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মার্চ ২০০৫/ফাল্গুন ১৪১১

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সূচিপত্র

Recruitment & Selection: 'Psychometric' and 'Social Perspective' Model <i>Mohammad Rezaul Karim</i>	১
Hydrogeological Study for the Determination of Groundwater Potentiality A Case Study in Netrokona Sadar Upazila <i>Kazi Kamrul Ahsan</i> <i>Md. Musaraf Husain Molla</i> <i>A.F.M. Amir Hussain</i>	১৩
Human Training and Neural Networks Concept Learning <i>Dr. Mohammad Liakot Ali</i> <i>Md. Farid Hasan</i>	২৯
Problems and Prospects of Optimum Currency Area in Asia <i>Mohammad Moniruzzaman</i>	৫৫
Designing Pro-Poor Service Delivery Strategy at the Grass-roots Level A Case Study <i>Syed Shamsul Alam</i> <i>S M Zobayer Enamul Karim</i>	৬৭
Learning, Training and Development Intervention for Adult: An Overview <i>Md. Abul Basher</i>	৯৫

Recruitment & Selection: 'Psychometric' and 'Social Perspective' Model

Mohammad Rezaul Karim*

Abstract: To meet the global competition and changing nature of customer needs, human elements are important where recruitment and selection (R & S) is the first step of human resource management in the organization. It is no longer sufficient to be effective in selling a product or service on the reputation of the organization where competent and skilled workforce is urgent to recruit. In order to recruit and select human potentials from the possible source, some models are practised at the organization level. Though psychometric model is traditional one, it is widely used either in public or private institutions; and social perspective or exchange model is being taken into consideration as best practice in HRM. To overcome the limitations of psychometric model of R & S, academics and practitioners emphasize on social perspective model to recruit and select best suited persons for the organization. This article aims at discussing the importance of two models in R & S and providing a comparative analysis so that any recruiting agency can adopt a strategy combining the both model which can be conducive to the organization to recruit potential human resources.

1.0 Introduction

The intensity of global competition and the changing nature of customer needs mean that to deepen organisational growth, a mere reliance on effective selling of a product or service would be inadequate (Newell 2005). What this implies is that corporate growth is contingent on attracting and retaining people who can contribute meaningfully to organisational success. Employing competent individuals requires setting up effective recruitment and selection procedures designed to 'select the right individuals and reject the wrong ones' (Newell 2005). Poor selection decisions can be quite expensive in terms of time and cost involved in retraining poor performers, dealing with disciplinary cases and replacing wrongly selected individuals who leave shortly after resuming (Marchington & Wilkinson 2000). The psychometric model, with its 'person-job fit' approach, has been used by selectors and reinforces the 'good practice model of recruitment and selection' (Newell 2005:116). This paper critically examines the psychometric model's contribution to our understanding of recruitment and selection. It also investigates how the 'social perspective' has broadened the understanding of the realities of recruitment and selection methods.

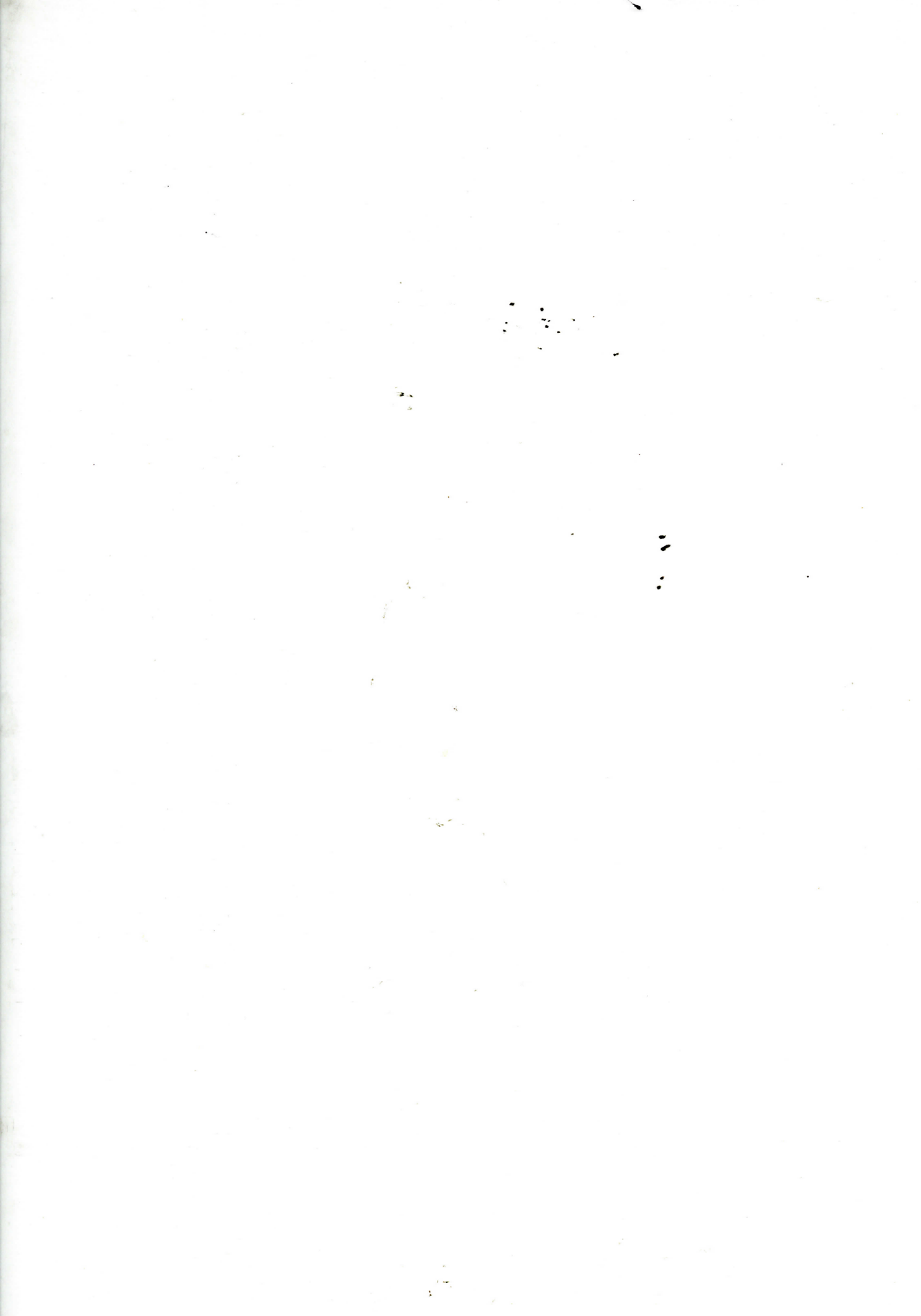
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2.0 Recruitment and Selection

Watson defines recruitment and selection as 'the processes by which organisations solicit, contact and interest potential appointees, and then establish whether it would be appropriate to appoint any of them (Watson, 1994:185). Traditionally, recruitment and selection has its roots in the psychometric model where the organisation attempts to correctly match an individual to a particular job (Newell, 2005). The recruitment and selection process constitutes a core activity within human resource management (HRM), and with the incorporation of the management of human resources into organisational strategy, it has since acquired a strategic intent (Millmore 2003). Strategic HRM is therefore concerned with acquiring, deploying and allocating human resources in a manner that gives the organisation a competitive edge (Wolf and Jenkins 2006). To deepen the understanding of this process, it is important to examine what the terms 'recruitment' and 'selection' really mean from the HRM perspective.

2.1 The Recruitment Process

Recruitment refers to the process of attracting individuals who are likely to have the attributes required to fill a specific role or job (Newell 2005). The recruitment process is usually triggered by retirement, promotion, resignation, transfer and dismissal or technological or product market changes (Watson 1994). The first stage in the recruitment process is the job analysis, which is a process that describes a 'job's content and complexity in such a way that the information can subsequently be used to define the required knowledge, skills and abilities, and other characteristics needed by applicants' (Wilk and Cappelli 2003:105). Marchington and Wilkinson identify observation, work diaries, questionnaires and interviews as the four techniques to use for analysing jobs but also state a lot depends on the cooperation of the job holders and the context within which the analysis occurs. A job analysis is important because the information generated from the activity forms the basis of the job description and the person specification (Taylor 2000). The second stage involves the development of a job description. This outlines the 'purpose of the job, the tasks, duties and responsibilities assigned to the job, expected performance standards, remuneration and reporting relationships (Newell 2005). The third stage is to do a person specification which incorporates the human attributes necessary to carry



out the job (Marchington and Wilkinson 2000). Rodger's seven-point plan' and Munro-Fraser's fivefold grading system comprising impact on others, acquired qualifications, innate abilities, motivation and emotional adjustment are two main tools used in defining person specifications (Taylor 2000). However, because both frameworks are heavily dependent on 'personal judgement to determine what human qualities are associated with successful performance', a competency-based recruitment approach, emphasising job competencies rather than personal qualities is becoming quite prominent (Newell 2005). Attracting individuals who meet the requirements of the job specification is the next stage. Critical issues to consider include whether to recruit internally or externally, and the methods to adopt in attracting the right people. Sources of external applicants include employee referrals, employment agencies, 'walk-ins' and educational institutions while methods of attracting a suitable pool of applicants include advertising, corporate websites and employment agencies and job centres (Newell 2005).

2.2 The Selection Process

The selection process involves measuring differences between the candidates who have been attracted 'to find the person who has the profile which best matches the person specification as indicated by the job profile or description' (Newell 2005). Not only is selection a decision-making process, it is also a process of reciprocity between the employer and the candidate (Watson 1994). While it is the employer who offers employment to a candidate, the selection process is only concluded when that individual accepts the offer and reports for duty (Marchington and Wilkinson 2000). Since the selection process entails collecting and ordering data and opinions from which decisions are made (Watson 1994), it is therefore important that employers choose appropriate methods in selecting candidates ((Marchington and Wilkinson 2000). The interview is the most popular method used to make selection decisions, although other methods are being applied to enhance the efficiency of the process (Newell 2005). The chosen methods are often determined by 'the employers' view of what is required to provide a satisfactory basis for decision-making and awareness of the appropriateness of particular techniques to provide what is sought' (Watson 2000:204). Marchington

-
1. Physical make-up: no specific requirement; 2. Attainments: good academic qualification and some experience; 3. General intelligent: good intelligence; 4. Special attitudes: high verbal ability; 5. Interest: extra curriculum activities; 6. Disposition: dependable and sociable to the staff and incumbents & 7. Circumstances: must be prepared to do something anytime if needed.

and Wilkinson (2000) however argue that no matter how efficiently designed or administered, none of the methods can generate perfect selection decisions that predict with accuracy who will and will not perform effectively in a given role. In assessing the effectiveness of each method, Marchington and Wilkinson outline four major criteria. They are practicability, sensitivity, reliability and validity. There are various selection methods. The most notable are interviews, assessment centres and psychometric testing. Newell writes that the interview technique remains the most widely used. Assessment centres are also used as selection methods. For better understanding a brief description is stated herein below.

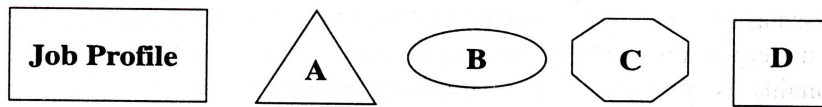
2.3 Assessment Centres

An assessment centre 'is not a single selection method, nor is it a place' but refers 'to the utilization of a number of different selection methods over a specified period' to enable 'multiple assessors to assess many candidates on a range of identified competences or behavioural dimensions (2005:136). Assessment centres are incorporated with a variety of methods including interviews, psychological tests, and core element is simulation of actual job tasks to observe job related behaviours (Cooper and Robertson, 1995). It is typically 1-4 days duration assessment. Here in-tray exercise and group decision making are common for managerial job. There are so much information and problems given in the tray where candidates have to take decision. Observers and interviewers are assigned to observe and mark on their ability of taking decision, personal interaction, stressfulness they feel, leadership quality etc. Even participants are also provided lunch, dinner, snacks with tea-coffee, while they are taking these they are being assessed. Formalities, style of having, introducing, gossiping, habit of dinning, sharing tendency etc are evaluated. Finally marks given by assessors are accumulated and decision is taken who will be selected. This process is very effective to select 'the right person for the right position'. This is now popularly used in developed countries including the UK. However it is very difficult to design and develop the whole system as this process involves huge tasks, materials and time as well.

3.0 The Psychometric Model

Recruitment and Selection is the prediction of future behaviour of candidates so that they can be most suitable for the organisation. Traditionally R & S is viewed as the process by which organisation tries

to match the individual accurately to the job that can be compared to completing a jigsaw puzzle. R & S is the process of selecting the correct piece of jigsaw (the right person) from the incorrect pieces (the wrong individuals) to fit into the particular hole in the jigsaw puzzle. In the figure D would be the best candidate for the job. So s/he will be chosen.



Candidates' Profiles

This referred to psychometric model. This approach has become quite popular, particularly in the UK, and it is regarded as crucially relevant in the quest to enhance the objectivity of the selection process (Newell 2005). In the psychometric paradigm, 'performance criteria are selected and individual attributes of various kinds (knowledge, skills, abilities, etc.) are chosen as predictors of job performance' (Iles 2001). The selected attributes are measured using a variety of procedures such as tests, interviews, and biodata while the process is then validated based on criterion-related predictive validity, which basically defines the efficiency of the predictor in predicting job performance (Iles, 2001). Ramsay and Scholarios (1999) write that three assumptions underpin the psychometric model: firstly, that 'good' or 'poor' performance in most jobs can be measured in terms of 'relatively stable, observable behaviours and static job demands'; secondly, that individual differences in human abilities are responsible for differences in job performance; and thirdly, that effective selection decisions are determined by 'efficient processing of information within organisations about job-related human capacities. These assumptions shape selection research. The model basically involves two types of testing: personality tests and cognitive or ability tests (Newell 2005). Rigorous procedures aimed at ensuring objectivity and reliability in psychometric tests have been developed to enable inferences proving the measures for predicting specific job behaviours are valid (Ramsay and Scholarios, 1999).

Cognitive or ability testing is becoming widely used and is far less controversial than the high-validity selection methods (Taylor 1998). Using meta-analysis, researchers have demonstrated that cognitive tests are 'valid predictors in a wide range of job situations' and that general intelligence predicts 'some of the performance variation in most job situations' (Newell 2005:134). Cognitive tests are superior to other selection methods and its utility across a range of job types, once

established as a valid measurement tool, is its major advantage (Taylor, 1998). Newell however states that for 'most jobs the range of intelligence of those applying for the job is likely to be restricted and that 'cognitive tests can be biased against certain groups' (Newell 2005:134).

The use of tests that purportedly measure personality in the selection process has been very controversial (Taylor 1998). The basic assumptions that underpin the validity of personality testing are that: human personality is measurable; the underlying human personality is stable over time and across different situations; individual jobs can be analysed based on the personality traits that would be preferable for the job to have; a personality questionnaire offers adequate information about an individual's personality (Taylor 1998:150). Newell argues that although research has shown that personality measurement can be useful 'when specific personality constructs are linked to specific job competencies' it is doubtful that personality tests alone will be 'good predictors of future job behaviour' because job situations can create situational pressures capable of minimising the variations in individuals' behaviours (2005:135).

The 'traditional' approach to organisational recruitment and selection is rooted in the psychometric model where effort is aimed at defining the kind of individual who will perform a specific job effectively and 'assessing applicants against defined personal attributes in order to establish a person/job fit' (Millmore 2003:87). Still on the issue of the traditional approach to recruitment and selection, Newell notes that the objective is to use selection methods with 'sound psychometric properties of validity and reliability' to predict 'good employees from bad employees' (2005:116). This psychometric approach of fitting the individual to a particular job has been the most influential position in practice and 'underpins the good practice model of recruitment and selection' (Newell 2005:116). The psychometric positions that individual attributes can predict individual performance, that attainment of corporate goals constitute performance criteria and the cost-effectiveness of using different selection procedures, are areas the model has influenced recruitment and selection (Iles 2001).

The integration of HRM into business strategy has led to the management of employee relations by HR professionals who have boosted the use of psychometric tests (Wolf and Jenkins, 2006). In three-quarters of the private sector organisations sampled by Wolf and Jenkins (2006), the HR professionals testified that psychometric test use was promoted to 'tighten

up the recruitment process and make procedures and criteria fit clear job and person specifications. With HRM integrated into organisational strategy, recruitment and selection, its core activity, also has to be strategically driven (Millmore 2003). The paradigm's postulation that individual differences in performance contribute to organisational differences has underpinned the development of HRM (Iles 2001). Using the psychometric model, organisations are able to do a proper person and job specifications which will guide them in their selection decisions while the test use will help to measure the individual attributes of applicants against those job/person specifications. Organisations keen on enhancing their overall performance will find the psychometric model useful in realising this corporate goal.

Extensive psychometric research has also formalised and professionalised selection practice in favour of procedures which promote 'objective and fair selection decision-making' (Ramsay and Scholarios, 1999:66). Based on their research findings, Wolf and Jenkins (2006) note that the use of the psychometric model has enabled organisation cope effectively with the changing legal and regulatory environment. Strict state regulations have encouraged organisations to use psychometric tests because of the need to defend their selection decisions as fair and objective in case they are challenged in a court or tribunal (Wolf and Jenkins 2006). The increased use of this method, according to Wolf and Jenkins, is as a result of 'the need for recruitment and selection procedures to be demonstrably relevant and demonstrably valid and reliable' and the model provides 'a powerful evidence for the presence of properly thought out and objective procedures' (2006:2002).

3.1 Critique of the Psychometric Model

The challenges of globalisation and the need for greater flexibility and innovation make the psychometric model's 'best practices' difficult for organisations to adopt (Newell 2005). The changing global economy requires employees to be generalists, capable of handling different roles needing a range of skills and competences and that where persons are recruited for a specific job, the job is likely to change (Newell 2005). This therefore questions the appropriateness of doing a job analysis to define the task and person requirements of a particular job. The model also stifles innovation since individuals have been selected based on whether they can do specific jobs efficiently and fit the corporate culture, and not necessarily whether they have the capacity to challenge the status quo as well as think and act differently (Newell 2005).

The political and legal implications of the psychometric model of assessment have questioned the 'fairness and validity of assessment and selection procedures' (Iles 2001:154). Some American court cases and tribunal court cases in the UK have ruled against companies because psychometric tests conducted discriminated against minorities (Wolf and Jenkins 2006). Newell (2005) blames the resulting discrimination on the model's 'one best way' assumption. Besides, cross-national differences make it difficult for organisations to replicate their home-base policies abroad as individuals from different nationalities may respond differently to psychometric tests (Newell 2005).

As organisations are often confronted with the need to change, decentralise or restructure, 'the conception of the job as a stable collection of discrete tasks has come under pressure' (Iles 2001:153). Iles argues that developments such as 'multiskilling, flexible specialisation, and self-directed work teams' have redefined the notion of a 'job' while 'career portfolios' have added new meanings to career development concepts. Newell (2005) also maintains that by presenting a static job profile, the paradigm emphasises personal attributes influencing job performance and de-emphasises the role as well as situational pressures thereby failing to capture change levels within organisations and situational influences on individuals. Selection is now represented as a 'process of exchange or negotiation' between the organisation and the potential employees. Service jobs such as call centre jobs where recruitment is based on personality and workers are required to perform according to predefined instructions give little opportunity for negotiation as the result is that the rigidity of the job creates high labour turnover (Newell 2005).

4.0 Recruitment and Selection from the Social Perspective

The recruitment and selection process is described as a 'socially constructed phenomenon, formed and sustained within a social context and impacting individual and organisational levels of functioning' (Ramsay and Scholarios 1999:76). From the social perspective, the selection process must be seen as a series of episodes within a social process involving and characterised by a mutual exchange of information between the organisation and the potential employees (Herriot 1984). Newell (2005) provides an outline of recruitment and selection from the social perspective. It starts with the organisation communicating its expectations of the kind of individual they would like to recruit and the type of job and work environment in which they will work. The information conveyed to potential applicants must contain both the

positive and negative aspects of the job and organisation. Having understood this information, potential recruits can then compare these details with their own personal expectations and goals, making it easier for them to decide whether or not to apply for the job. Herriot (1984) states that this process continues with the applicants communicating their readiness to enter into negotiations, and the organisation compares the applicants' self-presentation with its own expectations and decides whether or not to continue with the process. The interview stage is also an extension of the exchange process and both parties negotiate with each party possibly 'willing to adapt expectations in the light of similar concessions by the other' (Herriot 1984:56). The two parties should have adequate information about the assessment process and must be 'perceived as transparent' by 'providing candidates with honest and detailed feedback about their performance in the assessment process (Ramsay and Scholarios 1999:76).

The social perspective approach is different from the traditional mode of recruitment and selection where an exaggerated image of the organisation and possible career opportunities are presented to potential applicants (Newell 2005). As a result of this glossy portrayal of job opportunities by organisations, prospective applicants find it difficult to distinguish between organisations or determine 'suitable and unsuitable prospective employers' (Newell 2005:140). While the justification for this approach is the need to attract the best candidates ahead of competition, a major consequence is that new employees' expectations are not likely to correspond with the reality of the work environment and this may create a high turnover level. The traditional approach sees recruitment and selection as a one-way process of decision making, without a mutual giving and receiving of information between the organisation and the candidate (Newell 2005). However, the exchange approach requires the recruitment and selection process to be a platform for 'genuine exchange of valid and reliable information between both parties' with the aim of establishing 'whether there is a fit between the two sets of expectations' (Newell 2005:141). In the social exchange approach, both parties must have some control or involvement in the social episodes (Ramsay and Scholarios 1999:76). The social process therefore is a two-way process in which the organisation has to adapt its expectation in line with the individual's personal experience (Herriot 1984). Recruitment is not aimed at attracting 'a maximum number of good quality candidates' but intended to 'attract candidates most suited to the job and organisation' (Newell 2005:141).

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Iles (2001) states that the social perspective assumes that people undergo changes in the course of their careers in organisations, that subjective individual views influenced by assessment and selection procedures are important to motivation and performance. Selecting employees with the requisite competences actually marks the beginning and not the end of the process and subsequent interactions between the employee and the organisation, including the opportunities made available, will impact on commitment and turnover (Newell 2005). Iles (2001) argues that the accent on 'negotiation, interaction and mutual influence' is perhaps the reason behind the continued use of the interview, which creates room for mutual negotiation and decision making, by organisations in Europe. By locating recruitment and selection within a social context and identifying the influence of situational factors on the parties involved, the social perspective succeeds in deepening our understanding of the realities of the selection process.

5.0 Conclusion

With the addition of HRM into organisational strategy, more attention is now given to recruitment and selection and it is not surprising that it is now strategically oriented. Critical evaluation of the validity, reliability and utility of the various selection methods in choosing the best candidates for a position has been done within the realm of psychology (Wolf and Jenkins 2006). The psychometric approach, with its assessment of candidates against defined attributes to establish a person/job fit has greatly influenced traditional approach to recruitment and selection and remains dominant (Millmore 2003). However, its obvious weaknesses, especially in the light of globalisation and increased need for change, innovation and job flexibility, have led to recruitment and selection being seen in the light of a social perspective in which selection becomes a 'process of bilateral negotiations, rather than a one-sided process within the organisation alone' (Ramsay and Scholarios 1999:75). The social perspective identifies the social dimension of recruitment and selection, highlights the situational factors underpinning the process and declares that the socialisation process continues even after the individual has joined the organisation. While the social approach will help in recruiting individuals who can give a long-term commitment (Newell 2005), the opportunistic tendencies of organisations, including the fact that they have to recruit from a highly competitive graduate market might make it appear unattractive.

References

- Cooper, D. and Robertson, I. T. (1995) *The Psychology of Personnel Selection*, London: Routledge.
- Herriot, P. (1984) *Down from the Ivory Tower: Graduates and their Jobs*, John Wiley & Sons Ltd.
- Iles, P. (2001) 'Employee Resourcing', in Storey, J. (ed.) *Human Resource Management*, Thomson Learning.
- Marchington, M. and Wilkinson, A. (2000) 'Core Personnel and Development', CIPD (Chartered Institute of Personnel and Development), London.
- Millmore, M. (2003) 'Just How Extensive Is the Practice of Strategic Recruitment and Selection?', *Irish Journal of Management*, 24 (1) pp. 87 - 108.
- Newell, S. (2005) 'Recruitment and Selection', in Bach, S. (ed.) *Managing Human Resources: Personnel Management in Transition*, Oxford: Blackwell Publishing.
- Ramsay, H. and Scholarios, D. (1999) 'Selective Decisions: Challenging Orthodox Analyses of the Hiring Process', *International Journal of Management Reviews*, 1 (1), pp. 63 - 89.
- Taylor, S. (1998) *Employee Resourcing*, London: CIPD.
- Watson, T. (1994) 'Recruitment and Selection', in Sisson, K. (ed.) *Personnel Management: A Comprehensive Guide to Theory & Practice in Britain*, Blackwell Business.
- Wilk, S. and Cappelli P. (2003) 'Understanding the Determinants of Employer Use of Selection Methods', *Personnel Psychology*, 56 (1) pp. 103 - 124.
- Wolf, A. and Jenkins A. (2006) 'Explaining Greater Test Use for Selection: The Role of HR Professionals in a World of Expanding Regulation', *Human Resource Management Journal*, 16 (2) pp. 193 - 213.

Hydrogeological Study for the Determination of Groundwater Potentiality : A Case Study in Netrokona Sadar Upazila

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A.F.M. Amir Hussain***

Abstract: Bore log data of 52 deep tube-wells installed in Netrokona Sadar Upazila were interpreted to obtain a clear picture of hydro geological properties of northeastern region of Bangladesh for real assessment of groundwater resource and its optimum utilization. The main aquifer or exploitable aquifer thickness varied from 19.22 meter to 71.37 meter having thickness of 39.65 meter. The main aquifer is found to be well productive and potential for water abstraction. The coefficient of transmissibility (T) and coefficient of storage (S) were determined from pumping test data by using Jacob's time-drawdown Method and Theis Recovery Method. Transmissibility varied from 1043 to 2939 m²/day and coefficient of storage varied from 0.00006 to 0.0097. The average specific yield value has been estimated as 8 by using USGS Hydrologic Lab-provisional values. The aquifer may be categorized as confined. The hydraulic properties ranked the aquifer highly potential for groundwater exploitation.

Introduction

Water is the most indispensable commodity for the sustenance and well-being of mankind. Modern civilization imposes heavy demands on water. The largest available source of fresh water lies under ground. Groundwater now-a-days, is considered as one of the important resources to form a significant component in the agriculture development programme. It also plays vital role for domestic, industrial and municipal purposes. In Bangladesh average rainfall is very high but it does not occur uniformly in all seasons rather skewed to high monsoonal character. Therefore groundwater becomes a vital resource for irrigation during half of the year i.e. dry months. The development of groundwater resources plays a very important role in increasing agricultural production to meet the increasing food demand of the country. The surface water is still now unable to meet the irrigation demand. Most of the surface water bodies dry up in irrigation season. Moreover, river flows of the country are gradually decreasing in the dry season due to gradual withdrawal of

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water in the upstream rivers by the neighbouring country. Therefore, utilization of ground water is increasing day by day at an accelerated rate. But this resource is not unlimited. Unplanned withdrawal may lead to a dangerous imbalance in the local geology. So proper management of this resource is a crying need of the country. The future strategies for the management of this renewable resource and its judicious utilization completely depend on the basis of extensive studies on groundwater reserve. The groundwater reserve depends on the various factors governing the availability and dependability of the resource among which the lithological and hydraulic characteristics of the aquifer are two very important factors. Many investigations were carried out in the past related to aquifer lithology and hydraulic properties. Most of the works are confined to northwest region of the country. A very little work has so far been done on the northeastern region. Therefore for assisting in planning and developing ground water resource in the northeastern region by providing reliable and complete database, an intensive study and critical analysis of data must be required. With a view to this, a study was undertaken in Netrokona sadar upazila to determine the lithological characteristics and hydraulic behaviour of the study aquifer.

Review of Literature

a) Lithology: The country is mostly covered by unconsolidated to poorly consolidated sediments deposited by the rivers passing through which were thick over most areas and form good water bearing formations (Curry and Moore, 1971). Most parts of the country are covered by the recent alluvial deposits. Their characters changed laterally and with depth owing to the frequently shifting and meandering of the streams and reworking of the sediments during the depositional history. The thickness varied from a few hundred to more than thousand metres. Over much of the area, silts and clays predominate on the top 15 to 25 metres, whereas sands are the major constituents in the deeper part. Gravels are found in some locations also. (Morgan and McIntire, 1959). On the basis of the hydro-geologic study of UNDP/BWDB (1982) and MPO (1995) it was identified that the aquifer system throughout the country is generally made up of the upper clay and silt layer (about 20 m thick), composite aquifer (varies from about 3 to 60 m) main aquifer (extends from a depth of 150 to about 300 m) and deep aquifer (300 to 1000 m).

In Muktagacha Upazila of Mymensingh district, a hard clay layer of 20 m thickness existed above a 5 to 10 m thick fine sand layer. Below the hard

clay layer the formation was layered with fine, medium, coarse sands and gravels up to 100 m from the surface (Ahmed et al, 1991). Semi confined nature of the aquifer was reported. Since most of the deep tube-wells were installed within this (100m) depth, information beyond this was not known.

Mojid (1993) reported that the sub-surface lithology of Trishal upazila was represented by the upper part of the formation consisted in mainly of clay, silty clay and fine sand layers while the lower part constituted the water bearing formation was formed with medium coarse sand, coarse sand and also their mixtures. A thick hard clay layer of thickness ranging from 18 to 150 m existed over the main aquifer. The aquifer was semi-confined in nature.

It was reported that surface clays arranged 10m in thickness in southern part of Mymensingh district but increased rapidly to over 30m in the north. This was accompanied by a reduction in thickness of aquifer materials within the top 100 m, as extensive aquiclude clays existed from 20 to 50 m and 96 to 76 (McDonalds and partners limited, 1983)

In Netrokona sadar upazila, the depth to top of the main aquifer was 40 m to 50 m thickness of aquitards above the main aquifer was 20m to 30m (Mott McDonald, 1992).

Hydraulic properties of the aquifer

Bhuiyan et al., (1977) evaluated the aquifer's hydraulic properties of Mymensingh -Tangail area. It was found that the transmissivity varied from 1409.00 to 1681.81 m²/day for Dewanpur, 1312.27 to 2090.90 m²/day for Lucia (Nagbari), 1327.27 to 1681.81m²/day for Jamalpur and 1327.27 to 1927.27 m²/day for Modhupur; while the storativity varied from 0.0434 to 0.0556 for Dewanpur, 0.0110 to 0.0175 for Lucia, 0.013 to 0.0445 for Jamalpur and 0.0710 to 0.0250 for Modhupur.

The transmissivity varied from 1250.00 to 4440.90 m²/day in Jamalpur district (Chowdhury, 1978). Ali (1978) observed the transmissivity value of 148.81 to 1954.54 m²/day for Muktagacha, 1009.09 to 1863.63 m²/day for sadar upazila of Mymensingh.

The average value of storativity, transmissivity and permeability of Muktagacha aquifer were found as 0.0069, 1764d m²/ay and 30.4m/day respectively (Ahmed et al., 1991). They also ranked the aquifer to be good and potential.

Khan (1989) found a range of transmissivity of 3128 to 5970 m²/day, and storage coefficient of 0.0007 to 0.0356 for Tangail sadar upazila.

Hyde (1979) reported that storage coefficient for Bangladesh was between 0.10 and 0.15. For entire Bangladesh, UNDP (1982) reported that transmissivity between 100 and 7020 m²/day and storativity values between 0.0003 and 0.0072 respectively.

Mott McDonald (1992) reported that permeability of the main aquifers for Netrokona Sadar upazilla was 60 to 70m/day and specific yield at 10m was 5 to 6%.

From the review of the past literature it is revealed that a very few research has so far been conducted in the study area to determine the lithological and hydraulic properties. The present study will fulfill the gap.

The main objective of the present study is to evaluate the hydro-geologic properties of Netrokona aquifer and the potentiality of the ground water abstraction. The specific objectives are as follows:

- 1) To determine the aquifer (water bearing formation) on the basis of subsurface lithology i.e. thickness of the different aquifer.
- 2) To estimate the hydraulic and hydrogeological properties of the aquifer e.g.
 - a) Specific yield.
 - b) Transmissibility.
 - c) Storage coefficient.
 - d) Specific drawdown.
 - e) Specific capacity.

Methodology

1) Lithological Data Analysis

Borelogs of 52 deep tube-wells have been collected from Bangladesh Agricultural Development Corporation (BADC), Netrokona region. These were prepared by BADC during construction of the tube-wells. Vertical cross sections of subsurface lithology have been divided into four zones depending on the lithological constituents and the aquifer. By lithological analysis specific yield of the aquifer has been determined by using US Geological Survey Hydrologic Lab- Provisional values. The

hydrological laboratory of the US Geological Survey in Denver, Colorado, under the direction of AI Johnson had undertaken a research study on the specific yield of unconsolidated materials based on lithological analysis. The results of the work were available and are shown in Table 1. These values have been used in estimating the specific yield of the study area in the present work. The specific yield of any volume of geologic material can be obtained by summing up the specific yield values of all unit volumes it contains. Since nearly all such zones include various types of materials with different specific yield, it is necessary to weigh each material according to its proportions of the entire volume.

Table-1: Values of Specific Yield after U.S.G.S. Hydrologic Lab-Provisional Values

Material	Specific yield (%)
Clay	1
Silty Clay	2
Sandy Clay	3
Clay Silt	5
Silt	7
Clay Sand	7
Sandy Silt	14
Silty Sand	20
Fine Sand	26
Medium Sand	35
Coarse Sand	33
Sand (undifferentiated)	32
Fine Gravel	25
Medium Gravel	20
Coarse Gravel	14

2) Pumping Test and Data Analysis

Pumping tests were conducted earlier by BADC during the installation of the deep tube-wells. While conducting the test, data on water levels were collected by avometers and stopwatches. Each test lasted for six (6) hours duration. During the first ten (10) minutes of the test, data were collected

at one (1) minute interval, while for 10 to 30 minutes, 30 to 120 minutes and 120 to 360 minutes the time intervals were 5, 10 and 30 minutes respectively. The ground water level recovery data in each well were recorded after pumping was stopped. The same time intervals of pumping test were followed for the recovery test. Pumping test of eight (8) deep tube-wells were used for the determination of transmissibility and storage coefficient.

2(a) Determination of Hydraulic Characteristics

In the present study two standard methods were used to estimate Transmissibility and Storage Coefficient. e.g.

(1) Jacob's Time - Drawdown Method.

(2) Theis Recovery Method.

2(a)(1) Jacobs's Time - Drawdown Method

This method gives fair predictions only when steady state condition prevails or steady shape condition developed. This method is especially applicable to artesian conditions since it takes long period to reach steady shape conditions in water table aquifer. The method is extremely useful in making long term predictions of withdrawals from aquifers which boundary conditions are known. This method is valid for the value of $u < 0.01$. The early drawdown data of pumping test is omitted in this method. The time-drawdown graphs were prepared on semi-log papers with drawdown in the vertical axis (arithmetic scale) and time on the horizontal axis (logarithmic scale). The slopes of the straight line would be proportional to the pumping rate and transmissibility. Jacob derived the following equations for determination of transmissibility and storage coefficient from the time -drawdown graph.

$$T = \frac{2.3Q}{4\pi\Delta S} \dots\dots\dots (1)$$

$$S = \frac{2.25Tt_0}{r^2} \dots\dots\dots (2)$$

Where,

Q = pumping rate, m^3/day

T = transmissibility, m^2/day

t_0 = time, at which the straight line intersects the zero drawdown, min.

S = storage coefficient.

r = distance of the observation well from the pumping well.

2(a)(2) Step- Drawdown Pumping Test

Step- drawdown pumping test data of eight deep tube-wells of the study area were collected from BADC, Netrokona office. Among them two were used for four stepped tests and the rest were used for the three-stepped test. The specific drawdowns were determined for each step by the well discharge of each step. Every step lasted for 100 minutes. By inverting the specific drawdown values specific capacities were also calculated. The average values of the three and four steps were determined. The results were interpreted to help selecting the appropriate tube well technology.

Results and Observation

The present study was undertaken in generating detailed information about ground water condition on Netrokona Sadar upazila. During the study the collected data and relevant information were analyzed by established methods and were interpreted systematically. The results and findings generated from the study were provided and discussed in the following:

Sub-Surface Lithology of the Investigation Area

The lithological analysis was carried out over the study area. It was conducted based on 52 bore logs existing installed deep tube-wells.

Vertical Cross Sections

The vertical cross-sections of subsurface lithology have been contracted which showed the variations in lithological sequences from place to place. They were grouped according to unions. According to lithological constituents and on the basis of aquifer types the subsurface layers were divided into four zones namely; zone I, II, III, IV. The thickness of zone I, II and IV are shown in Table 2, 3 and 4. Their descriptions are given below :

Zone I

This is the uppermost zone, which is composed mainly of clay and silt. This zone found to be extended from 2.44 m to 16.47 m below the ground surface having the average of 8.2m (Table 2). Because of its lithological character, it is characterized by low permeability and productivity. Most of the dug wells are situated in this zone.

Zone II

This zone is found to be composed of fine sand and medium sand or fine to medium sand. The thickness of this zone varies from 3.05 m to 33.25 m having the average thickness of 22.27 m (Table 3). It is characterized by moderate permeability because of which all types of hand tube wells and some shallow tube-wells are installed in this zone. It can be considered as composite aquifer.

Zone III

This zone is another clay layer mixed with silt or fine sand. The thickness was found to vary from 3.05 m to 28.06 m having average thickness of 12.2 m. This zone is also low permeable and low productive. This may be considered as aquitard from lithological point of view.

Zone IV

This zone was found to be composed of medium to coarse sand, coarse sand and gravels. The thickness of this zone was ranging from 19.22 m to 71.37 m having average thickness of 39.65 m (Table 4). This zone is highly permeable and productive from the lithological point of view. That is why most of the deep tube-wells and shallow tube-wells were installed in this zone. This zone can be regarded as main aquifer.

Table-2 : Upper Clay & Silt Layer Thickness (m) Obtained From 52 Bore Logs

Well No	Thickness	Well No	Thickness
1	16.17	37	05.19
9	05.19	38	05.19
12	05.19	39	05.19
13	05.19	40	02.44
14	13.42	41	05.19
15	10.68	42	10.68
16	13.42	44	05.19
17	13.42	45	13.42
17	10.68	46	07.93
19	02.44	47	10.68
20	07.93	48	02.44
21	05.19	49	02.44
22	05.19	50	02.44
23	10.68	51	10.68
24	00.68	52	07.93
25	02.44	53	05.19
26	05.19	69	16.47
27	05.19	57	10.98
29	05.19	4/k	03.05
30	16.17	3/k	09.15
31	07.93	2/k	03.05
32	02.44	72	15.25
33	07.93	5/k	03.05
34	16.17	D1	12.20
35	16.17	D2	12.20
36	10.68	6	07.93

*Highest thickness: 16.47 meter

*Lowest thickness: 02.44 meter

*Average thickness: 08.24 meter

Table-3 : Composite Aquifer Thickness Obtained From 52 Bore Logs.

Well No	Thickness (m)	Well No	Thickness (m)
1	16.47	37	19.22
9	30.20	38	27.45
12	24.71	39	27.45
13	13.73	40	30.20
14	19.22	41	27.45
15	21.96	42	27.45
16	10.98	44	24.71
17	10.98	45	24.71
17	13.73	46	24.71
19	32.94	47	21.96
20	27.45	48	30.20
21	24.71	49	24.71
22	24.71	50	91.22
23	27.45	51	08.24
24	27.45	52	19.22
25	30.20	53	30.20
26	27.45	69	33.25
27	27.45	57	10.98
29	30.20	4/k	21.96
30	19.22	3/k	27.45
31	19.22	2/k	21.35
32	24.71	72	18.30
33	27.45	5/k	03.05
34	16.47	D1	09.15
35	19.22	D2	09.15
36	24.71	6	21.35

*Maximum thickness: 71.37 meter

*Minimum thickness: 19.22 meter

*Average thickness: 39.65 meter

Table-4 : Main Aquifer Thickness Obtained From 52 Bore Logs

Well No	Thickness (m)	Thickness (m)
1	24.71	32.94
9	54.90	57.65
12	30.20	32.94
13	24.71	52.16
14	24.71	43.92
15	19.22	29.56
16	52.16	38.43
17	31.72	32.94
17	35.69	24.71
19	38.43	32.94
20	38.43	52.16
21	19.22	32.94
22	30.20	60.39
23	60.39	49.41
24	24.71	27.45
25	71.37	30.20
26	57.65	63.75
27	32.94	31.72
29	38.83	33.55
30	32.94	33.55
31	30.20	33.55
32	24.71	36.60
33	71.37	42.70
34	68.32	36.60
35	65.88	42.70
36	32.94	32.94

*Maximum thickness: 71.37 meter

*Minimum thickness: 19.22 meter

*Average thickness: 39.65 meter

Evaluation of Specific Yield

Specific yield have been estimated based on lithological data analysis. The specific yield varied from 2 to 22 percent having the average value of 8 percent. (Table-5).

Table-4 : Main Aquifer Thickness Obtained From 52 Bore Logs

Well No	Thickness (m)	Thickness (m)
1	24.71	32.94
9	54.90	57.65
12	30.20	32.94
13	24.71	52.16
14	24.71	43.92
15	19.22	29.56
16	52.16	38.43
17	31.72	32.94
17	35.69	24.71
19	38.43	32.94
20	38.43	52.16
21	19.22	32.94
22	30.20	60.39
23	60.39	49.41
24	24.71	27.45
25	71.37	30.20
26	57.65	63.75
27	32.94	31.72
29	38.83	33.55
30	32.94	33.55
31	30.20	33.55
32	24.71	36.60
33	71.37	42.70
34	68.32	36.60
35	65.88	42.70
36	32.94	32.94

*Maximum thickness: 71.37 meter

*Minimum thickness: 19.22 meter

*Average thickness: 39.65 meter

Evaluation of Specific Yield

Specific yield have been estimated based on lithological data analysis. The specific yield varied from 2 to 22 percent having the average value of 8 percent. (Table-5).

Table-5 : Estimation of Specific Yield Obtained From 52 Bore Logs for Different Location

Well No	Sp. yield (%)	Well No	Sp. yield (%)
1	3	37	8
9	13	38	14
12	10	39	15
13	14	40	15
14	2	41	5
15	2	42	15
16	5	44	2
17	2	45	7
17	2	46	2
19	20	47	11
20	11	48	14
21	14	49	9
22	14	50	22
23	2	51	2
24	2	52	7
25	20	53	14
26	11	69	3
27	14	57	4
29	14	4/k	11
30	4	3/k	3
31	6	2/k	8
32	8	72	3
33	8	5/k	9
34	2	D1	2
35	2	D2	2
36	6		

*Average Specific Yield: Eight (8) percent.

Determination of Hydraulic Properties of the Aquifer

Analyzing pumping data by Jacob's time-drawdown method and Theis time recovery method, the hydraulic properties of seven places of the study area have been estimated which were shown in Table-6.

The coefficient of transmissibility (T) at Zila parishad, Medni, Kailati, Mougati, Singherbangla, Thakurkona was found to be 1043, 2755.62, 1469.67, 2593.53 and 2939 m²/day respectively using Theis Recovery

method. Using Jacobs time drawdown method the transmissibility at Satpai Graveyard and zila parishad was found to be 852.18 and 734.4 m^2/day respectively. The values of storage coefficient (S) were found to be 0.0049, 0.0033, 0.0097, 0.0038, 0.0035, 0.00006, 0.00023 respectively at the places mentioned above. These results revealed that the storage coefficient fell in the range of S values for confined aquifer (0.00005-0.005) except in one location (0.00006). The results (shown in Table 6) showed that the values of T varied widely with a minimum of 734.40 m^2/day to a maximum of 2939.00 m^2/day with a average value of 1800.51 m^2/day . UNDP (1982) reported that T value varies from 500 to 3000 m^2/day for this zone. So the aquifer properties estimated under this study might reasonably be accepted for evaluating the aquifers potentiality. Johnson (1966) categorized an aquifer with transmissivity of 1500 m^2/day or above to be good and potential for irrigation purpose. However, except the municipal area the aquifer in Netrokona Sadar upazila may be ranked as good and potential.

Table-6 : Transmissibility and Storage Co-efficient Values at Six Places of Netrokona Sadar Upazila

Well No	Name of the location	Parameter		Method used
		Transmissibility	Storage coefficient	
		T (m^2/day)	S	
D1 (Production well)	Satpai Graveyard	852.18	0.00023	Jacob's time- drawdown method
D2 (Test Tubewell)	Zila parishad	1434.21	0.0015	Jacob's time- drawdown method
do	do	1043.00	0.00039	Theis Recovery method
D2 (Production well)	do	734.40	0.0049	Jacob's method
4/k	Medni	2755.62	0.00033	Theis Recovery method
72	Kailati	1469.67	0.0097	do
73	Singherbangla	2593.53	0.0035	do
5/k	Thakurkona	2939.00	0.00006	do

Specific drawdown and specific capacity were obtained from the step drawdown data for eight representative deep tube-wells at eight locations, which were shown in Table 7. As the specific drawdown and specific capacity are the useful concepts to indicate the productivity of both aquifer and wells, the results obtained here will be able to predict the efficiency of both aquifer and wells in the study area. The highest and

lowest values of specific drawdown were found to be 228.11 m/cumec of the wells situated at Satpai graveyard and at Medni respectively. The specific capacities were 0.0043 and 0.013 cumec/m at the same places respectively. The average value of specific drawdown and specific capacity were 128.90 m/cumec and 0.0078 cumec/m respectively. These data will help in selecting the well discharge and well screen for the investigated area.

Table-7 : Specific Drawdown and Specific Capacity (Within Parenthesis) for Eight Deep Tube Wells Obtained from Step Drawdown Pumping Test.

Well No	Step - I Ft/cusec (Cusec/ft)	Step - II Ft/cusec (Cusec/ft)	Step - III Ft/cusec (Cusec/ft)	Step - IV Ft/cusec (Cusec/ft)	Average Ft/cusec (Cusec/ft)	Average M/cumec (Cumec/m)
D1	20.14 (0.05)	20.93 (0.05)	21.59 (0.05)	22.16 (0.05)	21.20 (0.05)	228.11 (0.0043)
D2	12.92 (0.077)	13.76 (0.072)	14.31 (0.07)	15.17 (0.066)	14.09 (0.071)	151.61 (0.0066)
5/k	8.63 (0.116)	9.67 (0.103)	9.72 (0.103)	---	9.34 (0.107)	100.50 (0.0099)
71	12.30 (0.081)	13.27 (0.0753)	13.33 (0.075)	---	12.97 (0.077)	139.56 (0.0072)
72	12.17 (0.082)	11.43 (0.088)	11.67 (0.086)	---	11.76 (0.085)	126.54 (0.0079)
4/k	7.08 (0.141)	7.13 (0.140)	7.42 (0.135)	---	7.21 (0.139)	77.58 (0.013)
73	8.92 (0.112)	8.17 (0.122)	8.25 (0.121)	---	8.45 (0.118)	90.92 (0.011)
74	10.98 (0.091)	10.82 (0.092)	10.65 (0.094)	---	10.82 (0.092)	116.42 (0.0086)

Overall Average : Specific drawdown - 128.90 m/cumec, Specific capacity - 0.0078 cumec/m

Conclusion

From the present study it can be concluded that the main aquifer is well productive and enough potential for water abstraction. The specific yield value (8) indicated the high potentiality of the Netrokona aquifer. From the values of transmissibility (T) and storage coefficient (S), the aquifer may be categorized as confined. Therefore the results obtained from this study can be considered as informative and indicative only and should not always be used as the absolute information for the entire area without further verification.

References

- Ahmed M, M S U. Talukder, S, M, A, Ali and M A Mojid 1991. Recharge and depletion characteristics and irrigation water quality of Muktagacha aquifer. A research report of Irrigation and Water Management department. Bangladesh Agricultural University (BAU), Mymensingh. PP 1-84.
- Ali M, S.1978. Evaluation of aquifer characteristics in the southern zone of Mymensingh. A research report submitted to the department of Irrigation and water management, BAU, Mymensingh pp I - 15.
- Bhuiyan, S. I. M.A. Karim and M, Rozai. 1977. Evaluating hydraulic characteristics and yield potentialities of aquifer from development and test pumping data. An example of Mymensingh -Tangail area, paper presented at the second annual conference of the Bangladesh Association for Advancement of Science.
- Curry, J.R.1978. And D.G. Moore, 1971. Growth of Bengal sea pan and Denundation in the Himalayan. Geo. Soc. Amer, Bull, 82:563 - 572.
- Chowdhury, J.U. 1978. Evaluation of aquifer characteristics and deep tube well performance in the three selected areas in Bangladesh. Paper presented in the third annual Bangladesh Science Conference, Bangladesh Association of Advancement of Science.
- Hyde, L.W.1979, Hydrogeology of Bangladesh Ground water Circle, Bangladesh Water Development Board, Dhaka. PP, 10 - 45.
- Khan, L.R.1989, Ground water resources, Assessment for development planning of tube well irrigation system in Tangail Upazila. A report presented at the annual workshop of ongoing contract research projects of BARC, Dhaka, PP. 1- 16.
- McDonalds and partners ltd. 1983. Water Balance Studies, Bangladesh. Final report BWBD, Dhaka. PP, 5 - 30.
- Morgan, J.P. and G.W. McIntire 1959. Quaternary Geology of the Bengal Basin, East Pakistan and India. Bull, Geo.Soc. Amer.70: 319 -342.
- Mojid, M.A. 1993. Hydro geological Properties and Ground water development in Trishal Thana, Mymensingh. M, Sc. Thesis submitted to the department of Irrigation and Water Management BAU, Mymensingh.PP, 15 - 20.

MPO (Master Plan Organization) 1995. Ground water availability in second interim report , Vol. III, Ministry of Irrigation Water Development and Flood control, GOB, PP 105.

MPO (Master Plan Organization) 1984. Ground water Resource Evaluation for the 1984 irrigation season. PP. 15 - 20.

Matt McDonald International ltd, 1992. Deep Tube-well II Project - Bangladesh Main Report, BADC/ODA, June PP. 10 - 28.

UNDP, 1982. Ground Water Survey. The hydro- geologic Condition of Bangladesh ground water circle. Bangladesh Water Development Board, Dhaka. PP 1 - 113.

Human Training and Neural Networks Concept Learning

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Abstract: *In our real life, neural networks provide a basis for studying various aspect of human training system and cognitive development in a seemingly 'psychologically plausible' manner. Here a 'hybrid' neural network architecture comprising two Kohonen maps interrelated by Hebbian connections to perform a neural network based human training experiment for the development of a 'concept memory', 'word lexicon' and 'concept lexicalisation' in an unsupervised training environment using realistic psycholinguistic data. The results of the simulation demonstrate how neural networks, incorporating unsupervised human training mechanisms, can indeed simulate the learning of categories amongst children. The work demonstrates the efficacy of neural networks towards providing some insights into the elusive mechanisms that lead to the emergence of human learning categories and an explication of inherent conceptual categories.*

1.0 Introduction

Neural Networks is a research discipline with the agenda to (a) understand the nature of human intelligence by simulating aspects of human behaviour; (b) incorporate 'human-like' intelligence within computer systems; and (c) provide a conceptualisation of the mind. These objectives are addressed by a highly parallel architecture comprising simple processing units that facilitates massive co-operative computation among these processing units. The processing units are provided with a variety of 'stimuli' and by communicating with each other they 'respond' in a manner that mimics aspects of human behavior. The key notions in neural networks include learning: learning from being instructed by a 'tutor' in a supervised manner or learning on its own through observation and deduction in an unsupervised fashion.

The emergence of neural networks has provided scientists, both in computer science and psychology, an alternative framework for understanding the intricate and elusive tenets of human cognition; and a case can be made that this new class of information processing models construe cognition not as involving symbol manipulation, rather neural

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networks focus on causal processes that facilitate the excitation and inhibition of simple, highly interconnected processing units. Such a methodological position makes neural networks a prime candidate for modeling human cognition— researchers recommend neural networks as a set of general principles, primitives, structures and approach that appears to provide a computational framework that is both psychologically and neurologically plausible (Rumelhart, 1986). In fact, the argument is extended further by arguing neural networks to be seen as a vehicle for operationalising cognitive development theories (Bechtel, 1991). One important aspect of cognitive development is the emergence or learning of conceptual categories amongst humans, in particular developing children. Human learning of categories is a fairly indirect affair. Many categories that humans learn in real life are acquired in observational conditions in an autonomous learning environment that does not involve any feedback from a 'tutor'. In neural network terms this would have clear parallels with the unsupervised mode of learning as opposed to the supervised mode of learning based on feedback from a 'tutor'. If one believes that categories are a means of making sense of the environment then the argument goes that some aspects of learning about the environment should be unsupervised because humans, or more appropriately developing children, must invent their own categories for describing the environment as they perceive it. The question we ask in this paper is how do humans learn categories? Indeed how one goes on to investigate how categories are learnt? There is no direct evidence. The only evidence that shows children have in fact learnt some categories is when they talk about groups of animals, groups of people, sets of toys, edible items, furniture and so forth. Child language researchers would argue that when children learn language, they appear to learn concepts first, or more precisely categories of concepts. Furthermore, the learnt concepts have been lexicalised - meaning that the child has not only learnt about concepts and categories of concepts but has also learnt to name them and articulate about them.

The lexicalisation of concepts, then, a phenomenon which has to be simulated within the scope of neural networks in order to evaluate whether neural models can indeed simulate human learning and that the models demonstrate the emergence of categories during learning. This task would require the learning of concepts and associated words. We believe that such a study would provide students of human learning an operational framework where data and theory can be tested.

This paper describes neural network based simulations involving the learning of concepts and the learning of associated words and furthermore discusses how one can use a 'hybrid' neural architecture to interrelate concepts and words, i.e., to simulate lexicalisation of concepts. In architectural terms, we present a 'hybrid' neural network architecture comprising two Kohonen maps and a Hebbian connection network. Note that Kohonen maps and Hebbian connections are both instances of unsupervised learning and we show how unsupervised learning algorithms can indeed learn categories by using realistic child language development. We believe that development of language involves continuous interaction of the child with the environment, which in turn leads to the unsupervised 'invention' of categories. In neural network terms environmental influence, in terms of 'perceptual' and 'audio' (phonetic) stimuli, during learning is demonstrated by the adaptability of the 'plastic' structure of the neural networks to account for information received from the environment. In passing, we would like to note here that not much work has been undertaken on the learning of categories using unsupervised learning neural networks.

2.0 Introduction to Neural Networks

Neural networks attempt to mimic the neural structure of the brain albeit rather simplistically in that a neural network comprises a large number of computationally simple processing units. The processing units are highly interconnected through plastic connections. The 'plasticity' in the architecture of a neural network is introduced with the help of varying connection weights that can change over time and with experience. Basically, the connection weight determines the effect of the incoming input on the activation level of the unit. The configuration of the neural network dynamically adapts to the environment as a consequence of 'learning'. Put simply, learning in neural networks can be envisaged as the problem of finding a set of connection weights, which allow the neural network to store experiential knowledge and to exploit it to simulate the desired behavior. One can then argue that neural networks have a 'natural' propensity for storing experiential knowledge, which is acquired and retained through 'training' or 'learning' as opposed to explicit programming.

Typical explanations of neural network learning begin with statements like "learning would involve relatively enduring changes in a system of given architecture that results from its interaction with the environment.

Neural networks learning algorithms are broadly classified into two main categories: supervised learning and unsupervised learning. Supervised learning algorithms require an input pattern along with a desired output pattern. The learning algorithm typically computes the difference between the desired output of the network to its actual output, i.e. an error value. The computed error is then used to modify the interconnections between the units. Best examples of supervised learning are perceptrons and backpropagation networks. Unsupervised learning logarithms relate to the so-called 'self-organising' networks. Here, the neural network is presented only with a series of input patterns and is given no information or feedback at all about its performance or desired output. Kohonen maps (Kohonen, 1984) are amongst one of the best examples of this class of neural networks and are particularly useful for organising and categorising complex, multidimensional information.

3.0 A 'Hybrid' Neural Network Architecture

A psychologically plausible simulation of category learning involves the simulation of three distinct, yet highly interrelated, psychological activities - (i) the development of concepts, (ii) the learning of words and (iii) the lexicalisation of concepts - associating concepts with corresponding words. These activities can be further distinguished by the existence of a variety of input patterns, representation schemes, outputs and the underlying processing requirements. To perform a realistic simulation of human category learning we propose a 'hybrid' neural architecture that synthesises three individual neural networks: (1) Concept Memory- characterising children's 'semantic store' where the acquired conceptual knowledge (i.e. concepts) is stored; (2) Word Lexicon - characterising children's 'phonological store' where words corresponding to concepts are stored; and (3) Naming Connection Network - storing associative relationships between concepts and their lexical labels, i.e. names. For our purpose, a 'hybrid' neural network integrates in a principled manner a number of neural networks, where each neural network simulates a particular psychological activity. The efficacy of hybrid neural network architecture originates from the architectural and functional synthesis of the neural networks and a co-operation between the constituent neural networks yields the overall objectives of the simulation. The choice of appropriate neural networks for each activity, and more so how these neural networks are to be synthesised to form a hybrid architecture, is far from universal and formal. Furthermore, in order to maintain psychological plausibility we

base our selection of the neural networks, from the wide range of available neural network classifications, architectures and learning algorithms, on the following criterion: (a) type of data to be learnt, (b) input data representation formalism, (c) explication of output and (d) learning strategy involved.

Psychological evidence suggests that all three activities that are to be simulated involve an unsupervised mode of learning. For that matter we have chosen an unsupervised learning neural network - the so-called Kohonen maps (Kohonen, 1984) for simulating the development of the concept memory and the learning of words. Kohonen maps employ a 'self-organising' algorithm for learning; in fact the efficacy of Kohonen maps is further extended by the fact that the learning algorithm segregates the input space into distinct regions or 'topological maps', where each region may contain similar patterns— the so-called automatic categorisation of patterns.

Development of naming connections is also to be simulated by using an unsupervised learning algorithm—Hebbian connections that are regarded to be the simplest algorithm for learning associations between two entities. Architecturally, the naming connection network connects all the output units in the concept memory with all the output units in the word lexicon. Appropriately weighted Hebbian connections, termed as 'naming connections', establish a relationship between a concept in the concept memory with its corresponding lexical label, i.e. word, in the word lexicon. These Hebbian connections are used to spread the activations from one Kohonen map to another such that a localised activity pattern in either Kohonen map will cause a corresponding localised activity pattern on the other Kohonen map, and this would be the basis of concept lexicalisation. Table 1 gives the architectural specifications of the three neural networks to be used for the simulation with detailed description to follow in the forthcoming discussion.

Table-1 : Architectural Specifications of the Hybrid Neural Network Architecture

Activity	Input layer	Output Layer
Development of <u>Concept Memory</u> (<i>Kohonen Map</i>)	20 units	121 units
Development of <u>Word Lexicon</u> (<i>Kohonen Map</i>)	5 units	121 units
Development of <u>Naming Connections</u> (<i>Hebbian Connection Network</i>)	121 units	121 units

Now that we have specified the constituent neural networks we present a synthesis of these neural networks to realise our 'hybrid' neural network architecture (see Fig. 1) to carry out the simulations. A simulation model development framework for the synthesis of various neural networks to yield a conglomerate' neural network architecture has been proposed by Abidi (Abidi, 245:1997). Here, the integration of the concept memory, word lexicon and the naming connection network is in line with the modular (or hybrid) architecture approach proposed in detail by Abidi (Abidi, 252:1997).

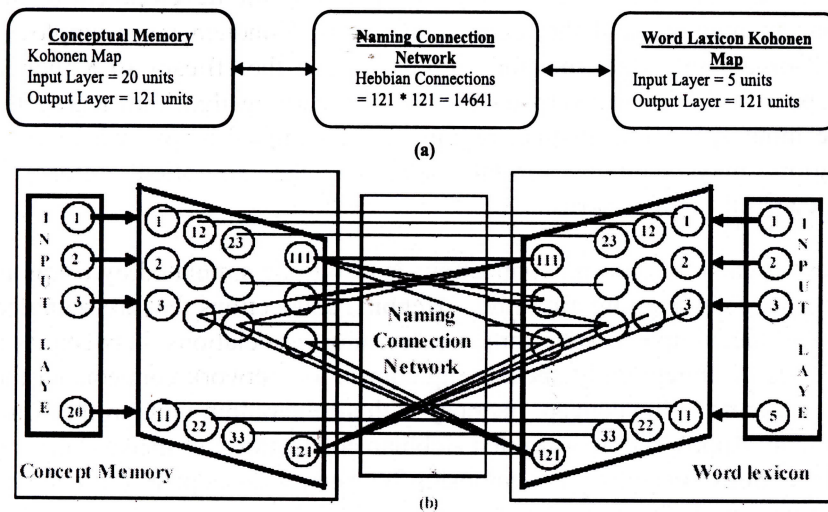


Fig. 1: The 'hybrid' simulation architecture: A synthesis of two Kohonen maps via Hebbian connections

4.0 A Simulation of the Development of the 'Concept Memory'

In neural network terms, children's concept memory where the acquired conceptual knowledge is 'stored', can be characterised by (a) the concept representation scheme, (b) the organisation of stored concepts, (c) the means for learning new concepts. Assuming that the child must take some initiative during concept development, we regard the learning of new concepts as an unsupervised process, whereby children appear to detect the salient 'semantic features' of a concept without any guidance. The storage of concepts is affected by categorising them on the basis of perceived semantic features. We have simulated the development of a 'concept memory', i.e., the learning of 42 concepts using a 121 unit Kohonen map. The 42 concepts being learnt were selected from the 50-

60 concepts reported in child language literature (Bloom, 1973). Previous simulations of the development of concepts were conducted in a supervised learning environment (Clapper, 451:1994); a concept was learnt by repetitively associating its semantic feature based representation with the concept's lexical label. Categorisation was achieved by merely learning the label of the category to which it belongs. The present study has some disagreements with this strategy to learn concepts, as it seems more as a case of 'rote learning'. The study elaborates below the simulation of the development of the concept memory together with the discussion on the emergence of conceptual categories.

4.1 A Neural Network Inspired Concept Representation Scheme

Representation of natural concepts in neural network formalism is of prime importance and demands a fine balance between psychological plausibility and neural network pragmatism. To represent concepts in a neural network environment we have adopted the conventional 'semantic feature' based formalism, which describes the similarities and differences between various concepts that leads to the definition of categories. Each concept in our representation scheme is represented by a 20-dimensional 'semantic feature vector' (Nelson, 27:1973) comprising two types of features: 'defining features' - determining a category structure, and 'individual features' - distinguishing individual concepts within a category. We discuss below how these defining and individual features are used to construct a semantic feature vector for representing a concept.

The defining features of concepts are based on 'object-oriented' taxonomy suggested by Katherine Nelson (Nelson, 32:1973). Nelson's 'semantic structure' classifies or categorises 'objects' and 'non-objects' at a considerable level of detail, enabling us to determine the category of the object/non-object concept in consideration.

Children's possession of a variety of concepts, differing from one another in terms of salient features, suggests that a category level abstraction alone may not suffice to represent children's concepts. We argue that 'individual features' unique to a concept help discriminate one concept from other concepts having the same 'defining features'. For instance, children are believed to distinguish various objects by observing aspects such as 'size', 'shape', 'color' and even, at times, their 'function'. For that matter, the individual features derive from a taxonomy of children's concepts suggested by Bloom (Bloom, 1973), comprising concepts

belonging to seven different categories: objects, agents, events, states, locations, prepositions and function words.

To conclude, our semantic feature vector encodes two types of information: super-ordinate category information (defining features) and specific information (individual features). Table 2 illustrates the semantic feature vectors for some exemplar concepts using in our simulation.

4.2 Description of the Simulation

The simulation of the development of the concept memory is carried out in an iterative manner, such that in each iteration a different concept is presented to the concept memory (Ahmad, 1996). The repeated presentation of the concepts over a number of iterations is analogous to the child's increased appreciation and knowledge of the concept over a period of time. Presentation of individual concepts in a random order ensures that the 'learning' taking place is not biased and does not reflect a predefined course of development.

Table 2: Semantic Feature Vectors for Concepts - 'Boy', 'Girl', and 'Dog'.
The Defining Features are Given in Bold Type-Face.

Concept Instance	Defining Features	Individual Features
<i>boy</i>	object - animate - agents, not self, people - specific	human, human-beings, familiar, does cares, is kin, <u>male</u> , large, has name
	[1,1,1,1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1]	
<i>girl</i>	object - animate - agents, not people - specific	human, human-beings, self, familiar, does cares, is kin, <u>female</u> , large, has name
	[1,1,1,1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1]	
<i>dog</i>	object - animate - agents, is animal - generic	non-human, animal, indoor, furry coat, unfamiliar, no distinct color, has distinct sound, medium, no name
	[1,1,0,0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 0]	

At the start of the simulation of the development of the concept memory, the Kohonen map implementing the concept memory is initialised with random weight vectors. This ensures that the concept memory does not contain any a priori knowledge. This claim is validated by noting that potentially close concepts are mapped quite sparsely, indicating the absence of any prior categories. (see Fig. 2a).

Kohonen map's learning can be quantified in terms of two parameters - (i) activation level (ACT) of the desired concept's unit when retrieved and (ii) the 'Euclidean Distance' (ED) between the desired concepts' unit and the most highly active unit. In fact, as learning progresses, the ED is minimised by the self-organisation mechanism inherent in Kohonen map learning algorithm, whereas at the same time the activation level of the desired concept's unit increases. A concept is deemed to be learnt when the activation level of its representative (or image) unit higher than all other units (approaching unity), and its ED is the lowest (close to zero).

In order to describe this complex simulation involving 42 concepts, we discuss the learning profile of just four concepts-'dog', 'juice', 'boy' and 'cow' out of the 42 concepts to be learnt. The learning period spanned 8000 iterations. To provide a learning profile we noted the amount of learning achieved after intervals of 500 iterations by taking a snapshot of the evolving concept memory. The learning profile of the concept memory is given in Table 3.

Table 3 shows that at the very first iteration, the ED between the (random) weight vector of all the units and the input stimulus is computed. The unit that has the minimal distance to the stimulus is 'assigned' the stimulus label. Subsequent iterations involve the computation of the ED and the reassigning of concepts to the units. After 500 iterations when the stimulus 'dog' was presented to the concept memory, it retrieved the concept 'pig' - the Kohonen map has not yet learnt to discriminate between a 'dog' and a 'pig' and can easily confuse the two. This 'confused' behaviour of the Kohonen map can be explained as follows: the semantic feature representations of both concepts - 'pig' and 'dog', share a number of features. The retrieval of the proximate concept 'pig' instead of the concept 'dog' clearly indicates that, at this stage, the Kohonen map has acquired an understanding of a category structure, i.e., the defining features have been learnt. However, the Kohonen map is still not able to discriminate amongst the individual features of the concepts 'dog' and 'pig' (since both concepts belong to the same category) and therefore confuses the stimulus 'dog' with the relatively close concept 'pig'.

At the end of 1000 iterations, the stimulus 'dog' retrieves the unit labeled 'dog', but the value of the ED is quite large (0.372) and the activation level is negative (-0.29): this retrieval may yet turn out to be a 'fluke'. This is justified at the end of 1500 and 2000 iterations; the Kohonen map now confuses the concept 'dog' with 'duck'. But after 2500 iterations, one sees a positive activation and a reduction of the ED in the learning profile for the concept 'dog'. Subsequent iterations do show that the network is becoming more 'stable' in its response to the stimulus 'dog'. At iteration 4000, the criteria for adequate learning have been satisfied, i.e., the activation level has approached unity and the ED has decreased to zero.

Table 3: Learning Profile Showing the Development of Concepts - 'juice', 'boy' and 'cow'. RU indicates the 'Retrieved Unit' in Response to a Specific Concept

Iteration	Dog RU	Juice RU	Boy RU	Cow RU
1 - 500	pig	--	boy	cow
501 - 1000	dog	juice	girl	horse
1001-1500	duck	juice	girl	horse
1501-2000	duck	juice	girl	horse
2001-2500	dog	juice	girl boy	cow horse
2501-3000	dog	--	boy girl	cow horse
3001-3500	dog	--	boy girl	cow horse
3501-4000	dog	cokie	boy girl	cow --
4001-4500	dog	juice	boy	cow
4501-5000	dog	juice	girl	cow
5001-5500	dog	juice	boy	cow
5501-6000	dog	juice	boy	cow
6001-8000	dog	juice	boy	cow

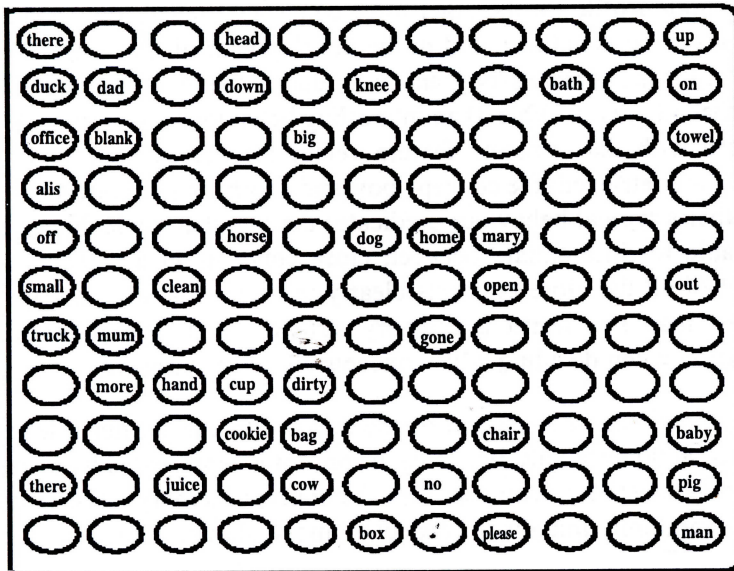
The learning profile for the other three concepts - 'juice', 'boy' and 'cow' follow a similar trend as noted in the development of the concept 'dog'. Note that for the concepts 'boy' and 'cow' during the iteration range 2000-4000 (shaded grey in Table 3) an interesting behaviour is observed. When presented with the semantic feature vector for the concept 'boy', two concepts are retrieved: the concept 'boy' and another close concept - 'girl'. This rather a typical behaviour predicates the fact that the Kohonen map is not able to differentiate between close concepts in a category. The retrieval of all the close concepts clearly indicates that at this stage the Kohonen map has learnt a category structure and is exploiting this information when deciding what concepts are to be retrieved.

Fig. 2b shows the organisation of the concept memory after a learning session of 8000 iterations, where each concept is represented by a unique unit. It is interesting to compare how the concept memory has originated from the randomly initialised concept memory, shown in Fig. 2a.

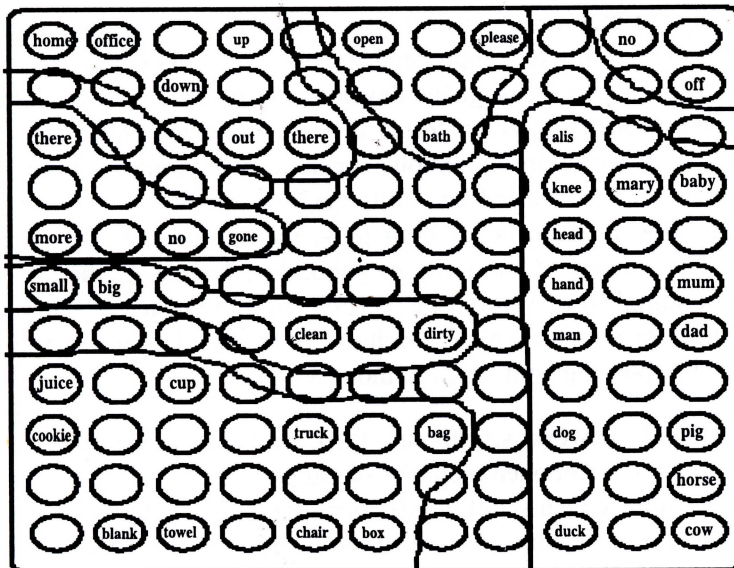
5.0 A Simulation of the Development of the 'Word Lexicon'

One significant manifestation of the development of language amongst children is their ability to comprehend and produce spoken language. One can model this aspect of language development by arguing that children can analyse acoustic input in terms of its constituent phonemes. The ability to 'spot' words in continuous speech can be compared with the development of the so-called 'similarity neighbourhoods'. -- set of words that differ from a given target by a phoneme substitution, addition or deletion. The concept of similarity neighbourhood relates to the fact that similar sounding 'words' would be represented in a cluster or 'category'. For instance, the similarity neighbourhood for the word pit would include the words bit, pot, pig, spit, and it, amongst others.

From a neural network standpoint, then, one can argue that, given phonetic input to a Kohonen map (the so-called word lexicon), the output from it construes to be a set of words corresponding to different phonetic inputs. Also, the organisation of these words in the word lexicon predicates a discrimination of phonetic information leading to a 'similarity neighbourhood' that seem analogous to the categorisation of the word lexicon, which results as a consequence of the temporal organisation of phonetic information. For the development of the word lexicon, we 'train' a 121 unit Kohonen map to initially learn and then to recognise 'words' given their phonetic representation.



(a)



b

Fig.2: (a) The concept memory before learning. (b) The concept memory after learning. The phonetic representation of each word is taken from the Oxford Advanced Learner's Dictionary. To represent words, we have devised an encoding scheme which assigns each phoneme a numerical value within the range of 0 -1.

The concept memory is divided into seven broad concept categories - objects, agents, locations, attributes, prepositions, events and function words .

The phonemic representation for a word, i.e. its 'phonemic feature vector', is formed by concatenating the encoded value of its constituent phonemes in a vector notation. For illustration purposes, the phonemic feature vector for some words is given in Table 4.

Table 4: Phonemic Representation of Words in Terms of a Phonemic Feature Vector

Word	Phonemic Feature Vector
dog	[0.45, 0.60, 0.65, 0.0, 0.0]
bag	[0.25, 0.40, 0.65, 0.0, 0.0]
pig	[0.15, 0.20, 0.65, 0.0, 0.0]
boy	[0.45, 0.40, 0.45, 0.0, 0.0]

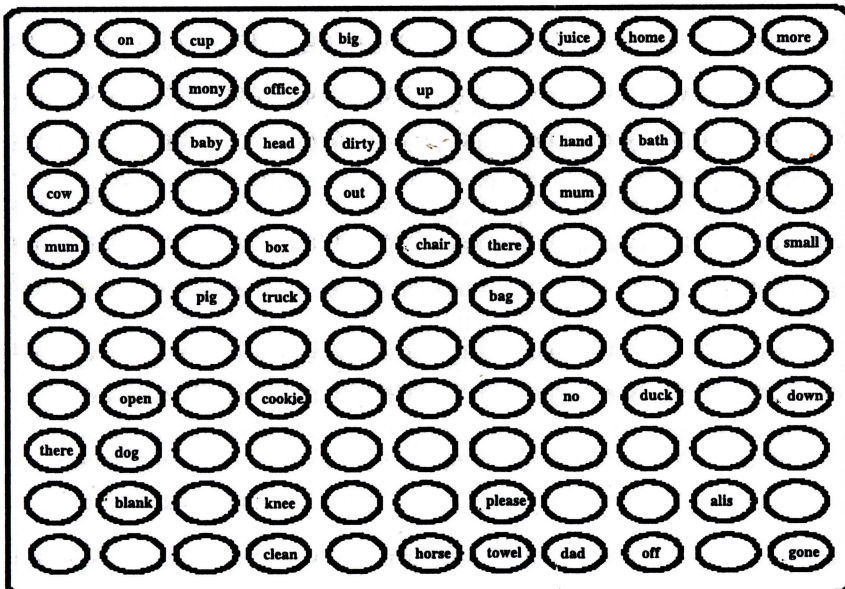
The simulation of the developing word lexicon is performed in a similar manner to that of the developing concept memory. Starting with a random Kohonen map, phonemic feature vectors of words are presented in a random order. The learning profile of the word lexicon follows a similar trend as that of the concept memory, and again the criteria is the activation level approaching unity and the ED being reduced to zero.

Fig. 3a shows the initially random word lexicon, whereas Fig. 3b shows the word lexicon after the learning session. In Fig. 3b it can be seen how the word lexicon has evolved from a random organisation of words to an ordered organisation that reflects categorisation of words on the basis of the length of the phonemic feature vectors. Again, like we did for the learnt concept memory, we have marked regions of the Kohonen map that store words of similar phonetic lengths. It is these regions that resemble the 'categories' or 'similarity neighbourhoods' argued by researchers (Luce, 128:1990). Note that the 'learnt' word lexicon clearly discriminates words on the basis of their phonetic content, and also within categories similar sounding words are stored in proximity, for instance note that the similar sounding words - 'bag', 'dog', 'pig', 'big', 'boy' and 'duck' are stored close to each other.

6.0 A Simulation of the Development of the 'Naming Connections' - Concept Lexicalisation

In child language literature, lexicalisation or 'naming' of concepts is regarded as the mapping of children's linguistic knowledge on to their conceptual knowledge (Ward, 217:1989). Lexicalisation of a concept can loosely be regarded as either learning by instruction or learning from examples. We believe that there are at least two 'ostensive naming' situations that can be simulated by neural networks conducting 'unsupervised learning'. The first situation relates to the assignment of a word to a 'known concept' where the child has a concept of an object or event but lacks the appropriate word to express it. The second situation relates to the assignment of a word to a 'novel concept': The child hears a novel word referring to a novel object or event, then the child relates the novel word to the new concept.

In both the above situations the child need to identify the category of the input concept and retrieve it from the concept memory. Also during word perception the demand on the child is to analyse the phonetic constituents of the word and retrieve the correct word, if present, from the word lexicon. The lexicalisation of concepts then is a viable simulation to further explicate and operationalise 'learnt' categories within the concept memory and word lexicon.



(a)

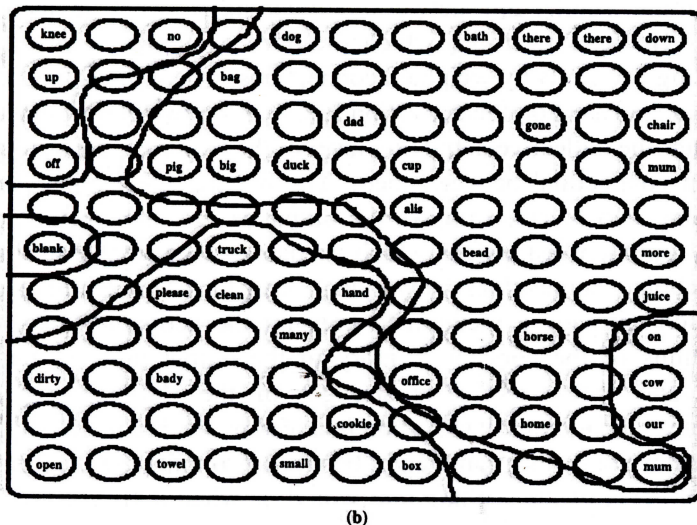


Fig. 3: (a) Word Lexicon before Learning. (b) Word Lexicon after learning. Words are arranged into four categories on the basis of their phonetic length, i.e. words constituting 2, 3, 4, and 5 phonemes.

6.1 Impetus for the Simulation Architecture

We have simulated concept lexicalisation as the development of an association between a lexical label (word) with the corresponding concept. In a neural network parlance such an association would be achieved by learning associative naming connections between a concept unit in the concept memory with the corresponding word unit in the word lexicon. Simulation of concept lexicalisation involves each unit in the concept memory to be connected, with varying connection strengths, to all units in the word lexicon and vice versa. This establishes a many-many relationship between concept units and word units, as shown in Fig. 4.

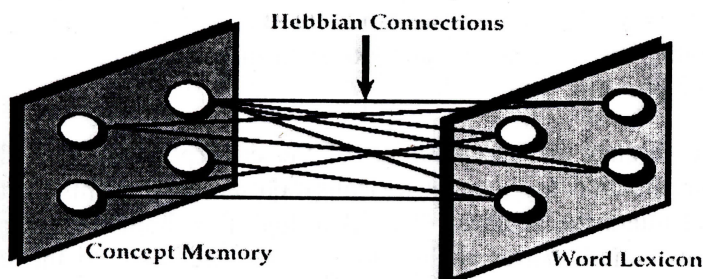


Fig. 4: Naming connections between the Concept Memory and the Word Lexicon.

The naming connection network, simulating concept lexicalisation, employs Hebbian Learning which provides a simple mechanism for associating two units by weighted connections, where the strength of the connection is based on the activation levels of the two connecting units - the greater the collective activation level of the two units the stronger the 'Hebbian connection' between them. The naming connection network, comprising two layers, employs the output layers of both the concept memory and the word lexicon which are then connected by 14641 ($121 * 121$) Hebbian connections of varying strengths. The 'learnt' Hebbian connections provide a medium to transmit the activation level of the output units of the concept memory to the output units of the word lexicon and vice versa. The strength of the Hebbian connection determines the amount of activation received by the recipient output unit - the greater the connection weight between two units the magnified the activation level of the sending unit would be when it is received by the recipient unit.

6.2 Simulation Scheme for Developing Naming Connections

Two types of stimuli were used in this simulation: (1) a perceptual stimuli, i.e. a 20-dimensional semantic feature vector representing a concept, and (2) a phonemic stimuli, i.e. a 5-dimensional phonemic feature vector representing the corresponding word. The entire training set comprises Bloom's 42 concepts and words learnt earlier.

The development of naming connections can be simulated in a developmental manner by simultaneously presenting a concept (the perceptual stimuli) to the concept memory and the corresponding word (phonemic stimuli) to the word lexicon. Presentation of the respective stimuli to each Kohonen map results in a group of units to become highly active due to the information retrieval mechanisms employed by Kohonen maps. Naming connections can then be established between these highly active units, in each Kohonen map, based on the Hebbian learning algorithm.

Here we discuss the lexicalisation of the concept 'dog'. Consider an exemplar situation for concept lexicalisation: an adult points towards a 'dog' and utters the sentence 'That is a dog', thus both the verbal and perceptual stimuli corresponding to 'dog' are presented to the learner almost at the same instance. The information retrieval mechanism of the Kohonen maps ensures that the presentation of the perceptual stimuli to

the concept memory forms a localised pattern of activity around the learnt 'dog' concept unit. In this scenerio similar concepts are more activated than less similar concepts. In a similar manner, the presentation of the verbal stimuli 'dog' to the word lexicon results in the learnt word unit 'dog' acquiring the highest activation level. At this stage, we apply the Hebbian learning algorithm to establish inter-map naming connections amongst all units in both Kohonen maps. The strength of the Hebbian connection established is proportional to the current activation of two connecting units. Therefore, a strong connection is established between the highly active concept and word units, i.e. the 'dog' concept and word units.

Concept lexicalisation is carried out in an iterative manner, where in each iteration a concept-word pair is presented to the naming connection network and learning involves slight increments to the strength of the Hebbian connections between the concept and word units. In this way, over a period of several iterations strong naming connections are established between concepts and their corresponding lexical labels (words). A concept is deemed to be lexicalised when a 'perceptual' stimuli representing a concept is presented at the concept memory and in response the lexical label - 'word' unit corresponding to the concept is highly active in the word lexicon.

Table 5 presents the learning profile of the lexicalisation of four concepts - 'dog', 'cow', 'juice' and 'boy' which are represented in the 'learnt' word lexicon by units 76, 88, 55 and 86, respectively (Recall that each unit in Kohonen map has been assigned a number in the range 1 - 121). For instance, at iteration 500 the concept 'dog' is associated with unit 2 in the word lexicon. This turns out to be an incorrect association since the actual word unit representing 'dog' is 76. During subsequent iterations the neural network is again incorrectly associating the concept 'dog', first with word unit 36, and then later with word unit 114. It is only after 6000 iterations that the neural network has learnt to lexicalise the concept 'dog', as now the concept 'dog' is associated with word unit 76, which represents the word 'dog'. The learning profile for the other three concepts show a similar trend where first incorrect associations are established between concept and word units in the concept memory and word lexicon, respectively. However with increased experience the correct associations are eventually 'learnt'. It may be noted (see Table 5) that during the lexicalisation of a particular concept, say 'dog', not only the concept 'dog' is associated with the word 'dog' but also other similar category members are associated with the word 'dog' though with a less strong connection.

This ensures that a strong naming connection is established between the close category members and less strong naming connections exist among other not so close category members.

Table 5: Learning profile for Concept Lexicalisation. Finally, the words dog, cow, juice and boy are represented by units numbered 76, 88, 55 and 86, respectively

Iteration Range	Dog RU	Cow RU	Juice RU	Boy RU
1-500	2	36	70	17
501-1000	36	88	56	17
1001-1500	36	88	56	17
1501-2000	36	88	91	17
2001-2500	114	88	91	17
2501-3000	114	88	56	17
3001-3500	114	88	56	17
3501-4000	114	88	91	17
4001-6000	114	88	91	119
6001-6500	76	88	91	119
6501-7000	76	88	91	119
7001-7500	76	88	55	86
7501-8000	76	88	55	86

7.0 Explicating the Evidences of Category Learning - the Simulation Results

The aim of the paper is to demonstrate the emergence of human conceptual categories. Our assumption, which is psychologically motivated, is that it is best to investigate the emergence of categories at the onset of concept development as usually whilst learning new concepts humans distinguish and discriminate various concepts; grouping and subgrouping of dynamically concepts are made and periodically refined with time and with increased appreciation of existing concepts, thereby realising categories of similar concepts. In the absence of any direct means to investigate how categories are learnt we exploit our three 'learnt' neural networks - the concept memory, word lexicon and naming connection network to explicate the subtle evidences implicit category learning during the processes of concept development, word acquisition and concept lexicalisation. We now explicate both direct and indirect (by exploiting the three neural networks) evidences of an underlying category structure that has been implicitly learnt by the three neural networks during the simulations.

7.1 'Automatic' Categorisation of Concepts

The organisation of the concept units in the concept memory reveals that concepts that have close semantic feature representations are actually stored in proximity, thus forming a global organisation into conceptual regions or, more appropriately, 'categories' of concepts (see Fig. 2b). Effectively, self-organisation in Kohonen maps demarcates the possible input space into hierarchical sub-areas which are then mapped on to the two-dimensional Kohonen map. In Fig. 2b we have marked the Kohonen map to explicate the emergent categories of concepts. The reader may note that the right side of the concept memory accommodates concepts of the category 'agent', whilst 'object' concepts are stored in the bottom left corner and similarly the 'location' category occupies the top left area of the concept memory.

Note that the semantic feature representation of each concept is based on a hierarchical structure: 'defining features' (containing category information) and 'individual features' (distinguishing individual concepts). Whilst learning the concepts, the Kohonen map exploited the category information and collected concepts with similar 'defining features'. These semantically close concepts were then stored in proximity to each other, resulting in clusters of concepts that resemble 'categories'. In this way the Kohonen map not only learnt the concepts, but also simulated an 'automatic categorisation' of the concepts.

It is interesting to note that during learning the neural network was not provided any category information nor explicit definition of the semantic features and the possible relationships among them. Nonetheless, the Kohonen map itself deduced the similarity among the 'defining features' of various concepts and 'automatically' created clusters or categories of close concepts.

7.2 Local Organisation Inside a Category - Presence of Sub-Categories

The same categorising principle which earlier formed global categories based on 'defining features' is again responsible for creating a local organisation or 'sub-categories' of even closer concepts within a category. This local organisation is a manifestation of the similarities among the 'individual features' of various concepts belonging to the same category (see Fig. 2b). Put simply, the Kohonen map's learning algorithm analyses the finer distinctions in the semantic feature vector of concepts belonging

to the same category and then organises close concepts in proximity. For instance, in Fig. 2b the agent category includes concepts boy, girl, Mary, and man that share a number of 'individual features' hence these concepts are stored in proximity to each other thus forming a sub-category, say 'humans'. Also, within the same agent category, concepts for animals such as dog, pig, cow and horse are in proximity to each other, thus resembling another sub-category - 'animals'. Recall that a concept's semantic feature vector encodes an implicit hierarchy; the 'defining features' determine the broad category and the 'individual features' distinguishes concepts within categories. It is interesting to note that the Kohonen map, whilst learning the concepts, was able to detect this implicit hierarchy in the feature representation of the concepts, thus instigating two categorisation activities: the 'defining features' were used to determine a broad category structure, whereas based, on the 'individual features', concepts belonging to the same category were locally categorised.

7.3 Indirect Evidence of the Existence of Categories - Concept Generalisation

Ward and Vela (Ward, 221:1989) have reported that the manner in which children generalise from a novel or partially visible category exemplar to other members of the category is influenced by children's prior knowledge of previously learnt categories. To investigate the presence of categories within the concept memory we tested the generalisation capabilities of the 'learnt' concept memory. This was achieved by presenting the concept memory with (a) an incomplete representation of a learnt concept and (b) a novel concept. For case (a) we presented an incomplete semantic feature representation of the concept 'dog'. In response the Kohonen map completed the partial representation and correctly retrieved the concept 'dog'. For case (b) we presented a representation of a novel concept - 'cat'. Again the 'learnt' Kohonen map determined the possible category of the novel concept, which is 'agents', and subsequently generalised the novel 'cat' concept to the closest learnt concept 'dog' in the 'animal' sub-category. It may be noted that, much as what Ward & Vela have suggested, during generalisation the concept memory first determined the appropriate conceptual category to which the novel or partially represented concept may belong. Then, from the candidate conceptual category one concept that was most similar to the novel concept was selected.

7.4 Indirect Evidence of the Existence of Categories - Addition of New Concepts

Child theorists have speculated that the categorisation of concepts helps in the learning of new concepts as the new concept can be perceived in terms of an existing concept. For instance, the child may identify a new concept 'cat' in terms of a known and similar concept 'dog', in that the new concept 'cat' shares features such as 'animal', 'has tail', 'has furry coat', 'roams in the house', 'is pet', etc. with the child's existing concept of a 'dog'.

Our neural network based concept memory verifies the existence of such a behaviour, as is illustrated when attempting to add a new concept 'cat' to the previously learnt concept memory (shown in Fig. 5). It may be noted that the new concept 'cat' (shaded dark in Fig. 5) is learnt and mapped (in the areas corresponding to the category agent and the sub-category animals) in the immediate proximity of the concept 'dog'. This indicates three things: (a) the learning mechanism is aware of the existence of an implicit category structure underlying the organisation of the concept memory, (b) the learning mechanism not only 'automatically' determined the category of the new concept but also determined the sub-category to which it belonged, and (c) within the sub-category the concept 'cat' was placed next to the concept which bears greatest resemblance to it, i.e. the concept 'dog'.

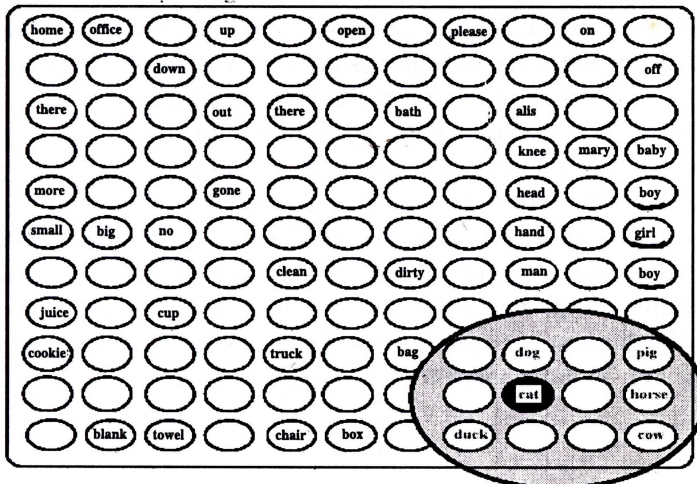


Fig. 5: The concept memory with the newly added concept 'cat'. The shaded area represents the sub-category 'animals' within the category 'agents'.

7.5 Indirect Evidence for Existence of Categories - Retrieval of a Concept Word Pair

Again, an indirect evidence of the presence of categories within the learnt concept memory and the word lexicon is available by simulating the retrieval of a word in response to a given concept. Here, the naming connection network is used to demonstrate concept lexicalisation.

Retrieval of a 'word' therefore involves an interaction among three neural networks - concept memory, naming connection network and word lexicon. The retrieval of a word in response to a concept is simulated by presenting a concept to the concept memory. This initiates the spreading of the activation of the concept units through the 'naming connections' to the word units. If a strong naming connection exists between a concept unit and its corresponding word unit, then the presentation of the concept to the concept memory enables the corresponding word unit in the word lexicon to acquire the highest activation level amongst all other word units.

We now demonstrate the retrieval of the word 'boy' when given the concept 'boy' to the learnt concept memory. To begin with, the presentation of semantic feature vector for the concept 'boy' is presented at the input layer of the concept memory. This brings into relief the information retrieval mechanism of Kohonen maps - the learnt concept unit 'boy' acquires the highest activation level and is deemed as being retrieved in response to the input (shown in Fig. 6). Next the naming connection network is used to retrieve the lexical label of the retrieved concept 'boy'. By employing the spreading activation mechanism the activation level of all active concept units is spread through the naming connections to the word-lexicon. This flow of activation results in the emergence of localised patterns of activations on the word-lexicon, such that word units that are strongly connected with the highly active concept units acquire a high activation level. In this case, the word unit 'boy' acquires the highest activation level and is deemed as being retrieved (shown in Fig. 7) in response to the concept 'boy'.

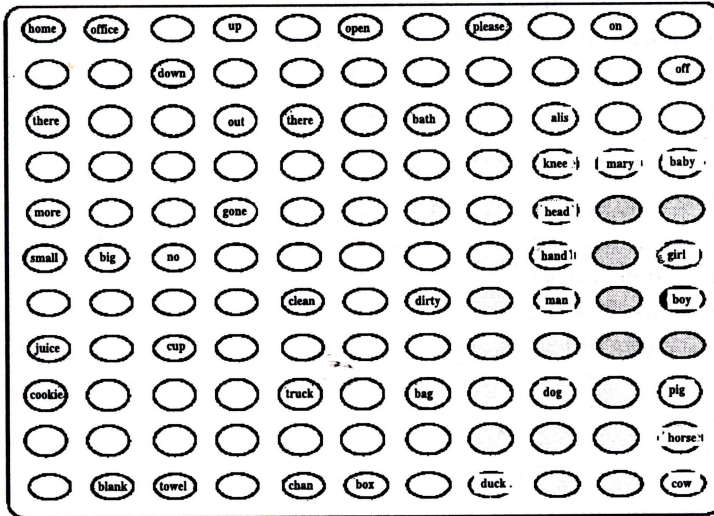


Fig. 6 : State of the concept memory when presented the concept 'boy'. The degree of activation level is depicted by darker shades of grey. Concept unit 'boy' has the highest activation level.

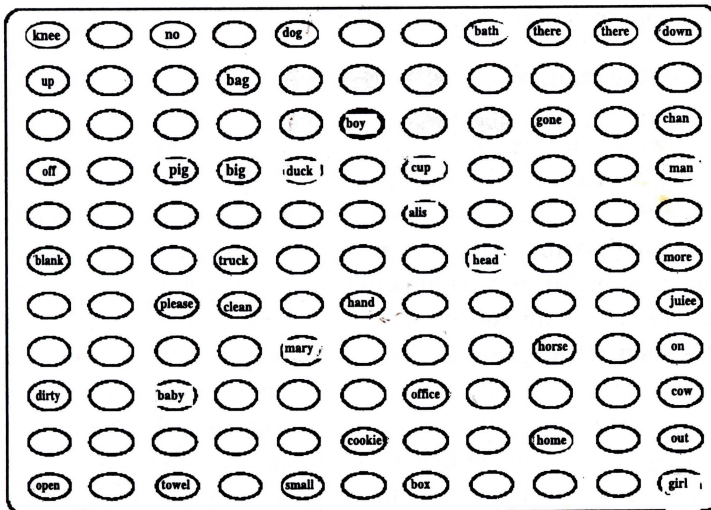


Fig. 7 : State of the word lexicon after activations are spread from the concept memory. Word unit 'boy' is retrieved as it has the highest activation level.

In Fig. 6, it may be observed that the presentation of the concept 'boy's perceptual stimuli to the concept memory has resulted in concepts belonging to the category 'agents' to acquire higher activation levels as

compared to other units in different categories, thereby suggesting the overall selection of the 'agent' category. It may therefore be argued that during the retrieval of the concept first the broad category was selected and subsequently the selection was narrowed down to one category member that best represented the perceptual stimuli, i.e. the concept 'boy'.

In Fig. 7, it may be observed that apart from the highly active word unit 'boy' the word unit 'girl' is the next most highly active unit. This again explicates the network's knowledge of an implicit category structure; the neural network has deduced that the concepts 'boy' and 'girl' are very similar to each other, and this conclusion is validated by the high activation level of words corresponding to concepts belonging to the 'agent' category.

We argue that this concept-word retrieval simulation not only demonstrates the information retrieval mechanisms inherent in Kohonen maps but also validates the efficacy of the Hebbian connections implemented in the naming connection network, and in turn proves to be a good means of explicating the category information learnt by the neural networks - the concept memory and the word lexicon.

8.0 Concluding Remarks

We have demonstrated that neural networks provide a basis for investigating human category learning. Our simulations showed effects of category learning during the development of concepts, associated words and the lexicalisation of concepts. The emergent categories are interpreted in terms of the neural networks partitioning or discriminating the input stimuli in an unsupervised learning environment. We have shown that such self-organising neural networks may have some parallel with human (category) learning. From a neural network standpoint we have demonstrated the efficacy of a 'hybrid' neural architecture for simulating aspects of human behaviour. Recall that the neural networks were subjected to unsupervised training, a training regime that has empathy with the developmental paradigm of language development. Furthermore, the connections between the two networks were established fairly successfully, through what appears to be a training regime based on non-Hebbian 'laws', rooted in the behaviouristic paradigm. The fact that a number of researchers in neurobiology, developmental psychology and linguistics are interested in neural networks and neural simulations leads us to believe that we have made a contribution towards some questions related to the understanding of human behavior.

References

- Abidi, S. S. R. & Ahmad, K. (1997) "Conglomerate Neural Network Architectures: The Way Ahead for Simulating Early language Development". Journal of Information Science and Engineering, Vol. 13, pp. 235-266.
- Ahmad, K. & Abidi, S. S. R. (1996) "Child Language Development: A Connectionist Simulation of the Evolving Concept Memory". M. Aldridge (Ed.) Child language. Clevedon: Multilingual Matters Ltd.
- Bechtel, W. and Abrahamsen, A. (1991) Neural Networks and the Mind. Oxford: Basil Blackwell.
- Bloom, L. (1973) One Word at a Time. Paris: Mouton.
- Clapper, J. and Bower, G. (1994) "Category Invention in Unsupervised Learning". Journal Of Experimental Psychology: Learning, Memory And Cognition, Vol. 20, pp. 442 - 460.
- Hinton, G. (1986) "Learning Distributed Representations of Concepts" in Eight Annual Cognitive Science Society Conference, Amherst.
- Kohonen, T. (1984) Self-organisation and Associative Memory. Springer-Verlag.
- Luce, J. & Luce, P. (1990) "Similarity Neighbourhoods of Words in Young Children's Lexicons". Journal of Child Language, Vol. 17, pp. 110-139.
- Medin, D. (1989) "Concepts and Conceptual Structure". American Psychologist, Vol. 44, pp. 1469-81.
- Nelson, K. (1973) "Some Evidence for Cognitive Primacy of Categorisation and its Functional Basis". Merrill-Palmer Quarterly, Vol. 19, pp. 21-39.
- Rumelhart, D. and McClelland, J. (1986) Parallel Distributed Processing, Vol II. Cambridge: MIT Press.
- Ward, T. & Vela, M. (1989) "What Makes a Vibble?" Child Development, Vol. 60, pp. 215-224.

Problems and Prospects of Optimum Currency Area in Asia

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Abstract: *In an environment of different currencies, transaction costs including the costs of obtaining information about prices, would be higher which would be a disincentive to trade, commerce and investment. Joining a monetary union can eliminate exchange rate risk, facilitate trade, makes price differences transparent among the member countries, sharpens competition and increases policy discipline. On the other hand, the key economic cost from formation of a currency union by a group of Asian countries is the loss of national autonomy in monetary union. Overall, composite Optimum Currency Area (OCA) indices for some of the Asian countries, especially the East Asia region, which take into account intraregional trade, wage-price flexibility, labor mobility, and shock symmetry, are similar to those for the European Union (EU). This paper finds the absence of a clear road map for monetary cooperation and the present process requires a deep abandonment of sovereignty and the setting-up of a common central bank. Finally this paper concludes that in view of the absence of institution building in Asian region, monetary unification is far-fetched.*

Introduction

A currency union zone consists of several countries or regions where (a) a single currency circulates; (b) a single monetary authority implements monetary policy defined at the union level; (c) a single exchange policy prevails; and (d) the single monetary authority maintains a common pool of reserves; (e) in the absence of political integration (Fabella, 2002). According to the Optimum Currency Area (OCA) literature, the key economic cost from formation of a currency union by a group of countries is the loss of national autonomy in monetary policy since there is no scope for independent monetary policies by the member countries of the union under a currency union. Many developing countries with open capital accounts have several constraints in the effective conduct of an independent monetary policy. This is especially so in the developing countries with thin capital markets and weak central banking institutions. In general, the records of developing countries in conducting independent national monetary policies to minimize cyclical fluctuations in economic activity have been somewhat patchy. This suggests that the economic loss

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from giving up an independent monetary policy may not be very large for such countries. On the contrary, a currency union may, in fact, elicit commitment to greater macroeconomic stability from countries that otherwise have a mixed track record in implementing monetary policy prior to joining the currency union. In Asia, especially after the financial crisis in 1997, increasing efforts have been made to promote regional monetary and financial cooperation. In 1999, ASEAN expanded itself into ASEAN plus three in 2001. ASEAN plus three launched Chiang Mai Initiative to ensure exchange rate stability among members and in 2003, decided to establish an ASEAN Economic Community (AEC) by 2020. The present paper has comprehensively examined the economic suitability for forming a monetary union within different blocks of Asia.

Theoretical and Empirical Background of Cost and Benefit of a Monetary Union

The OCA theory stems from the work of Mundell (1961). He assumed that (a) prices and wages are sticky and (b) countries are adverse to unemployment and inflation and defines a currency area as a 'domain within which exchange rates are fixed'. According to his theory, factors of mobility is positively related to suitability of forming a currency union. McKinnon (1963) considered trade integration and openness, defined as the ratio of tradables to non-tradables, as crucial criterion of optimality of monetary union. The more the participating countries are integrated by trade, the more open the economies and the more they are suitable for a monetary union.

From a purely economic point of view, a set of countries should opt for a common currency if the cost of losing national autonomy in monetary policy is mitigated by the benefits of a currency union. While it is difficult to quantify these costs and benefits, the OCA literature offers some guidelines to compare them. The benefits of a currency union increase and/or the costs decrease with greater flexibility in wages and prices among the countries of the union, greater mobility of factors of production (labor and capital) across countries, more symmetric shocks across countries, more openness among the economies within the union and larger share of trade among the countries of the region.

The feasibility of a common currency area can be tested by the criteria for an optimal currency area. Mundell (1961) regarded mobility of labor as a necessary condition of common currency areas, while McKinnon (1963)

regarded openness of the economy as another necessary condition. Symmetry of shocks was also pointed out as a factor for an optimal currency area (Bayoumi and Eichengreen, 1993). It is possible to form an optimal currency area because it is unnecessary to make intraregional adjustments in a region subject to symmetric shocks only. Symmetry of supply shocks is often emphasized because supply shocks have long-run effects on GDP while demand shocks have no long-run effects on GDP when the natural unemployment hypothesis holds. The supply shocks are those that affect a production function, such as productivity shocks and oil price shocks.

As a result of forming a currency union, there is a possibility that some of the countries that now have a patchy track record of inflation control and exchange rate management could benefit substantially from a monetary policy conducted by a more credible regional central bank. In terms of factor mobility, Asian countries especially the East Asian countries have relatively high labor mobility as well as capital mobility (Goto and Hamada 1994; Eichengreen and Bayoumi 1999; Moon, Rhee, and Yoon, 2000). For example, workers from Indonesia, Malaysia, Philippines, and Thailand account for 10 percent of the employment in Singapore. Emigration has been as much as 2 percent of the labor force of the sending countries.

Joining a monetary union can benefit a country's economy in a number of ways. First, it eliminates exchange rate risk with other monetary union members, which facilitates trade among them. Second, it makes price differences in member countries more transparent and therefore, sharpens competition. Third, it may increase policy discipline specifically, an individual country's central bank may become more credible in its commitment to price stability by delegating authority for monetary policy to a regional central bank. However, the principal cost of joining a monetary union is that an individual country's central bank loses independent monetary policy control and therefore, loses its ability to stabilize the economy when it is hit by a shock. Common currency removes volatility in exchange rates across the union. In an environment of different currencies, transaction costs including the costs of obtaining information about prices would be higher. This would be a disincentive to trade, commerce and investment (Rose, 1994).

Some empirical studies (Rose, 2000; Frankel and Rose 2000; Glick and Rose 2001) regarding costs and benefits of monetary union suggest that a

monetary union confers substantial benefits to trade. Rose (2000), in a cross-sectional study, showed that two countries that share the same currency, trade three times as much as they would do it with countries of different currencies. Glick and Rose (2001), in a time-series cross-sectional study found that bilateral trade rises/falls by about 100% as a pair of countries forms/dissolves a currency union. Frankel and Rose (2000) used economic and geographic data to show that belongingness to a currency union triples trades among the members countries. They also found that every 1% increase in trade (relative to GDP) raise income per capita by roughly one third over twenty years. Hence, their results support the hypothesis that the beneficial effects of currency unions on economic performance come through the promotion of trade rather than through a commitment to non-inflationary monetary policy or other macroeconomic influence. Rose and Engel (2002) found that members of international currency unions tend to experience more trade and less volatile exchange rates.

Problems and Possibilities of Forming Asian Currency Union

Compared to the EU, Asian countries also rank quite high in terms of wage and price flexibility. In fact, traditionally they are known for their flexibility and speed of adjustment to shocks. This result is consistent with the general impression that labor markets are more flexible in Asia than in Western Europe. Many Asian countries have trade-to-GDP ratios as well as trade-intensity ratios (which normalize bilateral trade by the relative share of the countries in total world trade to eliminate size effects) that are higher than in Western Europe (Goto and Hamada, 1994; Kawai and Takagi, 2000). Although there are inter country differences, the symmetry in shocks among the countries in the region is comparable to the EU (Eichengreen and Bayoumi, 1999). The regionwide economic slowdown in 2001 in response to the global economic downturn is another evidence of the high degree of shock symmetry among these countries. The high degree of shock symmetry reflects both the high degree of openness (export orientation, capital flows etc.) and the similarities in the production structures among these economies.

Overall, composite OCA indices for the region, which take into account intraregional trade, wage-price flexibility, labor mobility and shock symmetry, are similar to those of the EU (Eichengreen and Bayoumi, 1999). Using a variety of indicators drawn from the OCA literature, Eichengreen and Bayoumi conclude that from a purely economic

perspective, different regions of Asia/ East Asia are suitable for an OCA as European condition was the same prior to the Maastricht Treaty.

There are some constraints for Monetary Union in Asia as well. First, In terms of income levels, stages of development and economic structures, Asian economies have less similarities than those of European nations. The implication is that achieving any monetary arrangement including a common currency, is much more difficult in Asia. Second, Asia is less economically self-contained than Europe. Economies in Asia, especially in the East Asia have developed and intra-regional trade has grown recently. But about half of the intraregional trade is trading of raw materials and intermediate components that are ultimately exported to outside the region. East Asian countries still depend much more heavily on exports to countries outside the region. Thus, East Asia must be more concerned than Europe about exchange rate stability against currencies outside the region as well as within the region. Third, the two regions differ in terms of interest in political integration. In Europe, a monetary union was achievable primarily because it was part of the larger process of political integration. Most European countries share a history of intellectual belief in the benefits of integration and political democracy. There is no apparent desire for political integration in Asia, partly because of the great differences among those countries in terms of political systems, culture, and shared history. The fourth difference is that, in contrast to Europe, Asian governments appear much more suspicious of strong supranational institutions. European Commission, the European Parliament preceded establishment of the European Central Bank. They were indispensable to providing the popular support for delegating monetary decisions to a common central bank. In contrast, in Asia, sovereignty concerns have left governments reluctant to delegate significant authority to supranational bodies, at least so far. Four constraints have generally been considered as obstacle for a common currency union. These are (a) diversity in the level of economic development across countries, (b) weaknesses in the financial sectors of many countries, (c) inadequacy of region-level resource pooling mechanisms and institutions required for forming & managing a currency union and (d) lack of political preconditions for monetary cooperation and a common currency.

The diversity in the level of economic development among the Asian countries is quite large. This degree of diversity is higher than among the countries of the EU. It is sometimes argued that such a high degree of

income differentials could make it difficult to sustain a monetary union among the member countries. One of the lessons from some of the emerging market financial crises is that when countries with weak banking and financial sectors and heavy dependence on foreign capital peg their exchange rates, banking problems could turn into an exchange rate crisis (Eichengreen and Bayoumi, 1999). A weak banking system could, therefore, undermine an exchange rate regime such as a common currency arrangement. Historically, banking problems have not been as pervasive among the ASEAN countries as in other emerging market economies. Yet, the 1997 financial crisis in Asia has exposed the fragility of the banking systems and the financial sectors of many countries in Asia.

Inadequate mechanisms for regional reserve pooling as well as the absence of regional institutions could be another set of constraints on monetary cooperation and common currency among the Asian countries. Europe established a whole gamut of institutions such as the European Council, European Commission and European Central Bank to manage regional resource sharing and to coordinate the monetary union. It took decades of experimentation in Europe to establish these institutions. Given the almost total absence of institutions to support regional monetary cooperation in Asia, developing the regional institutions to manage a common currency is likely to be a major challenge.

Some Empirical studies can be considered regarding Monetary Union in Asia especially in the East Asia. Bayoumi et al. (2000) made an empirical analysis of an optimal currency area in the East Asian region. In his study correlations of supply shocks were relatively higher among Indonesia, Malaysia and Singapore. Also, the correlation was higher between Singapore and Thailand. Therefore, these four ASEAN countries might be able to form an optimal currency area from the viewpoint of symmetric shocks. Supply shocks in Japan had a positive correlation with those of Australia, Taipei, China and Korea. They had a lower correlation with ASEAN countries except Thailand. Ogawa and Kawasaki (2002) used a Generalised Purchasing Power Parity (G-PPP)¹ model to conduct empirical analysis on the possibility of an optimal currency area in East

Ogawa and Kawasaki attempted to make an important contribution to the literature by introducing a new approach, a Generalised Purchasing Power Parity (G-PPP) model, to analyze whether a common currency basket can be adopted in "ASEAN plus three" countries. The G-PPP model assumes that a linear combination of some bilateral real exchange rates may have a stable long-run equilibrium, which reflects the commonality in shocks and a strong economic relationship among the countries.

Asia. The G-PPP model is an extension of a simple Purchasing Power Parity (PPP) model by taking into account difficulties in holding the PPP because of nominal and real shocks that have sustained effects on macro fundamentals. Theoretically it is not difficult to expect that the East Asia region might form a common currency area in the future. With the common currency basket as an anchor currency, it is found that at least five Asian countries can form a common currency area. On the other hand, five Asian countries (four countries with one exogenous country) are found to be able to form a common currency area with the US dollar as an anchor currency. If a number of countries that can form a common currency area are used to judge a more applicable anchor currency, empirical results suggest that the common currency basket is better as an anchor currency than the US dollar. Lee, Park and Shin (2002) and McKinnon and Schnabl (2004) also found that East Asia is not unsuitable for a currency union. While Chow and Kim (2000), Wyplosz (2001) argued that East Asia does not satisfy the preconditions for implementing a monetary union yet. Kwack (2004) propose to form a quasi-monetary block in East Asia due to differences among member countries. For many of the growing number of smaller countries, the costs of maintaining separate currencies and floating exchange rates are likely to be very high. For them, therefore, the net benefits from joining a monetary union (or simply using another country's currency) are likely to be significant (Barro, 2001). This could encourage the formation of an increasing number of currency unions over time.

Monetary Union in South Asia

A similar level of economic development is crucial among potential members of a currency area in order to facilitate economic integration. Bangladesh has liberalized its economy progressively over the last decade, so that there exists enormous scope for the other Asian states to increase trade and investment links with it. Bangladesh and other SAARC countries structure of production are reasonably similar. Most of the SAARC countries have similar growth and inflation rates. Bangladesh along with other SAARC countries exhibits similar growth rates in money supply. Most of the countries have comfortable levels of foreign exchange reserves. As far as the value of domestic currency and flow of foreign direct investment (FDI) is concerned, the SAARC countries have experienced significant differences. Since Bangladesh and other member countries of SAARC currently have similar inflation rate, low current account deficits, similar growth, trade and production structure, it prods

to think of the possibility of monetary union in the region, even if not for all the SAARC countries, certainly for Bangladesh and some subgroup(s) of the member countries.

The benefits from an OCA accrue from a high level of intra-regional trade in the form of lower transaction costs. But the volume of intra-regional trade in South Asia is quite insignificant, resulting in a limited interdependence among the South Asian countries. The low level of intra-regional trade stands at odds with the openness of these economies to trade. However, further liberalization and intra-regional trade may be needed in order to gain the benefits of low transaction costs and elimination of exchange rate risk that accrue from using a common currency.

Since an entry into a monetary union means abandoning an independent monetary policy, it is essential for Bangladesh and other member countries to face similar economic shocks that would require a similar monetary policy response. Most of the SAARC countries do have similar production and export structure. Bangladesh and other SAARC countries are specialized in the production of few goods. If specialization is in the same goods, this in fact could be taken as an argument to form an OCA since they will be affected by similar shocks. Hence, these countries are more likely to experience symmetric external shocks. On analyzing the supply shocks, empirical studies find that the estimated correlation coefficients of supply shock for South Asia ranged between -0.46 and 0.42, while they ranged between -0.39 and 0.68 for Western Europe, -0.16 and 0.71 for East Asia, and -0.59 and 0.72 for the Americas (Saxena, 2002).

The OCA literature argues that labor mobility helps the members of a monetary union to adjust to asymmetric shocks by allowing labor to move from areas of high unemployment to low unemployment. It is argued that under free trade, smaller countries are expected to experience more trade gains that will bring all the economies in the region to converge in terms of macroeconomic performance. Also, in recent years, Bangladesh and other SAARC countries are doing well in terms of macroeconomic performance. There is a high and stable growth of output in the region. The key macroeconomic variables like inflation rates, exchange rates and fiscal deficits are converging. The ongoing macroeconomic reforms are the positive steps in the direction of monetary cooperation in the region.

Bangladesh and other South Asian countries can develop its own short, medium and long-term strategy for economic integration. It is important that each stage is implemented effectively before moving on to the next in order to build a sound foundation for progress. In this context the development of the European Union may be studied which is considered to be the most advanced model for regional grouping. The European integration evolved over four stages: First, a preferential free trade regime where member countries reduced or eliminated tariff and non-tariff barriers amongst them. Second, a Customs Union created a common external tariff so that import duties were the same for each member country. Economic Union was the third stage, which further integrated the market, eventually leading to a single market. The final step was a monetary union in which the national currencies of the member countries were replaced by a single currency. Already Bangladesh and South Asian countries crossed the first step by implementing SAFTA. But it is certainly a challenging task for Bangladesh and other SAARC countries to move from the "good neighbors' stage" to the European "happy family stage."

Conclusion

In order to strengthen international competitiveness and provide an engine of growth, the global economic integration has been complemented with a trend towards regional economic integration. The increased pace of globalization along with the spread of trade in goods and services and financial transactions and the heightened diffusion of technology are also likely to encourage the formation of currency unions. In an increasingly globalizing world, there is likely to be greater synchronization of business cycles across countries and hence the net benefits of having fewer currencies to conduct cross-border business are likely to be larger. Moreover, as the world gets more integrated, the volume of transactions involving citizens of different countries will increase. As international transactions become a larger share of total global transactions, the attractiveness of common currencies relative to a multitude of sovereign currencies is likely to increase. The preparatory groundwork itself would involve considerable effort. Going by international experience, the time required to complete the process is unlikely to be short either. Europe spent several decades in experimenting with regional monetary cooperation before adopting a monetary union. But, as is well known, regional monetary integration, by its very nature, is a long process involving a series of small, incremental, steps over time. The task may be even more challenging for the Asian countries.

The member states of the SAARC have set as a target for the achievement of an economic union by 2020. Reaching this goal will require greater levels of monetary cooperation. In South Asia the member states have minor trade linkages and face asymmetrical patterns of shocks. This paper concludes that absence of a clear road map for monetary cooperation, the present process requires a deep abandonment of sovereignty and the setting-up of a common central bank. In view of the absence of institution building in Asian region, monetary unification and optimum currency area seems far-fetched.

References

- Bayoumi Tamim and Barry Eichengreen (1994) "One Money or Many? Analyzing the Prospects of Monetary Unification in Various Parts of the World," Princeton Studies in International Finance, No 76.
- Bayoumi, Tamim, Barry Eichengreen, and Paolo Mauro(2000) "On Regional Monetary Arrangements for ASEAN." Journal of the Japanese and International Economies 14.
- Chow, H.K., and Y. Kim (2000) "A Common Currency Peg in East Asia? Perspectives from Western Europe" mimeo.
- Collignon, S. (1999)"Bloc Floating and Exchange Rate Volatility: The Causes and Consequences of Currency Blocs." In S. Collignon, J. Pisani-Ferry, and Y. C. Park, eds., Exchange Rate Policies in Emerging Asian Countries. Routledge, USA.
- Dash, K.C. (1996) "The Political Economy of Regional Cooperation in South Asia," Pacific Affairs, Vol.69, Number 2.
- Eichengreen Barry and Bayoumi Tamim (1996) "Is Asia an Optimum Currency Area? Can It Become One? Regional, Global and Historical Perspectives on Asian Monetary Relations," University of California Berkeley Centre for International and Development Economics Research (CIDER), Working Paper No C96/081.
- Fabella, Raul (2002) "Monetary Cooperation in East Asia: A Survey," ERD Working Paper.
- Frankel, Jeffery and Andrew Rose (2000)"Estimating the Effect of Currency Unions on Trade and Output", NBER Working Paper 7857.
- Glick, Reuven and Andrew Rose (2001) "Does a Currency Union Affect Trade? The Time Series Evidence" CEPR discussion paper No.2891.
- Lee, J., Y. Park, and K. Shin (2002) "A Currency Union in East Asia," mimeo.
- McKinnon, R. (2001) "After the Crisis, the East Asian Dollar Standard Resurrected: An Interpretation of High-Frequency Exchange Rate Pegging," in Joseph E. Stiglitz and Shahid Yusuf, eds. Rethinking the East Asian Miracle, World Bank and Oxford University Press .

- Moon, W. S., Y. Rhee, and D. R. Yoon(2000) "Asian Monetary Cooperation: A Search for Regional Monetary Stability in the Post euro and the Post Asian Crisis Era." *Economic Papers* 3(1).
- Ogawa, E., and K. Kawasaki (2002) "Possibility of Creating a Common Currency Basket for East Asia" A paper prepared for the International Symposium on China's Economic Development and Structural Change in East Asia in Commemoration of the Foundation of Shanghai Center for Economic Research, 8-9 February 2003, Kyoto University, Japan.
- Rajan, R. (2000) "Currency Basket Regimes for Southeast Asia: The Worst System with Exception of All Others" Policy DP No. 0028, Centre for International Economic Studies, Adelaide, Australia.
- Rose and Charles Engel (2002)"Currency Unions and International Integration", *Journal of Money Credit and Banking*, 34.
- Rose, A. (1994) "Are Exchange Rates Macroeconomic Phenomena" Federal Reserve Bank of San Francisco Economic Review 1.
- Rose, Andrew (2000) "One money, One market: the Effect of Common Currencies on Trade" *Economic Policy*, Vol.30.
- Saxena, Sweta Chaman, Baig Mirza Allim (2004) Monetary Cooperation in South Asia: Potential and Prospects and RIS-DP -71/2004, ,RIS Discussion Paper.
- Saxena, S.C.(2002) "Is the Euro Area a Role Model for Asia?", University of Pittsburgh mimeo.

Designing Pro-Poor Service Delivery Strategy at the Grass-roots Level: A Case Study

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Abstract: *The present study has been initiated as a first phase on the Savar and Dhamrai Upazila as laboratory area for developing an Upazila profile on poverty alleviation. The aim of the present study is an attempt to design pro-poor service delivery strategy on the basis of local natural resources, population and family planning, level of poverty and inequality as well as education at the grass-root level. It also attempts to examine and identify the causes of poverty situation and to determine the underlying dimensions of poverty on the study areas to understand its remedies and formulate appropriate strategies for poverty reduction at the grass-root level and recommendations as policy options for the government.*

Both Upazilas have got the same characteristics except density of population. There is a significant positive correlation between other information of the study area. Ratio of land use pattern is considerably consistent in comparison with various sectors in the study areas. There is a wide difference between the ratio of educational institutions, forestland use and homestead. Comparison of other indicators such as sources of drinking water and use of surface water dependency ratio does not have any significant variation between the villagers.

Distribution of population by different age groups provides a strong positive correlation between two Upazilas. Similar trend is also observed in respect to other demographic aspects such as average size of the family, dependency ratio and birth and death rate except density of population. Other variables indicate that household size, dependency ratio and sex ratio are important factors in explaining differentials in incidence of poverty. The poor households tend to have larger family size, higher dependency burden and higher proportion of female members than non-poor counterparts.

The education profile in the study areas also indicates that the well-to-do sections of people mainly enjoyed the facilities of education available.

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This situation has changed to some extent with the introduction of stipend system for the girl students from the primary to secondary level. Collateral system against credit prevents scheduled banks from responding to the need of poor people except Grameen Bank and other similar NGOs in a very limited scale. Thus an appropriate step should be taken from Government for promotion of rural development in general and to provide modern technology to small and marginal farmers in particular. It emerged from the various information of the present study that "Trickle Down" policy of development provided a mixed picture in the study areas. Although there has been some positive impact on agricultural productivity but the benefit accrued from development programmes have by - passed the largest groups i.e. landless rural poor.

Moreover, a target oriented programme to promote local level natural resources through formal and non-formal education and awareness campaign could be implemented. Special programmes for development of natural resources like social forest, homestead forest, roads and highway side etc. could be implemented under various institutional managements with input supports like supplying of different types of plants and extension support services for income generation. Population and family planning component need to be an integral part of every programme and development project in order to reduce the population growth and minimize the pressure on limited resources. The low rate of population growth may be achieved through wide spread literacy, family planning campaign expansion primary health care and strong birth planning policy.

To alleviate poverty in the study areas, it is necessary to allocate more government resources in favour of agro-based and modern technological programme mainly within disadvantaged group. Moreover, NGOs should extend their target-oriented activities for hard-core poor and landless people as well as marginal farmers to provide credit facilities without collateral and other means of fund to generate income. Human resource development and alleviation of poverty, specific target oriented programme including formal and informal training could also be given for asset forming, self-employment opportunities like fisheries, livestock and small business under various institutional support.

An appropriate land use policy in the study area is important for overall development as well as for attaining the goal of higher cropping intensity and higher productivity. These recommendations could be implemented

by adopting three major interconnected strategies such as (a) Creating Opportunities, (b) Empowering the Local Level Poor and (c) Increasing Security. Designing appropriate pro-poor service delivery strategy cannot be made by examining a few issues of two Upazilas in single study but it paves the initial step to start the process of poverty alleviation and local level development. Finally the elimination of poverty in the study area has to be based on increased production in various sectors and thereby increase labour productivity in different economic activities.

1.0 Introduction

Poverty reduction is the greatest single challenge of Bangladesh. The country is trapped in a kind of 'vicious circle' in which one problem leads to another and the new problem makes the first problem worse. It has branded our country not only as one of the poor countries in the world but also termed as bottomless basket to the donors. Historically, poverty has mainly been concentrated in rural areas of Bangladesh but in the midst of a massive urbanization, poverty is becoming an increasingly urban phenomena, where bulk of absolute poor are living in both areas in substandard housing. Moreover, rate of infants mortality are three times higher and rate of tuberculosis is nine times higher than the upper urban residents living in the same city¹.

The country has made notable progress in income-poverty reduction since Independence. The income-poverty trends since the early nineties based on the unit-record data of the Household Income and Expenditure Survey (HIES) show the following pattern. Between 1991/1992 and 2000, the incidence of national poverty declined from 58.8 to 49.8 percent, indicating a modest reduction rate of 1 percentage point per year. The declining trend remains valid for other poverty measures as well. The results further show that progress on reducing the head-count index of poverty was better in urban areas. However, rural areas displayed better progress in reducing the depth and severity of poverty, as captured by trends in poverty gap and squared poverty gap, respectively².

During the period between 1991-92 and 2000 the level of conjunction expenditure inequality increase from 30.7 to 36.8 in urban areas, and

¹ United Nations Population Fund. The state of world poverty 1999, New York 2002, p.16.

² Government of Bangladesh, Bangladesh : A National Strategy for Economic Growth, Poverty Reduction and Social Development, ERD, Ministry of Finance, March 2003. p.7.

from 24.3 to 27.1 in rural areas. The sources of rising inequality are linked with the uneven spread of economic and social opportunities, unequal distribution of assets especially in respect of human capital and financial capital, growing disparity between urban and rural areas as well as between developed and underdeveloped areas³ According to the Human Development Index (HDI) compiled by UNDP in 2004 for the year 2001, out of 175 countries Bangladesh ranks 141. It gives a value/score of 0.365 for Bangladesh, while the scores of some of our neighboring countries are 0.698 for Sri Lanka, 0.442 for Pakistan, 0.451 for Myanmar, 0.332 for Nepal and 0.307 for Bhutan.

Further, UNDP in its Human Development Report in 2004 estimates that 51.00 percent of the people of Bangladesh are income poor (headcount index), while 76.9 percent of the people are poor. On the basis of this report 52.85 percent were without access to health service, 63.35 percent were without sanitation and 26 percent of children were not attending primary school. It also reveals that life expectancy at birth was 39.6 years in 1960 and 60.40 years in 1999, while infant mortality rate per thousand live births was 153 in 1975 and 66.00 in 2000, adult literacy rate was 24 percent in 1970 and 37 percent in 1999, gross enrollment ratio for all (6-23) was 30 percent in 1980 and 46 percent in 1999.

Over the years, there has been remarkable improvement in some of these social indicators. First, Bangladesh has achieved impressive success in the area of population control. The population growth rate has come down from 2.9 percent per annum in 1975 to 1.5 percent in late nineties. Second, the country has achieved a desirable objective of self-sufficiency in rice production, third, it has achieved considerable success in mainstreaming the women in to the development process as well as progress towards a viable democratic transition.

In spite of these declining trend in income-poverty during first half of the nineties, the comparison picture of this information shows that the population of landless and the functionally landless in extreme poverty in the rural areas grew several time as fast as the natural growth of rural population. Moreover, the measure of progress recorded in income measure of poverty has not been equally matched by concomitant improvement in several crucial dimensions of poverty. Finally, after every statistical adjustment, the challenge of poverty alleviation in Bangladesh remains a momentum one with nearly 50 percent of the rural

³ Ibid.

population living in poverty of which approximately half are in extreme poverty level.⁴

2.0 Importance of the Study

The new century opened with an unprecedented declaration of solidarity and determination to rid the world of poverty. In 2000 the UN Millennium Declaration, adopted at the largest-ever gathering heads of states committed to eradicate poverty, promote dignity and equality and achieve peace, democracy and environmental sustainability. World leaders including Bangladesh promised to work together to meet concrete targets for advancing development and reducing poverty by 2015 or earlier.⁵

Following this commitment Government of Bangladesh formulated a national strategy for economic growth, poverty reduction and social development plan.⁶ It embraces a comprehensive approach promised on a right-based framework, that highlights the need to progressive realization of rights in the shortest possible time. For this, poverty reduction and accelerating the pace of social development have been made the major strategic goals.

The strategy envisages that by the year 2015, Bangladesh would achieve the targets⁷. Remove the 'ugly faces' of poverty by eradicating hunger, chronic food-insecurity and extreme destitution; reduce the member of people living below the poverty line by 50 percent; attain universal primary education for all girls and boys of primary school age; eliminate gender disparity and secondary education and reduce infant and under five mortality rates by 65 percent and eliminate gender disparity and child mortality;

As a formal field of inquiry, design and develop an Upazila Development Profile for poverty alleviation at the grass-root level through action research is quite new and the literature on it is very scanty in Bangladesh. Bangladesh Public Administration Training Centre (BPATC) was quite concerned about the gap and is interested to undertake a longitudinal

⁴ Most of the dominants including World Bank Clearly indicate that poverty scenario in real-sense has not substantially improved.

⁵ UNDP, Human Development Report 2003, p.1.

⁶ Ministry of Finance, Bangladesh: A National Strategy for Economic Growth Poverty Reduction Development , 2005 Government of Bangladesh , p. viii.

⁷ Ibid.

study to prepare an Upazila Development Profile for poverty alleviation to evolve guidelines and appropriate strategies. Given the above scenario, micro-research at the Upazila Level would not only help to formulate an appropriate development strategies and guidelines but also provide policy options for the Government.

The present longitudinal study has been initiated as a first phase on the Savar and Dhamrai Upazila as a laboratory area for developing an upazila profile on poverty alleviation. Moreover, findings of the study would be used as concerned public representatives for properly managing and administering at the Upazila, Union and village level.

3.0 Objectives of the Study

On the basis of the above background the present study is an attempt to delineate the poverty alleviation within the ambit of social development at the Upazila Levels in longitudinal perspectives. The aim of the present study is an attempt to design pro-poor service delivery strategy on the basis of general information on the study areas, local natural resources, population and family planning, level of poverty and inequality and education at the grass-root level in order to provide a reference document to the Upazila administration and training input for the members of Bangladesh Civil Service.

More specifically the objectives of the present study are as follows:

- (i) to examine and identify the causes of poverty situation of Bangladesh;
- (ii) to determine the underlying dimensions of poverty on the study areas to understand its remedies and
- (iii) to formulate appropriate strategies for poverty reduction at the grass-root level and recommendations as policy options for the government.

4.0 Methodology

The present study has been mainly based on collecting various type of interrelated information available in the study areas. In collecting this information, the authors of the present study therefore adopted following methods. Researchers along with data collectors initially made several field visits of two Upazilas to observe and to select the location of unions.

This was followed by additional visits to have the opinions of UNO, and Chairman of selected Union Parishads. Besides, secondary information has been collected from various published documents and records available at BPATC Library and Upazila Library.

4.2 Plan of the Paper

In the first section, introduction, objectives and scope methodology and limitations of the study have been presented.. Section two highlights analysis of data which begins with description of basic information of two Upazilas and respondents opinion regarding their problems and suggestions. Section three proposed some recommendations, which have been discussed, followed by conclusions.

5.0 Analysis of Data

An attempt has been made in this section to briefly discuss the socio-economic situation on the basis of the framework mentioned in the previous chapter. As the causes of poverty are however much more complex and no single factor is sufficient to understand the dynamics of socio-economic process of poverty at the grass-root level.

6.0 Savar Upazila

6.1 Background: Savar Upazila is the second biggest Thana of Dhaka district in respect of area and population. Savar Thana was established in 1912 and it was declared as an Upazila in 1983. It occupies an area of 280.13 sq. km. including 5.05 sq.km. river and 0.28 sq.km. forest area. The Upazila is located between 23° .44' and 24° .02' north latitudes and between 90° 11' and 90° 22' east longitudes. It is bounded to the north by Kaliakoir and Gazipur Sadar Upazila, on the east by Mirpur, Mohammadpur, Pallabi and Uttara, on the south by Keraniganj and on the west by Dhamrai Upazila of Dhaka and Singair Upazila of Manikganj district.

6.2 Demographic characteristics: The Thana has a population of 378,034 of which 206,669 are males and 171,365 are females. The sex ratio of the Thana is 121 males per 100 females as against 113 males per 100 females in 1981. The literacy rate is 37.8% for both sexes 7 years and over, 44.8% for male and 29.1% for female. In this Thana, the literacy is the highest i.e. 63.1% in Ward no. 02 Union and the lowest i.e. 20.3% in Bhakurta Union. The child-woman ratio (Children 0-4/ Women 15-49)

per thousand for the Thana area is 585. School attendance at the age group 5 - 24 for male is 42.4% and for female is 36.7%. This shows increases over the 1981 figures of 25.0% and 14.4% respectively.

7.0 Dhamrai Upazila

7.1 Background: Dhamrai is the largest Thana of Dhaka zila in respect of area and it was established in 1914 and it turned into an Upazila in 1985. Nothing is definitely known about the origin of the Thana name. It is learnt that in the past the area was named Dhamrai after the name of an influential man Dhama Khoje and his wife Rai Goalini.

7.2 Area and Location: The Thana occupies an area of 307.40 sq. km. including 5.98 sq. km. river area. It is located between 23° 49' and 24° 03' north latitudes and between 90° 01' and 90° 15' east longitudes. The thana is bounded on the north by Mirzapur thana of Tangail zila and Kaliakair thana of Gazipur zila, on the east by Savar thana, on the south by Singair thana of Manikganj zila and on the west by Saturia thana of Manikganj zila. The main rivers are Bangshi, Dhaleshari and Gazikhali. The Thana consists of 16 Unions, 307 Mauzas and 398 villages. The average population of Union, Mauza and village are 19,549, 1,019 and 786 respectively.

7.3 Demographic Characteristics: The Thana has a population of 312,777 of which 157,553 are males and 155,224 are females. The sex ratio of the thana is 102 males per 100 females as against the same number of males per 100 females in 1981. The decadal population growth rate is 17.77% and annual compounded growth rate is 1.65%.

The literacy (7 years and over) is 29.5% for both sexes, 37.0% for male and 21.9% for female. In urban area, it is 59.3% for both sexes, 65.6% for male and 52.1% for female which are as higher compared to the corresponding rates in rural area of 27.2% for both sexes, 34.6% for male and 19.7% for female. In the thana, the literacy is highest i.e. 52.0% in Dhamrai union and the lowest i.e. 17.8% in Rawail union. The child-woman ratio (children 0-4/women 15-49) per thousand for the Thana, rural and urban areas is 584, 586, and 554 respectively. School attendance at the age group 5-24 for male is 43.9% and for female is 32.0%. This shows increases over the 1981 figures of 23.9% and 12.5% respectively.

8.0 Comparative Scenario of Study Area

Table-1 reveals the comparative scenario of study area on general information of the sampled two upazila at a glance. Savar is the biggest upazila in terms of population having 5.80 lakhs inhabitants of which 52.51% percent are male and the rest (47.49%) are female followed by 50.27% and 49.73% male and female in Dhamrai Upazila comprising 3,47,520 population.

Table-1 Basic Information about Sampled Upazilas

Basic Information	Upazila	
	Savar	Dhamrai
Total Area (in Sq.Km)	282.45	307.40
Population:	5,80,516	3,47,520
Male	304812(52.51%)	174700(50.27%)
Female	275704(47.49%)	172820(49.73%)
(Census-2001)		
Density of Population (Per Sq.Km)	2055	1131
Average family size	5.40	5.12
Number of Union	12	16
Literacy rate (in %)	62.00	62.5%
Distance from district HQ(in Km)	22	36
No. Mouza	274	308
Number of village	376	408
Cultivable land(in hector)	22630	25300
Single crop land (in hector)	3676	2510
Double crop land (in hector)	17810	13895
Triple crop land (in hector)	12600	8895
Number of agri block	57	48
Govt. Primary School	99	139
NGOs	82	19
Bank	25	13
Deep Tubewell	172	118
Shallow Tubewell	503	3850
Power Pump	491	46

Source : Field Survey

9.0 Local Natural Resources

Distribution of land use by upazilas is shown in Table-2 that 55.21% of the total land is cultivable at Dhamrai Upazila, whereas for Savar Upazila this figure is 48.80% followed by homestead land 16.90% and 15.08% for Dhamrai and Savar respectively. While road occupies 9.23 percent and 10.19 percent which is third largest land use in both Upazila. Amongst other canal and river share 7.19 percent and 7.16 as well as 5.28 and 6.46 respectively.

Table-2 : Distribution and Use of Land by Upazila

Pattern of Land Use	Area in Acre %	
	Dhamrai(8 Union)	Savar (6 Union)
Cultivable	55.21	48.80
Uncultivated/Fallow	2.87	2.89
Forest	0.08	0.20
Low-lying	1.83	1.90
Industries	-	0.87
Homestead	16.90	15.08
Road	9.23	10.19
Canal/Waterway	7.19	7.16
Education/Institution	1.08	5.71
River	5.28	6.46
Other	0.32	0.74
Total	100.00	100.00

Source : Field Survey

The Table-2 also shows that land use for other items are very significant in the study area but the trend of land use pattern has got similar characteristics of both Upazilas. While, Table-3 shows that the study areas unfortunately do not have any natural forest under the Department of Forest although these areas commonly known to the local people as a forest area. 100 percent forest area in both the Upazilas remain under homestead forest.

Table-3 : Land Available for Forestry by Upazila

Type	Area in Acre(%)	
	Dhamrai	Savar
Natural Forest	-	-
Homestead Forest	100.00	100.00
Forest under department of Forest	-	-
Total	100.00	100.00

Source : Field Survey

The Table-4 clearly indicates that river, canal, pond and bil are the sources of surface water in both the upazila. For Savar and Dhamrai Upazila 47.27% & 41.12% accounts for surface water from river respectively followed by 21.31% and 22.80% from canal. For Dhamrai Upazila 22.31% surface water sourced from pond. Whereas, this figure is 18.60% for Savar upazila. It is noticed that both in Dhamrai and Savar Upazila, the surface water is used for bathing, washing, cultivation, communication and pisciculture.

Table-4 : Sources and Use of Surface Water by Upazila

Sources of water	Area Coverage in Acre(%)		Nature of Use of Water	
	Dhamrai	Savar	Dhamrai	Savar
Pond	22.31	18.60	Bathing, Washing and Pisciculture	Bathing, Washing and Pisciculture
River	41.12	47.27	Bathe, Wash & Communication	Bathe, Wash & Communication
Canal	22.80	21.31	Communication	Communication
Bil	13.77	12.82	Cultivation & Pisciculture	Cultivation & Pisciculture
Total	100.00	100.00		

Source : Field Survey

The survey revealed that tube-wells are the prime sources of drinking water for the sampled area. Table-5 shows that most of the tube-wells (95.00%) are operating properly followed by pond and kua. The remarkable finding is that people still drink water of pond, which may not be hygienic.

Table-5 : Sources of Drinking Water by Upazila

Sources	Dhamrai		Savar	
	Existing No.	Actually used for	Existing No.	Actually used for
Tubewell	12520	11977(95.67)	9630	9120(94.70)
Indra	14	00(0.00)	16	00(0.00)
Kua	150	45(30.00)	128	35(27.34)
Pond	552	434(78.62)	320	240(75.00)

N.B. Figures in the parenthesis indicate percentage of the Utilization of existing sources.

10.0 Population and Family Planning

In respect of age distribution, it is found that for Dhamrai upazila male consists of 50.71% of the total population followed by 49.29% female. It is evident from Table-6 that 51.27% of the total population is male. The study revealed that highest percentage of the population, (43.53% in Dhamrai & 43.87% in Savar) belonged to the age between 18-59 years followed by in between 5-17 years. The composition of population for both the sample Upazila noticed to be almost same.

Table-6 : Distribution of Population by Age

Age (in year)	Dhamrai (8 Union)			Savar (6 Union)		
	Women	Men	Total	Women	Men	Total
0-4	11975 (6.64)	12350 (6.85)	24325 (13.49)	9118 (6.65)	9350 (6.82)	18468 (13.47)
5-9	13255 (7.35)	13850 (7.68)	27150 (15.03)	9748 (7.11)	10280 (7.49)	20028 (14.00)
10-14	12220 (6.78)	12490 (6.93)	24710 (13.71)	9082 (6.62)	9646 (7.03)	18728 (13.65)
15-17	6650 (3.69)	6875 (3.81)	13525 (7.50)	5190 (3.78)	5840 (4.25)	11030 (8.03)
18-34	22675 (12.58)	23225 (12.88)	45900 (25.46)	17204 (12.54)	17930 (13.07)	35134 (25.61)
35-59	16125 (8.95)	16452 (9.12)	32577 (18.07)	12328 (8.98)	12735 (9.28)	25063 (18.26)
60+	5964 (3.30)	6120 (3.39)	12080 (6.69)	4230 (3.08)	4455 (3.24)	8685 (6.32)
Total	88860 (49.29)	91362 (50.71)	180222 (100.00)	66900 (48.73)	70236 (51.27)	137136 (100.00)

N.B. Figures in the parenthesis indicate percentage of the total population.

Table-7 depicts that density of population for per square km Dhamrai & Savar is 1131 & 2055 respectively. It is shown that average size of the household for Savar & Dhamrai is 5.10 & 5.06 respectively and dependency ratio is quite close in both the sample areas.

Table-7 : Density of Population and Dependency Ratio of Population

(Per Sq.Km.)

Features	Dhamrai	Savar
Density of Population	1131	2055
Average size of the family	5.06	5.10
Birth Rate	2.01	1.90
Death Rate	0.39	0.45
Dependency ratio	1:4.67	1:4.75

Source : Field Survey

Table-8 shows the distribution of population by occupation of study area, it may be observed that day labour was dominated (more than 37%) as percentage of total population for both the sampled Upazila followed by agricultural labour and business. Details may be shown in Table-8.

Table-8 : Distribution of Population by Occupation

Occupation	Dhamrai(%)	Savar(%)
Agriculture	27.67	26.55
Service	5.46	4.94
Business	20.00	22.47
Day Labour	37.33	38.22
Housework	4.05	4.60
Others	5.49	3.60
Total	100.00	100.00

Source : Field Survey

The researchers tried to know the migrational variety of the sampled areas. It is noticed that 57.46% of the migrated people of Dhamrai upazila are staying inside the country (not in the locality) and the rest 42.54% are residing outside the country (overseas). And for Savar upazila this figure was 59.94% and 40.06% respectively (Table-9).

Table-9 : Statement of Population by Migration

Description	Dhamrai	Savar
No. of people staying outside the country(Overseas)	42.54	40.06
No. of people staying inside the country (not in the locality)	57.46	59.94
Total	100.00	100.00

Source : Field Survey

Table-10 : Statement about Family Planning Methods

Item	Dhamrai	Savar
Eligible couple	19245	14638
Persons practicing the method in %	63.35	65.56
About the method		
Pill	49.47	50.63
Condom	13.63	14.43
Coper-T	8.86	8.96
Injection	15.36	15.81
Ligation	10.78	8.43
Vasectomy	01.89	1.71
Total:	100.00	100.00

Source : Field Survey

Table-10 shows that 63.35% percent of eligible couple of Dhamrai is practicing family planning methods and for Savar upzila the corresponding figure was 65.56 percent. Among the different method, pill taking by women was leading followed by injection. It is evident that contraceptive methods are being practiced mostly by female.

It is noticed from the Table-11 that for Savar, male & female voters accounts for 51.97% and 48.03% respectively, whereas for Dhamari it was 51.47% & 48.53%.

Table-11 : Distribution of Voter by Sex

Category	Dhamrai	Savar
Male	51.47	51.97
Female	48.53	48.03
Total	100.00	100.00

Source : Field Survey

The Table-12 illustrates that family planning department, agriculture department, Ansar and Village Defence Party (VDP), Union Parishad is taking part for expanding family planning activities in both the upazila, NGOs also rendered services to the people in this connection. It was known that the mentioned organizations render counseling and expansion of education and thus aware the people about the family planning programmes.

Table-12 : Description about the Organizations Related to Family Planning Activities

Organization	Dhamrai		Savar	
	Type of organization		Type of organization	
	Government	Others	Government	Others
Family Planning Department	†	-	†	-
School	†	-	†	-
Agriculture Department	†	-	†	-
Local Parishad (UP)	†	-	†	-
Ansar & VDP	†	-	†	-
NGOs		†		†

Source : Field Survey

It was found from the Table-13 that both Dhamrai and Savar the trend of literacy rate amongst the male and female by their classification are in the same direction. In percentage of unemployment, begging, disabling and disease affected, male are leading than female. Unemployed persons share more illiteracy in terms of education. Among the landless, female held more weightage (52%) in Dhamrai Upazila, which is almost reverse in case of Savar Upazila.

Table-13 : Distribution of Population by their Classification and Literacy Level

Class	Dhamrai					Savar				
	Sex		Education		Total	Sex		Education		Total
	Female	Male	Literate	Illiterate		Female	Male	Literate	Illiterate	
Unemployed	43.02	56.98	53.29	46.71	100.00	44.18	55.82	51.90	48.10	100.00
Landless	52.00	48.00	48.88	51.12	100.00	48.00	52.00	48.35	51.65	100.00
Begger	33.1	66.90	38.62	61.38	100.00	29.50	70.50	38.00	62.00	100.00
Sex worker	-	-	-	-	-	-	-	-	-	-
Disable	47.06	52.94	51.17	48.83	100.00	47.80	52.20	50.45	49.55	100.00
Disease affected	46.94	53.06	52.91	47.09	100.00	47.00	53.00	51.60	48.40	100.00
VGD Card holder	100.00	00.00	24.17	75.83	100.00	100.00	00.00	28.00	62.00	100.00

Source : Field Survey

The Table-14 demonstrates that 9.55% of the educated women in the study area of Savar are being in services followed by 7.96% in Dhamrai. The magnitude of child marriage is higher (12.70%) in Dhamrai, which

accounted for 11.55% in Savar. It is noticed that divorce rate in Savar upazila is higher (5.60%) than that of Dhamrai (4.88) Upazila.

11.0 Income Distribution

Table-14 : Information about Women in Service, Child Marriage & Related Issues

Item	Dhamrai	Savar
No. of Women in Service	07.96	9.55
No. of Child Marriage as % to total marriage	12.70	11.55
Divorce due to dowry	4.88	5.60

Source : Field Survey

Table-15 : Distribution of Household by Income

Income (in Tk.)	Dhamrai	Savar
	Percentage of Household	Percentage of Household
<750	3.13	3.16
750-999	4.81	4.54
1000-1249	7.33	7.58
1250-1499	16.32	16.86
1500-1999	8.89	8.85
2000-2499	4.24	4.36
2500-2999	11.57	11.67
3000-3999	10.16	09.79
4000-4999	8.11	08.43
5000-5999	7.66	7.35
6000-6999	6.01	5.82
7000-7999	4.20	4.23
8000-8999	3.31	3.20
9000-9999	1.50	1.39
12500-14999	0.33	1.60
10000-12499	1.76	0.30
15000-17499	0.42	0.44
17000-19999	0.24	0.22
2000+	0.19	0.17
Total Household	100.00	100.00

Source : Field Survey

The comparative Table-15 clearly shows that the distribution of household by income is concentrated in between Tk. 1250-1499 where Dhamrai Upazila has got 16.32 percent and Savar Upazila has got 16.86 percent respectively. The table also indicates that second highest group of distribution of household by income is concentrated in between Tk. 2500-2999 where 11.57 percent in Dhamrai Upazila and 11.67 percent in Savar Upazila. While the third highest group is concentrated in between Tk. 3000-3999 where 10.16 percent in Dhamrai 09.79 percent in Savar Upazila.

The above table also indicates that more than 80 percent household income distribution range in between Tk. 750 to 5999, while only 20 percent of household income could be classified into higher income group. It is clear from the Table-15 that the trend of distribution of household by income of Savar and Dhamrai Upazila is similar as they have almost equal opportunities of employment and business facilities. Location of Dhaka city and surrounding industrial estate as well as various types of organizations have given these facilities to both the Upazila.

12.0 Poverty and Employment

Household members were questioned about their standard of living in terms of poverty and their employment, including further information on poverty level and the member of people living below poverty line and how many of them are holding valuable group feeding card (VGD). The overall picture emerges from the table below that less than half of total population of Dhamrai and Savar are living below poverty line.

Table-16 : Information about Poverty & Employment

Item	Dhamrai	Savar
People live below poverty line(in %)	40.5%	39.60%
People do not have required food	09.00%	8.5%
People have work/employment	65.00%	67.5%

Source : Field Survey

Table-16 illustrates that 40.5 percent population of Dhamrai and 39.60 percent of Savar Upazila are living below poverty line. While, 65 percent population of Dhamrai and 67.5 percent of Savar Upazila have salaried work and self employed work respectively. Only 09.00% percent people are above poverty level and they do depend on either any employment or business. In fact their available resource do not encourage them to have employment and assistance from government.

13.0 Education in the Study Area

Education is essential for acquiring required knowledge, skill and attitudes for raising awareness of masses about the use of modern technology and information. It plays a vital role in enabling the individuals to have access to economic resources for the development. There is no single instance that illiterate society has been able to develop meaningfully and sustain their progress.

This section begins with the analysis of the educational scenario of two Upazilas covering primary, secondary and tertiary level as well as the different types of professional education such as general, Technical and Madrasha. The Primary Education spread over five years schooling and the secondary education is of seven years duration. It includes three years for junior secondary, two years for secondary and two years for higher secondary courses. The tertiary education is offered in Colleges and Universities.

There are three major types of educational institutes such as (i) Government, (ii) Non-Government and (iii) Private in Savar and Dhamrai Upazila. These educational institutes are again classified into three categories commonly known as Boys, Girls and Co-Education etc. In Dhamrai Upazila there are 54 Government Primary School (general category), 2 Madrasha with Co-Education facilities and only 1 Government Girl's High School (general category), While in case of Non-Government, there are 11 Co-Education Primary School, 13 Co-Education Primary level Madrasha followed by 4 Junior High School with Co-Education facilities 2 Technical Junior High School and 5 Junior High Madrasha with Co-Education facilities. There are also 9 High School (general category), 2 Technical High School and 6 High Madrasha with Co-Education facilities. In tertiary level Dhamrai Upazila has got only two Colleges (general category) and 2 Madrasha with Co-Education facilities. It has 11 Primary Boy's School and 1 Primary level Boy's and 1 Primary level Girl's Madrasha.

In Savar Upazila, there are 80 Government Primary level School with Co-Education facilities having no Madrasha and Girl's School. While, there are 19 Non-Government controlled Primary level School (general category), 12 Madrasha followed by 6 Junior Level High School (general category) and 4 Junior level High Madrasha with Co-Education facilities in Savar. There are also 32 High School (general category) and 5 High Madrasha with Co-Education facilities.

In tertiary level Savar Upazila has got 6 colleges (general category) and 2 Madrasha with Co-Education facilities. The table also indicates Savar Upazila has got 3 Private controlled Primary level Boy's School, 3 Primary level Girl's School and 2 Junior High School for Girls as well as 2 Junior High School with Co-Education facilities. Cross classification of the above information by educational level controlled by NGO's in Table-16 shows a strong and even relation between Dhamrai and Savar Upazila particularly in Co-Education in different level.

Finally, this section reflects standard of living of two Upazilas on the basis of distribution of households by income in general and various aspects of education in particular.

14.0 Level of Education by Unemployed and Landless

Table-17 highlights the level of education by unemployed and landless male and female of Dhamrai and Savar Upazila. 40.30 percent of male and 44.75 percent of female having primary education are unemployed in Dhamrai Upazila. While, 41.4 percent of male and 43.95 percent of female having primary level education are unemployed in Savar Upazila.

Table-17 : Level of Education by Unemployed and Landless of Male & Female

Level of Education	Dhamrai				Savar			
	Unemployed		Landless		Unemployed		Landless	
	Male	Female	Male	Female	Male	Female	Male	Female
Illiterate	21.05	25.04	26.41	31.25	22.54	26.10	27.05	32.10
Can Sign only	17.91	17.58	43.39	32.0	17.3	16.90	40.60	31.40
Primary	40.30	44.75	14.15	20.0	41.4	43.95	16.90	19.98
Junior-high	11.64	4.63	9.06	10.5	10.9	5.25	8.85	09.95
SSC	4.93	4.26	3.77	3.75	4.3	3.98	3.50	3.55
HSC	3.94	3.72	2.83	2.5	3.18	3.65	2.82	2.97
Bachelor/Masters	0.36	0.02	0.38	0.00	0.28	0.17	0.28	0.05
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source : Field Survey

Above Table indicates that 43.39 percent male and 32 percent of female are landless in Dhamrai Upazila who can sign only and 40.60 percent of male and 31.40 percent female are landless in Savar Upazila who can sign only. Whereas 21.05 percent of male and 25.04 percent illiterate male illiterate of female are unemployed in Dhamrai Upazila. While 24.41 percent of illiterate male and 31.25 percent illiterate of female in Dhamrai Upazila are landless. On the other hand 20.54 percent of illiterate male and 26.10 percent illiterate female are unemployed Savar Upazila. Where as 27.05 percent illiterate male and 32.10 percent of illiterate female are landless in Savar Upazila.

Comparative picture of level of education of Dhamrai and Savar Upazila provides striking scenario among the SSC, HSC and Bachelor/Masters degree holders are less unemployed and landless in both Upazila. Table also indicates educated persons are less unemployed and illiterate persons are unemployed in greater number.

15.0 Literacy rate of Study area

The table indicates that average literacy rate of Dhamrai and Savar Upazila is higher than national average at the age of 7 and above. In also indicates average literacy rate of Dhamrai Upazila in higher than Savar Upazila.

Table-18 : Average Literacy Rate (Can sign only) of the Study Area

Age	Dhamrai		Savar	
	Male	Female	Male	Female
7+	73.0%	67.50%	71.4%	64.8%
15+	58.25%	52.75%	56.75%	53.70%

Source : Field Survey

The above Table shows that 73 percent of 7 years old and above male and 67.50 percent of 7 years old and above female are educated in Dhamrai Upazila. Whereas 71.04 percent of 7 years old and above male and 64.8 percent of 7 years old female are literate in Savar Upazila. But the comparative picture shows that average rate of male and female at the age of 15 years and above are less in Dhamrai Upazila. While similar picture also emerges in the Savar Upazila.

16.0 Drop-out in education and ratio of teachers and student

Average rate of dropout in the study area is better than that of the other areas of Bangladesh. This might be the reason that the study area is located in and around Dhaka Metropolitan city. Table-19 indicates that drop-out rate in education is higher in college level. Where 28.0 percent of boys and 33.50 percent boys and girls are giving-up their education in Dhamrai Upazila. Whereas average drop-out in college level 29.0 percent of boys and 35.0 percent boys and girls are giving-up their education in Savar Upazila.

Table-19 : Statement of Average Dropout in Education and Ratio of Teacher & Student.

Level of Education		Rate of Droup out				Ratio of Teacher-student	
		Dhamrai		Savar		Dhamrai	Savar
		Boy	Girl	Boy	Girl		
Primary	General	12.5%	12.0%	13.20%	12.7%	1:65	1:63
	Madrasha	14%	13.0%	15.00%	13.6%	1:73	1:70
Secondary	General	19.75%	22.50%	20.4%	23.7%	1:47	1:44
	Madrasha	20.0%	23.5%	21.0%	24.0%	1:56	1:52
College	General	28.0%	33.50%	29.0%	35.0%	1:42	1:41
	Madrasha	29%	31.75%	28.0%	30.5%	4.50%	1:57

Source : Field Survey

Table-19 also shows an impressive picture on the ratio of teacher and students of both Upazila. Where teachers and student ratio is increasing from college level to secondary level as well as primary level in Dhamrai and Savar Upazila. This picture can be compared with other Upazila of Bangladesh.

17.0 Physical Infrastructure of Educational Institutes

Physical infrastructure of various levels of educational institutes of Dhamrai and Savar Upazila provides constructing picture in Table-20. 100 percent primary level school. Where there is no semi-pucca and kancha primary school in Dhamrai and 54.55 percent Madrasha are pucca and 45.45 percent Kancha in Dhamrai Upazila. Whereas, 89.36 percent and 10.64 percent primary level schools are pucca and semi-pucca.

Table-20 : Information about Physical Infrastructure of Educational Institute

Level of Education		Dhamrai			Savar		
		Pucca	Semi-pucca	Kacha	Pucca	Semi-pucca	Kacha
Primary	General School	99 (100.00)	-	-	42 (89.36)	5 (10.64)	
	Madrasha	06(54.55)	-	5 (45.45)	2 (11.11)	16 (88.89)	
Secondary	School	15 (78.95)	-	4 (21.05)	22 (68.75)	8 (25.0)	2(6.25)
	Madrasha	2 (66.67)	-	1 (33.33)	-	18 (94.74)	1(5.26)
College College	General Colleges	5 (55.55)	-	4 (44.45)	8(80.0)	-	2 (20.0)
	Madrasha	2 (50.00)	-	2 (50.00)	-	16 (94.11)	1 (5.89)

N.B: Figures in the Parenthesis show the percentage of the corresponding type of infrastructure.

The above Table-20 also shows college level physical infrastructure of the study area. In Dhamrai Upazila 54.55 percent colleges have pucca building and 44.45 percent colleges have kuncha walls. Whereas 50.00 percent Madrasha have got pucca building and another 50 percent have got kancha wall. In Savar Upazila the overall condition of physical infrastructure of the colleges are better than that of the Dhamrai Upazila. 80 percent colleges have pucca building and only 20 percent college do not have this type of infrastructure. The cross classification of physical infrastructure in two Upazilas in the Table-19 demonstrates Dhamrai has got larger number of pucca educational institutes than that of Savar Upazila.

It is revealed so far that physical infrastructure of educational institutes of two Upazilas is segmented and uneven in character. Table-21 indicates that 29.74 percent male population have got general education, 2.91 percent technical education and 20.10 percent Madrasha education at School Secondary Certificate level . While 36.00 percent female population having general education, 1.15 percent technical and 19.84 Madrasha educations at SSC level.

Table-21 : Information about Educated Population by Upazila

Type of Certificate	Population:				
		Dhamrai		Savar	
		Male	Female	Male	Female
SSC	General	29.74	36.00	32.50	34.75
	Technical	2.91	1.15	2.20	1.80
	Madrasha	20.10	19.84	19.85	18.10
HSC	General	19.70	22.35	18.77	21.25
	Technical	-	-	1.95	1.50
	Madrasha	6.54	2.43	7.80	3.40
Bachelor	General	15.91	18.08	14.65	17.0
	Technical	-	-	-	-
	Madrasha	3.10	0.09	2.98	2.20

Source : Field Survey

18.2 The above table also demonstrates similar picture between male and female. Education in all levels (i.e. SSC, HSC and Bachelor) is higher amongst the female population in both Upazila. Provision of stipends from Government to the girls students might be one of the major reasons for this situation. Moreover, work opportunities for the educated female persons call for an appropriate motivational factor of education these two Upazila.

18.0 Summary and Recommendations

On the basis of the information and data used in the study the following summary and major recommendations have been suggested for the development of Upazila profile and to formulate appropriate strategies for poverty reduction at the grass-root level.

- (i) Dhamrai Upazila is bigger than Savar in terms of area, Unions, Mouza and number of villages and cultivable land but Savar Upazila shows higher population with diversity 2055 per sq mile and other characteristics are almost similar and even in character. In addition, there is a significant positive correlation between other information of the study area.
- (ii) Ratio of land use pattern is considerably consistent in comparison with various sectors in the study areas. There is wide difference in case of educational institutions, forest land use and homestead. Comparison of other indicators such as sources of drinking water and use of surface water dependency ratio does not have any significant variation between the villagers.

- (iii) Distribution of population by different age groups provides a strong positive correlation between two Upazilas. It was found that more than 45 percent of population is concentrated between 10 to 34 years age group. Similar trend also observed in respect to other demographic aspects such as average size of the family, dependency ratio and birth and death rate except the density of population.
- (iv) The analysis of other variables indicates that household size, dependency ratio and sex ratio were important factors in explaining differentials in incidence of poverty. The poor households tend to have larger family size, higher dependency burden and higher proportion of female members than non-poor counterparts.
- (v) The main cause of uneven poverty in the study areas seems to be unequal access to income earning opportunities of people not only due to prevailing socio-economic differences but also presence of Export Promotion Zone (EPZ) other industries, business facilities. Location of both various government, private and NGOs' office as well as proximity of Dhaka Metropolitan City.
- (vi) The analysis of employment situation shows that a significant portion of rural labour force remained unemployed and under-employed throughout the year. The available information also indicates that employment opportunities had not grown as quickly as the rural labour force. Moreover, seasonality in employment in certain sectors both in terms of employment level as well as wage rate was mentioned as one of the important causes of greater hardship for the poor.
- (vii) The education profile in the study areas also indicates that the facilities of education available were mainly enjoyed by the well to do sections of people. This situation has changed to some extent with the introduction of stipend system for the girls students from the primary to secondary level. The poor students still drop-out to participate as child labour force outside family. The important reflection of the analysis is that lack of proper job oriented education system is mainly responsible for unemployment in the labour market and is one of major causes of poverty.
- (viii) Collateral system against credit prevents scheduled banks from responding to the need of poor people except Grameen Bank and other similar NGO's in a very limited scale. Thus an appropriate step

should be taken from Government for the benefits of rural development in general and modern technology in particular can reach small and marginal farmers.

- (ix) Introduction of functional education for the mass as well as vocational and technical education for the dropout can create with employment opportunities.
- (x) The Picture that emerged from the analysis of various information of the present study indicates "Trickle Down" policy of development provided a mixed picture. Although there has been some positive impact on agricultural productivity and the benefit accrued from development programmes have by -passed the largest groups i.e. landless rural poor.

19.0 Recommendations

- (i) As a part of employment generation strategy, a target oriented programme to promote local level natural resources through formal and non-formal education and awareness campaign could be implemented. Special programmes for development of natural resources like social forest, homestead forest and highway side etc. can be implemented under various institutional managements with input supports like supplying of different types of plants and extension support services for income generation.
- (ii) Population and family planning component need to be an integral part of every programme and development project in order to reduce the population growth and minimize the pressure on limited resources. The low rate of population growth may be achieved through widespread literacy, family planning campaign expansion primary health care and strong birth planning policy.
- (iii) To alleviate poverty in the study areas, it is necessary to allocate more government resources in favour of agro-based and modern technological programme mainly within disadvantaged group. Moreover, NGO's should extend their target-oriented activities for hard-core poor and landless people as well as marginal farmers to provide credit facilities without collateral and other means of fund to generate income.
- (iv) As education is pre-condition for overall human resource development and alleviation of poverty, specific target oriented programme including formal and informal training could also be

given for asset forming, self-employment opportunities like fisheries, livestock and small business under various institutional support.

- (v) Besides, intensive use of agricultural land and employment generations in non-farm sectors such as small-scale cottage and agro-based industries could be promoted as a matter of policy. Socio-economic equality, redistribution of assets and providing access to resources appear to a basic pre-condition for developing the present study area out of poverty trap.
- (vi) The elimination of poverty in the study area has to be based on increase production in various sectors and thereby increase labour productivity in different economic activities. An appropriate land use policy in the study area is important for overall development as well as for attaining the goal of higher cropping intensity and higher productivity.

20.0 Major Interconnected Strategies to be Adopted for Implementation of the Recommendations: -

- (i) Creating Opportunities: Special attention needs to be given to support the pro-poor growth and market opportunities for the local level poor as well as for the women and other disadvantage groups. Thus, appropriate investments are necessary to ensure that the benefits of growth could be easily shared by them.
- (ii) Empowering the poor: Strengthening the capacity of poor community not only in taking the right decisions that have important bearing on their lives, but also in removing barriers that prevent them from engaging effectively in socio-economic and political activities.
- (iii) Increasing Security: Development is seriously hampered by the frequent occurrence of both natural and man-made disasters particularly in rural areas. Poor people must be aware and motivated to manage their risk to sustain their socio-economic development.

21.0 Conclusion

Designing appropriate pro-poor service delivery strategy cannot be made by examining a few issues of two Upazilas in a single study but it paves the initial step to start the process of poverty alleviation and local level development. It demands a series of inter-related comprehensive studies in a holistic way to provide complete scenario.

Bibliography

- Alamgir, M. (1978): Bangladesh : A case of Below Poverty Level Equilibrium Trap. The Bangladesh Institute of Development Studies, Dhaka.
- Ahmed, M. (1981) "Lessons from Experiences of Rural Development in Bangladesh". The Journal of Management Business and Economics, IDA, Dhaka University, Vol. 7, No. 3.
- Ahmed, K and N. Hossain (1983) Nutrition Survey of Bangladesh (ed) 1981-82, Dhaka University, Dhaka.
- Bangladesh Bureau of Statistics (1996) Bangladesh Statistical Year Book, Government of Bangladesh.
- Bangladesh Bureau of Statistics (1997) Bangladesh Statistical Year Book, Government of Bangladesh
- Bangladesh Bureau of Statistics (1998) Household Expenditure Survey (1995-96), Government of Bangladesh.
- Islam, Serajul & Miah Sajahan (2003) Bangladesh : National Encyclopedia of Bangladesh. (ed), vol-3, Asiatic Society Bangladesh, Dhaka.
- Khan, A.R., R. Islam and M. Huq (1981) : Employment, Income, and the Mobilisation of Local Resources (A Study of Two Bangladesh Villages). Asian Regional Team for Employment Promotion (ARTEP), Bangkok.
- Khan, A.R. (1977) "Poverty in Bangladesh : Consequence and a constraint on Growth" Bangladesh Development Studies, Vol. XVIII, No. 3, Dhaka.
- Mujahid, G.B.S. (1977) "Measurement of Poverty in Bangladesh : A Note on Methodology, Bangladesh Development Studies, Vol. X, No. 4.
- Osmani. S.R (1982) Economic Inequality and Group Welfare (A Theory of Comparison with Application to Bangladesh). Clarendon Press, Oxford.
- Osmani. S.R (1990) Structural Change and Poverty in Bangladesh : The Case of a False Turning Point, The Bangladesh Development Studies, Vol. 18, No. 3.
- Planning Commission, The Fifth Five Year Plan 1977-2002, Ministry of Planning, GOB, Dhaka. p-i

Planning Commission (2003) Bangladesh : A National Strategy for Economic Growth, Poverty Reduction and Social Development, Government of Bangladesh.

Rahman, P.M. (1994) Poverty Issues in Rural Bangladesh, University Press Limited, Dhaka.

Rahman, H.Z. & Hossain, M. (1992) Rethinking Rural Poverty : A Case for Bangladesh Sage, Delhi.

Rahman, A. and T. Hoque (1988) Poverty and Inequality in Bangladesh in the Eighties : An Analysis of Some Recent Evidence. The Bangladesh Institute of Development Studies, Research Report No. 91.

Rein, M (1971) "Problems in the definitions of Poverty in Townsend. P.(ed) The Concept of Poverty, Heineman, London.

Sen, A.K (1982) Poverty and Famines : An Essay on Entitlement and Deprivation, Clarendon Press Oxford.

Siddiqui, K.U. (1982) The Political Economy of Rural Poverty in Bangladesh, NILG, Dhaka.

Siddiqui, K.U, (2000) Jagatpur 1977-97 : Poverty and Social Change in Rural Bangladesh, University Press Limited.

Townsend, P. (1962) "The Meaning of Poverty" The British Journal of Sociology Vol. 13, No. 3

United Nations Population Fund (2002) The state of World Poverty 1999, New York , U.S.A.

UNDP (2003) Human Development Report

Valentine. C. (1968) Culture & Poverty , University of Chicago, USA.

World Bank (2000-01) Poverty Reduction and World Bank : Progress in Operationalization the WRD, Washington, D.C.

Learning, Training and Development Intervention for Adult An Overview

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Abstract: *Training makes a man perfect but imparting training is not an easy task. Many interventions are related to training, learning and development, which are very systematic and logical. It is true that learning, training and development are very much inter-related but training may not be effective if the training is not conducted methodically. This paper will help assess the significance and importance of interventions related to training, learning and development for the adult. From this point of view, some theories and methodological aspects have been discussed in this paper.*

Introduction

Training, learning and development are inter-related. These learning, training and development intervention may be for both child and adult. Process and management of learning and training for children is easier than adult. In terms of adult learning, training and development intervention should be very logical and organized. Most of the training organizations are not immensely aware of this. Therefore, the goal of training is not achieved appropriately. However, learning is work based and self-directed system that assists to increase potentials of a learner. Ensuring adult learning is more difficult than that of child learning. McLean (2006) states that adult learning is a core idea for human resource development concepts such as improvement of quality and performance, knowledge management, changing management as well as organizational learning. But this adult learning may not be ensured without following right method or strategy. It is true that learning can occur naturally through everyday experience but systematic learning is rather volatile. So it is not easy task to ensure adult learning and development. Reid and Barrington (1999) mentioned, "training and development usually involves ways of abandoning random learning routes in favor of more productive, planned routes". Reid and Barrington (1999) also stated that training is a planned procedure to modify knowledge, attitude and skill through learning experience to achieve effective performance. So there is a relationship between learning and performance.

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Successful training intervention depends on few strategies. Reid and Barrington (1999) stated that training intervention is used to include any event that is deliberately used to help learning to take place. According to Reid and Barrington (1999), these strategies are : determination of training objectives, determination of appropriate training strategy, planning and implementation of the training and evaluation of the training program.

Management Training and Learning Intervention

According to Sloman (2001), training is the process of obtaining knowledge and skills related to work needs and it can be both formal and informal. On the other hand learning is physical and mental process involved in changing one's normal behavioral patterns and habits.

Gagne (1965) stated "learning is a change in human disposition or capability, which can be retained and which is not simply ascribable to the process of growth". Bass and Vaughan (1966) gave the most significant definition regarding learning. According to them, learning is quite permanent change in terms of behavior that occurs through practice or experience.

Horsley *et al.* (1996) stated that management training helps the learner to focus on particular issues and identify particular relevant components for planning. It also provides skills, which help to exercise power to motivate performance of staff and help proper development.

Theoretical Discussion

Many theories are used in the field of learning to make it successful. Knowles (1990) stated that a theory is a complete, logical and internally consistent system about the ideas regarding set of phenomena.

There are two dimensions of learning where one is for adult and another is for children. The theory *andragogy* is used in terms of adult learning on the other hand pedagogy, which is from Greek word and used for child learning. According to Knowles *et al.* (2005, p61), "the pedagogical model assigns to the teacher full responsibility for making all decisions about what should be learned, how it would be learned, when it would be learned and if it has been learned". Pedagogical model is basically teacher-directed learning or education. On the other hand andragogy is applicable for adult person and it is more flexible and informal and related to the participants' needs and requirements.

Theories of learning are categorised from different point of views. Hilgard and Bower (1966) classified learning theories into two, one is stimulus- response theories and another is cognitive theories.

Reid and Barrington (1999) mentioned six main types or groups of learning theory. These are:

- o Reinforcement theories.
- o Cybernetic and information theories.
- o Cognitive theories and problem solving.
- o Experiential learning theories.
- o Learning to learn and self development.
- o Mental process.

Cole (1997) classified the theories of learning into 2 broad categories such as (i) early theories of learning by Plato, Aristotle, Rousseau, Pestalozzi, Froebel, Pavlov, Thorndike, Skinner, Wertheimer, Koehler and (ii) modern theories of learning by Robert Gagne, Carl Rogers, David Kolb, Malcolm Knowles, Honey and Mumford.

Experiential Learning Theory

According to Knowles et al. (2005), David Kolb is a leader in advancing the practice of experiential learning. David Kolb was American psychologist who has developed a constructive model of experiential learning, which merges the features of both classroom and problem solving types of learning (Cole, 1997). He believes that learning and doing are separate activities. He also believes that it is important to distinguish classroom learning from problem solving. He has shown his model through a cycle.

Miettinen (2000) states that Kolb's learning model is the process whereby knowledge is formed through the transformation of experience. However, an example may be shown in favour of the cycle that a participant can learn. As per the cycle, participants gather experience, for example, using a computer key board for the first time. Through experience, the participants make some observations, for example about the arrangement or layout of keys and begin to make sense of keyboard, then they formulate abstract concepts. Then they test these concepts in a new situation by using keys. Therefore, a learner can learn through this cyclic process and gained understanding. In the Kolb theory four phenomena are

considered in four stages these are feeling or experiencing, observing, thinking and doing.

Another two aspects of Kolb model are deductive learning and inductive learning. Cole (1997) opined that inductive learning is the process by which the learner experiences an event or stimulus and draws a

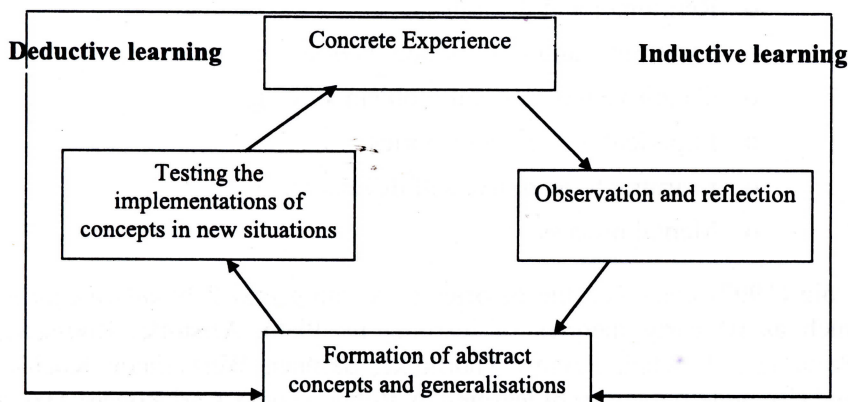


Fig: Experiential learning cycle

(Source: Cole, 1997)

conclusion from it like some rule or guiding principle. Deductive learning is a disparity commences with the rules of principle or theory, which is consequently applied by the learner.

On the other hand, Learning Style Inventory (LSI) is another important feature developed by Kolb, in which he describes a simple self-description on experiential learning theory that is designed to measure participants' or trainees' strengths and weaknesses as a learner in the four stage of the learning process. The main aim of the test is to help individuals to identify their learning style. (Cole, 1997). In other words it can be said that LSI was developed based on self-description. Through using LSI Kolb established norms for different types of professions such as marketing, personal management and finance. (Kenney and Reid, 1986).

Stewart (1999) tended to support the following schemes about Kolb's learning process :

- o Learning is continuous, natural and inevitable;
- o Learning requires engagement in separate but related activities;

Table-1 : Kolb's Model with Suggested Learning Strategies

Kolb's Stage	Example Learning/Teaching Strategy
Concrete experience	Simulation, Case study, Field trip, Real experience, Demonstrations.
Observe and reflect	Discussion, Small groups, Buzz groups, Designated observers.
Abstract conceptualization	Sharing content.
Active experimentation	Laboratory experiences, On the job experience, Internships, Practice sessions.

Source: (Knowles *et al.* 2005, p198).

- o Individuals can have different learning styles;
- o Learning is an ability, which can be developed and improved.

Learning Through Simulation

Craig and Bittel (1967) stated that the gap between training and learning program is frequently wide due to media of communication. They stated about many types of media of communication like words (lectures, printed matter), graphic (charts, diagrams, graphs), auditory aid (recordings, tapes), still picture (photo, slide), motion picture (documentaries, animations) live television (visual show), exhibit (display of objects), field trip (familiarizations), demonstration (lab, instruction), simulation (devices, role plays) and direct experience (guided, actual work). They also showed that the least effective media is words (lectures) and high effective is simulation and direct experience.

The simulation exercise provides knowledge of results. Two principal types of simulation exercises are used in training, one is gaming and another is a mock-up. For both cases there are some ground rules, conditions and structure. (Craig and Bittel, 1967). Through simulation a decision maker (player) can take decision easily. On the basis of simulation participants or adult learner can learn and understand a real situation throughout exercise or role-playing.

Table-2: Simulation method

What is it	What it can achieve
Dynamic exercises or case studies- usually involving 'coming to terms with' a situation, then managing it via a set of imposed decisions. Computerized models offer complex data and often decisions that interact.	Offers practice in management- observation, analysis, judgment, decision making etc. Interactive element generates enthusiasm, notably when teams are in simulated competition. Can be linked with the team development.

Source: Reid and Barrington, 1999, p. 349.

Insight in Learning

Cole (1997) stated that 'insight' is an important issue in learning which is particularly relevant to understanding. Lunzer (1968) stated that 'insight' covers suddenness of solution and smoothness of behaviours, ability to reproduce solution without mistake through successful presentations of original problem and ability to rearrange the solutions.

MBTI and Effective Management

Myers and McCauley developed myers-Briggs Type Indicator (MBTI) in 1990. According to Jarlstrom (2000, p145), "Briggs and Myers extended the model in the J/P (Judging and Perceiving) scale by making explicit one aspect of the theory that was implicit but undeveloped in Jung's work". Lindon (1995) stated that MBTI has four progressive phases like; sensing-feeling, intuition-thinking, intuition-feeling, sensing-thinking and each stage being unconnected into an information gathering and a decision-making phase. Myers Briggs Type Indicator (MBTI) is another effective strategy/method for learning in terms of management issue. It is effective for participants' psychological development. Case and Phillipson (2004) stated that the MBTI is normally used to help decision making in diverse management training as well as in personnel areas.

Application of Experiential Learning Theory in Terms of Adult Learning

The success of learning depends on appropriate learning theories or style. On the other hand, the success of learning theory/style depends of suitable learning or training strategy/method(s). Therefore, these are inter-related. Many phenomena like learning environment, nature or stage (age) of participants and their needs and requirements etc. might have

considered during selection of learning theory and strategy. Otherwise, the aim of learning and development would be hampered.

Knowles et al. (2005) stated that adults generally prefer a problem solving orientated learning rather than subject related learning. In addition, they learn most when new information is presented in real life context so that the experiential learning approach to learning has become strongly rooted in adult learning implementation.

Cranton (1989) believed that learners involved in learning based on experiential techniques are capable to link their learning with their daily lives. Experiential learning, therefore, promotes the transmission of knowledge and skill.

Cantor (1995) claimed that experiential learning activities are normal motivators and feedback round can be seen easily here. Through experiential learning participants or learners can participate in an activity and it helps to link theory and practice.

There are many learning theories belonging to the cognitive learning but Kolb's experiential learning theory ensures participants' needs and requirements considering their levels and roles. Moreover, it is well-structured and effective for problem-solving learning process.

Experiential learning is an established approach in terms of practicing adult education theory, which is used in Europe, North America and Australia (Miettinen, 2000). Experiential learning theory suggests that learning is continuous and cyclical (Stewart, 1999). In terms of senior management development training it is highly effective. In Bangladesh, it can also be applied to make the training and learning fruitful for senior level managers. Through this style, participants may overcome analytical weaknesses and would be able to solve management problems and it would help enhance their managerial qualities to manage situation in terms of decision making process. In addition to that it will help improve their administrative capabilities and performance. Participants acquire knowledge and skills in terms of management issues like decision making, handling numeric data etc. through experiential learning by the following way:

Feeling $\Rightarrow$ Watching $\Rightarrow$ Thinking $\Rightarrow$ Doing

Conclusion

Learning is a complex process of acquiring knowledge, skills, understanding, values etc. Knowles (1990) stated that some psychologists don't believe theories for learning at all. But theory is the key phenomenon, which makes a foundation of a system or a process. To ensure effective training intervention in terms of mid-level or senior level officials or managers the role and functions should be considered then the objectives of the training program should be designed accordingly and finally the learning style and learning strategy/method may be selected appropriately.

Experiential learning is a learner-centered approach that deals with the process and progress of self-sufficient thought. In spite of some limitations of Kolb's experiential learning theory it is very structured and systematic in terms of learning. Experiential learning helps ensure understanding and experience concurrently. From these points of views, Kolb's experiential learning theory may be more appropriate and significant rather than other learning theories of cognitive or situated learning theory or andragogy in the context senior level and mid level officials' training. Adoption of learning theories is a must for any training or learning situation and appropriate tools and strategies related to learning and training intervention should have to be used to make the training program successful and effective.

In conclusion it can be said that appropriate learning theory can play significant role in making a training program successful. The holistic approach related to training and learning is more helpful to make the training program fruitful, especially management related training for the adult learners.

References

- Bass, B. M. and Vaughan, J. A. (1966) Training in Industry-The management of Learning. London: Tavistock Publications.
- Cantor, J. (1995) "Experiential Learning in Higher Education: Link Classroom and Community." (Report no. 7). Washington D.C: The George Washington University, Graduate School of Education and Human Development.
- Case, P and Phillipson, G. (2004) "Astrology, Alchemy and Retro-Organization Theory: An Astro-Genealogical Critique of the Myers-Briggs Type Indicator®." Organization, Volume 11, Number 4 (July 01, 2004), pp. 473-495.
- Cole, G.A. (1997) Personnel Management. Fourth edition. London: Letts Educational.
- Craig, R. L. and Bittel, L. R. (1967) Training and Development Handbook. USA: McGraw-Hill.
- Craton, P. (1989) Planning Instruction for Adult learners. Toronto: Wall and Thompson.
- Gagne, R. M. (1965) The Condition of Learning. New York: Holt, Rinehart and Winston.
- Hilgard, E. R. and Bower, G. H. (1966) Theories of Learning. New York: Appleton-Century-Crofts.
- Horsley, S., Roberts, E., Barwick, D., Barrow, S. and Allen, D. (1996) "Recent trends, future needs: management training for consultants." Journal of Management in Medicine, Volume 10, Number 2, pp. 47-53.
- Jarlstrom, M. (2000) "Personality preferences and career expectations of Finnish business students." Career Development International, Volume 5, Number 3, pp. 144-154.
- Kenney, J. and Reid, M. (1986) Training Interventions. First edition. London: IPM.
- Knowles, M. (1990) The Adult Learner: A Neglected Species. Fourth edition. London: Gulf Publishing Company.

- Knowles, M. S., Holton, E. F. and Swanson, R. A (2005) *The Adult Learner*. London: Elsevier.
- Lunzer, E. A. (1968) *The Regulation of Behaviour: Development in Learning*. Staples Press.
- Lindon, L. (1995) "Linking an intervention model to the Myers-Briggs Type Indicator, consultancy and managerial roles." *Journal of Managerial Psychology*, Volume 10, Number 4, pp. 21-29.
- Reid, M. A. and Barrington, H. (1999) *Training Interventions Promotion learning opportunities*. Sixth edition. London: IPD House.
- Reid, M. A., Barrington, H. and Brown, M. (2004) *Human Resource Development Beyond Training Interventions*. London: CIPD House.
- Sloman, M. (2001) *The e-learning revolution*. London: CIPD House.
- Stewart, J. (1999) *Employee Development Practice*. Great Britain: Clays Ltd.
- Miettinen, R. (2000) "The concept of experiential learning and John Dewey's theory of reflective thought and action." *International Journal of Lifelong Education*, Volume 19, Number 1, pp. 54-72.
- McLean, G. N. (2006) "Rethinking Adult Learning in the Workplace." *Advances in Developing Human Resources*, Volume 8, Number 3, pp. 416-423

<http://reviewing.co.uk/research/learning.cycles.htm> (Accessed on 10/05/2007)