 and standard deviation of 2.9. While the girls mean score was 10.2 and standard 2.7. The difference between the mean was 1.1 in favour of girls.

The boys in school 2 had a posttest mean score of 7.7 and standard deviation 2.3, while the girls mean score was 8.2 and standard deviation 2. The difference between the means is 0.5 in favour of the girls. The boys in school 3 had a posttest mean score of 11.2 and standard deviation of 3.1 while the mean score for girls was 10.1 with standard deviation 3.9. The difference between the mean is 1.1 in favour of boys.

Hypothesis i

1. Null Hypothesis (Ho1): There is no significant difference between the student's pretest and posttest scores in the experimental group within each school.

Table 5: Non-Independent t-test analysis of the difference between students pretest and posttest scores for experimental group within each school.

Variables	N	$\bar{X}$	sd	t critical	t calculated
Pretest (sch. 1)	30	6.2	2.5	2.045	7.3
Post test (sch.1)	“	10	2.8		
Pretest (sch. 2)	30	4.0	1.8	“	12.2
Post test (sch.2)	“	8.0	2.1		
Pretest (sch. 3)	30	7.0	3.5	“	6.5
Post test (sch.3)	“	11.0	3.5		

p>0.05. Degree of Freedom = 29.

Decision: The data in the table above showed that there was a significant difference between the pretest and posttest scores of students in the experimental group in each of the schools. This was because the critical t-value of 2.045 is less than any of the calculated t-values of 7.3, 12.2 and 6.5 respectively in each of the schools given 0.05 level of significance at 29 degree of freedom.

Hypothesis ii

1. Null hypothesis (Ho2): There is no significant difference between the students pretest and the posttest scores in the control group within each school?

Table 6: Non-Independent t-test analysis of the difference between students pretest and posttest scores for control group within each school.

Variables	N	$\bar{X}$	sd	t critical	t calculated
Pretest (sch. 1)	30	5.5	2.7	2.045	3.6
Post test (sch.1)	“	8.0	3.8		
Pretest (sch. 2)	30	5.0	3.0	“	2.4
Post test (sch.2)	“	5.0	2.6		
Pretest (sch. 3)	30	5.1	3.6	“	5.9
Post test (sch.3)	“	9.7	3.0		

P>0.05. Degree of Freedom = 29.

The result of the data analysis as presented in the above table showed that the calculated t-values 3.6, 2.4 and 5.9 for the schools respectively were greater than the critical t-value of 2.045 at 0.05 level of significance with 29 degree of freedom. This means that there is a significant difference between the pretest and post test scores in each of the schools. In school 2 however there was no increase in mean score, yet the t-value was significant.

Hypothesis iii

1. Null hypothesis (Ho3): There is no significant difference between the performance of students in the experimental group and students in the control group in all the schools.

Table 7: Summary of Data Analysis of variance of the pretest/posttest scores of students in the experimental group and students in the control group for the 3 schools

Source of variance	SS	Df	MS	f critical	f calculated	α
Between group (pretest)	12.74	1	12.74	3.89	1.37	0.05
Within group (pretest)	1657.70	178	9.3			
Total	1670.44					
Between group (post test)	164.3	1	164.3		14.3	0.05
Within group (posttest)	2048.5	178	11.5	“		
Total	2212.8					

Decision: with 1 and 178 degree of freedom, the critical F ratio was 3.89 at 0.05 level of significance. Comparing the pretest scores for all the students in both groups, the calculated F ratio is 1.37 which is not significant. After the treatment has been applied, F ratio 14.3, was obtained. Since the calculated F ratio is higher than the critical value, we reject the null hypothesis and accept the alternative that there is significant different between the students performance in the experimental group and student performance in the control group.

Hypothesis iv

Null hypothesis (Ho4): There is no significant difference between the performance of boys and girls in the experimental group in all the school.

Table 8: Summary of Data Analysis of variance of the posttest scores of boys and girls in the experimental group for the three schools.

Source of Variance	SS	Df	MS =ssdf	F critical	F calculated	α
Between groups	0.8	1	0.8	3.96	0.08	0.05
Within groups	833.2	88	9.5			
Total	834.0					

Decision: With 1 and 88 df, the critical f ratio was 3.96 at 0.05 level of significance. Since this value is greater than the calculated F value 0.08, the null hypothesis that there is no significant difference in the performance of boys and girls in the experimental group was accepted.

Discussion of findings

For research question 1, the increase in performance can be attributed to the instructional method used in teaching these students in the experimental group. Mathematical games as an instructional method provided an opportunity for students to participate actively in the lesson through games. This is in consonance with the opinions of Pines and West (1986) that students' participation in any instruction brings about improvement in their performances. The high values of standard deviation in the schools revealed that the student were heterogeneous (individualistic) in their responses.

In the case of research question 2, the out comes showed that as a matter of fact no method is considerably entirely bad. As long as other factors are present, learning took place.

For research question 3, comparing the performance of both groups, there was an overall increase in students' performance for the experimental group above students in the control group. The out come of research question 2 is evident. This result only showed the superiority of mathematical games over the well known traditional method of teaching. This superiority may have resulted from the

high level source of amusement inherent in games. Also most students are often willing to play games in their mathematics classes (Higgins, 1973) This finding also supported Azuka (2001) who said that mathematical games do lead to improved learning.

This explained why students in this category were willing to receive any mathematical information the game contained and hence their better performance. Standard deviation in the schools revealed that the groups were heterogeneous (individualistic) in their responses.

In research question 4, apart from the government approved private schools where the boys did better than the girls, the girls performance was better than that of boys in the other schools. Generally speaking girls had a total mean score of 28.5 while boys had a total mean score of 28.0. This result disagreed with such researchers as Becker (1991), Forgasz, Leder and Gardner (1999), Osakwe (1990), Okeke (1997) and so on, who concluded that mathematics is male domain. This finding rather has shown that gender does not affect mathematics achievement. Girls are just as capable as boys. One can deduce here that traditional teaching method is less effective.

Considering hypothesis 2, individual students in the control group had an improved performance. This means that traditional method cannot be totally condemned. This agreed with the claim that other factors such as parental influence (Lassa, 1976), students attitude (Aiken, 1970), emotional factors (Henderickson, 1974) and so on, can affect students performance in mathematics. Not only the teaching method is responsible for students' achievements. Hypothesis 3 revealed that from the pretest scores for both groups, the difference that existed between the scores was insignificant. The mean difference between the 2 groups also indicated that the students in the experimental group (29) did better than that in the control group (22.7). Games approach in teaching is superior. This must have been one of the reasons for the popularity of the use of mathematical games in the western world.

For hypothesis 4, the finding did not corroborate that of a number of researchers such as Forgasz, Leder and Gardner (1999), and Osakwe (1990), who said that boys do better than girls in mathematics achievement and participations. With this finding, girls can be encouraged to study mathematics without gender inferiority complex

Summary of findings

On the aspect of students' achievement in mathematics test, the major findings of the study revealed that the students taught with mathematics games performed better than those taught with traditional method. Mathematics teachers should therefore treat mathematical games as an important valid teaching and learning strategy.

For the boys and girls in the experimental group, the difference in their performance was not significant i.e girls were just as capable as boys in mathematics achievement.

From the analyses of the data, it is concluded that the students' taught with mathematical games performed better than those taught without mathematical games.

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Community Norms and Cultural Attitudes and Beliefs Factors Influencing Violence Against Women of Reproductive Age in Nigeria

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Abstract

This study examined the influence of men's right to control their wives' behaviour, discipline their wives by force, how dowry can escalate threat and violence, how bride wealth is synonymous to purchasing a wife and how female, chastity and male honour serve to justify violence among women of reproduction age in Nigeria. A total of 250 men and women from different professions were drawn randomly in Ibadan constituted the sample for the study. The three instruments used were author-constructed questionnaires with 0.69, 0.72, and 0.66 reliability coefficients respectively. The data obtained were analysed using multiple regression analysis. The results indicated that significant relationships existed between, men's right to control their wives' behaviour, discipline their wives by force, that bridewealth is synonymous to purchasing a wife, and that, female chastity and male honour serve to justify violence but not with dowry demand. The results therefore, indicate the need for those in the helping professions, the government, community leaders and non-governmental organizations to mount strategies towards putting an end to violence against women.

Introduction

Violence against women is the most pervasive yet least recognized human rights abuse in the world. It is also a profound social, psychological and health problems, sapping women's energy, compromising their physical health, and eroding their self-esteem. Despite its high costs, almost every society in the world has social institutions that legitimize, obscure, and deny abuse. The same acts that would be punished if directed at an employer, a neighbour, or an acquaintance often go unchallenged when man direct them at women, especially within the family.

For over two decades women's advocacy group around the world have been working to draw more attention to the physical, psychological and sexual abuse of women and to stress the need for action. They have provided abused women with shelter, lobbied for legal reforms, and challenged the widespread attitudes and beliefs that support violent behaviour against women (Heise, 1996).

Increasingly, these efforts are having results. Today, international institutions are speaking out against gender-based violence. Surveys and studies are collecting more information about the prevalence and nature of abuse. More organizations, service providers, and policy-makers are

recognizing that violence against women has serious adverse consequences for women's health and for society.

Review of Relevant Literature

In nearly 50 population-based surveys from around the world, 10% to over 50% of women report being hit or otherwise physically harmed by an intimate male partner at some point in their lives (Center for Health and Gender Equity (CHANGE), 1999). Physical violence in intimate relationships almost always is accompanied by psychological abuse and, in one-third to over one-half of cases, by sexual abuse (Koss, Goodman, Browne, Fitzgerald, Keita; and Russo, 1994; Leibrich, Paulin, and Ransom, 1995; Centre for Health and Gender Equity, (CHANGE), 1999; Campbell, and Soeken, 1999; and Ellsberg, Pena, Herrera, Liljestrand and Winkvist, 1999). For example, among 613 abused women in Japan, 57% had suffered all three types of abuse-physical, psychological, and sexual. Only 8% had experienced physical abuse only (Yoshihama and Sorenson, 1994).

Most women who suffer any physical aggression generally experience multiple acts over time. In the Leon study, for example, 60% of women abused in the previous year were abused more than once, and 20% experienced severe violence more than six times. Among women reporting any physical aggression, 70% reported severe abuse (Ellsberg, Pena, Herrera, Liljestrand and Winkvist, 1999). The average number of physical assaults in the previous year among currently abused women surveyed in London was seven (Mooney, 1998); in the U.S. in 1997, three (Olsson, Ellsberg, Berglund, Herrera, Zelaya and Persson, 1999). In Nigeria and indeed, the sub-Saharan Africa, violence against women lacks statistics and records mainly because both the perpetrators and victims neither* report the case to the law enforce agency for intervention, for the behaviour is considered a personal or family affairs.

Ending violence against women means changing the community norms and cultural altitudes and beliefs that give rise to men's abusive behaviour towards women and that permit it to persist. Changing community norms alone will not eliminate violence. Nevertheless, it is difficult to make progress until there is a consensus in society that violent behaviour is wrong.

A variety of norms and beliefs are particularly powerful in perpetrating violence against women. These include a belief that men are inherently superior to women, that men have a right to "correct" female behaviour, that hitting is an appropriate way to discipline women, that a man's honour is linked to a woman's sexual behaviour, and that family matters are private and it is inappropriate for others to intervene (Heise, 1998). Many cultures hold that men have the right to control their wives' behaviour and that women who challenge that right even by asking for household money or by expressing the needs of the children may be punished. In countries, as "different as Bangladesh, Cambodia, India, Mexico, Nigeria, Pakistan, Papua New Guinea, Tanzania, and Zimbabwe, studies find that violence is frequently viewed as physical chastisement - the husband's right to "correct" an erring wife (Bradley, 1985; Counts, Brown and Campbell, 1992; Jejeebhoy, 1998; Gonzalez, 1998; and Armstrong, 1998). As one husband said in a focus-group; discussion in Tamil-Nada, India, "if it is a great mistake then the husband is justified in beating his wife. Why not? A cow will not be obedient without beating" (Jejeebhoy, 1998).

In many developing countries, culturally, women share the notion that men have the right to discipline their wives by using force. In rural Egypt, for example, at least 80% of women say that beatings are justified under certain circumstances (El-Zanaty, Hussein, Shawky, Way, and Kishori, 1996; David and Chin, 1998; Bawah, Loaiza, Primante, Barberena, Blandon and Ellsberg, 1998). Not surprisingly, refusing sex is also one of the reasons woman cite most often as triggering beatings (National Sex and Reproductive Research Team and Jenkins, 1994; Zimmerman, 1995; Khan, Townsend, Sinha, and Lakhan-Pal, 1996; and Wood and Jewkes, 1997).

Even where culture itself grants men substantial control over female behaviour, abusive men generally exceed the norm (Romero, 1994; Johnson, 1996; and Rosales, Loaiza, Primante, Barberena, Blandon and Ellsberg, 1999). For example, data from the Nicaragua Demographic and Health Survey

(DHS) show that, among women who were abused physically, 32% had husbands who scored high on a scale of marital control compared with only 2% among women who were not abused physically. The scale included such behaviour as the husband's continually accusing his wife of being unfaithful and limiting her access to family and friends (Rosales, Loaiza, Primante, Simmons and Phillips, 1998).

In recent years, for example, dowry has become an expected part of the marriage transaction in some countries, with future husbands demanding ever-increasing dowry both before and after marriage. Dowry demands can escalate into harassment, threats, and abuse; in extreme cases the woman is killed or driven to suicide, freeing the husband to pursue another marriage and dowry (Schular, Hashemi, Riley and Akhter, 1996; Rao, 1997; and Jha, 1999). Elsewhere, husbands are expected to pay "bridewealth", to compensate the bride's family for the loss of labour in her natal home. In parts of Africa and Asia this exchange has likewise become commercialized, with inflated bridewealth leaving many men with the impression that they have "purchased" a wife. In a recent survey in the Eastern Cape Province of South Africa, 82% of women said it is culturally accepted that, if a man pays "Labola" (bride-wealth) for his wife, it means that he owns her. Some 72% of women themselves agreed with this statement (Jemkes, Penn-Kekara, Levin, Ratsaka and Schriebar, 1999).

Cultural attitudes toward female chastity and male honour also serve to justify violence against women and to exacerbate its consequences. In parts of Latin America and the Near East, a man's honour is often linked to the sexual purity of the women in his family. If a woman is "defiled" sexually - either through rape or by engaging voluntarily in sex outside marriage - she disgraces the family honour. For example, in some Arab societies the only way to "cleanse" the girl. A study of female homicide in Alexandria, Egypt found that 47% of all women killed were murdered by a relative after they had been raped (Graiton and Youssef, 1993). At a recent conference in Jordan, experts from six Arab countries estimated that at least several hundred Arab women die each year as a result of honour killing (Jehl, 1999).

Culture is neither static nor monolithic, however. Women's rights activists argue that communities must dismantle those aspects of culture that oppress women while preserving what is good. In the words of Ghanaian lawyer Rosemary Ofei-Aboagye, "A culture that teaches male mastery and domination over women must be altered" (Ofei-Aboagye, 1994). Although culture can aggravate women's vulnerability, it can also serve as a creative resource for intervention. Many traditional cultures have mechanisms - such as public shaming or community healing - that can be mobilized as resources to confront abuse. Activists from Canada's Yukon Territory, for example, have developed circle sentencing, an updated version of the traditional sanctioning, and healing practices of the Canadian aboriginal people. Within the "circle", crime victims, offenders, justice, and social service personnel, as well as community residents, listen to the victim's story and deliberate about how best to "restore justice" to the victim and the community. Sentencing often includes reparation, community service, jail time, treatment requirements, and community healing rituals (Match International Centre, 1994; Basemore and Griffiths, 1999).

Most research work on violence against women focused on the nature, prevalence and causes. It is therefore, not to the knowledge of the researcher that studies linking violence on women and community norms and cultural attitudes and beliefs has ever been conducted in Nigeria. It is against this background that this study becomes relevant in filling such missing gaps in our knowledge in the issue of community norms and cultural attitudes and beliefs in the prevention of violence against women in Nigeria.

The purpose of this study is to investigate the relationship of men's right to control their wives' behaviour, discipline their wives' by force, how dowry demand can escalate threat and violence, how bride wealth is synonymous to purchasing a wife, and how female chastity and male -honour, serve to justify violence to violence against women of reproductive age.

In order to achieve the purpose of this study, the following research questions were answered:

1. To what extent would men's right to control their wives' behaviour, discipline their wives by force, how dowry demand can escalate threat and violence, how bridewealth is synonymous

- to purchasing a wife, and how female chastity and male honour serve to justify violence when combined predict violence among women of reproductive age?
2. What is the relative contribution of the factors to the prediction?

Methodology Research Design

This study adopted a descriptive survey research design in which questionnaires were employed in collecting data from the respondents on the variables studied.

Sample

A total of two hundred and fifty (250) participants both men and women were randomly drawn from (i) officers of the Nigerian Police Force, Eleyele, Ibadan Force Headquarters, (31 male and 19 female officers); (ii) 50 professional Bankers, (21 men and 29 female) from five reputable banks in Ibadan; (iii) 50 Professional Teachers, (36 and 14 both from senior and junior secondary schools) in Ibadan; (iv) 50 officers of the Nigerian Army (41 male and 9 female officers) Odogbo Cantonment, Ibadan; (v) and 50 Nigerian Nurses (39 female and male) from University Teaching Hospital (UCH), Ibadan. The range of participants' age was between 32 and 50 years with a mean age of 37.4 years and standard deviation of 9.60. All the participants are married with a minimum of two and maximum of four children.

Instrumentation

The three instruments used in this study were - (i) Self-Responding Questionnaire on Marital Violence (SQMV), (ii) Community Norms Inventory (CNV), and (iii) Attitudinal Scale on Culture and Beliefs (ASCB). The three instruments were author-constructed.

The Self-Responding Questionnaire on Marital Violence (SQMV) measures the likely causes and consequences of marital violence. It has 25 items rated on a 4 point likert-type scale. The respondents are to indicate their degree of agreement with each item by ticking, Strongly Agreed (SA) = 4; Agreed (A) = 3; Disagreed (D) = 2; and Strongly Disagreed (SD) = 1. It has 0.69 and 0.72 as the internal consistency and revalidation reliability respectively.

Community Norms Inventory (CNI) measures men's right to control their wives behaviour, right to discipline their wives by force and see how female chastity and male honour serve to justify violence. It has 15 items with True and False response format. It has 0.72 as the internal consistency and a test-retest reliability of 0.77.

Attitudinal scale on Culture and Beliefs (ASCB) measures how dowry demand escalates threat and violence, how bridewealth is synonymous to wife purchasing and how culture aggravate women's vulnerability. It has 15 items response format anchored on Partly True to Very Untrue. The test-retest reliability of the scale was found to be 0.66 and 0.71 respectively.

All the three instruments were considered valid through the favourable comments of experts in psychometrics on the suitability of the items.

Procedure

The participants for the study were administered to three questionnaires with the assistance of two Guidance Counsellors. The collected questionnaires were scored and the data obtained from them were analysed to answer the research questions. On the whole, 250 copies of the questionnaires were distributed and returned fully filled, giving a return rate of 100%.

Data Analysis

The data collected were analysed using Multiple Regression Analysis to establish the relationship between men's right to Control their wives behaviour, discipline their wives by force, how dowry demand can escalate threat and violence, how bridewealth is synonymous to wife purchasing, and how female chastity and male honour serve to justify violence and violence among women of reproductive age.

Results Research Question 1:

Using a combination of the Independent variables to predict violence among women of productive age.

Table 1a: Regression analysis on sample data using a combination of independent variables to predict violence among women of reproductive age

Multiple R	= 0.4821
Multiple R-Square	= 0.2324
Adjusted R-Square	= 0.1021
Standard Errors	= 8.2143

Table 1b: Analysis of Variance

Analysis of Variance					
Sources of Variation i	Df	Sum of Square	Mean Square	F-ratio	P
Regression	10	1073.77	107.377	*	
Residual	240	2029.442	10.514	10.212	.05
Total	250	3166.219			

* Significant at 0.05 alpha level

Table 1(a & b) show that a combination of the five independent variables, men's right to control their wives' behaviour, discipline their wives by force, how dowry demand can escalate threat and violence, how bridewealth is synonymous to purchasing wife, and how female chastity and male honour serves to justify violence in predicting violence among woman of reproductive age gave a coefficient of multiple regression (R) of 0.4821, and multiple R square (R^2) of 0.2324 accounting for 23.2% of the variance of violence among women of reproductive age. Table (1b) also shows that the analysis produced the Fishers value F-ratio of 10.212 at 0.05 alpha level. The table further shows that F-ratio is significant which implies that the R^2 value is not due to chance.

Table 2: Testing the significance on Relative Contribution to the prediction of regression weight of independent variables

No.	Variable Description	STD. REG WT. (B)	SEB	Beta	T-Value	P-Value
1.	Men's right to control their wives' behaviour	2.330	0.469	0.075	4.959	05
2.	Men's right to discipline their wives by force	1.319	0.434	0.236	3.038	05
3.	How dowry demand can escalate threat and violence.	-0.647	0.673	-0.078	-0.961	NS
4.	How bridewealth is synonymous to purchasing a wife.	1.276	0.471	0.0271	2.712	05
5.	How female chastity and male honour serve to justify violence.	-1.449	6.336	0.0066	-3.851	05
6.	Constant	48.472	3.851	12.587	.000	

Table 2 shows for each independent variable, the standardize Regression Weight (B), the Standard Error Estimate (SEB), the Beta, the T-ratio and the level at which the T-ratio is significant. As indicated in the table, the T-ratio associated with four variables (Men's right to control their wives' behaviour, discipline their wives by force, have bridewealth is synonymous to purchasing a wife and how female chastity and male honour serve to justify violence) were significant at 0.05 alpha level.

The contribution of how dowry demand can escalate threat and violence to the prediction of violence among women of reproductive age was not significant.

Table 3: Inter-correlation between the Variables

No.	Variable Description	1	2	3	4	5
1.	Men's right to control their wives' behaviour.					
2.	Men's right to discipline their wives by force	** .732				
3.	How dowry can escalate threat and violence	** .242	* .180			
4.	How bridewealth is synonymous to purchasing a wife	** .321	** .599	** .272		
5.	How female chastity and male honour serve to justify violence	** .223	-.161	.126	** .243	

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

* Correlation is significant at 0.05 level (2-tailed)

Table 3 shows the intercorrelation coefficients between the independent variables and violence among women of reproductive age. Most of the correlations were significant at 0.05 alpha level. For instance, men's right to control their wives' behaviour, has $r = 0.23$, $P < .05$, men's right to discipline their wives by force has $r = 0.161$, $P < .05$; how dowry can escalate threat and violence has $r = 0.126$, $P > .05$; and how bridewealth is synonymous to purchasing a wife has $r = 0.243$, $p < .05$.

Discussion

The major goal of this study was to find out the influence of men's right to control their wives behaviour, discipline their wives by force, how dowry demand can escalate threat and violence, how bridewealth is synonymous to purchasing a wife, and how female chastity and male honour serve to justify violence on violence among women of reproductive age.

In Table 1 (a & b) the total influence of these factors on violence among women of reproductive age accounted for only 23.2% of the overall causes. This means that 76.8% of the factors responsible lie outside the findings of this study. Also, the observed F-ratio on Table 1 which is significant at 0.05 alpha level indicates that the effectiveness of the combined effects of the component variables in predicting violence among women could not be attributed to chance. The results also show that men's right to control their wives' behaviour is the most potent contributor to the prediction followed by how female chastity and male honour serve to justify violence, men's right to discipline their wives by force, and how bridewealth is synonymous to purchasing a wife in that order.

Men's right to control their wives' behaviour was shown to significantly relate to violence among women. This result agrees with Heise, (1998). This result is also in agreement with Bradley, (1985); Counts, Brown and Campbell, (1992); Zimmerman, (1995); Schuler, Hashemi, Riley and Akhter, (1996); Jejeebhoy (1998); Ozawkie and Hilbert, (1998); Michaud, (1998); Gonzalez, (1998); and Armstrong, (1998).

The result obtained in this study also showed that men's right to discipline their wives by force was a significant contributor to the prediction of violence among women. This result agrees with that El-Zandt, Hussein, Shawky, Way, and Kosher, (1996). Furthermore, the result from this study showed that bridewealth is synonymous to purchasing a wife. This result is consistent with the works of Jewkes, Penn-Keanu, Levin, Ratsaka and Schreiber, (1999), but at variance with the works of Romero (1994), Johnson (1996); Blandon and Ellsberg, (1999).

Female chastity and male honour that justified violence was considered significant in this study. This finding supports the work of Graitcer and Youssef (1993); and Jehl, (1999). Dowry demand which often escalate threat and violence was not found to significantly predict violence among women in this study. This result of this finding is at variance from the works of Schuler, Hashemi, Riley and Akhter, (1996); Rao, (1997); and Jha (1999).

Conclusion and Recommendations

Ending violence against women requires strategies coordinated among many sectors of society and at community and national levels. Agenda for change must include:

- empowering women and girls;
- raising the costs of abusers;
- providing for the needs of victims;
- coordinating institutional and individual responses;
- involving youth;
- increase women's access to and control over economic resources;
- increase access to education for women and girls;
- strengthen women in leadership and decision-making;
- eliminate laws that discriminate against women and children;
- increase women's access to health and social information and women's control over their own bodies; and
- improve women's self-esteem and sense of personal power.

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The Impact of Internet Banner Advertisements on University Students

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Abstract

This study explores the University of Sargodha, students' exposure to Internet banner advertisements and their impacts on them. Total 240 students (120 male and 120 female) are interviewed for the collection of data. The results reveal that all the respondents significantly use Internet frequently for a variety of purposes. The analysis of the students' exposure to Internet ads and their purchasing trends shows that Internet banner advertisements providing them complete information about the advertised product and also bring favorable change in their attitudes and purchasing behaviors. The findings shows that most of the users think that creative techniques use in Internet ads can play an effective role in promoting the Internet ads. The results further reveal that most of the users are of the view that Internet banner ads provide them complete information about the product, which ultimately lead to favorable attitude toward that brand. It is also observed that more than half of the users take measures to avoid the display of the Internet ads. The findings support the assumption that 'the more the users exposure to Internet ad, then the more their trend of the product.'

Significance

"Advertising is paid, non-personal communication form an identified sponsor using mass media to persuade or influence an audience" (Wells, Burnett and Moriarty, 2006). The advertising messages consist of a lot of variations which include publicity, public relations, product placement, sponsorship, underwriting, and sales promotion. Every possible effective medium is used to deliver these messages: television, radio, movies, magazines, newspapers, the Internet and billboards (www.wikipedia.com). The Internet and the www are receiving increasing media attention, especially from the trade press. Growth is so phenomenal that it is nearly impossible to monitor. Estimates of web users range from 9 to 35 million in the United States (Maddox and Mehta, 1997). The Internet is of course, the major interactive medium. The Internet and the www network of interconnected computers permit the electronic transfer of information, including advertising messages. Millions of people around the world have access to the Internet and to the www. Thousands of advertisers have turned to the Internet as a prospective medium for promoting their brands and transacting sales. The Internet and its www shall

provide a medium for the consumer both to interact with the marketer and to transact commercial exchanges (Shimp, 2002). Interactive advertising is defined as encompassing all media that enable the user (who no longer is a “receiver” in the traditional, passive model of communication) to control the amount or rate of information that she or he wishes to acquire from a commercial message. The user can choose to devote one second or 15 minutes to a message. He or she is, for all intents and purposes, involved in a “conversation” with the commercial message at a sub vocal level. A request for additional information occurs with the push of a button, the user and the source of commercial information are engaged in a give-and-take exchange of information-intercourse rather than transmission and reception (p.394). As interactivity is one of the major tools of web tool of web advertising that makes it different from traditional advertising. Heeter (1989) used six elements to define interactivity: (a) complexity of choice available, (b) the amount of users must extent, (c) the extent of responsiveness to the consumer, (d) the capacity of monitoring information use, (e) the ease of adding information, and (f) the potential to facilitate interpersonal communication. Steuer (1992) defined interactivity that “the extent to which users can participate in modifying the form and content of a mediated environment in real time” (Roehm & Haugtvedt, 1999).

The percentage of advertising on Internet is increasing tremendously day by day. Internet advertising revenues continue to accelerate at an unprecedented rate with a 36% increase for the first half of 2006. First six months of 2006 hits \$ 7.9 billion and Q2 (Quarter) exceeds \$ 4 billion. Q2 2006 revenues represent a 5.5 % increase over Q1 2006 (www.iab.net.com). Research suppliers were trying to find a measurement and evaluation approach that would provide marketers with the information they needed about customers. By 1996, advertisers were promoting websites using traditional media. Now, online advertising is a world of rich media. Banners pop up into their own browser windows, advertisements appear on screen before the page is finished downloading, advertising interrupts online games and other interactions, and images are beginning to resemble television commercials. Online advertising is quickly becoming more diverse as sites cater to more traditional advertisers’ and search for ways to better meet advertisers needs (www.ciadvertising.org).

As Internet is a new medium of modern age and people of different age use it for variety of purposes. The Internet has become the hot new market space. What is clear is that advertisers can no longer ignore this medium. Nearly 60% of the US population, or 165 million people, had Internet access at home as of July 2001. In the same way the growth rate of Internet users in Pakistan has reached to 12 million. The number has grown significantly in the last couple of years with the service providers moving beyond Islamabad, Lahore, and Karachi to reach of the country’s 166 million population (<http://www.app.com.pk>). Though Conventional advertising media have served advertisers needs for many years, but the reason why interactive advertising is superior to traditional media is, as it provides consumer with virtually full control over the commercial information they choose to receive or avoid (Shimp, 2002). Various commentators have claimed that the Internet as a communication’s medium is versatile than the other media and superior at targeting customers. Interactive advertising is less costly, and potentially more effective than the established media. Individualization and interactivity (the Internet’s two I s) are key features of the Internet and of advertising in that medium, whereas in traditional media there is action but no interaction. Whereas, action involves a flow in one direction, interaction entails reciprocal behavior. This idea of reciprocity generally defines the nature of the new interactive media (pp. 393-94).

Internet Banner Advertisements

Banner ads remain the predominant advertising vehicle on the web-accounting for approximately 54% of total online advertising revenues (<http://www.ciadvertising.org>). Banner ads have proven to be the most effective direct marketing tool, producing quantifiable units to which an advertiser can apply readable metrics and make real conclusions with the real numbers about the effectiveness of the campaign. Millward Brown Internationals study proves banner ads have significant and conclusively impact on brand awareness. Further findings also show that single exposure to a Web banner generates

great awareness than a single exposure to a TV or print ad (<http://www.ciadvertising.org>). Wang and Burns (2005), state that roughly 21 percent of the Internet users consider Internet advertising to be the most relevant ad format. The segment overtakes traditional media, such as newspapers, magazines, and radio. Metrics and behavioral targeting make the channel attractive. "Because the Internet is an interactive and versatile platform and offers rich consumer usage data, advertisers can improve their ad target ability and achieve better results" (<http://www.clickz.com>). Only interactive advertising lets an advertiser target and create a dialogue with the audience that matters to his brand on interests, demographics, behavior and psychographics. With 718 million people online worldwide, there is a clear shift in how and where consumers are interacting with media. This is coupled with the fact that consumers have usurped control over their media consumption- they want it when they want it, where they want it and how they want it. (www.iab.net.com).

Recently in consumer marketing the focus has shifted from creating brand loyalty through mass advertising and sales promotion programs towards developing one-to-one relationships. The more the marketers try to develop a relationship directly with their consumers; the better will be the response and commitment from consumers. The Internet will be expected as the ultimate interactive and relationship building medium for buyer-seller relationships (Falk, Schmidt and Esomar, 1997), (<http://www.ciadvertising.org>). The future of interactive advertising is about the convergence of data. Consumer will reduce the probability to see ads that promote or advertise the products which they do not need. Consumers can control what information is presented in front of them and how the information appears. Marketers will offer incentives to consumers in exchange for personal data and right to contact them in a very personal ways. Because consumers are not controlled anymore, advertisers and marketers cannot treat consumers like before. With the new technology developing, marketers may develop one-to-one marketing on the Internet in order to build customer loyalty. Interactive advertising over the web has several characteristic qualities that make it better. These qualities are: (a) targetability, (b) tracking, (c) deliverability and flexibility, (d) interactivity (<http://www.ciadvertising.org>).

Study defines global interactive advertising as cross-cultural marketing communications that are deliberately planned and executed to actively engage persons in advertising processing through interactivity as a part of overall localized, regionalized, or worldwide strategic communication efforts (Ko, and Roberts, 2001). Chen, et al. (2005) study investigated the effects of web site interactivity on consumers' trust in brands and product evaluations, and their subsequent purchase intentions in a multi-channel context. Results from the experiment indicated that through greater interactivity, individuals developed greater trust in the vendor and better understanding of its products. In general the direct response paradigm has become the yardstick of online advertising success due to the universal measurement. The study indicates that click-through is primarily a consequence of the brand building effect combined with a willingness to learn more about the specific brand as a result of an immediate need for a product or service of that type. Study compares the effectiveness of Internet advertisements (pop-ups), print advertisements (posters) and radio advertisements for an airline ticket and for a weekend stay at a hotel. The potential interactivity of online creates an environment where consumers feel more in control (Hollis, 2005, pp.255-68), (www.iabuk.net.com). The benefits of banner are evident, and even if computer users ignore entreaties to "click here" and read additional material to which the banner may be linked. That is significant because some advertisers, like the Procter & Gamble Company, are basing their payment for interactive ads only on click-through rate. A university of Chicago business school study shows that the lowly banner may be the most effective ad in helping retain customers, even better than email or pop-ups. It seems that customers find the banners much less intrusive than the other formats, and as a result react more efficiently to them for additional purchases. Non-customers, tend to be left cold by banners as a first means of communication (<http://www.marketing vox.com>).

It is claimed that more people notice and pay attention to the ad if it has animation, even if they don't click on it. They are more likely to click for more information if the animation is done in an effective way (emphasize what product is about). Even with the animation, an ad must have a strong,

well-crafted message and a clear call to action. The animation does not take the place of response-driven copy and a creative idea. (Business Marketing, 11/1/96). “Banner immunity” is creeping into mix- Customers under 30 and college educated are saying “no” to banner advertising techniques. If banner ads are not integrated into the site; they stick out like “sore digital” (www.wmo.com). “Banner advertising has fallen out of favor with some Web marketers who say it is expensive and ineffective. A new trend, they say, uses the interactive nature of their Web sites to create ongoing relationships with potential customers on the Internet”. This has led to Relationship Marketing: becoming a new buzzword in Internet promotion (Kansas City Business Journal, 3/14/97). Gong and Maddox (2003) study examines Chinese consumers’ perceptions and responses to web banner advertising. Results suggest that just one additional banner exposure improves Chinese user’s brand recall, changes their attitude toward the brand, and increases their purchase consideration.

Mullarkey and Danaher (2003) examine the factors that might impact on web advertising recall and recognition. These factors include the viewing mode, duration of page viewing, and web page context factors, including text and page background complexity and the style of the banner advertisement. The key finding is that the longer a person is exposed to a web page containing a banner advertisement, the more likely they are to remember that banner advertisement. Baltas (2003) considers the structure of advertising effectiveness on the Internet and investigates empirically the importance of creative and media factors for banner effectiveness. Econometric modeling of actual data on banner ads demonstrates that creative factors such as campaign length, number of host web sites, use of off-line media, and campaign cost, may influence the direct response of the target audience as measured by click-through rates. The results lead to important practical implications for Internet advertising. Yoo, Stout and Kim (2004) study attempts to examine the effects of animated banner ads, as well as the moderating effects of involvement, on each stage of the hierarchy of effects model. The results provide support for the notion that animated banner ads prompt better advertising effects than do static ads. Animated banner advertising has better attention-grabbing capabilities, and generates higher recall, more favorable ad, and higher click-through intention than static ads.

Lee and Millar’s (2006) study that showed the general attitude towards Internet advertising and the level of product involvement had a positive impact on users’ attitude (site and brand) and behavioral intention. Carr Jr, Brackett (2001) report on the findings of a survey about attitudes now, and predictions for the future, regarding web advertising versus other media, with college students as the target. College students’ present attitude toward web advertising is compared to the attitudes of people familiar with the web in Ducoffe’s 1996 study. Additionally, students predict that web advertising will overtake television advertising as the most valuable source of information for the future. Leggatt (2006) states that despite attitudes towards online advertising being more favorable than a few years ago, the number of people using ad blockers and spam filters has doubled since 2004. The Internet as a communication medium is still in its infancy stage in Pakistan, however, it is very appropriate for mainly urban based Pond’s consumers. This initiative was taken with a view to experiment and response was seen to be very encouraging. With the every-growing clutter of brands on popular media and increase in advertising cost, Internet advertising will play a key role in the future (see <http://www.map.org.pk>). That is why, the present study seeks to explore and analyze the extent of the attention the student users pay to interactive ads on the web with specific focus on the beneficial aspect of the said advertisements to student users. This study investigates the promotion of Internet advertisements by the creative techniques. The study further aims to explore, the impact of exposure to such advertisements on the student user’s purchasing behaviors and also to explore that relatively which type medium is more credible medium of advertising in students’ perspective.

Sampling Methods

Stratified sampling procedure was adopted for classification—subgroups of demographic characteristics—of the respondents. “Stratification is the process of grouping the members of a population into relatively homogeneous strata before sampling. This practice has the effect of

improving the representation of a sample by reducing the degree of sample error.” (Babbie 1992) Selltez, Wrightsman, Cook, (1976) explain that the degree of sample population is divided into two or more strata in stratified method. These strata may be based on a single criterion, for example, education--Masters and Bachelors, or on a combination of two or more criteria like age, sex, income and locations.

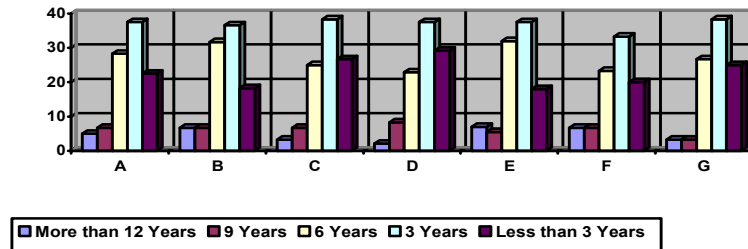
In the present study, this procedure generated population subgroups or stratification variables that are to be represented in the sample. This approach adequately organized the population into homogeneous subsets and selected various elements from each. Travers, (1978) asserts, “Major advantage of this procedure is that it increases accuracy.” For data collection purpose the 240 respondents were stratified on the basis of education. The teaching departments were selected carefully to assure equal representation of both Masters and Bachelors. 120 respondents from Masters and 120 from Bachelors Program were selected. The sample was further divided on the basis of gender—120 males and 120 females. The age range was further divided into two subgroups—19 to 25 years and 26 to 31 years. 12 students—6 males and 6 females—were interviewed from each discipline of the University of Sargodha.

For collection accurate data from the target population a well-planned questionnaire was developed in the line of lengthy discussion made with focus target groups. Constructing good survey questions involve two basic considerations: (a) the questions must clearly communicate the desired information to the respondents, and (b) the questions should be worded to allow accurate transmission of respondents’ answer to research (Wimmer and Dominick, 1983). Through deep contacts with the respondents, efforts were made to explore and estimate the effects process on three levels-cognitive, affective, and behavior-- of the study’s homogeneous subgroups. In this way an attempt was made to find out answers to the following major research questions:

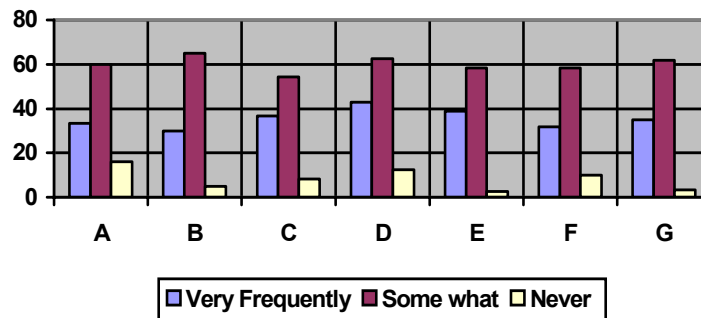
1. Whether the users are influenced by interactive advertisements on Web on the basis of gender.
2. Whether there is any difference between natural and social sciences students’ Internet using habits.
3. Whether interactive ads on Web influence attitude and behavior towards products available in Pakistan.
4. Whether there is any difference between male and female users’ Internet using habits.
5. Whether the creative techniques of interactive ads are playing an important role in promoting these ads.
6. Whether the credibility of ads is differentiated on the basis of medium that is TV, internet, radio, print and so on.

Findings

The Internet as a new appliance of information technology has pervasive in our lives as most integral part of culture. It is used for variety of purposes and most of the users spend reasonable amount of time on using the Net. The results of the study that how long the users using Internet illustrate that all types of students—overall, gender wise, natural versus social sciences, post graduates and under graduates—are those who significantly using the Internet for the last three or less than three years. It is further observed that somewhat users are using it for the last six years (fig. 1.1). The overall situation can be summarized that Internet is significantly used by the students in term of time spending habits.

Figure 1.1: Time of using Internet:

A Over all, B Male, C Female, D Natural Sciences, E Social Sciences, F post graduate, G under graduate

Figure 1.2: Familiarity with the types of Internet Advertisements

A Over all, B Male, C Female, D Natur.Science, E Soc. Sciences, F Post graduate G Und. graduate

One of the study's most focal areas is to explore users' watching habits of Internet Advertisements and their perceived perceptions about different ads showing on the screen. The results (fig. 1.2) reveal no significant difference between the users' somewhat habits of watching internet advertisements during their internet using timing (chatting, e-mail, surfing, and downloading). However, students of natural sciences gained more score on their exposure to the same very often during internet using time compared to the study's other focus groups.

The findings that often the users use Internet for variety of purposes (tab. 1.1) illustrate that overall and other sub groups of the study use Internet for chatting purpose but little difference is observed between the students of natural (29.1%) versus social sciences (45.8%) and masters (31.6 %) versus bachelors (46.7%) students using Internet for the same purpose. The findings further reveal that the overall and sub groups of the study significantly use Internet for e-mailing, surfing, and downloading purposes. However, the analytical comparison of the findings shows somewhat difference between the users Internet using habits for e-mail, and downloading purposes than using the same for surfing and chatting purposes.

Table 1.1: Internet using purposes

	Overall	Male	Female	Natural Sciences	Social Sciences	Masters Students	Bachelors Students
<u>Chatting</u>							
Very Often	39.2*	41.6	36.7	29.1	45.8	31.6	46.7
Some what	42.5	38.3	46.7	54.2	34.7	56.7	28.3
Never	18.3	20.0	16.6	16.7	19.4	11.7	25.0
<u>E-mail</u>							
Very often	67.4	70.0	65.0	68.7	66.6	68.3	66.7
Some what	25.1	21.6	28.3	18.7	29.2	35.0	25.0
Never	07.5	08.3	06.7	12.5	04.2	16.7	08.3
<u>Surfing</u>							
Very Often	53.3	48.4	58.4	58.3	50.0	60.0	46.6
Some what	24.2	28.3	20.0	14.6	30.7	21.6	26.7
Never	22.5	23.3	21.6	27.1	19.4	18.3	26.7
<u>Downloading</u>							
Very Often	76.7	76.6	76.7	81.2	73.0	71.7	81.7
Some what	18.3	15.0	21.7	10.4	23.0	21.6	15.0
Never	05.0	08.3	01.6	08.3	04.0	16.7	03.3
	n: 240	120	120	96	144	120	120

*: Figures in the table show percentages.

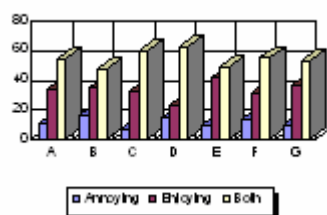
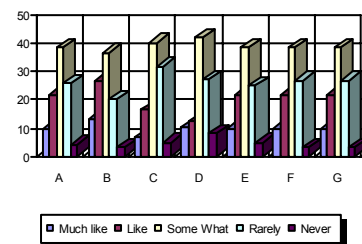
The details of the results of table 1.2 illustrate that all of the Internet users are very much familiar with the banner advertisement during their use of Internet. The analysis of the sub groups reveals some what difference between students of natural (62.5%) versus social sciences (51.4%), and master (46.6%) versus bachelor (65.0%) students. The findings further reveal that almost all users' are equally familiar with mini-windows ad, while little difference is observed between familiarity of the students of social sciences (50.0%) and natural sciences (38.0%).

In the view of the users' response to the question regarding their exposure to pop-up advertisement illustrate that overall and most of the sub groups equally familiar with it, but the students of natural sciences are somewhat (62.4%) significantly more familiar with the same compared to all other sub groups of the study. The results regarding the familiarity to superstitious ads illustrate that the users are significantly some what more familiar than their very much familiarity with the same. The results regarding floating ads reveal that there is also the same situation shown by the results of superstitious ads, here again overall and other sub groups are somewhat more familiar with the ads than their very much familiarity with same.

Table 1.2: Users' exposure to various type of Net advertisements

	Overall	Male	Female	Natural Sciences	Social Sciences	Masters Students	Bachelors Students
Banner Ads							
Very Much	55.8*	56.7	55.0	62.5	51.4	46.6	65.0
Some what	32.5	35.0	30.0	30.0	39.0	41.6	23.2
Never	11.7	08.3	15.0	14.6	09.7	11.7	11.6
Mini-Windows							
Very Much	45.0	41.7	48.3	38.0	50.0	48.3	41.7
Some what	42.5	45.0	40.0	47.0	39.0	36.7	48.3
Never	12.5	13.3	11.7	15.0	11.1	15.0	10.0
Pop-up Ads							
Very Much	54.2	51.6	56.7	62.4	48.6	51.6	56.7
Some what	38.3	38.3	38.3	29.2	44.4	38.4	38.3
Never	07.5	10.0	05.0	08.3	07.0	10.0	05.0
Superstitial Ads							
Very Much	27.5	26.6	28.3	22.9	30.5	30.0	25.0
Some what	48.3	48.3	48.3	43.8	51.3	46.7	50.0
Never	24.2	25.0	23.3	33.3	18.1	23.3	25.0
Floating Ads							
Very Much	33.3	31.6	35.0	25.0	38.8	35.0	31.7
Some what	50.0	50.0	50.0	54.2	47.2	43.3	56.6
Never	16.7	18.3	15.0	20.8	14.0	21.7	11.7
	N: 240	120	120	96	144	120	120

*: Figures in the table show percentages.

Figure 1.3: Perceptions about Net ads**Figure 1.4:** Liking Net ads

A overall B Male C Female D Natural Sciences E Social Sciences F postgraduate G undergraduate

Most of the viewers are of view that the frequency of appearing advertisements during Net use is both annoying and enjoining. The analysis further shows that majority of the users are those who enjoy the ads (fig. 1.3). The results of the study regarding the question that to what degree the respondents like internet ads reveal that majority of the respondents are those who somewhat or rarely like internet ads (Fig. 1.4).

As it is evident from the table 1.3 that overall and all other sub groups of the study are of the view that banner ad is very often displayed on a web page. The study results about the frequency of mini-windows displayed on a web page shows no significant difference between focus groups perceptions that the same is very frequently displayed on a web page.

Table 1.3: perceptions type of Ads displayed on a web page

	Overall	Male	Female	Natural Sciences	Social Sciences	Masters Students	Bachelors Students
<u>Banner Ads</u>							
Very frequent	63.3*	68.3	58.3	66.7	61.2	60.0	66.7
Some what	26.0	23.3	28.4	20.8	29.1	26.6	25.0
Never	10.8	08.3	13.3	12.5	09.7	13.3	08.3
<u>Mini-Windows</u>							
Very frequent	44.2	43.3	45.0	39.7	47.2	40.0	48.3
Some what	47.5	48.4	46.6	49.9	45.7	51.7	43.3
Never	8.3	08.3	08.3	10.4	07.0	08.3	08.3
<u>Pop-up Ads</u>							
Very frequent	54.3	60.0	48.3	60.4	50.0	46.7	61.7
Some what	34.1	28.3	40.0	23.0	41.7	38.3	30.0
Never	11.6	11.7	11.7	16.7	08.3	15.0	08.3
<u>Superstitial Ads</u>							
Very frequent	28.3	28.3	28.3	25.0	30.5	26.7	30.0
Some what	54.2	53.4	55.0	54.1	54.2	56.6	51.6
Never	17.5	18.3	16.7	15.2	16.7	18.3	
<u>Floating Ads</u>							
Very frequent	39.2	36.7	41.7	41.7	37.0	50.0	28.3
Some what	45.8	46.6	45.0	39.8	50.5	28.3	63.3
Never	15.0	16.7	13.3	18.0	12.5	21.7	08.3
	N: 240	120	120	96	144	120	120

*: Figures in the table show percentages.

The findings however, show somewhat difference between male (60.0%) and female (48.3%) and between postgraduate (46.7%) and undergraduate (61.7%) student's perceptions that pop-up ads very often displayed on a web page show. The result regarding frequency of superstitial ads displayed on a web page illustrate no significant difference and almost all the users believe that the same is more often displayed on web page. Results (table 1.3) regarding the frequency of floating ads, displayed on a web page depict the same position but here only the postgraduates (50.0%) are some what more of the view that floating ads often displayed on web page than the undergraduates (28.3%).

The empirical findings shown by table 1.4 regarding the liking of Internet banner advertisements reveal that most of the users like very much the banner ads but little difference is observed between the students of natural sciences (45.8%) and student social sciences (58.2%), and post graduates (48.3%) and under graduates (58.4%). Whereas, response about mini-windows liking illustrate all the users equally some what like the same, it is observed that students of natural sciences significantly (60.4%) some what like mini-windows ad compared to other sub groups of the study.

Table 1.4: Formats of Interactive Internet Advertisements liking:

	Overall	Male	Female	Natural Sciences	Social Sciences	Masters Students	Bachelors Students
<u>Banner Ads</u>							
Much Like	53.3*	56.7	50.0	45.8	58.2	48.3	58.4
Some what	31.7	30.0	33.4	35.4	29.1	33.4	30.0
Never	15.0	13.3	16.6	18.7	12.5	18.3	11.6
<u>Mini-Windows</u>							
Much Like	31.7	33.3	30.0	23.0	37.5	31.7	31.7
Some what	45.0	50.0	55.0	60.4	47.2	55.0	50.0
Never	15.8	16.7	15.0	16.7	15.2	13.3	18.3
<u>Pop-up Ads</u>							
Much Like	37.4	38.3	36.7	39.5	36.0	38.4	36.7
Some what	36.8	36.7	36.6	29.2	41.7	35.0	38.3
Never	25.8	25.0	26.7	31.2	22.2	26.0	25.0
<u>Superstitial Ads</u>							
Much Like	26.6	25.0	28.3	20.8	30.5	28.3	25.0
Some what	44.2	45.0	43.3	52.1	38.8	41.7	46.6
Never	29.2	30.0	28.3	27.1	30.5	30.0	28.3
<u>Floating Ads</u>							
Much Like	31.7	21.7	41.7	37.5	37.5	31.6	31.6
Some what	46.7	53.3	40.0	45.8	45.8	43.4	50.0
Never	21.6	25.0	18.3	16.7	16.7	25.0	18.3
	N: 240	120	120	96	144	120	120

*: Figures in the table show percentages.

The users' response about liking of pop-up and superstitial advertisements reveals no significant difference between their perceived perceptions about liking the same advertisements on the Net. The same picture is also depicted in the users' response to the extent of liking Floating ads but here only female students somewhat more like (41.7%) the same than the sub groups of the study.

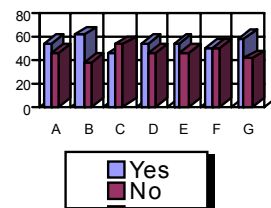
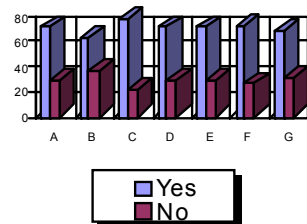
The users' response to the question that how much they feel annoying when advertisements display during the Net using timing, reveals no significant difference and almost all the users that the same very much or some what annoying them (table 1.5). The results further illustrate that almost all overall and sub groups of the Net users also feel annoying during display of mini- windows and pop-up advertisements, but the under graduates are significantly (60%) more of the view that the displaying of pop-up advertisements are annoying them compared to the perceptions about the same of other sub groups. The users perceived perception about the display of superstitial and floating advertisements mostly depict the same position shown by the findings regarding mini-windows and pop-up advertisements, but again the under graduates are more (63%) of the view that the display of floating advertisement is annoying them than the perceived perceptions of other sub groups about the same.

Table 1.5: Formats of Interactive Internet Advertisements annoying

	Overall	Male	Female	Natural Sciences	Social Sciences	Masters Students	Bachelors Students
Banner Ads							
Very Much	29.2*	36.7	21.6	25.0	31.9	28.3	30.0
Some what	49.2	48.3	50.0	48.0	49.9	45.0	53.3
Never	21.6	15.0	28.3	27.1	18.1	26.7	16.7
Mini-Windows							
Very Much	39.2	38.4	40.0	33.3	43.0	33.4	45.0
Some what	45.0	43.3	46.6	47.9	43.0	48.3	41.7
Never	15.8	18.3	13.3	18.7	13.9	18.3	13.3
Pop-up Ads							
Very Much	50.0	51.7	48.3	56.2	45.8	40.0	60.0
Some what	40.8	43.3	38.4	35.4	44.4	46.7	35.0
Never	09.2	05.0	13.3	08.3	09.7	13.3	05.0
Superstitial Ads							
Very Much	30.0	23.3	36.7	29.2	30.6	38.3	21.6
Some what	54.1	60.0	48.3	56.3	52.7	45.0	63.3
Never	15.8	16.7	15.0	14.5	16.7	16.7	15.0
Floating Ads							
Very Much	30.0	26.7	33.4	25.0	33.3	38.3	21.6
Some what	44.1	48.3	39.9	47.9	41.7	36.7	51.7
Never	25.8	25.0	26.7	27.1	25.0	25.0	26.7
	N: 240	120	120	96	144	120	120

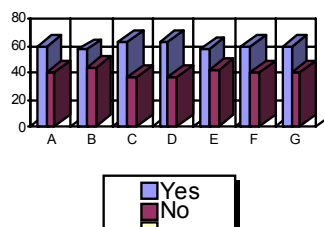
*: Figures in the table show percentages.

Measures to avoid Internet Advertisements

Figure 1.5: Ad Blockers**Figure 1.6:** Close Mini-sites

A Over all, B Male, C Female, D Natural Sciences, E Social Sciences, F post graduates, G under graduates

Figure 1.5 shows the users' response to the question that do they prefer to take measures to avoid the frequency of internet advertisements displaying. Slightly more than half of them yes they take measure to avoid the display of the same, while some of them don't need to take measure in order to avoid the display of the same. In the continuation of the another the users' response to the question that do they close mini-site to avoid the display of advertisements. The figure 1.6 shows that majority of them close the mini-site to avoid the display of advertisements.

Figure 1.7: To be Inattentive

A Over all, B Male, C Female, D Natural Sciences, E Social Sciences, F post graduates, G under graduates.

Figure 1.7 shows the users another measure to avoid internet ads. As evident from the findings that more than half of the users more likely show their inattentiveness to avoid the display of advertisement during the Net using time.

Table 1.6: Effects of Internet Advertisements

	Overall	Male	Female	Natural Sciences	Social Sciences	Masters Students	Bachelors Students
Information	70.0*	71.6	68.3	64.5	73.6	65.0	75.0
Curiosity	21.6	21.6	21.6	27.1	20.8	30.0	16.7
Change attitude	25.8	33.3	18.3	29.1	23.6	30.0	21.7
Waste of time	25.8	23.3	28.3	27.1	25.0	26.7	25.0
	N: 240	120	120	96	144	120	120

*: Figures in the table show percentages.

Responses to the question ask about the effects taken from internet advertisements are shown in table 1.6. The findings reveal that that almost all users. The results further that the users are not so much clear that the Net advertisements can play an effective role their curiosity bring about change in attitude and waste of time.

Figure 1.8: Techniques promoting Internet Advertisements

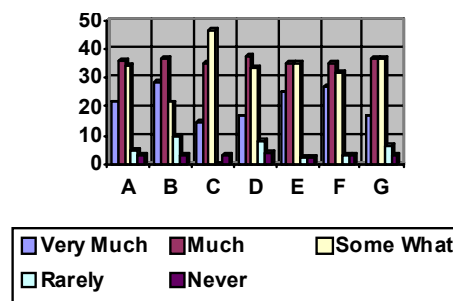
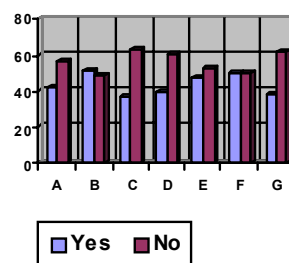


Figure 1.9: Click rate of Internet Banner ads



A Over all, B Male, C Female, D Natural Sciences, E Social Sciences, F= post graduates, G under graduates

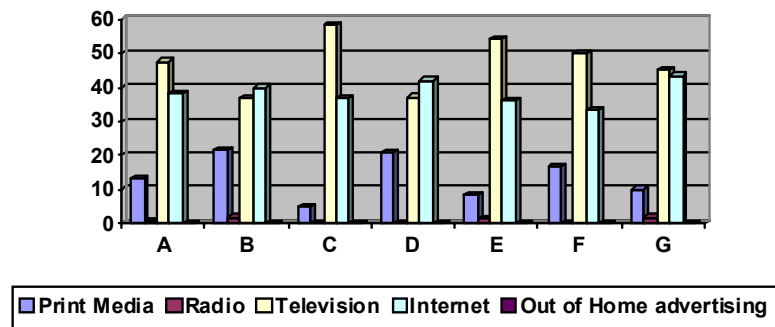
The figure 1.8 shows that majority of the users are of the view that creative techniques use can play an effective role in promoting the Internet advertisements. In response to question asked from the respondents that they “click” Internet banner ad when they see it on a web page, as from the (figure 1.9) it is clear that more than half of the users “click” on the Internet banner ad and go for further details.

Table 1.7: Effects of Internet Banner ads

	Over all	Male	Female	Natural Sciences	Social Sciences	Masters Students	Bachelors Students
Appearance							
Very Often	56.7*	63.3	50.0	50.0	61.0	55.0	58.4
Some what	38.3	30.0	46.7	45.8	33.4	38.3	38.3
Never	05.0	06.7	03.3	04.2	05.5	06.7	03.3
Techniques							
Very Often	45.0	53.4	36.6	43.7	45.8	41.7	48.3
Some what	48.4	36.6	60.0	50.0	47.2	50.0	46.6
Never	06.6	10.0	03.3	06.2	07.0	08.3	05.0
Message Display							
Very Often	48.4	45.0	51.7	54.2	44.5	51.6	45.0
Some what	45.0	51.7	38.3	41.6	47.2	41.7	48.3
Never	06.6	03.3	10.0	04.2	08.3	06.7	06.7
	N: 240	120	120	96	144	120	120

*: Figures in the table show percentages.

In response to one another research question that to what extent the appearance of banner ads positively effect, most of the users are of the view that the same is very often positively effect them, however, male users, students of social sciences, and under graduates little more of the opinion that that the same ad appearance effect them very often (table 1.7). The results further reveal no significant difference between the users' perceptions about using various techniques of the ad and the display of message about any advertised product.

Figure 1.10: Rating of Advertising sources

A Over all, B Male, C Female, D Natural Sciences, E Social Sciences, F post graduates, G under graduates

The users' perceptions about the most credible advertising medium illustrate that significant majority of the users are of the view that television and the Net are first and second most credible source of advertising compared to other type of advertising sources respectively.

Internet Banner ad. The over all responses to the question asked about the information provided by an Internet banner ad give us a view that over all 50.8% students has given positive response and 49.2% say no. There is significant different in case of males and females respondents. 55% male give a positive response whereas, 45% are not in this favor. The responses of female are also notable, as 46.7% females show a positive response and 53.3% say "no" in their answers. The percentage of the students of natural sciences who responses positively is 44% and 56% say "no", and 55% of the students of social sciences say that Internet banner ad gives complete information and 44.4% are not in the favor. Further, the students are also divided in masters and bachelors category. 55% masters' students say "yes" to the question and 45% say "no". Bachelors' students replied with 46.7% in the favor and 53.3% say that Internet banner ad does not give complete information about the advertised

product. This condition extend strong support to our research hypothesis that 'the more the detail information provide by Internet banner ad, then the more the likelihood of favorable users' attitudes.'

Favorable Change in Attitude. In the continuation of the above question, further it is asked by the respondents that the same Internet banner ad brings a favorable change in attitude. 70.5% percent respondents are agree with this and 29.5% respondents say that there is no change in their attitude. So 78.8% male respondents' response positive and 21.5% say "no" in their reply. In the case of female respondents, 60.7% say "yes" and 39.2% are not in the favor of the question. The responses of the students of natural sciences is notable, as 67% of the students respond positively and 27.5% are of the view that banner ad gives information but does not bring a change in the attitude. In the same way, 72.5% students of social sciences are strongly of the view that banner ad brings a change in the attitude and 27.5% say "no" in their answers.

Buy that Product. In the last part of the question finally, it is asked by the students, that if Internet banner ad gives them complete information about the advertised product and also bring a favorable change in their attitude, then they buy that product. The responses are notable as 48.4% male say that they buy that product and 51.5% say "no" in their answers. Whereas, the percentage of female is less in the favor of response to the question 35.7% say "yes" and 64.2% say "no" in their answers. This situation supported the research hypothesis that 'the more the users exposure to Internet ad, then the more their trend of the product.'

Summary & Discussion

This study was designed to explore and document respondents' exposure to Internet banner advertisements and their impacts on them. Keeping in view the degree of difference among the subgroups of the users documented responses, it can be summarized that all the respondents significantly frequently used Internet for a variety of purposes. The analysis of the students' exposure to Internet ads and their purchasing trends showed that Internet banner advertisements providing them complete information about the advertised product and also brought favorable change in their attitude and then purchasing behavior of that product. This position not only extended support to the research hypothesis that 'the more the users exposure to internet advertisements, then the more their purchasing trend of the product available on the ad, but also to the view point of Gong & Maddox (2003) that one additional banner exposure improves Chinese user's brand recall, changes their attitude toward the brand, and increases their purchase consideration (Cited at: www.warc.edu.com).

The analysis of the results showed that most of the users were of the view that creative techniques used in Internet advertisements can play an effective role in promoting the Internet advertisements (see figure 1.8). This situation extended support to another research hypothesis that 'the more the attractive techniques used in internet ads 'then the more the grabbing capabilities for users' attention.' This condition is in line with Yoo, Stout & Kim (2004) that animated banner ads prompt better advertising effects than do static ads. Animated banner advertising has better attention-grabbing capabilities, and generates higher recall, more favorable ad, and higher click-through intention than static ads (Cited at: www.warc.edu.com), and also ZD Net study's result, that more people notice and pay attention to the ad if it has animation, even if they don't click on it. They are more likely to click for more information if the animation is done in an effective way (emphasize what product is about). Even with the animation, an ad must have a strong, well-crafted message and a clear call to action (Cited at www.wmo.com).

The findings of the study strongly supported the research hypothesis that 'the more the detail Internet banner ads has regarding the product or services, then more likelihood of users favorable attitude.' The analytical review of the results further showed that significant majority of respondents agreed that Internet banner advertisement gave them complete information about the product, which ultimately led to favorable attitude toward that brand. This condition is in the line with Lee and Millar's (2006) view point that general attitude towards Internet advertising and the level of product involvement had a positive impact on users' attitude (site and brand) and behavioral intention. The

results also showed that the extent to which users perceive a corporate website is customized from information derived from their individual-level differences and is influenced by their general attitude towards internet advertising and level of involvement.(Cited at www.inderscience.com).

The analysis of the users response towards the questions that if the Internet advertisements were annoying then did they take any measure to avoid them, showed that more than half of them said “yes” they took measures to avoid the display of the Internet ads, while some of them did not need to take measures in order to avoid the display of the annoying Internet advertisements (see figure 1.5). This position extended not only support to research hypothesis that ‘the more the users find Internet ads annoying, then more likely they will take measures to avoid them’ but also support the view point of Leggatt (2006) that despite attitudes towards online advertising being more favorable than a few years ago, the number of people using ad blockers and spam filters has doubled since 2004. The report of Forrester Research also showed that the sheer prevalence of online ads is enough to disrupt a trawl round the internet, and some pop ups have become as crafty and impossible to clear as to be positively distracting. This has undoubtedly driven the rise in use of ad blockers and spam filters, especially amongst broadband users (81 percent). Consumers cite clutter, interruption and irrelevance as the key reasons for their frustration stated the report (Cited at: www.bizreport.com).

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Mathematical Formulation of Poverty Index

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Abstract

There are people with different economic levels in any society in the world. The economic range will vary from household to household, society to society and from country to country. The economic level of a household will depend on the income and the inherent wealth of that family. This implies that once the household income drops below an acceptable level (depending on the country), then that family can be considered as poor. Obviously, the definition of “poor” would vary from country to country. A person/family considered “poor” in a developed country like USA or U.K. may not be poor in an underdeveloped country. The ideal situation is to eradicate poverty completely. While this is not possible, the aim should be at least reduce the poverty. For this it is important to first define the human poverty index or simply poverty index. This paper suggests a simple and new model different than the existing models. The model is then validated using some of the data from U.S. Census Bureau (2006) and data from Health & Human Services (2007). Application of optimization principles to poverty index has also been illustrated.

1. Introduction

As stated earlier, the definition of “poor” is not uniform. It changes from country to country. For a reasonable comparison, an indicator such as human poverty index or simply poverty index can be used.

The poverty index can be considered as an indicator of the standard of living in a country. It changes from country to country.

Quantification of poverty index is a complex issue. This is because it is a function of so many parameters. United Nations has generated a document to define HPI (human poverty index). It is expressed in terms of three factors P_1 , P_2 , and P_3 as follows:

$$HPI = \left[\frac{1}{3} (P_1^\alpha + P_2^\alpha + P_3^\alpha) \right]^{1/\alpha} \quad (1)$$

Where, P_1 = probability at birth of not surviving to age 40

P_2 = adult illiteracy rate

P_3 = unweighted average of population without sustainable access to an improved water source and children under weight for age

α = 3

This formulation, in the opinion of this author doesn't represent realistically the poverty index. It misses important factors such as the economy of the household and the family size while it includes unimportant factors such as illiteracy rate and sustainable access to improved water source and children under weight.

It can be argued that since literacy is directly connected to the economic level of a household and hence illiteracy is connected to poverty. On the other hand, it is difficult to justify the connection of human poverty index to sustainable access to an improved water source.

Similarly, there are some other definitions of poverty index given in the literature (Bhattacharya et al., 1991; Krishnaswamy, 1990; India, 2003).

For example, Gini coefficient has been suggested by Bhattacharya et al. (1991) connecting the mean income and population size.

It is given as follows:

$$G(y) = 1 + (1/n) - (2/nz) \sum_{i=1}^n (n+1-i) y_i \quad (2)$$

Where, $G(y)$ = Gini coefficient

z = mean income

n = population size

But, none of these models existing in the literature catch the essence of poverty index for families of different sizes. Some of the work reported literature in this respect connects the poverty level to the prices of the commodities like sugar and rice.

It is to be noted that these are indirect parameters that effect the poverty level.

Further, the equation suggested by United Nations is a non-linear equation not very easy to use.

Hence a need for new formulation of poverty index.

2. Description of new model

$$PI = k f/e \quad (3)$$

Where, PI = poverty index

e = economic level (family income)

f = family size

k = constant of proportionality

The above relation is based on the inherent realistic assumption that PI is inversely proportional to economy level (e) or family income and directly proportional to the family size (f).

Derivation of the formula for new model is given below:

$$PI \propto 1/e \quad (4)$$

$$PI \propto f \quad (5)$$

From the above, one can write the following equalities:

$$PI = k_1/e \quad (6)$$

$$PI = k_2 f \quad (7)$$

Combining the above two equations,

$$PI = k f/e \quad (8)$$

$$\text{Where, } k = k_1 k_2 \quad (9)$$

In here k_1 and k_2 are the constant of proportionalities connected with family income (e) and family size (f). k is the combined constant of proportionality.

It is to be noted that Eq.8 is the same equation as Eq.3.

The constant of proportionalities can be evaluated based on the actual data. The data for family size and median family income can be either in terms of median or mean value.

It can be said that this is a simple but realistic approach to calculate the poverty index. It is to be noted that eq.2 for calculation of poverty index is simple to use even though non-linear in nature.

3. Validation of the new model

The above model (shown in eq.2) can be validated using the actual data existing in the literature.

Table 1: Median Family Income in the past 12 months is given below by family size:

State	Median Income Estimate ⁺	Margin of Error
Alabama	\$49,207	+/- 747
Alaska	\$69,872	+/-2,371
Arizona	\$55,709	+/-646
Arkansas	\$45,093	+/-813
California	\$64,563	+/-413
Colorado	\$64,563	+/-524
Connecticut	\$78,154	+/-951
Colorado	\$64,614	+/-975
Delaware	\$62,623	+/-2217
District of Columbia	\$61,015	+/-4029
Florida	\$54,445	+/-402
Georgia	\$56,112	+/-609
Hawaii	\$70,277	+/-1454
Idaho	\$51,640	+/-1028
Illinois	\$63,121	+/-529
Indiana	\$55,781	+/-459
Iowa	\$55,735	+/-577
Kansas	\$56,857	+/-698
Kentucky	\$48,726	+/-682
Louisiana	\$48,261	+/-794
Maine	\$52,793	+/-973
Maryland	\$77,839	+/-851
Massachusetts	\$74,463	+/-753
Michigan	\$57,996	+/-535
Minnesota	\$66,809	+/-485
Mississippi	\$42,805	+/-1,008
Missouri	\$53,026	+/-561
Montana	\$51,006	+/-829
Nebraska	\$56,940	+/-649
Nevada	\$61,466	+/-837
New Hampshire	\$71,176	+/-1,111
New Jersey	\$77,875	+/-649
New Mexico	\$48,199	+/-1,132
New York	\$62,138	+/-364
North Carolina	\$52,336	+/-481
North Dakota	\$55,385	+/-1,467
Ohio	\$56,148	+/-388
Oklahoma	\$47,955	+/-776
Oregon	\$55,923	+/-757
Pennsylvania	\$58,148	+/-361
Rhode Island	\$64,733	+/-1,971
South Carolina	\$50,334	+/-657
South Dakota	\$53,806	+/-936
Tennessee	\$49,804	+/-564
Texas	\$52,355	+/-275
Utah	\$58,141	+/-835
Vermont	\$58,163	+/-1,411
Virginia	\$66,886	+/-623
Washington	\$63,705	+/-650
West Virginia	\$44,012	+/-823
Wisconsin	\$60,634	+/-462
Wyoming	\$57,505	+/-1,708
Puerto Rico	\$20,425	+/-414

4. Analysis of data

Using the values tabulated in Table 1, the poverty index can be calculated from the following equation, derived from Eq.6. This is given as,

$$PI = \{k_1 k_2 (f/e)\} \quad (10)$$

HHS (2007) gives poverty guidelines. These are given in Table 2 below.

Table 2: 2007 HHS Poverty Guidelines

Persons	48 Contiguous		
In family or household	States and D.C.	Alaska	Hawaii
1	\$10,210	\$12,770	\$11,750
2	\$13,690	\$17,120	\$15,750
3	\$17,170	\$21,470	\$15,750
4	\$20,650	\$25,820	\$23,750
5	\$24,130	\$30,170	\$27,750
6	\$27,610	\$34,520	\$31,750
7	\$31,090	\$38,870	\$35,750
8	\$34,570	\$43,220	\$39,750

The e values are obtained from Table 1 for each of the states in USA. That includes 48 contiguous States and D.C. and the states of Alaska and Hawaii. The k_1 values can be obtained from Table 2 for the corresponding state. There exists no specific data for the median family size like the median family income tabulated in Table 1. The indirectly derived median family size as per the existing data existing in literature is found to be 4.5. This implies that 50% population has family size more than 4.5 and 50% less. As this number seems to be high, a median family size is taken as 2 ($k_2 f=2$) for calculation of poverty index. $K f$ represents the modified value of actual f using the constant of proportionality.

5. Application of Optimization principles to poverty index

To get an optimal value of poverty index, one can apply the principles of NLPP (Nonlinear Programming problem) to Eq. 8 which is a non-linear equation.

A Non-linear Programming problem (NLPP) can be solved by successive linearization of the linear Programming problem (LPP). There are several techniques available for solving LPP problems for standard and non-standard LPP (Hillier and Lieberman, 2000; Putcha, 2007).

Alternatively, one can use the principles of Lagrange Multiplier (Revelle et al., 2004) to get an initial optimal value of Poverty index. Then, the value of the poverty index can be refined by standard techniques of NLPP.

Lagrange formulation:

For this the optimization problem can be formulated as follows:

$$\text{Minimize } p = k_1 k_2 f/e \quad (10)$$

$$\text{s.t. } f \leq 8 \quad (11)$$

$$e \geq 13690 \quad (12)$$

The numbers 2 and 8 have been picked based on HSS(2007).

The corresponding Lagrange function L can be written as,

$$L = p + \lambda_1 (f-8) + \lambda_2 (e-13690) \quad (13)$$

The solution of the above optimization problem can be found by the solution of simultaneous equations obtained by taking partial derivatives of EQ. 13 with respect to p , e , λ_1 and λ_2 . This will give optimal values of poverty index as well as optimal values of the family income (e) and the family size for the minimum poverty index.

6. Results

The poverty indices are tabulated in Table 3 below for various states.

Table 3: Poverty indices for various states in USA

State	Poverty index
Alabama	0.55
Alaska	0.49
Arizona	0.49
Arkansas	0.60
California	0.42
Colorado	0.42
Connecticut	0.35
Delaware	0.43
District of Columbia	0.44
Florida	0.50
Georgia	0.48
Hawaii	0.44
Idaho	0.53
Illinois	0.43
Indiana	0.49
Iowa	0.49
Kansas	0.48
Kentucky	0.56
Louisiana	0.56
Maine	0.51
Maryland	0.35
Massachusetts	0.36
Michigan	0.47
Minnesota	0.40
Mississippi	0.62
Missouri	0.52
Montana	0.53
Nebraska	0.48
Nevada	0.44
New Hampshire	0.38
New Mexico	0.56
New York	0.44
North Carolina	0.52
North Dakota	0.49
Ohio	0.48
Oklahoma	0.57
Oregon	0.48
Pennsylvania	0.47
Rhode Island	0.42
South Carolina	0.50
South Dakota	0.54
Tennessee	0.54
Texas	0.52
Utah	0.47
Vermont	0.47
Virginia	0.40
Washington	0.42
West Virginia	0.62
Wisconsin	0.45
Wyoming	0.47
Puerto Rico	1.34

7. Conclusions

Poverty indices have been calculated for various states in general using the new model.

It has been found that the poorest state is Puerto Rico, followed by West Virginia based on the poverty indices.

The model suggested is a robust and general model and can be used to determine the poverty indices in other countries in the world with out any loss of generality even though it has been used to study the poverty level in various states in USA in this study.

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U.S. and Japanese Electronic and Electrical Equipment Manufacturing Firms: A Comparison

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Abstract

In this study, we compare the financial characteristics of U.S. and Japanese electronic and electrical equipment manufacturing firms using the Multivariate Analysis of Variance (MANOVA) method with data drawn from the DISCLOSURE database for the December 31, 2001-December 31, 2005 period. The multivariate test statistics indicate that the overall financial characteristics of U.S. and Japanese firms are significantly different. The univariate test statistics show that U.S. firms have significantly higher inventory turnover, whereas Japanese firms have significantly higher total assets turnover. U.S. firms have significantly higher liquidity and equity levels. These results imply that Japanese firms have significantly higher liquidity risk and financial risk compared with U.S. firms. The profitability ratios of firms in the two countries are not significantly different.

Keywords: U.S. and Japanese Electronic/Electrical Equipment Manufacturing Firms, Financial Characteristics, MANOVA

JEL Classification Codes: F36, G30, L60, M10

1. Introduction

Comparing the financial characteristics of firms in different countries has become a popular research topic. Meric and Meric (1994) compare the general financial characteristics of U.S. and Japanese manufacturing firms. Meric, Ross, Weidman, and Meric (1997) compare the financial characteristics of U.S. and Japanese chemical firms. Meric, Weidman, Welsh, and Meric (2002) compare the financial characteristics of U.S., EU, and Japanese manufacturing firms. Meric, Gishlick, McCall, and Meric (2003) compare the financial characteristics of U.S. and Canadian manufacturing firms. The objective of this study is to compare the financial characteristics of U.S. and Japanese electronic and electrical equipment manufacturing firms.

Japan is a major trading partner of the U.S. U.S. exports to Japan have increased from \$53 billion in 1994 to \$55.4 billion in 2005. During the same period, Japanese exports to the U.S. have increased from \$119 billion in 1994 to \$138 billion in 2005. There is fierce competition between U.S. firms and Japanese firms to capture a greater market share in each other's local markets and in the

world's other markets. Knowing how the financial characteristics of U.S. firms and Japanese firms compare would be helpful to corporate managers in managerial decision making. Financial ratios can be a useful tool in determining the financial strengths and weaknesses of firms. This study compares the financial characteristics of U.S. and Japanese electronic and electrical equipment manufacturing firms with eight widely used financial ratios.

U.S. investors have substantial portfolio investments in the Japanese stock market. During the last ten years, the amount of U.S. stock investments in Japan has increased from \$71.7 billion in 1994 to \$214 billion in 2004. Knowing how the financial characteristics of U.S. firms and Japanese firms compare would be helpful in global investment decision making. This study provides useful information to global investors about the comparative financial characteristics of U.S. and Japanese electronic and electrical equipment manufacturing firms in terms of liquidity, asset management, financial leverage, profitability, and risk.

2. Data and Methodology

The data for the study were drawn from the DISCLOSURE database in July 2006. The research sample includes 203 U.S. firms and 135 Japanese firms from the electronic and electrical equipment manufacturing industry (SIC 36) with no missing financial information for the December 31, 2001-December 31, 2005 period.

A study by Brown, Soybel, and Stickney (1993) concludes that alternative accounting principles do not seriously distort the comparability of U.S. and Japanese financial statement data. The financial characteristics of U.S. and Japanese firms are compared by using eight well-known financial ratios. Financial ratio values may fluctuate from one year to the next. Financial ratios computed with data for a single year may be influenced by some temporary unusual circumstances occurring in that year and may not represent the true long-term financial characteristics of firms. Therefore, financial ratios used in this study are 5-year averages for the December 31, 2001-December 31, 2005 period computed with data from the year-end financial statements of the firms. The financial ratios used in the comparisons are presented in Table 1.

Using financial ratios to compare the financial characteristics of different groups of firms has long been a widely used research methodology in finance. A number of studies use financial ratios to compare the financial characteristics of bankrupt and non-bankrupt firms [see, e.g., Altman (1968) and Deakin (1972)]. Some studies use financial ratios to compare the financial characteristics of firms which have been take-over targets with the financial characteristics of firms which have not been take-over targets [see, e.g., Rege (1984) and Meric, Leveen, and Meric (1991)]. A study compares the financial characteristics of UK listed and unlisted companies [see: Hutchinson, Meric, and Meric (1988)].

Multiple Discriminant Analysis (MDA) and Multivariate Analysis of Variance (MANOVA) are the two multivariate statistical techniques most widely used in previous studies to compare the financial characteristics of different groups of firms with financial ratios. The MANOVA technique is used in this study to compare the financial characteristics of U.S. and Japanese electronic and electrical equipment manufacturing firms.

Table 1: Financial Ratios Used in the Study

Financial Ratio Name	Financial Ratio Definition*
<i>Liquidity</i>	
Current Ratio (CUR)	Current Assets/Current Liabilities
Quick Ratio (QUR)	(Current Assets - Inventories)/Current Liabilities
<i>Turnover</i>	
Inventory Turnover (ITR)	Sales/Inventory
Total Assets Turnover (TAT)	Sales/Total Assets
<i>Financial Leverage</i>	
Equity Ratio (EQR)	Common Equity/Total Assets
<i>Profitability</i>	
Net Profit Margin (NPM)	Net Income/Sales
Return on Assets (ROA)	Net Income/Total Assets
Return on Equity (ROE)	Net Income/Common Equity

*All financial ratios are five-year averages for the December 31, 2001-December 31, 2005 period.

3. Multivariate Analysis of Variance (MANOVA)

The MANOVA test statistics are presented in Table 2. The multivariate F-value is 16.115, which is significant at the one-percent level. This indicates that the overall financial characteristics of U.S. and Japanese electronic and electrical equipment manufacturing firms, as measured by the eight financial ratios used in the study, are significantly different. The univariate F-values show that the differences between the financial characteristics of the firms in the two countries are statistically significant at the one percent level in terms of the Current Ratio (CUR), Quick Ratio (QUR), Inventory Turnover (ITR), Total Assets Turnover (TAT), and Equity Ratio (EQR). However, the differences are not statistically significant in terms of the Net Profit Margin (NPM), Return on Assets (ROA), and Return on Equity (ROE).

Both liquidity ratios are significantly higher in U.S. firms than in Japanese firms. U.S. firms have more liquidity compared with Japanese firms. Liquidity measures a firm's ability to meet its short-term obligations. Therefore, a high liquidity level reduces the firm's risk of not being able to meet its maturing obligations (e.g., interest payments on debt). However, if the liquidity level is too high, it can adversely affect the firm's profitability.

Inventory Turnover (ITR) is significantly higher in U.S. firms than in Japanese firms. However, Total Assets Turnover (TAT) is significantly higher in Japanese firms than in U.S. firms.

Table 2: Multivariate Analysis of Variance (MANOVA)

Financial Ratios	Means and Standard Deviations ¹		Univariate Statistics	
	United States	Japan	F-value	P-value
Liquidity				
Current Ratio	4.735 (4.287)	2.342 (1.756)	37.826*	0.000
Quick Ratio	3.492 (3.749)	1.767 (1.566)	25.580*	0.000
Turnover				
Inventory Turnover	8.493 (5.900)	6.430 (4.994)	11.184*	0.001
Total Assets Turnover	0.890 (0.375)	1.015 (0.400)	8.465*	0.004
Financial Leverage				
Equity Ratio	67.70% (17.70%)	50.00% (21.50%)	67.747*	0.000
Profitability				
Net Profit Margin	2.60% (12.30%)	2.70% (4.60%)	0.010	0.919
Return on Assets	2.10% (8.30%)	2.40% (3.50%)	0.120	0.729
Return on Equity	4.50% (7.90%)	4.20% (6.90%)	0.176	0.675
Multivariate Statistics:			16.115*	0.000

¹The figures in parentheses are the standard deviations.

*Significant at the one-percent level.

Both results are significant at the one-percent level. Although ITR is significantly higher in the U.S., TAT is significantly higher in Japan. It implies that the turnover of non-inventory assets, such as accounts receivable, and fixed assets, may not be sufficiently high in U.S. firms compared with Japanese firms. Therefore, to improve their TAT, U.S. firms should try to improve their accounts receivable and fixed asset turnovers by managing these assets more efficiently.

The Equity Ratio (EQR) is significantly higher in the U.S. than in Japan at the one-percent level. It indicates that financial leverage (debt ratio) is significantly higher in Japan than in the U.S. The high level of financial leverage indicates a high level of financial (bankruptcy) risk. This result implies that financial (bankruptcy) risk is higher in Japanese firms than in U.S. firms.

In terms of the profitability ratios, there appears to be no significant differences between the two countries. The mean Net Profit Margin (NPM) and Return on Assets (ROA) ratios are slightly higher in Japan than in the U.S. However, the mean Return on Equity (ROE) ratio is slightly higher in the U.S. than in Japan. The standard deviations of the U.S. profitability ratios are considerably larger compared with the Japanese profitability ratios. It indicates the presence of a wider spectrum of firms in the U.S. sample, compared with the Japanese sample, with very high positive and very high negative profitability ratios. The Japanese profitability ratios appear to be more closely clustered around the mean value.

The U.S. mean ROE ratio is slightly higher than the Japanese mean ROE ratio. Since we also concluded above that Japanese firms have a higher liquidity risk and financial (bankruptcy) risk compared with U.S. firms, this result implies that U.S. common equity securities are likely to have more favorable market valuation compared with Japanese common equity securities.

4. Summary and Conclusions

In this study, we have compared the financial characteristics of U.S. and Japanese electronic and electrical equipment manufacturing firms with the Multivariate Analysis of Variance (MANOVA)

method by using eight five-year ratio averages as measures of the firms' financial characteristics. The research sample consists of 203 U.S. firms and 135 Japanese firms with no missing data in the DISCLOSURE database for the December 31, 2001-December 31, 2005 period. The multivariate test statistics indicate that the overall financial characteristics of U.S. and Japanese firms are significantly different.

U.S. firms have a significantly higher liquidity level compared with Japanese firms. Liquidity ratios measure the ability of firms to meet their maturing obligations. Therefore, we conclude that U.S. firms have a lower level of liquidity risk compared with Japanese firms. The equity ratios of U.S. firms are also significantly higher compared with Japanese firms (i.e., Japanese firms have significantly higher financial leverage). This indicates that U.S. firms also have a lower level of financial (bankruptcy) risk compared with Japanese firms.

U.S. firms have a significantly higher inventory turnover than Japanese firms. However, Japanese firms have a significantly higher total assets turnover than U.S. firms. This implies that the turnover of non-inventory assets, such as accounts receivable and fixed assets, may not be sufficiently high in U.S. firms compared with Japanese firms.

The mean net-profit-margin and return-on-assets ratios are slightly higher in Japan than in the U.S. The mean return-on-equity ratio is slightly higher in the U.S. than in Japan. However, the differences between the two countries in terms of the three profitability ratios are not statistically significant. Since they have a higher mean return on equity and lower liquidity and financial (bankruptcy) risks, we can conclude that U.S. firms are likely to achieve a higher common equity market valuation compared with Japanese firms.

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Groundwater Pollution in Africans Biggest Towns: Case of the Town of Abidjan (Côte D'ivoire)

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Abstract

Groundwater of the town of Abidjan is collected by many private traditional wells. This study use hydrochemical, isotopic and statistical methods whose, classification in typical of water and multivariable analysis. The physicochemical analyses carried out on this water show that they are acid. The average temperature of water is close to the ambient temperature (25°C) of the city. Groundwaters are strongly mineral bearing. They are chlorinated sodic (76%) and bicarbonated sodic (26%). The contents of certain chemical elements in particular the nitrates and lead present values excessive higher than the standard of potability defined by the organization of the health (WHO) of 50 mg/L and 0,1 mg/L what thus endangers public health which consumes them. The groundwaters collected of wells in the town of Abidjan are polluted. The principals components analyse shows that this pollution is of anthropic origin. It is the consequence of the domestic, industrial and or artisanal activities carried out in the town of Abidjan. The contents of stable isotopes of the environment indicate that this tablecloth is reloaded starting from the infiltration of rainwater.

Keywords: Abidjan, physico-chemical analyse, aquifer, groundwater, pollution and Côte d'Ivoire

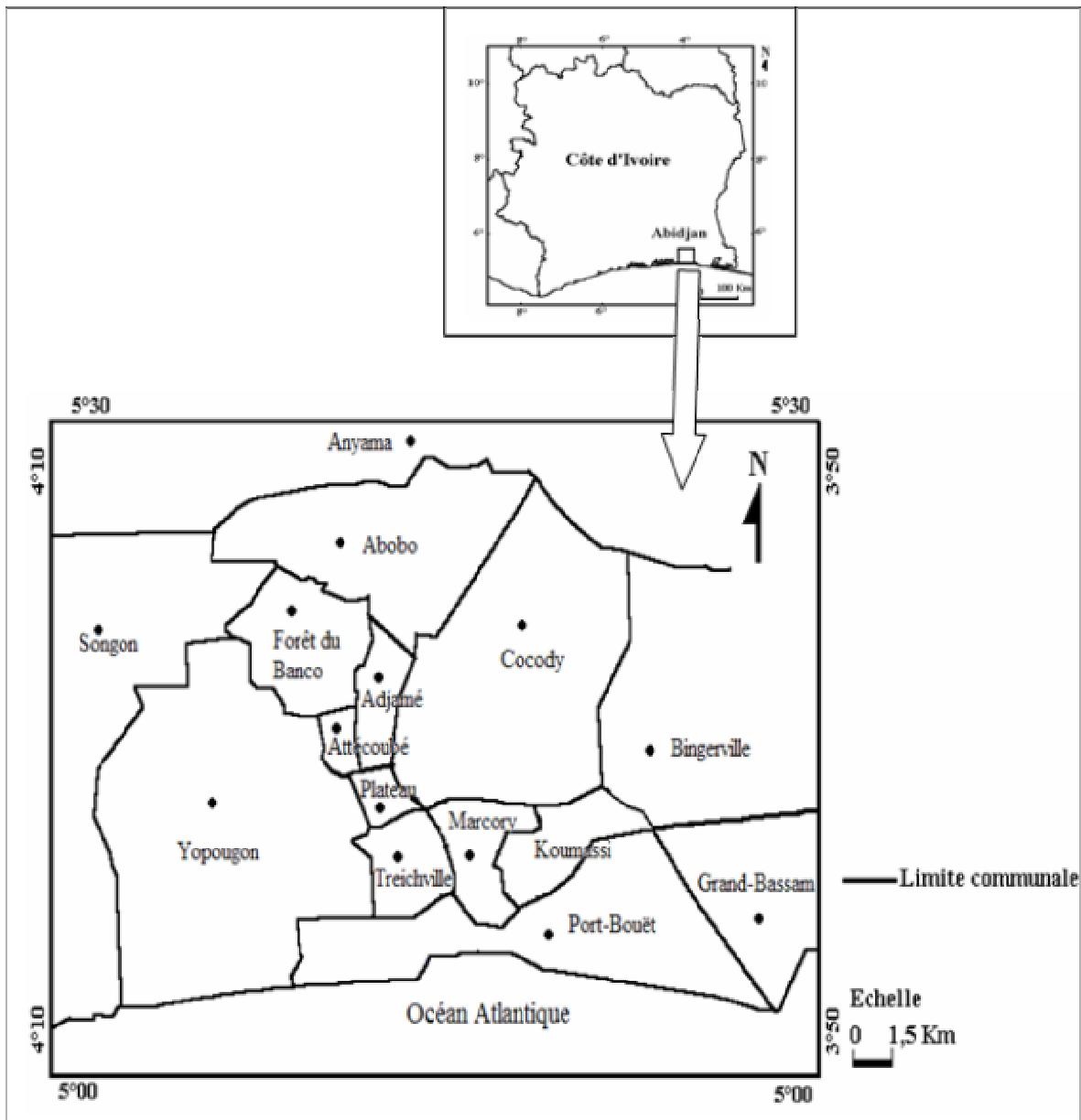
Introduction

Les grandes villes des pays en voie de développement connaissent généralement une croissance démographique et une industrialisation galopante qui engendrent des problèmes multiples et complexes. L'insuffisance de drainage des eaux pluviales, de collecte des déchets, de valorisation des ordures ménagères et l'absence d'infrastructures d'assainissement contribuent fortement à dégrader la qualité des eaux souterraines de ces grandes villes (Savané et al., 2003). La ville d'Abidjan n'est pas en marge de ces problèmes. Située au Sud de la Côte d'Ivoire entre les latitudes 5°00' et 5°30' N et les longitudes 3°50' et 4°10' W, Abidjan s'étend sur une superficie de 57 735 hectares dont 8 981 hectares de lagune soit 16% de la superficie. La ville d'Abidjan représente la capitale économique de la Côte d'Ivoire et est composée de dix communes (figure 1). Avec une population de 50 000 habitants avant l'indépendance, Abidjan compte aujourd'hui une population estimée à environ 3 millions d'habitants soit le cinquième de la population du pays. Cette ville cosmopolite est une zone portuaire qui rassemble les principales activités industrielles et services du pays. Les eaux souterraines constituent la principale source des systèmes d'approvisionnement en eau de la ville. La région est sous l'influence d'un climat de type équatorial marqué par quatre saisons. A la station d'Abidjan-Aéroport la moyenne interannuelle de la pluviométrie observée sur 64 ans (1937-2000) est de 1920 mm (Soro et al., 2006) et une température moyenne de 25°C. L'approvisionnement en eau potable de la ville est assuré par la nappe du Continental Terminal. La société de distribution d'eau de Côte d'Ivoire (SODECI) exploite cette nappe (nappe d'Abidjan) à partir d'un ensemble de forages situés dans le Nord, l'Est et Ouest de la ville. Au Sud de la ville la nappe phréatique est captée par de nombreux ménages à partir de puits traditionnels privés servant aux usages domestiques de la population. Les différents quartiers de la ville d'Abidjan ne disposent pas tous de dispositifs adéquats d'évacuation des eaux usées. Le système d'assainissement de la ville présente beaucoup de lacunes, le taux de raccordement des ménages au réseau d'assainissement est faible (29%). A cela s'ajoute le dysfonctionnement et la dégradation de la quasi totalité des ouvrages d'assainissement de la ville entraînant le rejet des eaux usées hors des systèmes d'égout. Ces rejets sont estimés à 60% de la production des eaux usées domestiques (NEDECO, 1981). Par ailleurs seulement 55% de la production des ordures ménagères de la ville sont évacués chaque année (BNETD, 2002). Les déchets non collectés (45%) se retrouvent directement dans la nature entraînant un risque certain de pollution de la qualité des eaux souterraines de la ville. De nombreux foyers de pollution sont annoncés un peu partout dans la ville sur les forages d'exploitation de la SODECI. C'est suite à ce constat que le présent travail a été entrepris pour étudier l'importance et les mécanismes de la contamination de la nappe phréatique captée par les puits au niveau de la ville d'Abidjan.

Cadre géologique et hydrogéologie

Le cadre géologique de la région d'Abidjan se confond à celui du bassin sédimentaire côtier ivoirien. Il s'étend sur 400 km de long et 40 km de large (Aghui et Biémi, 1984). Au Nord les terrains géologiques sont constitués des sédiments du Tertiaire représentés par les sables, les argiles, les grès ferrugineux. Vers les bordures lagunaires l'on rencontre les vases et les sables lessivés. Au Sud, ce sont les sédiments du Quaternaire constitués de sables des cordons marins, de sables, d'argiles et de grès ferrugineux avec des vases et des sables lessivés (figure 2). Sur ce bassin, on dénombre trois principaux aquifères:

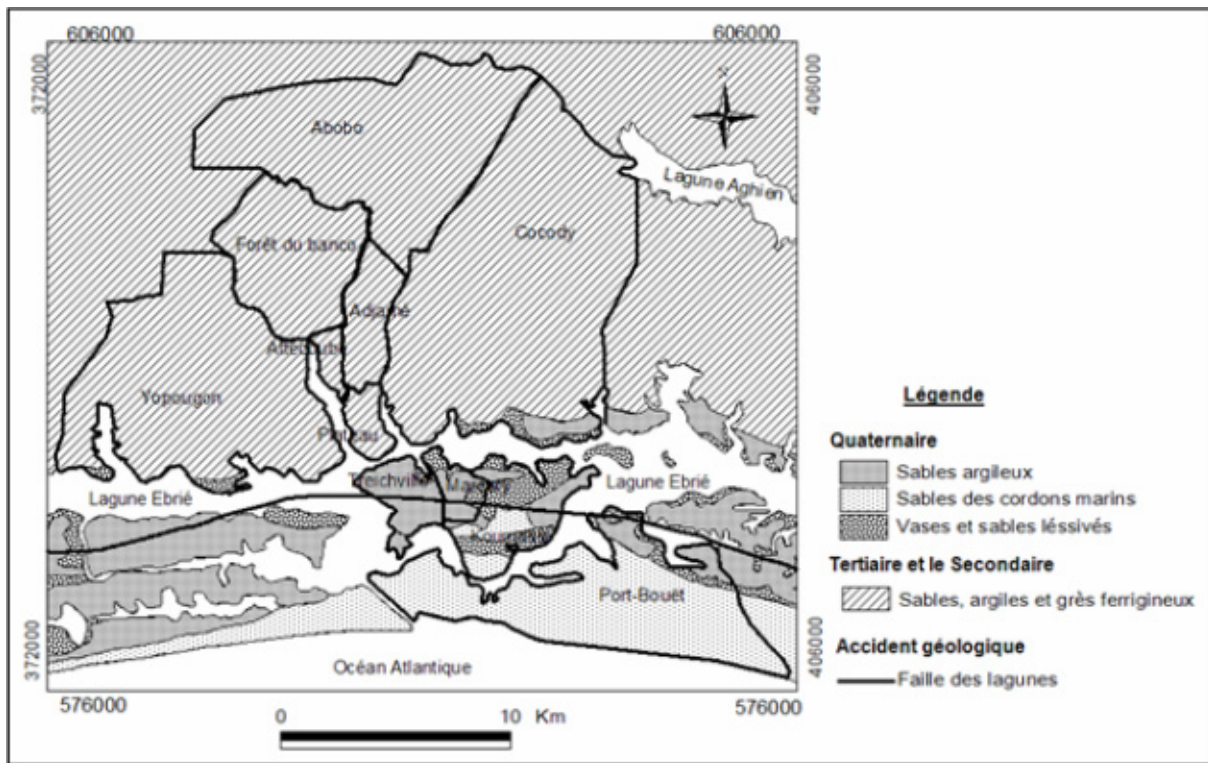
- l'aquifère du Quaternaire, il contient la nappe la plus vulnérable de la ville d'Abidjan. Cette nappe est très proche de la surface du sol et a une épaisseur de 1 à 20 m;

Figure 1: Carte de situation de la zone d'étude

- l'aquifère du Continental Terminal, il abrite la nappe la mieux indiquée pour l'alimentation en eau de consommation de la population Abidjanaise. Dans cette nappe, l'eau s'y trouve à des profondeurs décroissantes du Nord au Sud;
- l'aquifère du Maestrichtien, situé à 200 m de profondeur, est exploité par la Société Africaine des Eaux Minérales (SADEM) pour la production d'une eau minérale, l'eau "AWA".

Du point de vue tectonique le bassin sédimentaire est traversé d'Est-Ouest par la faille des lagunes. Cette faille présente un pendage sud et un rejet pouvant atteindre 5000 m. Cette étude s'intéresse à la nappe du Quaternaire et celle du Continental Terminal captées par les puits au niveau de la ville d'Abidjan.

Figure 2: Carte géologique de la ville d'Abidjan



Méthodologie

Cette étude a été effectuée sur 57 puits traditionnels privés captant la nappe phréatique au niveau de la ville d'Abidjan. Les mesures de la profondeur de la nappe ont été effectuées à l'aide d'une sonde piézométrique sonore. Ces puits ont été visités et les paramètres physiques tels que la température, le pH et la conductivité de l'eau ont été mesurés in situ à l'aide d'un pH-mètre knick Portatest et d'un conductimètre WTW 330. Les échantillons d'eau de puits destinés aux analyses chimiques ont été recueillis dans des bouteilles en polyéthylène et transportés au laboratoire pour être analysés. Les ions majeurs (Ca^{2+} , Mg^{2+} , Na^+ , K^+ , SO_4^{2-} , Cl^- , HCO_3^- et NO_3^-) et les ions métalliques (Fe^{2+} , Cu^{2+} , Zn^{2+} et Pb^{2+}) ont été dosés. Ces analyses ont été réalisées par la méthode d'absorption atomique à la flamme à l'aide d'un spectrophotomètre d'absorption atomique de type VARIAN AA-1275. Les sels nutritifs (NH_4^+ et NO_2^-) ont été analysés par colorimétrie à l'aide d'un spectrophotomètre de type BECKMAN DU[®]-64. Les eaux de puits ont également fait l'objet d'une analyse isotopique au laboratoire d'isotopie de l'Agence Internationale de l'Energie Atomique (A.I.E.A.). Cette analyse concerne l'oxygène-18 et le deutérium. Les données collectées sur les différents puits ont été traitées en utilisant une combinaison de méthodes hydrochimiques classiques, isotopiques et statistiques. L'aspect hydrochimique est réalisé par une projection des données chimiques dans les diagrammes de Piper et de Schoeller-berkaloff. Cette méthode permet de faire une classification des eaux. L'utilisation des isotopes de l'environnement permet de mettre en évidence les conditions de transit des eaux d'infiltration (Savané et al., 2001). L'approche de la statistique descriptive repose sur l'Analyse en Composantes Principales (ACP) sur des variables centrées réduites. Cette analyse statistique a pour but de suivre l'évolution chimique des eaux souterraines. L'ACP est une méthode statistique multidimensionnelle descriptible utilisable comme outil d'aide à l'interprétation d'une matrice de données (Travi et al., 1997). Cette analyse permet de synthétiser et de classer un nombre important de données afin d'en extraire les principaux facteurs qui sont à l'origine de l'évolution simultanée des variables et de leur relations propres. Elle se propose de trouver les valeurs propres de la matrice des

coefficients de corrélation linéaires entre les variables centrées réduites (Mudry et al., 1986). Cette analyse statistique va permettre de mettre en évidence les ressemblances et la position graphique que présenteraient deux ou plusieurs variables chimiques au cours de leur évolution. L'ACP comporte 30 descripteurs et 18 variables. Elle a été réalisée à l'aide du logiciel STATISTICA 6.0. La combinaison de toutes ces méthodes dans cette étude apporte des connaissances sur l'évolution qualitative des eaux, ainsi qu'une compréhension du mode d'enrichissement minéralogique des eaux souterraines de la ville d'Abidjan.

Résultats et discussion

I. Hydrochimie et Qualité des eaux

Les eaux des puits de la ville d'Abidjan présentent des valeurs de température qui varient entre 26,6°C et 29,8°C avec une moyenne de 27,9°C. Cette température est en moyenne basse par rapport à celle des eaux souterraines de Dabou (28,2°C) (Tapsoba, 1995) et sensiblement identique à celle mesurée dans le bassin de la Marahoué (27,2°C). Elle correspond aux variations saisonnières des températures atmosphériques ambiantes. Cela indique l'ouverture du système aquifère, donc de sa vulnérabilité vis-à-vis de la pollution (Tandia et al., 1999). Le pH indique que les eaux des puits sont acides avec une valeur moyenne de 6. Ces valeurs de pH sont compatibles avec le milieu silicaté qui constitue l'aquifère. Les eaux acides se rencontrent dans plusieurs régions de la Côte d'Ivoire. Des observations similaires ont été faites dans les eaux du Continental Terminal de Niamey au Niger (Leduc et al., 1997). L'acidité des eaux souterraines en zone tropicale humide est principalement liée à la production de CO₂ dans les premières couches du sol (Tapsoba, 1995).

Les valeurs de conductivité électrique des eaux de la nappe phréatique varient de 155 à 2350 µS/cm pour une moyenne de 483,3 µS/cm. Ces valeurs indiquent que les eaux sont fortement minéralisées. Les valeurs du potentiel d'oxydo-réduction sont positives, ce qui indique que les eaux de la nappe sont bien oxygénées.

Les résultats statistiques des analyses chimiques sont présentés dans le tableau 1. La projection des résultats chimiques dans le diagramme de Piper montre que les eaux de la nappe phréatique se classent en deux faciès hydrochimiques: les eaux chlorurées sodiques les plus importants (76,2%) et les eaux bicarbonatées sodiques (23,8%) (figure 3). Une eau de boisson doit répondre aux normes de potabilité de l'OMS pour mieux se prêter aux utilisations domestiques. Pour répondre à ces conditions cette eau doit respecter certaines normes de critères physiques, chimiques, organoleptiques et bactériologiques. La comparaison des éléments physiques et chimiques des eaux aux normes usuelles de l'OMS 1986 montre que les paramètres Na⁺, K⁺, Ca²⁺, NO₃⁻, NO₂⁻, NH₄⁺, Pb²⁺ et la conductivité électrique (CE) présentent des teneurs supérieures aux normes admissibles pour une eau de boisson. Les valeurs élevées en éléments chimiques montrent que les eaux de puits ne sont pas acceptables pour la consommation car elles sont polluées.

La répartition spatiale des teneurs en nitrates montre que 70% des puits qui captent la nappe phréatique sont touchés par une pollution nitratée (figure 4). Cette pollution est due à une source de contamination beaucoup plus importantes que les teneurs de nitrates des pluies de la région d'Abidjan qui rechargent la nappe et qui sont en moyenne de l'ordre de 2,5 mg/L (Oga, 1998). La carte de la répartition du plomb montre également que 96,7% des puits étudiés présentent des teneurs en plomb au-dessus de la norme OMS (0,1 mg/l) (figure 5). La carte de la qualité des eaux de puits de la ville d'Abidjan indique que la quasi totalité des eaux de puits sont polluées (figure 6).

Table 1: Caractéristiques moyennes (mg/L) des eaux de la nappe phréatique de la ville d'Abidjan

Paramètres	Moyenne	Min	Max	Ecart-type
T°(C)	27,86	26,60	29,80	0,83
pH	6,02	3,86	7,70	1,02
Cond(μS/cm)	720,66	155,00	2350	483,33
HCO ₃ ⁻	197,27	8,00	688	173,20
Cl ⁻	133,18	4,16	568	125,21
Fe ²⁺	1,21	0,008	20,01	3,79
Mn ²⁺	0,11	0,008	0,40	0,08
NO ₃ ⁻	52,17	0,05	196,20	55,02
NO ₂ ⁻	0,70	0,006	2,80	0,80
NH ₄ ⁺	3,65	0,007	32,20	6,63
SO ₄ ²⁻	51,27	1,50	195,00	48,02
PO ₄ ³⁻	0,54	0,01	6,30	1,18
Na ⁺	59,33	1,90	243,80	55,41
K ⁺	23,20	0,60	87,75	19,99
Ca ²⁺	41,14	0,70	175,50	39,71
Mg ²⁺	3,05	0,07	18,82	3,56
THT	44,19	1,42	185,25	41,72
Cu ²⁺	0,04	0,01	0,14	0,03
Pb ²⁺	0,82	0,02	2,80	0,61
Zn ²⁺	0,04	0,01	0,14	0,03
MT	658,86	96,00	1555,70	378,70

II. Origine et mécanisme de minéralisation des eaux souterraines

Les valeurs propres issues de l'analyse en composantes principales permettent d'apprécier la variance exprimée par chaque facteur et de montrer l'importance du caractère représenté par l'axe factoriel par rapport aux autres. Les trois premiers facteurs (F1, F2 et F3) expriment les pourcentages d'informations les plus importants (87,2%) donc peuvent nous renseigner sur les interactions hydrochimiques dans l'aquifère.

II.1. Apport du plan factoriel F1-F2

Les facteurs F1(51,7%) et F2(23,3%) expliquent à eux seuls 75% de la variance. Dans l'espace des variables (figure 7a); le facteur F1, le plus important est défini par la majorité des variables dont le Cl⁻, le HCO₃⁻, le Fe²⁺ et le Mn²⁺ ainsi que la minéralisation totale (MT), le Cu²⁺, le Zn²⁺ et le Pb²⁺. Le regroupement de ces variables dans la majeure partie du cercle de communauté suivant l'axe F1 indique que ce facteur explique les mécanismes prépondérants d'acquisition de la minéralisation des eaux de la nappe phréatique de la ville d'Abidjan. La bonne corrélation qui existe entre les différentes variables qui définissent le facteur F1 traduit une origine commune de ces ions.

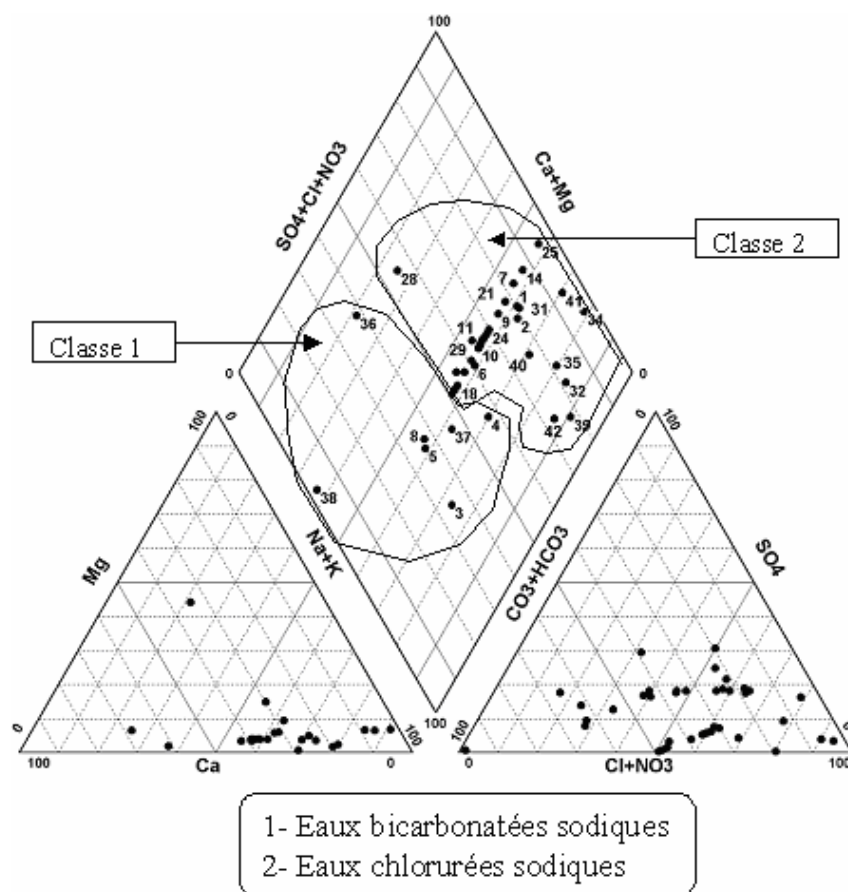
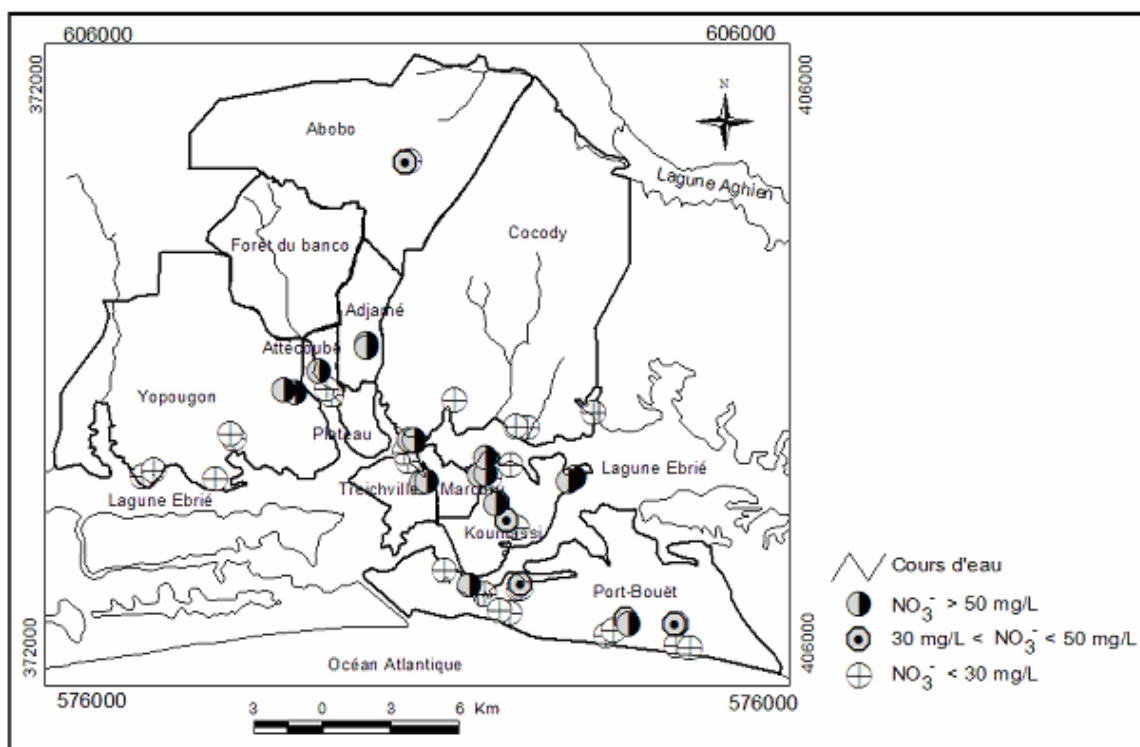
Figure 3: Projection des eaux du Quaternaire dans le diagramme de Piper**Figure 4:** Répartition spatiale des teneurs en nitrates dans les eaux puits de la ville d'Abidjan

Figure 5: Répartition spatiale des teneurs en plomb dans les eaux puits de la ville d'Abidjan

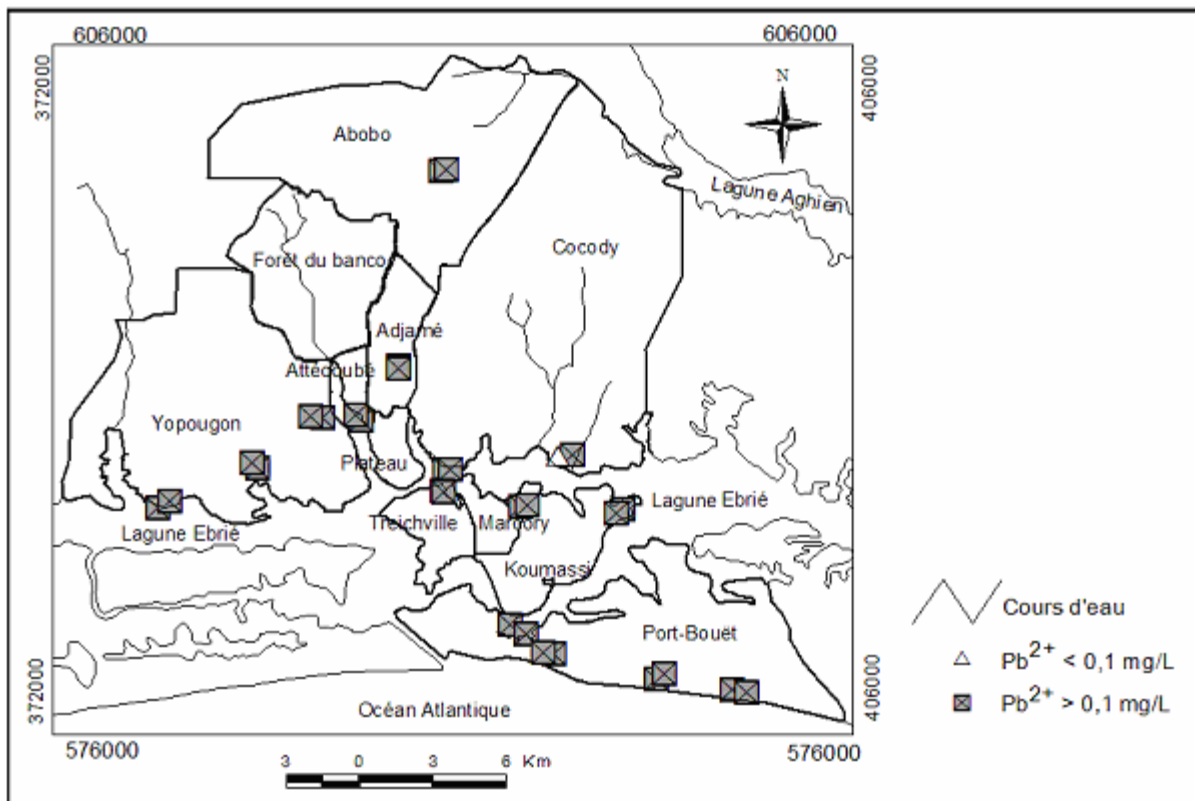
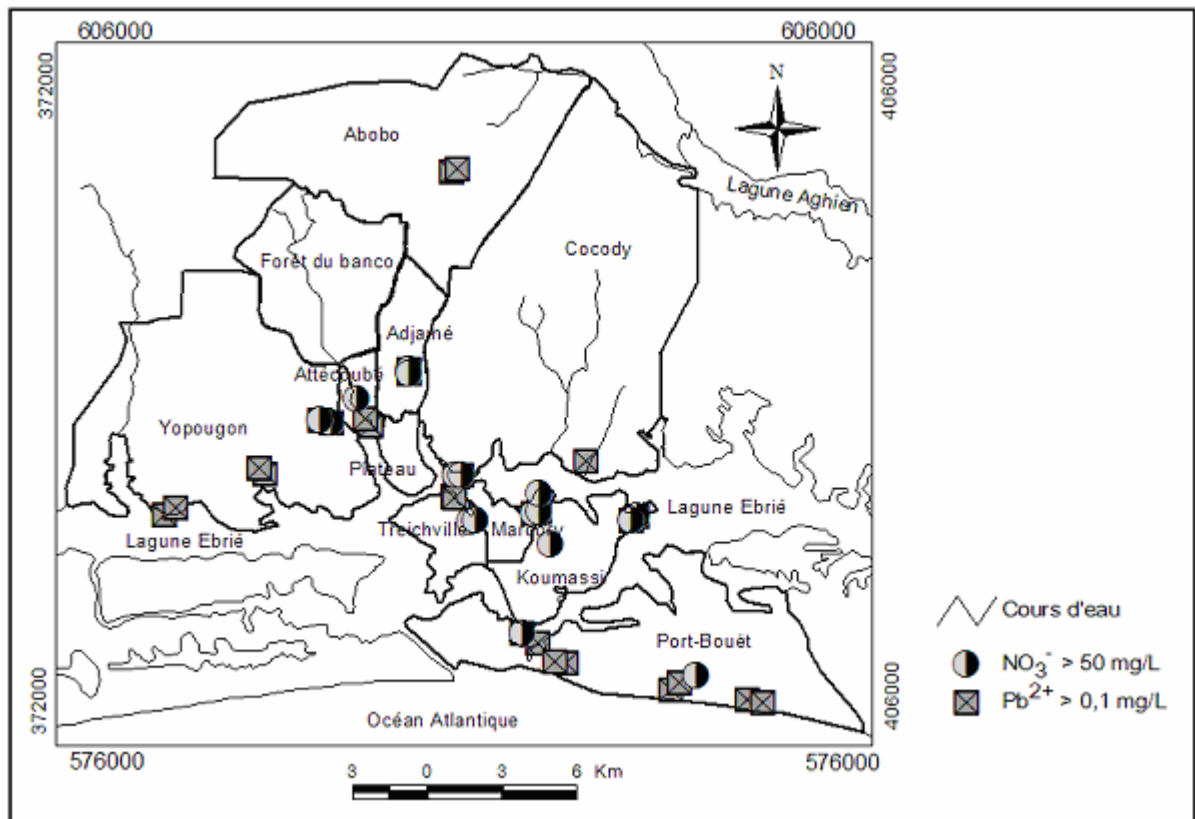


Figure 6: Carte de répartition de la qualité des eaux de puits de la ville d'Abidjan



L'analyse de la matrice de corrélation donne le degré de liaison entre ces différents paramètres et montre les liens successifs entre le Cl^- et le Pb^{2+} (0,99); le Cl^- et le Zn^{2+} (0,97); le Cl^- et le Cu^{2+} (0,99); le Cu^{2+} et le Mn^{2+} (0,98) (tableau 2). Cette bonne corrélation entre ces éléments traduit le même processus de mise en circulation de ces ions. Ces éléments métalliques sont souvent dépendants des activités agricoles, industriels et portuaires (Henry et al., 1989). La présence des métaux lourds tels que le plomb, le zinc et le cuivre dans les eaux de cette nappe est liée aux activités industrielles et/ou artisanales pratiquées dans la ville. Ils sont reconnus comme de bons indicateurs de pollution anthropogène liés aux activités industrielles et urbaines (Forstner et al., 1981). Les niveaux piézométriques mesurés varient de 0,85 m à 4,54 m avec une moyenne de 2,77 m, ce qui favorise une infiltration rapide des eaux de surface. Le facteur F1 exprime donc la pollution industrielle et/ou artisanale.

Table 2: Matrice de corrélations entre les variables

	pH	HCO_3^-	Cl^-	Fe^{2+}	Mn^{2+}	NO_3^-	NO_2^-	NH_4^+	SO_4^{2-}	Na^+	K^+	Ca^{2+}	Mg^{2+}	THT	Cu^{2+}	Pb^{2+}	Zn^{2+}	MT
pH	1,00																	
HCO_3^-	0,31	1,00																
Cl^-	0,12	0,68	1,00															
Fe^{2+}	0,10	0,68	0,99	1,00														
Mn^{2+}	0,06	0,66	0,99	0,99	1,00													
NO_3^-	0,28	0,08	0,07	0,05	0,05	1,00												
NO_2^-	0,13	0,40	0,23	0,22	0,25	0,69	1,00											
NH_4^+	0,15	0,50	0,17	0,15	0,17	0,39	0,65	1,00										
SO_4^{2-}	0,38	0,13	0,33	0,30	0,29	0,17	0,02	0,04	1,00									
Na^+	0,44	0,29	0,35	0,33	0,31	0,06	0,04	0,16	0,90	1,00								
K^+	0,38	0,26	0,25	0,24	0,23	0,03	-0,02	0,16	0,87	0,95	1,00							
Ca^{2+}	0,42	0,34	0,39	0,38	0,36	0,07	0,08	0,18	0,89	0,99	0,94	1,00						
Mg^{2+}	0,46	0,30	0,30	0,29	0,26	0,10	0,03	0,17	0,88	0,98	0,96	0,97	1,00					
THT	0,42	0,33	0,39	0,37	0,36	0,07	0,08	0,18	0,89	0,99	0,95	0,99	0,98	1,00				
Cu^{2+}	0,11	0,71	0,99	0,99	0,99	0,03	0,22	0,18	0,32	0,36	0,29	0,40	0,32	0,40	1,00			
Pb^{2+}	0,10	0,68	0,99	0,99	0,99	0,07	0,25	0,18	0,32	0,35	0,26	0,39	0,30	0,39	0,99	1,00		
Zn^{2+}	0,05	0,61	0,97	0,97	0,98	0,11	0,26	0,14	0,27	0,26	0,18	0,30	0,20	0,30	0,97	0,98	1,00	
MT	0,42	0,81	0,80	0,79	0,78	0,28	0,41	0,43	0,62	0,70	0,63	0,74	0,69	0,73	0,81	0,80	0,74	1,00

Le facteur F2 représente 23,3% de la variance exprimée. Il est déterminé par le THT, le Ca^{2+} , le Mg^{2+} , le K^+ , le Na^+ et le SO_4^{2-} (figure 7a). Ces paramètres occupent 32% de la minéralisation totale soit près de la moitié. La proximité de ces éléments témoigne d'une forte corrélation entre eux. Ces variables traduisent le degré de minéralisation des eaux de la nappe. Elles présentent des variations continues sur de longues périodes ce qui caractérisent la minéralisation de l'eau dans son encaissant. Elles variables rendent compte des conditions d'acquisition du chimisme de l'eau et sont donc liées au temps de séjour. Ces paramètres proviennent du contact eau roche dans l'aquifère. Le facteur F2 exprime donc le phénomène de la minéralisation temps de séjour.

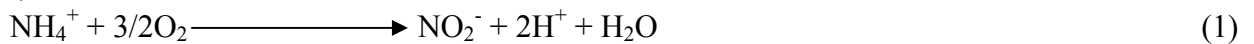
L'espace des unités statistiques rend compte de la répartition des ouvrages d'eau en fonction de la position des variables dans le cercle de communauté. L'analyse de la figure 7b permet de dégager trois classes d'eau:

- classe 1: les eaux fortement minéralisées riches en métaux lourds. Cette minéralisation liée à une pollution d'origine industrielle et ou artisanale. Ce sont les échantillons 19 (Abobo Plaque 1); 21 et 22 (Koumassi Campement 1 et 2); 27; 28 (Anoumambo 1 et 2); 29 et 30 (Gonzaqueville 1 et 2). Ce sont des zones d'intenses activités anthropiques.
- classe 2: les eaux minéralisées et riches en métaux lourds. La minéralisation est liée d'une part à la pollution industrielle et/ou artisanale et d'autre part à la minéralisation temps de séjour. Les échantillons d'eau concernés sont: 3; 4; 10; 11; 12; 13; 14; 15; 16; 17; 20; 23; 24; 25;
- classe 3: les eaux faiblement minéralisées. Cette classe d'eau regroupe les échantillons 5; 6; 7; 9; 12.

II.2. Apport du plan factoriel F1-F3

L'analyse du cercle de communauté dans le plan factoriel F1-F3 montre que ce plan factoriel représente 63,4% de la variance exprimée. Ce plan confirme que le facteur F1 régit l'essentiel de l'acquisition de la minéralisation des eaux. Le facteur F1 est déterminé par les ions Cl^- , HCO_3^- , Fe^{2+} , Mn^{2+} , MT , Cu^{2+} , Zn^{2+} et Pb^{2+} . Ces éléments traduisent toujours le phénomène de pollution industrielle et ou artisanale.

Le facteur F3 qui exprime 12,1% de la variance exprimée est déterminé par les ions NO_3^- , NO_2^- et NH_4^+ . La présence de ces composés azotés dans une eau souterraine rend compte des conditions du milieu et leur influence sur les eaux d'infiltration. Ces composés azotés proviennent essentiellement de la dégradation de la matière organique par les microorganismes dans les couches superficielles du sol avec une production de CO_2 (Tapsoba, 1995). Dans le sol, la matière organique est minéralisée à partir de l'oxydation biologique de l'ammonium (NH_4^+) en NO_3^- . Ces transformations successives sont effectuées par les bactéries chimio-autotrophes. Les bactéries du genre *Nitrosomonas* donnent cette réaction:



Par contre les bactéries du genre *Nitrobacter* donnent la réaction ci-dessous:



Les transformations produites à la surface du sol sont entraînées par lessivage du sol avec l'infiltration des eaux de pluie en profondeur. Les eaux de la nappe du Quaternaire sont peu profondes ce qui favorise l'infiltration de cette pollution organique et microbienne. Le facteur F3 est lié à cette pollution, conséquence de l'infiltration des eaux superficielles. Il traduit donc le phénomène de l'infiltration superficielle.

L'analyse dans l'espace des unités statistiques permet l'identification de trois regroupements des eaux de puits.

La classe 1 renferme les eaux fortement minéralisées et riches en NO_3^- , NO_2^- et NH_4^+ . Cette minéralisation est liée à l'infiltration des eaux superficielles issue de la pollution d'origine organique et microbienne. Les échantillons concernés sont les puits 5 (Biafra 1); 17 et 18 (Adjamé Latin 1et 2); 21 et 22 (Koumassi Campement 1 et 2); 27 (Anoumambo 1).

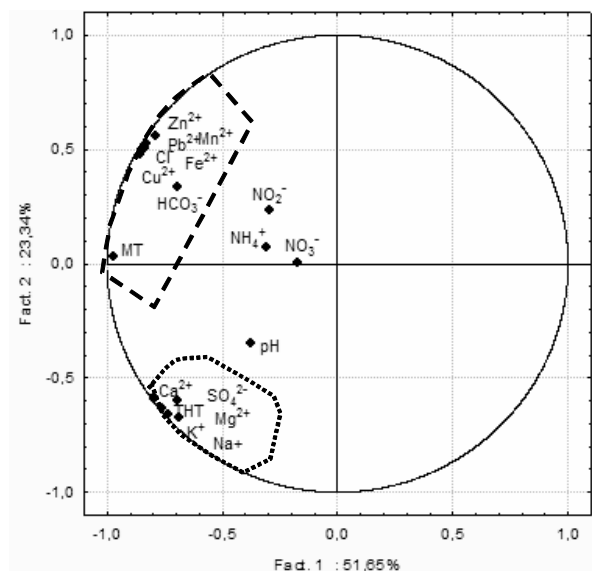
La classe 2 regroupe les eaux minéralisées et riches en NO_3^- , NO_2^- et NH_4^+ . La minéralisation résulte du temps de séjour et de la pollution industrielle et/ou artisanale. Les échantillons d'eau concernés sont 2; 3; 4; 6; 7; 8; 9; 10; 11; 14; 15; 16; 20; 24; 25; 30.

La classe 3 représente les eaux dont la minéralisation est influencée par la pollution d'origine industrielle et/ou artisanale. Elle regroupe les points 19; 21 et 29.

III. Isotopie

Dans la nappe phréatique, les valeurs en isotopes stables de l'environnement varient de -1,91 ‰ à -2,66 ‰ pour l'oxygène-18 avec une valeur médiane de 2,31‰ (tableau 3). Celles du deutérium vont de -4 ‰ à -10,55‰ avec une moyenne de -6,95‰. Les valeurs sont plus resserrées dans le cas de l'oxygène-18 et sont voisines de celles des précipitations de la ville d'Abidjan (-2,22‰).

Figure 7: Analyse en composantes principales normées dans le plan factoriel F1 - F2
a: Espace des variables dans le plan factoriel F1 - F2



b: Espace des unités statistiques dans le plan factoriel F1 – F2

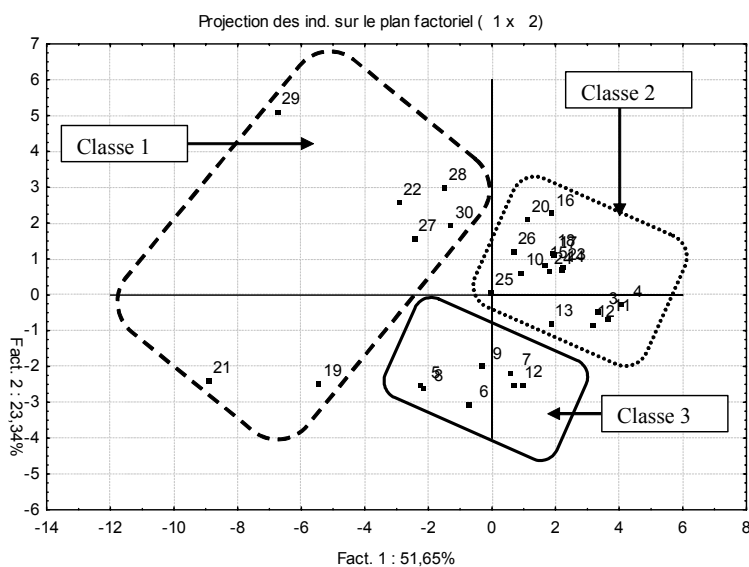
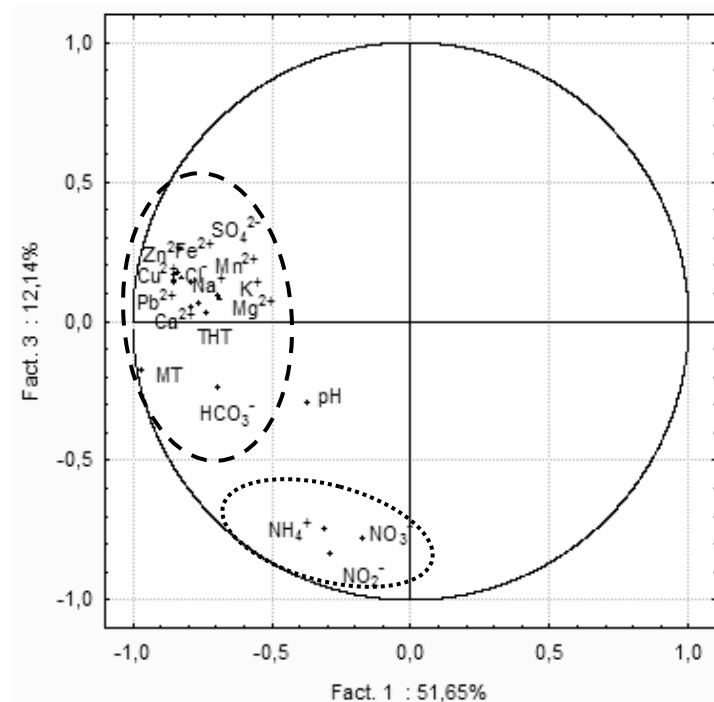
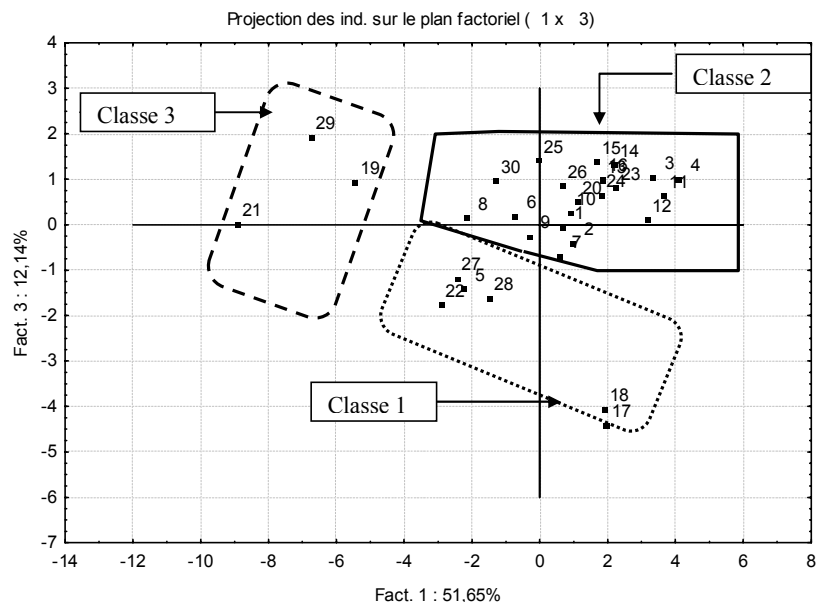


Figure 8: Analyse en composantes principales normées dans le plan factoriel F1 – F3
Espace des variables dans le plan factoriel F1 – F3



Espace des unités statistiques dans le plan factoriel F1 – F3



Les points représentatifs des échantillons d'eau, reportés dans le diagramme $\delta^2\text{H}$ - $\delta^{18}\text{O}$ (figure 9) permettent d'identifier deux regroupements des points d'eau par rapport à la droite météorite mondiale (DMM) définie par Craig, (1961) d'équation:

$$\delta^2\text{H} = 8\delta^{18}\text{O} + 10 \quad (3)$$

Celle-ci donne des indications sur l'origine et les processus de recharge des eaux souterraines.

Le premier regroupement d'échantillons d'eau s'aligne sur la droite des eaux météoriques. Ces eaux n'ayant subies aucune évaporation proviennent d'une infiltration directe des précipitations locales

sans modification en accord avec des ordonnées à l'origine voisines de 10 telles qu'observés dans la commune de Yopougon ($d = 9,5\text{‰}$) et Port-Bouët ($d = 10,8\text{‰}$).

Le second groupe d'eau renferme les eaux actuelles et se localisent au-dessus de la droite météorique mondiale. Elles sont caractérisées par des ordonnées à l'origine "d" supérieures à 10 indiquant la participation des masses de vapeur d'eau d'origine continentale dans la recharge des eaux souterraines de la ville. Un tel phénomène a été mis en évidence dans la région de Grand-Lahou (Soro et al., 2003) et dans le sud de la Côte d'Ivoire. Les eaux de ces ouvrages seraient issues de précipitations recyclées soit lors du passage des lignes de grains (Baudet, 1976) soit à partir de la forêt tropicale considérée comme relais de l'océan dans la production de vapeur d'eau.

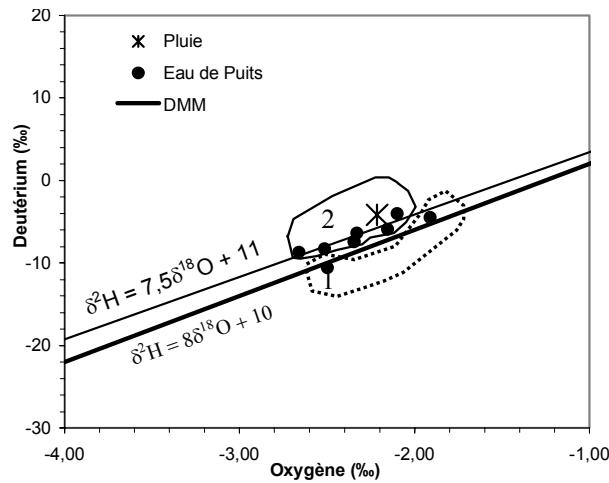
Table 3: Valeur en isotope stable des eaux de pluie de la ville d'Abidjan

Localités	$d^{18}\text{O}$ [‰]	$d^2\text{H}$ [‰]	Excess [‰]
Treichville Biafra	-2,35	-7,4	11,4
Port Bouet	-2,50	-10,6	9,5
Koumassi Bia sud	-2,33	-6,4	12,3
Marcory Aliodan	-2,52	-8,3	11,9
Cocody	-2,66	-8,7	12,6
Mbadon	-2,10	-4,0	12,8
Attécoubé	-2,16	-5,9	11,3
Yopougon Azito	-1,91	-4,5	10,8
Moyenne	-2,31	-6,95	11,57
Max	-1,91	-4,00	12,80
Min	-2,66	-10,55	9,45
Ecart-type	0,2	2,2	1,1

Conclusion

Les mesures piézométriques, hydrochimiques et isotopiques réalisées sur les eaux de la nappe phréatique de la ville d'Abidjan captée par les puits traditionnels ont permis de définir les grands traits de fonctionnement de cette nappe. Les eaux sont acides avec une température proche de celle ambiante. Elles ont un niveau piézométrique proche de la surface du sol (en moyenne 2,77 m). Cette faible profondeur des eaux est la résultante d'une forte minéralisation de celles-ci. Les ions les plus abondants sont Na^+ , Cl^- , HCO_3^- et NO_3^- . Ils représentent plus de la moitié de la minéralisation totale soit 82%. Les eaux des puits sont dominées par le faciès chloruré sodique (76%) et faciès bicarbonaté sodique (24%). La comparaison des teneurs en éléments dissous par rapport aux normes de l'OMS pour les eaux de boisson montre que les eaux de la nappe phréatique sont polluées avec une présence massive de NO_3^- et de Pb_2^+ .

Figure 9: Diagramme oxygène-18 deutérium des eaux de puits de la ville d'Abidjan



Cette pollution, d'origine anthropique rend ces eaux impropres à la consommation humaine. Elle est la conséquence des activités domestiques, industrielles et/ou artisanales de la ville d'Abidjan. La population s'alimente à partir des eaux de mauvaise qualité sont exposées à des risques sanitaires. Il s'avère nécessaire de réaliser une étude bactériologique sur ces eaux en vue de déterminer la corrélation entre les pathologiques liées à la consommation de ces eaux et les populations. L'analyse en composantes principales montre que la minéralisation des eaux est influencée par trois phénomènes dont la minéralisation temps de séjour, la pollution industrielles et artisanales et l'infiltration superficielle de la pollution organique et microbienne. L'étude isotopique des eaux indique que la nappe est alimentée par les apports superficiels qui sont les précipitations.

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Multi-Objective Planning of Distribution System with Distributed Generation

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Abstract

This paper presents a multi-objective formulation for optimal siting and sizing of distributed generation (DG) resources in distribution systems in order to minimize the cost of power losses and energy not supplied. The implemented technique is based on a genetic algorithm (GA) and weight method that employed to obtain the best compromise between these costs. Simulation results on 33-bus distribution test system are presented to demonstrate the effectiveness of the proposed procedure.

Keywords: Distributed Generation, distribution networks, genetic algorithm, reliability, weight method

1. Introduction

For many years, the distribution system has been planned, built and operated always in the same way. But in the last decade, the first signs of changes have appeared due to the liberalization of the electricity market, the governmental drive to reduce number and duration of long interruption and the growing presence of DG. In particular, if DG penetration reaches a high level, as predicted by many authors, distribution utilities will probably have to dismiss the traditional radial network operation, adopting a more flexible meshed structure. If DG is properly planned and operated, it may provide benefits to distribution networks (e.g., reduction of power losses, capacity saving, reliability and power quality improvement). The effect of adding DG on network indices will vary depending on its type and position and (forecast) load at the connection point. Consequently, one or more sites on a given network may be optimal.

There are many methods available for DG planning. Most of them have been considered only one objective function. In [1] an algorithm to determine the near optimal, with respect to system losses, placement of these units on the power grid has been presented. Further, the impacts of dispersed generation at the distribution level are performed with an emphasis on resistive losses, and capacity savings.

Moreover in [2] a strategic DG placement method has been proposed to enhance the reliability and obtain the benefits for DG placement. In [3] a methodology has been formulated for the optimal siting of distributed generators and reclosers. Optimal siting is determined by sensitivity analysis of the power flow equations. The sizing method for a set of loading conditions, generation penetration level and power factor is formulated as a security constrained optimization problem.

The cost of active and reactive power generation based on GA and optimal power flow calculations, has been minimized in [4]. Furthermore in [5] a technique has been presented for assisting network planners to determine the optimum rating and position of dispersed generators in an established distribution network, considering practical objectives and constraints over a number of planning years. The objectives considered were: the minimization of system losses, the minimization of disruption to the existing network, the minimization of costs and the maximization of the rating of the dispersed generators. The tool exploits conventional techniques in assessing the constraints imposed by the network, subsequently using Genetic Algorithms to provide an optimization of the decision making process.

In this paper, a genetic algorithm based multi-objective (MO) formulation is proposed to optimize cost of power losses and energy not supplied simultaneously. Then, a global non-inferior solution for MO problem is achieved by means of Genetic Algorithm. In a next stage, by using weight method, a set of non-inferior solutions can be produced with an iterative procedure in order to find the most compromised solution.

2. Multi-Objective Programming

Recently, the liberalization of electric energy markets has brought important changes in the economic and technical aspects of power system planning and operation; the grids have to be managed according to new principles but taking into account the technical constraints. Therefore, it is necessary to change the methodologies and the algorithms used for the power system optimization. In particular, new tools that allow managing the system, complying with the rules of the electric market, must be available. The new scenario forces a change in the duties and objectives of the traditional planning and it compels to take into account several objectives that are likely to be in mutual conflict. The MO methodologies give a different solution that obtained by standard optimization methods. First of all, their intermediate results are not unique, but provide an infinite set of optimal solutions called Pareto set. Each point belonging to the Pareto set has an important characteristic: The improvement in one of the objectives results in the worsening of at least another objective. The general formulation of a MO problem is expressed by:

$$\begin{aligned} \min & [f_1(x), f_2(x), \dots, f_m(x)]^T \\ x & \in \Omega \\ g_j(x) &= 0 \quad j = 1, \dots, n \\ h_k(x) &\leq 0 \quad k = 1, \dots, p \end{aligned} \quad (1)$$

Where x represents a decision vector, f_i is the i_{th} objective function, Ω is the domain of solutions, g_j and h_k are the equality and inequality constraints, respectively.

Therefore, to solve a MO problem it is necessary to follow these steps: a) define the useful objectives; b) find the Pareto set and c) choose a solution from Pareto set. Step c) is the most important, because the final solution depends on the point of view of the decision maker who has to take into account the relative importance of the conflicting objectives. There are various techniques for generating non-inferior solutions (Non-inferiority means that improvements in one objective are attained only at the cost of some sacrifice in the other objective functions). The method presented and used in this paper is the Weight Method. It transforms the MO optimization problem into a traditional problem: the different objective functions are weighted and added to form a single objective function to be optimized. The optimization problem can be defined as follows:

$$\min \sum_{i=1}^k w_i f_i(\bar{x}) \quad (2)$$

Where $w_i \geq 0$ are the weighting coefficients representing the relative importance of the objectives. It is usually assumed that

$$\sum_{i=1}^k w_i = 1 \quad (3)$$

The main strength of this method is its efficiency (computationally speaking) and its suitability to generate a strongly non-dominated solution that can be used as an initial solution for other techniques [6].

3. Problem Formulation

The main goal of this paper is to determine optimal locations and sizes for new generators by minimizing the cost of energy losses and cost of energy not supplied subject to bus voltages limits, DG power limit, short circuit currents and network power flow equations.

In the following, each cost function is described in detail under the assumption of a linear load growth during the whole planning period.

3.1. Cost of Energy Losses (C_L)

The losses of distribution system depend on the line resistance and currents and are usually referred to as thermal losses. While the line resistances are fixed, the currents are a complex function of the system topology and the location of generation and load.

In this work, only the real power injections as they relate to distribution losses are of concern. The system losses at the beginning of the planning period can be expressed as

$$P_{0L} = \sum_{i=1}^n P_{Gi} - \sum_{i=1}^n P_{Di} \quad (4)$$

Where P_{0L} is the real power loss, P_{Gi} is the real power generated at the i_{th} bus, P_{Di} is the real power required at the i_{th} bus. All of the above parameters are calculated by power flow program. The net present value of the power losses cost in the whole planning period can be calculated as follows:

$$C_L = 8760 \times U_E \times \sum_{h=1}^{N_y} B^h \cdot P_{0L} \cdot (1 + \gamma)^h \quad (5)$$

$$B = \frac{1 + f}{1 + \mu}$$

Where B is a economic factor for converting costs to present value, f and μ are inflation and interest rate respectively, γ is a load growth rate per year, U_E is cost of energy(\$/kWh) and N_y is planning period. In eq. (5) it has been assumed that DG units operate 24 h/day at their rated power. That's why coefficient of $24 \times 365 = 8760$ h/year has been used.

3.2. Cost of Energy Not Supplied (C_{ENS})

In order to calculate the cost of energy not supplied the duration of a branch fault is usually divided into two phases: fault location and fault repair. Automatic sectionalizers and reclosers can restrict the area of influence of a fault, reducing the number of customers affected by long-term interruptions during the fault location phase. In this stage, intentional islanding may be used to supply unfaulted portions of the network automatically separated from the faulted section. The repair stage consists of the time required to isolate the faulted branch, connect any emergency ties and repair the fault. DG, enabling power to be restored to the nodes downstream the sectionalized branch, can lead to significant reliability improvements. Load flow studies should be performed to check that voltages and currents

are within their operative ranges and that DG units have a sufficient probability to pick up the loads in the islanded network. Equation (6) gives the cost of energy not supplied of the j_{th} network branch.

$$C_{0aj} = 8760 \times U_E \lambda_j L_j \times \left(\sum_{i=1}^{N_{loc}} P_{0i} \cdot t_{loc} + \sum_{i=1}^{N_{rep}} P_{0i} \cdot t_{rep} \right) \quad (6)$$

Where λ_j is the branch fault rate (number of faults per year and km of feeder), L_j is the branch length (km), N_{loc} and N_{rep} are the number of nodes isolated during the fault location and repair stages, respectively, P_{0i} is the node power (kW) at the beginning of the planning period, and t_{loc} and t_{rep} are the durations of the fault location and repair stages (h), respectively.

The net present value of the cost of energy not supplied due to a fault in the j_{th} branch during the planning period is calculated with the following expression:

$$C_{ENSj} = \sum_{h=1}^{N_y} C_{0aj} \times (1 + \gamma)^h \times B^h \quad (7)$$

The cost of energy not supplied (C_{ENS}) is then obtained as the sum of the C_{ENSj} for each branch in the whole planning period.

3.3. Problem Constraints

Two above objectives were subject to the following constraints:

1. The network voltage levels should be held within specified limits.
2. The short circuit limitations of network plant needed to be respected.
3. DG real and reactive power capabilities needed to be respected.

These are represented by the following equations:

$$\begin{aligned} V_{\min} &\leq V_i^n \leq V_{\max} \quad n = 1, \dots, N \\ S_{\min}^b &\leq S_i^b \leq S_{\max}^b \quad b = 1, \dots, B \\ P_{DG\min}^k &\leq P_{DGi}^k \leq P_{DG\max}^k \quad k = 1, \dots, K \\ Q_{DG\min}^k &\leq Q_{DGi}^k \leq Q_{DG\max}^k \quad k = 1, \dots, K \end{aligned} \quad (8)$$

Where N is the number of nodes in the network, K is the number of DG units and B is the number of branches (transformers and lines), V_i is the node voltage in year i , P_{gi}^k and Q_{gi}^k are real and reactive power generated by generator k in year i respectively and S_i^b is the apparent power flowing in branch b in year i .

4. GA Implementation

In this paper, a GA optimization technique has been used for finding the non-inferior solutions of the MO optimization algorithm. The key steps in the implementation of GA involve formulation of the fitness function for the problem, choice of representation and coding techniques for the solution, evaluation the fitness of each candidate solution and application of the genetic operators, namely reproduction, crossover and mutation iteratively to evolve the solutions until a desirable solution is obtained [7].

If the network structure is fixed, all the branches between nodes are known, and the evaluation of the objective functions described above depend only on the size and location of DG units. For this reason two control variables were identified for each solution vector. These were the position and size of DG units. A node chosen for installation of a generator was treated as a PV bus, thus the node active power and voltage values had to be specified within their specified limits.

There are different coding techniques to code the solution of GA optimization problems. But the most important ones are binary and real coding methods. In many optimization problems using GA, binary coding was used. But if the number of decision variables increase, binary coding will be complicated and the length of solution vector increased. In addition, the size of DG units is real values and it is easier to represent it with real coding. That's why in this paper real coded GA was used.

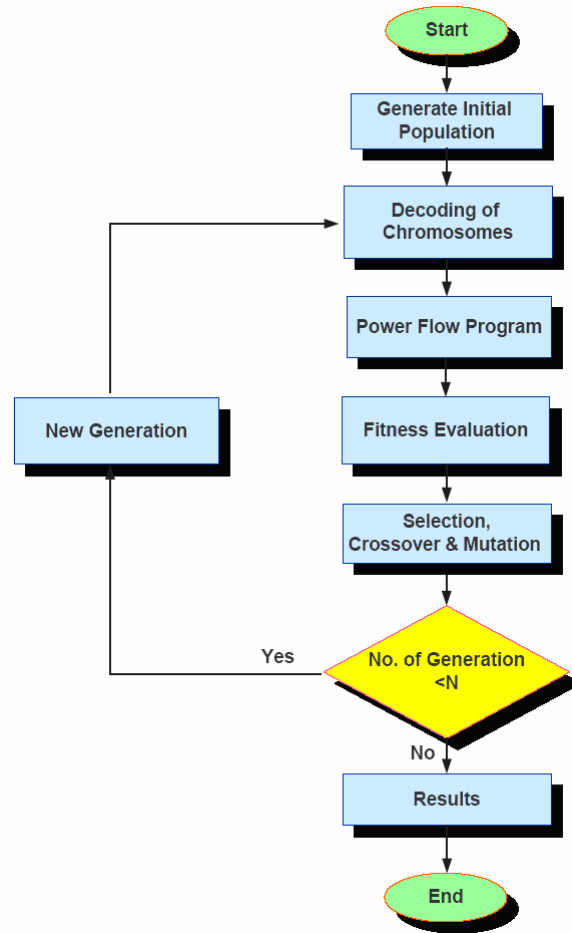
The fitness function was derived from the objective function by transforming it so that the minimization problem became a maximization problem. The following transformation was used:

$$\text{Max } \text{Fitness} = \frac{1}{C} \quad (9)$$

$$C = w_1 C_L + w_2 C_{ENS}$$

Where C is weighted sum of C_L and C_{ENS} .

Figure 1: Optimization process block diagram in sizing and placement of DG units



The implemented GA starts by randomly generating an initial population of possible solutions. For each solution a value of DG penetration is chosen between 0 and a maximum limit, fixed by the planner on the ground of economical and technical justifications; then, a number of DG units of different sizes is randomly chosen until the total amount of power installed reaches the DG penetration level assigned. At this point, the DG units are randomly located among the network nodes and the objective function is evaluated verifying all the technical constraints. Regarding the population size, the best results have been found assuming it equal to the number of network nodes. Once the initial population is formed, the genetic operators are repeatedly applied in order to produce the new solutions. In particular, a “roulette wheel” scheme has been applied for the selection operator and a “two cut-point crossover” has been chosen by which each vector’s element is swapped with probability 0.7. For the mutation operator, all the vector elements are mutated, with a small mutation probability of 0.05. Finally, according to the GA “steady-state” typology, the new population is formed comparing old and new solutions and choosing the best among them. The algorithm stops when the maximum number of generations is reached or when the difference between the objective function value of the

best and the worst individuals becomes smaller than a specified value. The block diagram of the described MO optimization algorithm is depicted in Figure 1.

5. Results and Discussion

In order to show the capability of the proposed algorithm to solve the problem of the optimal DG allocation, a 33 bus distribution test system has been considered. A fast decoupled power flow program for radial distribution systems has been developed and used for simulation of proposed method [8].

The period taken into consideration for the planning study is 10 years long, with all nodes existing at the beginning of the period. For each node a constant power demand growth rate of 5% per year has been assumed. The inflation and interest rate has been considered 7% and 10% respectively. The cost of energy has been assumed 4.2 ¢/kWh.

The total cost of the network during the assigned study period is equal to k\$486.5 (see Table 1.) without any operating DG. Such a high generalized network cost is due to the significant growth rate of the demand, which requires the enforcement of a large number of branches. The attempt to minimize the global cost has led to a solution with many lines operate close to their maximum capacity and for this reason the cost of the energy losses counts for a significant percentage of the generalized cost of the network. The use of DG as an electric supply option can reduce both costs.

Very often the planner needs more alternatives to evaluate and sometimes he can prefer to reduce the cost of losses instead of improving service quality, depending on strategic decisions, regulatory directives regarding the electric service, and budget restrictions. As showed in the following examples, the proposed MO optimization process permits of finding out alternative configurations, characterized by different costs for each single function constituent of the global cost. In each optimization stage the MO algorithm looks for alternative solutions according to weighting coefficient of objective functions. Three cases with different weighting coefficients have been investigated. In the first case study (see Table 2. and 3.), the power losses cost has been regarded and a larger weighting coefficient has been given to it. The value assumed by the cost of the power losses in the initial network configuration is equal to k\$227.4. Three consecutive steps of iteration have been run. In the first iteration, the power losses cost and energy not supplied cost reduced in percentage of the 23% and 5.3% respectively. The total cost also reduced 13.6%. This cost reduction is obtained resorting to a DG penetration level (DG% is the ratio between the DG capacity and the power of load) of 15.98%. In the second iteration, the cost of C_L decreases from the value of k\$175.1 to the value of k\$152.5. The penetration level of DG increases from the value of the 15.98% to the value of 26.67%. Finally, in the third iteration a new optimal solution has been achieved and C_L decreases to k\$138.7 with DG penetration level of 37.34%. In the second case study, the cost of service interruptions C_{ENS} has been regarded with larger weighting coefficient. In this case the planner aims at reducing the number and the duration of service interruptions by positioning DG in suited locations. Even though many standards and almost all the distributors do not generally allow resorting to “intentional islanding” operation, in order to emphasize the effect of DG it has been hypothesized that this practice can take place. In the proposed example, the capability of optimizing the location of DG has been advantageously used to find a network arrangement able to give the customers a much more reliable service avoiding the construction of new emergency ties. The starting network configuration is equal to the previous case study, where the C_{ENS} cost has the value of k\$259.1. With the first optimization step this value is reduced to k\$198.6 (see Table 4.). A further optimization permits reducing C_{ENS} up to k\$169.3 thanks to a new allocation of DG. It is worth noticing that in this case generators are located at the end of long and heavy loaded lateral edges to serve as back up energy sources during upstream faults. Global benefits on energy not supplied and cost of not supplied energy are clearly recognizable, but benefits are much more significant for those customers that suffer for poor quality due to their position in the network.

In the third case, the weighting coefficient for both of costs has been considered the same and equal to 0.5. The results of optimization process were represented in Table 6. and 7.

Table 1: Cost of Distribution Network before DG Installation

C_L (k\$)	C_{ENS} (k\$)	C_{TOT} (k\$)
227.4	259.1	486.5

Table 2: Cost Progression in MO Iterative Procedure (Case 1)

$W_1=0.75, W_2=0.25$			
Iteration No.	C_L (k\$)	C_{ENS} (k\$)	C_{TOT} (k\$)
1	175.1	245.2	420.3
2	152.5	230.4	382.9
3	138.7	221.5	360.2

Table 3: DG Location and DG% (Case 1)

Iteration No.	DG Location (Bus No.)	DG (%)
1	8,31	15.98
2	24,25	26.67
3	8,24,31	37.34

Table 4: Cost Progression in MO Iterative Procedure (Case 2)

$W_1=0.25, W_2=0.75$			
Iteration No.	C_L (k\$)	C_{ENS} (k\$)	C_{TOT} (k\$)
1	220.8	198.6	419.4
2	205.5	180.2	385.7
3	198.2	169.3	367.5

Table 5: DG Location and DG% (Case 2)

Iteration No.	DG Location (Bus No.)	DG (%)
1	8,14	24.89
2	8,30,32	30.23
3	7,8,30,32	40.9

Table 6: Cost Progression in MO Iterative Procedure (Case 3)

$W_1=0.5, W_2=0.5$			
Iteration No.	C_L (k\$)	C_{ENS} (k\$)	C_{TOT} (k\$)
1	208.3	240.7	449
2	194.9	230.6	425.5
3	183.9	213.2	397.1

Table 7: DG Location and DG% (Case 3)

Iteration No.	DG Location (Bus No.)	DG (%)
1	8,32	14.22
2	8,25	24.89
3	8,24,25	33.78

6. Conclusions

The values of Distributed Generation are very dependent on its type, size and location as it was installed in distribution feeders. Hence, a genetic multi-objective optimization for siting and sizing of

distributed generation resources in distribution systems has been performed in order to minimize the cost of power losses and energy not supplied. Simulation results on 33-bus distribution test system have been presented for three case studies. The results show 25.96%, 24.46% and 18.37% reduction on total cost for case1, case2 and case3, respectively.

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Appendix

Figure 2: The 33-bus radial distribution test system diagram

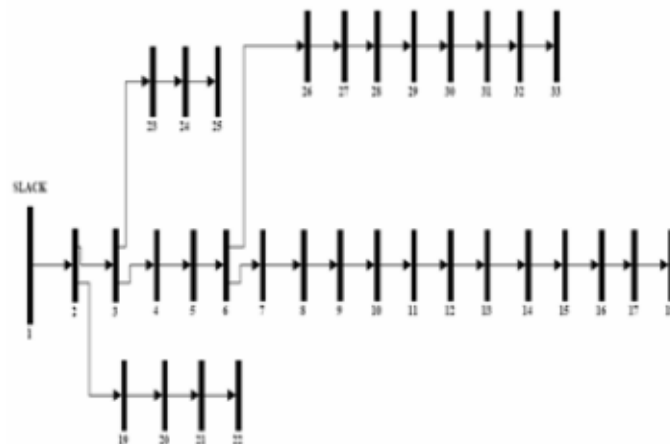


Table 8: Line Length for 33-bus Test System

Line No.	Length (km)	Line No.	Length (km)	Line No.	Length (km)
1	0.103	12	0.125	23	0.650
2	0.350	13	0.427	24	0.641
3	0.335	14	0.452	25	0.270
4	0.279	15	0.457	26	0.390
5	0.134	16	0.245	27	0.194
6	0.560	17	0.300	28	0.449
7	0.540	18	0.120	29	0.304
8	0.453	19	0.224	30	0.496
9	0.510	20	0.512	31	0.187
10	0.306	21	0.423	32	0.192
11	0.200	22	0.198	-	-

Table 9: Data used for Reliability Calculation

Parameter	Overhead Lines
λ	$1.2 \text{ (year.km)}^{-1}$
t_{loc}	2 h
t_{rep}	6 h

Table 10: Load and Line Data for Test System before DG Installation

Sending Bus	Receiving Bus	R (Ω)	X (Ω)	Load at Receiving Bus	
				P (kW)	Q (kVar)
1	2	0.0922	0.0477	100	60
2	3	0.4930	0.2511	90	40
3	4	0.3660	0.1864	120	80
4	5	0.3811	0.1941	60	30
5	6	0.8190	0.7070	60	20
6	7	0.1872	0.6188	200	100
7	8	1.7114	1.2351	200	100
8	9	1.0300	0.7400	60	20
9	10	1.0400	0.7400	60	20
10	11	0.1966	0.0650	45	30
11	12	0.3744	0.1238	60	35
12	13	1.4680	1.1550	60	35
13	14	0.5416	0.7129	120	80
14	15	0.5910	0.5260	60	10
15	16	0.7463	0.5450	60	20
16	17	1.2890	1.7210	60	20
17	18	0.7320	0.5740	90	40
2	19	0.1640	0.1565	90	40
19	20	1.5042	1.3554	90	40
20	21	0.4095	0.4784	90	40
21	22	0.7089	0.9373	90	40
3	23	0.4512	0.3083	90	50
23	24	0.8980	0.7091	520	200
24	25	0.6960	0.7011	320	200
6	26	0.2030	0.1034	60	25
26	27	0.2842	0.1447	60	25
27	28	1.0590	0.9337	60	20
28	29	0.8042	0.7006	120	70
29	30	0.5075	0.2585	200	600
30	31	0.9744	0.9630	250	70
31	32	0.3105	0.3619	210	100
32	33	0.3410	0.5302	60	40

Reflection of US Policy Towards Pakistan in Pakistani Press

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Historical Perspective

Since World War II, after the decline of British and French global colonial dominance, the US emerged as the most potent power on the world scene. As it eventually evolved, Pakistan's relationship with the US became qualitatively different from its relationships with other major countries of the capitalist world for Pakistan has been made subject to a form of indirect colonial rule. The US has exercised a decisive influence, from time to time, on the establishment and survival of regimes in Pakistan. The weight of US power over Pakistan is pervasive. But this is not without its tensions and contradictions, so that often the US has to manipulate forces in Pakistan to achieve its purposes and that not always successfully. The most eloquent testimony to Pakistan's relative autonomy, as a post-colonial state, is the long on-going struggle over Pakistan's nuclear program. Despite pressure and sanctions such as suspension of aid and military supplies, the US does not appear to have been able to do much about it (Hanan, 2006; King & Lester, 2005; and Saleem, 2006).

The story of the US-Pakistan relationship has been an uneven and complex one. The fact is that during the first five years after the partition, Pakistan was quite insecure in the international arena, in its relationships with the US and Britain as well as the Soviet Union, especially in the context of its bitter confrontation with India. The actual and prospective economic stake in India for US and British capital was far greater than what the backward and smaller economy of Pakistan could possibly offer. For the US and Britain there was no point in jeopardizing Indian goodwill because of any entanglement with Pakistan ((Kronstadt, 2007; and Naqvi 2006). The long and checkered Pakistan-U.S. relationship has its roots in the Cold War and South Asia regional politics of the 1950s. U.S. concerns about Soviet expansionism and Pakistan's desire for security assistance against a perceived threat from India prompted the two countries to negotiate a mutual defense assistance agreement in 1954. By 1955, Pakistan had further aligned itself with the West by joining two regional defense pacts, the SEATO and the CTO or "Baghdad Pact." As a result of these alliances, Islamabad received nearly \$2 billion in U.S. assistance from 1953 to 1961, making Pakistan one of America's most important security assistance partners of the period. During and immediately after the Indo-Pakistani wars of 1965 and 1971, the United States suspended military assistance to both sides, resulting in a cooling of the Pakistan-U.S. relationship and a perception among many in Pakistan that the United States was not a reliable ally (p.10).

In the mid-1970s, new strains arose over Pakistan's efforts to respond to India's 1974 underground nuclear test by seeking its own nuclear weapons capability. U.S. aid was suspended in 1979 in response to Pakistan's covert construction of a uranium enrichment facility. However, following the Soviet invasion of Afghanistan later that year, Pakistan again was viewed as a front line ally in the effort to block Soviet expansionism. In 1981, the Reagan Administration offered Islamabad a five-year, \$3.2 billion aid package. Pakistan became a key transit country for arms supplies to the Afghan resistance, as well as home for some three million Afghan refugees, most of whom have yet to return. Despite this renewal of U.S. aid and close security ties, many in Congress remained troubled by Pakistan's nuclear weapons program. With the Soviet withdrawal from Afghanistan, Pakistan's nuclear activities again came under intensive U.S. scrutiny and, in 1990, Bush (senior) again suspended aid to Pakistan. Under the provisions of the Pressler' amendment, most bilateral economic and all military aid ended, and deliveries of major military equipment ceased (Hanan, 2006; and King & Lester, 2005)

In 1992, Congress partially relaxed the scope of sanctions to allow for food assistance and continuing support for nongovernmental organizations. Among the notable results of the aid cutoff was the non delivery of F-16 fighter aircraft purchased by Pakistan in 1989. Nine years later, the United States agreed to compensate Pakistan with a \$325 million cash payment and \$140 million in goods, including surplus wheat, but the episode engendered lingering Pakistani resentments. During the 1990s, with U.S. attention shifted away from the region, Islamabad further consolidated its nuclear weapons capability, fanned the flames of a growing separatist insurgency in neighboring Indian-controlled Kashmir, and nurtured the Taliban movement in Afghanistan, where the radical Islamist group took control of Kabul in 1996. After more than a decade of alienation, U.S. relations with Pakistan were once again transformed in dramatic fashion, this time by the September 2001 terrorist attacks on the United States and the ensuing enlistment of Pakistan as a pivotal ally in U.S.-led counterterrorism efforts. A small trickle of foreign assistance to Pakistan again became a prodigious flow and, in a sign of renewed U.S. recognition of the country's importance, President George W. Bush designated Pakistan as a major non-NATO ally of the United States in June 2004. One month later, a Congressional Pakistan Caucus was formed (p. 11)

Rose, L. E., and, Noor A. H (1987) write in their book "United States-Pakistan Forum" that American foreign policy in a global sense is focused on the two central issues of our times (a) the problem of seeking more just and equitable social, economic, and political progress, can be subsumed by the single word "development", and (b) focused on the questions of war and peace. On the preservation in effect of the human race in the nuclear age, and on the difficult and complex problems of regional and strategic stability that can be subsumed by the single word, "security." Development and security are thus the foci of American global involvement. After Vietnam, an equally significant development has been a greater awareness by the American people vis-à-vis the outside world and their country's role in it. Congress, with its control of the purse and the power of the veto, has been exercising its authority over the chief executive's foreign policy actions. The media continue to be a powerful instrument in U.S. politics, both at home and abroad and are fast overtaking the role of traditional opinion-makers, thus influencing major decisions (p.108).

In recent years, Pakistan has learned firsthand about the reality of the key role that institutions such as Congress, the media, and academia play in shaping U.S-Pakistan relations. The experience since 1971 has been educative. Consequently, many Pakistanis recognize the fact that no matter how supportive a given administration is toward Pakistan, the support of these and other institutions is equally and, at times more, important for the smooth conduct of relations between the two countries. Indeed, it is in these areas that Pakistan needs to impress its positions and explain its national interests. Pakistan focus its full intention on the South West Asia-Middle East region, an area where Pakistan has far greater stakes. U.S-Pakistan relations could be more enduring and tangible if Washington perceived and treated Islamabad as an independent entity, not as its neighbor's coattails. (p.109)

Study Background

A penetrating survey of the last fifty years of Pakistan foreign policy would reveal certain distinct constants which permeate the entire gamut of Pakistan's relations with external world. The first trait which can be easily discerned is the pre-eminence accord to the US by Pakistan policy Planners to ensure the country's security against the perceived threat from outside. Notwithstanding the change in the regional and global scenarios, maintenance of special ties with Washington has always remained the basic motto of the ruling elites. Despite various ups and downs in Pakistan-US relations and Islamabad's membership of the NAM, the country's foreign policy has remained US-tilted (Ali, 2001). After 9/11, Musharraf made a momentous decision to join the war on terrorism. But this did not mean an immediate U-turn on all support to militant groups in Pakistan. The skeptics doubted the US' staying power' lamented the costs of turning against long time Jihadi associates, and questioned the wisdom of picking fights with global terrorist outfits. And he needed US assistance to bolster his political allies and win over the remaining fence sitters (Markery, 2007). In order to build trust with the Musharraf regime, the Bush administration launched a robust engagement strategy, with total assistance to Pakistan estimated at more than \$ 10 billion since 9/11. Washington has also worked through international financial institutions to ease Pakistan's debt burden, opening the door for economic growth of just under six percent for the past four years. And in June 2006, the Pentagon notified Congress' plans to sell up to 36 F-16 jets and associated high-tech weapons system to Pakistan, a major reversal of US policy dating from 1990, when such transactions fell victim to sanctions over Pakistan's nuclear weapons program. Meanwhile, top members of President Bush's national security team have turned Pakistan into a regular destination. Washington's post-9/11 engagement with Islamabad has achieved notable successes. Such achievements would not have been possible without extensive cooperation between Pakistani and US agencies; they also netted extensive information on AL Qaeda's tactics and future plans (p.).

The media are highly diverse in content and in form of organizations and include a very wide range of activities which could have effects on society. Media work most directly on consciousness by providing the constructed images of the world and social life and the definition of social reality. Media take a planned and deliberate role in social development. Media can attract and direct attention to problem solutions or people in ways which can favor those with power, and correlatively divert attention from rival individuals or groups and also segregated society of what the consensus actually is and what the nature of deviations is. Media are responsible for promoting moral panics identifying scapegoats, and acting as a guide to social control (Curran, James, & Michael 1977). Of the different forms of mass media, the press has much importance. Press is one of the dominant institutions of any democratic society. It performs the important function of mediation between the various institutions of society. The press facilitates a constant dialogue between these institutions and create a web of interacting individuals and groups. Additionally, it creates space for expression of opinions, dissent and protest. It also acts as a platform for organizing similar yet divergent ideas and gives them the shape of movements and revolutions (Sharma, 2005).

There has emerged over the last three decades a set of journalistic narratives on "Muslim Terrorism" whose construction is development on basic cultural perception about the global system of nation/states violence and the relationship between Western and Muslim societies. The dominant discourses about these issues help shaped the cognitive scripts for reporting the acts of terrorism carried out by people claiming to act in the name of Islam. The extraordinary nature of the terrorist attacks in the United States on September 11, 2001 produced a significant repute in media (Hasan, & Salam 2007). The press facilitates a constant dialogue between these institutions and creates a web of interacting individuals and groups. Additionally it creates space for expression of opinions dissent and protest. It also acts as a platform for organizing similar yet divergent ideas and gives them the shape of movements and revolutions (Sharma, 2005). Of course, not all analysts of the period were so optimistic about the prospects of the mass media to produce dramatic change in opinions, but it was the dominant view (Wartell and Middlestadt, 1991).

Many studies have focused on the concept of attitude or people's general predispositions to evaluate other people objects, and issue favorably or unfavorably. The attitude construct achieved its pre-eminent position in social influence because of the assumption that a person's attitude is information, on the hand, and behavioral change on the other (Peterson and Thurston, 1933). Over the past 50 years numerous theories of attitude change and models of knowledge-attitude-behavior relationships have been developed (Eagly, & Chaiken, 1993; McGuire, 1985; Petty, Unnava, & Starthman, 1991). Contemporary analysts of mass media persuasion have focused on the variables that determine when the media persuasion will be effective versus ineffective, and what the underlying processes are by which the media induce change. Perhaps the most well known psychological framework for categorizing and understanding mass media persuasion effects was popularized by Hovland and his colleagues (Hovland, 1954, 1959; Hovland, Janis, and Kelley, 1953). Although the person ability to learn and recall new information was often thought to be an important casual determinant of and prerequisite to attitude and behavior change. Little empirical evidence has accumulated to support the view that message learning is a necessary step (Greenwald, 1968; McGuire, 1985; Petty, & Cacioppo, 1981). The message comprehension and learning can occur in the absence of attitude change, and that a person's attitudes can change without learning the specific information in the communication that is a person might be able to comprehend all of the intended information perfectly, but not be persuaded either because the information is counter argued or seen as personally irrelevant. On the other hand a person might get the information all wrong (scoring zero on a knowledge test) but think about it a manner that produces the intended change. This analysis helps to why previous research on mass media effects has sometimes found that message learning and changes in knowledge occur in the absence of attitude change and vice-versa (Petty, Baker & Gleicher 1991).

The attitude change process involves considerable cognitive work does not mean that the attitude formed will be a rational or "accurate one." However, the important point is that a rather thoughtful process in which people attend carefully the issue-relevant information presented changes sometimes attitudes. Examine this information in the light of their relevant experiences and knowledge and evaluate the information along with the dimensions they perceive central to the merits of the issue. People engaged in this effortful cognitive actively have been characterized as engaging in "systematic" (Chaiken, Ciberman, & Eagly, 1989), "mindful" (Palmerio, 1984), and "piecemeal" (Fiske & Pavelchak, 1986) processing. Of course, much of the correlation between print media coverage and ratings of issue importance is due to the fact that the media covers issues, people already think are important. Nevertheless, some researches show that the media coverage can precede public perception (Mackuen, 1981). "Greater thinking about a message can also be included by having the individuals arguments presented by multiple sources rather than just one" (Harkin & Petty, 1981; Moor & Reardon' 1987). The multi-source effect is attenuated if people suspect that the multiple sources are not providing independent analyses of the issue (Harkin and Petty, 1987; Wilder, 1990). When strong arguments are presented, disrupting thinking diminish persuasion, but when weak arguments are presented disrupting thinking should enhance persuasion by reading counter-arguing (Petty and Brock, 1981). Different media sources have an impact on peoples ability to think about message specially people are generally better able to process messages that appear in the print media than those that are controlled externally (e.g., radio and television; Chaiken and Eagly, 1976; Wright, 1981).

Mass communication has the potential to formulate public opinion and polish their behaviors regarding any social phenomena (Petty, 1994). Lass well (1927) concluded, propaganda is one of the most powerful instrumentalities in the modern world. During this period there were several salient examples of seemingly effective mass communication effects. The assumption of Lass well and others was that transmission of information via mass communication produced direct effects on attitude and behaviors (Doob, 1935; and Lipman, 1922). Bernard Cohan (1963) stated that the press may not be successful much of the time in telling people what to think but it is stunningly successful in telling its readers what to think about. Walter Lip-man in his book Public Opinion raised the idea that the mass media create images of events in our minds, the picture in our head. He emphasized that picture of reality created by the news media were merely reflection of reality and therefore sometimes pseudo

environment is created by the media in addition to actual environment. People react to pseudo environment which media creates. (Nawaz, 2006).

The idea of a frame in relation to news has been widely used in place of terms such as frame of reference, context, theme, or even news angle. In a journalist context' stories are given meaning by reference to some particular news value that connects one event with other similar ones. According to Entman (1993) framing involves- selection and salience. He summarizes the main aspects of framing by saying that frames define problems, diagnose causes, make moral judgments and suggest remedies. A large number of textual devices can be used to perform these activities. They include using certain words or phrases, making certain contextual reference, choosing certain picture or film, giving example as typical, referring to certain sources and so on (McQuail, 2006).

In the of the cited references it can concluded that World War II the U.S became a super power and she started to interfere in other countries' affairs including Middle East and South Asia. She made policies which had power to influence the societies at large. Researchers' effort regarding this topic is related to U.S policies towards Pakistan particularly after 9/11. Even after 9/11, US policy makers were well aware that Pakistan was at the centre of the World's worst Islamist terrorist networks. The Bush administration quickly moved to persuade once-sanctioned Islamabad to become an essential partner in the global war on terror. This war drastically expended in Afghanistan, Iraq and after Iraq it seems that there is turn of Iran. It is would be matter of interest to examine the role of the Pakistan elite press' editorial treatment of U.S policy towards Pakistan. Because editorials exist to allow the newspaper (usually in the person of its editor) to comment, give view on and draw conclusions from the day's events. The editorial gives a newspaper the opportunity to address its readership directly, and the editorial is the place where the reader may expect to find overt comment on the news of the day. However, the created reader, the implied reader, is again in evidence as the editorials address a group with shared but not always explicitly expressed values. Due to multidimensional contents people equally prefer newspaper for getting information. The content of the newspaper can be generally divided into two broad categories subjective and objective (Mahsud, 2000). Researchers selected the subjective writing includes editorial and editorial note, which reflect the policies of newspaper.

Data Collection

Three major English dailies "Dawn", "The Nation", "The News", and "Dawn" are selected for the collection of data for the study. The Nation sister newspaper of Nawa-e-Waqat and it is ideology based newspaper. The News' sister newspaper of Jung is considered as pro-government newspaper, while 'Dawn' is an independent leading national English daily. That is why researchers selected these newspapers to examine and check their opinion pages' treatment of US policy towards Pakistan. Systematic sampling procedure is adopted through which 135 newspapers (containing 45 issues of each newspaper) out of total 270 issues of the selected three dailies are being selected for analysis. All those editorials and editorial notes published on the issues, such as politics, economics, education, health, defense, and terrorism by the selected newspapers are taken as unit of analysis. To adequately deal with the data collection on scientific way, a broad level standardized coding sheet is developed in which exclusive and exhaustive categories are created. The required data was collected from initially 21 newspapers containing 7 issues of each selected newspaper. Six coders (students) were properly trained and facilitated to check the authenticity of the coding sheet.

Coding Sheet

	Categories	Politics	Economics	Education	Defense	Health	Terrorism
Editorial	Total space Favor Against Neutral						
Editorial Note	Total space Favor Against Neutral						

The required data for the study in hand was collected through the analysis of the editorial pages of the newspapers issues from 1st January to March 31st, 2007. First, data is analyzed thoroughly and then with the help well-defined coding sheet, the data was converted from qualitative to quantitative manner. Pilot study is made to check how reliable the coding process is (Hansen, A. et al., 1998). Reliability in content analysis is essentially about consistency: consistency between different coders (inter-coder reliability), and consistency of the individual coder's coding practice over time (intra-coder reliability). There are several different ways of checking or measuring reliability in content analysis, from a simple check on the percentage of coding decisions which coders agree, to more complex formula which take into account the degree to which a certain level of agreement would occur simply by chance in a set number of coding decisions (pp.120-21). Higher percentage of inter-coder reliability was observed. In this way, finally the required data from the selected 135 newspapers was collected. Total measurement of the all the newspapers was observed as:

'The Nation'	(a) total number of published editorials=	09 (space 1691 in cm).
	(b) total number of published ed. Notes=	27 (space 3470 in cm).
'The News'	(a) total number of published editorials=	05 (space 1068 in cm).
	(b) total number of published ed. Notes=	17 (space 2865 in cm).
'Dawn'	(a) total number of published editorials=	12 (space 2363 in cm).
	(b) total number of published ed. Notes=	10 (space 1244 in cm).
All Papers	(a) total number of published editorials=	25 (space 5122 in cm).
	(b) total number of published ed. Notes=	53 (space 7579 in cm).

Findings

The results of the study reveal the overall editorials and editorial notes coverage to United States policy towards Pakistan by the elite English press—daily 'The Nation', 'The News' and 'Dawn' for the months of January, February and March, 2007. The analytical review of figures 1.1 & 1.2 illustrates that 'The Nation' for the first entire month of the study did not publish any editorial on the issue under investigation and for the same month published significantly more editorial notes. While for the month of February the paper published more editorials and less editorial notes on the same issue. Similarly for the month of March the said paper published reasonable editorials and somewhat editorial notes on the study's issue. The month wise comparison of the paper in term of the published editorials shows that the paper significantly published more editorial notes on the issue compare to its editorials for the whole three months stipulated period.

Reflection of US Policies by The Nation

Figure 1.1: Editorial

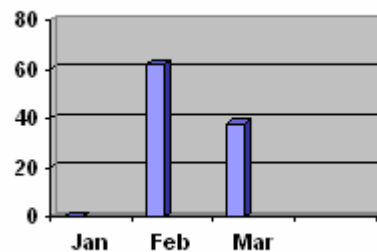
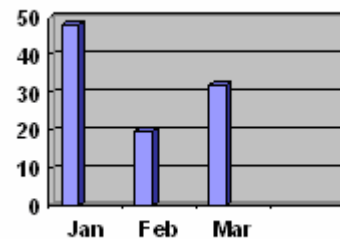


Figure 1.2: Editorial Notes



The analytical review of figures 1.3 & 1.4 illustrate that ‘The News’ for the first month of the study published less editorials and more editorial notes on the issue of US Policy. While for the month of February the paper published no editorial, and published more editorial notes on the issue. Similarly for the month of March the said paper published significant editorials compared to its editorial notes. The month wise comparison of the paper in term of the published editorials shows that the paper significantly published more editorial notes on the issue for the three months period than its number of editorials published on same issue. It can be concluded that the issue is given little more importance in the paper’s editorial notes compared to its editorials.

Reflection of US Policies by The News

Figure 1.3: Editorials

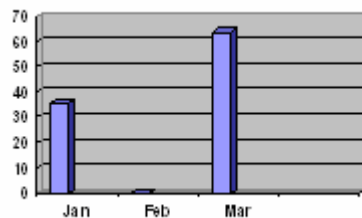
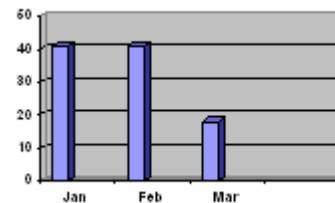


Figure 1.4: Editorial notes



The daily ‘Dawn’ comparison of editorials and editorial notes published on the mentioned issue shows that the paper for the study’s first month published less editorials and more editorial notes on the reflection of US Policy (figures 1.5.& 1.6). The results further illustrate that for the month of February the paper published more editorials than its editorial notes published on the said issue. It is also observed that the paper for the month of March published more editorials and editorial notes, but the comparison shows that the said paper relatively published some what more editorial notes than its editorials. It can be concluded that the paper that the paper significantly published more editorials and editorial notes on the issue for the month of March compared to its matters for the months of January and February. While the comparison of the published editorial notes on the issue illustrates that again the paper published more editorial notes for the month of March than its editorial published for the months of January and February. It can be summarized that all the national dailies have given more importance in editorial notes than their editorials.

Reflection of US Policies by Dawn

Figure 1.5: Editorial

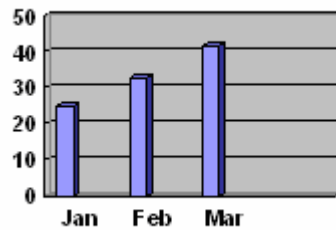
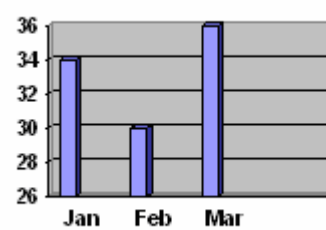


Figure 1.6: Editorial Note



Figures 1.7 & 1.8 reveal the selected three national English dailies' published editorials and editorial notes on the issue of US policy toward Pakistan for the whole three months study's period. It is evident from the findings that all the three dailies have given more importance to the issue in their editorials for the month of March compared to their editorials published on the selected issue for the months of January and February. Similarly the comparison of the selected papers editorial notes on the issue shows that the leading dailies have given significantly more coverage to the issue by their editorial notes for month of January than their importance in editorial notes given to the same issue for the months of February and March.

Reflection of US Policies by the three dailies

Figure 1.7: Editorials

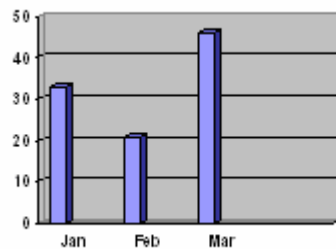
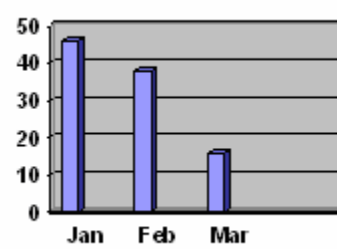


Figure 1.8: Editorial notes



Month wise editorials' comparison of the selected dailies shows that all the papers published more editorials on the issue for the month of March compared to their published editorials on the same issue for the months of January and February. While their published editorial notes' comparison illustrates that all the dailies published more editorial notes on the issue for the month January than their editorial notes published for the months of February and March on the same issue.

Table 1.1: 'The Nation' three months coverage of the issue

Months	Editorial	Space	Ed. notes	Space
January	00	00	12	1653
February	05	055	06	689
March	03	636	09	1128
N:	09	1691	27	3470

The figures of table 1.1 illustrate the number of editorials and editorial notes and the space given to reflection of US policies by daily 'The Nation' for the period of three months. The results show that for the month of January the paper published total twelve editorials with the observed space (1653) given to them, for the month of February the paper has published five editorials with space

(1055) devoted to them, and six editorial notes with the observed space (689) devoted to them. For the month of March the daily published three editorials with 636 space, and nine editorial notes with measured space 1128. As evident from the findings that The Nation for the entire study period published more editorial notes and also devoted more space compared to its number of published editorials and space given to them.

Table 1.2: ‘The News’ three months coverage of the issue

Months	Editorials	Space	Ed. notes	Space
January	02	385	07	1187
February	00	00	07	1168
March	03	683	03	510
N:	05	1068	17	2865

The results of table 1.2 reveal that daily ‘The News’ for the month January has published two editorials with 385 space in centimeter, and seven editorial notes (1187cm space), in February published again seven editorials (1168 space), and in March published three editorials (383 space), and only three editorial notes (510 space). The review of intra daily ‘The News’ editorials and editorial notes space coverage given to US policy for the period of three months reveals that the paper published more editorial notes (17) with more space (2865) on the issue than the its total number of editorials (05) and space (1068) given to them.

Table 1.3: The ‘Dawn’ three months coverage of the issue

Months	Editorials	Space	Ed. notes	Space
January	03	594	04	423
February	04	775	03	369
March	05	994	03	452
N:	12	2363	10	1244

The findings of the study (table 1.3) reveal that daily ‘Dawn’ for the month of January published three editorials (594 centimeter space), and four editorial notes (423 space), in February published four editorials (775 space), and three editorial notes (369 space), and for the month of March published five editorials (994 space), and three editorial notes (452 space). The review of intra daily ‘Dawn’ editorials and editorial notes space coverage given to US policy for the period of three months reveals that the paper published more editorials (12) with more space (2363) on the issue than the number of its editorial notes (10) and the observed space (1244) given to them.

Table 1.4: Reflection of US by the selected papers

Papers	Editorials	Space	Ed. notes	Space
The Nation	08	1691	27	3470
The News	05	1068	17	2865
Dawn	12	2363	10	1244
N:	25	5122	53	7579

The review of the selected three major national dailies’ editorials and editorials space coverage given to US policy for the period of three months reveals that daily ‘Dawn’ published more editorials (12) and also devoted more space (2363) to the published editorials compared to ‘The Nation’ and ‘The News’ number of editorials and their space given to the published editorials (table 1.4). The comparison of all the selected papers’ editorial notes published on the same issue for the same period illustrates that ‘The Nation’ has published more editorial notes (27) and also spared more space (3470) to the them than ‘The News’ and daily ‘Dawn’ number of editorial notes and total observed space.

Treatment of US Policy by the selected newspapers

Figure 1.9: editorials' treatment

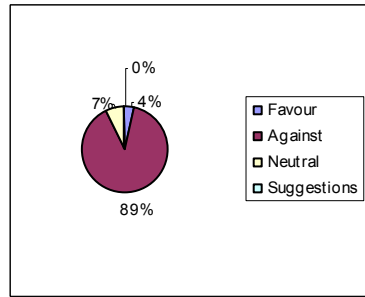
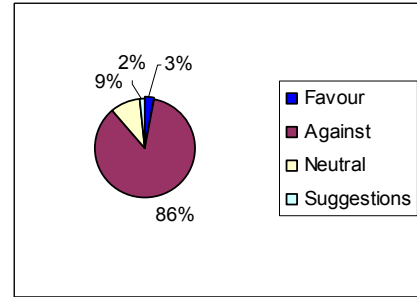


Figure 1.10: editorial notes' treatment



The results of figure 1.9 obviously illustrate that all the national leading dailies have devoted significant (89%) space to their editorials that have condemned the United States policies towards compared to their nominal space given to favorable or neutral editorials' content. This condition is clearly in the line with the Pakistani people feelings and attitudes that at present our country follows United States policies through the world with particularly her policy regarding Afghanistan, Iraq, Iran, Kashmir, and Waziristan. The papers editorial treatment also negates the official claim that Pakistan has a very strong relationship with US. The papers stressed upon the need that we should not compromise on basic principles. The same picture that has shown by the newspapers editorials also depicted in figure 1.10 that illustrate that all the dailies have spared significantly (86%) space to the statements that are stand against the United States policy toward Pakistan compared to their nominal space given to favorable or neutral editorials' content.

Figure 1.11: Editorials coverage to US Policy

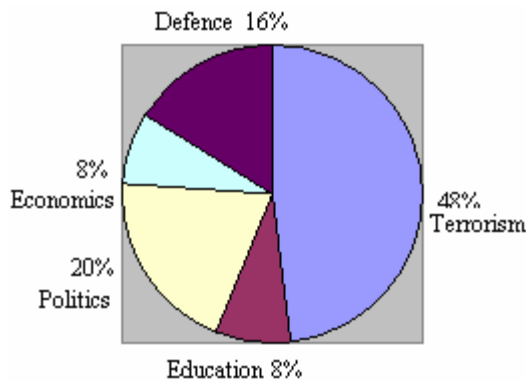
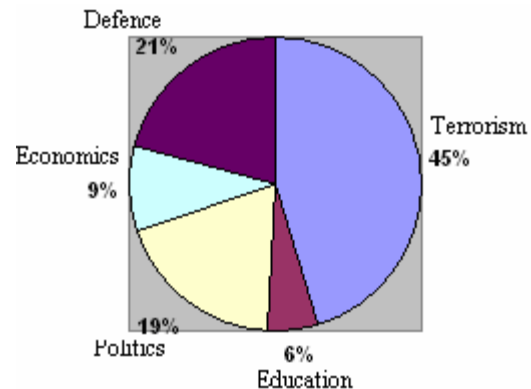


Figure 1.12: Editorial notes coverage to US Policy



The elite press editorials and editorial notes coverage to the United States policy towards Pakistan shows no significant difference (figures 1.11 and 1.12). However, the findings clear cut illustrate that all the editorials and editorial notes paid significant focus on US policy on the war of terrorism followed by interference in Pakistani politics and defense situation with the false pretext that the United States and NATO are fighting, just as the Pakistani military establishment has for some time supported Al Qaeda and other Jihadi organizations operating out of Afghanistan, northern and western Pakistan, and in Kashmir.

Conclusion

as it is evident from the observed empirical findings that all the selected national dailies have published more editorial notes and also devoted more space compared to their number of published editorials. It was also observed that all the papers have devoted highly significantly (89%) space to the condemning

matters of editorials on U.S. policies compared to their nominal space given to favorable or neutral editorials' content. This situation strongly supported the research hypothesis that 'it is more likely that all the papers give more space to their editorials published against on U.S. policy. It was further observed that all the selected newspapers have spared highly significant (86%) space to editorial notes statements that are stand against the United States policy towards than their space given to favorable or neutral editorial notes content which strongly endorsed the research hypothesis that it is more likely that all the papers give more space to their editorial notes published against the of U.S. policy towards Pakistan. The results also extended support to another research hypothesis that 'it is more likely that all selected papers' editorial matters give more coverage to the US policy on terrorism, then their coverage to US policy on defense, education, politics, and economic issues.

Summary and Discussion

This study was planned to explore how the three elite national dailies editorial content treatment of U.S policies towards in term of some issues of national and international importance. It was observed that all the newspapers have given due importance to the US policies, but the papers in most of the cases strongly opposed the US policy on some vital issues such as, US aggression in Afghanistan, Iraq, and particularly in Waziristan. As it was evident from the observed empirical findings that all leading dailies did not extent support to the US policies not only towards Pakistan but towards Iraq, Iran, Afghanistan, and Middle East. The papers have strongly opposed the US and to some extent Pakistan view point on various issues particularly the US aggression in Waziristan and most of the affairs of our country with a set of logic based upon national interest. The papers' significant unfavorable treatment of US policies is in the line with the view of Grare (2007) "Rethinking Western Strategies Towards Pakistan" that without Pakistan's active and full cooperation, the United States and the broader international community cannot reconstruct Afghanistan, defeat the Taliban, and turn the tide of international terrorism. Yet most observers (Poole, 2000; and Hanan, 2006) agree that Pakistan has not provided the fullest possible cooperation. Debate is growing about whether the Pakistani state is merely unable to do better or is actively undermining international efforts in Afghanistan and against terrorism. The Grare (2007) report makes the case that the Pakistani state bears responsibility for the worsening security situation in Afghanistan, the resurgence of the Taliban, terrorism in Kashmir, and the growth of Jihadi ideology and capabilities internationally. At the core of the problem is the Pakistani military, which has dominated Pakistan's politics since 1958 and has developed over the years nationalism based more on its own delusions of grandeur rather than on any rational analysis of the country's national interest. Inheriting a highly divided polity, the Pakistan army has tried to muster solidarity by stoking religiosity, sectarianism, and the promotion of jihad outside its borders, particularly in Afghanistan and Kashmir.

The review of the anti US policy editorials' content showed that the Pakistan elite press view points are mush relevant to the view point of previous studies (Durrani, 2005; Resse, 2001; Mughees, 1997; Berenger, 2004; and King & Lester, 2005). They are of the view that the United States and most Western countries have traditionally dealt with Pakistan according to short-term interests, and they have left deep, structural problems to "the next administration." Pakistan exploited this natural tendency by offering assistance in achieving urgent U.S objectives—establishing listening posts to spy on the Soviet Union, offering entry to China, and assisting in expelling Soviet forces from Afghanistan and capturing Al Qaeda leaders. Throughout much of this history, Pakistan has been led by military dictators. In return for helping the United States pursue its objectives, these dictators obtained sizable economic and military aid and political support. Indeed, Pakistan is now arming and training forces that the United States and NATO are fighting, just as the Pakistani military establishment has for some time supported Al Qaeda and other Jihadi organizations operating out of Afghanistan, northern and western Pakistan, and in Kashmir.

The elite press showed disagreement with Pakistan' outstanding support to U,S and supported the view of Grare (2007) that Pakistani priorities reflect the specific institutional interests of the

military and therefore cannot be fundamentally changed unless the army gradually cedes its political role to representative civilian leaders and limits itself to defending borders. In other words, the United States and other international actors vital to Pakistan's future must stop taking the metaphorical bribe of partial Pakistani cooperation in fighting Al Qaeda terrorists in return for propping up an unrepresentative, military government. The papers urged new strategy to be designed to encourage Pakistanis, particularly the military, to reestablish the preeminence of civilian government according to the Pakistani constitution. The key to this strategy is to not allow Pakistan to trade off democratization for the country's cooperation on terrorism, Afghanistan, and to a lesser extent, Kashmir. Pakistani progress on these objectives would bring increased international rewards, while its abandonment of a single one of them would expose the Pakistani leadership to the withdrawal of foreign assistance.

The papers editorials comments on the US aid to Pakistan revealed that the amounts of aid are impressive, and the United States and Pakistan are developing multi-year programs that testify to a mutual renewed commitment to a strong and enduring bilateral relationship. This is an important time in U.S. relations with Pakistan and in our relations in this part of the world more generally. The papers editorial stand on President Bush speech in Washington, spoke of the importance of democratic development globally and described U.S. policies as a "forward strategy of freedom, representative governments in different parts of the world will reflect their own cultures and their own historical experience, they will not, and should not, look like us" showed very much clear position. That is that Pakistan has long been a strong US ally, but now more than ever, Pakistan stands as an important and pivotal nation in the world. Pakistan is a large, moderate Muslim nation with a diverse population in a very critical region. It serves as the gateway, the crossroads, to both Central and South Asia. Pakistan's continued progress and development are vital not only for its own people, but also for the stability of the region, the United States, and the rest of the world. The editorials matter further revealed that US support to Pakistan only for security and counter terrorism. It was further observed that the nation press was of the firm view that U.S. media support U.S. policies on foreign affairs and framed foreign countries images accordingly to government's interests. The Pakistani media stand is strongly acknowledged by Colton (2007). He said I am a great admire of the Pakistani news media. I read at least nine English newspapers every day and get translation of many Urdu papers and watch TV and listen to the radio. In fact, I really enjoy all the press/media in Pakistan and applaud all for the great strides made every day towards more independent and responsible media.

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Storage and Cost Efficient Mining on an OLTP System using Schema Enhancement Method

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Abstract

Mining process has been in research now-a-days. There have been many efforts done to improve the DSS solution and make it reliable and practical for OLAP (DWH) systems however there need a lot of efforts to implement the same for OLTP systems. Schema Enhancement method to improve the Performance of the system has been very practical [1] however by applying the same method, Storage and Cost of OLTP can also be decrease. The method will be applied to the normal OLTP system and the Mining module developed by this method will be the part of actual schema of OLTP.

Keywords: Online Transaction Processing, Online Analytical Processing, Decision Support System, Performance Efficient Mining on an OLTP System using Schema Enhancement Method [1].

1. Introduction

OLTP systems are in high demand in developing countries like Pakistan. These systems are implemented in shops and small factories. These systems are very helpful to run the daily business and help improve the efficiency of the business and by applying the DSS [1], efficient business forecasting is done without implementing high cost DSS software.

In the research paper “**Performance Enhancement mining on an OLTP System using Schema Enhancement Method**”, the performance effective aspect of the Schema Enhancement Method is discussed. The System become very efficient and Query time decreases thus resulting in the effective solution for an OLTP environment.

Storage and Cost is also one of the issues for OLTP systems, as the volume of daily business is very huge, it become very difficult to manage the data after 3-4 years and it is also not practical to save all the data in the system instead only some data is required for Reporting and business foresting purposes. Schema Enhancement method helps to achieve these targets by modifying the schema to include the DSS module in the OLTP system normal function of the system is not affected by this enhancement.

2. Case Study (UFone PTML Pakistan, Image Processing System)

UFone, Pakistan Telecommunication Mobile Limited, provides Mobile Services in the country. Company has its Head Office in Islamabad, Pakistan. Company has developed an Image Processing System for the Data entry of CSAF. These forms are filled and submitted by the customers at the time of new SIM purchase. It also benefits two folds i.e. data availability for the PTA and relevant government departments and the elimination of the manual data entry of the subscriber antecedents (through the ICR technique).

Schema Enhancement was applied on the existing System without making any changes in the Software.

In the scanning system, complete data is loaded including the Image of the form and identity card copies (front and rear side) of the customer. Image is stored for permanent basis after QC is done from data. After the process text data is not needed and I can safely be deleted from the system however for reporting purpose it is not deleted. After the implementation of Enhanced Schema, separate space is allocated and data for reporting module (DSS) is loaded in that schema. This schema is a part of actual system however data is loaded on regular interval time. This save a lot of storage as text data is deleted and only reporting data is saved. Cost of hardware is also saved as there need less storage and no high fi system is required to run reporting.

System efficiency is increased and less storage is required to save the reporting data.

Table 1.1: Comparison Report

	No of Records	Bytes	Kilo Bytes	Mega Bytes
Conventional OLTP	5680435	5091885056	4972544	4856
Enhanced Schema	5608	20971520	20480	20

Table 1.2: Yearly Analysis

Year of Sale	No of Records
2004	20806
2005	80146
2006	1001345
2007	1680435

3. Storage and Cost Efficient Schema Enhancement Method

Storage and Cost Efficient System is the demand of every business of the 21st century. Storage Efficient method as compared to the conventional OLTP is very practical approach for some organizations. As from the comparison it is clear that the storage required to store the summary data that can be used for future reporting and analysis purpose occupy very less hard drive space as compared to the actual data and thus reducing the cost of the overall system.

4. Conclusions

Schema Enhancement Method has shown very positive results on this Implementation. We are hopeful that the results on other systems will also be very practical. This process is very easy to implement and the normal structure of the system is not affected by the change.

Acknowledgement

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Statistical Approach on the Impact of the Activity of the Industrial Zone of Skikda on the Quality of the Waters of Saf-Saf Wadi (Skikda Algerian East Coasts)

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Abstract

During the period that spreads between August 2005 and October 2006, has been done a follow-up of the variations of eight physicochemical parameters, in the residuary waters of the Saf-Saf wadi upstream and downstream the passage of this wadi by the petrochemical zone of Skikda "ZIK1". This sampling is completed by another sample done at sea, which is in continuity with the diffusion of the water flux of the Saf-saf wadi in the bay of Skikda.

The chosen parameters are represented by the temperature, the pH, the dissolved oxygen and the conductivity, by two elements considered like undesirable Iron and the Copper and by two toxic elements mercury and lead. The choice of these parameters is justified by the nature of the industrial activities in the petrochemical zone of Skikda and their impact on the aquatic life of the gulf of Skikda.

Keywords: Residuary waters, industrial zone of Skikda, Statistical treatment, chemical pollution, impact on the environment.

Introduction

The pollution by the residuary waters to the level of the Saf-saf wadi is linked to the industrial dismissals (petrochemical, agro-alimentary industry etc.), to waters from urban origins and to the results of the use of the pesticides and fertilization in agriculture.

Our preoccupations move toward the quality of water that decreases with time in this important river in this region, from where the necessity to conduct frequent and extended controls.

The present work is interested in the identification of the chemical pollution in the Saf-saf wadi during the period spreading between August 2005 and October 2006 either a period of 15 months.

Our objective is to achieve a comparison between the qualities of the water of this river, before and after its passage by the petrochemical pole of Skikda, on the basis of the regulation texts adopted in Algeria (J.O.R.A, 2006) as well as to note the impact of these changes on the receiving environment.

Material and Methods

Presentation of the survey zone

The industrial activity is especially intense in the department of Skikda. The industrial zone of Skikda (ZIK) is located at the East of the city of Skikda with a surface of 1200 ha (Fig1). It regroups several specialized units in transportation, refinement and transformation of the hydrocarbons.

All this concentration of activities generates liquid dismissals. These dismissals are either, rejected directly in the sea or by the slant of Saf-saf wadi that it also succeeded thereafter in the sea. Saf-saf is a river that borders the (ZIK) by the West on a length of 6 km, its middle width is of about twenty meters with a debit of $569 \text{ m}^3/\text{s}$ (SCI, 1989) (fig. 1).

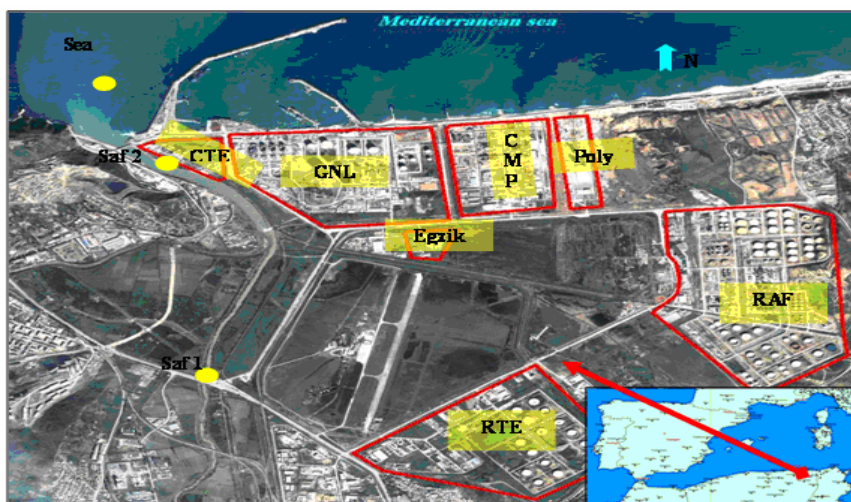
To better surround the problems and the nuisances generated by the industrial zone of Skikda (ZIK), we conducted survey on the water quality of the Saf-saf wadi upstream before its passage by (ZIK) (Saf 1) and a station downstream in the mouth of the Saf-saf wadi with the sea (Saf 2) and the third witness point in the Sea (figure 1).

Collect and chemical analysis of the data

Because of the difficulty to define a satisfactory and representative sampling technique, the withdrawals are done manually and instantaneously. This type of sampling is of a big interest when it is about studying some parameters in the state of traces or susceptible of very big variations (Prichards, 1995 and Rodier, 2003).

Three points are chosen, two to the level of the riverbed of the Saf-saf (upstream and downstream) to the coordinates (Saf 1: $6^{\circ}56'17'' \text{ E}$ & $36^{\circ}51'23'' \text{ N}$) and (Saf 2: $6^{\circ}55'54'' \text{ E}$ & $36^{\circ}55'54'' \text{ N}$). The third point is located at level of sea, to the coordinates (sea: $6^{\circ}56'5'' \text{ E}$ & $36^{\circ}52'56'' \text{ N}$) (figure 1).

Figure 1: Sampling stations for the study



The physicochemical characteristics measured in the sampled residuary waters are: the temperature (T°), the (pH), the conductivity (condi) and the dissolved oxygen (O_2). All these parameters are measured by means of land probes WTW type 197-S. The inorganic parameters are represented by four metals iron (Fe), the copper (Cu) and lead (Pb), they are measured out by means of a spectrophotometer to flame references D2576 (ASTM, 1974). The mercury (Hg) is measured by means of a mercury-meter references D3223 (ASTM, 1974).

Statistical analysis of data

After data's collection, a statistical treatment of these last is imposed. The data collected by stations constitute a matrix ($8 \times 15 = 120$). At first, we calculate the statistical parameters of basis for every characteristic, and then we compare the 3 stations between them for each of the 8 variables with the help of the test of analysis of variance to criteria of classification (ANOVA) (Dagnélie, 1975 and 2006).

An observation in group or hierarchical classification has been achieved according to the method of Bouroche and Saporata (1980), which permits to estimate the level of likeness or divergence between the sites, object of our survey, and to get a distribution of these stations in groups or homogeneous classes. The survey of the structuring and the classification of the 3 stations in groups are achieved with the help of the method of the simple linkage and the Pearson distance (Dagnélie, 1975 and 2006; Palm, 2000 and X, 2000).

All calculations have been executed with the software MINITAB of analysis and statistical treatment of the data, version 14.1 for Windows (X, 2000).

Results and discussions

The description of data in each site, for all physicochemical parameters, is presented in the table 1.

Table 1: Description data results.

Variable	Saf-saf 1			Saf-saf 2			Sea		
	M	SE	SD	M	SE	SD	M	SE	SD
T ($^\circ\text{C}$)	18,93	1,26	4,89	24,82	1,17	4,53	20,67	1,16	4,48
PH	7,4833	0,0949	0,3674	7,565	0,112	0,435	7,768	0,122	0,473
Condi(mS/cm)	1,498	0,100	0,388	49,40	1,96	7,58	55,497	0,761	2,948
O_2 (p.p.m)	4,925	0,485	1,879	5,777	0,217	0,841	6,326	0,268	1,037
Hg (p.p.m)	0,0928	0,0795	0,3081	0,00449	0,00267	0,01034	0,00165	0,00105	0,00406
Fe (p.p.m)	3,10	1,48	5,73	0,526	0,149	0,578	0,519	0,114	0,440
Cu (p.p.m)	0,00667	0,00256	0,00993	0,00887	0,00378	0,01464	0,01513	0,00854	0,03307
Pb (p.p.m)	0,0251	0,0152	0,0588	0,0378	0,0183	0,0708	0,0561	0,0232	0,0898

The results of the test of analysis of variance to a criteria of classification (ANOVA) presented in the table 2, show the existence of significant differences between the three stations for [T ($^\circ\text{C}$), O_2 (mg/l), Condi (mS/cm)]. These differences are linked to the nature of waters rejected in the river, by the industrial pole of Skikda, which changes its main physicochemical features completely. For the pH the differences are non significant. With regard to the variations of the heavy metals (Fe, Cu, Hg, Pb) significant differences don't exist between the 3 stations, it is linked to the diffusion of these metals in the import quantity of rejected waters and also to the different variations of these inorganic variables in the natural habitat (absorption by the living organisms, combination with other elements more complex to detected, evaporation or precipitation) (Rodier, 1982.; Bliefert and Perraud, 2001 and Quevauvillers, 2001).

Table 2: the ANOVA results

Variable	F	p
T (°C)	6,39	0,004 **
PH	1,77	0,183 ns
Condi(mS/cm)	593,35	0,000 ***
O2 (p.p.m)	4,22	0,021 *
Hg (p.p.m)	1,27	0,291 ns
Fe (p.p.m)	2,99	0,061 ns
Cu (p.p.m)	0,62	0,544 ns
Pb (p.p.m)	0,66	0,522 ns

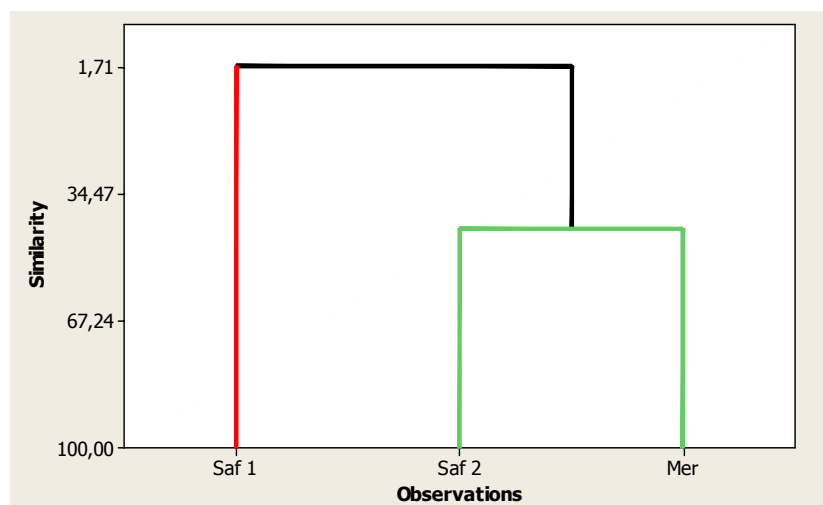
$p > \alpha = 0,05$: (ns) not significant

$p \leq \alpha = 0,05$: (*) significant

$p \leq \alpha = 0,01$: (**) highly significant

$p \leq \alpha = 0,001$: (***) very highly significant

Figure 2: Dendrogram with Single Linkage and Pearson Distance



The regrouping of the 3 stations according to the physicochemical quality of analyzed waters, by means of a dendrogram with simple linkage and Pearson distance, with a level of similarity of 43,40% (Figure2), permits to distinguish two distinct groups. This classification gives a first group composed by the point (Saf 1), characterized by river waters with normal temperature following the seasons, low conductivity, a neutral pH and a rate of dissolved oxygen relatively middle. The second group shows the closeness between the point (Saf 2) and the point (Sea). This two stations in spite of their different natural features, the first point is situated to the level of the mouth of Saf-saf wadi and the second point is located at sea level are very close. This likeness is bound to the liquid discharges rejected by the industrial zone of Skikda which have a direct influence, not only on the quality of the waters of Saf-saf wadi, but also on the quality of the waters of the bay (more elevated temperature, very elevated conductivity, relatively neutral pH etc.).

Conclusion

The present work is about the variability of the industrial chemical pollution in the residuary waters of Saf-Saf wadi (Skikda).

The gotten results are exploratory, and show the influence of the industrial activities on the quality of the waters of the waters courses in the region of Skikda. The present work must be done on several years in order to better surround the accumulation of these parameters, especially the heavy

metals, in the sediments and in the marine fauna and flora, and therefore to follow their cycles in the food chain.

In the future this type of survey must be driven not only in an aim to satisfy the texts and guides, but also to succeed to a better respect of the middle while assuring a reasonable effort to decrease these nuisances in their whole.

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Toxicokinetic Studies of Cadmium and Zinc in Goats Following Intratracheal and Intravenous Administration of Particulate Matter

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Abstract

Toxicokinetic studies of chromium and zinc in dust particles were carried out following intratracheal and intravenous administration of dusts to goats at a dose of 50mg/kg. Blood samples were collected at 0.25, 0.5, 1, 2, 3, 4, 6, 8, 12, 18, 24, and 36 hours following administration of dusts. Tissue samples were similarly collected post-mortem on days 3, 7, 14, 21, and 28. The results of the serum kinetics study showed that the elements present in the dust were readily absorbed following intratracheal and intravenous administration and distributed to various organs and tissues. High concentrations (68.8 ± 16.9 - $265.2 \pm 32.5 \mu\text{g/g}$) and low concentrations (0.31 ± 0.03 - $0.51 \pm 0.05 \mu\text{g/g}$) respectively of chromium and zinc were measured the tissues. The concentration of chromium and zinc were determined using Atomic Absorption Spectroscopy (AAS). The elements had highest half-lives in lungs (up to 173.2 days) for intratracheally treated animals. This study has shown that the liver acted as the main accumulator of the elements of interest. The enhanced half-lives and low elimination rate constants in tissues was an indication of how widely the elements were distributed. There was however an indication that chromium and zinc would be eliminated from the studied organs with time.

Keywords: Toxicokinetic, Cadmium, Zinc, Goats, Intratracheal, intravenous, Particulate matter.

Introduction

Particles in the atmosphere make up the most visible and obvious form of atmospheric pollution. They are made up of an amazing variety of materials and discrete objects that may consist of either solid or liquid droplets (Stanley,2005). Exposure of population to these dusts through inhalation is therefore of environmental concern as particulates often lodge and exert chronic effects on the lungs.

Elemental contents of suspended particulate matter from Maiduguri, Nigeria have been determined (Ogugbuaja and Goni, 1999; Ogugbuaja and Barsisa, 2001, Moses *et al.*,2007). These dusts show appreciable high levels of heavy elements. Biological systems possess mechanisms for absorption, transportation, storage and excretion of elements. This helps to keep the level in the body optimal. It is important therefore to understand the distribution of trace elements in biological systems as elements are known to accumulate in the blood and tissues. (Schwartz,1977). Cadmium (Cd) is a naturally occurring metallic element that is used for electroplating and galvanization processes, in the production of pigments, batteries and as a chemical reagent (ATSDR, 1989) It is a known carcinogen. Zinc is an essential element in the nutrition of human beings, animals, and plants. It is required in the genetic make-up of every cell and is an absolute requirement for all biologic reproduction (O'Dell, 2000). Its accumulation in the body is harmful.

It has been recognized that measurement of the circulating concentration of metals and their metabolites can provide useful information on the magnitude and duration of exposure of possible sites of toxicity (Rosenstock, 2004). Such information on the toxicokinetics of elements provides an understanding of the extent of absorption, distribution and the pathways and rates of elimination. This study therefore, was undertaken to add to the knowledge in this area.

Methodology

Collection of dust samples

The study was conducted in Maiduguri, Nigeria. The dust collection technique was carried out according to the method described by McTainsh and Walker (1982). The technique is designed to measure the amount of suspended dust falling to the ground from the atmosphere. Samples were collected from low and high density areas of the town. Sampling was done twice weekly for each location for a period of one year, pooled and used for subsequent studies.

Experimental animals

The Forty-three (43) adult healthy Sahel goats of both sexes were used for the studies (blood kinetics, 10; tissue kinetics, 30; control, 3). The goats were fed with green leaves and husk of grains and water was provided *ad libidum*.

Blood Kinetic Study

Ten adult Sahel goats of both sexes were used. The goats were apparently healthy at the onset of the experiment. The goats were separated randomly into two equal groups. One group was treated with the dust sample in phosphate buffered saline (PBS) solution intratracheally at the dose of 50mg/kg body weight, while the other group was treated with the same dose intravenously. The intravenous administration was done through the left jugular vein using a syringe and needle. All blood samples were collected through the right jugular vein.

Sample Preparation

Fifteen minutes before the administration of the dust sample, blood samples were collected as control from the goats. Following dust, blood samples were again collected at 0.25, 0.5, 1, 2, 3, 4, 6, 8, 12, 18, 24, and 36 hours. All blood samples were collected into plain bottles and allowed to clot. The clotted

samples were centrifuged after collection at 2000rpm for ten minutes to obtain serum. Serum samples were stored in plastic vials at -20°C prior to elemental analyses.

Determination of Elements in Serum Samples

One millilitre of serum was diluted to 10 millilitres with de-ionized water. Determinations for Cr and Zn were made on each solution, using Flame Atomic Absorption spectrometer (Model UNICAM 969). The results of each sample were the average of three sequential readings.

Tissue Kinetics

Thirty adult Sahel goats of both sexes were used for the study. The goats were apparently healthy at the onset of the experiment. They were divided randomly into two groups of fifteen goats each. One of the groups was treated with 50mg/kg body weight of dust sample intravenously while the other group was treated with the same dose of dust sample intratracheally.

Post-mortem Studies

Three goats were sacrificed at 3, 7, 14, 21, and 28 days post inoculation. Tissue samples (liver, kidney, lungs and heart) were taken at each of the periods. Tissue samples were oven dried at 40°C, ashed and then analyzed for Cd and Zn using Atomic Absorption Spectroscopic technique as described by Ogugbuaja (1984). Three goats served as control and were used to prepare tissue standards.

Calculation of Kinetic constants

Linear regression analyses were performed on the semi-logarithmic plot of mean elemental concentrations against times for blood and tissues. And the slope of elimination curves determined. The elimination half-life ($t_{1/2}$) was then calculated using the formula

$$t_{1/2} = 0.693/k \text{ where } k = \text{elimination rate constant}$$

Results

Concentration - time curve for serum chromium and zinc are shown in Figure.1 and 2. Mean cadmium serum concentration of $5.10 \pm 0.11 \mu\text{g/ml}$ and $7.21 \pm 0.10 \mu\text{g/ml}$ were respectively obtained for intratracheally and intravenously treated goats at two hours post exposure. Thereafter, there was a steady decline in serum chromium concentration to $1.17 \pm 0.06 \mu\text{g/ml}$ and $0.31 \pm 0.03 \mu\text{g/ml}$ after 18 hours post exposure. By the thirty-sixth hour, chromium concentrations reduced to non-detectable levels in intratracheally treated goats. A mean zinc serum concentration of $2.88 \pm 0.11 \mu\text{g/ml}$ was obtained 15 minutes post intravenous dust administration. This was followed by a constant decrease in serum zinc concentration. Fifteen minutes after intratracheal dust administration, the serum concentration was observed to be $1.62 \pm 0.33 \mu\text{g/ml}$. An increase in serum concentration was observed until a peak concentration of $2.13 \pm 0.13 \mu\text{g/ml}$ was recorded at 2 hours post dust administration. The concentration thereafter decreased to $0.33 \pm 0.04 \mu\text{g/ml}$ after 36 hours.

Figure 1: Plot of Cr concentration against times for intratracheally and intravenously treated goats

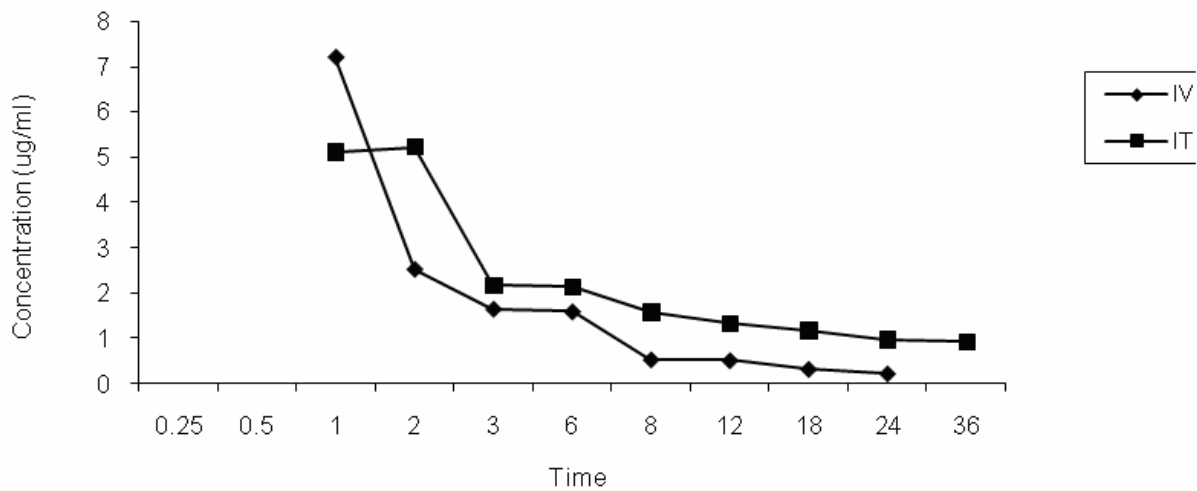
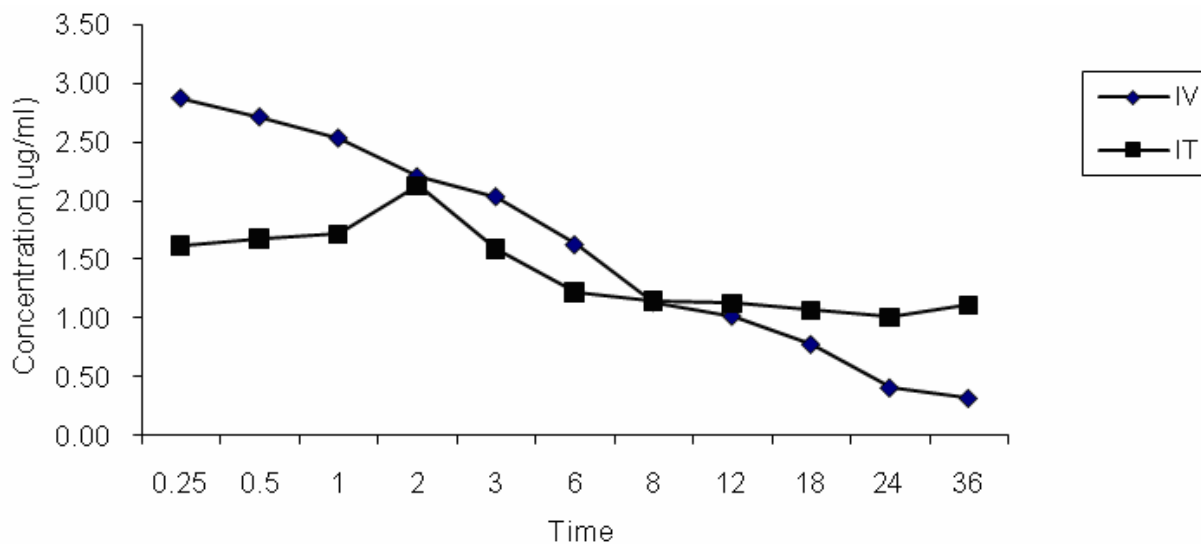


Figure 2: Plot of Zn Concentration against times for intratracheally and intravenously treated goats



Tissue kinetics of elements present in dusts

The mean concentrations of chromium in the tissues at 72 hours for intratracheally treated goats were $0.48 \pm 0.02 \mu\text{g/g}$ for lungs, $0.45 \pm 0.06 \mu\text{g/g}$ for liver, $0.44 \pm 0.02 \mu\text{g/g}$ for heart and $0.44 \pm 0.05 \mu\text{g/g}$ for kidneys (Figure 3). For the intravenously treated goats, at 72 hours after dust treatment, tissue concentrations were $0.43 \pm 0.04 \mu\text{g/g}$ for lungs, $0.47 \pm 0.03 \mu\text{g/g}$ for liver $0.46 \pm 0.04 \mu\text{g/g}$ for heart and $0.51 \pm 0.02 \mu\text{g/g}$ for kidneys (Figure 4). The concentrations of chromium in the tissues were observed to show a continuous decrease and at 21 days, the concentrations of elements in the tissues dropped close to pre-treatment levels

Figure 3: Linear plot of Cr in Tissues of goat at various times following a single dose of dust (50mg/kg) intratrachially

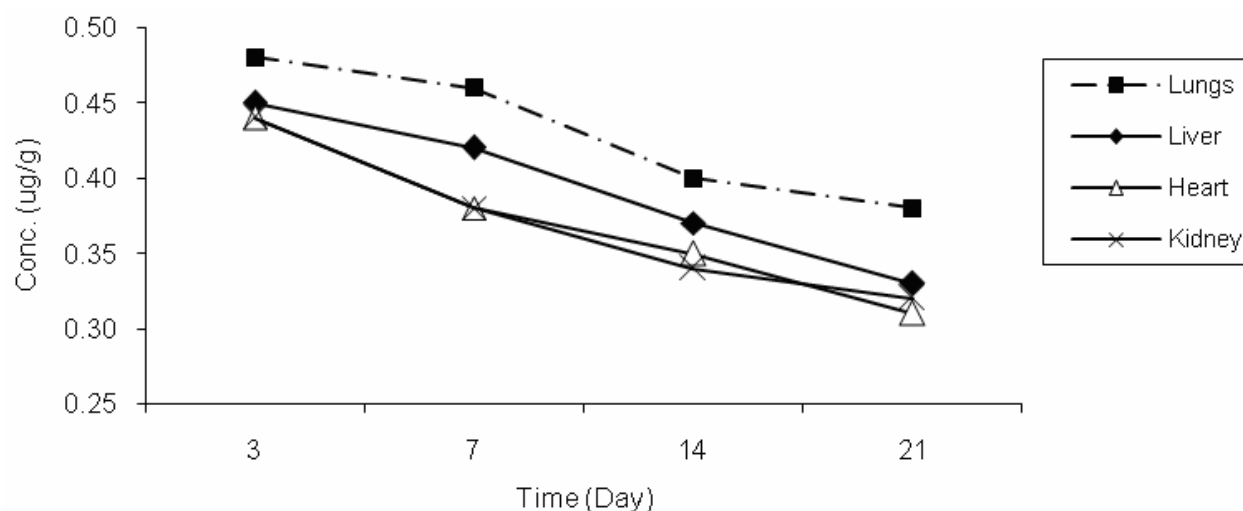
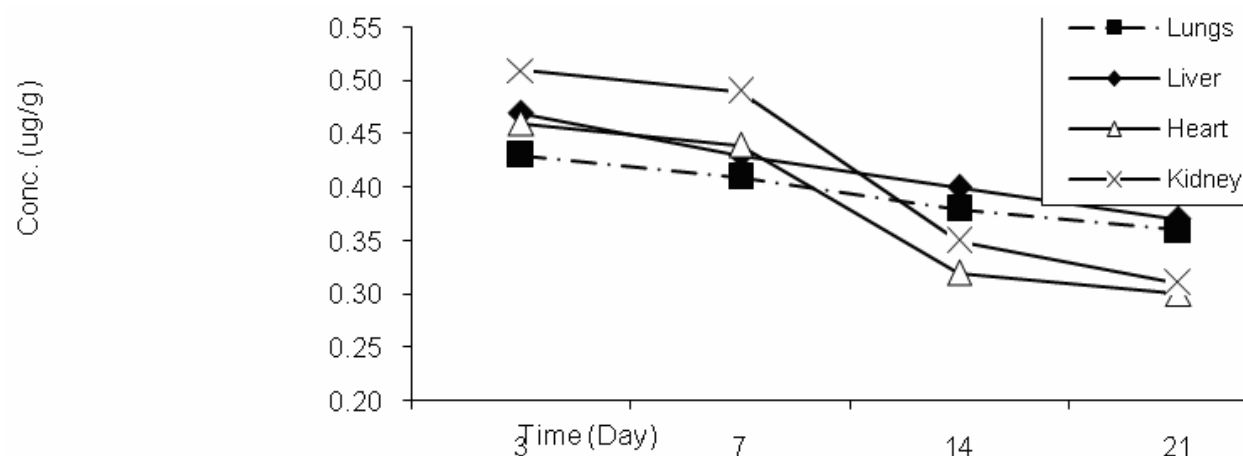


Figure 4: Linear plot of Cr in Tissues of goat at various times following a single dose of dust (50mg/kg) Intravenously



The mean concentrations of zinc found in the tissues at 72 hours for intratracheally treated goats were $110.5 \pm 19.2 \mu\text{g/g}$ for lungs; $216.3 \pm 21.6 \mu\text{g/g}$ for liver; $96.5 \pm 18.2 \mu\text{g/g}$ for hearts and $153.2 \pm 25.5 \mu\text{g/g}$ for kidneys (Figure 5). In intravenously treated animals, at 72 hours following dust treatment, tissue concentrations were $93.2 \pm 16.4 \mu\text{g/g}$ for lungs; $265.3 \pm 32.3 \mu\text{g/g}$ for liver; $107.2 \pm 18.7 \mu\text{g/g}$ for heart and $185.3 \pm 21.2 \mu\text{g/g}$ for kidneys (Figure 6). Subsequently, there was decline in the concentration of zinc and at day 21 post treatment substantial amounts were still detectable.

Figure 5: Linear plot of Zn in Tissues of goat at various times following a single dose of dust (50mg/kg) intratrachially

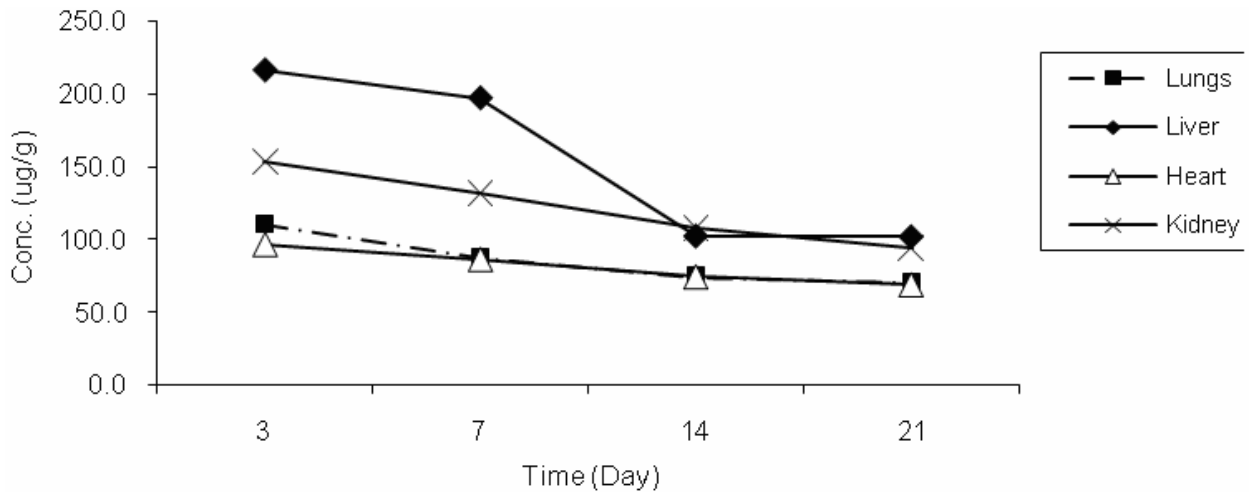


Figure 6: Linear plot of Zn in Tissues of goat at various times following a single dose of dust (50mg/kg) intravenously

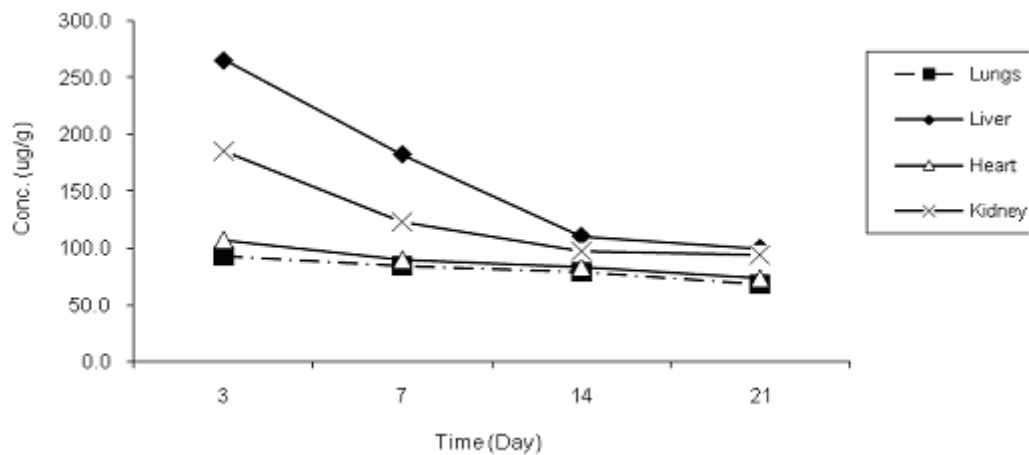


Table 1 and 2 show the half-lives and elimination rate constants of chromium and zinc respectively in serum and various organs following intratracheal and intravenous administration of dusts to goats. The elimination half life of serum chromium was low lowest (3.0 and 3.3 days) for both intratracheally and intravenously treated animals, with elimination rate constants of 0.21 and 0.19 per day. The longest elimination half-life was in the lungs of intratracheally treated animals. The same observation was made for the zinc with half-lives of 3.3 and 3.6 days respectively for intratracheally and intravenously treated animals. The elimination half-life was highest (173.2 and 115 days) in the lungs of intratracheally treated animals for both cadmium and zinc respectively.

Table 1: The Half-lives and Elimination rate constants of Chromium in Various Tissues of Goats Treated Intratracheally and Intravenously with a Single Dose (50mg/kg) of Dusts.

Tissue	Intratracheal route		Intravenous route	
	Half-lives (days)	Elimination rate constant. (Per day)	Half-life (days)	Elimination rate constant. (Per day)
Lung	173.2	0.004	69.3	0.01
Liver	69.3	0.01	69.3	0.01
Heart	23.1	0.03	17.3	0.04
Kidney	69.3	0.01	34.3	0.02
Serum	3.3	0.21	3.6	0.19

Table 2: The Half-lives and Elimination rate Constants of Zinc in Various Tissues of Goats Treated Intratracheally and Intravenously with a Single Dose (50mg/kg) of Dusts.

Tissue	Intratracheal route		Intravenous route	
	Half-lives (days)	Elimination rate constant. (Per day)	Half-life (days)	Elimination rate constant. (Per day)
Lung	115.5	0.006	69.3	0.01
Liver	173.2	0.004	34.7	0.02
Heart	3.6	0.10	23.1	0.03
Kidney	69.3	0.01	69.3	0.01
Serum	3.0	0.23	3.3	0.21

Discussion

The results of the serum kinetics study showed that the elements present in the dust were readily absorbed following intratracheal and intravenous administration and distributed to various organs. The presence of chromium and zinc in blood following dust administration may be an indication of the blood protein binding of these elements and or movement of the element from the peripheral compartments to central compartment for elimination (Onyeyili *et al*, 2001).

High concentrations of zinc were found in the lung, liver kidney and heart of animals treated both intravenously and intratracheally with the dust. The high amounts present in these tissues may be due to increased uptake of zinc by organs and tissues involved. The high concentration of these elements in the tissues may also be due to the levels of these elements in the dust sample. The low levels of chromium found in the various tissues following both routes of administration may be an indication of their low concentrations in the dust.

Lung elemental accumulation from intratracheal dust exposure mode, as expected, are markedly higher than those from intravenous dust instillation. However, the accumulation from the dust introduced into the lung displayed by other studied tissues, although low; demonstrate the anticipated transportation (absorption) of the dust from the lung into the rest of the goat system.

This study has shown that the liver acted as the main accumulator of the elements of interest. Indications of the observed high liver accumulations are probably related to their effective absorption from the respiratory tract and the ability of the liver to store them. Other studies have reported capabilities of most organs, notably liver and kidney, to store large quantities of elements in the biological systems. The mechanism entails interactions between these elements with the intrinsic proteins in the organs (King, 1999). Large amounts of some of the detected elements in the liver can therefore be accounted for.

The half-lives of the elements found in the dust samples was an indication of the length of time each of these elements will be present in a particular organ or tissue. The higher the half-life of an element, the longer the persistence of that element in a particular tissue (Renwick, 1996). Slow elimination of the elements from the lungs is substantiated by the fact that the half-life of elimination ranged between 115.5 to 173.2 hours after intratracheal administration. The higher half-lives of elements in lungs following intratracheal administration of dusts compared to intravenous

administration may be a reflection of increased tissue sequestration, prolonged absorption and/or presence of complexing compounds in the dust. It also indicates of how widely the elements were distributed or increased serum protein or tissue binding of the elements which limits their distribution to excretory organs.

Conclusion

The study has shown uptake of Cr and Zn from intratracheal and intravenous administration of dusts and subsequent distribution of the elements to all organs and tissues. The half-lives of Cr and Zn in lungs were relatively high following intratracheal administration. There was an indication that Cr and Zn would be eliminated from the organs with time.

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Trade Diversion and Trade Creation the Case of Turkey Establishing Customs Union with the European Union

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Abstract

This paper explores the logical and empirical determinants of the Custom Union membership of Turkey with European Union effective in 1996 and reflects on the potential of trade creation and trade diversion effects of this membership. The paper applies a gravity model to estimate such trade effects. The gravity model offers a good application of the spatial interaction method. Results show that trade has been diverted by this membership for the first five years.

JEL Classification Codes: F15, F17

1. Introduction

In the field of international economics the correlation/causality between trade liberalization and gains from trade is still a widely debated issue. The empirical evidence in this area is far from unanimous. This issue is of interest for a multitude of reasons. One important presumed benefit of trade liberalization is the possible favorable effect on the developing nations in the forms of technological diffusion, productivity increase, new product developments, and commodity standardization. On the other hand, some scholars have argued that any form of a custom union deteriorates the terms of trade in developing nations, suggesting that the prices of their exports relative to their imports have fallen. Scholars have pointed out that exports of developing countries are concentrated in primary products (agricultural goods, raw materials, textiles, etc.) implying that they generally maintain accrue disproportionately to the industrial nations.

This paper explores the logical and empirical determinants of the Custom Union membership of Turkey with European Union in 1996 and reflects on the potential of trade creation and trade diversion effects of this membership.¹ Throughout the analysis, we review the economic effects of such an agreement on the Turkish economy and lay down the political implications. The corresponding effects include the benefits and costs of trade creation and trade diversion, as well as gains or loss from scale and competition.

¹ Trade creation effect is caused by the extra output produced by the member countries. This extra output is generated due to freeing up of trade between them. Increased specialization and economies of scale should increase productive efficiency within member countries. The trade diversion effect, however, exists where low-cost production in the rest of the world is displaced by higher-cost production in the partner country.

International trade theory suggests that the formation of a free trade area or custom union agreement improves the welfare of member countries if the volume of trade by those countries increases. In other words, when trade creation among members exceeds the diversion of trade away from nonmember countries, the country will gain from such a partnership. The application is based on the Turkish economy. Turkey's Customs Union (CU) agreement with the European Union (EU) in 1996 has been a very controversial issue in Turkey. The issue attracted extra attention and interest due to the fact that only the member countries of the EU have a CU with the EU and that Turkey is the only non-member country that has a CU with the EU.²

Section 2 provides some general information and stylized statistical facts regarding trade diversion and creation effect of custom unions. Section 3 investigates the trade creation and/or trade diversion effects of Turkey's membership empirically using 2-digit harmonized system manufacturing export data. Section 4 draws some policy implications and concludes.

2. Trade Diversion and Trade Creation

In a pioneering study, Viner (1950) drew the distinction between the trade creating and trade diverting effects of regional integration agreements. It is accepted that free trade allows consumers and producers to obtain the goods and services from the cheapest sources of supply. Viner, however, emphasizes that corresponding benefits should be complete not partial for welfare to improve.³ Since Viner's seminal analysis, trade creation and diversion have been treated as virtually synonymous with the impact of custom unions and other regional integration arrangements on economic welfare. Accordingly, many empirical and quantitative studies have sought to estimate trade creation and diversion on either *ex ante* (before the fact) basis or *ex post* (afterwards) basis (DeRosa, p. 9).

Lipsey (1951) argued that joining with countries that are already one's largest trading partners is unlikely to lead to diversion, since the fact that the countries were originally the largest trading partners suggest that they are the lowest cost source of supply. On the consequences of regional integration, Venables (2000) suggests two main points. The first is that changes in trade flows may change world prices, possibly improving the terms of trade of member countries, although this gain arises at the expense of outside countries. The second is that changes in tariffs and trade volumes will lead to loss of government tariff revenue. This can occur directly and as a consequence of trade diversion as imports are diverted away from external, tariff inclusive, source of supply. Kruger (1999) empirically examined the changing patterns of trade flows and noted that the trade relationship among the North American Free Trade Agreement (NAFTA) countries intensified in the 1990s.

This research follows the methodology that is used in gravity model in international trade. We use two-digit trade data in Harmonized System classification to look for the evidence of the benefit and costs of Turkey's membership to CU with EU.

² The public opinion in Turkey regarding the CU with the EU have always been polarized along the same line with the public opinion regarding the full membership of Turkey to the EU. In other words, people who oppose Turkey's CU with the EU and claim that the CU is working for the disadvantage of Turkey, are generally the ones who believe that the EU will never accept Turkey as a full member to the Union. Hence, this group claims that Turkey made a badly negotiated deal with the EU regarding the CU. On the other hand, people who support Turkey's CU with the EU and claim that the CU is working for the benefit of Turkey, are the ones who believe that the EU will finally accept Turkey as a full member of the Union. Hence, the CU with the EU was an important step (to the benefit of Turkey) in finalizing Turkey's full membership to the EU.

³ As in Venables (2000), if partner country production displaces higher cost domestic production then there will be gains-trade creation. But it is possible that trade partner country production may displace lower cost imports from the rest of the world, and that is welfare reducing trade diversion.

3. Empirics of Regional Trade Agreement

The paper applies a gravity equation modeling for Turkey establishing a CU with EU15 countries. In order to extract the diversion and creation effects of trade data include the rest of the world (ROW) through time as well. The gravity model offers a good application of the spatial interaction method. The model predicts bilateral trade flows based on the economic sizes of often using GDP or manufacturing output measurements and distance between two units. Among others (Deardorff (1998), Frankel (1997), Bergstrand (1985), presents a general equilibrium world trade model with perfect international product substitutability. Feenstra, Markusen and Rose (2001), work for differentiated goods consistent with the theoretical predictions of the monopolistic-competition model, or a reciprocal-dumping model with free entry

There are basically two main forms of empirical work on trade creation and trade diversion; econometric studies of changes in trade flows, and computer simulation studies that use general equilibrium models. Most econometric studies take the advantages of gravity models developed by Linder (1961) and Linnemann (1966). The basic idea of the gravity approach is to ignore comparative advantage and concentrate on locational factors instead. These models connect trade flows between two countries to the importer's demand, exporter's supply and the trade costs. The importer's demand and exporter's supply are substituted by countries' gross domestic product (GDP) as well as GDP per capita. Trade costs (transport and transaction costs) are measured by geographical distance between countries (Fidrmuc, 1999, p. 634)

Baldwin (1994) literature survey on gravity models gives more broad views to researchers. Markusen (1986) and Markusen and Wigle (1990) present a model of trade between capital-abundant and labor-abundant countries using utility function approach and show that the differences resources (factors) and economies of scale determine the direction of trade.

The basic econometric model the paper seeks to estimate is a redefined form of gravity models. In particular, we add the manufacturing sector international competitiveness indicator to the most accepted gravity models.⁴ A *pooled time-series-cross-section* regression was estimated using data collected on trade values, manufacturing scale, agricultural scale, distances among countries, and competitiveness indicators between the years 1990 and 2000, inclusive. Theory predicts that transport and transaction cost increase with distance, so that any two countries will trade more if they are located closer to each other.⁵ Similarly, trade between any two countries increases with scale and/or income measured as per capita manufacturing output. We follow Krueger (1999) in employing the following basic specification:

$$\begin{aligned} \text{Export}(\text{TR}, \text{EU}) = & \alpha_0 + \alpha_1 (\text{D90}) + \alpha_2 (\text{D91}) + \alpha_3 (\text{D92}) + \alpha_4 (\text{D93}) + \alpha_5 (\text{D94}) + \alpha_6 (\text{D95}) + \\ & \alpha_7 (\text{D96}) + \alpha_8 (\text{D97}) + \alpha_9 (\text{D98}) + \alpha_{10} (\text{D99}) + \alpha_{11} (\text{D20}) + \alpha_{12} \text{MQ}(\text{EU}) + \alpha_{13} \text{MQPC}(\text{EU}) + \\ & + \alpha_{14} \text{MIC} + \alpha_{15} \text{DIS} + \alpha_{16} \text{DUM}(\text{NAFTA}) + \alpha_{17} \text{DUM}(\text{CU}) + \text{error} \end{aligned}$$

where TR and CU are the exporting and importing countries respectively; Dummy variables from 1990 to 2000 represented by D with corresponding years. D90, for example, takes value 1 if the year is 1990, 0 otherwise. These variables illustrate the time path of the export model and answer the question of how the export performance evolves through time. MA and MQPC are manufacturing output and per capita manufacturing output of importing countries respectively; MIC is the manufacturing international competitiveness; DIS is the distance between the capitals of exporting and importing countries. This variable is the proxy for the transportation costs that directly affect the unit price of the goods exported and imported. The variable DUM(NAFTA) is the one when the exporting country is

⁴ Data source for this variable is the OECD's international competitiveness indicators. OECD presents different kinds of competitiveness measure. We use the international competitiveness of manufacturing sector simply because Turkey's CU membership covers only the manufactured goods. There is, however, possibility that being member in this sector may benefit or harm the other sectors in terms of welfare, its distribution, wage and the price of capital, mobility of factors, and factors commonly investigated in the international economics theory.

⁵ Measuring the distance between any two countries is, of course, somewhat arbitrary. One approach that is to employ distances as the crow flies between capitals. The data for distances are obtained in <http://www.indo.com/distance>.

Turkey while importing country is a member of NAFTA. It takes 1 if the country is the member; it takes the value of 0 otherwise. DUM(CU) is the dummy variable if the importing country is the CU member while exporting country is Turkey. The model includes also 19 countries dummy corresponding each importing countries specific factors. Australia and New Zealand are in the sample to control the fact that remoteness is also affect trade. These effects are presented in their dummy variables.

Table 1 presents the estimated results from the regression model for manufacturing sector. Our econometric model is estimated using both time-series and cross-sectional fixed effects. Controlling these specific effects enable us to see the changes in trading relationship among countries. Since the share of trade has been the same on average for Turkey, we assumed that taking 1990 through 2000 to clarify the effects of CU membership.

The estimation procedure was conventional as shown in Krueger (1999): The log of export was regressed on distance (LDIST), manufacturing scale (LMQJ) of importing countries, per capita manufacturing scale (LMPCJ) of importing countries, competitiveness (LMIC) of importing countries. There are 19 trading partners of Turkey. It includes all countries, except for Luxemburg in EU15 and other trading blocks.⁶ Dummy variables were then added when importing countries were a member of the Custom Union (CU), Nafta (NAFTA). Remoteness factor was controlled by adding the country specific factors in their country dummies (not reported here).

Table 1: Regression Results of Gravity Equation (Manufacturing Sector)

Variable	Coefficient	t-stat
T1990	19.65	7.55
T1991	9.81	7.63
T1992	6.60	7.63
T1993	4.93	7.64
T1994	3.97	7.65
T1995	3.34	7.71
T1996	2.87	7.72
T1997	2.51	7.72
T1998	2.25	7.75
T1999	2.03	7.70
T2000	1.85	7.77
CU	-8.20	-8.30
NAFTA	0.69	1.81
LDIST	-4.50	-10.89
LMQJ	1.75	6.91
LMPCJ	0.045	0.14
LMIC	0.73	4.36

Method: Ordinary Least Squares with time and country fixed effects, using White heteroskedasticity-consistent standard errors and covariance. The Wald test indicates that heteroskedasticity corrected test is suitable for the model. Number of Observations: 210

The gravity equation works well: it fits the data well and delivers precise reasonable estimates for trade diversion. As can be seen from Table 1, the coefficients of the income in manufacturing sector, LMQJ, per capita income in manufacturing sector, LMPCJ, the competitiveness in manufacturing, LMIC, NAFTA membership, NAFTA, and all the time dummies are all similar to those reported in most gravity equation estimates. LMIC is new to this theory. The corresponding magnitude shows that any improvement in competitiveness in importing countries has a positive effect on the Turkish export performance.

⁶ These are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, U.K., Australia, Canada, Japan, New Zealand, U.S.A.

The crucial coefficient for the present purposes is the one attached to the Custom Union membership (CU). The negative sign shows the trade diversion.⁷ The parameter estimate is statistically significant. The coefficient implies that exports were $\exp(-8.20) = 0.0274\%$ of what they would have been if neither country had been in the Custom Union. Further calculation indicates that 60 billion \$ export volume would create a $60 \times 0.0274 = 1.644$ billion\$ loss in export each year on average. This is a rather small value, but once one considers the trade creation effects of the membership, loss will be interpreted accordingly.

The coefficient on NAFTA indicates that when the importing countries are in NAFTA, the expected trade of Turkey is estimated to be almost 100 percent (since $\exp(0.69) = 1.993$) larger than otherwise, with a statistically significant coefficient. Scale parameter LMQJ in manufacturing sector positively affects trade volume. The result suggests that learning effect via scale may further stimulate trade volume between Turkey and trade partners.

The results implies that, for the time period the paper covers, the Turkish manufacturing industries experience trade diversion as it is expected from Viner's (1950) approach stating that the membership to any trading blocks with industrialized countries in general harms the participating developing countries in the short-run. The negative sign and its statistical significance of the variable CU (custom union membership) in Table 1 justify the corresponding trade diversion for the manufacturing industries.

4. Conclusion Some Policy Implications

In the research summarized here, we have used the gravity model to show that if there is a potential of trade creation and trade diversion effects of Turkey's membership to the CU with EU15. From the estimated parameters, we could not find enough evidence that the membership of Turkey to CU created new trade volume. In fact the evidence shows an inverse effect where trade has been diverted by this membership for the first five years. Although, there is no doubt that the Turkey's CU membership has further strengthened the Turkey-EU relations towards more integration, it is not wrong to say that Turkey made a badly negotiated political deal with the EU with regard to the CU membership.

In light of the findings of this research, we believe that Turkey should take certain policy implementations in order to decrease the shortcomings of the CU membership. First, since it is the EU only which benefited from the cheap Turkish exports, Turkey should try to revise the trade policy with the EU in order to balance the mutual benefits of the two parties. Especially, Turkey should pressure the EU to include the agricultural and service sectors in which Turkey has comparative advantage in trade. Second, Turkey should internally revise its manufacturing structure in order to be more competitive in the global markets.

⁷ This dummy is supposed to have positive coefficient, meaning that countries within a trading block trade more than the predicted by their scale and distance alone. The positive coefficient can be interpreted as trade creation effect indicating that both partner countries trade more.

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Éfficacité Comparée de Deux Méthodes de Diagnostic Précoce de Gravidité Chez la Brebis Ouled Djellal

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Abstract

The diagnosis of pregnancy is a fundamental importance in sheep breeding. The objective of this work is to evaluate the efficiency of progesterone (P4) and pregnancy associated glycoprotein (PAG) for precocity, sensitivity, specificity and reliability; confronted with the reality of the events which could occur on the females since the breed until the end of pregnancy, followed of the precision of their possible limits. The test proceeded in the East area Algeria - Guelma- on 25 ewes Ouled Djellal. The oestrus is synchronized by hormonal treatments and with natural breeding. The blood tests are weekly, of the 17 to the 49 days post-breed. The plasmatic concentration of progesterone is determined by radioimmunoassay (RIA) according to the direct method and the PAG by RIA semihomologous, using ^{125}I on bovine PAG as tracer and a PAG antibody ovine n° 780 diluted to 1/40.000. The adopted discriminatory threshold levels are $\text{P4} \geq 1 \text{ ng/ml}$ and $\text{PAG} \geq 1.2 \text{ ng/ml}$. The PAG showed an efficiency raised for reliability and the precision from the 28 days of pregnancy. The two methods are identically precise in the determination of the embryonic losses. Their announcement is on the other hand earlier for the PAG and their combined use in practice for the diagnosis of pregnancy is useless. This complementarity's interesting in the identification of the embryonic losses and the ewes declared wrongly empty by progesterone. The insufficiency of progesterone in relation to the adopted threshold is not inevitably synonymous of empty females.

Keywords: Ouled Djellal ewes – pregnancy diagnosis - progesterone – PAG - radioimmunoassay - Algeria.

1. Introduction

Les exigences d'une bonne maîtrise de la reproduction devenue obligatoire pour une meilleure productivité tant recherchée dans les élevages, ont conduit et inciter les principaux acteurs du monde ovin à s'intéresser de plus près aux différentes méthodes de diagnostic de gestation. Aux techniques anciennement utilisées comme la détection des chaleurs un cycle après la lutte [32] viennent s'ajouter d'autres méthodes de type biophysique [25] ou biochimique basées sur le dosage des hormones stéroïdiennes, surtout la progestérone [32] et des protéines associées à la gestation dont la PAG est la plus employée ces dernières années [1,40].

La progestérone hormone stéroïdienne d'origine lutéale au départ, puis lutéale et placentaire ensuite, est un bon indicateur pour le diagnostic précoce de la gestation chez la brebis. Par rapport aux non gestantes ayant subi la lutéolyse, des niveaux élevés de progestérone dans le sang sont observés chez celles possédant des corps jaunes gestatifs 17 à 19 j après insémination [31] et même au-delà. Ce qui peut encore permettre de discriminer les femelles gestantes des non gestantes [14]. La progestérone est aussi très précise pour détecter les femelles non fécondées [19] comparées à celles présumées gravides [19,3]. De fait, l'exactitude dans ce sens n'est pas absolue et des variations importantes sont constatées entre races, troupeaux, saisons et années [19]. De même, la proportion des fausses gravidités varie selon les troupeaux et l'état physiologique des brebis et reflète l'importance des pertes embryonnaires chez ces femelles [3]. En effet, la présence de cette hormone dans le sang n'est pas spécifique à la présence d'un embryon dans l'utérus. Des diagnostics positifs faux pour diverses raisons peuvent être décelés [4,2,22,39,20,14]. Ceci est confirmé par la variabilité des résultats annoncés tant pour la sensibilité comme pour la spécificité pour ce type de dosage [27, 13,20].

En revanche, la PAG tout comme la PSPB (Pregnancy-Specific Protein B) est aussi une glycoprotéine placentaire synthétisée par les cellules binucléées du trophoblaste dès le début de la gestation [40,36]. Sa stabilité dans le sang lui confie cette qualité d'excellent marqueur de gestation; d'où son intérêt particulier dans le diagnostic précoce et de la fonction placentaire et donc son utilisation récente chez les espèces bovine [42] ovine [23, 36, 12, 8, 20, 33, 34] et caprine [26,14]. Son emploi par radioimmunoassay [20,34] offre une efficacité remarquable pour la sensibilité et la spécificité dès même le 22^{ème} j de gestation [20].

Ainsi, l'objectif du présent travail a été orienté vers l'évaluation de l'efficacité de deux méthodes de diagnostic de gestation par l'analyse des niveaux plasmatiques de la progestérone et de la PAG. Ceci sur les plans de la précocité, sensibilité, spécificité et fiabilité (valeurs prédictives positive et négative) tout au long des différents stades de gravidité des brebis Ouled Djellal, confrontées à la réalité des événements qui ont pu se produire pour ces femelles durant toute leur gestation. Comme il s'agit aussi de préciser éventuellement leurs limites.

2. Matériels et Méthodes

2.1. Animaux, synchronisation des chaleurs et lutte

Un effectif total de 25 brebis multipares de race Ouled Djellal, du même élevage de la région de Guelma (Est de l'Algérie) a été utilisé durant la même période (mars-juillet). Les femelles sont d'un âge compris entre 2,5 et 4 ans, d'un poids vif et de note d'état corporel moyens de $47,42 \pm 0,97$ kg et $3,1 \pm 0,09$ respectivement et d'un intervalle mise bas antérieure-lutte $\geq$ à 90 j. Ces brebis sont conduites en semi-intensif et alimentées à base de paille de blé, pâturage en vert à volonté et d'orge en grains concassés selon les besoins. Leur oestrus est synchronisé au moyen d'éponges vaginales imprégnées de 40 mg de FGA (Acétate de Fluorogestagène) (Chronogest Intervet) durant 13 j, suivies lors de leur retrait d'une injection de 500 UI de PMSG (Pregnant Mare Serum Gonadotropine). La lutte, de mode

naturel et contrôlée est assurée par 3 béliers de la même race à partir de 48 h après le retrait des éponges.

2.2. Prise de sang et collecte des échantillons de plasma

Elles sont réalisées hebdomadairement et d'une manière régulière du 17^{ème} j jusqu'au 49^{ème} j post-lutte. Les prises de sang sont faites au moyen de seringues jetables dans des tubes à EDTA de 5 ml. La collecte des échantillons de plasma est réalisée après centrifugation du sang (1 500 x g pendant 12 mn) juste après son prélèvement. Une fois séparés, ces derniers sont directement transférés dans une glacière pour leur congélation à - 20° C jusqu'à leur dosage.

2.3. Dosage de la progestérone (P4) et de la protéine associée à la gestation (PAG) par radioimmunoassay (RIA)

Les dosages radioimmunologiques (RIA) ont été réalisés au laboratoire d'Endocrinologie et de Reproduction Animale (Faculté de Médecine Vétérinaire, Université de Liège, Belgique). Cette opération a concerné deux indicateurs de la gestation, la progestérone et la PAG et a trait à toutes les prises de sang effectuées entre les 17^{ème} et 49^{ème} j post-lutte.

Progestérone (P4)

La concentration plasmatique de la progestérone a été déterminée par radioimmunoassay (RIA) selon la méthode dite directe, sans extraction de l'hormone, basée sur l'utilisation d'un agent bloquant la liaison stéroïde protéine de transport tel que l'ANS (Anilino-Naphtalene-Sulfonic-Acid) ou (Acide sulfonique 8-anilino-1-naphtalène (Fluka and Riedel-de Haën, Schweiz, Suisse) [24]. Cette méthode testée avec succès dans le même laboratoire chez les bovins [5] a été réessayée par nous dans le présent travail avec un point de sensibilité de 0,02 ng/ml.

La courbe standard de la progestérone (Sigma Chemical Co., St Louis, MO) a été constituée de 8 points (20; 10; 5; 2,5; 1,2; 0,6; 0,3 et 0,15 ng/ml), dilués de 2 en 2 dans du sérum stéroïde-free à partir du point le plus haut de la courbe (20 ng/ml). Le traceur (P4-11-hemisuccinate-2[¹²⁵I]-iodohistamine; Amersham Biosciences, Uppsala, Suède) a été dilué dans le tampon salin phosphate (0,10 M, pH 7,0) de façon à obtenir une radioactivité d'environ 20.000 cpm par 100 µl. L'anticorps anti-progestérone (AS#43) a été utilisé à une dilution initiale de 1: 15.000. Le système précipitant contenant le deuxième anticorps était composé d'anticorps de mouton anti-gammaglobuline de lapin à 0,87% volume: volume, de sérum normal de lapin à 0,17% volume: volume, de polyéthylène glycol 6000 à 20 mg/ml (Vel, Leuven, Belgique); de cellulose microcristalline à 0,05 mg/ml (Merck, Darmstadt, Allemagne) et de BSA (Bovin Serum Albumen) à 2 mg/ml (INC Biochemicals, Aurora, OH) solubilisés dans du tampon phosphate.

Ainsi, La technique utilisée a été récemment décrite par Faye et al. (2004) [10] et peut être résumée comme suit: 50 µl de chaque échantillon plasmatique ainsi que des différents points de dilution de la courbe standard ont été prélevés en duplicate dans des tubes en polystyrène à fond conique. Ensuite, 300 µl de tampon citrate-ANS (0,10 M citrate, 0,25% BSA contenant 100 µl d'ANS, pH 4,0), 100 µl de traceur et 100 µl d'anticorps anti-progestérone R43 dilué à 1: 15.000 ont été successivement ajoutés dans chaque tube. Le tout a été agité et incubé pendant 4 h à 4° C. Chacun des points standards et d'échantillons a été ensuite additionné de 1,0 ml de la solution contenant le 2^{ème} anticorps, avant d'être laissé en incubation pendant 30 min à T° ambiante. Enfin 2,0 ml de tampon phosphate ont été ajoutés à tous les tubes, lesquels ont été ensuite centrifugés à 1.500 x g pendant 20 mn et à 10 °C. À l'issue de cette opération, le surnageant a été éliminé et les tubes ont été décantés avant la lecture de la radioactivité du précipité dans un compteur MultiGamma, relié à un ordinateur et une imprimante (LKB Wallac 126 Multigamma counter, Turku, Finlande).

Protéine Associée à la Gestation (PAG)

Les concentrations plasmatiques en PAG ont été déterminées par un RIA semi-homologue, avec de la PAG bovine 67 kDa (boPAG_{67kDa}) [41] comme standard et traceur et un anticorps anti-PAG ovine 55 kDa et 59 kDa (ovPAG_{57+59kDa}; AS#780) [9] comme anticorps primaire (dilution initiale 1: 40.000). Les dosages de PAG ont été réalisés dans du tampon Tris-BSA (0,025 M de Tris, 0,01 M de MgCl₂, 0,02% poids: volume de NaN₃, pH 7,5) contenant 1,0 mg/ml de BSA. Les points de la courbe standard ont varié de 0,4 à 100 ng/ml. Le traceur (¹²⁵I-PAG) a été marqué par la méthode à la Chloramine T [15] et a subi une dilution appropriée de manière à obtenir une radioactivité de 25.000 cpm/100 µl. Le système précipitant contenant le deuxième anticorps été similaire à celui utilisé pour la progestérone et les différents composants ayant été dilués dans du tampon Tris. La sensibilité du dosage RIA de la PAG a été de 0,40 ng/ml.

Succinctement, les échantillons de plasma de brebis (100 µl) ainsi que les différentes dilutions de la courbe standard (100 µl) ont été additionnés à des tubes coniques contenant respectivement 200 et 100 µl de Tris-BSA. Ensuite, les tubes contenant les différents points de dilution de la courbe standard ont été additionnés de 100 µl de sérum de brebis PAG-free (sans PAG). Finalement, 100 µl de traceur et 100 µl d'antisérum dilué (1: 40.000) ont été ajoutés à tous les tubes, à l'exception de ceux mesurant la liaison non spécifique (NSB pour non-specific binding), lesquels n'ont pas reçu de l'antisérum. Les tubes ont été vortexés et ensuite incubés toute une nuit à température ambiante. Le lendemain, 1,0 ml du système précipitant contenant le deuxième anticorps a été ajouté. L'ensemble a été incubé pendant 30 mn avant l'addition de 2,0 ml de tampon Tris-BSA. Une centrifugation à 1.500 x g pendant 20 mn a été effectuée afin de permettre une bonne séparation des fractions libres et liées. Le surnageant a été écarté et la radioactivité du culot mesurée à l'aide d'un compteur Multigamma (LKB Wallac 126 Multigamma counter, Turku, Finlande).

Les résultats sont exprimés en ng de progestérone ou de PAG/ml de plasma. et le niveau seuil discriminatoire adopté pour différencier entre brebis gestantes et non gestantes est ≥ 1 ng/ml pour la P4 et $\geq 1,2$ ng/ml pour la PAG.

2.4. Analyse statistique

Les résultats des concentrations de progestérone et de PAG sont présentés sous forme de moyenne $\pm$ erreur standard (moyenne $\pm$ s.e). Leur comparaison entre brebis gestantes et non gestantes selon les âges de gestation est analysée par le test-t de Student et la différence dans leur évolution à travers les âges de gestation à l'intérieur de chacun des deux groupes (gestantes ou non) est analysée par le test de Friedman; utilisant le logiciel Minitab, release 13.31 for windows PA State College [37]. La comparaison des critères de qualité ou d'efficacité du test employés pour les besoins de cette étude (spécificité, sensibilité et valeurs prédictives négative et positive) [21,8] est analysée par le test de Khi-Carré (χ^2).

3. Résultats

Sur les 25 brebis luttées, 18 ont mis bas, 2 ont avorté et les 5 restantes n'ont rien manifesté. À priori, ces dernières sont considérées soient non gestantes par suite d'une non fécondation, soit comme femelles fécondées mais ayant connu une perte embryonnaire précoce.

En revanche, après dosage de la progestérone et de la PAG, les résultats enregistrés dans ce sens n'ont pas uniquement approuvé d'une manière commune ou individuelle la gestation réelle des 20 brebis ayant mis bas ou avorté, mais ont pu apporté une réponse certaine aux situations des 5 femelles qui n'ont rien manifesté. Par conséquent, les résultats consignés dans le tableau 1 font apparaître que la concentration de la progestérone est plus élevée depuis le 17^{ème} j jusqu'au 49^{ème} j chez les femelles gestantes ($p < 0,05$ entre les 17^{ème} et 28^{ème} j et $p < 0,001$ entre les 35^{ème} et 49^{ème} j). Il en est de même pour la concentration plasmatique de la PAG au 17^{ème} j. Cependant, à l'opposé de la progestérone qui reste

stable entre les 17^{ème} et 49^{ème} j pour les deux groupes de femelles ($p>0,05$), la PAG par contre, son expression augmente avec la progression de la gestation depuis le 17^{ème} j jusqu'au 49^{ème} j pour les femelles gestantes ($p<0,001$). Cependant, aucune trace de cette glycoprotéine pour celles présumées vides jusqu'au 42^{ème} j. Pour cette dernière catégorie de femelles et pour ce dernier stade de gestation, il est détecté une faible concentration de PAG pour deux femelles ($0,36\pm0,21$ ng/ml). Conséquence fort probable, d'une perte embryonnaire enregistrée apparemment juste avant ce stade. Le même scénario est déclaré au 49^{ème} j avec l'apparition d'une autre femelle ayant subi le même sort. Effectivement, les 3 femelles étaient comptabilisées une semaine auparavant comme gestantes ($p<0,001$).

Table 1: Concentration plasmatique (moyenne $\pm$ s.e) de la P4 et de la PAG des femelles gestantes et non gestantes à différents stades de gestation

Stade de gestation	P4 ng/ml (moyenne $\pm$ s.e)			PAG ng/ml (moyenne $\pm$ s.e)		
	Femelles gestantes		Fem. non gestantes	Femelles gestantes		Fem. non gestantes
	≥ 1 ng	< 1 ng	< 1 ng	1,2 ng	$< 1,2$ ng	$< 1,2$ ng
J 17	$2,77\pm0,31^a$	0,35	$0,24\pm0,08^b$	$2,06\pm0,54^a$	$0,23\pm0,08^b$	0
J 21	$2,53\pm0,26^a$	-	$0,13\pm0,04^b$	$6,63\pm0,84^a$	$0,44\pm0,20^b$	0
J 28	$2,43\pm0,31^a$	0,81	$0,13\pm0,06^b$	$28,26\pm2,50^a$	-	0
J 35	$2,31\pm0,31^a$	$0,82\pm0,07$	$0,12\pm0,08^b$	$26,37\pm2,31^a$	-	0
J 42	$2,16\pm0,25^a$	0,48	$0,30\pm0,19^b$	$26,11\pm2,02^a$	-	$0,36\pm0,21^b$
J 49	$2,35\pm0,28^a$	0,46	$0,27\pm0,12^b$	$30,28\pm2,06^a$	-	$0,27\pm0,18^b$

Femelles non gestantes: sont considérées toutes les femelles qui à un moment ou à un autre du stade de gestation se sont avérées réellement non gestantes ou ayant perdu leurs embryons.

Valeurs avec lettres différentes dans la même ligne pour chacun des deux types de dosage (P4 et PAG), différent significativement entre elles.

Par ailleurs, les résultats de sensibilité, spécificité et fiabilité des différents dosages consignés dans les tableaux 2 et 3 font observer qu'au 17^{ème} j, sur les 25 brebis luttées, 22 ont été diagnostiquées positives exactes par la progestérone contre seulement 5 brebis par la PAG. Ce qui rend le nombre de femelles diagnostiquées négativement fausses par la PAG plus élevé par rapport à celui marqué par la progestérone (18 vs 1) (78,26% vs 4,34%; $p<0,0001$). À ce stade de gestation, tant la sensibilité comme la valeur prédictive négative est plus élevée pour la progestérone ($p<0,0001$). Ce qui est signalé également au 21^{ème} j bien qu'une nette amélioration par rapport au 17^{ème} j est enregistrée pour la PAG (+ 65 points pour la sensibilité) ($p<0,0001$). Cependant, du 28^{ème} j jusqu'au 49^{ème} j, la balance est inversée en faveur de la PAG pour tous les paramètres évalués. En effet, si pour la progestérone ces derniers se trouvent instables d'une semaine à l'autre (tableaux 2 et 3) suivant l'évolution de la gestation, ceux relatifs à la PAG par contre sont marqués par une amélioration continue depuis le 17^{ème} j. Ils atteignent déjà le taux de 100% dès le 28^{ème} j, pour se maintenir ainsi jusqu'au 49^{ème} j (niveaux de signification compris entre $p<0,05$ et $p<0,01$ pour la sensibilité et $p<0,0001$ pour la valeur prédictive négative). Si pour la PAG il y a eu identification et récupération de 3 brebis gestantes, pour la progestérone par contre, il y a eu perte d'une 1^{ère} brebis au 28^{ème} j suivie d'une 2^{ème} au 35^{ème} j (tableau 2). La 1^{ère} brebis diagnostiquée à tort négative à tous les stades par la P4 (excepté à j 21) a été cependant détectée gestante par la PAG depuis le 28^{ème} j jusqu'au 49^{ème} j (femelle ayant avorté à j 66). Il en est de même pour la 2^{ème} brebis en question identifiée aussi à tort comme vide par la progestérone au 35^{ème} j mais restée positive pour la PAG (femelle ayant mis bas). Pour ces deux tests durant ces deux phases de la gestation (j 28 et j 35) tant la sensibilité comme la valeur prédictive négative sont largement supérieures pour la PAG. ($p<0,05$ et $p<0,0001$ au 28^{ème} j et $p<0,01$ et $p<0,0001$ au 35^{ème} j, respectivement). La même tendance est signalée également aux 42^{ème} et 49^{ème} j. Compte tenu de ce qui précède, il apparaît clair que si le dosage de la progestérone peut être perturbé d'une semaine à l'autre, identifiant des femelles gestantes pendant un stade puis les détectant non gestantes pendant un autre, il n'en est pas ainsi pour la PAG qui apparaît très précise. Pour cette dernière, si une femelle est décelée gestante, elle le restera ainsi jusqu'à sa perte embryonnaire, son avortement ou sa mise bas. Dans le même sens, les pertes embryonnaires identifiées entre les 42^{ème} et 49^{ème} j (tableau 1 et figure 1) sont identifiées suite à la chute de la PAG en premier, suivie une semaine environ après par la chute brusque et en parallèle jusqu'à leur niveau basal de la progestérone et de la PAG. Ces femelles ont rejoint le lot

des 2 autres diagnostiquées vides par les deux tests depuis le 17^{ème} j jusqu'au 49^{ème} j et même au-delà, suite certainement à une non fécondation. En réalité, ces brebis n'ont ni mis bas, ni avorté, ni détectées par les deux tests comme ayant perdu leurs embryons. Par conséquent, la spécificité comme la valeur prédictive positive sont de 100% pour les deux tests et à tous les stades de gestation. L'exactitude des diagnostics négatifs exacts est très élevée tant pour la progestérone comme pour la PAG.

Table 2: Nombre de femelles diagnostiquées positives ou négatives selon les différentes méthodes de diagnostic de gestation (P4 ou PAG) et le stade de gravidité des femelles

Stade de gestation	J 17		J 21		J 28		J 35		J 42		J 49	
	P4	PAG	P4	PAG	P4	PAG	P4	PAG	P4	PAG	P4	PAG
a	22	5	23	20	22	23	21	23	20	21	19	20
b	0	0	0	0	0	0	0	0	0	0	0	0
c	2	2	2	2	2	2	2	2	4	4	5	5
d	1	18	0	3	1	0	2	0	1	0	1	0
Total	25	25	25	25	25	25	25	25	25	25	25	25

Dont: **a:** diagnostic positif exact (gestantes); **b:** diagnostic positif faux (non gestantes); **c:** diagnostic négatif exact (non gestantes) et **d:** diagnostic négatif faux (gestantes).

Table 3: Sensibilité, spécificité et valeurs prédictives positive et négative (fiabilité) des diagnostics de gestation selon le stade de gravidité des femelles et les différents types de dosages (P4 ou PAG)

Stade de gestation	Sensibilité (%)		Spécificité (%)		Valeur prédictive positive (%)		Valeur prédictive négative (%)	
	P4	PAG	P4	PAG	P4	PAG	P4	PAG
J 17	95,65 ^{a1}	21,73 ^{a2}	100	100	100	100	66,66 ^{a1}	10 ^{a2}
J 21	100 ^{b1}	86,95 ^{b2}	100	100	100	100	100 ^{b1}	40 ^{b2}
J 28	95,65 ^{a1}	100 ^{c2}	100	100	100	100	66,66 ^{a1}	100 ^{c2}
J 35	91,30 ^{a1}	100 ^{c2}	100	100	100	100	50 ^{c1}	100 ^{c2}
J 42	95,23 ^{a1}	100 ^{c2}	100	100	100	100	80 ^{d1}	100 ^{c2}
J 49	95 ^{a1}	100 ^{c2}	100	100	100	100	83,33 ^{d1}	100 ^{c2}

-Valeurs avec lettres différentes dans la même colonne, diffèrent significativement entre elles.

-Valeurs avec numéros différents dans la même ligne pour chacun des paramètres évalués, diffèrent significativement entre elles.

Dont:

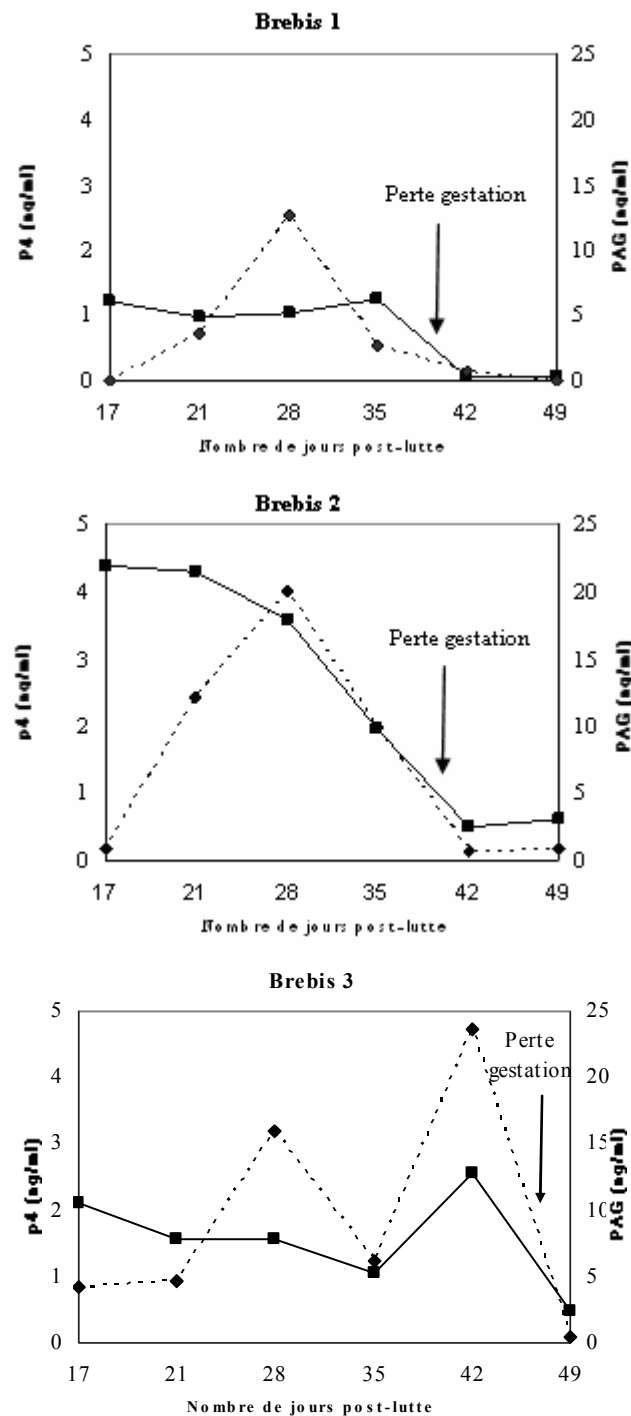
Sensibilité = $[a/(a+d)] \times 100$; soit nombre diagnostic positif (+) exact/nombre femelles réellement gestantes.

Spécificité = $[c/(c+b)] \times 100$; soit nombre diagnostic négatif (-) exact/nombre femelles réellement non gestantes.

Valeur prédictive positive = $[a/(a+b)] \times 100$; soit nombre diagnostic positif (+) exact/nombre diagnostic positif (+) total.

Valeur prédictive négative = $[c/(c+d)] \times 100$; soit nombre diagnostic négatif (-) exact/nombre diagnostic négatif (-) total.

Figure 1: Évolution des concentrations plasmatiques de la P4 (—■—) et de la PAG (----◆----) des brebis ayant connu des pertes embryonnaires.



4. Discussion

Malgré l'emploi de réactifs non spécifiques pour le dosage par RIA semi-homologue de PAG, l'identification et la discrimination des femelles gestantes et non gestantes est précisée dès le 21^{ème} j de gestation ($p < 0,0001$). Des résultats similaires sont signalés chez la même espèce [23, 35, 20] par emploi de la PSPB et de la PAG pour des tests hétérologues ou homologues [34].

La très faible sensibilité produite par la PAG au 17^{ème} j est due au fait qu'à cet âge précoce de gestation, la placentation est encore faible et la production de PAG au seuil discriminatoire n'a

concerné que 21,73% des femelles présumées gestantes. À l'inverse, son amélioration spectaculaire au-delà de cet âge ne peut être expliquée que par la mise en place et surtout le développement du système placentaire, combinés à la fixation de l'embryon. Ce qui rend le placenta très fonctionnel à partir du 21^{ème} j. Nos résultats de sensibilité et de spécificité aux 21^{ème} et 28^{ème} j vont globalement dans le même sens que ceux enregistrés chez la croisée Awassi x Mérinos aux 22^{ème} et 29^{ème} j [20] bien qu'une légère différence est observée entre sensibilités pour le 1^{er} âge indiqué (86,95 vs 93,5%). Ceci revient aux brebis diagnostiquées négatives fausses, suite à une production de PAG faible par rapport au seuil discriminatoire et à celle développée par les brebis repérées gestantes durant le même stade ($p < 0,01$). Situation justifiée sans doute par le développement insuffisant du système placentaire et son fonctionnement partiel, combinés probablement à l'effet race [23] et à la non détermination du niveau discriminatoire optimum qui peut différencier entre femelles gestantes et non gestantes. Cette imprécision est assimilée possiblement à l'existence de la grande variabilité dans le début de la sécrétion effective de cette glycoprotéine [11,13,]. Cependant, au 28^{ème} j nos résultats sont supérieurs à ceux annoncés chez la Manchega [13] dus probablement à l'effet race [23] ou au test employé. Pendant que ceux aux 28^{ème}, 35^{ème} et 42^{ème} j sont similaires à ceux de la Texel [33,34].

Par ailleurs, l'évaluation de la progestéronémie aux mêmes stades évoqués pour la PAG fait ressortir également une différence significative ($p < 0,05$) entre brebis gestantes et non gestantes; confirmant des conclusions antérieurement établies [30, 28, 31,32]. La très forte sensibilité enregistrée au 17^{ème} j de gestation par la progestérone ($p < 0,0001$) est assimilée certainement à l'existence et au bon fonctionnement d'un corps jaune gestatif chez la plupart des femelles. Ceci face à un développement insuffisant du système placentaire et à une fixation embryonnaire non bien établie pour la majorité des brebis (78,27%).

Nos résultats de spécificité pour la progestérone sont très identiques [13] sinon plus élevés à tous les stades de gestation [19, 27,20]. La sensibilité cependant est supérieure à celle observée chez la Manchega [13] mais faible par rapport à celle enregistrée chez la croisée Awassi x Mérinos [20].

Ainsi, bien que tous les auteurs s'accordent à dire que la fiabilité des diagnostics négatifs est toujours élevée [30-32] et celle des diagnostics positifs est faible [19,3], dans notre cas, l'inverse est vrai. Il est confirmé par ces deux brebis qui jouent l'exception de diagnostic négatif faux (brebis pseudo-vides) sur plusieurs prélèvements. En effet, avec 5 prélèvements sériés négatifs pour la 1^{ère} brebis et 1 seul au 35^{ème} j de gestation pour la seconde, nos résultats contredisent cette affirmation, soutenant qu'un faible niveau de progestérone plasmatique environ un cycle après insémination est caractéristique d'une femelle sûrement non gravide [31]. Notre situation est similaire à celle notée chez les bovins [29] indiquant que les niveaux de la progestérone ne sont pas toujours faibles (< 1 ng/ml) lors des oestrus détectés. Ce qui peut être aussi valable dans notre cas où la P4 peut ne pas être forcément toujours élevée (≥ 1 ng/ml) pour déclarer la gravidité d'une femelle.

Devant cette évolution particulière des concentrations de la progestérone et de la PAG de ces deux brebis, et exceptionnellement pour la 1^{ère} où d'un côté le niveau de la progestérone se trouve systématiquement inférieur à 1 ng/ml (entre 0,35 et 0,89 ng/ml pour 5/6 prélèvements sériés) la déclarant à tort vide, et d'un autre côté une évolution croissante et continue de celui de la PAG (de 0,49 à 25,61 ng/ml) l'identifiant à raison gestante, le cas de cette brebis identifiée ne peut être intégré dans aucune classe par référence au travail de classification des états physiologiques basé sur les niveaux de la progestérone proposé [32]. Ce résultat exceptionnel et curieux à la fois, ne fait qu'allonger probablement la liste des limites de la méthode de la progestérone déjà connues et répertoriées antérieurement [6,18,22,32,20], dépassant même de loin cette condition posée et exigée [32] de: 5 prélèvements positifs pour caractériser la gravidité des femelles inséminées, 3 prélèvements négatifs pour caractériser l'anoestrus anovulatoire, ou enfin l'alternance de ces concentrations faibles et élevées pour caractériser les femelles cycliques ovulatoires. Cependant, avec la méthode de la PAG, cette curiosité est levée et la présence en parallèle de cette glycoprotéine trophoblastique dans le sang n'est qu'un indicateur précis de l'existence bel et bien d'un embryon et donc d'une gestation effective (brebis ayant avorté au 66^{ème} j post-lutte).

Par conséquent, si la thèse indiquant qu'au début, la présence de la progestérone dans le sang n'est pas spécifique à la présence d'embryon dans l'utérus est valable à cause des anomalies qui peuvent surgir et qui justifient les limites répertoriées de la méthode de la progestérone, dans notre cas, nous pouvons possiblement émettre l'hypothèse que l'insuffisance aussi de la progestérone par rapport au seuil de 1 ng/ml n'est pas forcément synonyme ou spécifique à l'absence d'embryon dans l'utérus. En revanche, l'inverse est vrai au seuil de 1,2 ng/ml à partir du 21^{ème} j et surtout du 28^{ème} j de gestation pour la méthode de la PAG; confortant de ce fait l'exactitude, la précision et la fiabilité de cette dernière face à celles de la progestérone.

En effet, cette glycoprotéine appartenant à la famille des protéines aspartiques est sécrétée par les cellules binucléées du trophoblaste quelques jours après la fécondation [38]. Bien qu'irrégulière et faible au départ, elle est plus importante à partir du 28^{ème} j. Ce qui permet par dosage de RIA, de discriminer sans difficultés ni confusion aucune entre les deux groupes de femelles. Dans le même sens, si l'évolution progressive et continue de la PAG chez les femelles gestantes est synonyme de l'existence d'embryon et d'une placentation bien établie et fonctionnelle, il n'en est pas de même pour les femelles vides. Pour ces dernières, aucune trace de cette glycoprotéine n'est détectée depuis le début jusqu'à la fin. Ce qui rend alors le diagnostic négatif exact (spécificité) pour ce groupe de femelles très élevé (100%). La même tendance est observée dans le cas de la progestérone pour les mêmes femelles ayant subi la lutéolyse ou se trouvaient en période anovulatoire. Ceci ne corrobore pas certains résultats annoncés [20], affirmant la supériorité de la spécificité ($p < 0,05$) de la PAG face à la progestérone; mais conformes à d'autres signalés [32].

L'identification des pertes embryonnaires annoncées tant par la PAG comme par la progestérone est conforme à ce qui est publié antérieurement [19,16]. En effet l'analyse des niveaux de progestérone chez des femelles inséminées et présumées gestantes est aussi un bon moyen pour préciser les phases où la mortalité embryonnaire peut survenir ou être élevée. La précision de ces pertes embryonnaires est très élevée tant pour la PAG comme pour la progestérone. Ceci après une chute affirmée et un retour à leur niveau basal respectivement précoce et progressif pour la 1^{ère}, mais tardive et brusque pour la seconde (figure 1). Des résultats similaires sont notés pour la PSPB et la progestérone chez la brebis [35], la PSPB chez la chèvre [17], la PAG et la progestérone chez la chèvre [39] et la PAG chez la vache [7].

5. Conclusion

Le dosage séquentiel des concentrations de la PAG et de la progestérone chez la brebis Ouled Djellal fait montrer que la progestérone, hormone stéroïdienne, est plus précoce dès le 17^{ème} j de gestation. Pendant que la PAG, glycoprotéine placentaire facilement détectable dès le 21^{ème} j, est très exprimée, plus précise et plus fiable à partir du 28^{ème} j de gestation; rendant de ce fait, le diagnostic précoce de gestation très possible et réalisable par RIA semi-homologue. L'annonce des pertes embryonnaires bien qu'elle est précise pour les deux méthodes prises séparément, est néanmoins plus précoce d'environ une semaine dans le cas de la PAG. Cependant, leur combinaison en pratique, même si elle est inutile pour le diagnostic de gestation, est plutôt intéressante et même nécessaire dans l'identification et la confirmation des pertes embryonnaires, la mesure de leur importance selon le stade de gestation et donc la détermination des causes de faible fécondité des troupeaux. De même, nous pouvons émettre l'hypothèse que l'insuffisance de la progestérone par rapport au seuil de 1 ng/ml même pour 5 prélèvements sériés négatifs, n'est pas forcément toujours synonyme ou spécifique à l'absence d'embryon dans l'utérus et donc de femelles vides.

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Generic Architecture Based Agent for Context and Schema Mediation

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Abstract

This paper is to propose a generic architecture based agent for the semantic mediation of the information systems. This solution combines two approaches (schema mediation and context mediation) in a progressive way and uses new technologies in order to ensure better advantages of the two approaches. Our solution makes it possible to solve the majority of the semantic conflicts in a dynamic way and respects the properties of interoperability (autonomy, scalability, evolutionarily...) by using the concept of intelligent agent

1. Introduction

The evolutions of these last years, as well in terms of organization as of technology, generated the multiplication and the dissemination of heterogeneous information, thus returning the information systems heterogeneous and distributed. The cooperation of systems is confronted with many problems of heterogeneities and must take account of the open and dynamic aspect of modern environments.

Various types of heterogeneity can be met. Technical heterogeneity refers to the coexistence of disparate material platform and operating systems. Syntactic heterogeneity relates to the diversity of choice on the level of the models and the data types. Structural heterogeneity characterizes the differences between the concepts of the data models (schematic conflicts) and between query languages. Semantic heterogeneity refers to cases of different interpretation. Several types of semantic conflicts appear: naming conflicts (taxonomic problems and linguistics), values conflicts (units and scales problems...)

The solutions for the interoperability of the information systems evolved to *the semantic mediation of the systems*, defined [5] [7], "*any process of database interoperability allowing to solve the semantic conflicts related to the objects values domain and dependent on the objects structuring of the real world*"

We propose a solution for the semantic mediation of the information systems, section 2 presents a synthesis of the various existing approaches and then introduced the key points of our solution. Two sections 3.3 and 3.4 describe the architecture of the mediation and the various types of agents. Then sections 3.5, 3.6 and 3.7 explain the protocol which makes it possible to add systems, the

mediation model and the queries processing. Finally, sections 3.8, 3.9 and 3.10 describe the communication language between agents, a cooperation scenario and the prototype implementation.

2. Interoperability approaches of the information systems

We compare the various approaches according to the following criteria:

1. The formulation of the user query (in ontology/schema terms)
2. Capacity of the system to solve the majority of the semantic conflicts (solved conflicts type).
3. The degree of automation of the resolution process.
4. The resolution of the requests (treated statically/dynamically)
5. Transparency, evolutionarily (add/remove/modification of an information sources) and the scalability (capacity to manage an exponential increase in information sources) of architecture.

Many solutions were proposed to solve the interoperability problem of information systems (virtual integration) [3] [4] [2], The most recent systems are the broking information systems whose objective is oriented directed on the semantic conflicts resolution (or semantic mediation). Three approaches [6] [8] [2] are distinguished:

The schema mediation is a direct extension of the federate approach. Data conflicts solved statically. It consists with associates to the mediator a knowledge set (mapping rules) allowing locating the data sources. An execution plan is established by rules, which define where are the relevant data to a query processing are. The Global schema is generally specified by interfaces object, logic or XML. In this approach the transparency is assured, the degree of automation resolution is weak and the scalability and the evolutionarily are respected compared to the context mediation. The majority of the solutions not solve the semantic conflicts of values [02].

A first tendency can be illustrated using work of Kashyap and Seth carried in 1994 for the context mediation approach. Sensitive to the semantic heterogeneity problem which can make difficult query processing, they introduced the concept of *context*. The role of the mediator in this approach, it identifies and locates, transforms and integrates the relevant data according to semantics associated with a query [02]. The data conflicts resolution is dynamic and does not require the definition of a mediation schema. The user's queries are generally formulated in terms of ontologies. The data are integrated dynamically according to the semantic information contained in the description of the contexts. This approach allows the best taken into account of the evolution of the local sources and thus the automation degree is better compared to the schema mediation.

Two categories of context mediation are defined: the approach single domain SIMS [9], COIN [10] works on a single domain where all the contexts are defined by using a universal of consensual speech. The scalability and evolutionarily are respected but remains limited by the unicity of the domain; and multi domains approaches Infosleuth [11], Observer [12]. In this approach the conflicts resolution is a dynamic way, during the execution of the queries allows the best taken into account of the evolution of the local sources and thus the automation degree is better compared to the schema mediation. Concerning the semantic conflicts, the majority of the projects solve only the taxonomic conflicts Coin [10]. The resolution of the values conflicts either is guided by the user Infosleuth [11], or unsolved in the majority of the cases Observer [12] [13].

The hybrid approach combines between the schema mediation and the context mediation, named DILEMMA [02][24] and based on the queries static resolution. The mediation is ensured by a couple mediator/wrapper and a knowledge base associated with each system taking part in the cooperation. The mediator comprises a queries processor and a facilitator. This last is composed of two services: a fusion service (distant context, local context) and a generation service of mediation rules. Shared information is described in a data model directed objects deductive and attached to an applicability or local semantic context expressed using terminological logic. This approach offers a better transparency like the schema mediation and makes it possible to solve the values semantic conflicts, but in a manner a priori. The automation degree is better compared to the schema mediation

and remains always necessary the recourse to an expert of the domain. It has a low capacity to treat evolutionarily and the scalability especially in a multi-domain context.

2.1. The use of the SMA for the semantic mediation of the information systems

The appearance of the agent paradigm gives a new sight for the development of the of complex, heterogeneous, distributed and/or autonomous systems nature[14]. Several projects of semantic interoperability use the agent paradigm [15] [11]. Among work completed: The purpose of the Infosleuth project [11] is to implement a set of cooperative agents which *discover*, integrate *and present information* according to the needs for a user or an application for which they produce a simple and coherent interface. The Infosleuth architecture project consists of a set of agents collaborative communicate by ACL KQML. The users express its queries on a specific ontology. KIF and SQL are used to represent the queries. The queries are to dispatch with the agents specialized (agent broker, ontological, planner...) for the data retrieval on distributed sources and for integration. The resolution of many semantic conflicts remains guided by the user [02].

3. Approach Description

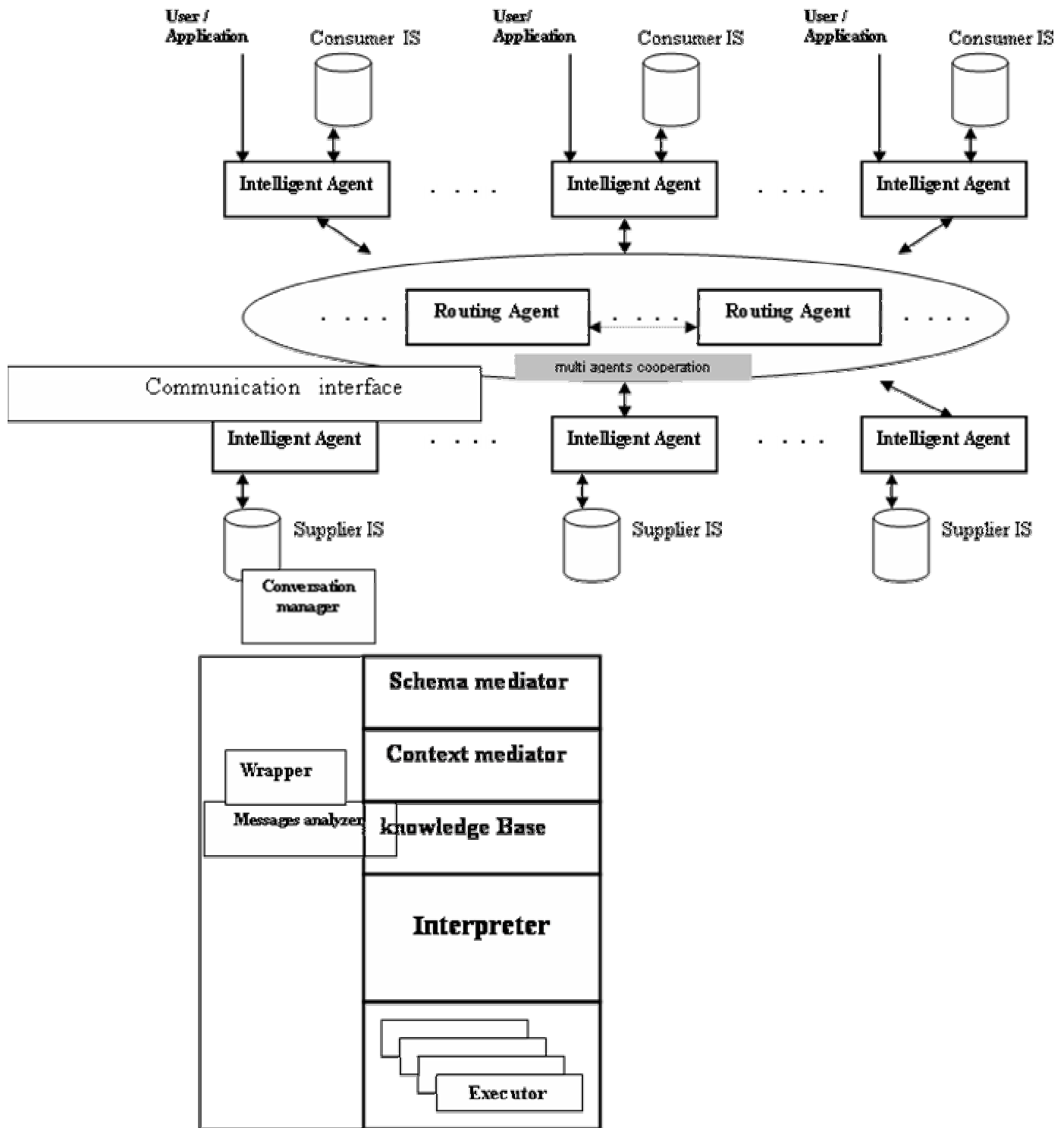
3.1. Approach objectives

The objectives of our solution are the realization of a semantic mediation having the following characteristics:

1. To allow a system which provides its context of application, to find the information systems and information shared by those, useful to this application, of integrated dynamically into the system and to use them in a transparent way.
2. To ensure the advantages of the context and schema mediation, and to avoid their disadvantages. Our contribution concentrates on the dynamic change of the multi-agents mediation system, of the context mediation to the schema mediation during the operation of the mediation system. That is done by the use of the intelligent agents, in order to ensure the open aspect of the context mediation (high automation degree of the query resolution process...) and the robustness of the schema mediation (reliability of the answers by the use of the mapping rules, the formulation of the queries in schema terms...).
3. To solve the majority of the semantic conflicts by using new technologies, and by respecting a high automation degree of the query resolution process of semantic conflicts.
4. To build a flexible semantic mediation system makes it possible to ensure evolutionarily (addition/withdrawal/modification of an information source) and the scalability of architecture.

3.1. A Generic architecture based agent for context and schema mediation

The cooperation suggested in our solution rests on a preliminary construction of information having to be integrated and on the mixed query resolution static and dynamics. An information system can play in turn the role of supplier or consumer [Figure1] of information.

Figure 1: General architecture

3.2. The principal interns structure of an intelligent agent

3.2.1. Components description

Communication interface: allows an agent to communicate with the environment: It sends query to its the local source and receives answers, answers query of the users. Cooperate with the other agents of the multi agent system.

Messages analyzer: analyzes the received messages, and determines their types.

Conversations manager: ensure the good comprehension of the message by checking that the context of the message is known. It identifies the cooperation protocol used for the dialogue between the transmitter and the receiver and it control the progress report of the conversation.

Wrapper play mainly three roles:

1. Translation of sub queries written by using common language OWL towards the language owner with the local source;
2. Translation of the schema local source towards a schema written by using the common data model (OWL);
3. Translation of the results obtained of the local source towards the common format.

Base knowledge: contains knowledge of the agent on the environment, this base is always to update by the agent during its communication with the other agents. It contains mainly the schema local base, its ontology, the links schema-ontology and of the mapping rules between schemas of other agents which are discovered by the agents.

Schema mediator: execute the schema mediation (described in the next sections).

Context mediator: execute the context mediation (described in the next sections).

Interpreter: fact the management of synchronization enters different the threads. Thus according to the type of the received message, it activates and call the component necessary for the query processing according to the various strategies applied.

Executor: the role of an executor is multiple according to the mission for which it east creates. For example: An executor east creates by the schema mediator to execute a recombining query of the results.

3.2.2. Definitions

Definition 1:

The semantic distance (ds) between two elements $e1$ and $e'1$, of two ontologies, of two different agents, is the rate of resemblance between these two elements. The calculation of this distance rests on a taxonomic analysis of the terms (list of the synonyms and antonyms) which characterize the two elements and on also the vicinity of the two elements.

Definition 2:

The comparison of two ontologies, from two different agents, amounts finding a correspondence between their entities which are semantically similar. The comparison is defined by the *Comp function* as follows: $Comp: O \rightarrow O'$ such as $Comp(e1) = e'1$ if $ds(e1; e'1) > tr$ where O and O' are two ontologies to be compared, tr indicates a minimal threshold of similarity belonging to the interval $[0,1]$, $e1 \in O$ and $e'1 \in O'$. $e1$ and $e'1$ the entities of two ontologies represent. The tr indicates the minimum level so that two entities are similar.

Definition 3:

- Is two agents A, B .
- the schema Sa and ontology Oa of agent A . ontology Ob of the agent B
- the function $Comp: Oa \rightarrow Ob$ it is the comparison between two ontologies Oa and Ob of A and B respectively.
- $COab$ is the set of the elements $e \in Oa$, such as $Comp(e) = e'$ and $ds(e; e') > tr$ with $e' \in Ob$.

3.3. Description of the various types of agents

- **Intelligent agents**

They are mono-domain agents. They acquire information coming from other agents; they adapt gradually and grow rich starting from their internal knowledge bases and evolution coming from the system. The roles of an intelligent agent are multiple:

1. Execution of the queries of the users or applications.

2. The comparison of ontologies and the automatic generation of the mapping rules of the schemas between an intelligent agent consuming (IAC) and another intelligent agent supplier (IAS), the principal steps are:
 - a. To compare the ontology of the IAC with the ontology of the IAS. The classes of two ontologies are compared using a semantic distance (the calculation of the semantic distance between two classes is calculated starting from elementary calculations of distances which takes into account the various elements of the environment [24] from a class in its ontology). The identified classes as equivalent are retained for the reconciliation process.
 - b. To adapt useful information of the IAS ontology in the IAC ontology. Sub schema dependent on the equivalent classes of the IAS ontology is dependent on the classes of the IAC ontology.
 - c. Generation of the mapping rules which make it possible to bind information been essential in order to ensure the static query resolution.
 3. Reformulation of the query Q, which consists in reformulating the query in terms of ontology.
 4. It translates the query Q coming from other IACs into query Q' expressed in the proper language of handling of the local base of the supplier.
 5. Filtering of the results.
- **Routing agents**
They are multi-domain agents, gathering the nearest semantically domain. The roles of a routing agent are:
 1. To gather the nearest semantically intelligent agents in a net contacts to be used as suppliers.
 2. To ensure the dynamic query resolution, and to communicate with other routing agents for execute reformulated queries.
 3. To record/eliminate dynamically the agents which take part in the cooperation.
 To search intelligent agents which contain information to which the domain is nearest to the domain of an intelligent agent (consuming).

3.4. Adding a new information system

The integration phase, of a new information system within the proposed mediation system, begins with creation from an intelligent agent and continues with the fastening of this last to a routing agent which is nearest semantically.

The intelligent agent applies the Contract Net protocol. The intelligent agent sends an invitation to tender describing its domain. The routing agents receiving the call provide their ability (semantic proximity rate). Once that the intelligent agent receives answers of all the routings agents, it evaluates these rates and makes its choice on a routing agent which is nearest semantically. The chosen routing agent, adds the intelligent agent to its net contacts.

3.5. Description of the proposed mediation model

The use of a common representation model ensures on the one hand the comprehension of the information schema and on the other hand a uniform access to the whole of the distributed data. The majority of the studies on the distributed and heterogeneous data management systems use the relational model or the object model like integration data model [16].

Our approach is to use the OWL (Web Ontology Language) like common data model and we base on work [17] which uses OWL like ontologies representation model. The OWL enriches the RDF Schemas model by defining a rich vocabulary for the description of complex ontologies. So it is more expressive than RDF and RDFS, which some reproach an insufficiency of expressivity due to the only definition of the relations between objects by assertions. OWL brings also a better integration, an

evolution, a division and an easier inference of ontologies [27]. The language used to interrogation the semantic mediation system is SOWL [28].

We adopt that ontology described the concepts of a domain while the schema describes the structure of a database, and the establishment of bonds between them makes it possible to data integrate while being based on their significance and not on their structure. Our approach uses the OWL to represent all information concerning the semantic mediation of the information systems. OWL is used like

- A common representation model of the schemas: our approach is based on work which was completed to convert schema represented on the relational model, object or XMLSchema [21] [22] [23] towards OWL model.
- A common representation model of ontologies: to clarify the concepts of the schema compared to the application domain of the cooperation system.
- A representation language of the links schema-ontology: to link a schema to its ontology.
- A representation language of the mapping rules: to link a consuming schema system to suppliers schemas systems, in the case of the schema mediation

3.6. Queries processing

The query processing breaks up into several steps, and during this process, the multi-agents system uses a set protocol. The principal steps are:

1. Static query resolution

Step 1: query validation the IAC checks the validity of the query. i.e. is this which is written in schema mediation terms or not.

Step2: query decomposition: the request is broken up at a recombining query of the results and sub queries intended for the intelligent agent suppliers (IAS) who contain data necessary to the execution of the query. The decomposition of the query is done by the use of the mapping rules. The IAC applies the cooperation protocol of static query resolution.

Step3: recombining of the results: the intelligent agent consuming (IAC) execute the recombining query of the results.

2. Dynamic query resolution

The dynamic resolution makes it possible to take into account the appearance of new IASs. The principal steps are:

Step 1: query reformulation the IAC reformulates the query in its ontology terms by using the links schema-ontology which is in its knowledge base.

Step 2: Transmission of the reformulated query the IAC applies the cooperation protocol of dynamic query resolution. So it transmits the reformulated query to the routing agent which is nearest semantically. And this last sends it to all IASs of its net contacts.

Step 3: Semantic evaluation of the reformulated query: Each IAS answers according to its capacity to treat the query:

- a. To compare elements of the query with its ontology. The elements of the query and its ontology are compared using a semantic distance. The identified elements as equivalent are retained.
- b. The query is rewritten in terms of the equivalent elements of its ontology (then interpreted on its schema) to take of them into account the semantic conflicts of values (each intelligent agent has library of functions for the conversion of the types).
- c. The answer is sent then to the routing agent, by indicating the manner of treating the query, for this last can build recombining queries of the results.

If no IAS answers, the routing agent sends the query to the other routings agents of other domains and if there are answers the routing agent updates its net contacts.

Stage 4: Results recombining: the routing agent recomposes the results obtained of IASs. Then it sends the final result to the IAC, this last recomposes the results of static and dynamic query resolution.

3.7. Communication between agents

The communication process in a multi agent system is based on three elements: acts of language, a common ontology and rules (or protocols) of conversation. The ACL (Agent Communication Language) take seat in a layer logically higher than that of the protocols of transfer and addresses the intentional and social level agents. The two most known ACL are KQML [19] and FIPA-ACL [20] both are based on the acts theory of language. In our solution we adopted the ACL of the FIPA like a communication language between agents. FIPA-ACL has on KQML the advantage of a more rigorous semantics as well as a significant effort of standardization. Our agents use a cooperation protocols. These protocols are rules of common conversations; structure the dialogue between the agents. Indeed each act of language (inform, cfp...) is to be interpreted via its context and more particularly in according with the other acts of languages which surround it temporally. The act of language takes its direction like element of a context and more specifically of a conversation. Each agent has a conversation manager.

3.8. Prototype implementation on the multi-agents JADE framework

The cooperation protocols were established on the Jade framework (Java Agent Development Framework) which provides API to develop a multi-agents system. This framework was selected because it proposes a library of interaction protocols. The addition of new information sources implies the creation of new agents on the Jade framework. The addition of the sources in great quantity concerns the property of scalability. The importance of the number of agents requires a more significant number of communications, which affects the request of the system of transport of the Jade messages. The scalability and the performances of the transport system of Jade message were treated in [29] [26]. The results obtained confirm the fact that Jade milked well the scalability according to several scenarios (will intra or inter framework).

4. Conclusion and prospects

We presented in this paper a generic architecture based agent for the semantic mediation of the information systems and in a multi-domain context. The solution suggested is of hybrid type, it combines the schema and context mediation approach in order to ensure a better transparency, a real sheared of information (at the semantic level) and a better scalability of architecture. The developed prototype shows us the functionality of architecture suggested. As prospect we try to slacken our data mediation towards service mediation in general and to use intelligent methods to reduce ontologies to be compared [30].

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Photovoltaic-Stand-Alone Hydrogen System

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Abstract

A photovoltaic system consists of an array, a storage medium and elements for power conditioning. Many photovoltaic systems operate in a stand-alone mode and the total energy demand is met by the output of the photovoltaic array. The output of the photovoltaic system fluctuates and is unpredictable for many applications making some forms of energy storage or backup system necessary. The role of storage medium is to store the excess energy produced by the photovoltaic array, to absorb momentary power peaks and to supply energy during sunless periods or during night. One of the storage modes is the use of electrochemical techniques, with batteries and water electrolysis as the most important examples. In this paper, we report the optimal design for a stand-alone hydrogen system with the volume of hydrogen produced against current as regards the concentration of electrolysis cell. Operating characteristics of a small capacity solar hydrogen system have been determined and also demonstrated that the I-V characteristics of the battery-photovoltaic module and electrolysis cell are influenced by variations in the concentration of the electrolysis cell, which in turn determines the amount of current that flows through it. A 50W photovoltaic panel rated as 17.4V, 2.87A yielded a maximum volume of about 8.6ml per minute for 1.0M cell concentration. Numerical simulation was used to compare the experimental results and also the possibility of increasing the cost-effective yield of hydrogen.

Introduction

Solar hydrogen is one of the most interesting options for the sustainable energy future relating to the increasing concerns of the environmental effects of current energy production and will accelerate the transition into renewable energy systems. The production of hydrogen from the decomposition of water (H_2O) using solar energy as the driving force has been a main focus of many scientists and engineers since the early 1970s when Fujishima and Honda [1] reported the production of hydrogen and oxygen in a photoelectrochemical hydrogen cell using a titanium dioxide (TiO_2) electrode exposed with near ultraviolet light. Since then there has been an explosion of scientific interest and experiments in this direction. The energy required to produce hydrogen via electrolysis (assuming 1.2 V) is about 32. kW-hr/kg. For 1 mole (2g) of hydrogen the energy is about 0.0660 kW-hr/mole. The power in this case is the voltage required to split water into hydrogen and oxygen (1.2 V at 25°C). The rate is the current flow and relates directly to how fast hydrogen is produced. Time, of course, is how long the reaction runs. It turns out that voltage and current flow are interrelated. To run the water splitting reaction at a

higher rate (generating more hydrogen in a given time), more voltage must be applied. For commercial electrolysis systems that operate at about 1 A/cm², a voltage of 1.75 V is required. This translates into about 46.8 kW-hr/kg, which corresponds to an energy efficiency of 70%. Hofmann's Voltameter, for that matter, 12V is applied for a current of between 0.1 to 2.0A [2].

Efficiency expressions for solar hydrogen storing system

In some solar photonic processes, solar photons drive a chemical reaction that stores part of the photon energy as chemical energy-rich product P (e.g. hydrogen). The efficiency η of such a photoprocess is defined as

$$\eta = \frac{\Delta G_p R_p}{E_s A} \quad (1)$$

where ΔG_p is the standard Gibbs energy for the energy storage reaction generating product P, R_p is the rate (mol s⁻¹) of generation of P in its standard state, E_s is the incident solar irradiance (Wm⁻²) and A is the irradiated area (m²). The water splitting reaction



is thermodynamically a two-electron process per molecule of hydrogen generated, with $\Delta G_o = 237 \text{ kJ mol}^{-1}$ [3].

In practice, efficiencies are measured using equation (1), where ΔG_p for reaction (2) is 237,200 J mol⁻¹ at 298 K. This requires that no matter what the system, the evolved hydrogen must be collected and measured volumetrically with appropriate corrections for water vapour if present. The factor R_{H_2} in equation (1) is the mole per second of pure hydrogen gas produced by the system, where the hydrogen is generated in its standard state.

In equation (1), $E_s A$ is the total light power incident on the system. This factor is replaced with power input of the battery (i.e. current x voltage).

Also, by Gas Equation the mole of hydrogen generated is

$$n_{\text{H}_2} = \frac{PV}{RT} \quad (3)$$

where P is the dry pressure (atm) of hydrogen, V is the volume measured in litre of hydrogen gas generated, R is the molar gas constant (0.082058 L atm K⁻¹ mol⁻¹) and T is the absolute temperature in K [4].

Also if the hydrogen is generated at a pressure P_1 lower than 1 atm (P_o), a term $RT \ln(P_o/P_1)$ is subtracted from G_p in equation (1).

$$\eta_{\text{H}_2} = \frac{\Delta G_p R_p - RT \ln(P_o / P_1)}{E_s A} \quad (4)$$

Experimental Setup

A Stand-alone Solar Hydrogen System consists of a photovoltaic module, an alkaline battery, a datalogger, a Hoffman Voltameter (Hydrogen Unit) and an inverter. The system (Fig. 1) consists of the physical structure made of Aluminum angle bar built in the form of movable stand with four wheels. On this structure is mounted the PV panel, wired through a power regulator to a 12V battery. The structure makes it possible for the system to be moved out into the sun. The battery is charged during the day, and can be used for hydrogen production, lighting, PC works, etc. The module is fixed mounted with tilt-angle of 9° to the horizontal. An Inverter capable of converting 12V from the battery to 220V AC is mounted to the rear of the stand. This inverter connects directly to the battery, not through the regulator. In the box are the Datalogger, power regulator and a potential divider. The

structure in this case supports the hydrogen cell connected to the battery through the regulator, that is, the hydrogen cell is connected to load point of the regulator.

Figure 1: Stand-alone system

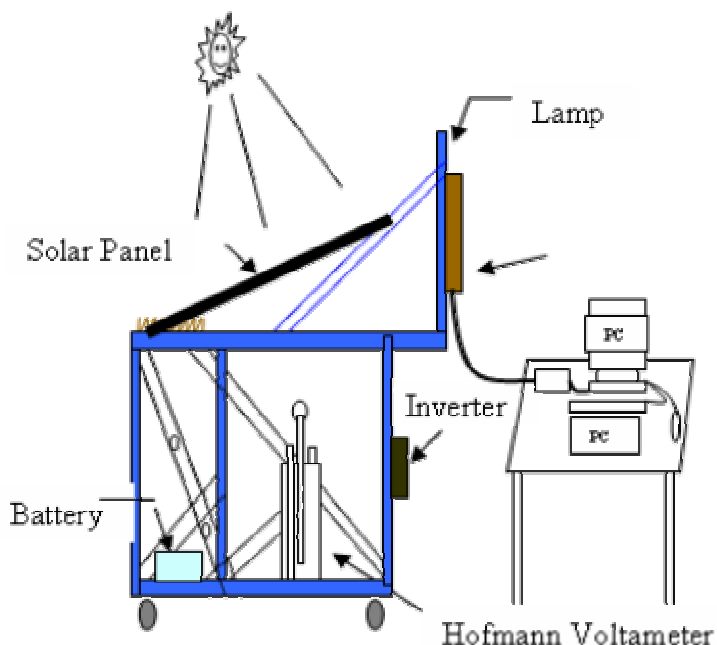
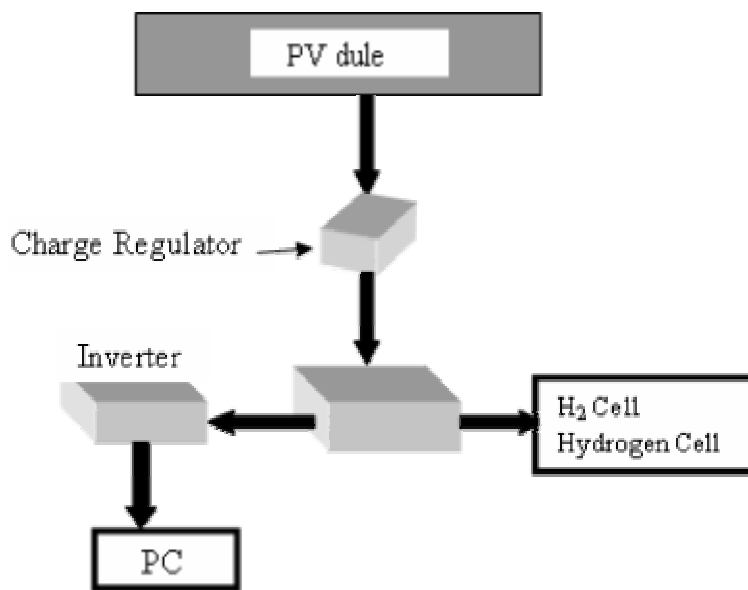
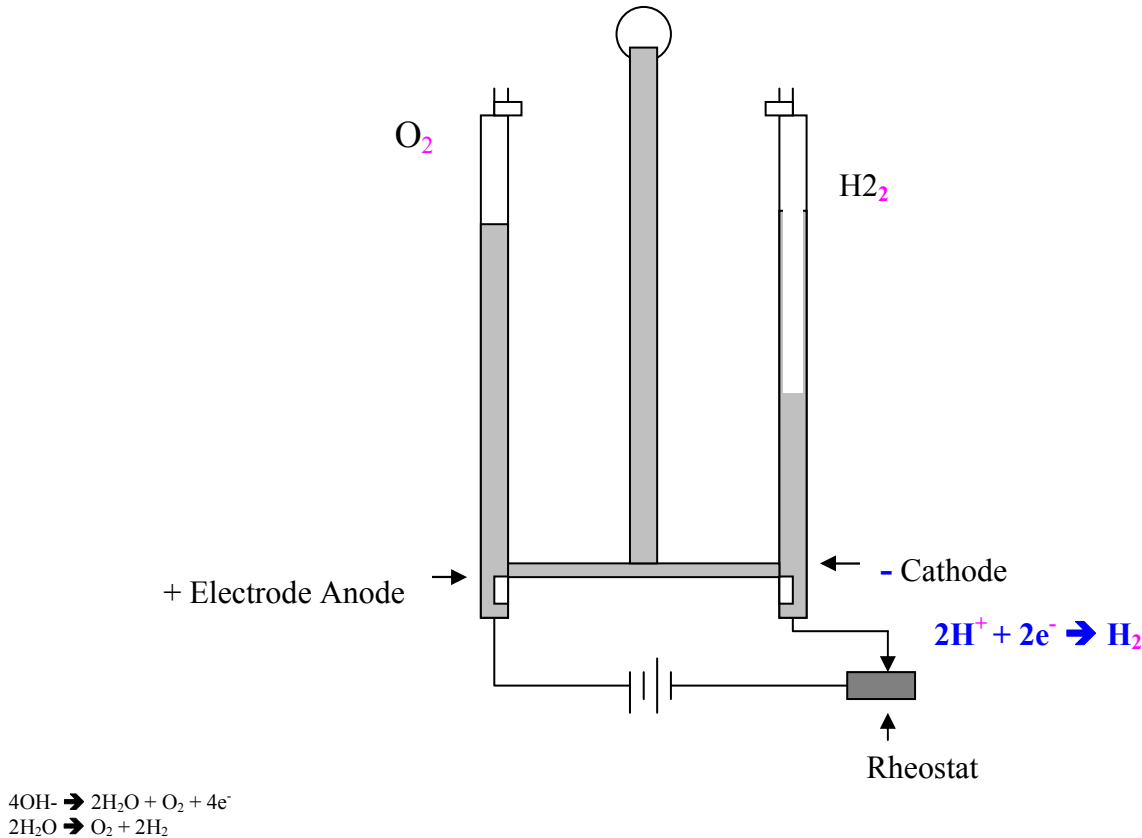


Figure 2: Block Diagram of the Setup



The hydrogen cell consists of three (3) joint glass tubes (Fig. 3). Two arms of which are the electrodes made of platinum foils. The two tubes are also fitted with taps for gas collection. The electrode can be replaced with Carbon rod or TiO₂. Pure water does not conduct electricity. A few drops of tetraoxosulphate (VI) acid (H₂SO₄) added to water cause it to conduct. In electrolysis, it is known that the carriers of current through the acid or salt solution are ions, which may be positively or negatively charged. The electrolysis is, in fact, the electrolysis of very dilute tetraoxosulphate (VI) acid. A water voltameter in this experiment uses platinum electrodes. The gases are collected in the gas tubes as the process continues. Two volumes of hydrogen to one volume of oxygen are collected. The gases are tested respectively with a lighted splint and a glowing splint.

Figure 3: Hofmann Voltameter: Electrolysis of water.

Mode of collection of Data

The system is connected as in Fig 1. Three types of electrodes were considered in turns. The Hofmann voltameter is filled with water of acid concentration of 0.2, 0.4, 0.6, 0.8, 1.0M and Sea-water and connected to the load terminal of the regulator through Bel Merit DM4000 Model ammeter, a rheostat, HP 34401A multimeter and a switch. The taps of the voltameter were opened for several minutes, then closed. This saturates the acid and the cathode with hydrogen. The rheostat adjustment is kept constant throughout the measurement. The initial volume of water is read in the two arms. Current is passed for several minutes and the volume of gas accumulated in each arm is read at one-minute interval. Air temperature is measured using CR10X Datalogger. Atmospheric pressure is also measured using Mercury Station barometer.

Volumes per minute of hydrogen reduced to dry gas at standard temperature and pressure using gas equation:

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2} \quad (5)$$

where p_1 is the partial pressure of hydrogen collected, V_1 is the volume of gas collected over the water at temperature T_1 , p_2 is the atmospheric pressure, T_2 is the absolute temperature and V_2 is the dry gas at s.t.p [3,4].

Computer simulation

Using modern standard programming tools well appropriate for Windows environment, namely C++, user- friendly approach implies a rather flexible user-program interface, which clearly defines simulated part of this project. Inputs of this program are based on the Faraday's law, namely; current, period of current flow, number of atoms of hydrogen and Faraday's constant. [Appendices A, B, C, D].

This simple computer model was to examine the dynamics of battery-concentration system in relation to current flowing through the hydrogen cell and the moles of hydrogen produced. The first part of the model was to calculate the moles of hydrogen produced by passing current through the hydrogen cell for a minute (60seconds) using the law put forward by Faraday [5]. The mole of hydrogen is then converted to volume of the gas, since one mole of hydrogen at standard temperature and pressure is 22.4 dm^3 . From the experimental data collected in the battery-panel combination it was found necessary to simulate the specific current output as Faraday's law is silent about the concentration but put more emphasis on the current that flow through the hydrogen cell.

Results and Discussion

Influence of Concentration on Current and Volume of hydrogen Produced

Table 1 provides the current-voltage values of the hydrogen cell as regards the varying concentrations of the electrolysis cell. The concentration is varied in order to find the suitable concentration that would yield optimum volume of hydrogen. The results show that the higher the concentration the higher the current that flow through the hydrogen cell. It can also be seen that the higher the concentration the greater the volume of gases collected in accordance with Faraday's law [6,7]. In the case of seawater the concentration of conductive ions may be lower than that of $0.2\text{M H}_2\text{SO}_4$ resulting in low current flow and hence the low volume of hydrogen collected.

Newton's Divided Difference relationship between current **I** and concentration **x** of acid water has been to predict the current as well as the volume of hydrogen produced when the concentration is known.

$$I(x) = 8.3x^5 - 16.9x^4 + 12x^3 - 3.8x^2 + 1.45x \quad (6)$$

Carbon electrode produced similar result as the Platinum electrode as shown in Table 3, but Carbon dissolve at the anode, and the rate of dissolution increases as the concentration. This means carbon electrode failed the durability test and cannot be suitable for this type of stand-alone system which is supposed to produce hydrogen for 24 hours a day. Titanium oxide electrode system was disappointing, as it could not perform in darkness. Even in the sun it had to be exposed directly under the sun; because of its semiconducting property, insignificant values were observed. Major measurement is, therefore base on the Platinum system.

The simulated system compared favourably with the experimental volume of the gas collected. Tables 1 and 2 show the similarity between the two systems. The model shows the dependence of a mole of gas produced in electrolysis on the current flowing through the hydrogen cell. Graphs of the relation are shown in Figure 4, 5 and 6. The potential difference across the hydrogen cell, no matter how small or large, is only needed to drive the charges through the hydrogen cell. Obviously the need arises to consider increasing the current while keeping the voltage as low as possible to reduce the power consumed by the hydrogen cell. It is thought that this course of action is a good representation of the situation observed in all the experiments undertook by other researchers. The current through the 1.0 M concentration hydrogen cell appears reasonable, since the higher amount of acid added to water would definitely add to the cost of production of the gas. It is also known that the more the hydrogen gas produced from the hydrogen cell the more concentrated the hydrogen cell becomes, implying that only water may be added from time to time.

Table 1: Effect of concentration on hydrogen production with volume converted to standard temperature and pressure (s.t.p).

Platinum Electrode						
Hydrogen cell Conc./M	Hydrogen cell Voltage/V	Hydrogen cell Current/A	Volume of Hydrogen/ml/min	Volume of hyd. at s.t.p	Power/W	Efficiency /%
0.2	11.41	0.21	1.5	1.2864	2.3961	9.73
0.4	10.98	0.40	3.6	3.0876	4.3920	12.75
0.6	10.63	0.57	4.2	3.6019	6.0591	10.78
0.8	10.23	0.71	5.5	4.7167	7.2633	11.77
1.0	9.18	1.12	8.6	7.3752	10.2816	13.01

Table 2: Simulated volume of hydrogen produced based on the experimental concentration.

Simulation using Faraday's Law			
Hydrogen cell Conc./M	Hydrogen cell Current/A	Mole of Hydrogen	Volume of Hydrogen/ml/min
0.20	0.21	0.000065	1.462383
0.40	0.40	0.000124	2.785492
0.60	0.57	0.000177	3.969326
0.80	0.71	0.000221	4.944249
1.00	1.12	0.000348	7.799378

Table 3: Electrolysis using Carbon electrode with varying hydrogen cell concentration from 0.2M to 1.0M.

Carbon Electrode						
Hydrogen-cell Conc./M	Hydrogen cell Voltage/V	Hydrogen-cell Current/A	Volume of Hydrogen/ml/min	Volume of hyd. at s.t.p	Power/W	Efficiency / %
0.2	11.75	0.20	1.6	1.3721	2.3500	10.59
0.4	11.54	0.40	3.2	2.7443	4.6160	10.78
0.6	11.32	0.56	4.4	3.7734	6.3392	10.79
0.8	11.12	0.74	5.6	4.8025	8.2288	10.58
1.0	10.54	1.21	9.2	7.8898	12.7534	11.22

Table 4: Influence of load on the Battery voltage and simultaneous volume of hydrogen produced.

Temp/°C	Batt-Volt	Vol. of Hy/min	Time/min	Temp/°C	Batt-Volt	Vol. of Hy/min	Time/min
28.41	12.19	7.4088	0	28.26	11.62	7.0658	18
28.35	11.87	7.2226	1	28.26	11.62	7.0658	19
28.32	11.87	7.2226	2	28.26	11.61	7.0658	20
28.32	11.93	7.2618	3	28.26	11.58	7.0462	21
28.29	11.86	7.2128	4	28.29	11.57	7.0364	22
28.29	11.84	7.2030	5	28.29	11.66	7.0854	23
28.26	11.69	7.1148	6	28.29	11.58	7.0462	24
28.26	11.72	7.1246	7	28.29	11.57	7.0364	25
28.26	11.70	7.1148	8	28.29	11.58	7.0462	26
28.26	11.70	7.1148	9	28.29	11.56	7.0364	27
28.26	11.69	7.1148	10	28.29	11.56	7.0266	28
28.26	11.68	7.1050	11	28.29	11.58	7.0462	29
28.26	11.68	7.1050	12	28.32	11.58	7.0462	30
28.26	11.74	7.1344	13	28.32	11.57	7.0364	31
28.26	11.66	7.0854	14	28.32	11.64	7.0756	32
28.26	11.65	7.0854	15	28.32	11.59	7.0462	33
28.26	11.64	7.0756	16	28.32	11.57	7.0364	34

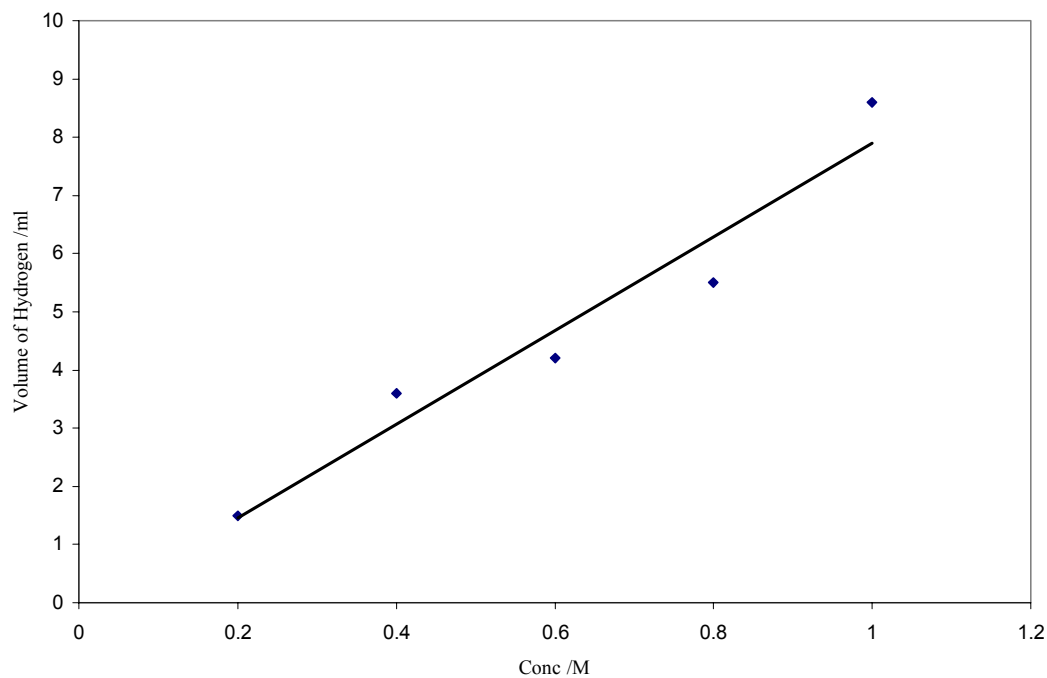
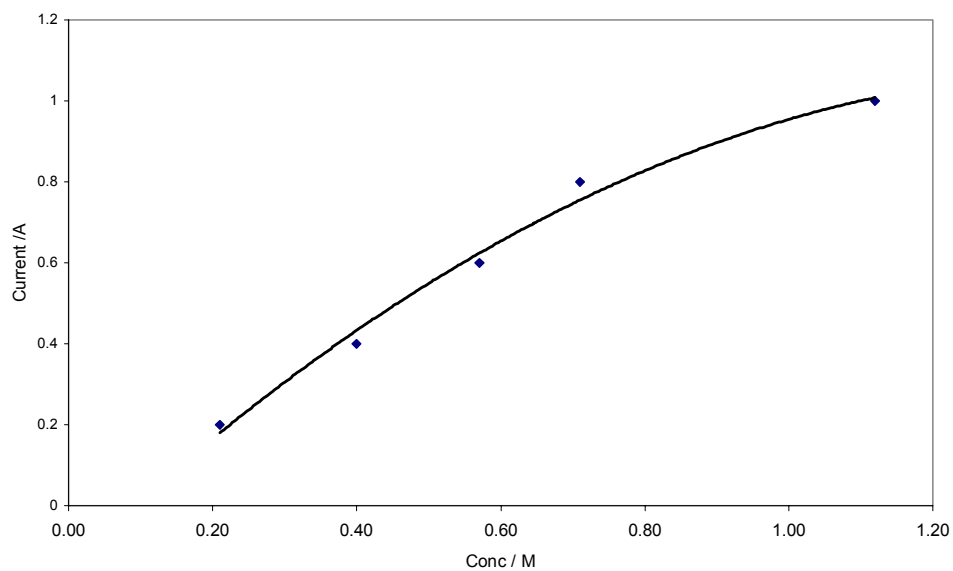
Figure 4: Variation of Volume of Hydrogen produced as a function of Concentration**Figure 5:** Variation of current as a function of the electrolysis cell Concentration

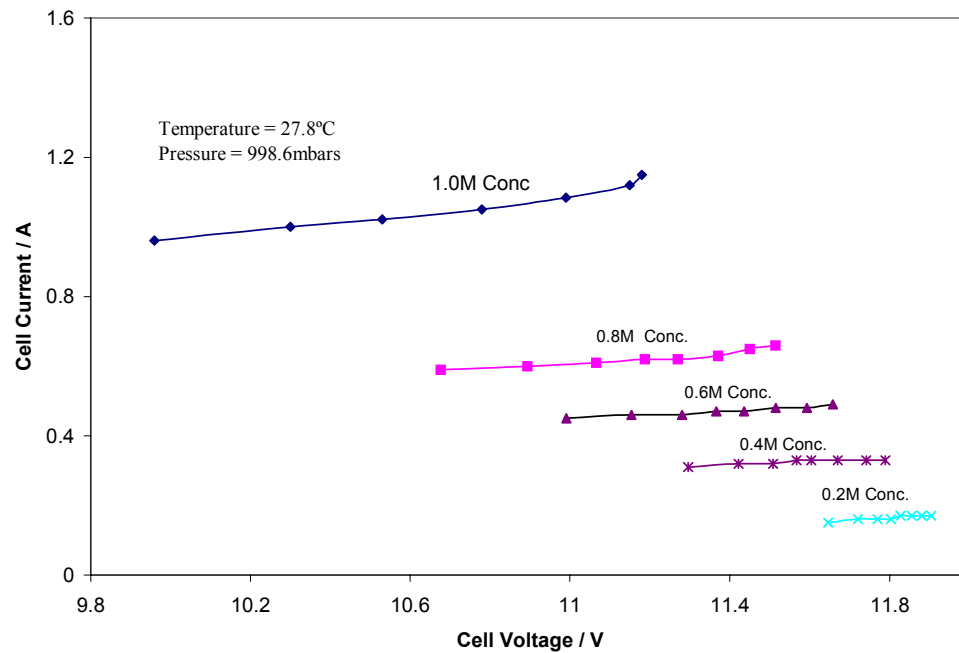
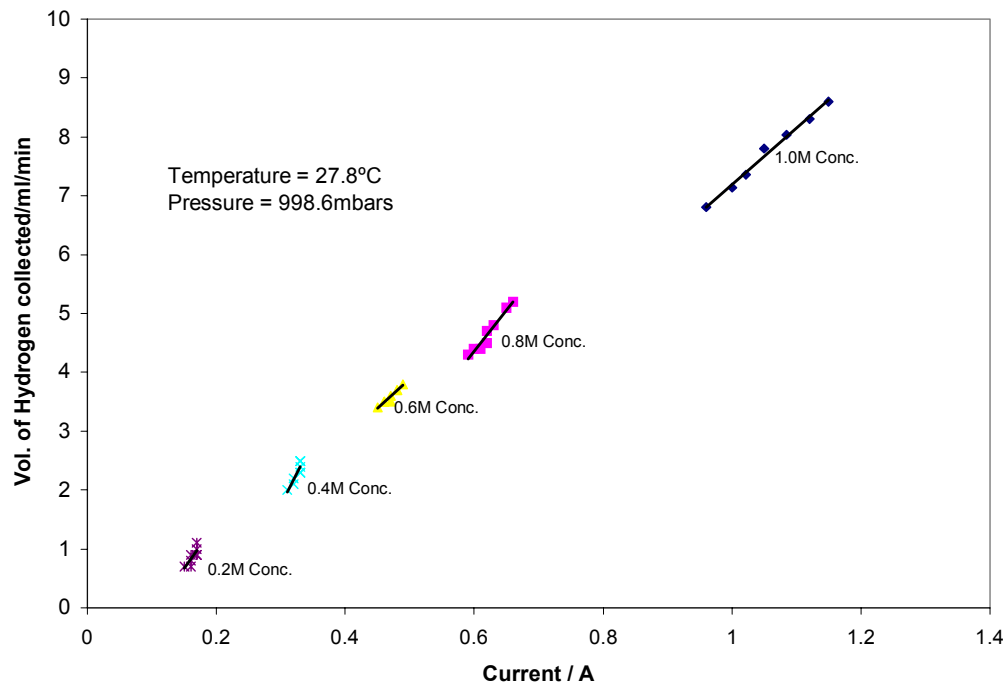
Figure 6: I-V Characteristics for varying Concentrations ranging from 0.2M to 1.0M**Figure 7:** A graph of volume of hydrogen collected as against current flowing through the electrolysis cell for varying concentrations compared.

Figure 8: Variation of volume of Hydrogen produced as a function of Power consumed by the system for the concentrations ranging from 0.2M to 1.0M.

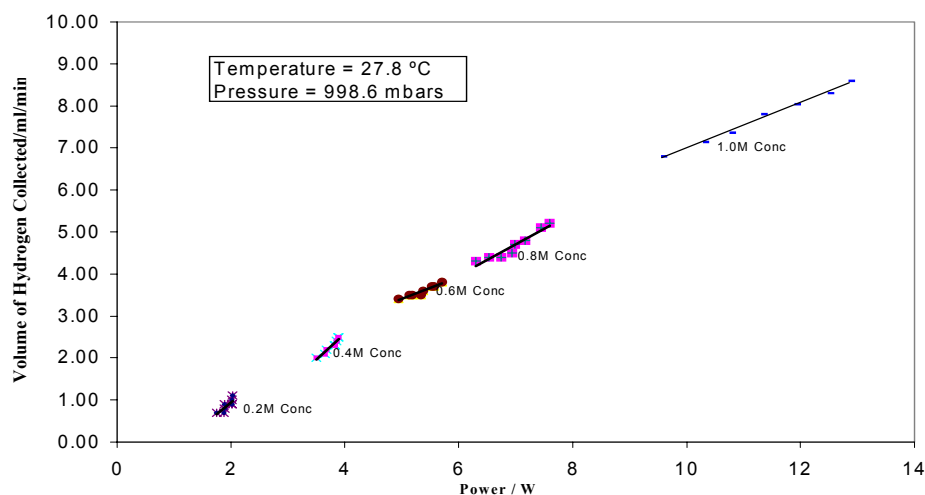
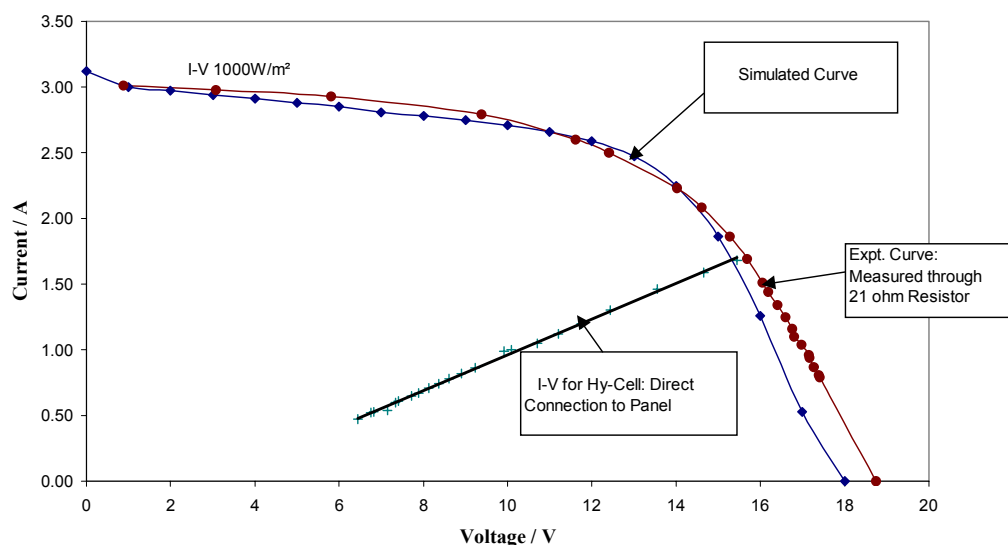


Figure 9: I-V Characteristic for Experimental and Simulation Compared: Ambient Temperature = 30.1°C, Pressure = 998.5mbar



Influence of Potential Difference across the H₂-cell

For the performance assessment of the hydrogen energy system in relation to the concentration, the data sets have been divided into five subsets. Each data is associated with each hydrogen cell concentration. Tables 5(a), (b), (c), (d) and (e) show the results of the observations for varying potential difference across the hydrogen cell. It has been shown that changing the voltage across the hydrogen cell definitely changes the current through the system. Observation indicated that a decrease in the current results in decrease in the volume of the gas collected so is the power consumed by the system.

This behaviour of current-volume of gas relationship actually obeys Faraday's law, but the influence of the volume of the gas by the voltage suggests that for a stand-alone system the power output of the battery depends on both charging voltage and current from the panel. For the present fixed 50W panel-battery system, the dependence of voltage with volume of hydrogen, volume with current and volume with power are depicted in Figure 7, 8 and 9 for various concentrations. It can be observed that the volume of gas collected increased with increasing concentration in almost linear

nature from 0.7ml/min to 8.6ml/min. The voltage rate of change of the current and volume of the gas is significantly low as the hydrogen cell concentration reduces, suggesting that the influence of conduction ions at the lower concentration is trivial.

Table 5a: Influence varying potential difference across the hydrogen cell for 1.0M conc.

I-V characteristic for 1.0M concentration			
Hydrogen cell Voltage/V	Hydrogen cell Current/A	Volume of H ₂ /ml/min	Power/W
11.18	1.15	8.60	12.8570
11.15	1.12	8.30	12.4880
10.99	1.08	8.04	11.9132
10.78	1.05	7.80	11.3190
10.53	1.02	7.36	10.7617
10.30	1.00	7.14	10.3000
9.96	0.96	6.80	9.5616

Table 5b: Influence varying potential difference across the hydrogen cell for 0.8M concentration.

I-V characteristic for 0.8M concentration			
Hydrogen cell Voltage/V	Hydrogen cell Current/A	Volume of H ₂ /ml/min	Power/W
11.514	0.66	5.2	7.5992
11.450	0.65	5.1	7.4425
11.371	0.63	4.8	7.1637
11.270	0.62	4.7	6.9874
11.187	0.62	4.5	6.9359
11.066	0.61	4.4	6.7503
10.894	0.60	4.4	6.5364
10.677	0.59	4.3	6.2994

Table 5c: Influence of varying potential difference across the hydrogen cell for 0.6M concentration.

I-V characteristic for 0.6M concentration			
Hydrogen cell Voltage/V	Hydrogen cell Current/A	Volume of H ₂ /ml/min	Power/W
11.658	0.49	3.8	5.7124
11.593	0.48	3.7	5.5646
11.515	0.48	3.7	5.5272
11.436	0.47	3.6	5.3749
11.367	0.47	3.5	5.3425
11.281	0.46	3.5	5.1893
11.154	0.46	3.5	5.1308
10.991	0.45	3.4	4.9460

Table 5d: Influence of varying potential difference across the hydrogen cell for 0.4M conc.

I-V characteristic for 0.4M concentration			
Hydrogen cell Voltage/V	Hydrogen cell Current/A	Volume of H ₂ /ml/min	Power/W
11.790	0.33	2.5	3.8907
11.742	0.33	2.5	3.8749
11.670	0.33	2.4	3.8511
11.604	0.33	2.3	3.8293
11.567	0.33	2.3	3.8171
11.509	0.32	2.2	3.6829
11.422	0.32	2.1	3.6550
11.296	0.31	2.0	3.5018

Table 5e: Influence of varying potential difference across the hydrogen cell for 0.2M concentration.

I-V characteristic for 0.2M concentration			
Hydrogen cell Voltage/V	Hydrogen cell Current/A	Volume of H ₂ /ml/min	Power/W
11.904	0.17	1.1	2.0237
11.881	0.17	1.0	2.0198
11.856	0.17	0.9	2.0155
11.827	0.17	0.9	2.0106
11.804	0.16	0.9	1.8886
11.770	0.16	0.8	1.8832
11.721	0.16	0.7	1.8754
11.646	0.15	0.7	1.7469

Maximum volume (8.6ml/min) of hydrogen collected would amount to 12384ml/day if the system operates 24hrs a day. Looking at the voltage rate of change of the current, there is no significant decrease in the current through the hydrogen cell as the concentration decreases. Volume of hydrogen produced per minute rather reduces significantly, showing that far lower hydrogen cell concentration than 1.0M results in low conductive ions. Taking into consideration the power rate, volume of hydrogen produced is quite significant.

Table 6a: I-V characteristics of both Electrolysis cell and Panel for 1000W/m² radiation when coupled with varying resistor. (Vo = Open-Circuit Voltage; Isc = Short-circuit Current)

Radiation=1000W/m ²			Temp=30.1°C		
CELL		Vo=18.75V	Isc=3.01A	PANEL	
Voltage/V	Current/A		Res/ohm	Voltage/V	Current/A
15.45	1.68		0	0.88	3.01
14.66	1.59		1	3.08	2.98
13.55	1.46		2	5.81	2.93
12.44	1.30		3	9.38	2.79
11.75	1.20		4	11.61	2.60
11.20	1.12		5	12.40	2.50
10.71	1.05		6	14.02	2.23
10.09	1.00		7	14.61	2.08
9.91	0.99		8	15.27	1.86
9.22	0.86		9	15.68	1.69
8.90	0.82		10	16.04	1.51
8.61	0.78		11	16.18	1.44
8.37	0.74		12	16.41	1.34
8.13	0.71		13	16.59	1.25
7.88	0.67		14	16.76	1.16
7.72	0.65		15	16.81	1.10
7.41	0.61		16	16.98	1.04
7.34	0.60		17	17.14	0.96
7.15	0.54		18	17.16	0.94
6.82	0.53		19	17.27	0.87
6.76	0.52		20	17.38	0.81
6.44	0.47		21	17.40	0.79
			22	18.75	0

Table 6b: Simulated I-V characteristics for 1000W/m² radiation.

SIMULATED DATA The Radiation = 1000 W/m ² The temperature = 30.1 °C		
Voltage/V	Current/A	Power/W
0	3.12	0.00
1	3.00	3.00
2	2.97	5.95
3	2.94	8.83
4	2.91	11.64
5	2.88	14.39
6	2.85	17.08
7	2.81	19.70
8	2.78	22.25
9	2.75	24.73
10	2.71	27.09
11	2.66	29.27
12	2.59	31.09
13	2.47	32.14
14	2.25	31.53
15	1.86	27.88
16	1.26	20.14
17	0.53	9.00
18	0.00	0.00

I-V Characteristics of H₂-Cell

The I-V characteristics of the hydrogen cell and its simulation are shown in Fig. 9. The reading was done by increasing the series resistance with the hydrogen cell in order to adjust the current through the hydrogen cell. Since the voltage and current supplied by the panel are constant, the I-V characteristic of the H₂-cell is a linear one. One would expect to have this characteristic to be of hyperbolic type, but then the concentration remains the same throughout the experiment. When the resistor of resistance 0-21Ω was in turn connected to the load point of the panel the characteristic obeyed the hyperbolic nature of the panel. In this test the load is varied in small steps and the output voltage and current measured once the system has reached a steady state after each load variation. The top two curves of Fig. 9 show the agreement in both experimental and simulated I-V characteristics for 1000W/m² radiation. As can be seen from the curve the maximum power point for the 1.0M concentration occurred at 26W.

Conclusion

Not only is the system convenient when in use as a stand-alone system, prevailing wisdom suggests that it is also multi-tasking as depicted in Table 4 if only the PV panel system is capable of keeping the battery above 50% charge for most of the year. It is obvious that this level of charging is obtained throughout the year in Ghana (between Lat. 5° and 11° North of the Equator). The evidence of this multi-tasking is that a PC of 600W was connected to the designed system for more than 30 minutes and at the same time 6W lamp and the hydrogen cell, drawing a current of 1.0 A, were working simultaneously. It is showed in Table 4 that the battery was at 12.19 V before the experiment was started, and for the 30 minutes period the battery went down to only 11.57 V. This portion of the experiment was carried out during the evening when the battery was not being charged. This means that during the day when the sun is up and the battery is being charged the system can be used simultaneously for storing energy as hydrogen to be used later. The Computer program developed to simulate I-V characteristics for the solar hydrogen system was used to calculate the I-V characteristics for the system which compared well with experimental results.

The Al-C/Pt-PEM-C/Pt-Cu fuel cell was fabricated successfully and the results obtained show that Al and Cu were suitable conducting materials for hydrogen fuel cell. It was also found that Al-

C/Pt-PEM-C/Pt-Cu cell did not clearly exhibit mass transport over-potential, while it was observable for Al-C/Pt-PEM-C/Pt-Al cell.

The efficiency of Al-C/Pt-PEM-C/Pt-Cu fuel cell was calculated and compared with other fuel cells and was found to be very encouraging. This provides more room for varying other parameters like flow rate of H₂ and O₂, choice of other suitable electrode materials, operating temperature etc.

Recommendations

The use of this hydrogen stand-alone system would make it possible to capture and store small percentage of abundant energy in the form of hydrogen from the sun to be used during the sunless period. The system is also used as a multi-purpose system with varying loads connected. Compared to the other methods of producing hydrogen, the current system is designed not only to produce hydrogen but also to store electrical energy for other purposes. Therefore, this system addresses the problem of variability of incidence of solar radiation and enables the user to get energy on demand.

Efforts should be made to find suitable substitutes for PEM, and some other conducting materials for electrodes to reduce the cost and fragility of the cell.

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Operating Characteristics of Proton-Exchange-Membrane (PEM) Fuel Cells

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Abstract

The H₂-O₂ fuel cells in which solar hydrogen and oxygen supplied to the anode side and cathode side of the cell respectively were fabricated and the two sides of the cells were separated by a proton-exchange-membrane (PEM) which allowed the passage of hydrogen ions H⁺ but not the oxygen O₂. The operating characteristics of two fuel cells, Al-C/Pt-PEM-C/Pt-Al and Al-C/Pt-PEM-C/Pt-Cu were plotted and internal resistance as well as the efficiency of these cells were computed and compared. It was found that Al-C/Pt-PEM-C/Pt-Cu cell did not clearly exhibit mass transport over-potential, while it was clearly observable for Al-C/Pt-PEM-C/Pt-Al cell.

1.0. Introduction

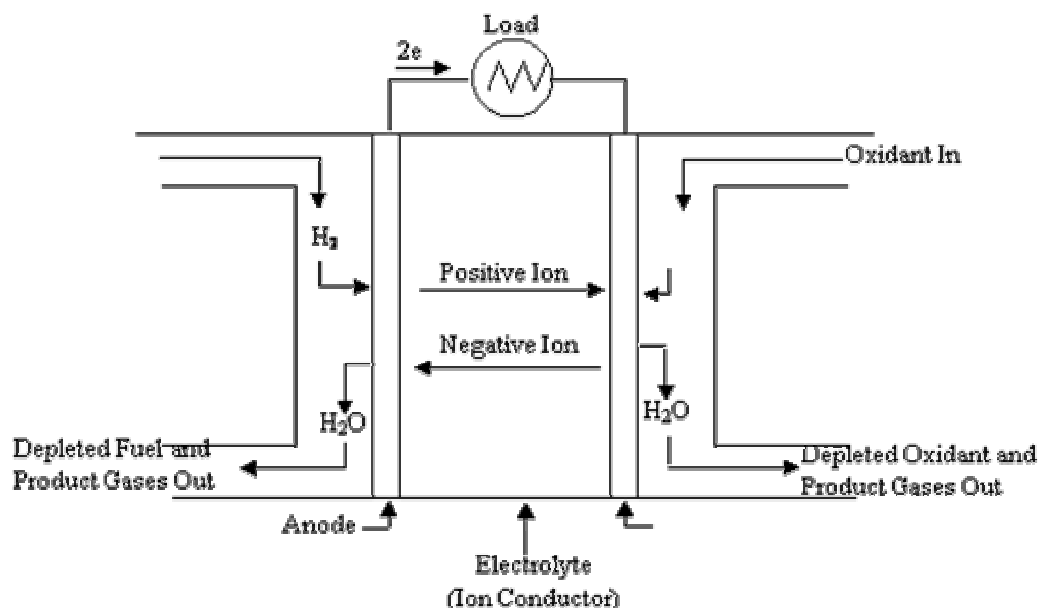
Hydrogen, for quite some time, has been hailed as a potential, pollution free future energy source. As a consequence there have been considerable advances in research and development devoted to hydrogen production. Among the hydrogen production methods investigated, water electrolysis is the only industrially, established clean hydrogen production technology available at present. Solar hydrogen is certainly promising long-term global energy option. Also, solar hydrogen has already found a commercial application in the form of seasonal energy storage for remote stand-alone power system. In a stand-alone solar hydrogen energy system, the photovoltaic array is coupled with an electrolyser to produce H₂, which is stored to be later converted back to electricity in a fuel cell (Stuart Baird, 1993).

After more than 40 years, fuel cells are finally coming of age rapidly. Back in the 1950s, fuel cells were hailed as the next step in the production of energy. A few proved themselves in space, others in utility demonstration projects but the technology never really took off until now. Because these electrochemical devices convert fuels such as hydrogen and methanol directly into electrical energy without combustion they create virtually no pollution. So they do not add carbon dioxide and other Greenhouse gases to the atmosphere. Moreover, new developments in catalysts and improved reliability have made them viable candidates in a broad range of energy applications (Report of the DOE, 1995)

1.1. Fuel Cell Description

The basic physical structure or building block of a fuel cell consists of an electrolyte layer in contact with a porous anode and cathode on either side. A schematic representation of a fuel cell with the reactant/product gases and the ion conduction flow directions through the cell is shown in Fig. 1.

Figure 1: Schematic of an individual fuel cell



In a typical fuel cell, gaseous fuels are fed continuously to the anode (negative electrode) compartment and an oxidant (i.e., oxygen from air) is fed continuously to the cathode (positive electrode) compartment; the electrochemical reactions take place at the electrodes to produce an electric current. A fuel cell, although having components and characteristics similar to those of a typical battery, differs in several respects. The battery is an energy storage device. The maximum energy available is determined by the amount of chemical reactant stored within the battery itself. The battery will cease to produce electrical energy when the chemical reactants are consumed (i.e., discharged). In a secondary battery, the reactants are regenerated by recharging, which involves putting energy into the battery from an external source. The fuel cell, on the other hand, is an energy conversion device that theoretically has the capability of producing electrical energy for as long as the fuel and oxidant are supplied to the electrodes (EG&G Services, 2000).

2.0. Fabrication of Al/xxxx/Al and Al/xxxx/Cu Fuel cells (/xxx/=-C/Pt-PEM-C/Pt-)

The search for alternative electrodes apart from Pt is aiming to reduce the cost of fabrication of the cell. Carbon paper impregnated with platinum powder (C/Pt) was chosen as the ideal candidate. This C/Pt is really brittle and cannot support external connections; therefore, aluminum mesh conductors were used for the preliminary fabrication to form an Al/xxx/Al fuel cell. For long term use of the cell, the oxygen side will form aluminum oxide and thus increase the resistance of the electrode. The oxygen side was therefore changed to a copper conductor, forming a Al/xxx/Cu fuel cell, as copper may not react directly with oxygen at the usual working temperature.

2.1. Preparation of PEM film

The PEM film was prepared for catalyst application by dipping the membrane in six different heated solutions in glass beakers. The solutions were all held between 80°C and 85°C by immersing the beakers in an ultrasonic washer containing heated water. The bath is heated by means of an immersion heater. Each beaker held the PEM for 30 minutes in sequence. The sequence of beakers used was set up as follows:

Beaker 1 → 150 ml of distilled water to hydrate the membrane and dissolve surface contaminants.

Beaker 2 → 150 ml of 3% hydrogen peroxide solution to remove organic contaminants from the PEM surface.

Beaker 3 → 150 ml of sulfuric acid (new battery electrolyte) to remove metal ion contaminants from the PEM surface, and sulfonate the PEM surface.

Beaker 4 → 150 ml of distilled water to rinse sulfuric acid from the surface and hydrate the PEM.

Beaker 5 → 150 ml distilled water to repeat rinse.

Beaker 6 → 150 ml distilled water repeat rinse.

A mercury thermometer was used for checking the beaker bath temperature. From time to time, more water had to be added to the bath surrounding the beakers, due to evaporation. The ultrasonic action quickens the washing process. After the PEM disk was dipped in each of the six hot solution beakers for 30 minutes, it was then air-dried in a clean place (Pyle W., et al, 2003).

2.2. Hot-Pressing the Sandwich Together

Two sheets, 3 cm by 5.5 cm were cut from the platinum-carbon impregnated sheet to serve as electrodes. A membrane of 5 cm by 7 cm was also cut. A hot press was made using a workshop vice and two metallic containers, each 200 cm³ capable of holding the immersion heater, shown below. Since water is the heating medium the highest temperature attained was 100°C.

First, the surfaces of the heating containers in contact with the catalyst were coated with graphite from a 2B pencil. The three layers, catalyst-PEM-catalyst, of the sandwich were then set in between the two heating containers. The layers were carefully aligned so that the smaller catalyst disks were centered above and below the larger PEM disk. At this time the heaters were turned off and the plates let cool to room temperature. Next, the two temperature controllers were initiated and the sandwich was taken up to 100°C for one hour. Once the heating plates and the sandwich reached 100°C, pressure was applied by tightening the vice. After this time the heater was turned off and the plates and sandwich cooled to room temperature. The heating containers were opened, and the finished fuel cell sandwich was removed using the tweezers.

The PEM sandwich was placed between two aluminum meshes to enable external electrical connection, thus forming the Al/xxx/Al cell. The five-layered sandwich was then placed in between machined transparent Acrylic blocks. The indenture retains the passing fuel for enough time to allow for absorption or consumption. An Al/xxx/Cu was also fabricated and tested.

3.0. Results

The measured values of current and voltages for Al/xxx/Al and Al/xxx/Cu

Cells are presented in Table 1 and Table 2 respectively.

Table 1: Current, voltage and Output power for Al/xxx/Al fuel cell.

Expt1				Expt2			
V/V	I/A	R/ Ω	Power/W	V/V	I/A	R/ Ω	Power/W
0.904	0.001	1000	0.001	0.900	0.001	1000	0.001
0.715	0.002	400	0.001	0.887	0.002	500	0.002
0.700	0.002	350	0.001	0.882	0.002	300	0.002
0.699	0.002	300	0.001	0.875	0.004	200	0.004
0.698	0.003	250	0.002	0.858	0.008	100	0.007
0.693	0.003	200	0.002	0.853	0.009	90	0.008
0.686	0.005	150	0.003	0.849	0.011	80	0.009
0.674	0.007	100	0.005	0.843	0.012	70	0.010
0.644	0.013	50	0.008	0.837	0.014	60	0.012
0.633	0.016	40	0.010	0.829	0.017	50	0.014
0.621	0.021	30	0.013	0.818	0.021	40	0.017
0.598	0.030	20	0.018	0.804	0.027	30	0.022
0.559	0.054	10	0.030	0.781	0.039	20	0.030
0.554	0.060	9	0.033	0.737	0.073	10	0.054
0.545	0.066	8	0.036	0.725	0.080	9	0.058
0.535	0.074	7	0.040	0.712	0.088	8	0.063
0.522	0.084	6	0.044	0.700	0.098	7	0.069
0.505	0.097	5	0.049	0.684	0.111	6	0.076
0.482	0.114	4	0.055	0.665	0.129	5	0.086
0.448	0.139	3	0.062	0.640	0.154	4	0.099
0.397	0.180	2	0.071	0.607	0.191	3	0.116
0.303	0.233	1	0.071	0.556	0.250	2	0.139
0.098	0.288	0	0.028	0.394	0.325	1	0.128
				0.077	0.366	0	0.028

Washer Ultrasonic Washer
Ultrasonic Washer

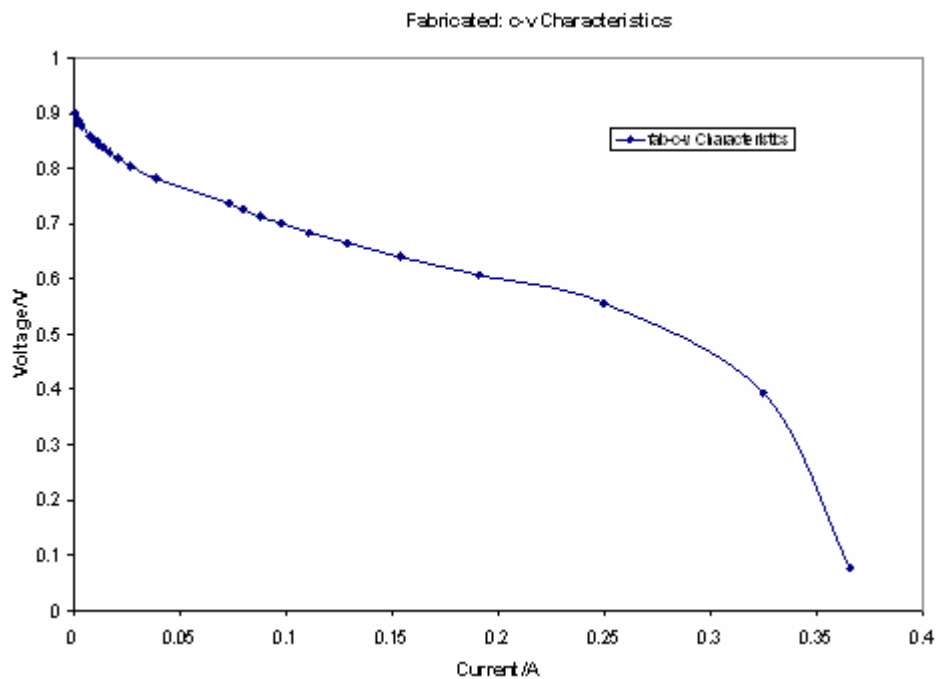
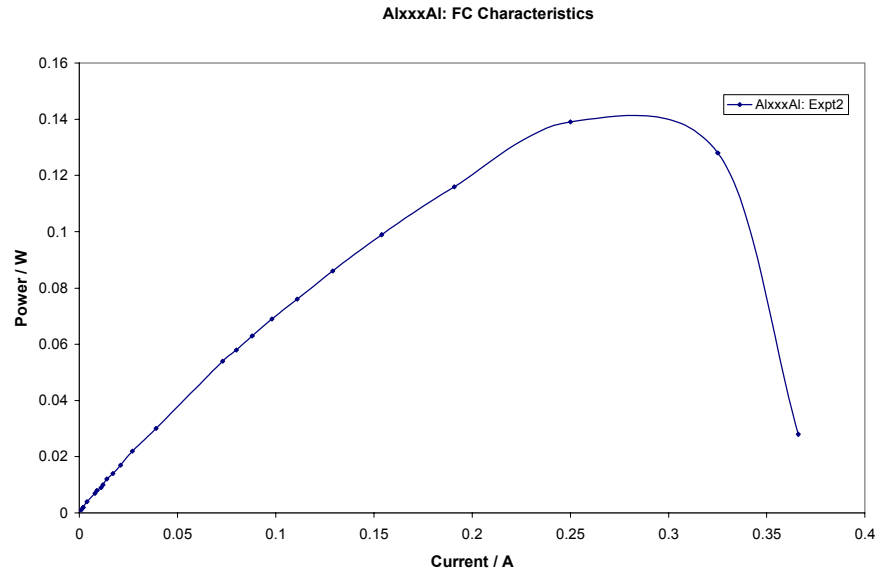
Figure 2: Voltage –Current characteristic of the fuel cell with Al conductors

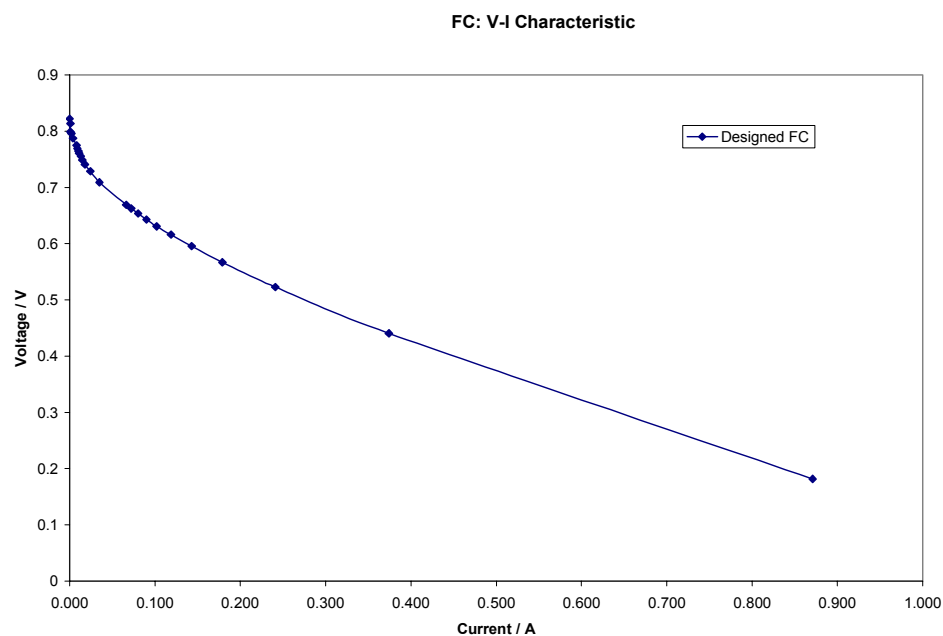
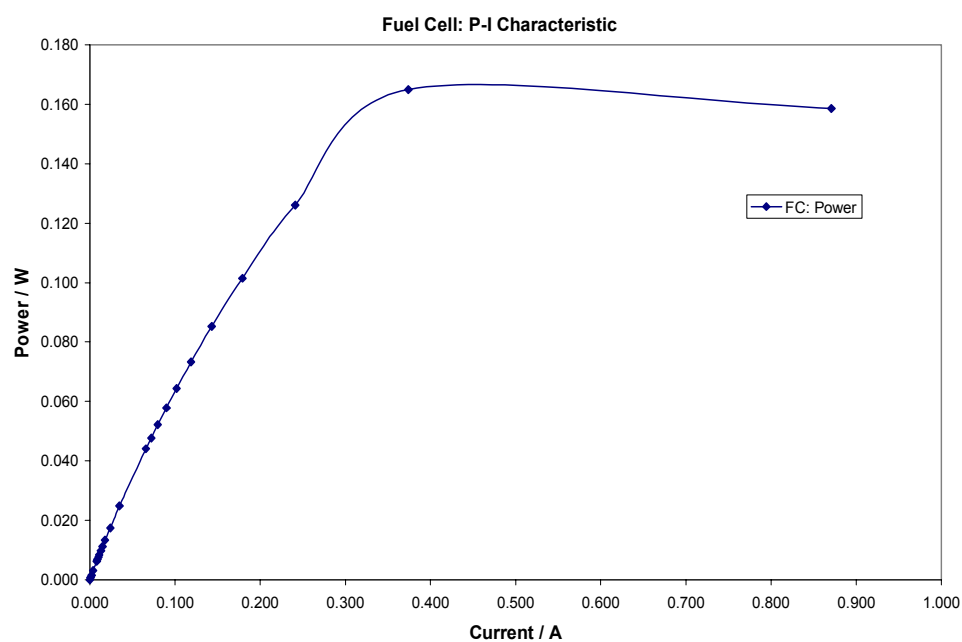
Figure 3: Power curve of the fuel cell with Al Conductors

The current at which the fuel cell gives the greatest power output is clearly evident from the power curve. Maximum power arises at about 0.25 A which corresponds to a load resistance of 2 Ω . The load must therefore be 2 Ω if the maximum possible output is to be achieved.

From the experiment using Al/xxx/Al conductors the maximum voltage obtained was 0.904 V and the efficiency obtained was 61.05.

Table 2: Current, Voltage and Power output for Al/xxx/Cu fuel cell

R/ Ω	I/A	V/V	Power/W
1000	0.000	0.822	0.000
800	0.001	0.814	0.001
600	0.001	0.799	0.001
400	0.002	0.796	0.002
200	0.004	0.788	0.003
100	0.008	0.775	0.006
90	0.009	0.769	0.007
80	0.010	0.765	0.008
70	0.011	0.761	0.008
60	0.013	0.756	0.010
50	0.015	0.749	0.011
40	0.018	0.741	0.013
30	0.024	0.729	0.017
20	0.035	0.709	0.025
10	0.066	0.669	0.044
9	0.072	0.663	0.048
8	0.080	0.654	0.052
7	0.090	0.643	0.058
6	0.102	0.631	0.064
5	0.119	0.616	0.073
4	0.143	0.596	0.085
3	0.179	0.567	0.101
2	0.241	0.523	0.126
1	0.374	0.441	0.165
0	0.871	0.182	0.159

Figure 4: Voltage –Current characteristic of a fuel cell with Al/xxx/Cu conductors**Figure 5:** Power curve of fuel cell with Al/xxx/Cu conductors

Using Al/xxx/Cu conductors the maximum voltage obtained was 0.822 V. and the efficiency obtained was 55.5%.

Figure 6: Voltage–Current characteristic of a fuel cell with PtxPt experimental fuel cell, Al/xxx/Al and Al/xxx/Cu conductors

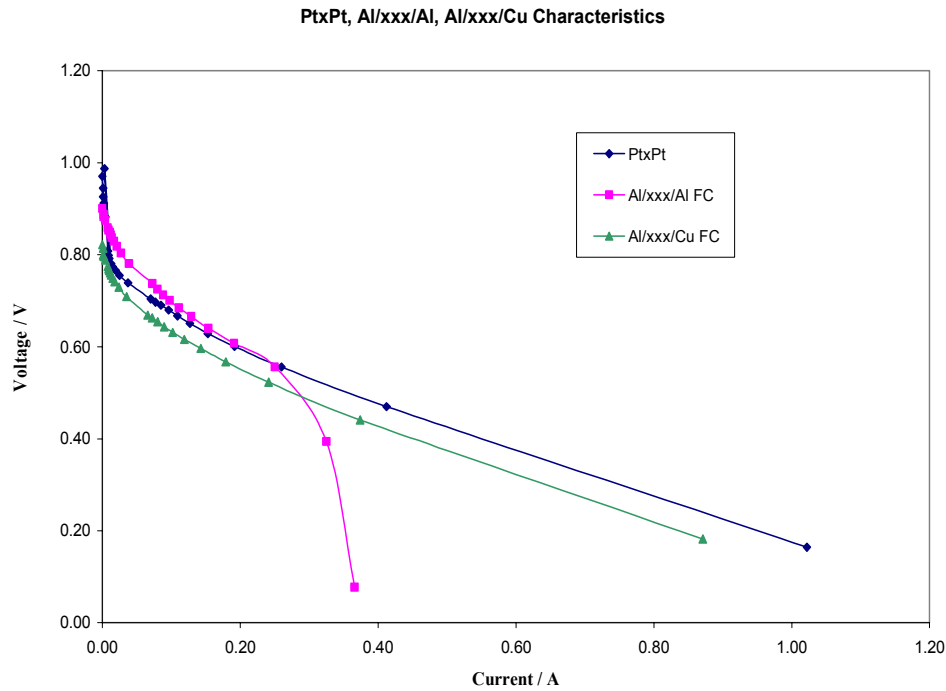
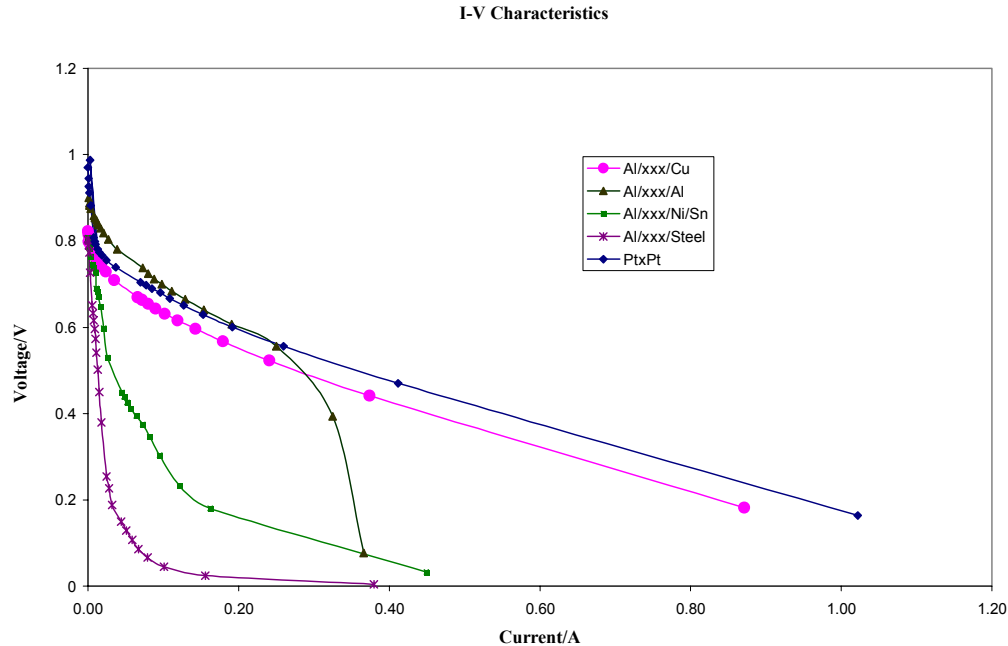


Figure 7: Voltage–Current characteristic of a fuel cell with PtxPt experimental fuel cell, Al/xxx/Al and Al/xxx/Cu conductors



4.0. Discussion

The current collectors can impact the current-voltage characteristic in several ways. If they are not highly electronically conductive, then they can contribute to the Ohmic resistance of the cell. Another issue is mass transport of the gaseous reactants, H_2 and O_2 . In this type of cell design in particular, if the current collectors are not porous, they may block or at least restrict the flow of reactive gas through the gas diffusion electrode. This would contribute to the mass transport limiting current of the cell. In

fact, it may be of interest that Al/xxx/Cu cell did not clearly exhibit mass transport overpotential, while it was clearly observable for Al/xxx/Al cell. Finally, the collector may undergo galvanic reaction, oxidizing itself to provide external current. Compared to PtxPt fuel cell, the platinum electrodes are also acting as both catalyst and conductor, shown is Fig. 7.

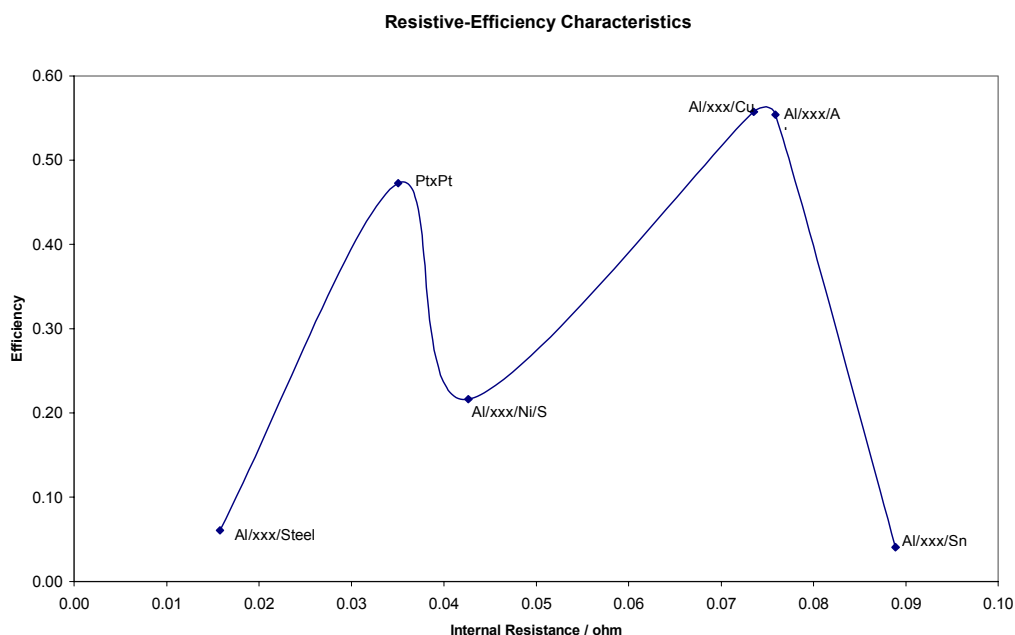
As an experimental variable, any gas leakage would lower the partial pressure of the gas at the electrode/electrolyte interface, hence lowering the current density. Actually, the current-voltage curves for the two fuel cell current collector combinations do not vary all that much; it is only at high currents that the Al/xxx/Al cell seemed to mass transport limit sooner. Corrosion of the anode current collector is a fundamental problem of fuel cell technology, and so was observed in this designed too. Corrosion of some materials may occur even without producing an external current, undergoing a redox reaction directly with water, O₂, or the combination of the two. The anode assumes the potential given by the partial pressure of O₂ over it, which at room temperature, open circuit, acidic standard state, and one atmosphere of pressure, is 1.23 V. Very few electronically conductive substances are indefinitely stable under those conditions.

The reason for the initial drop (Fig. 7), or activation polarization, is probably due to effects of internal resistance of conducting metals as there is no change in the electrode characteristics. This effect is also depicted by the dominant factor for the linear drop in the operating range adding to the ohmic resistance of the electrolyte.

Table 3: Variation of efficiency with internal resistance

Conductor	Int Res/ohm	Efficiency	Efficiency %
AlxxxSteel	0.016	0.061	6.0
PtxxxPt	0.035	0.473	47.3
AlxxxNi/Sn	0.043	0.216	21.6
AlxxxCu	0.074	0.557	55.7
AlxxxAl	0.076	0.554	55.4
AlxxxSn	0.089	0.041	4.1

Figure 8: Variation of efficiency with internal resistance



The current-voltage characteristics show that conductor characteristic play significant role in the fabrication of the fuel cell. Obviously electronically conductive materials contribute less ohmic resistance to the cell. In this type of cell design in particular, the current collectors are not porous, they

may block or at least restrict the flow of reactive gas through the gas diffusion electrode. This might have contributed to the mass transport limiting current of the cell. In the PtxPt cell where the platinum serves as a catalyst, electrode and current collector the open-circuit current was high. These trends are illustrated in Fig. 7.

The most common solution to the above conductive problem may be to use carbon block instead of machining an acrylic block, a milled pattern into the face of a graphitic carbon block may serve as both gas distributor and current collector. Other current collector materials, such as metals that form thin, conductive oxide films may work, like Ni, Ru, and Pb. Of course, obtaining these materials as screens or meshes is difficult.

With acrylic block, platinum mesh is ideal to act as both electrode and current collector as proved by the hi-tec (Wasserstoff-Energie-System, 2005) experimental fuel cell.

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Diversity of a Mosaic Ecosystem in the Surroundings of the Téné Classified Forest (Oumé), Western Center of Côte D'Ivoire

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Abstract

The area of Oumé is localised in the Western Center of the Côte d'Ivoire in West Africa. The Botanic inventories carried out on a device called grid, gave 463 vegetable species. This device was established on a field made up of 8 biotopes, in which the anthropic actions are various levels. These surroundings are the primary forests, the secondary forests, the Teak reforestations planted in 1994, the Teak reforestations planted in 2000, the reforestations planted with several Woody species, the cocoa-trees plantations, the food crops and the fallow. Among these biotopes, the most diversified are the secondary forests, on the other hand the least diversified are the Teak 1994 reforestations. The analyses showed that the more the surrounding is exploited, the less it is diversified. But as soon as this anthropic pressure disappears diversity recovers to increase to the disturbed forests, before stabilizing itself in the primary forests.

Keywords: Richness, diversity, Biotopes, Oumé and Côte d'Ivoire

1. Introduction

The ivoiriens forests formations are constantly subjected to various anthropic pressures of which the most significant are the forestry running and agriculture. These human activities, which largely contributed to the development of the country, also involved a strong degradation and a destruction of the dense forests. Thus, we noted that surfaces of the majority of the primary clump forest decrease regularly with the profit of those of the secondary or degraded forests, of the perennial cultures (coffee, cocoa) and food crops.

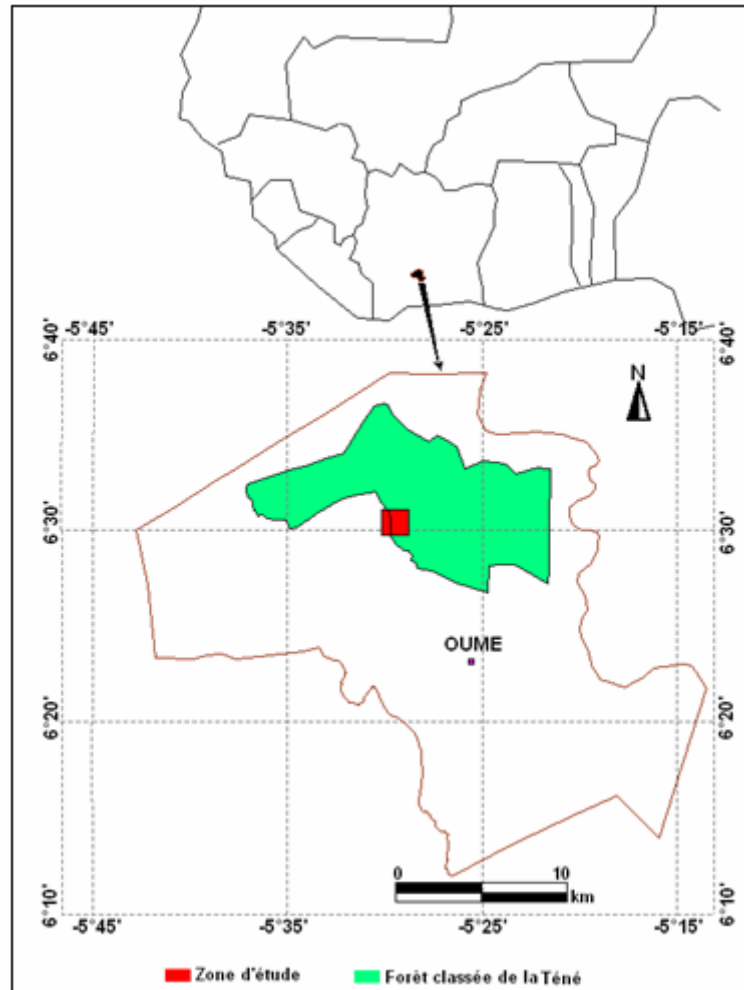
The zone of study installed on ecological agro units given according to the intensity and of the type of human activity. These units are made up of the primary forest, the secondary forest, the cocoa plantations, the food crops, the fallow and the reforestations. Those various biotopes have each one a particular vegetation and a characteristic flora. That is good to know the flora of these environments and to determine the similarities between them. It is also important to determine the floristic diversity of these ecosystems.

2. Material and methods

2.1. Zone of study

The Classified Forest of Téné is located in the sub-prefecture of Oumé, in the Mid-west of Côte.d'Ivoire (figure 1). The site of the study is a square grid of 2 km side, localised in part in the classified forest and the rural field with its immediate periphery. At the scale of figure 1, the site is materialized by a point whose, the co-ordinates are 6°31' of Northern latitude and 5°30' of Western longitude. According to the phytogeographical subdivisions, this zone belongs to the sub-equatorial climate with an Attien feature. It is characterized by a great raining season from Mars to June, with a maximum of rain in April (203 mm on average); and a great dry season from November to February with a minimum of rain in December (30,2 mm on average). The temperatures vary between 24,1° and 26,7° on average (MIELLOT, J & BERTAULD, J.G., 1980). The vegetation is a semi deciduous forest, witch is characterized by an association of *Celtis* spp. and *Triplochiton scleroxylon* (GUILLAUMET & ADJANOHOOUN 1971).

Figure 1: Situation of the study area



2.2. Material

The material used to make up this study includes:

- Cards of botanical survey for the establishment of the lists.
- Plastic sachets for harvests of plants.

- Two cameras, to photograph plants

The flora of HUTCHINSON and DALZIEL (1954-1972), the works of LEBRUN and STORK (1991, 1992, 1995, 1997) and the flora of AKÉ ASSI (2001, 2002) were used to name taxa in this peace of writing.

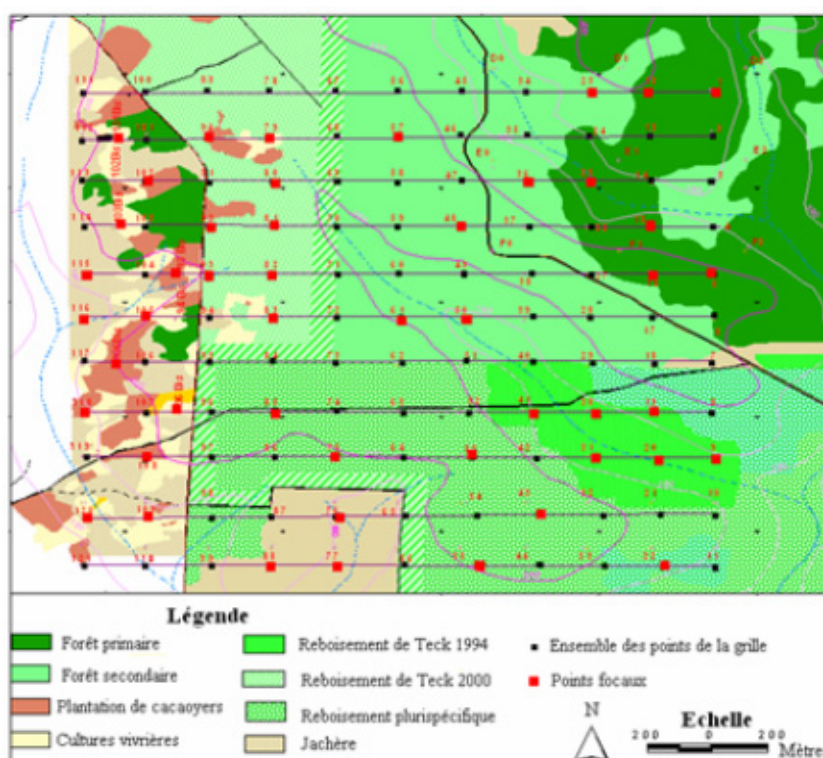
2.3. Mode of sampling and data processing

2.3.1. Sampling

The botanical surveys were made on a square surface of 2 km side called "grid" (figure 2). In this grid, it was open 10 tailboards in the East-West direction. On the tailboards, at each 200 meters, parcels of land with 10 m width and 20 m long were posed. The floristic inventories are carried out on these surfaces called "points" and on the tailboards connecting the points.

In the points, all the vegetable species are identified and their names noted on the cards of survey without taking account of their abundance and their frequency. Eight principal types of biotopes were considered according to types' of vegetation. It is: primary forests, secondary forests, fallow, reforestations multispecific, cocoa plantations and food crops, the teak reforestation on different dates (2000, 1994). In the grid, there was only 6 points inventory in primary forest. Thus, in all the other environments, we chose in a random way, 6 focal points to carry out the analyses of comparison.

Figure 2: Sampling system



2.3.2. Analyze data

2.3.2.1 Floristic diversity

Floristic richness

The floristic richness of a territory is measured by the number of the species listed inside its limits, taking into account its surface (O.R.S.T.O.M., 1983). Many methods make it possible to evaluate the floristic diversity of a territory. The floristic richness represents the simplest floristic characteristic of a territory. Thus, for each type of vegetation considered, we drew up the corresponding floristic list.

Index of diversity (Shannon and weaver)

Specific diversity is a measurement of the composition in species of a plants population which takes account of the number of species and their relative abundance (LEGENDRE & LEGENDRE 1982). This index will be calculated for each ecosystem.

If we indicate by N the total number of *the* S species considered, n_i the total number of the individuals of a species i and p_i (n_i/N) the relative abundance of this species i , then the index of Shannon and Weaver is estimated by the following mathematics expression:

$$I = -\sum_{i=1}^S P_i \times \log_2 \times P_i$$

Index of equitability

The equitability in a plants population, informs about the distribution of total number between the different species. Here, the index of equitability will be calculated to compare the distributions of the species in the biotopes. Thus, the calculation of the index of specific diversity must be always accompanied by that of the equitability, because 2 populations with different aspect can have same diversity (KOUASSI, 2002). The equitability E is obtained by bringing back diversity observed to maximum theoretical diversity.

$$E = \frac{I}{\log_2 \times S}$$

The equitability varies from 0 to 1. It tends towards 0 when the near total of total number is concentrated on a species and towards 1, when all the species have same abundance.

2.3.2.2. Test of homogeneity

Cluster

It is a test which consists in grouping the entities according to their resemblances, and to move them away at a distance, according to their dissimilarities. The results are expressed in the form of trees with ramifications various lengths.

Constancy

Constancy is a categorization of the species met in our survey according to their relative frequencies brought back to 100 (DAJOZ, 1982). It is calculated according to the following formula:

$$C = \frac{px}{P} \times 100$$

With px : a number of survey in which species x is listed

P : a total number of survey of the sample

When the values of C are higher than 50 %, the species are qualified constants. For the values ranging between 50 % and 25 %, the species are known as accessory. Lastly, for the values of C lower than 25 %, the species are known as accidental. The formula will be applied to the ecosystems to characterize the degree of presence of the inventoried species.

3. Results

3.1. Floristic richness

During one week of inventory, we sampled 98 points in other words 19600 m² (1,96 ha) and carried out 20 km of traverse itinerant in a total surface of 400 ha. Table 1 gives has distribution of the points in the different ecosystems.

The conciliation of the lists of species inventoried in the 98 points and on the tailboards, gives a flora rich of 463 species in which 2 taxa known until to genera. This flora is distributed between 312 genera and is assembled in 78 families. In term of a number of species, the most important families are *Rubiaceae*, *Poaceae*, *Euphorbiaceae*, *Fabaceae*, *Celastraceae*, *Sterculiaceae*, *Apocynaceae*, *Annonaceae*, *Mimosaceae*, *Caesalpiniaceae*, *Sapindaceae*, *Asclepiadaceae*, *Moraceae*, *Dioscoreaceae* and *Verbenaceae* (table 2). These families (15 families out of 78) alone represent 54,64 % (253 species out of 463) of the inventoried flora.

Table 1: Sampled points numbers through ecosystems

Ecosystems	Sampled points	Surfaces (m ²)
Food crops	9	1800
Primary forests	6	1200
Secondary forests	23	4600
Fallow	16	3200
Cocoa plantations	8	1600
multispecific reforestations	21	4200
Teak reforestations 1994	7	1400
Teak reforestations 2000	8	1600

Table 2: The most representatives families in terms of species numbers

Rangs	Family	Number of species	Percentages	
1	<i>Rubiaceae</i>	30	6,48	54,64
2	<i>Poaceae</i>	25	5,40	
3	<i>Euphorbiaceae</i>	23	4,97	
4	<i>Fabaceae</i>	23	4,97	
5	<i>Celastraceae</i>	19	4,10	
6	<i>Sterculiaceae</i>	19	4,10	
7	<i>Apocynaceae</i>	18	3,89	
8	<i>Annonaceae</i>	14	3,02	
9	<i>Mimosaceae</i>	14	3,02	
10	<i>Caesalpiniaceae</i>	13	2,81	
11	<i>Sapindaceae</i>	13	2,81	
12	<i>Asclepiadaceae</i>	11	2,38	
13	<i>Moraceae</i>	11	2,38	
14	<i>Dioscoreaceae</i>	10	2,16	
15	<i>Verbenaceae</i>	10	2,16	
	63 other families	210	45,36	45,36
	Total	463	100	100

3.2. Characterization of ecosystems

3.2.1. Cluster resulting from frequencies of species in the focal points

The cluster of figure 3 gives a separation of the biotopes using the frequencies. The first group which emerges finds with the 24 x-coordinate (distance) and is made up of the forest environment (primary and secondary). The second unit is made up of the ecological fallow and agro units formed of the biotopes whose anthropic actions are still more or less visible and perceptible. They are located at the 23 x-coordinate. With this x coordinate, the fallows are detached and does not resemble to any group any more. The block of the ecological agro units composed of cocoa plantations, the food crops on the

one hand and on the other hand by the multispecific reforestations, of the teak reforestations 2000 and 1994 merges in one group.

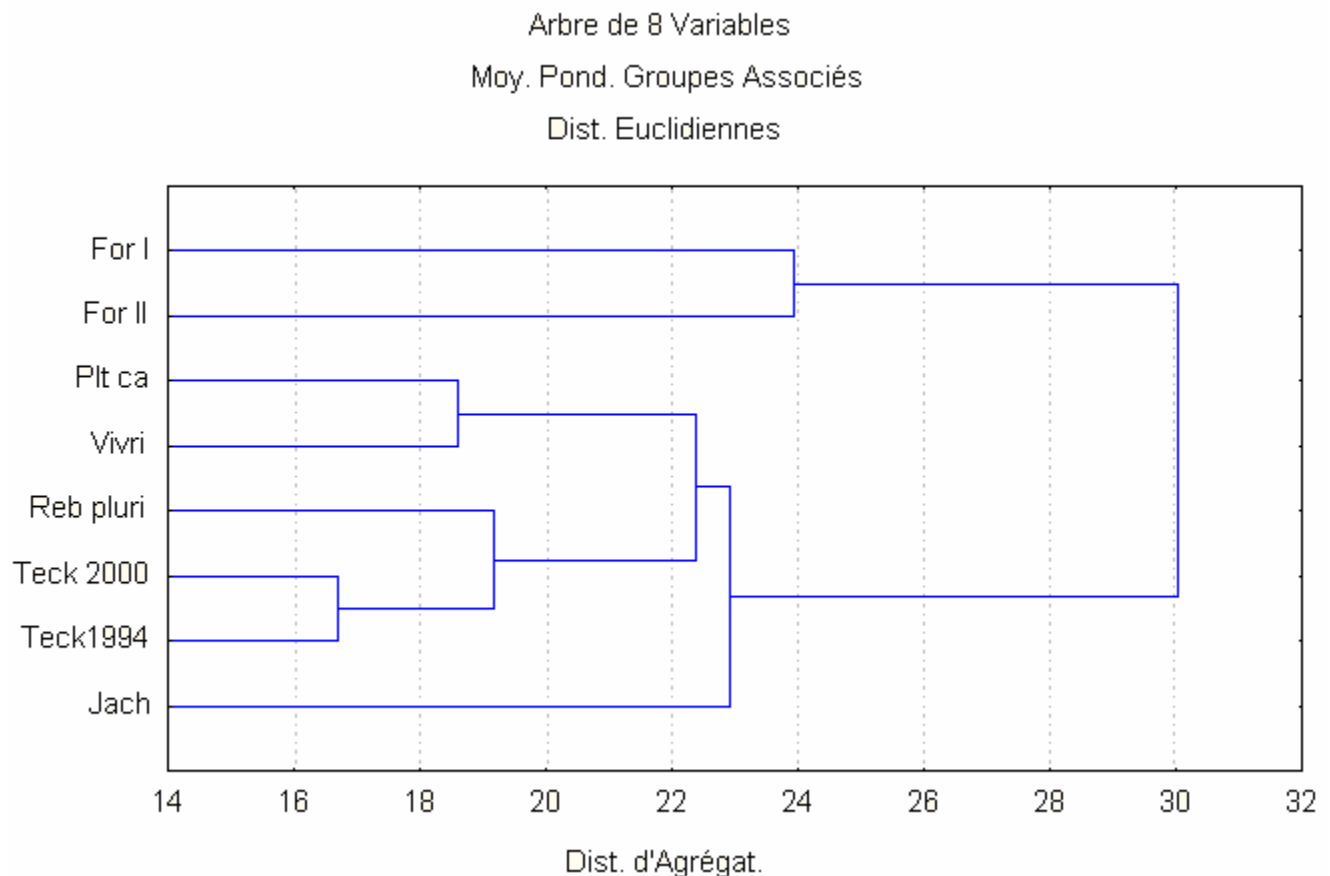
From 21,8 x-coordinate, this block starts its segregation in more homogeneous flora groups. At 19,2 distance; all the reforestations form an identical unit. In this whole reforestations environment, the multispecific type (reforestation carried out with several types of timbers) is disunited initially, before the Teak reforestations arranging themselves according to the dates' of planting in 2000 and 1994. At 18,8 x-coordinate, villagers plantations group merge in the same entity, forming by cocoa plantations and the food crops.

In short, according to distances' calculated with the frequencies, the ecosystems are arranged in the following way:

- primary forests (24 distance)
- secondary forests (24 distance)
- fallow (23 distance)
- multispecific reforestations (19,2 distance)
- teak reforestations 1994 (19,2 distance)
- teak reforestations 2000 (19,2 distance)
- cocoa plantations (18,8 distance)
- food crops (18,8 distance).

This arrangement follows an increasingly loudly gradient of human action.

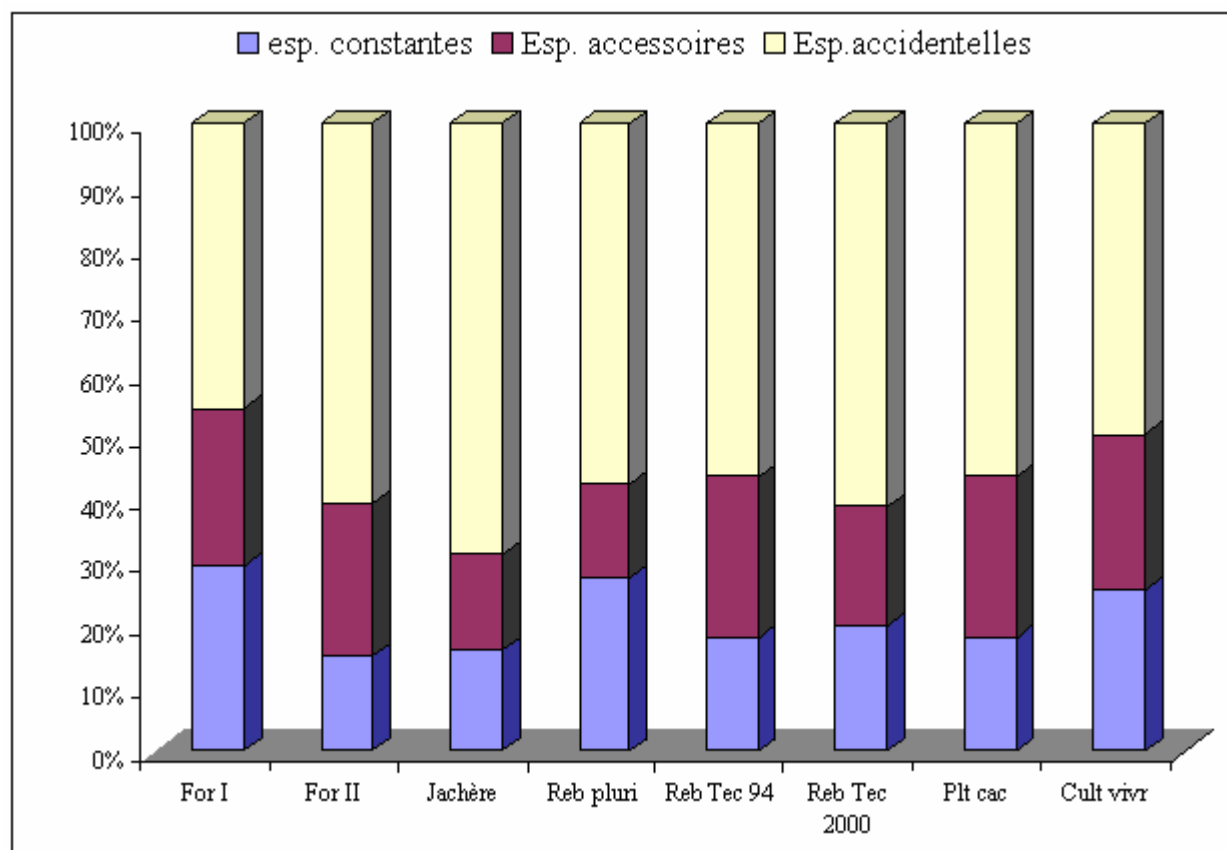
Figure 3: Cluster of biotopes of Oumé grid



3.2.2. Groups of species according to Dajoz frequencies

The histograms graph of constancies of figure 4, shows that the accidental species (yellow), are the most abundant in all environment. The constant taxa (blue) more large in primary forest (more than 30%), are followed by multispecific reforestations, food crops and Teak reforestations 2000. concerning the accessory species (red), they are the same ones everywhere, except in fallow and multispecific reforestations.

Figure 4: Species groups formed by the constancy



3.2.3. Gradient of anthropisation and diversities

The abundance, the Shannon indices diversities and the equitability results were assembled in the below table 3. On the whole, the values of the Shannon indices are high. The highest value of the Shannon index is obtained in secondary forest (figure 5) which is 7,28. The low value (5,91) is observed in Teak reforestation 1994. The secondary forests are the most diversified environment, followed by primary forests, fallow, food crops, cocoa plantations and multispecific reforestations. The Teak reforestations 1994, and 2000 are the less diversified environment. Concerning the equitability (distribution of the species in the biotopes), according to figure 5, all the biotopes have the same species representativeness. Nevertheless the forests have the highest values of equitability while the low values meet in the multispecific reforestations and Teak reforestations 2000. In short, the taxa met in the ecosystems equitably are well distributed because the values of equitability obtained are all close to 1.

The curve of the species numbers (abundance) change in logarithm has the same style as that of the diversities index (figure 5) The correlation coefficients between the curve of Shannon index of and those of the constant, accessory and accidental species are respectively, $R_1=0,4$; $R_2=0,34$ and $R_3=0,89$. At 5% in decreasing order, the probabilities (P calculated) are $P_1=0,33$; $P_2=0,41$ and $P_3=0,003$. The best and significant correlation (R_3 , P_3) is given by the accidental species. That shows that the accidental species contribute more strongly and significant to the diversity of the biotopes.

They are at the origin of diversity. The more these species are abundant in one biotope, the more this biotope is diversified and inversely. From primary forest to food crop, diversity variations are irregular. It increases from primary to secondary forests. From secondary forests to Teak reforestations 1994, the index of diversity decreases gradually. Diversity restarts another increase in Teak reforestations 1994 to food crops. In this succession as shown by figure 6, it is difficult to explain the evolution of diversity through the gradient of anthropisation. To facilitate the observations, we subdivided the biotopes in 2 groups according to their modes of creation. After that, we made a cycle from the less damage environment (primary forest), to the biotope in reconstruction (secondary forest). The first group is formed by those environments made by mechanized anthropisations (tractors, weedkillers): primary forests, Teak reforestations 2000, Teak reforestations 1994, multispecific reforestations and the secondary forests. The second entity regroups those environments made by manual way (machetes, hoes): primary forests, food crops, cocoa plantations, fallow and secondary forests. The two groups were analyze respectively in the figure 7 and 8.

In figure 7, diversity decrease from primary forests to Teak 1994 while passing by Teak 2000. It takes up to increase again from multipecific reforestations to secondary forests. To close the cycle, diversity slightly will be reduced to stabilize itself in primary forests. In the other operating system (figure 8), from primary Forests diversities drop to cocoa plantations while passing by food crops. The index takes up to grow from cocoa plantations to fallow and secondary forests. The end is the same one as in the preceding cycle.

In the 2 cases, floristic diversity decreases when the human action increases according to the classification produced by the cluster. When this action disappears, diversity is raised to cumulate in the secondary forests and is stabilized finally in the primary forests.

Table 3: Richness, Shannon index and equitableness of biotopes

Ecosystems	Species numbers	Shannon index	Equitability
Primary forest	163	7.10	0.97
Secondary forest	108	7.28	0.97
Cocoa plantation	84	6.31	0.96
Food crops	117	6.64	0.96
Fallow	125	6.66	0.96
Multispecific reforestetion	94	6.28	0.95
Teck reforestation 2000	85	6.13	0.95
Teck reforestation 1994	70	5.91	0.96

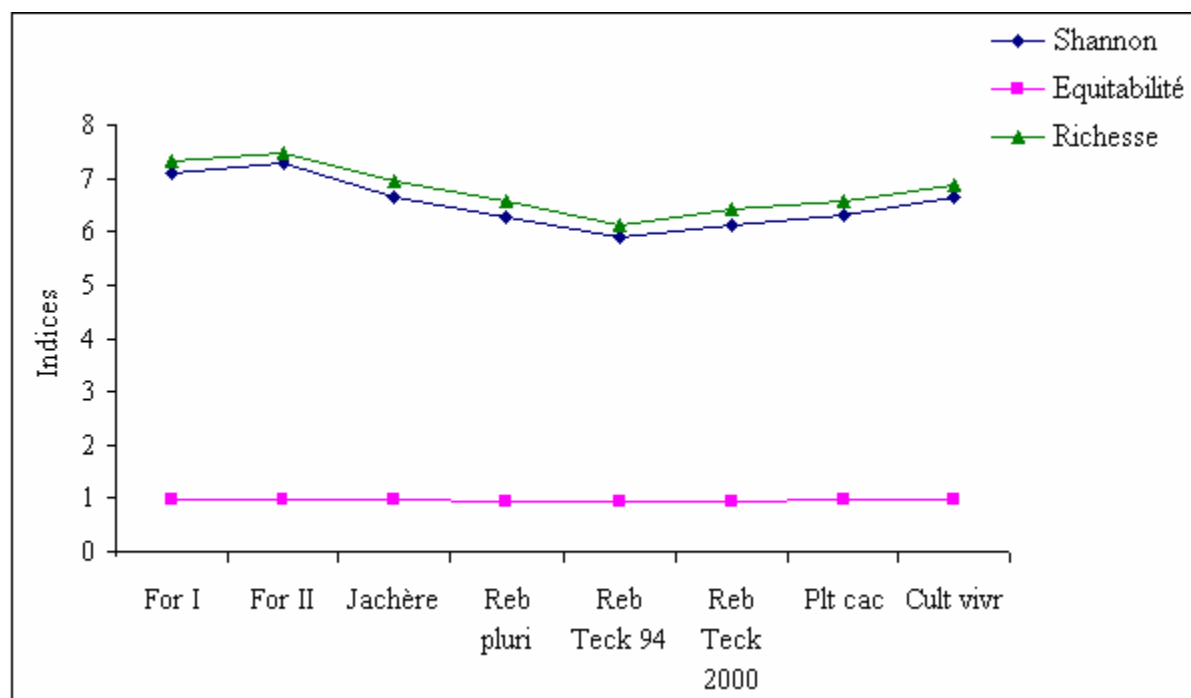
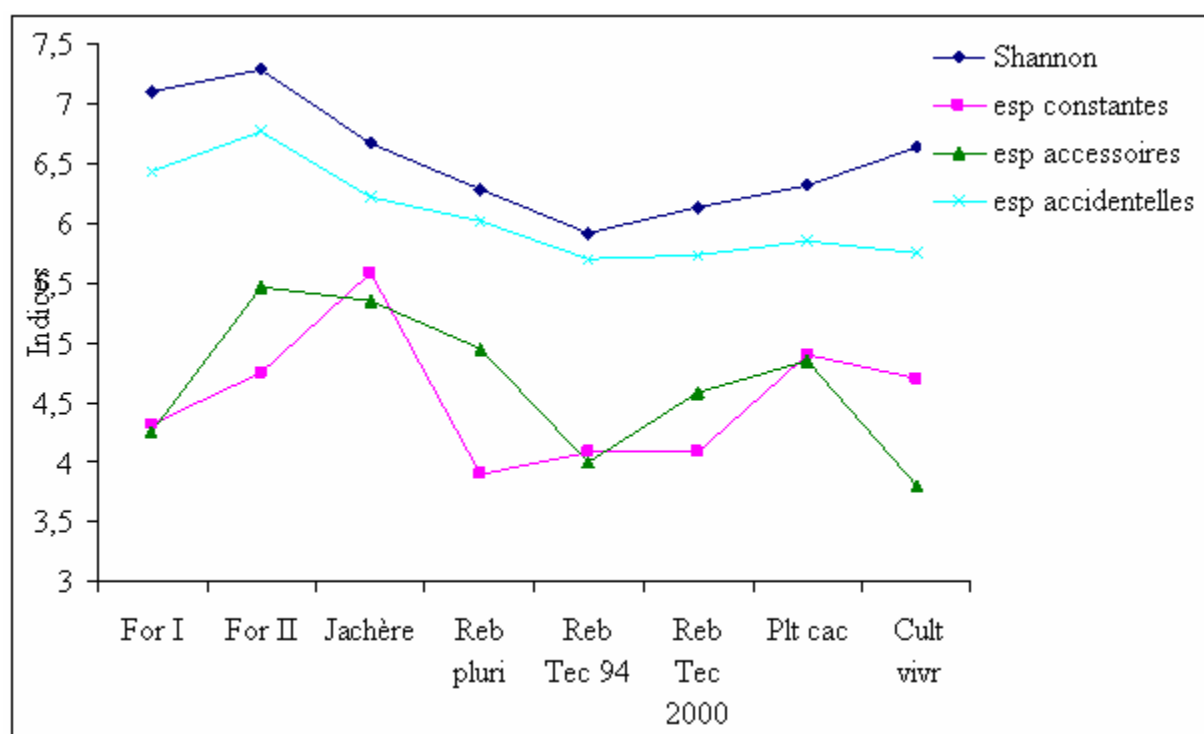
Figure 5: Graphs of richness, diversity and equitability of ecosystems**Figure 6:** Species groups and diversity

Figure 7: graph of species groups numbers and the diversity inside méchanic ecosystems

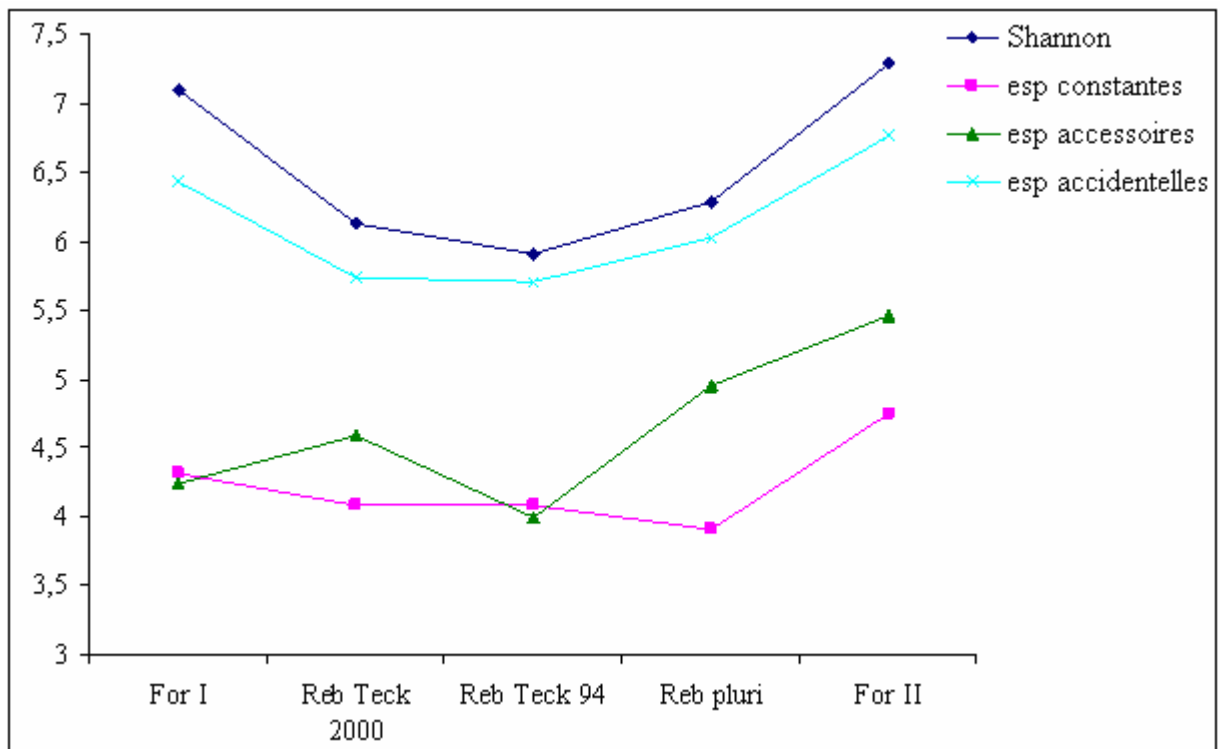
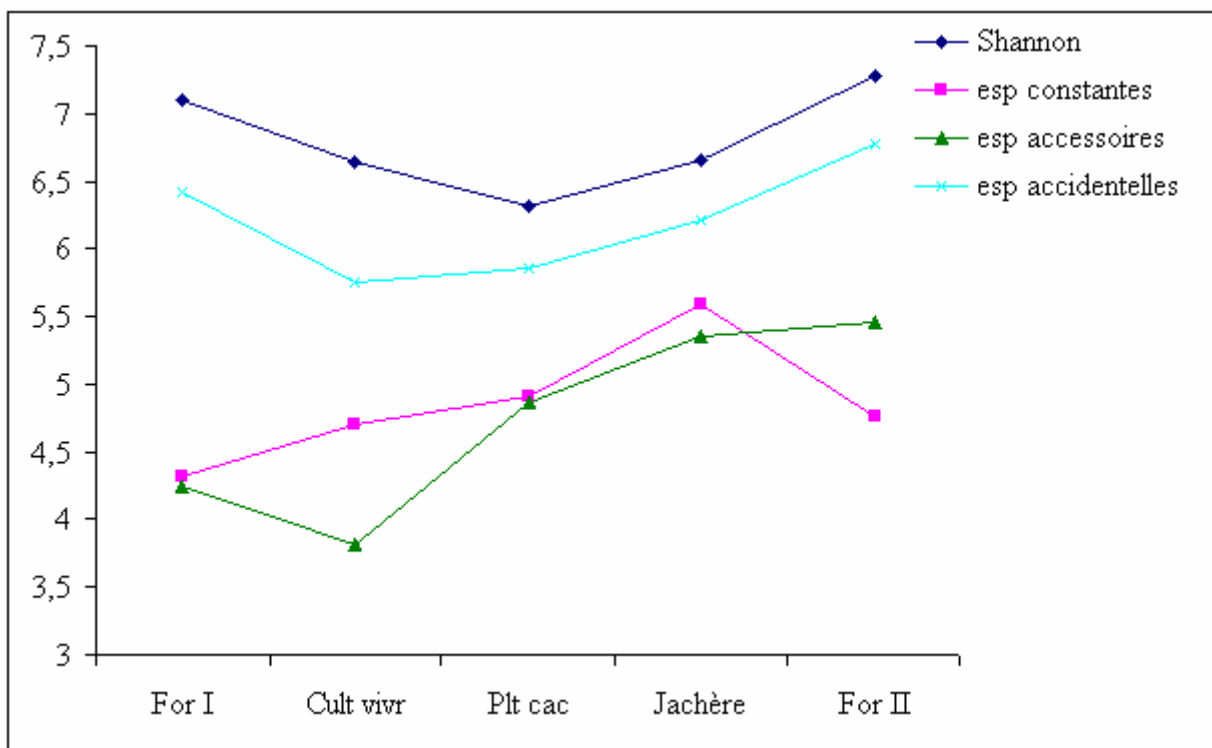


Figure 8: graph of species groups numbers and the diversity inside manual ecosystems



4. Discussions

The flora of the grid (400 ha) is rich of 463 species, in a fast inventory in 7 days working. KOUADIO (1999) in Mopri and BAKAYOKO (1999) in Bossématié respectively obtained 162 and 308 vegetable species during their study that take 6 months. Mopri forest covers a surface of 32 500 ha and that of Bossématié extends on 22 200 ha. These 2 forests are located the same semi décidious field as that of Téné Observing the results, the grid method presents better output than the surfaces methods of KOUADIO (1999). It is the same in the association of surface and linear methods applied by BAKAYOKO (1999). This good output is the consequence of the good site of the grid, witch is located in several environments, where human actions are different. Like SOMÉ *et al.* (2002), the age landings are replaced by the continuous, recent or old human action in the biotopes. Also it knows that, human action an environment is synonymous of a floristic restructuring. By visiting several environments, we increase our chances to meat several species. The method of the grid has the advantage of maximizing the number of species in a short time.

The results obtained show that in a total way, species numbers (abundance) and diversities in the biotopes are proportional (figure 5). But that are the accidental species which have an evolution more similar to that of diversity.

The degree null of anthropisation is logically in the primary forest formations. The forest flora of the grid is dominated by, *Griffonia simplicifolia*, *Mansonia altissima*, *Motandra guineensis*, *Nesogordonia will papaverifera*, *Sterculia rhinopetala*, *Marantochloa leucantha*, *Trachyphrymum braunianum*... A these constant species, we can add the other accidental ones for better characterizing the forest vegetation of the grid. This species are *Acridocarpus alternifolius*, *Baphia bancoensis*, *Culcasia liberica*, *Musseanda elegans*, *Rinorea longicuspis* and *Xylopia acutiflora*. The creation of plantations brings destruction of the vegetation in place. It is replaced by another flora having diversity lower than that of the primary forest (figure 7 and 8). In the 2 cycles define in the top, in the case of Teak 2000 (figure 7) or in the food crops (figure 8), there is a fall of floristic diversity. In the 2 cases, human action consists in a voluntarily elimination of useless species and favoured some others planted species. This maintains of cultivated species, involves a fall of the number of species in general. The cultivated taxa and the adventitious species, most resistant constitute the dominant new flora artificially installation by men. The most abundance species of this new flora are *Chromolaena odorata*, *Laportea aestuans*, *Manihot esculenta*, *Croton hirtus*, *Euphorbia heterophylla*, *Mucuna pruriens*, *Parquetina nigrescens*, *Theobroma cacao*, *Solanum erianthum*, *Centrosema pubescens*, *Tectona grandis* and *Panicum maximum*. Aside the cocoa-trees (*Theobroma cacao*) and Teak (*Tectona grandis*) which is cultivated, the others taxa are the adventitious ones (AKOBUNDU and AGYOKWA, 1989). The few residual forest species are found in the group of accidental and some times in the accessories. It's a matter of *Deinbollia pinnata*, *Griffonia simplicifolia*, *cnestis ferrugenea*, *Dalbergiella welwitschii*, *Baphia bancoensis*, *Mallotus oppositifolius*, *Sterculia rhinopetala*...

After 3 or 4 years of maintains, the food crops become cocoa plantations. When Teak planted into 2000 are replaced by the Teak reforestations 1994. We still attend a fall of diversity in the new biotopes. This reduction is still made the weedings. For that it is necessary to add the effect of shade creates by the increasingly significant foliages of the cocoa trees and the Teak. Under the seedlings (Cocoa trees and Teak), the micro climate of shade will eliminate little by little the heliophilous species from the preceding flora witch is dominated by the adventitious ones. The new flora is form by the species of the crop plants, the certain adventitious ones and pioneer woody species: *Theobroma cacao*, *Tectona grandis*, *Chromolaena odorata*, *Nephrolepis biserrata*, *Cyathula prostrata*, *Panicum laxum*, *Centrosema pubescens*, *Parquetina nigrescens*, *Pouzolzia guineensis*, *Millettia zechiana*, *Albizia zygia*, *Clerodendrum buchholzii*, *Mondia whitei*, *Synedrela nodiflora*, *Deinbollia pinnata*, *antiaris toxicaria*, *Blighia unijugata*.

And then, when the Cocoa plantations of are abandon, they are transformed into Fallow. Some years later, the fallow will transformed in secondary forests and cycle of manual action is finish. In the cycle of mechanic action, the following environment are the multispecific reforestations composed of the seedlings of *Terminalia superba* (Fraké) and *Gmelina arborea* (Gmelina). These multispecific

plantations were installation, approximately 15 years ago. In these biotopes diversities go back to increase. SODEFOR (Forests Development Company in Côte d'Ivoire) look after his reforestation only during the first 4 years.

At the end of this period, the young seedlings of Fraké and Gmelina are abandoned in the waste lands. These timbers witch less shady foliage, allow the growth of the heliophilous species. Diversity thus becomes very close to that of the fallow with the same dominant adventitious species: *Chromolaena odorata*, *Mucuna pruriens*, *Lantana camara*, *Solanum torvum*, *Parquetina nigrescens*, *Centrosema pubescens*. The floristic restructuring passes to recruitment forest species, which become more numerous: *Gmelina arboria*, *Terminalia superba*, *Griffonia simplicifolia*, *Ficus exasperata*, *Blighia sapida*, *Cola gigantea*, *Holarrhena floribunda*, *Cedrela toona*, *Sphenocentrum jollyanum*, *Clerodendrum buchholzii*, *Cnestis ferrugenea*, *Millettia zechiana*, *Motandra guineensis*, *trichilia prieureana*.

Most logically, the evolution of the flora tends towards the forests. With time, the forest species strategists "K" (FAURIE *et al.*, 1998) more adapted will become large. In the 2 cycles we end at the secondary forests, which have the highest diversity of all the biotopes of the grid of Oumé (table 3 and figure 5). This medium associates a proportion of anthropogenic species such as *Chromolaena odorata*, *Parquetina nigrescens*, *Urera keayi*, *Acacia pennata*, *Solanum erianthum*, *Albizia adianthifolia*, *Costus afer*, *Croton hirtus*... These cicatricial species (KOUAMÉ 1998), meet in parts where the canopy of the large trees is perforated. Concurrently to those, the floristic framework of primary forests is present: *Marantochloa leucantha*, *Motandra guineensi*, *Secamone afzelii*, *antiaris toxicaria*, *Griffonia simplicifolia*, *Nesogordonia papaverifera*, *Lasiodiscus mildbraedii*, *Mansonia altissima*, *Sphenocentrum jollyanum*, *Blighia sapida*... It is this mixture of species which gives to the secondary forests strong diversity. The strategists "K" will choke smallest of them in their evolution and even will reduce the strategists "r" (FAURIE *et al.*, 1998) to the seed state or all other organs being able to preserve the species of the unfavourable conditions (Under shaded wood of the forests). The disappearance of this category of heliophilous species is responsible of the decrease of diversity in the primary forests. It is also responsible for the stability of the primary forests, because of the preponderance of the species of strategist "K". The conditions of the area being favourable for the Strategists "K" and they proliferate in a number of individuals with strong densities and become constant species. It is what explains why the primary forests have the strongest rate of constant species (more than 30%).

5. Conclusion

The primary forests remain the forest biotopes most stable. On the other hand the most diversified mediums are the secondary forests, where the disturbances of human and or natural origins are perceptible. More the human actions are accentuated and are prolonged in time, more diversity of the biotopes is negatively affected. Diversities lower primary forests with the plantations of cacao-trees and the Teak 1994 afforestations. But the opposite one as soon as this action stops, the favorable climatic conditions allow a raising of diversities of the mediums above quoted the secondary forests. Diversity lowers and stabilizes in primary forest with a preponderance of the species of strategists "K".

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Forecasting as a Strategic Decision-Making Tool: A Review and Discussion with Emphasis on Marketing Management

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Abstract

Most companies find that obtaining information about the future is particular to ensuring future organisational success. The analysis of macro and micro environmental factors and conditions is one of the main procedures in strategy formulation for a business company. Forecasting is a decision tool that has a variety of managerial application areas, one of which is the strategic decision-making. The study mainly discusses the potential uses of forecasting within the strategic, particularly marketing, management, and strategic decision-making. It points out both the internal and external strategic decision areas in companies and highlights the potential application areas of forecasting within these areas. The paper also highlights how functional forecasting is as a managerial tool that provides the information needed in critical strategic decision situations.

Keywords: Forecasting, strategic management, marketing, competitiveness, strategic decision-making, internal decision areas, external decision areas.

Introduction

In today's high and intensive competitive environment, many companies face severe market conditions where no many options are left to choose except adopting themselves to new conditions or leaving the market. A middle point, at the best chance, could be to keep on their operations as small companies. On the other hand, adapting to new states is costly both in terms of time and money. It requires considering various strategic decisions to be able to make a difference in highly competitive market conditions. An underlying character of the strategic decisions is higher (alternative) costs that could be incurred. It is therefore essential for strategic decision-makers to have true, reliable, and up-to-date data and/or information and data producing mechanisms, tools, and techniques for such decisions, which strategic decisions can be built on, in order to reduce and avoid such costs. Therefore, any managerial tool and technique with a potential to contribute to the managerial and strategic decision-making is of a particular value for strategic managers.

Strategic management is a style that mostly focuses on the strategies to achieve specific corporate objectives. Strategic management includes various processes such as the analysis of internal and external environment of business, the determination, formulation, and implementation of business and corporate level strategies (see Hill & Jones, 1992 for detailed information). Strategic management style is an important method in achieving the management goals in a company, which are achieved mostly through the activities of functional management. The traditional definition of strategy states that

an organisation's strategy is the result of a rational *intended* processes (*planned*) while the emergent (*unplanned*) strategies can appear from within an organisation when there are no prior plans (Hill & Jones, 1992: 29; see also Mintzberg, 1978). Most companies normally make planning in various areas such as human resources, financial budgeting, and production planning even though the emergent strategies are also the case.

Strategic decisions are mostly made in corporate and business levels. Corporate level management sets up the goal, mission of the corporate, and determines the strategic targets. Business level management translates the general statement of direction and intent from the corporate level into concrete strategies for individual business (Hill & Jones, 1992: 21). In this respect, strategic decisions are mostly subject to top-down approach but they have to be based on, data or information, input from the functional level. That is why the role of functional level management is substantial.

In the functional level, there are, by definition, no strategic managers. They are responsible for specific business functions; however, they have an important strategic role such as developing functional strategies in marketing, production, research and development, which are the main factors in achieving the objectives set by corporate and business level strategic managers (see Hill & Jones, 1992: 22). The main strategies determined by the business and company level managements can be achieved only if the functional level strategic goals are attained thoroughly. Therefore, functional level strategic success is a pre-condition for the success of more general strategies.

For any strategic plan to work, two important points should be considered carefully: (i) Strategic managers need to know the strengths and weaknesses of their companies, given that they are keen to establish a sustainable comparative advantage. This information can best be observed and obtained in the functional level. In practice, strategic plans should normally be made by managers who will implement them. Planning specialists may assist the line managers in finding the direction [Chung, 1987: 195]. (ii) Strategic planning works only if it is designed correctly. In most strategic decisions, decision-making is frequently based on assumptions due to unavailability of sufficient information of the future at the time of decision-making. If the assumptions are unrealistic, not strong enough, or not based on (data or) high quality of information, then it is unlikely that such a planning scheme works or, at least, achieves its objectives. Forecasting has the potential to form more realistic assumptions with facts and figures that these plans can be built on.

There are a variety of managerial tools and techniques, including forecasting, that may help produce this sort of strategic information. Forecasting has a variety of uses from functional to strategic decision areas in different levels of business. It mainly refers to a systematic approach and a collection of statistical and judgemental procedures that yield data and information about the future.

Although the forecasting function has lots of potentials to be used for many strategic decision situations, the current literature does not sufficiently make this explicit. In fact, the forecasting literature mostly focuses on the technical side of forecasting covering a wide-range of technical details from data pre-processing to increase forecasting accuracy. The issues such as how to obtain the needed data and information from the forecasting processes, how to improve the accuracy and performance of forecasts and forecasting methods, what methods are better, and if there was any specific methods for specific forecasting problems and cases [Makridakis et al., 2001, 1998, 1982] have been more concentrated on than on other issues. Comparatively little attention has been given to forecasting with respect to how to use it as a strategic managerial tool and how effectively the forecasting function can be used in making effective (strategic) decisions. Therefore, it is needed to look at forecasting in a wider context than usual operational view.

The purpose of this paper is (i) to review the potential uses of forecasting for strategic management purposes in various strategic decision areas, especially in marketing decisions, and (ii) to investigate if and how the forecasting function (as an information and data production mechanism) can be used as a strategic decision tool in various decision-areas (e.g. market share and sales). Despite many studies imply or refer to forecasting's potential in various domains directly or indirectly, the most of the related conceptual and empirical information is already spread out in the forecasting and

strategic management literature, giving no clear picture of the potential value and usability of such a tool in strategic decision-making context. This points out the necessity of a comprehensive and thorough review and discussion of the topic in order (iii) to clarify the issue and make a conceptual framework. To do this, the paper extracts and filters some of the relevant information in the literature and puts them together in order to present a brief and comprehensive picture. In this manner, the paper attempts (iv) to fill some of the gap in the literature by pointing out to the potential of forecasting as a strategic tool and highlighting its functionality in various macro and micro environmental and strategic decision areas, which is not adequately discussed either in the forecasting or strategic management literature. It also draws a theoretical frame of to what extent forecasting can be utilised in various areas and presents a judgemental outline within this theoretical view. Thus, the paper also attempts (v) to draw the attention of both practitioners and academicians to ‘forecasting’ as a strategic decision tool. It additionally points out new application and evaluation areas for both strategic managers and forecasting researchers, and suggests potentially productive directions for future research.

The paper is organised in six main parts. The second part discusses the forecasting in the strategic context. The third and fourth parts discuss the potentials of forecasting with respect to the internal and external environments of a company, respectively. The fifth part discusses the criticism of forecasting to strategic decision context. Finally, the last part contains the summary and conclusion.

‘Forecasting’ in the Strategic Management Context

Surviving in highly competitive markets and adapting to new states require both strategic thinking and utilising all the available information about the future, as well as that about the present. Nevertheless, it may not always be readily available the information required about the future. Even though it is possible to obtain a part of those data and/or information (e.g. inflation figures, growth forecasts, exchange rates) from external sources, firms mostly produce and obtain the required data (e.g. the amount of future stocks, cash flows, market shares) themselves within their own bodies. Moreover, firms, themselves, may also have to produce some of the external data needed (e.g. inflation rates and exchange rates) for themselves, which could normally be obtained from external providers otherwise.

Strategic management is applied in three different levels: Corporate, business, and functional levels (Hill & Jones, 1992). In fact, the functional level management is the main management unit where the strategies in a company are put into action. In strategy formation, the business and corporate level managers need and use the information being fed from the functional level. Forecasting activities can take place anywhere in these three levels based on the managerial needs and forecasting problems. However, as we get from top to bottom of managerial levels, the more intensive and more frequent forecasting function is utilised.

On the other hand, strategic decisions mainly focus on creating ‘*competitive advantages*’ and differ from other daily or operational decisions from several aspects. Some of the characteristics of strategic decisions are that (i) they are made less frequently than (e.g. daily) operational decisions; (ii) they are generally more costly (in terms of the decision-making process e.g. may require longer time and more money, and the alternative costs) to make compared to other type of decisions; (iii) the consequences may be too severe for the firm; (iv) it generally requires background work and longer time to make; (v) they may normally require more and detailed information (e.g. data and (full) analysis of the situations, which may not be a pre-condition for ordinary daily decisions). The decisions such as market segmentation, new product development, application of new manufacturing process, selection of a new distribution channel, and application of a new marketing mix, all can be considered as strategic decisions. In addition to these, some decisions may be an ordinary type but might have strategic consequences (e.g. making a new purchase agreement and finding a new supplier for a company in a critical industry where the number of suppliers might be very limited, which may completely change the cost of production or may provide sustained raw material supply). Similarly, the major decisions directed at obtaining substantial cost reductions can significantly contribute to gaining competitive advantages and, that is why, can be considered as a strategic type.

As already pointed out, information is one of the most valuable strategic tools. Forecasting is a collection of mostly statistical and/or judgemental procedures¹, which aim at predicting the future based on the available information and/or data. In such processes, forecasting has lots of potentials for strategic level managers including revealing system dynamics, problem determination, predicting, monitoring, and control. More specifically, forecasting of costs, market share, sales, inventory, cash flows, dividends, stock prices, and capacity requirements, which are only some of the internal utility areas, besides interest rates, inflation rates, and growth rates of economy, which are some of the external utility areas, all are closely related to strategic decision-making in one way or another. The operation of forecasting function, in this sense, is an inter-departmental activity and, therefore, the development of forecasts (e.g. sales or market potential) should be done by the inclusion of several parties (e.g. market research manager, sales manager, and production manager in a company). This is particularly important for especially if the forecasts are used for strategic (e.g. marketing) planning, integration, and realisation of those strategic plans.

Integration of forecasting system to management activities is particularly important in utilizing the potential of forecasting, which has two main dimensions: (i) the production of the desired forecasts and (ii) putting them into use. As the first one is related to the forecasting function, the second one is related to the managerial decision processes. As with any other decision tools, a failure in utilizing it will make it difficult to achieve the desired objectives, especially if a particular decision is heavily based on the information from the forecasting system such as the decisions regarding manufacturing capacity planning based on sales forecasts). In a survey of expert opinions on cash flow forecasting in British companies, Polat [2003] has found the variety of forecasts performed (e.g. sales, costs, revenue, inventory, capital expenditures, working capital, and other type of forecasts) were mainly for planning purposes in addition to monitoring and control. Probably, that is why, top-level strategic managers are closely interested in many aspects of forecasting activities in British companies. Another important finding of the study from the strategic management point of view was that the people who were interested in and who directly or indirectly undertook the forecasting task were mostly, in 8 of the 10 companies, top-level managers including chief executive officer (CEO), finance directors, and financial controllers, which indicates the relevance of forecasting to strategic decision-making. The study also pointed out the multi-purpose character of forecasting, which supports this idea. The potential uses of forecasting in strategic decision processes can be stated as follows:

Goal Setting: Strategic planning requires input and the forecasting system in a company provides the underlying input necessary for the underlying process. Strategic managers can base their plans on these inputs in determining more realistic and attainable goals. In other words, forecasts can be taken as benchmarks for determining what are (are not) possible and achievable in a managerial decision context.

Firm Performance: The information produced by the forecasting system is ready-to-use material for measuring the firm performance whether the predetermined strategic goals are achieved. That is, the forecasting plays or can be used as a performance evaluation and a monitoring device in assessing the success of strategic plans. Assume that the company X forecasted its market share to be 25% in a 3 years time and determined all its strategies to attain this market share. At the end of the 3 years period, the strategic management could easily use market share forecast as a benchmark for evaluating to what extent it achieved its objectives or how well it performed during these last 3 years, so that it can calibrate its strategies.

Strategy Formulation: Strategy formulation is one of the key processes in strategic management. Broad range of forecasting processes provides with company managers the relevant information from procedural and analytical designs so that the outcomes from various scenarios can be investigated and

¹ These processes may include the activities such as data collection, data pre-processing and preliminary data analysis, forecasting method selection, which also involves model selection, model fitting, and diagnostic checking, and control in a forecasting system in use.

taken as a ground for such processes and activities. This would give managers the opportunity to make more realistic assumptions in their plans and projections and determine alternative strategies concerning different outcomes of forecast results for the scenarios being considered.

Flow of information and data from bottom-to-up (functional level to business level and business level to corporate level) is one of the major inputs in strategic management. Without this information and data flow from functional level, for instance, to business level managers are unlikely to formulate business strategies. Also, without such input, business level managers might choose a strategy that the company does not have the operational and functional resources to attain (Hill & Jones, 1992: 23). The same is valid for corporate level managers.

Strategy Implementation: Strategy implementation is another key process in strategic management. The attainability and consistency of strategic objectives are particularly significant for strategic management levels. The strategic objectives expressed in clear and objective figures are the key elements in strategy implementation. A good communication between strategic managers at all levels is a prerequisite in achieving these objectives, which requires clear, concrete, and understandable messages. Forecasts produced, in this sense, are a major part of the messages in the communication between both different levels of strategic and operational managers, and among themselves, as well.

The same as in the strategy formulation, without the flow of information (and data) from the top level to the functional level, the opposite of above, the functional level managers would not know what strategic objectives are pre-determined; in turn, what the functional level objectives should accordingly be, what functional decisions to make, and what tools to use for monitoring and control purposes. In other words, without concrete strategic goals dressed with figures, which are made more concrete and visible by forecasts, it would be too difficult to implement these strategies determined.

Forecasting can be used in two different ways for strategic purposes: for (i) the realization of strategic decisions in functional and operational levels and (ii) planning strategic decisions directly. While the short-term operational forecasts are an example of the former, the medium term and long-term capacity forecasts based on the market potential are the examples of the latter. Short-term operational forecasts should normally be the basic guide in running the business' daily operations. For instance, production schedules can be set, raw material purchases be guided, and inventories be controlled, and cash flows are managed by these forecasts (see McLaughlin, 1974: 4-56). The medium or longer term forecasts can directly be considered for strategic planning purposes mainly because they have to consider economic, political, social, demographic, and, say, other relevant external (or internal) characteristics. Good sales forecasts start from forecasting of the general state of an economy, and goes to forecasting of the specific industry and then to the market potential and sales for a specific period of time. Within these processes, it is expected that various scenarios are considered and different set of forecasts for each scenario is produced. Here, strategic thinking is an integral part of forecasting for different scenarios and the end product is a set of information obtained from such processes, made ready to be used for strategic purposes.

The following points are about how forecasting function is related to strategic management context: Strategic decisions are long-termed. Long-term decisions are riskier than are short-term decisions due to an increase in the uncertainty in the long-term. The higher the increase in uncertainty, the more the managers need for information for strategic decision-making. In principle the longer the time horizon is, the higher the planning requirements are (e.g. capacity planning) in companies. It is obvious that in such situations the information requirements by management increases dramatically, especially, if the intention is to make strategic decisions, which makes forecasting central to strategic decision-making.

Cost considerations are another factor that forces strategic managers to consider forecasting. A forecasting activity with a high accuracy may be needed especially in major planning and investment decisions based on the forecasts of market potential or sales where high costs are incurred (e.g. plant expansion and new facilities construction). The size of the costs or financial resources to be invested may make firms utilize forecasting function in making a ground for such decisions.

Forecasting function has the required capability to meet such a necessity. It has a data production mechanism, is an analytical tool (for the data gathered), and is a systematic approach to reveal system dynamics. It requires an extensive analysis of the decision situation. Forecasting function has the capability to explain the factors that affect the decision problem by using the methods such as regression and time series analysis. Through this way it can reveal information about the changes in the data generation mechanism under interest.

However, there also exist some opposing views about the use of forecasting in strategic planning. The claims are based on the idea that while certain repetitive patterns (e.g. seasonal) may be predictable, the forecasting of discontinuities including technological breakthroughs and price increases is “practically impossible.” Therefore, according to Makridakis et al.’s opinion, ““very little, or nothing” can be done other than to be prepared, in a general way, to ...react quickly once a discontinuity has occurred”.” (Mintzberg et al., 1998: 67-68; see also Makridakis, 1990: 115). In spite these views can be credited to a certain extent, it would be misleading to take or understand it in the strategic context that as if discontinuities are the only factors that affect or determine the company strategic plans. Theoretically, in no single company strategic plans are normally be based fully on discontinuities albeit they should absolutely be taken into account in strategic planning. Alternatively, if not discontinuities, general tendencies can easily be estimated in most of the times and this should be the minimum, if not sufficient, condition for a successful strategic planning especially for long-term. Another criticism is related to the decrease in the accuracy of forecasts as the time horizon increases, which is supported by several studies including Makridakis & Hibon (2000). “Long-range forecasting (two years or longer) is notoriously inaccurate” (Minzberg et al.: 68; see also Hogarth & Makridakis, 1981: 122). This can be taken as a valid criticism for operational level decisions. Strategic level decisions are, and should rather be, based on range or, many times, trend forecasts rather than point forecasts. In other words, strategic targets should have wider forecast ranges than should operational level targets have.

Moreover, a firm’s strategic capabilities depend on its ability to adapting to new situations. As it faces new conditions, the firm may have to readjust its position accordingly. It is difficult to argue that, because of these difficulties with or problems of discontinuities, the firm should give up strategic planning. In fact, this should rarely be the case in practice and no company does it just because some discontinuities are likely to occur. Therefore, the claims are unjustifiable since: (i) Although discontinuities are important in strategic planning, they are rarely the only factors that determine it; (ii) In strategic management regularities make the core of the required data for strategic planning purposes but discontinuities are the exceptions; (iii) Strategic planning is a process rather than a decision in a point of time. By the time, the more data becomes available, the larger the amount of data that the company can use for strategic decisions. The company can thus revise its plans under new conditions, which means that strategic plans are subject to continuous revisions. It is probably rarely the case that strategic plans are made once and applied to the end without any calibration. (iv) Apart from the point forecasts at the operational level, strategic forecasts are made to determine intervals, ranges, and, particularly, trends. (v) When the forecasts based on statistical methods fall short of achieving the desired accuracy and objectives, judgemental forecasts can consider the factors that could not be included in the statistical models. The expert knowledge can easily be embedded in the statistical forecasts through adjustments or it can be utilised separately for variety of conditions where statistical methods are insufficient. (vi) In many industries, even though there happened many discontinuous events, it did not change the tendency of many traditional industries (e.g. tyres, automobile, household) as much as it did that to others; at least, the changes were manageable. (vii) Discontinuities may not always easy to adopt and commercialise in a short period of time, especially in new innovation cases. In other words, every discontinuity that is not forecast accurately does not mean that it reduces the applicability of forecasting to strategic planning. Additionally, there exists a wide-range of forecasting techniques available for different type of forecasting tasks. The existence of such a wider-range of

techniques also indicates the capability and flexibility of forecasting techniques to be applied to various decision situations (see endnotes).

The competitive power of companies depends on their competitive advantages². Companies outperform their competitors with their distinctive competencies. The higher the number of operational areas that a firm has, the more competitive and more advantageous it is against its competitors. In this sense, the role forecasting plays and the contribution that it makes to create competitive advantage is essential. At the very basic level, forecasting helps a company cut and reduce (e.g. inventory) costs and giving opportunity to providing information about the future and reducing uncertainty. Since strategic management is more concerned with the future than with the present, the strategic management, from this perspective, is the management of the future. The future almost always contains some degree of uncertainty and one of the main purposes of forecasting is to remove and, at least, to reduce this uncertainty. Therefore, there is a common ground between the purpose of forecasting and the focus of strategic management, an area shared by these two. In this part of the paper the contribution of forecasting to firm competitiveness is discussed in more detail with its both internal and external dimensions.

The Role and use of Forecasting in Internal Environment of Business

Besides external factors of business, the most of the contribution to 'creating competitive advantage' comes from the internal and functional factors. Therefore, business firms should heavily concentrate on its functional strategies. The *functional strategies* refer to the strategies determined by the individual functional areas (e.g. manufacturing, marketing, R&D, and human resources). Forecasting can significantly contribute to establishing strategies in each of these functional areas, which are the main areas for creating 'competitive advantage', the building blocks of competitive power in companies [see Polat, 2003 for a wider discussion].

The 'competitiveness' is mainly related to creating 'distinctive competence'³, which basically comes from a company's resources (e.g. production facilities) and capabilities, a company's ability to manage its resources (e.g. company specific decision-making style and processes). The capability of strategic management in utilising the forecasting function in strategic decisions is the main determinant of the success of forecasting and its contribution to creating distinctive competencies and determining the durability of these distinctive competencies.

While the distinctive competencies are created in the functional level, the functional strategies are mostly formulated in the business level. Different from many decision-making processes that use 'top-down approach,' the strategy formulation generally uses the 'bottom-up approach'. This is mainly because functional level managers have more opportunity to have the detailed information about the firm operations, which may be essential for strategic decisions. An examination of a company's strengths and weaknesses at the functional level reveals the information for management about what the company can and can not do at the business level more clearly than at the higher levels of management. Forecasting is just the proper tool to understand the future dimension of this expectation and firm's capabilities.

A company's distinctive competencies in certain operational areas are closely related to the stability of environment in which it operates, where each operational area has distinctive and particular

² Competitive advantage refers to a cost advantage obtained from the process of converting inputs (labour, raw materials, and capital) into goods and services within the same industry. A firm's technology and managerial performance give such competitive advantages [Chung, 1987, pg. 192].

A company must either perform value-creation functions (e.g. procurement, manufacturing, and marketing) at a lower cost than its rivals or perform them in a way that leads to differentiation and a premium price in order to gain a competitive advantage. The company must have a distinctive competence in one or more of its value-creation functions to do either [Hill & Jones, pg. 108].

³ "The term distinctive competence refers to a company strengths that competitors can not easily match or imitate. Distinctive competencies represent the unique strengths of a company." (Hill & Jones, pg. 102).

features. It is, however, not surprising that environment is unlikely to stay unchanged and constant. Even the biggest organisations in the world may have a limited power to control these changes. Therefore, it is more sensible for companies to attempt to predict the direction and effects of these changes and to adopt and position themselves respectively. At this very point, forecasting has a role in predicting the changes in social, economic, and technological environment, which are discussed below separately. First, the role and use of forecasting for strategic purposes in internal environment of business are discussed with respect to various functional areas of business.

Marketing

Forecasting aims at predicting the future. By forecasting, it can be established more accurate goals and objectives, and, in turn, the strategies and tactics for reaching these objectives. Forecasting helps determine markets for products, plan corporate strategy, decide on distribution channels, price products and services, decide on product features, and determine profit and sales potential for products, determine advertising and sales promotion budgets within the strategic context. In other words, sales forecasting includes decisions in almost all aspects of marketing plans [see Cohen, 1987: 115].

Development of marketing competencies is particularly important in creating *competitive advantage*. The following three key decision areas are considered to be 'central' to strategic marketing management and to the development of marketing competencies.

First, the design of marketing mix (price, promotion, product, place) that determines how the company will compete in these target markets: The marketing mix elements are a wide-range of application areas for the forecasting function both for strategic and functional management. Forecasting function can be applied to each of the elements of the marketing mix in order to achieve the specific objectives of these elements. It is well-known how important it is to determine the right price for a specific market segment, which is one of the most particular factors for the success of a particular product and, of course, marketing activities. The price prediction for a specific market segment may have to be made for analysing various scenarios, on which strategic decisions (e.g. product launch) can be based. It can also be utilised forecasting for strategic decisions for the other elements of marketing mix such as place (e.g. the selection of distribution centres). A wrong strategic decision may make a firm to incur considerable and long-lasting costs that could remove the big part of the competitive advantages created by other functional and strategic areas of the firm.

Second, marketing managers may have to choose between markets or market segments. The selection of a target market segment determines where the company will compete. Market segmentation and the choice of market segment both are major strategic marketing decisions. The choice of decision might be judgemental or model-based. No matter the method of choice is, it has to include a forecasting procedure (at least, in mind). This choice decision may be about the market share, sales, and the future state of it. Frank (1974) discussed the factors that affect market segmentation and their effects on sales forecasting. Which classifiers including socio-economic, life-cycle, or locational characteristics besides personality and demographic variables, which are the main segment classifiers, should be established is one of the main problems regarding the market segmentation issue. The relevant weights and significance of these factors can be established and determined with the forecasting function; so that a better segmentation can be made possible. There exist clear examples that show the significance of the estimate of the right market segment. Apple computer example is an interesting one in this matter. It was first thought that home computer market had a good potential and was big enough to sustain the computer industry. It focused on that segment of the market in order to have leadership position but later it found out that, in fact, the market segment was not big enough to support continuous sales. On the other hand, IBM concentrated on the business segment and became the market leader in this segment in 1990's. Besides other factors, Apple's wrong estimate of the market size led it to the marketing decisions, which then became quite difficult to recover. With a good

forecasting practice, such a wrong positioning and market segmentation decision could be avoided easily.

Third, advertising media selection, which refers to the prediction of the media to be used, is another decision area within the marketing function. At the product launch phase, the success of the advertising media may become crucially important in delivering the projected messages to the consumer target. The substantial amount of money spent during the introduction phase of a product and a likely failure of a company's substantial product (e.g. the contribution of a wrong decision regarding the media selection) makes the choice of advertising media selection highly critical. In this regard, the evaluation of the performance of various advertising media and the prediction of the best media, in terms of its consequences, can be considered as a strategic process for marketing decisions.

Fourth, the design of marketing mix is, at large, a forecasting practice, by which marketing management attempts to predict the best available options (for each of the marketing mix elements, which are product, place, price, and promotion) for a given mix or estimates that a specific set of assumptions will hold for a set of alternative mixes. Therefore, the decisions related to each of the marketing mix elements unquestionably include a sort of, judgmental or statistical, forecasting activity.

Based on the market potential, marketing management may utilize forecasting function in allocation decisions (of marketing budget and effort) between/to the marketing mix elements that it can develop profitable marketing plans and programs for the products and services offered. The same is valid for pricing decisions, channel selection decisions (e.g. facility location decisions including sales office or warehouse) and promotion decisions (e.g. advertising and management of sales force) (see Schendel, 1974: 4-85).

Positioning⁴ strategy is another marketing decision area where forecasting has a substantial contribution. Forecasting can be utilised in determining the market potential for a specific market segment before any positioning strategy is applied to. There are already many applications of forecasting to market potential in practice. These forecasts form a sort of strategic information in the choice of right market segment to focus on and in the selection of right marketing mix for it.

Forecasting literature has focused extensively on the forecasts of market potential⁵, market growth, and market share. Cohen (1987: 115-140) discussed how to forecast market potential and sales forecasting with different forecasting techniques with relation to a marketing plan. Schendel (1974) discussed how to estimate market potential for established (old) products, the benefits of practising market potential, and the estimation methods in detail. Market potential has a useful and significant role for allocation decisions and market planning. The importance of forecasting function here is that the demand response is a function of assumptions and forecasts that must be made about environmental conditions and competitive marketing programs (see Schendel: 4-82). The degree of variability for the demand for a specific product/product group may deeply affect the outcome for the market potential and, in turn, the entire marketing plans and strategies. Forecasting may determine the variability of demand and enhance the validity of assumptions for the marketing plans and strategies.

The stage of a product in its life cycle is important in determining the type of strategies to be applied and the product life cycle (PLC) model retains its appeal as a planning tool to assist corporate and marketing managers shape strategy and tactics (Wong, 1994: 104). The factors that may affect the next stage of the patterns (e.g. trend) that the product may follow in the PLC model can also be determined. Company managers may investigate and detect the factors (variables) that may affect every next phase in the PLC. Consequently, forecasting can help determine demand and strategies along with the PLC including new product launch decisions.

⁴ Based on two principles of marketing strategy: (1) the choice of target segments that a company decides to focus on and (2) the design of the marketing mix to create a differential advantage that defines how the company will compete with rivals in each segment.

⁵ "Market potential is the maximum demand response possible for a given group of customers within a well-defined geographic area for a given product or service over a specified period of time under well-defined competitive and environmental conditions." (Schendel, 1974, pg. 4-81)

Forecasting also helps managers determine the timing of entrance to the market. The companies that are 'first-to-market' can determine the market potential through forecasting function and can decide whether or not to enter the market. The players that are 'second-to-market' can get benefit from forecasting in obtaining the required market information as quick as possible, which is needed for fast investment decisions in order to evaluate if it worth to follow a specific innovator into the market, which is the main character of this type of firms. For the firms launching products into an established market in the late growth phase of the PLC, forecasting provides detailed strategic information about different segments of it. The contribution of forecasting at this stage is particularly important because marketing's emphasis shifts to segmentation and positioning, which requires a concomitant increase in investment in applications, customs engineering, and product design skills. (Wong, 1994: 107). For the firms planning to enter the market during maturity or later stage, forecasting again provides valuable information about the market potential and the market share that the firm can gain so that it can decide if the assumption of high unit volume sales holds and if it should enter the market based on the forecast results regarding the achievable sales level.

Market potential is critically dependent upon general external environmental factors including the state of the economy, levels of disposable personal income, tax levels, etc., and the actions of competitors' similar products. Therefore, to be able to estimate the market potential, appropriate set of assumptions have to be made about and these uncontrollable variables have to be forecast first.

Market share has a central role in strategic marketing planning and is frequently used as a key strategic objective in the development of marketing plans (Ryans, 1987: 135). Since market shares are less sensitive to the impact of growth and seasonal fluctuations, it is a considerable tool for strategic planning of the future. Of course, achieving a higher market share and thus being a market leader is a considerable strategic objective for most of the firms. A market share leader can have comparably lower overall costs due to its greater accumulated experience and its potential for learning by doing, process and product improvements that lead to lower cost, and the reduction of unit costs that come from higher scale of operations, which all give it a considerable competitive power to it. Market power can also accrue to a large market share firm, which enables it in some cases to extract more favourable terms from suppliers or customers (Ryans: 139).

Forecasts and judgements of market share are also crucial in resource allocation decisions. Management needs reliable and consistent information in order to take a step towards strategic resource allocation decisions such as protecting the existing market share or achieving a higher market share. The study by Fox & Franses (2001), who attempted to forecast market shares at the brand level with simulation-based models, can be taken as an example of the forecasting studies of market share.

Sales prediction is another area in which forecasting is utilised intensively. Sales forecasts refer to an estimate of company sales for a specified future period [Johnson et al., 1994: 191]. Sales forecasting is the most important planning task within any company-large or small [Johnson et al.: 192] and the sales forecast should be one of the company's most important documents (McLaughlin, 1974: 4-55). Sales forecasts are one of the most widely used areas and have the most functional uses in marketing.

There are many reasons for extensive use of forecasting in sales prediction. In addition to the information requirement of the future by management, variability in demand forces firms to exercise sales forecasting practices in order to reduce or remove the risks associated with this uncertainty, provide inputs to various major planning decisions including capacity planning and investment planning. The high functionality of sales forecasting is not only because of its contribution to many marketing related decisions but also because of its importance and contribution to many other decision areas, such as inventory, employment, capacity planning, and distribution, into which sales forecasts provide inputs directly or indirectly. Sales forecasts provide a start point for the assumptions used in various planning activities and for the development of short-term financial control systems. For instance, financial budgets are prepared based on varying levels of production according to which they

show different expense patterns. Also, a firm's production level is linked closely to its sales output and, thus, the financial budget is dependent upon the sales forecasts [Johnson et al., 1994: 191].

Besides forecasting sales for established goods, predicting sales of a new product has a particular importance for management from strategic point of view. The decisions regarding new products include many uncertainties in addition to those regarding established products (such as the environmental factors that may affect the new product and their weights on it, the uncertainties that may come from pricing decisions made in uncertainty, the resistance that come from competitors, and the uncertainties about the expected perception of customers (see Kelly, 1974: 4-73)). That is why, forecasting new product sales is of particular importance for management when making decisions in uncertainty before a new product is launched into the market. Given that a success in a particular product may deeply affect the strategic position of a company in a specific market, the importance of and the emphasis that should be given to it in order to achieve the desired success by strategic management can easily be understood. Marketing and forecasting literature have given particular importance to the subject. For the sake of our purpose, two studies are mentioned here as an example among many. Kelly (1974) discussed the nature of prediction problems, the sources of information, and techniques for sales level regarding predicting new products in detail. Hsiao et al. (2002) also investigated the role of stated intentions in new product purchase forecasting and developed various models to investigate the role of intentions and explanatory variables in forecasting purchase. They found that a weighted average of stated intentions together with the explanatory variables included are powerful indicators of future purchase behaviour.

In short, sales forecasts have many uses in variety of decision areas such as in (i) setting of financial (e.g. capital) and operational (e.g. sales) budgets; and (ii) scheduling of purchasing and production activities and controlling of inventories; and (iii) establishing sales projections and sales quotes, each of which has, direct or indirect, strategic implications, at least, at the operational level, which is where strategic plans are put into action.

Price forecasts are another application area of forecasting function. Price forecasts are used frequently in management decisions about marketing strategy, new investments, budgeting, and raw material purchasing. Price forecasting practices have a long history, probably due to its strategic value for management. The more realistic price forecasts are available, the higher the number of implications for management is, including the improved pay off in better decisions regarding marketing strategy, which is probably the most important one. For instance, "a knowledge of pricing trends for various product lines also suggests the most appropriate balance of marketing effort for each product." Hegeman (1974) reviewed the price forecasting practices and techniques used. Price forecasts are mostly based on appropriate demand and supply curves developed for the products of concern. In order to help reduce the risk and uncertainty in management decisions, a variety of techniques have been developed to deal with the problems associated with supply, demand, and prices for most of which products' supply and demand curves have never been developed (Hegeman, 1974: 4-286). Due to a large number of uncertain factors in the marketplace, price forecasting becomes a rational behaviour in reducing these uncertainties and price and volume forecasts are required by for all business planning activities. For instance, improved price forecasting can significantly influence budgeting because the forecasts of future product and raw material prices help in making more accurate sales budgets and appreciation of changing production costs, which leads to important potential for inventory savings (see Hegeman: 4-294). The forecasts of tendencies in prices additionally provide a company to adjust its investment plans and activities, providing the greatest payoff to company. The problem is, in fact, rarely whether or nor to forecast, it is whether to forecast systematically or judgemental. In this sense, forecasting is a natural and essential part of strategic marketing management.

Manufacturing

How long time does it take to design and produce a product for a company and how long does it take for a competitor to imitate and follow such a product in the market? Time plays a critical role,

particularly in product launch to a market. In such times forecasting has an ability to become a very major part of the decision-making process, in estimating different requirements, effects, conditions expected, and making assumptions.

Companies may have different manufacturing strategies based on market conditions. Many strategic marketing decisions are mostly closely related and tied to production strategies in companies. In other words, what kind of marketing strategy (e.g. market leadership) a company should follow is, at large, based on its production strategies. Although 'cost leadership' is one of the highly desired production strategies in most companies, other sort of strategies such as 'quality leadership' can also be followed as the main strategy. For instance, the decisions regarding shifting from the cost leadership to quality leadership is considered to be a main strategic decision and should have a strong forecasting background.

In theory, the purpose of a company's manufacturing strategy should be to produce cost-competitive products that are sufficiently high in quality. The experience curve, the product-process life cycle, and the flexible manufacturing technologies are the three factors that require specific attention in creating cost competitive manufacturing. Companies may utilise a manufacturing system from among several including flexible and mass manufacturing systems with respect to their operational area, production schedule, etc. Regardless of the manufacturing system in use, cost minimisation⁶ is the basic purpose probably for all companies. The contribution of forecasting comes into use, for instance, in increasing the utilisation of individual machines through better scheduling. The forecasts of the material requirements of each of the machines, operating times, and labour requirements needed to complete specific manufacturing processes in each step of manufacturing may be needed for maximising the (automatic) distribution of materials and labour times among machines. By doing so, it can significantly improve the efficiency of manufacturing processes and reduce the costs.

Being different from the mass production schedule, the flexible manufacturing technologies allow companies to be highly responsive to unique customer demands and, at the same time, to compete on the basis of cost [Hill & Jones, 1992: 116]. Forecasting has lots to do especially in such circumstances like it can produce the estimates of the time and amount of specific customer demand so that it does not interrupt the usual manufacturing schedules due to the information about the patterns of unique customer demand. Therefore, one of the basic contributions of forecasting to manufacturing process is to support the production schemes by producing and collecting data and/or information. Forecasting function, in this sense, plays an intermediary role between the production department, management department, and the market (customers). It provides the flow of data continuously and closes the time gap between the production time and the time of sale.

Capacity Planning and Scheduling: Capacity planning generally refers to a long-term decision-making. Almost all businesses need to make long-term forecasts for planning new (plant) investments and equipment expenditures. Long-term forecasts may sometimes extend to a period of 5, 10, or 20 years, depending on the life cycle of the equipments under consideration for installation. Capacity planning policies for growth firms⁷ and mature firms are expected to be significantly different, depending on the forecasts of the sales and market potential (see McLaughlin, 1974: 4-60). In such cases where significant financial investments are considered, forecasting has a significant role in analysing various outcomes and evaluating whether or not to go for a significant amount of investment for capacity planning purposes. Such decisions are 'strategic' in this sense. For instance, while an investment decision to increase capacity based on the forecasts of market potential for product 'A' may provide good opportunities and competitive distinctions (e.g. a higher market share and cost

⁶ The contribution of forecasting to lowering the costs can be in several ways including, but not limited to (1) saving from the storage costs related to products and raw material; (2) saving from the financial costs related to financial resources tied up to the raw material; (3) saving from labour costs due to the availability in planning labour force in advance.

⁷ Businesses that are still in the rising phases of the *S curve*, not yet having reached saturation, are called 'growth' firms and those that are at the upper ends of the *S curve* are called 'mature' business.

advantages through economies of scale) for a company, an opposite scenario may lead to considerable costs, e.g. financial, and lose of market share.

In the short-term, forecasting function helps in estimating and scheduling the labour and machine hours in a certain capacity and demand conditions so that the critical production resources of a company is utilised properly. For instance, especially in the companies that produce goods and services based on customer order, the demand uncertainties may lead to serious difficulties in capacity planning [Krajewski & Ritzman, 1993: 436]. Forecasting here helps to reduce and remove the underlying uncertainties.

Materials Management

An efficient materials management is one of the key areas in creating cost competitive advantages. *Materials management*⁸ deals with purchasing, inventories, production plans, staffing plans, schedules, and distribution [Krajewski & Ritzman, 1993: 521]. Although the decisions regarding these areas are more tactical than strategic, due to their capabilities and contributions to creating distinctive competencies and competitive advantages, they can also be considered within the strategic decision context.

Inventory Management: Inventory management and control is a sub-area but an essential part of the materials management. Inventory is a stock of materials held to satisfy some eventual demand and requirements. The importance of inventory management is related to the uncertainty of demand and higher costs associated with inventory. Demand is rarely constant and it sometimes may fluctuate considerably, which is what 'uncertainty' is. Demand uncertainty can lead to ordering too much or too little, which can result in a cost or customer service penalties. Holding inventory is not free of costs, which may sum up to a very high amount of money. Holding (carrying) costs may vary between 20-40 percent of the inventory's value in a year [Krajewski & Ritzman, 1993: 563]. Inventory forecasting is one of the most widely utilised areas of forecasting function, whose contribution to inventory management is mostly through more efficient use of inventory management that cuts down the associated costs with inventory. A significant amount of financial resources can be released and substantial savings can be made from storage and financial costs tied up to inventory with the reduction of safety stock levels. Forecasting also helps protect the firm from losing the company's loyalty and losing customers through maintaining and securing a satisfactory inventory level that meets the customer demand.

Distribution and Collection Management: It is another area that has a high strategic value for a company. Forecasting again has a huge potential in the formation of decisions regarding distribution and collection functions. The distribution function is related to the management of flow of materials from manufacturers to customers (or from customers to firms especially in service firms), involving storage and transportation of products, materials, and/or services. Distribution is important both for manufacturing and service firms. Manufacturing firms may need to distribute hundreds or, sometimes, thousands of items to variety of places. For the service firms such as Federal Express, TNT, Aras Kargo, which are cargo carriers, forecasting is one of the best tools that can be utilised in planning, scheduling, and routing the distribution and collection tasks (from/to various collection and distribution points to service points), work force, service vehicles (e.g. based on the regional areas and the quantity of collections and distributions), carrier selection, estimating demand size, and in increasing the service quality and customer satisfaction (e.g. through decreasing the service times). These very basic and particular roles of distribution and collection functions may potentially provide lots of strategic options

⁸ According to materials management approach, purchasing, production, and distribution are not separate activities but three aspects of one basic task. It controls the flow of materials and products from sources of supply through manufacturing and channels of distribution and into the hands of customers; in order words, through the value chain. Coordination and control of the material flow give a company the opportunity to take advantage of cost savings, inventory reductions, and performance improvement opportunities, which would be unavailable without materials-management function [Hill & Jones, 1992, pg. 124].

for managers upon which variety of strategic decisions can be made. For instance, the distribution (and collection) channels chosen to enter a market may significantly affect the success of a product and/or service level and consequently the whole success of a firm in the market. Therefore, the efficiency of the distribution and collection systems may offer serious competitive advantages and, that is why, is a serious strategic mechanism. Forecasting function has the capability to enhance the strategic functionality of the system and the strategic value of it.

Financial Forecasting

Financial resources can seriously affect the company's ability to build distinctive competencies in almost all the areas of business. Companies often make substantial investments. Those decisions that are not based on good and reliable forecasts may lead a company to severe financial states and, the opposite does to substantial gains. Probably that is why, as with many sub-areas, financial management is one of the business functions where forecasting is utilised most commonly.

Especially in the evaluation of investment projects from various perspectives (e.g. market growth, future sales projections, and future cash flows), it can easily be understood how important, invaluable, and functional the forecasting is for such strategic decisions. Otherwise, such critical strategic decisions may have to be based on a complete uncertainty without any stand and systematic approach.

Research and Development

Research & Development (R&D) function is another application area of forecasting with one of the best uses as a strategic decision tool. R&D function is crucial for many firms, especially for those operating in an industry where the competition is high and/or the industry is a high-tech one. In many industries, R&D costs may sum up to a high amount of money but only about 12 to 20 percent of R&D-based projects actually generate profit given that they get to the marketplace. The remaining 80 to 88 percent fail [Hill & Jones, 1992: 125]. The reasons vary as follows:

1. *Uncertainty*: Developing a new product is a risky business. No one can really predict what the demand for it would be. A good market research can reduce the risk of failure but it cannot eradicate it completely.

Forecasting Solution: Forecasting has a potential to reduce this uncertainty considerably (with the utilisation of judgemental or statistical methods). The literature reports many applications of forecasting to new product demand predictions (for instance, see Hsiao et al., 2002)

2. *Poor commercialisation*: It refers to the case that when there is an intrinsic demand for a new technology but the technology is not well adapted to consumer needs.

Forecasting Solution: A good market research and some forecasting techniques can be utilised in predicting the consumer needs properly and then commercialise.

3. *Marketing mistakes*: If marketing function incorrectly estimates the demand for a product, service, or technology, when there are no sufficient demand, prices are too high (e.g. due to higher costs), or determines a wrong marketing mix, a new product may fail. For instance, the Supersonic jetliner, Concorde aircraft attempt has failed because there was never any demand for it at a price that it cost to produce the aircraft. Thus a whole venture was a costly mistake [Hill & Jones, 1992: 126].

Forecasting Solution: A good marketing research and obtaining the forecasts of the cost of production and, in turn, the demand for a specific price ranges.

4. *The speed of introducing a product*: The speed of introducing a product to market may deeply affect its success. As the time between initial development and final marketing gets longer, it is more likely that someone else will beat the new product developer and gain a first-mover advantage [Hill & Jones, 1992: 126]. This is particularly the case in information industry.

Forecasting Solution: Estimating the competitors' position and forecasting the time that it takes to develop and market the products and services that a company produces.

As a further point the integration of the R&D and forecasting function can contribute to creating distinctive competence in R&D area. The forecasting function contributes to determining to what way to direct the R&D activities.

Information Systems (IS)

Information is a competitive resource that allows companies to function productively [Kim et al. 2003]. A company with a strong information system can exploit information-based competitive advantage in many of the business functions [Hill & Jones, 1992: 139]. A well-developed information system is the basic infrastructure for forecasting activities from data gathering and collection to forecast evaluation. It enables company to manage its data sources (from different economical, geographical, and political regions) easily, to obtain the information required easier, to have the required inputs (e.g. data and information e.g. for judgemental forecasts) into forecasting system, and to have more accurate forecasts available. That is why, it plays a crucial role in obtaining healthy and accurate forecasts that may affect very major operational and strategic decisions as well as strategic information gathering and processing.

The success of strategic decision-making and strategic management closely related to the existence of IS and efficient use of IS and IT (Information Technology) in a company, where the information itself has become a strategic tool. No method can produce higher quality of forecasts (e.g. for market potential and sales) unless there are high quality of inputs, data (and information). A better information system is a pre-condition for collecting and processing (e.g. cleaning) data in improving the accuracy of forecasts. Higher quality of data is needed especially for the methods such as time-series and regression type methods, where the functional form rests, at large, in the quality of historical data.

The collection, processing, production, distribution and utilisation of information all depend on the availability of a well-organised IS, which is at the same time, one of the basic requirements of a well functioning forecasting system. In other words, in order for a forecasting system to perform its basic data gathering, processing, production, and utilisation activities for functional and strategic decision purposes, a well-working and efficient IS are the basic necessity. Such an IS provides effective communication within business units and a faster collection and utilisation of data. It also avoids data and information losses based on the time and physical data collection and management systems and, more importantly, avoids the erosion and losses in the value of data with the passage of time, which may especially happen to the market data, of which value is subject to change or diminish quickly. Therefore, the IS in a company creates a time advantage of data for strategic and functional management.

In sum, an effective utilisation of information resources (gathered or produced) can be utilised in critical decision situations, and the company can create information-based competitive advantage.

Other

It has already been stated that strategic decisions are mostly of higher costs. Location selection is one of the most costly strategic decisions that can fully affect the whole business from many ways (e.g. its market segment, production costs, marketing activities, and productivity). These types of decisions generally require long decision-making processes, long investigations, and need feasibility works since once a wrong decision is made and high volume of costs are yielded, the decision process is almost impossible to take it back. Therefore, it is needed that such decisions are fully based on all the available information, a lot of which can be produced by forecasting. For instance, in the determination of a hotel or a warehouse location, or a distribution center location, say, the existence of sufficient demand is crucially important for the investment decision. Forecasting can easily include the factors

such as population, economic and social factors or the effects of them into decision-making process. Such a decision process that takes these factors into account is more likely to lead 'better decisions' in such circumstances.

In spite of the criticism for formal strategy planning in companies (e.g. Peters & Waterman, 1982), which assumes that corporate strategies are mostly emergent, it is little likely that most of the firms operate without any strategic medium or long term, formal or informal, strategy planning. Decision-making processes that utilize forecasting function should be included in strategic planning. Strategic managers should utilize this function to the end in achieving better decision that are based on relatively cheaper data (and/or information) produced by the forecasting system.

The Role and use of Forecasting in External Environment of Business

Analysis of macro-environmental factors is one of the main procedures in strategy formulation and strategic management. Macro-environmental factors are external factors to an industry. Strategic managers need to determine what conditions will exist within an organization's environment at some future time. Most companies find that determining future environmental conditions are particular to ensuring future organisational success. The forecasting procedures related to the environmental factors are called '*environmental forecasting*.' When environmental forecasts are performed, strategic managers need to predict the future status of critical environmental components at all environmental levels. Environmental forecasts include economic forecasts, social forecasts, political forecasts, and technological forecasts (Certo & Peter, 1993: 53). The types of forecasts made by any organization depend on the particular situation which an organization to be in. Nevertheless, several environmental trends are commonly followed and forecast by many organizations, which are explained in Certo & Peter (1993: 55). Three of the basic points that forecasting should be considered about strategic management are as follows:

1. Forecasting is an instrumental tool for strategic management. Strategy formulations include many plans. Forecasting function may provide a link between these plans and the future dimension of the forecast subject.
2. Forecasting function is responsive to the information needs of strategic level managers on the ever-changing conditions.
3. Forecasting function provides opportunity with the strategic management to understand the movements and dynamics of environmental factors, which are very crucial for strategic decisions.

Macro-environmental factors influence the level of demand and directly affect company (profits) as well as corporate decisions in many decision areas. Many of the external factors change constantly. These changes in the factors may create new opportunities and new threats for an industry. Therefore, it is highly important that strategic managers understand the importance of these factors and their impacts on their company and industry [Hill & Jones, 1992: 92-97].

Table 1: External Environment of Business and Role of Forecasting

Environmental Factors		Forecasting Methods Useable	Role of Forecasting
1)	Macroeconomic environment	Statistical (including Artificial Intelligence such as Neural Networks and Genetic Algorithms) and Judgemental Methods	
	a) Economic Growth		Direction and size of economic growth
	b) Inflation Rates		Direction, size, and increase (decrease) of inflation rates
	c) Interest Rates		Direction, size, and increase (decrease) of interests rates
	d) Exchange Rates		Direction, size, and increase (decrease) of exchange rates
2)	Technological Environment	Judgemental (e.g. Delphi Method and Executive Judgement)/Statistical	The direction of technological developments and their effects on company and industry.
3)	Social Environment		The direction of changes in social environment and their likely effects on company and industry
4)	Demographic Environment		Population growth (decrease) rates, population structure, and company's and/or industry's future customer potential (e.g. forecasting potential tricycle customers in the next 10 years based on population growth rates)
5)	The Political & Legal Environment		Political and legal changes and developments and their effects on industry and company
6)	Global Environment		The direction of global changes, new industries created, global economic changes (e.g. economic trends) and their effects on country, industry, and company (e.g. the amount of foreign investments that the country X can obtain and their likely effects on the industry Y)

Macroeconomic Environment

Forecasting has an important role in understanding the dynamics and behaviour of many of the macroeconomic factors and predicting their future. Compared to the microeconomic factors at the business level, the forecasts of these factors may sometimes be more difficult and costly at the same time for a firm due to the fact that this forecast area may differ from the forecasts of microeconomic factors in terms of the expertise required. In modelling macroeconomic area, the strategic managers and forecasters in a firm has a more limited control over the factors in terms of data sources, ever-changing economic factors and variables, and effects on them. In contrast to this in microeconomic area, strategic managers have the forecasts first, and then, based on these they have a power to change the outcomes with their decisions. In other words, while strategic managers are active players in the microeconomic decision area, they are in passive form and affected by external factors in their decisions in macroeconomic environment. Information obtained prior to strategic decisions about the future behaviour of these external factors provides invaluable contribution to the management. That is exactly the point that strategic managers need the support of forecasting function in such decision areas. Some of the major macro-environmental factors and the role and use of forecasting can be explained as follows:

Economic Growth: It has a direct impact on the level of opportunities and threats that companies face. Economic growth leads to an expansion in consumer expenditure and gives companies opportunity to expand their operations. On the other hand, economic decline does the opposite and leads companies to reduce and shrink their operations [Hill & Jones, 1992: 93]. Companies are supposed to form their policies by considering the current and/or and the future state of the economy. For instance, it would

not be a sensible policy to expand company operations, if it is expected and/or forecast a sharp economic downturn. Forecasting gives managers the opportunity to reconsider their positions, given that they timely forecast economic upturns or downturns (or use the forecasts available). Forecasting literature is rich in providing the studies of forecasting business cycles, also called *classical cycle*, which refers to economic fluctuations (see García-Ferrer & Queralt, 1988; Diebold & Rudebusch, 1999; and Sichel, 1993, 1994). Banerji & Hiris (2001) present a framework for analysing and forecasting cyclical behaviour in economic activity, employment, and inflation. They extend that framework to foreign trade and important domestic sectors of an economy (e.g. manufacturing, services, and construction). There also exist examples of growth cycle forecasting studies (see García-Ferrer et al., 2001). For comparatively shorter-term strategic planning purposes, forecasts and knowledge of *growth cycles*⁹ can also be very informative and beneficial for strategic managers. Garcia-Ferrer et al. analyse the growth cycle chronology of the Spanish economy from 1970 to 1998 and propose a method that can be used as a forecasting tool in predicting turning points. Summers (2001) analyses and forecasts Australia's economic performance during the Asian crisis with respect to some economic factors including imports and exports, interest rates, and inflation. Qi (2001) predicts US recessions with leading indicators (via, relatively a new type of forecasting techniques, e.g. neural network models). She examines the relevance of various financial and economic indicators and predicts the probability of a future recession.

Interest Rates: The level of interest is directly related to the level of prices in an economy. It is important both for consumers and companies. Buyers finance their purchases (e.g. appliances, mortgages, or automobiles) from financial institutions or sellers and companies use lots of financial resources from financial institutions or from their suppliers for a variety of reasons (e.g. capital requirements or raw material purchasing). Therefore, an increase in the interest rates can be considered as a threat and a decrease as an opportunity for both consumers and companies.

Since interest rates are one of the major factors that directly affects the cost of capital, it is highly significant for a project's or a strategy's success. Forecasting can provide a significant piece of information in advance to evaluate the relevant strategies and projects. Due to its importance, the study of interest rates is one of the major subjects in financial economics, which mainly focuses on understanding the dynamics of interest rates and forecasting the future rates. Summers' (2001) study of interest rate forecasts during the Asian crisis in Australia can be presented as an example among, maybe, thousands of studies in the field.

Currency Exchange Rates: The existence of huge amount of international trade, vast number of multinational companies, international financial markets, globalisation in trade and finance, borderless trade opportunities both for consumers and companies (e.g. through Internet) are the realities of the current time. An increase or decrease in the value of a country's currency has direct effect on the volume of its trade (import and export) and finance. All these trade opportunities make the foreign currency a trade medium itself. The changes in the value of a foreign currency brings new opportunities and threats for traders and the need to forecast the future value of exchange rates.

There exists a vast literature on forecasting exchange rates. If it is taken the amount of foreign currency circulating in international area and the size of this forecasting literature in exchange rates together, the significance of forecasting the future rates can easily be figured out.

Inflation Rates: Inflation is a threat for companies for variety of reasons such as slower economic growth, more volatile currency rates, a higher interest rates and, as a likely result, a destabilised economy. In such an economic environment, it is unlikely to have a healthy investment planning and decision-making.

Because inflation lessens the predictability of future, forecasting can be used as a functional managerial tool to forecast inflation rates in order to remove or reduce this uncertainty as much as

⁹ "..., growth cycles represent alternating periods of above and below trend rates of growth and can be seen as short-term fluctuations around previous peaks and troughs." (García-Ferrer et al. 2001, pg. 517).

possible. Thus, companies can easily adjust their positions based on the forecast inputs. Summers (2001) makes an example of inflation rate forecasts during the Asian crisis in Australia. Junttila (2001) also examines the structural breaks in the economy and forecasts the rate of future inflation (but for short-term) in Finland for the time period of unregulated financial markets from 1987 to 1996.

Technological Environment

Technological developments also create new opportunities and threats for firms. They create threats because accelerating technological change and developments shortens the life cycle of products and sometimes a new product may become old fashioned or out-dated even before being introduced to the market or a short period of time after being introduced. For many companies, it may be impossible even to follow these developments and make the investment necessary to produce such products. If companies cannot adopt themselves to the new conditions, they can quickly lose their market share or positions. Such accelerating technological changes also bring new opportunities including new manufacturing methods and low cost production opportunities. In industries that require technological know-how and high research and development costs (e.g. microchip companies such as Intel), companies can lead the market and can turn this into a competitive advantage in their industries. In the industries where severe competition exists, mistakes such as delays in adopting new technologies or developing wrong type of products for the market can severely damage companies and their positions in that market. In such circumstances, forecasting plays an important role in analysing the current technological developments and predicting the direction of these changes and their likely effects on companies.

Social Environment

Similar to the changes in technological environment, the changes in the social environment may also bring some threats and opportunities for companies. For instance, the decline in the tobacco industry in the recent years especially in the developed countries is partially due to the public awareness on the risks of tobacco for health and public pressure on tobacco companies and government bodies. Similarly, an observed increase in the demand for organic foods in the developed countries has been the mostly result of public awareness of genetically modified foods and their risks. As the invent of sweeteners was a new opportunity for many food companies against sugar, the release of information about the fat-giving contents of X brand of potato chips in America in 1997's created lots of tension for the producing company.

Forecasting is, again, put into use to analyse and predict the direction of social changes. Thus, company operations, and strategies as well, (e.g. research and development activities) can be adjusted or build on these analyses.

Demographic Environment: Markets are frequently defined in terms of geographic boundaries. Much of the research in marketing is based upon the importance of customer groupings in market segments. The composition of demographic structure of a specific geographic area is of particular importance from marketing point of view. For instance, it simply helps defining market segments and subsets of potential consumers (e.g. in terms of variables influencing purchase behaviour). The changes in the composition of these demographic characteristics can also create threats and opportunities for companies. For a company that operates in the toy industry, an expansion plan through domestic production may not be very sensible in a country such as Netherlands, where the population growth is minimum, while it might be very feasible in another country where the rate of population growth is higher, given that population composition is the only decision factor. In such cases, forecasting is the proper tool to determine the likely demand for their products and the feasibility of their (e.g. investment) plans and strategic decisions.

Political and Legal Environment

Political and legal factors sometimes create very major threats and opportunities for companies such as regulation and deregulation of industries and privatisation of public firms has done in the countries like UK, Turkey and East European countries. As the regulation of advertising in the tobacco and alcoholic beverages created threats for the companies in these industries, the deregulation of telecommunication, airline, and banking industries created new opportunities for many companies (in many countries including USA, UK, and Turkey). Forecasting can be used to predict the likely directions of the future developments so that company can make itself ready and strategic management have more time to adapt to and consider new conditions. The company can use new opportunities faster than their competitors.

Global Environment

The changes in the global environment are also important for companies in maintaining their competitive power. New economic and/or political blocks such as the birth of Asian Tigers (Taiwan, Japan, South Korea and, maybe, other south eastern countries, North American Free Trade Agreement (NAFTA), and European Union (EU) may bring both new threats and new opportunities for companies. Just after the Soviet Union collapsed in the late 80's, many American and European companies were already in operation in the region. The same is true for the new process, called globalisation. Even if not in the same level as the big multinational corporations can get benefit of the process through the free flow of capital in the world, the process also created many new opportunities for many medium-sized companies. Even many local companies have grown up to national and international sizes. Therefore, the analysis and prediction of global changes are highly important for companies to create new opportunities and forecasting plays a significant role in this.

Criticism of Forecasting's Applicability

As it is the case in many other managerial methods, it is also possible to see some criticism of the applicability of (especially statistical) forecasting methods and the applicability of the forecasts produced to strategic management. The main criticism is related to the key assumptions in statistical forecasts that the past data contains information about the future and the patterns in the data are expected to repeat themselves, which are expected be captured by statistical methods. However, due to the rapid changes in technological, economic, political, social, and environmental factors, statistical forecasts are expected to be most effective for a one-to-two year period. On the other hand, the magnitude of the pressures from those major changes tends to negate the validity of these forecasts. Also, since statistical forecasts assumes that the past will be repeated, they are seldom accepted as the sole basis for strategic planning and decision making (Hegeman, 1974: 4-289 - 4-290). In spite of some of these criticism can be credited to some extent, most of them are not valid due to the following reasons:

- 1) One and two year periods are critical in formulating and implementing future strategies. The data and information produced by the forecasting system has the highest value for strategic managers and, in fact, this is the time for managers to observe if strategic plans are carried out smoothly. Therefore, the contribution of forecasting can not be ignored.
- 2) Forecasting methods (statistical and simulation type techniques) can capture and explain the system dynamics and their effects. For instance, the forecasting system can focus on what intervening price cycles the industry will experience rather than what the price maybe in ten years.
- 3) Statistical forecasts are mostly adjusted and combined with judgemental forecasts. Therefore, the patterns and expectations that are not revealed in the statistical forecasts can still be reflected to the forecasts. Today, judgemental forecasting has been a very major research area

within the forecasting discipline [see Sanders & Ritzman, 1991; Bunn & Wright, 1991 for gaining more perspective about judgemental forecasting]. Management knowledge and understanding about future events and trends can therefore be incorporated into forecasts.

On the other hand, no strategic planning is expected to reach its goal without considering the future (state of a specific circumstance).

Summary and Conclusion

The paper has discussed in detail the various areas in which forecasting has the potential capability to use as a strategic decision tool in the strategic context. More specifically, the paper has pointed out the potential internal and external decision areas where forecasting can extensively be used for strategic decisions as an essential support tool. The paper pointed out the central role of forecasting function as regard to how it provides the critical needs of information with the strategic management, which is the key to strategic managerial decisions and the forecasting function concentrates on the production of it by the means of various techniques. It has also highlighted the criticism raised about the applicability of forecasting to strategic management. As a general conclusion it can be said that forecasting has a major role and the potential capability to use in many of the decision areas; therefore, it can easily be used for functional and strategic decision-making in these areas.

However, forecasting is an expertise area and it requires technical knowledge, reasoning, and the ability to analyse and judge, and an infrastructure in order to obtain the expected benefits from it. "Forecasts may be needed for prices, costs, events (such as new laws or regulations, entry of competitors, or the shortage of critical resources), or the advent of new technologies." [Krajewski & Ritzman, 1993]. Thereby, forecasting has a capability to be used almost in every steps of strategic and functional management. It has a substantial potential in terms of capabilities that it has. Being different from many other decision tools, its main capability lies in producing and providing information about the future, which most of the strategic decision processes are directly concerned with. Forecasting contributes significantly to building up a background and stand for strategic decisions. In this sense, forecasting is more like a collection of essential support procedures in the background, which feed the information required by strategic managers. However, due to variety of reasons, though it is applied widely in many developed countries, it is not explicitly expressed its importance, functionality, and the problem domains that it can be applied to. As there exist many academic journals, conferences, and institutions specific to forecasting, it is even rarely the case to see academic articles in most of the developing countries e.g. Turkey in spite of its potential.

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Endnotes

Forecasting methods can be classified in various ways: Statistical and judgemental or quantitative, which includes time series analysis and casual methods, and qualitative, which includes sales force estimates, executive judgement, market research, and the Delphi method.

Quantitative Methods

Casual methods use historical data on independent variables, such as promotional campaigns, economic conditions, and competitors' actions, to predict the future behaviour of forecast subject. These are the methods such as the linear regression, which explains the relationship between the dependent variable and other internal and external independent variables (factors).

Time series analysis is a statistical approach that mainly relies on historical time series data, which are the data observed in regular time intervals, to predict the future.

Qualitative Methods

Qualitative techniques mostly rely on managerial judgement and experience and other sort of qualitative information to generate forecasts. This sort of techniques translates managerial judgement, expert opinion, and survey results into quantitative estimates. Some of the qualitative techniques are sales force estimates, executive judgement, marketing research, and the Delphi technique.

Sales force estimates are a method of forecasting based on compilation of periodic personnel estimates of future demands by the members of sales force in a company.

Executive Judgement summarizes the opinions of a group of executives to obtain a single forecast. The opinions are mostly based on executives' experience with similar products or services.

Marketing Research can be expressed as a systematic approach to creating and testing hypotheses about the market. The analyses are based on data, which are usually gathered by survey methods. That is why it may sometimes be an expensive method and may lead to faulty and 'difficult to interpret' conclusions, especially if the sample is not the representative of the population.

Delphi Method is a process of obtaining agreement from a group of experts, which generally includes several steps (panels) of consensus search. It is useful especially when there are no historical data to develop statistical models and when judgement or opinion based on experience and study of the market, industry, or scientific developments are the only bases for making forecast. The Delphi method might also be useful for long-range forecasts of product demand, sales estimates of new products, and technological forecasting (e.g. estimating the future of intelligent manufacturing systems). Delphi method can be preferred in estimating the changes and directions in environmental and social forces such as quality of life, governmental regulations, and competitors' actions. The results of such a process can provide direction for a firm's R&D activities.

Equation of Motion in Appearance Potential Spectra of Simple Metals

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Abstract

The equation of motion is applied to the function $\Gamma_{k_1 k_2 k_3 k_4}$ which describes the propagation of two particles in the presence of a core hole. Neglecting final state interactions and assuming constant matrix elements, the X-ray yield and the associated appearance potential spectrum is found to depend on the convolution of the empty density of states above Fermi level of the metal.

Keywords: Potential spectra, potential spectrum, core hole, propagation.

Introduction

In addition to such well-established spectroscopies as XPS, UPS, ESCA, LEED and AES, new tools for both bulk and surface studies have emerged in recent years. Among these new techniques are “Soft X-ray Appearance Spectroscopy” (SXAPS or simple APS), Auger Electron Appearance Spectroscopy (AEAPS), Characteristic Isochromat Spectroscopy (CIS), and Ionization Spectroscopy (IS). These spectroscopies can be broadly divided into two groups, Riviere, (1973), namely:

- (a) Those which explore the filled bands below the Fermi level, i.e. filled band probes
- (b) Those which concentrate on the empty states above the Fermi level, i.e. empty and probes. APS, CIS and IS belong to the latter group Opara, (1995) and Omubo-Pepple and Opara, (2004).

In APS monoenergetic electrons from a thermionic emitter bombard the sample under investigation and the voltage between the emitter and the sample is varied. The incident electron energies range from a few eV to a few KeV and for such energies the mean free path for inelastic scattering is small; consequently, the method samples only a few layers from the surface, Park and Houston, (1972). At certain critical potentials a core electron is excited and the subsequent de-

excitation of the core hole leads to the emission of characteristic X-rays. The method is also convenient for surface composition studies.

The threshold for the excitation of a core electron is signaled by a sudden change in the bremsstrahlung background. The excitation edge is detected in the derivative of the photocurrent while the edge shape is related to the self-convolution of the empty density of states above the Fermi level, Park and Houston, (1992). Thus APS provides direct information on the binding energies of the core levels. Levels obtained by Park and Houston compare favourably with X-ray values given by Nearden and Burr (1967).

In this paper we derive the expression for the excitation probability of a core hole using the equation of motion method. Assuming constant matrix element and neglecting final state interactions, we find that the transition rate above the thresholds is given by the self-convolution of the empty density of states.

The Response Functions

The Coulomb interaction responsible for the core hole excitation is given by

$$H_1 = \sum_{k, k_1 k_2} M_{k_1 k_2}(K) a_{k_1}^+ a_{k_2}^+ a_k b \quad (1)$$

where a_k^+, b_k^+ are the creation operators of a conduction electron of energy ϵ_k and a core electron, respectively, while a_k annihilates an incident electron of energy ϵ_k . $M_{k_1 k_2}(K)$ is the matrix element describing the scattering process. The dynamics of the system is described by the Hamiltonian.

$$H = \sum_k \epsilon_k a_k^+ a_k + E_c b^+ b + \sum_{k', k''} V_{k' k''} a_{k'}^+ a_{k''} b b^+ \quad (2)$$

where $E_c (< 0)$ is the energy of the core level. The third term on the right of equation (2) represents final state interactions between the core hole and the conduction electrons. We take the view that the core hole presents a sudden potential to the system and that this potential is subsequently canceled when the core hole is filled with the concomitant emission of X-rays. Following Nozieres and de Dominicis, (1969), we assume that the core hole does not possess any dynamical degree of freedom, except to appear and disappear. The transition rate is proportional to the real part of the Fourier transform of the response function $S(t-t')$, where

$$S(t-t') = \langle \Psi_N | T \{ H_1(t) H_1(t') \} | \Psi_N \rangle \quad (3)$$

$|\Psi_N\rangle$ is the initial ground state wave-function of the N-particle system with the core hole filled.

We treat the incident electron K as an independent particle and the response function is then obtained as

$$S(t-t') = \sum_{\substack{k_1 k_2 \\ k_3 k_4}} M_{k_1 k_2}^*(K) M_{k_3 k_4}(K) x \quad (4)$$

$$x \langle \Psi_N | T \{ \bar{a}_{k_1}(t) \bar{a}_{k_2}(t) \bar{b}^+(t) \bar{b}(t') \bar{a}_{k_3}^+(t') \bar{a}_{k_4}^+(t') \} | \Psi_N \rangle$$

where the operators are in the Heisenberg representation for the full Hamiltonian of the solid.

Next we generate the equation of motion of the function $\Gamma_{k_1 k_2 k_3 k_4}$ Laramore, (1971), where

$$\Gamma_{k_1 k_2 k_3 k_4}(t_1, t_2, t_3, t_4; \tau_1, \tau_2) = \langle \Psi_N | T \{ \bar{a}_{k_1}(t_1) \bar{a}_{k_2}(t_2) \bar{a}_{k_3}^+(t_3) \bar{a}_{k_4}^+(t_4) \bar{b}^+(\tau_1) \bar{b}(\tau_2) \} | \Psi_N \rangle \quad (5)$$

Thus the equation of motion

$$i \frac{\partial}{\partial t} \Gamma = [H, \Gamma] \quad (6)$$

leads to the result

$$\begin{aligned}
i \frac{\partial}{\partial t} \Gamma_{k_1 k_2 k_3 k_4}(t_1, t_2, t_3, t_4; \tau_1, \tau_2) &= \varepsilon_k \Gamma_{k_1 k_2 k_3 k_4}(t_1, t_2, t_3, t_4; \tau_1, \tau_2) + \\
&+ i \delta(t_1 - t_4) \delta_{k_1 k_4} F_{k_2 k_3}(t_2, t_3; \tau_1, \tau_2) - i \delta(t_1 - t_3) \delta_{k_2 k_4} F_{k_4}(t_2, t_4; \tau_1, \tau_2) + \\
&+ \sum_{k''} V_{k_1 k''} \langle \Psi_N | T \{ \bar{a}_{k''}(t_1) \bar{b}(t_1) \bar{b}^+(t_1) \bar{a}_{k_3}(t_2) \bar{a}_{k_3}^+(t_3) \bar{a}_{k_4}^+(t_4) \bar{b}(\tau_1) \bar{b}^+(\tau_2) \} | \Psi_N \rangle
\end{aligned} \quad (7)$$

where

$$F_{k_2 k_4}(t_2, t_3; \tau_1, \tau_2) = \langle \Psi_N | T \{ \ddot{a}_{k_2}(t_2) \ddot{a}_{k_3}^+(t_3) \ddot{b}(\tau_1) \ddot{b}^+(\tau_2) \} | \Psi_N \rangle \quad (8)$$

Eq. (7) is rewritten as

$$\begin{aligned}
\left(\frac{\partial}{\partial t_1} + i \varepsilon_k \right) \Gamma_{k_1 k_2 k_3 k_4}(t_1, t_2, t_3, t_4; \tau_1, \tau_2) &= \delta(t_1 - t_4) \delta_{k_1 k_4} F_{k_2 k_3}(t_2, t_3; \tau_1, \tau_2) - \\
&- \delta(t_1 - t_3) \delta_{k_1 k_3} F_{k_2 k_4}(t_2, t_4; \tau_1, \tau_2) \\
&- \sum_{k''} V_{k_1 k''} \langle \Psi_N | T \{ a_{k''}(t_1) b^+(t_1) a_{k_2}(t_2) a_{k_3}^+(t_3) a_{k_4}^+(t_4) b(\tau_1) b^+(\tau_1) b^+(\tau_2) \} | \Psi_N \rangle
\end{aligned} \quad (9)$$

The last term on right of eq. (9) vanishes unless $\tau_2 < t_1 < \tau_1$, in which case $b(t_1) b^+(t_1) = 1$ Laramore, (1971). Eq. (9) then takes the closed form

$$\begin{aligned}
\left(\frac{\partial}{\partial t_1} + i \varepsilon_k \right) \Gamma_{k_1 k_2 k_3 k_4}(t_1, t_2, t_3, t_4; \tau_1, \tau_2) &= \delta(t_1 - t_4) \delta_{k_1 k_4} F_{k_2 k_3}(t_2, t_3; \tau_1, \tau_2) \\
&- \delta(t_1 - t_3) \delta_{k_1 k_3} F_{k_2 k_4}(t_2, t_4; \tau_1, \tau_2) \\
&- i \sum_{k''} V_{k_1 k''} \Gamma_{k'' k_2 k_4}(t_1, t_2, t_3, t_4; \tau_1, \tau_2)
\end{aligned} \quad (10)$$

We next set up the equation of motion for the function F and obtain

$$\begin{aligned}
\left(\frac{\partial}{\partial t_1} + i \varepsilon_k \right) F_{k_1 k_2}(t_1, t_2; \tau_1, \tau_2) &= \delta(t_1 - T - 2) \delta_{k_1 k_2} g(\tau_1, \tau_2) - \\
&- i \sum_{k''} V_{k_1 k''} F_{k'' k_2}(t_1, t_2; \tau_1, \tau_2)
\end{aligned} \quad (11)$$

with

$$g(\tau_1, \tau_2) = \langle \Psi_N | T \{ b(\tau_1) b^+(\tau_2) \} | \Psi_N \rangle \quad (12)$$

Finally, the equation of motion for $g(\tau_1, \tau_2)$ yields

$$\left(\frac{\partial}{\partial t_1} + i E_\varepsilon \right) g(\tau_1, \tau_2) = \delta(\tau_1, \tau_2) - i \sum_{k_1 k''} V_{k_1 k''} F_{k'' k_1}(\tau_1, \tau_1 + \tau_1, \tau_2) \quad (13)$$

Eqs. (10), (11) and (13) will determine the response function for our model. These equations take on a rather simple form if final state interactions are neglected. We then find

$$\begin{aligned}
\Gamma_{k_1 k_2 k_3 k_4}(t_1, t_2, t_3, t_4; \tau_1, \tau_2) &= G_{k_1 k_4}(t_1 - t_4) F_{k_2 k_3}(t_2, t_3; \tau_1, \tau_2) - \\
&- G_{k_1 k_3}(t_1 - t_3) F_{k_2 k_4}(t_2, t_4; \tau_1, \tau_2)
\end{aligned} \quad (14)$$

$$F_{k_1 k_2}(t_2, t_4; \tau_1, \tau_2) = G_{k_1 k_2}(t_1 - t_2)(\tau_1, \tau_2) \quad (15)$$

$$g(\tau_1, \tau_2) = \theta(\tau_1, \tau_2) e^{-i E_c(\tau_1, \tau_2)} \quad (16)$$

In these equations we have converted the differential equations (10), (11), (13) into the integral forms, and have put

$$G_{k_1 k_2}(t_1 - t_2) = \theta(t_1 - t_2) \delta_{k_1 k_2} e^{-i \varepsilon_{k_1}(t_1 - t_2)} \quad (17)$$

where $G_{k_1 k_2}$ is the one-electron Green's function, while $g(\tau)$ is the core-hole Green's function. We may then interpret $\Gamma_{k_1 k_2 k_3 k_4}$ as two-particle propagator in the presence of a core-hole. The second term

on the right of equation (14) then corresponds to the inclusion of exchange of the two conduction electrons. If this exchange is neglected, we obtain

$$\Gamma_{k_1 k_2 k_3 k_4}(t) = \theta(t) e^{-iE_c t} G_{k_1 k_4}(t) G_{k_2 k_3}(t) \quad (18)$$

Correspondingly, the response function becomes

$$S(t) = \theta(t) |M|^2 e^{-iE_c t} \sum_{\substack{k_1 k_2 > k_F \\ k_3, k_4 > k_F}} M^*_{k_1 k_2}(K) G_{k_1 k_4}(t) G_{k_2 k_3}(t) \quad (19)$$

Taking the matrix elements to be constant, we get

$$S(t) = \theta(t) |M|^2 e^{-iE_c t} \sum_{\substack{k_1 k_2 > k_F \\ k_3, k_4 > k_F}} G_{k_1 k_4}(t) G_{k_2 k_3}(t) \quad (20)$$

If we substitute

$$G_{k_1 k_4}(t) = \theta(t) \delta_{k_1 k} e^{-\varepsilon_{k_1} t} \quad (21)$$

we obtain

$$S(t) = \theta(t) |M|^2 e^{-iE_c t} \sum_{k_1 k_2 > k_F} e^{-i(\varepsilon_{k_1} + \varepsilon_{k_2} t)} \quad (22)$$

The k -summation is performed by means of the transformation

$$\frac{1}{\Omega} \sum_k f_k \rightarrow \int N(\varepsilon) f(\varepsilon) d\varepsilon \quad (23)$$

where Ω is the normalization volume which is taken to be unity and $N(\varepsilon)$ is the density of states at energy ε . The use of (23) then leads to

$$S(t) = \theta(t) |M|^2 e^{-iE_c t} \int_{\varepsilon_1 > \varepsilon_F} d\varepsilon_1 \int_{\varepsilon_1 > \varepsilon_F} d\varepsilon_2 N(\varepsilon_1) N(\varepsilon_2) e^{i(\varepsilon_1 + \varepsilon_2)t} \quad (24)$$

Transition Probability and X-ray Yield

We take real part of the Fourier transform of (24) to obtain transition probability per unit time $P(E)$:

$$\begin{aligned} P(E) |M|^2 \text{Re} \int_{\varepsilon_1 > \varepsilon_F} d\varepsilon_1 \int_{\varepsilon_1 > \varepsilon_F} d\varepsilon_2 N(\varepsilon_1) N(\varepsilon_2) \int_{-\infty}^{\infty} dt \theta(t) e^{i(E - E_c - \varepsilon_1 - \varepsilon_2)t} \\ = |M|^2 \int_{\varepsilon_1 > \varepsilon_F} d\varepsilon_1 \int_{\varepsilon_1 > \varepsilon_F} d\varepsilon_2 N(\varepsilon_1) N(\varepsilon_2) \lim_{\delta \rightarrow 0} \text{Re} \int_0^{\infty} dt e^{i(E - E_c - \varepsilon_1 - \varepsilon_2 + i\delta)t} \\ = |M|^2 \int_{\varepsilon_1 > \varepsilon_F} d\varepsilon_1 \int_{\varepsilon_1 > \varepsilon_F} d\varepsilon_2 N(\varepsilon_1) N(\varepsilon_2) \pi \delta(E - E_c - \varepsilon_1 - \varepsilon_2) \\ = \pi |M|^2 \int_{\varepsilon > \varepsilon_f} d\varepsilon_1 N(\varepsilon) N(E - E_c - \varepsilon) \end{aligned} \quad (25)$$

The limits of the ε -integration are $\varepsilon = 0$ at the Fermi level and $\varepsilon = E - E_c$ which is the difference between the energy of the incident electron E and the core-level binding energy E_c .

The X-ray yield is proportional to $P(E)$ and so we obtain

$$Y(E) \propto \int_0^{E - E_c} d\varepsilon N(\varepsilon) N(E - E_c - \varepsilon) \quad (26)$$

where $Y(E)$ represents the X-ray yield

The Appearance Potential Spectrum consists of the derivation of the X-ray yield with respect to the incident electron energy. So from (26) we get

$$A(E) \propto \frac{d}{dE} \int_0^{E - E_c} d\varepsilon N(\varepsilon) N(E - E_c - \varepsilon) \quad (27)$$

i.e. the yield is a self-convolution of empty states above type Fermi level.

Conclusion

We have applied the equation of motion method to derive the often-quoted formula for the Appearance Potential Spectrum of simple metals. We observe that the self convolution formula (27) has been obtained under the assumption of a constant matrix element and the neglect of final state interactions. The result gives a good fit to experimental data on the 3-d transition series where the core-hole seems to be well screened. The formula, however, fails to explain the Appearance Potential Spectra of the Lanthanides where the excited electron is conjectured to remain bound to the excited atomic or ionic site.

However, we remark that the core-hole excitation considered in this paper must be regarded as an intermediate state in the entire APS process.

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