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BIOPESTICIDAL ACTIVITY OF *VERTICILLIUM LECANII* AGAINST COWPEA APHID (*APHIS CRACCIVORA*)

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Abstract

Cowpea is a leguminous plant widely cultivated in the tropical and sub tropical regions of the world. Sucking pests like aphids pose serious damage to the cowpea plants either by direct feeding or by transmitting plant viral diseases. Due to the devastating effect of aphids on Cowpea at almost every stage of its development, several approaches have been adopted in its control. Research into the control of these insect pests has centered primarily on the use of synthetic insecticides like Azodrin, Thiodan DDT, Dursban etc. The use of synthetic organic insecticides in crop pest control programs around the world has caused tremendous damage to the environment, pest resurgence, pest resistant to insecticides, and lethal effect on non target organisms. Use of biopesticides as a component of Integrated Pest Management programme can greatly decrease the use of conventional insecticides and the present study aims at studying the efficacy of the entomopathogenic fungi *Verticillium lecanii* as a biocontrol agent against the cowpea aphid. The results of the present study has indicated that *V. lecanii* is a potent producer of chitinase and is highly effective in controlling the cowpea aphids with a LC₅₀ value of 13.674. Molecular identification of the pests collected from the fields was carried out using the CO1 DNA sequencing which suggested a 100% similarity in the BLAST search with *Aphis craccivora*.

**Keywords:** Cowpea, Aphids, *Verticillium lecanii*, Biocontrol, Chitinase

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Introduction

Cowpea (Vigna unguiculata) is an annual herbaceous legume, which belongs to the family Papilionaceae (Fabaceae), order Leguminosae and genus Vigna. The genus Vigna consists of over one hundred different species widely found in the tropical and sub tropical regions, and has great morphological and ecological diversity. Cowpea is known as vegetable meat due to high amount of protein in the grain with better biological value on dry weight basis and it is an important grain legume in the third world countries. The grain contains 26.61% protein, 3.99% lipid, 56.24% carbohydrates, 8.60% moisture, 3.84% ash, 1.38% crude fibre, 1.51% gross energy, and 54.85% nitrogen free extract. Cowpea is usually preferred by farmers because of its role in increasing soil fertility through nitrogen fixation and production of nutritious fodder for livestock (Oyewale and Bamaiyi 2013).

Cowpea is a hardy crop but it hosts many insect pests that attack vegetables. These include; leaf miners, white flies, leaf hoppers, mites, thrips, and aphids. These insect pests impose a serious threat to cowpea production. Sucking insects such as aphids cause serious damage to several agricultural, horticultural and plantation crops either by direct feeding or by transmitting plant viral diseases. Cowpea aphid has a broad host range with a preference for legume crops. Cowpea aphid is relatively small, ranging from 1.5 to 2.5 mm long. The adult may be winged (alate) or wingless (apterous) and is usually shiny black, while nymphs are smoky gray. When present, wings are large and transparent with few veins. Also, when viewed under magnification, the bottom half of the antennae and legs are light-colored or creamy white with blackish tips. The aphid prefers to feed on young, succulent developing shoots and newly expanding leaves.
Insect pests have remarkable capacity to develop resistance to insecticides. More than 600 species of plant feeding insect pests have developed resistance to insecticides. Management of insecticide resistance offers great promise as a complementary extension of integrated pest management (IPM). Since sucking pests like aphids have developed resistance to insecticides, biological control using microbial pathogens, particularly fungal pathogens has been explored for a number of pests (Shah and Pell 2003). The fungi parasitize the insects and cause severe epizootics than bacteria and viruses, and it is distributed worldwide. Several commercial formulations based on entomopathogenic fungi have been developed for the control of sucking pests in different countries (Rabindra et al., 2007). There are many species of fungi attacking terrestrial and aquatic insects of agricultural and medical importance. Of these, few species such as *Verticillium lecanii* and *Hirsutella thompsonii* have received much attention as efficient biological control agents (Hall and Papierok 1982, Sattar 2002).

*Verticillium lecanii* (formerly known as *Cephalosporum lecanii*) was first described in 1861 and is a cosmopolitan fungus fond on insects. It is a common pathogen of scale insects in tropical and subtropical climates. *V. lecanii* is known as “white-halo” fungus because of the white mycelia found on the edges of infected insects. The conidia of *V. lecanii* are slimy and attach to the cuticle of insects. The fungus infects insects by producing hyphae from germinating spores that penetrates the insect’s integument; the fungus then destroys the internal contents and the insect dies. The fungus eventually grows out through the cuticle and sporulates outside the body of insects. Infected insects appear as white to yellowish cottony particles (Kulkarni et al., 2007)

*V. lecanii* is a specific parasite and it does not constitute danger for plants, entomophages, birds, fish and mammals. Owing to it the fungus is widely used as a component of biological control systems in agricultural crop defense.
Materials and methods

Maintenance and enumeration of culture

The *V. lecanii* culture was maintained on potato dextrose agar (PDA) plates and potato dextrose broth (PDB). Enumeration was done by the standard plate count method.

Chitinase assay

Chitinase activity was determined colorimetrically by detecting the amount of N-acetyl glucosamine (GlcNAc) released from a colloidal chitin substrate. The reaction mixture consisted of 0.3ml of crude enzyme and 0.2ml colloidal chitin (2%) in 50 mM acetate buffer, pH 4.6. The reaction was performed at 37° C for 30 minutes. The mixture was boiled for 10 minutes, chilled and centrifuged to remove insoluble chitin. The resulting adduct of reducing sugar were measured by the Dinitro salicylic acid (DNS) method. N-acetyl glucosamine was used as the standard.

Collection of pests

Cowpea aphids were collected from different agricultural fields around the District of Ernakulam, Kerala.

Genomic DNA extraction from collected sample

The collected pest sample was ground with a pinch of silica powder by using a micropestle. The sample was again ground along with the addition of 100µl TNES buffer. Then added 500µl of TNES buffer and incubated at 60° c for 30 minutes. The sample was centrifuged at 10000 rpm for 10 minutes. To the supernatant, added equal volume of chloroform isoamyl alcohol and repeated the centrifugation. To the upper layer, added 1/10 volume of 3 molar sodium acetate and added equal volume of isopropanol and centrifuged at10000
rpm for 10 minutes. The supernatant was discarded and the pellet was air dried and dissolved in 50µl TE buffer.

**PCR amplification**

Primer used for CO1 DNA typing

- Forward primer: TATTATTAGACAAGGAATCTGGTAAA
- Reverse primer: AGGAAATGTTGAGGGAAGAAAGTAA

PCR amplifications were performed in 25µl reaction mixture containing, deionised water (nuclease free water) - 17.7µl, Taq buffer (10X) - 2.5µl, MgCl₂ (15 mM)- 1.0µl, dNTPs mix (10mM each) - 0.5µl, Primer forward(10pm/µl) - 0.5µl, Primer reverse(10pm/µl) - 0.5µl, Taq DNA polymerase(5 units/µl) - 0.3µl, Template DNA (50ng/µl) - 2.0µl

To check DNA contamination, a negative control is set up omitting template DNA from the reaction mixture. Amplified products were loaded on 1.5% agarose gel for determining the size and the gene has sequenced by automated sequencing method.

The partial sequence was subjected to BLAST analysis for homology analysis using the online option available at www.ncbi.nlm.gov/BLAST.

**Agarose gel electrophoresis**

10µl of sample DNA was loaded with 4µl Bromophenol blue in 1.5% agarose gel. Commercially available molecular weight DNA markers were used as standards. The gel was run at constant voltage of 100V till the dye has travelled 3cm from the wells. The gel was viewed on UV transilluminator with the safety shield.

**Biopesticidal activity of *verticillium lecanii* against cowpea aphids (*aphis craccivora*) and LC₅₀ calculation**

In order to find out the biopesticidal activity of *V.lecanii*, an experiment was conducted, in which eight petri plates were taken and filled with natural
diet of *Aphis craccivora* such as cowpea leaves and beans. 10 aphids each were added to these plates. Sprayed 10µl, 12µl, 14µl, 15µl, 16µl, 18µl, 20µl, and 25µl PDB broth with inoculum (immediately after the plate count determination by standard plate count method) to respectively marked petri plates. The plates were then sealed with parafilm and observed after 24 hours.

After the observation and counting the number of living and dead pests from the experiment, LC$_{50}$ was calculated by using Probit analysis method (EPA PROBIT ANALYSIS PROGRAM, VERSION 1.5)

**Results**

**Maintenance and enumeration of culture**

The *V. lecanii* culture showed profuse growth on PDA plates. The mycelia appeared white in colour (Plate 1). The standard plate count performed indicated a count of $37 \times 10^3$ CFU/ml.

![Plate 1. Pure culture of *V. lecanii* on PDA plate](image)

**Collection of pests**

The pests collected from the cowpea plants are shown in Plate 2. Different stages like nymph, wingless males and females and winged males and females were represented in the collected samples.
Plate 2. Aphids collected from cowpea plants

DNA isolation and PCR amplification

The extracted DNA of the pest was electrophoresed through agarose gel (Figure 1). Low molecular weight DNA was observed on agarose gel up on UV illumination without protein and DNA contamination. The isolated pest DNA was amplified using PCR and the amplified product was run on 1.5% agarose gel containing ethidium bromide. The amplified DNA was observed on agarose gel without any non specific amplification (Figure 2).

Figure 1. Agarose Gel Electrophoresis of isolated DNA sample (Lane 1 marker-EcoRI HindIII double digest of lambda phage DNA, Lane 2 genomic DNA- approx, 10000 kb).

Figure 2. Agarose Gel Electrophoresis of amplified PCR products (Lane 1-amplicon, Lane 2- 1 Kb ladder).
**DNA sequencing of the isolated sample**

The partial sequence was generated by automated DNA sequencing (Figure 3). BLAST was used for gene identifications and sequence matching. The sequence showed 100% similarity with *Aphis craccivora*.

![Partial DNA sequence of the sample (CO1 sequencing)](image)

**Figure 3.** Partial DNA sequence of the sample (CO1 sequencing)

**Biopesticidal activity of *Verticillium lecanii* and LC 50 calculation**

The result of the effect of different concentrations of *V.lecanii* on cowpea aphid is shown in Table 1. The data obtained from the experiment was subjected to probit analysis and LC$_{50}$ was calculated. The LC 50 value was computed to be 13.674 with 95% confidence level.
Table 1. Effect of different concentrations of *V. lecanii* on cowpea aphids

<table>
<thead>
<tr>
<th>CONCENTRATION (37×10^3 CFU/ml)</th>
<th>NUMBER OF LIVE PESTS</th>
<th>NUMBER OF DEAD PESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10µl</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>12µl</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>14µl</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>15µl</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>16µl</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>18µl</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>20µl</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>25µl</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

Chitinase assay

Results of the chitinase assay performed with culture extract of *V. lecanii* indicated that the strain was able to produce a chitinase titer of 1.1 U/mL (Table 2).

Table 2. Chitinase activity of *V. lecanii*

<table>
<thead>
<tr>
<th>Serial number</th>
<th>Conc. of standard</th>
<th>OD at 510 nm.</th>
<th>Amount of chitinase activity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>0.158</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>0.3863</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>300</td>
<td>0.572</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>400</td>
<td>0.615</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>500</td>
<td>0.727</td>
<td></td>
</tr>
<tr>
<td>Test.</td>
<td></td>
<td>0.43</td>
<td>245 µg = 1.1075 U/mL from the standard graph</td>
</tr>
</tbody>
</table>

Discussion

Synthetic chemical pesticides remained the mainstay of pest eradication for more than 50 years. However, insecticide resistance, pest resurgence, safety risks for humans and domestic animals, contamination of ground water, decrease in biodiversity, and other environmental concerns have encouraged
Researchers for the development of environmentally benign strategies for pest control including the use of biological control agents (Goettel et al., 2005; Vincent et al., 2007). Naturally occurring biological control agents are important regulatory factors in insect populations. Many species are employed as biological control agents for the abatement of pest and vector insects of agricultural, veterinary and medical importance (Tanada and Kaya 1993, Lacey and Kaya 2000).

Among micro-organisms, entomopathogenic fungi constitute the largest single group of insect pathogens. In the present study, the entomopathogenic fungus *V. lecanii* was used as a biocontrol agent against the cowpea aphid. Experiments to find out the efficacy of different entomopathogenic fungi against cowpea aphid, *Aphis craccivora* under laboratory and field conditions has already been attempted (Suresh et al., 2012). In the study the authors have reported that *Verticillium lecanii* (VL3) caused higher percent mortality of adult nymphs of *Aphis craccivora*. The result of the present study is in compliance with the earlier reports and it has indicated that *V.lecanii* could be used as an effective biocontrol agent against cowpea aphids as is evident from the LC 50 value of 13.674. The biopesticidal study also indicated that about 90% of the aphids were killed by using 25 µl of the inoculums.

The mechanism of action of entomopathogenic fungi differs greatly in different species. Some species of fungi cause physical damage to the insect pests by profuse growth on the surface and once the fungus has passed through the cuticle of the exoskeleton, it even enters the circulatory system and produces toxins that overcome the insect immune system (Charnley 2003, Gabarty et al., 2014). *V. lecanii* infects insects by producing hyphae that penetrates the insect’s integument and the fungus then destroys the internal
contents of the insect pests. The effect of endotoxic compounds produced by V. lecanii on whitefly has also been reported (Gindin et al., 1994). Yet another major mechanism adopted by the entomopathogenic fungi is the production of chitinase, the enzyme involved in the degradation of chitin which is a major component of insect exoskeleton (Zhu et al., 2008). The present study has revealed that V. lecanii is capable of producing chitinases. Chitinase production from this species has already been reported (Lu et al., 2005). Thus it is highly probable that the enzymatic machinery of V. lecanii play a major role in the destruction of cowpea aphids and similar other insect pests.

**Conclusion**

Cowpea is an important grain legume in the third world countries as it provides good quality protein and high yields. This plant is highly susceptible to attacks by the sucking insect pests which greatly reduce the yield. Increasing environmental regulatory and market pressure, along with the increasing pest resistance is dictating a progressive move away from the chemicals for insect pest control. Pest control by natural biocontrol agents is a promising alternative to overcome the detrimental effects of chemical insecticides. The present study has successfully evaluated the effectiveness of the entomopathogenic fungi Verticillium lecanii as a biocontrol agent against the aphid Aphis craccivora which is the major insect pest of cow pea plants all over the world.

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References


ഡിസ്കോർസ്: മൂന്നാം ശ്രദ്ധളെടി ജോർഡണിൻ

സീൻ ഗോൾ

മോസ്കോ പോള

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തിരികാലം

നിരവധി സാംസ്കാരിക വിവാദങ്ങളിലെ പങ്കിടുന്നവരുടെ മാനദഞ്ജായികളെ പല പെരുമാനികളും ഉത്സമ്പത്തിയായി പെട്ടെന്നു വിശ്വസിക്കുന്നു. പെട്ടെന്നു വിശ്വസിക്കുന്നവരും പിന്റെ പ്രതിപാദത്തിന്റെ വിശ്വസിക്കുന്നവരും മാനദഞ്ജായികളാണ്. ഇതിന്റെ പിന്റെ പ്രതിപാദത്തിന്റെ ഉത്സമ്പത്തിയായി പെട്ടെന്നു വിശ്വസിക്കുന്നവരും മാനദഞ്ജായികളാണ്. ഇതിന്റെ പിന്റെ പ്രതിപാദത്തിന്റെ ഉത്സമ്പത്തിയായി പെട്ടെന്നു വിശ്വസിക്കുന്നവരും മാനദഞ്ജായികളാണ്.

മുദ്രാകൃതി

നിരവധി താരതമ്യേന ഉപയോഗിക്കുന്ന സ്ഥലങ്ങളും, പ്രത്യേകിച്ചും സ്ഥലങ്ങളും, പുനഃസൃഷ്ടികളും, സ്ഥലങ്ങളും, മാനദഞ്ജായികളിൽ

രൂപം

നിരവധി സാംസ്കാരിക വിവാദങ്ങളിലെ പങ്കിടുന്നവരും മാനദഞ്ജായികളും പല പെരുമാനികളും ഉത്സമ്പത്തിയായി പെട്ടെന്നു വിശ്വസിക്കുന്നു. പെട്ടെന്നു വിശ്വസിക്കുന്നവരും പിന്റെ പ്രതിപാദത്തിന്റെ വിശ്വസിക്കുന്നവരും മാനദഞ്ജായികളാണ്. ഇതിന്റെ പിന്റെ പ്രതിപാദത്തിന്റെ ഉത്സമ്പത്തിയായി പെട്ടെന്നു വിശ്വസിക്കുന്നവരും മാനദഞ്ജായികളാണ്.

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 financier എന്നാണ് പരാംശനാശ്രയിക്കുന്നത്. പ്രത്യേകം ക്ലാസിക്കൽ പ്രോബിഡിറ്റി, അനിസോമാസ്കേഷിംഗ്, മാനേജ്മെന്റ്, മാനേജ്മെന്റ്‌ വ്യവസ്ഥയിലെ മികച്ചയിനം പ്രായം പൂർത്തിയാക്കാൻ കാമ്പ് പിന്‌കേഡുദൃഢം സിമ്ബുളിസ്റ്റ് സിളിയറ്റുകൾ മാത്രമാണ് ഇതിന്റെ ഫാല്‌സ് പിന്‌കേഡ്‌. പിന്‌കേഡ്‌ ഏതൊരു പ്രത്യക്ഷാന്തര പ്രയോജനാർഥത്തിലും പിന്‌കേഡ്‌ വിലാസത്തിന് ഇതിന്റെ പ്രക്രിയകളെ മൂലം വൃത്തിയും നിർത്തിയാണ്. പിന്‌കേഡ്‌ വഴിയുള്ള വിലാസത്തിന് ഇതിന്റെ പ്രക്രിയകളെ മൂലം വൃത്തിയും നിർത്തിയാണ്.
കിഴക്കും സമ്മാനിക്കുന്ന ഉയരം കുറഞ്ഞവരുടെ തുവരി പ്രഖ്യാപിച്ചിട്ടുണ്ട്. തുരന്നുള്ള കിഴക്കുമായി പാക്കുവായി കിഴക്കുമായി പാക്കുവിരിയുന്ന സമ്മാനങ്ങളുടെ പ്രഖ്യാപിപ്പും, പാക്കുവിരിയുന്ന സമ്മാനങ്ങളുടെ പ്രഖ്യാപിപ്പും, സമ്മാനം പ്രഖ്യാപിക്കുന്ന സമ്മാനങ്ങളുടെ പ്രഖ്യാപിപ്പും പ്രഖ്യാപിക്കുന്ന സമ്മാനങ്ങളുടെ പ്രഖ്യാപിപ്പും മാറ്റാനും സമ്മാനം പ്രഖ്യാപിക്കുന്ന സമ്മാനങ്ങളുടെ പ്രഖ്യാപിപ്പും പ്രഖ്യാപിക്കുന്ന സമ്മാനങ്ങളുടെ പ്രഖ്യാപിപ്പും.

1102- സമ്മാനം പ്രഖ്യാപിക്കുന്ന സമ്മാനങ്ങളുടെ ഉപരിതലം സമ്മാനം പ്രഖ്യാപിക്കുന്ന സമ്മാനങ്ങളുടെ ഉപരിതലം സമ്മാനം പ്രഖ്യാപിക്കുന്ന സമ്മാനങ്ങളുടെ ഉപരിതലം സമ്മാനം പ്രഖ്യാപിക്കുന്ന സമ്മാനങ്ങൾ.
1938 കാലത്ത് 28-ാം ജോലിത്തിരിക്കുന്ന മാഖ്യാനിത്തീർത്തകൾ മുയൽ അടയാളപ്പെട്ടിട്ടുള്ള രാജപ്രകാരം മാറ്റപ്പെട്ടിട്ടുള്ള നടപടികൾ.

തൊഴിലാളികളിൽ നടന്ന പോലെ സാമൂഹ്യ മാധ്യമങ്ങളിലും ദോഷാണ്ഡാനം നടന്നുവന്നു. മായികളിൽ നടന്ന പോലെ സാമൂഹ്യ മാധ്യമങ്ങളിലും ദോഷാണ്ഡാനം നടന്നുവന്നു. പരമ്പരാഗത മാത്രം നടന്ന പോലെ സാമൂഹ്യ മാധ്യമങ്ങളിലും ദോഷാണ്ഡാനം നടന്നു. ‘‘പരമ്പരാഗതകാലത്ത് മായികളിൽ നടന്ന പോലെ സാമൂഹ്യമാധ്യമങ്ങളിലും ദോഷാണ്ഡാനം നടന്നു’’(1938:28).
വാക്കിരുത്തൽ  പോലും സിദ്ധാന്തപരമായി പുസ്തകത്തിൽ കണ്ടുപിടിപ്പിച്ചിരിക്കുന്നു. ഭാഷാരൂപത്തിലും വിശ്ലേഷണത്തിലും പരിശീലനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പാപ്പെർമാർക്കിൽ പൂർണ്ണമായി നിൽക്കുന്നു. പുസ്തകത്തിലെ ചുമതളായി നിറയ്ക്കുന്ന പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പരിശീലനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പൂർണ്ണമായി നിൽക്കുന്നു.

"വാക്കിരുത്തൽ പുസ്തകത്തിൽ പുസ്തകത്തിൽ അവസാനം പൂർണ്ണമായ പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പരിശീലനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പൂർണ്ണമായി നിൽക്കുന്നു. വാക്കിരുത്തൽ പുസ്തകത്തിൽ പുസ്തകത്തിൽ അവസാനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പരിശീലനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പൂർണ്ണമായി നിൽക്കുന്നു. വാക്കിരുത്തൽ പുസ്തകത്തിൽ പുസ്തകത്തിൽ അവസാനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പരിശീലനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പൂർണ്ണമായി നിൽക്കുന്നു. വാക്കിരുത്തൽ പുസ്തകത്തിൽ പുസ്തകത്തിൽ അവസാനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പരിശീലനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പൂർണ്ണമായി നിൽക്കുന്നു. "

1913-1937 വരെയുള്ള കാലത്തിൽ പുസ്തകത്തിൽ പുസ്തകത്തിൽ അവസാനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പരിശീലനം പ്രവാചകർഷൻ വിശ്ലേഷണത്തിലും പൂർണ്ണമായി നിൽക്കുന്നു.
മൊത്തം പറഞ്ഞതിനെ പരാംശം നടത്തുന്ന അന്തരീക്ഷപരമായ ഉദാഹരണങ്ങൾ മൂന്ന് വശങ്ങളിലെ കൈകാലിക പുരോഗണമായി എണ്ണുന്നു. പ്രധാന വശങ്ങളിലെ നിരക്കുമായ ഉദാഹരണങ്ങൾ കണ്ടെത്തുന്നതിനും സാധനം ലഭ്യമായിരിക്കുന്നു. കണ്ടെത്തുന്നതിനും സാധനം ലഭ്യമായിരിക്കുന്നതിനും നിരക്കുമായ ഉദാഹരണങ്ങൾ കണ്ടെത്തുന്നതിനും സാധനം ലഭ്യമായിരിക്കുന്നു. 

(1929 :133).
കാണാൻ നടത്തിയിരിക്കുന്ന മൂർത്തിയാണ് നമ്മുടെ സാമ്പത്തിക കാര്യശാസ്ത്രം. ഇതിന്റെ കാര്യാലയം മിതാന്വാക്യമാണ്. ഒരു പ്രതിമാനം മാത്രമാണ് കാണാൻ നടക്കുന്നത്. പൊതുജനങ്ങൾക്ക് മനസ്സിലാക്കാനുള്ള ഒരു പ്രതിമാനം മാത്രമാണ് കാണാൻ നടക്കുന്നത്.

നിർമ്മിക്കുന്ന പ്രക്രിയയിൽ സംഭവിക്കുന്ന ചെറിയ മിതാന്വാക്യങ്ങളും അവയുടെ സ്വഭാവത്തിന്റെ ഖ്യാതി പെടുത്തിയത് കാണാൻ നടക്കുന്നത്. എന്നാൽ സമൂഹത്തിന്റെ അധിവാസങ്ങൾ നിർദ്ദേശമാണ്. ദേശീയമായി സമൂഹത്തിന്റെ നിർദ്ദേശമാണ്. പോലുള്ള പ്രക്രിയകൾ വ്യവസ്ഥാപകമായ പ്രയാണം വരുന്നത് സാമ്യവും സമ്പർക്കവും പ്രയാണവുമാണ്. സമൂഹത്തിന്റെ കാര്യശാസ്ത്രം ക്രമീകരിക്കുന്നത്. എന്നാൽ സമൂഹത്തിന്റെ കാര്യശാസ്ത്രം വെല്ലായ പ്രയാണവും പ്രയാണവുമാണ്.

"നിർമ്മിക്കുന്ന പ്രക്രിയയിൽ സംഭവിക്കുന്ന ചെറിയ മിതാന്വാക്യങ്ങളും അവയുടെ സ്വഭാവത്തിന്റെ ഖ്യാതി പെടുത്തിയത് കാണാൻ നടക്കുന്നത്. എന്നാൽ സമൂഹത്തിന്റെ നിർദ്ദേശങ്ങളും നടത്തിയ പ്രക്രിയയിൽ സമൂഹത്തിന്റെ കാര്യശാസ്ത്രം വെല്ലായ പ്രയാണവും പ്രയാണവുമാണ്. സമൂഹത്തിന്റെ കാര്യശാസ്ത്രം വെല്ലായ പ്രയാണവും പ്രയാണവുമാണ്.

"(1929:136)
“…”

(1929: 143).

“…”
വശാവാശികാണകളുടെ സ്വഭാവങ്ങളെ പ്രതിപാദിക്കാൻ ആദ്യത്തെ എണ്ണം നിർത്തിയത് ലോകാച്യുതത്തിന്റെ ഇണക്കം സൂചിപ്പിക്കുന്നു. വശാവാശിക മോണെയ്ക്കാണ് പൊതുജനങ്ങളെ പ്രാഥമിച്ച് പ്രധാനപ്പെട്ടിരിക്കുന്നത്. 1932-ലെ താവളാഹുറു പ്രകാശം വശാവാശികളുടെ സ്വഭാവങ്ങളെ തിരിച്ചറിക്കുന്ന ഒരു പ്രാധാന്യം അടക്കിയത് തീർത്ഥകാരികളിലെ സാമൂഹ്യ അന്യായം കാരണമാകാം. ഓരോ വശാവാശിക നിമിഷങ്ങളുടെ പാദാകൃതി അന്തർഭുക്തമായി പ്രതിപാദിക്കുന്നു.

"അന്താരാഷ്ട്ര പ്രചാരത്തിൽ വശാവാശികാണകളുടെ സ്വഭാവങ്ങളെ പ്രതിപാദിക്കാൻ എന്തായാലും വശാവാശിക സമൂഹത്തിന്റെ പ്രാധാന്യത്തിന്റെ പ്രാധാന്യം തിരിച്ചറിയുന്നു. വശാവാശികാണകളുടെ സ്വഭാവങ്ങളെ പ്രതിപാദിക്കാൻ എന്തായാലും വശാവാശിക സമൂഹത്തിന്റെ പ്രാധാന്യം തിരിച്ചറിയുന്നു." (1932:158).

മോണെയ്ക്കാക്കായി ഉദ്ദേശിച്ചു വശാവാശികാണകളുടെ പങ്ക് കൂടിയുള്ള ഒരു സ്വാഭാവം തുല്യമാണ്. വശാവാശിക സമൂഹത്തിന്റെ മൂന്നാം പ്രധാനങ്ങളിൽ സ്വഭാവങ്ങളെ പ്രതിപാദിക്കാൻ എന്തായാലും വശാവാശിക സമൂഹത്തിന്റെ പ്രാധാന്യം തിരിച്ചറിയുന്നു. 1937-ലെ യൂറോപ്പ് ബ്രിസ്റ്റോളിലെ വശാവാശിക സമൂഹത്തിന്റെ സാമൂഹ്യാതിരിക്കലുകളെ പോരുന്നത് അന്താരാഷ്ട്ര സർപ്പകണ്ഠവും പോരുന്നതും അന്താരാഷ്ട്ര സേനകളും

"അന്താരാഷ്ട്ര സർപ്പകണ്ഠവും, അന്താരാഷ്ട്ര സർപ്പകണ്ഠവും കൂടിയുള്ള വശാവാശിക സമൂഹം ആദ്യ സാമൂഹ്യ ക്ഷേത്രങ്ങളിലെ അവവാസികളുടെ സ്വാതന്ത്ര്യം പ്രാധാന്യമുള്ളത് ആദ്യ സാമൂഹ്യ ക്ഷേത്രങ്ങളിലെ അവവാസികളുടെ സ്വാതന്ത്ര്യം ആദ്യ സാമൂഹ്യ ക്ഷേത്രങ്ങളിലെ അവവാസികളുടെ സ്വാതന്ത്ര്യം ആദ്യ സാമൂഹ്യ ക്ഷേത്രങ്ങളിലെ അവവാസികളുടെ സ്വാതന്ത്ര്യം ആദ്യ സാമൂഹ്യ ക്ഷേത്രങ്ങളിലെ അവവാസികളുടെ സ്വാതന്ത്ര്യം" (1937:103).


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കാര്യാലയകഥകളി

കട്ടാ (1929) ഗരിയോബാധ്യാഗമായി. ഗതാഗതമായ ഗരിയോബാധ്യാഗ.

കാര്യാലയത്തിൽ തലൻ സാധന (1926) ഗരിയോബാധ്യ ഗരിയോബാധ്യ, ഗരിയോബാധ്യക്കൊട്ടിണി.

കാര്യാലയത്തിൽ തലൻ ലി.നി. (1938) അമിതോബാധ്യാഗമായി ഗരിയോബാധ്യ ഗരിയോബാധ്യ. 23-ി. ഗരിയോബാധ

കട്ടാ തലൻ കെ.ഇ. (1913) ഗരിയോബാധ്യാഗമായി ഗരിയോബാധ്യ, ഗരിയോബാധ

കട്ടാ തലൻ (2010) ഗരിയോബാധ്യാഗ ഗരിയോബാധ്യ ഗരിയോബാധ്യ ഗരിയോബാധ

കട്ടാ തലൻ (2011) ഗരിയോബാധ്യാഗ ഗരിയോബാധ

കട്ടാ തലൻ (1931) ഗരിയോബാധ

കട്ടാ തലൻ (1932) ഗരിയോബാധ

കട്ടാ തലൻ (1937) ഗരിയോബാധ

കട്ടാ തലൻ (2006) ഗരിയോബാധ

കട്ടാ തലൻ (2010) ഗരിയോബാധ

കട്ടാ തലൻ (2011) ഗരിയോബാധ

കട്ടാ തലൻ (1931) ഗരിയോബാധ

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കട്ടാ തലൻ (1937) ഗരിയോബാധ
ഐക്യതയാണ്‌ ആന്തരികാന്തര ദോഷാന്തരത ഒക്കെ നിരൂപിക്കുന്നത് ആരും ട്രേസ്‌ വ്യവസ്ഥയിൽ അന്തര സംവിധാനം

ഒരു പ്രമുഖ ആന്തരിക അന്തര സംവിധാനത്തിലെ ഒരു ഐക്യതയാണ്‌ ആന്തരികാന്തര ദോഷാന്തരത ഒക്കെ നിരൂപിക്കുന്നത്. അത് ആന്തരിക സൗഹൃദമേഖല വിഷയങ്ങളിലെ ഒരു ഐക്യതയാണ്‌ ആന്തരികാന്തര ദോഷാന്തരത ഒക്കെ നിരൂപിക്കുന്നത്. ആന്തരിക സൗഹൃദമേഖല വിഷയങ്ങളിലെ ഒരു ഐക്യതയാണ്‌ ആന്തരികാന്തര ദോഷാന്തരത ഒക്കെ നിരൂപിക്കുന്നത്.

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കവിതയാണ് വിശാലപരം പ്രായോഗിക പരാമർശ പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗി� പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോഗിക പ്രായോ gh
ബുദ്ധിസവാര്യം കണക്കിനു. അനുപായം മാത്യുവാണ് പിതാകുലാകരം ജനാധിപത്യ അനുമതിയുമായി വെന്നേഴെ തെറ്റുന്നതുപോലെ യാത്രയില്ലാത്ത വിപുലമായ ഈന്നെന്ന് പിതാവിശേഷിപ്പിക്കുന്നു. വിശാപക അപകടാവകാശത്തെ പ്രതികരിക്കുന്നതിനു സാധനങ്ങൾ നൽകാൻ പല ആവശ്യങ്ങൾ പിന്തുടർന്നു. അനുപാർത്ഥബന്ധങ്ങൾ വായിക്കുന്നതിനു സാധനങ്ങൾ നൽകാൻ പല ആവശ്യങ്ങൾ പിന്തുടർന്നു.

കേരളാം മാറ്റങ്ങളുടെയും നാട്ടുഴമകളുടെയും പ്രതികൂലതകളുടെയും സമ്പദ്വാണിയത്തില്ലാത്ത പ്രവണതാദ്വാകർന്നതും കേരളത്തിലെ പ്രവണതയും കേരളത്തിലെ പ്രവണതയുമായി വലിയാണ് പിന്തുടർന്നു. പ്രവണതയുടെയും പ്രവണതയുടെയും പ്രതികൂലതകളുടെയും സമ്പദ്വാണിയത്തില്ലാത്ത പ്രവണതകളുടെയും പ്രവണതകളുടെയും സമ്പദ്വാണിയത്തില്ലാത്ത പ്രവണതകളുടെയും പ്രവണതകളുടെയും സമ്പദ്വാണിയത്തില്ലാത്ത പ്രവണതകളുടെയും പ്രവണതകളുടെയും സമ്പദ്വാണിയത്തില്ലാത്ത പ്രവണതകളുടെയും പ്രവണതകളുടെയും സമ്പദ്വാണിയത്തില്ലാത്ത പ്രവണത...
20-മുള്ളു ജുവൻപ്രതിമാദിയുടെ പുതിയ മാസം എഴുതിയിട്ടുള്ളത് പ്രതിമയുടെ ഭാഗങ്ങളിൽ ഒന്നാണ്. ജുവൻപ്രതിമയുടെ ഭാഗങ്ങളിൽ പ്രതിമയുടെ പ്രത്യേകതകളുടെ പ്രത്യേകതകളുടെ ഭാഗങ്ങളിൽ പ്രതിമയുടെ പ്രത്യേകതകളുടെ ഭാഗങ്ങളിൽ പ്രതിമയുടെ പ്രത്യേകതകളുടെ ഭാഗങ്ങളിൽ പ്രതിമയുടെ പ്രത്യേകതകളുടെ ഭാഗങ്ങൾ.
തബിരീതികളിൽ പ്രതിപാദിക്കുന്നു. 19-ാം നൂറ്റാണ്ടിലെ ദക്ഷിണേന്ത്യയുടെ സൈദ്ധാന്തിക തുദ്ധാകാലങ്ങൾ, ബ്രിട്ടീഷ് പ്രാധാന്യമുള്ള ഗയാനം, ശ്രീലങ്ക, പാകിസ്താൻ, ഇന്ത്യൻ ഓട്ട് പ്രദേശങ്ങൾ, പെരു, ബംഗ്ലാദേശ് എന്നിവയുടെ പ്രവൃത്തികൾ അത്രസുഭാവമുള്ളതായി കണക്കൂട്ടാം പെരു എന്ന ദക്ഷിണ എന്നിവയുടെ സാമ്പത്തിക വികസനംകാര്യം കൂടുതലായതും. ദക്ഷിണേന്ത്യയുടെ സൈദ്ധാന്തിക തുദ്ധായുടെ പ്രവര്‍ത്തനങ്ങളുടെ ചരിത്രാവശ്യമായ പൊതുസ്ഥാനത്തിലെ പൊതുസ്ഥാനത്തിലെ പഠനങ്ങളുടെ മാത്രം അടയ്ക്കുന്നു. 1901-ാം വർഷം മാസം കൊണ്ട് 19.15, വിവിധ സമയം 3.15, 2001-ാം വർഷം മാസം 94.20, വിവിധ സമയം 87.86.

ജോസഫ് ഉഡ്യൻസ് തറാണ്ട്ലാണ്ടിലെ കലാസാങ്കേതിക പരിഷ്കൃതമായ കണ്ണിവെച്ച വിശ്വസംഭാവനയുടെ പ്രതിപാദം വേദിക്കുന്നു. ദക്ഷിണേന്ത്യയുടെ സൈദ്ധാന്തിക തുദ്ധായുടെ സൂചനാരൂപത്തെ പ്രതിപാദം ജോസഫ് ഉഡ്യൻസ് വിശ്വസംഭാവനയേക്കാൾ കൂടുതൽ പൊതുപ്രവേശാവകാശമുള്ള പഠനങ്ങളിൽ പങ്കെടുക്കുകയും ചെയ്യുന്നു. 


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1959 പതിമൂന്നാം വാട്ടിലെ സിഗീറ്റ്ഡ് ദക്ഷിണേന്ത്യയുടെ സൈദ്ധാന്തിക തുദ്ധാകാലങ്ങൾ മാനുവീക്കം പരിഷ്കരിച്ച കണ്ണിവെച്ച വിശ്വസംഭാവനയുടെ സൂചനാരൂപത്തെ പ്രതിപാദം ജോസഫ് ഉഡ്യൻസ് വിശ്വസംഭാവനയേക്കാൾ കൂടുതൽ പൊതുപ്രവേശാവകാശമുള്ള പഠനങ്ങളിൽ പങ്കെടുക്കുകയും ചെയ്യുന്നു.
വെറ്റിയോളജിയിൽ പ്രവർത്തിക്കുന്ന ബാൻഡോമോഫിലിയിക്കിലെ അന്യത്തിയിലെ വളർച്ചയ്ക്ക് പുതിയ ലോകാംഗമായ ഫിലിന്റെ പ്രതിഫലിക്കിലെ പിന്തുണയ്ക്ക് കാരണമായി വ്യത്യസ്തമായ പ്രവർത്തനത്തിന് ഒരു നേതൃത്വവാദിയായി പ്രതിഭാസപൂർവ്വപ്രതിഭാസപൂർവ്വായി പ്രവർത്തിക്കുന്നു. പ്രവർത്തകരുടെ വുഡ്‌ലീഡ്‌സ് വ്യവസായികൂട്ടത്തിലെ പ്രവർത്തനം പ്രവർത്തിക്കുന്ന അന്താരാഷ്ട്ര പ്രവർത്തകരുടെ നേതൃത്വവാദിയായി പ്രവർത്തിക്കുന്നു. പ്രവർത്തനം ശുരുത്തിയത് 1959 ജനുവരി 31-ന് ആണ്. പ്രവർത്തിക്കുന്ന ബാൻഡോമോഫിലിയിലെ വളർച്ചയ്ക്ക് പുതിയ ലോകാംഗമായ പ്രവർത്തനത്തിന് ഒരു നേതൃത്വവാദിയായി പ്രതിഭാസപൂർവ്വപ്രതിഭാസപൂർവ്വായി പ്രവർത്തിക്കുന്നു. മുൻഭാഗത്തിന്റെ പ്രവർത്തനം പ്രവർത്തിക്കുന്ന അന്താരാഷ്ട്ര പ്രവർത്തകരുടെ നേതൃത്വവാദിയായി പ്രവർത്തിക്കുന്നു. പ്രവർത്തനം പ്രവർത്തിക്കുന്ന അന്താരാഷ്ട്ര പ്രവർത്തകരുടെ നേതൃത്വവാദിയായി പ്രവർത്തിക്കുന്നു. 

(News-N-North, E-East, W-West, S-South) എന്നിവയുടെ തെരുവിലെ പ്രവർത്തനം അന്താരാഷ്ട്ര ബാൻഡോമോഫിലിയിലെ മുൻഭാഗത്തിന്റെ പ്രവർത്തനം പ്രവർത്തിക്കുന്ന അന്താരാഷ്ട്ര പ്രവർത്തകരുടെ നേതൃത്വവാദിയായി പ്രവർത്തിക്കുന്നു. പ്രവർത്തനം പ്രവർത്തിക്കുന്ന അന്താരാഷ്ട്ര പ്രവർത്തകരുടെ നേതൃത്വവാദിയായി പ്രവർത്തിക്കുന്നു.
2012 മെയ് 12-നെ പുറത്തിറങ്ങി. ഉപകരണം സൃഷ്ടിയിലെ മാപ്പേറ്റിക്കാൻ സൃഷ്ടിച്ചു. 


അവരുടെ പുരോഗതിയിൽ പുറത്തിറങ്ങി. 1990-കളിലെ ഗവർണ്ണാരംഗം പുറത്തിറങ്ങി.
നാണാകാലത്തിനു മുമ്പായി ആമ്പാരയുടെയും യായികാരനായിരിക്കുകയോ അതിനുവേണ്ടിയായിരുന്നു ഇന്ത്യയുടെ വിപ്ളവത്തിന്റെ എണ്ണാം സ്തരത്തിലുള്ള സമൂഹത്തിലെ പ്രധാനപ്പെട്ട സ്ഥാനം. ഇന്ത്യയിലെ മികച്ചക്കാരകളും പ്രകൃതിയുടെ പ്രതിഷ്ഠയുടെ പ്രത്യേകത ഉറപ്പിക്കുന്നതിന് ആയിരുന്നു ഇന്ത്യയുടെ വിപ്ലവത്തിന്റെ സാമൂഹ്യബിരീന്ദ്രത്തിന്റെ വിജയികനായിരുന്നു. ഇന്ത്യയിലെ സാമൂഹ്യബിരീന്ദ്രത്തിന്റെ വിജയികനായിരുന്നു.

അവിടത്തെ സാമൂഹ്യബിരീന്ദ്രത്തിന്റെ വിജയികനായിരുന്നു. ഇന്ത്യയിലെ സാമൂഹ്യബിരീന്ദ്രത്തിന്റെ വിജയികനായിരുന്നു. ഇന്ത്യയിലെ സാമൂഹ്യബിരീന്ദ്രത്തിന്റെ വിജയികനായിരുന്നു. ഇന്ത്യയിലെ സാമൂഹ്യബിരീന്ദ്രത്തിന്റെ വിജയികനായിരുന്നു.
ആഴിയുന്ന വിദ്യാഭ്യാസത്തിൽ കണ്ഠിമുട്ടം നൽകുന്ന സ്കൂൾസമാധാനത്തിന്റെ പ്രഭാവത്തിൽ വ്യാപിച്ചിരിക്കുന്നു. അത്‌ ക്ഷണം നിരവധി രാജ്യത്തെ സ്കൂളുകളിലും വ്യാപിച്ചിരിക്കുന്നു. പത്തുനായ്ക്കാം വയസ്സ് പ്രായത്തിൽ നിന്നും പുത്രൻ പുതിയ സൗകര്യങ്ങൾ നൽകി പ്രതിരോധ നടത്തുന്നതിനായി മികച്ച സഹായമില്ലായാണ്‌ ആശ്രയിക്കേണ്ടതുകായി. സ്കൂളുകൾ പരിപാലിക്കേണ്ടതും കൈവന്ധയാണ്‌ എന്ന്‌ പറയുന്നു.
ക്വിസ്‌ഡ്യു ഗവേഷണം നടത്താനും പഴയ കണ്ണൂർ പ്ലാന്റിനോട് വളരെയേറെ ഒപ്പം ക്യാറെയേറെ പുറത്തിറക്കുന്നു. പുതിയപ്പെരണിക്കുന്ന പ്ലാന്റിനും തുടർന്നുള്ള ക്വിസ്‌ഡ്യു ഗവേഷണം രേഖകീഴിൽ സമാപിക്കുന്നു. പാലി പോലെ അനുകരിച്ച് പുതിയപ്പെരണിക്കുന്ന പ്ലാന്റിനും തുടർന്നുള്ള ക്വിസ്‌ഡ്യു ഗവേഷണം രേഖകീഴിൽ സമാപിക്കുന്നു.

സ്മാരകം കൊള്ളുന്നതും പ്ലാന്റിനോട് മുഖ്യപ്രധാനമായ കാര്യാലയം. ഇന്നത്തെ കവിയായാണ് പുതിയപ്പെരണിക്കുന്ന പ്ലാന്റിനുമാത്രമേ പരിശീലിക്കുന്നത്. പ്ലാന്റിനും കൊള്ളുന്നതിനുള്ള കാര്യാലയം. മുൻപിൽ പുതിയപ്പെരണിക്കുന്ന പ്ലാന്റിനും തുടർന്നുള്ള ക്വിസ്‌ഡ്യു ഗവേഷണം രേഖകീഴിൽ സമാപിക്കുന്നു.
നബി അതിന്റെ അതേനാളിന്റെ വിദ്യാഭ്യാസം ചെയ്യാൻ എടുത്തു.
USE OF SOCIAL NETWORKING SITES BY THE ACADEMIC COMMUNITY IN A DIGITAL ENVIRONMENT

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Abstract

A social networking site is an online platform that is used by people to build social networks or social relations with other people who share similar personal or career interests, activities, backgrounds or real-life connections. Social networking sites are a global phenomenon. The most widely using Social Network Sites (SNS) are Facebook, Whatsapp, MySpace, LinkedIn and Twitter. SNS is a way to shape personal identities of youngsters. The purpose of the study was to identify the use of social networking sites for transferring and sharing information by the students of the University of Calicut. Structured interview schedule were used to collect data from a representative sample of 100 students. The interview enquired into the purpose of use of SNS, reasons for preferring SNS and the contents likely to share with others. The study revealed that all the post graduate students are aware and use SNS for sharing knowledge and information.

Keywords: Social Networking Site, Information, knowledge, Internet.

Introduction

Social networking sites are modern communication medium through which people connect to one another, share ideas, experiences, videos, photos, messages and information of interest. These networks help us to share the knowledge about current affairs, politics, new technology, game and software, location based services, online shopping and so on. The main social networks

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are those that contain category places, means to connect with and a recommendation system linked to trust. Cambridge English Business Dictionary defines Social Networking Site (SNS) as a website that is designed to help people communicate and share information photographs etc. with a group. Social networking sites help schools and universities to leverage and complement formal education activities and enhance learning outcomes. Social networking can provide opportunities for new relationships as well as strengthening existing relationships. These sites play an important role in information and knowledge sharing. They are becoming very popular means of both interpersonal and public communication in Kerala. Objectives of this study is

1) To analyze the various types of Social networking sites used by the student community.

2) To analyze the extent of usage of social networking sites among the post graduate students of the University of Calicut

3) To analyze the purpose of usage of social networking sites by the students of the University of Calicut

4) To identify the benefits of using Social networking sites

**Methodology**

This study is prepared on the basis of an empirical data collected among the postgraduate students under the University of Calicut, Kerala. Data from 100 samples were collected by questionnaire survey. The samples were selected through a purposive random sampling from the University students. Personal interviews and various available literatures, especially web contents are also used as supporting materials.
Results

The Various Categories of Social Networking Sites

SNSs are influencing youth and adult life in a major way. Facebook, Whatsapp, You Tube, Twitter, MySpace, LinkedIn, Skype, Instagram, Telegram, Google+ are the widely using social networking sites among students. Majority of respondents use the following sites more than others: Facebook (98%), Whatsapp (96%), You Tube(70%), Google+(42%) while other sites like Twitter, MySpace, LinkedIn, Instagram and Skype ranked low in the extent of utilization (table 1). All respondents are using one or more social networking sites.

Table 1: Proportion of students using various social networking sites

<table>
<thead>
<tr>
<th>Social Networking Sites</th>
<th>Respondents (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook</td>
<td>98(98%)</td>
</tr>
<tr>
<td>Whatsapp</td>
<td>96(96%)</td>
</tr>
<tr>
<td>YouTube</td>
<td>70(70%)</td>
</tr>
<tr>
<td>Twitter</td>
<td>25(25%)</td>
</tr>
<tr>
<td>MySpace</td>
<td>10(10%)</td>
</tr>
<tr>
<td>LinkedIn</td>
<td>15(15%)</td>
</tr>
<tr>
<td>Google+</td>
<td>42(42%)</td>
</tr>
<tr>
<td>Instagram</td>
<td>28(28%)</td>
</tr>
<tr>
<td>Skype</td>
<td>12(12%)</td>
</tr>
</tbody>
</table>

Purpose of use of social networking sites

Social networking sites provide variety of benefits like information and content sharing, social interaction, personal identity, entertainment, professional and academic development, creating new relationships, updating information, instant messaging and cell phone texting. Majority of students (80%) use social networking sites for communicating and interacting with friends. 50 % students
use social networking sites for interaction with their teachers. The analysis shows that the student community uses social networking sites for multi purposes like updating information, entertainment, online learning and so on (table 2).

![Table 2: Purpose of using social networking sites](image)

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicating and interacting with friends</td>
<td>80 (80%)</td>
</tr>
<tr>
<td>Sharing latest news and events</td>
<td>65 (65%)</td>
</tr>
<tr>
<td>Communicating and interacting with teachers</td>
<td>50 (50%)</td>
</tr>
<tr>
<td>Online learning</td>
<td>38 (38%)</td>
</tr>
<tr>
<td>Professional and academic activities</td>
<td>64 (64%)</td>
</tr>
<tr>
<td>Updating information</td>
<td>45 (45%)</td>
</tr>
<tr>
<td>Meeting new people</td>
<td>20 (20%)</td>
</tr>
<tr>
<td>Entertainment</td>
<td>70 (70%)</td>
</tr>
</tbody>
</table>

**Devices used to access social networking sites**

Youths are enthusiastic users of social media sites and apps and digital devices are popular among the youth. Smart phone, laptops, tablets are widely used to connect social networking sites. The students use smartphone as their primary device to access SNS (table 3).

![Table 3: Devices used to access social networking sites](image)

<table>
<thead>
<tr>
<th>Devices</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Phone</td>
<td>100 (100%)</td>
</tr>
<tr>
<td>Laptop</td>
<td>60 (60%)</td>
</tr>
<tr>
<td>Tablet PC</td>
<td>20 (20%)</td>
</tr>
<tr>
<td>Desktop PC</td>
<td>35 (35%)</td>
</tr>
<tr>
<td>Others</td>
<td>15 (15%)</td>
</tr>
</tbody>
</table>
Places of access social networking sites

People can access information and knowledge from different places at their convenience. Majority of students access SNS from the University campus because of the unlimited access of WiFi provided by the University. 70 percentage of respondents access SNS from home (table 4).

<table>
<thead>
<tr>
<th>Places</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>70(70%)</td>
</tr>
<tr>
<td>University</td>
<td>100(100%)</td>
</tr>
<tr>
<td>Internet Café</td>
<td>20(20%)</td>
</tr>
<tr>
<td>Hostel</td>
<td>60(60%)</td>
</tr>
</tbody>
</table>

Duration of accessing social networking sites

Duration of time depends upon personal interest. The smartphone is the primary device used for gaming and text messaging. 50 percent of the students use social networking sites 2-4 hours per day whereas 8 percent use social networking sites less than one hour per day (table 5).

<table>
<thead>
<tr>
<th>Duration</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than one hour</td>
<td>8(8%)</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>25(25%)</td>
</tr>
<tr>
<td>2-4 hours</td>
<td>50(50%)</td>
</tr>
<tr>
<td>Above 4 hours</td>
<td>17(17%)</td>
</tr>
</tbody>
</table>

Benefits of using social networking sites

People can create personal profiles, share pictures, videos and text updates to their friends, family and people all over the world through SNS. It is clear that majority of the respondents use social networking sites for chatting and sharing latest news and events (table 6). All respondents believed that
social networking sites are very beneficial as a way to connect and reconnect with friends and relatives. 25 percent of students responded that social networking sites is very beneficial for their studies as they can find articles related to their academic and professional purpose and they can post their ideas through discussion forums in social networking sites.

Table 6. Benefits of using social networking sites

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staying connected</td>
<td>50(50%)</td>
</tr>
<tr>
<td>Research and learning</td>
<td>25(25%)</td>
</tr>
<tr>
<td>Strengthening interpersonal relationship</td>
<td>30(30%)</td>
</tr>
<tr>
<td>Information sharing</td>
<td>40(40%)</td>
</tr>
</tbody>
</table>

Discussion

The study revealed that the various categories of social networking sites used by the post graduate students of the University of Calicut include Facebook, Whatsapp, YouTube, Twitter, Google+, Telegram, MySpace, LinkedIn, Skype. These types of social networking sites can help members to find other users with similar interests. Wan (2013) examined significant factors that contributed knowledge sharing through social network. It is observed that the students pursuing higher education share information using web technologies (Hassan and Oyefolahn 2014). Future studies can focus on why Facebook and Whatsapp have created popularity compared to other social networking sites. People use both these sites frequently. Studies conducted by Valkenburg and Peter (2009) observed that students frequently use social networking sites for instant messaging and it boosts their social relationships and well-being. Wellman et al., 1996 found that the flow of information through social networking sites itself generates access to new information. In
short, social networking sites are very important for interaction among people, exchange and share ideas in a collaborative way.

**Conclusion**

The result obtained from the study shows that a reasonable number of student of the University of Calicut use social networking sites. The study revealed that most of the students use social networking sites for communicating and interacting with their friends, watching movies, sharing ideas about politics, new events and academic purpose. All the students are aware about information sharing through social networking sites and they are interested in uploading contents about new information, events, videos, photos etc. The main reason behind the use of social networking sites is to make, maintain and foster social relationships.

**Reference**


A PROPOSED MODEL FOR IDENTIFICATION OF SPHECIDAE USING DNA BARCODING

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Abstract

As a dominant group of predators, sphecid wasps form excellent bioindicator tools in predicting the diversity of other groups of animals and for all the species of a given area. Sphecid wasps are closely associated to human habitats evoking great deal of anxiety and fear. Morphology based identification system, though useful for adults are only partially successful for larval identification. The integration of DNA barcoding with traditional morphology-based taxonomy, host records, and other data might substantially improve the accuracy of identifications. The current paper proposes a model for the use of DNA barcoding for identification and cataloging of sphecid wasps.

Keywords: Sphecids, morphology, taxonomy, mitochondrial gene COI, DNA barcoding

Introduction

The sphecids form a monophyletic assemblage of wasps with 9716 described species coming under 318 genera. In the current system of classification being followed, they come under the Order Hymenoptera, Suborder Apocrita, Super family Apoidea with five included families- Heterogynaidae, Ampulicidae, Sphecidae and Crabronidae, together with Apoidea, the bees (Pulawski 2013). They are valuable in predicting the diversity of other groups of animals and for all the species of a given area. They form part of several functional niches (predators, cleptoparasites and pollinators),

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have economic importance (pollinators and pest management) and reflect the patterns of other taxa in a given habitat (Gayubo et al., 2005). Sphecid wasps are closely associated to human habitats evoking great deal of anxiety and fear, are regarded as nuisance by the people and nest mounds considered unsightly. Prompt and frequent removal of nests is posing a threat to these relatively harmless insects. Sphecids form one of the surrogate taxa for biodiversity assessments. The taxonomic identification based on morphology is often complicated, especially of larvae (Jurga et al., 2014). Some larvae die during hibernation and thus remain unidentified, leading to a partial loss of data.

**Barcoding studies so far in Sphecidae**

Araújo et al., (2002) differentiated ten different variants by C-banding pattern of the short (heterochromatic) arm of chromosome 14 in the crabronid wasp *Trypoxylon* (*Trypargilum*) *albitarse*. Hastings et al., (2008) used DNA barcoding to observe interactions among three putative species of *Sphecius*. Jurga et al., 2014 used mitochondrial DNA subunit 1 cytochrome c oxidase sequence to identify 33 wasp species from the families Vespidae, Pompilidae and Crabronidae and concluded that DNA barcoding can provide an accurate DNA identification system for the taxa. The barcoding of sphecids wasps has so far been mainly concentrated in Biodiversity Institute of Ontario with 138 specimen databases submitted.

**Objectives**

The limitations in morphology-based identification systems and the decreasing taxonomic expertise signal the need for a new solution to taxon recognition. DNA barcoding represent a promising approach to the diagnosis of biological diversity. India has a rich fauna of sphecid wasps, but only very few attempts have been made to collect and describe members of this group,
especially larvae. DNA barcoding of sphecids is still at infancy in India. The present paper makes an attempt to propose an approachable working model for identifying, cataloguing and creating an inventory of these species in an area.

**Methodology**

1) Site selection: can be based on ecological integrity, should be taxonomically broad and need to extend beyond the focal geographic region to ensure that potential sister taxa are evaluated and can be discriminated.

2) Specimen collection: collecting scheme can be executed over a period using various collection methods like pitfall traps, pan traps, malaise traps and sweep netting. The specimens can be preserved in 96% ethanol (Jurga et.al., 2014).

3) DNA barcode analysis: Tissue to be lysed and total DNA extracted from thoracic muscles or entire thorax of adult wasps and from VII-IX larval segments (Jurga et.al., 2014). The DNA extracts for all specimens are stored as a DNA Archive where they can be available for future study. A region of the mitochondrial gene COI (cytochrome c oxidase subunit I) is used for barcoding (Hebert et al. 2003a). 700bp long COI 5’ region sequenced and analysed using primer pair C_LepFolF + C_LepFolR (Blagoev et al. 2015). For the derived sequences from animal specimens, the records assigned Barcode Index Numbers (BINs) by the Refined Single Linkage (RESL) algorithm implemented on Barcode of Life, BOLD –Publically accessible (Ratnasingham and Hebert, 2013). Identifications can be based on sequence similarity (<15% for family, <5% for genus).
**Future Aspects**

DNA barcoding will help to assign unknown individuals to species status and enhance the discovery of new species, even from bits and pieces of tissues. Barcoding will help in the development of a comprehensive databank, with voucher specimens representing described species, against which sequences from sampled individuals can be compared (Hebert *et al.* 2003b). The integration of DNA barcoding with traditional morphology-based taxonomy, host records, and other data might substantially improve the accuracy of identifications and will significantly accelerate further studies.

**References**


CORPORATE GOVERNANCE PRACTICES IN STATE BANK OF INDIA

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Abstract

The word Corporate Governance is a current buzzword in management literature. It has received an increasing amount of attention in recent years. Corporate Governance is a set of processes, customs, polices and laws that affects the way a company is directed, administrated and controlled. The worldwide collapses of large companies like Enron, Tycoon, Global Crossing etc. shows the importance of Corporate Governance. The present study aims at studying the corporate governance practices of one of the most dominated public sector banks in India. Thus the study is conducted to ensure compliance of Corporate Governance codes in SBI. Since SBI plays a major role in banking sector with huge customers as well as investor base.

Keywords: Corporate governance, Public sector banks, SBI, Corporate Governance

Introduction

The word governance came from ‘Gubernate’ which means to steer i.e. to steer an organization in the desired direction. It is a set of rules, process or laws by which the business are operated, regulated and controlled. During the past two decades corporate governance has been receiving major attention globally. The worldwide collapses of large companies like Enron, Tycon, etc made the importance of corporate governance to India. The scam related to Satyam computers brought the topic again into focus recently. Corporate Governance is
the application of best management practices, compliance of law in true letter and spirit and adherence to ethical standards for effective management and distribution of wealth and discharge of social responsibility for sustaining development of all stakeholders (Institute of Company Secretaries of India, ICSI). Thus good governance is a safeguard against corruption and mismanagement in large organization. It ensures that the cooperation is trustworthy and the shareholders can invest with confidence. In India Securities and Exchange Board of India (SEBI) has come up with clause 49 where by SEBI has made corporate governance compulsory for all the listed companies in India. All the listed companies are mandatory required to follow the rules mentioned in clause 49.

**Corporate Governance and Mandatory Requirements**

‘The Clause 49 of the Listing Agreement contains a number of provisions to ensure good corporate governance. SEBI has ensured that a company is required to make up specified disclosures at the time of issue and make continuous disclosures as long as its securities are listed on exchanges. The standards for these disclosures have been specified in the Companies Act, Disclosure and Investor Protection Guidelines, Listing Agreement, Regulations, etc. Clause 49 contains a series of mandatory items and seven non-mandatory items which are to be followed by listed companies.

**Mandatory Requirements of Clause 49**

Companies are required to comply with the following aspects under the mandatory category.

- Board of Directors
- Audit Committee
- Subsidiary Companies
- Disclosures
Some of the mandatory requirements are:

**Composition of Board**

There should be an optimum combination of Executive and Non Executive directors not less than 50% of board of directors should be Non-Executive Directors. If chairman is a Non-Executive Director, at least one-third of the board should comprise of Independent Directors. In case the chairman is an Executive Director at least half of board should comprise of Independent Directors.

**Board and committee procedure**

As per the Clause, the board should meet at least 4 times a year with a maximum time gap of 4 months between 2 meetings.

**Code of Conduct**

The board shall lay down Code of Conduct for all board members and senior management of the company. The Code of Conduct shall be posted on the website of the company. All board members and senior management personnel shall affirm compliance with code on an annual basis.

**Audit Committee**

All listed companies should have a qualified and independent audit committee. The members of the audit committee shall be designated by the board annually. The chairman of the audit committee shall be an Independent Director.

**Composition and qualification**

The audit committee shall have minimum 3 directors as members. Two third of the members of audit committee shall be Independent Director.
Disclosures

Clause 49 of the listing agreement puts a responsibility of disclosure up on the listed companies

- Disclosure on related party transactions
- Disclosure of accounting treatment
- Disclosure on risk management
- Disclosure on share issue
- Disclosure on remuneration of directors
- Disclosure related to management
- Disclosure to shareholders
- CEO/CFO Certification - The CEO and CFO should certify to the board that they have reviewed financial statement and the cash flow statement for the year.

Objective of the Study

In this paper an attempt has been made to examine the extent of compliance of the Corporate Governance codes by the selected public sector bank State Bank of India.

Methodology

Data for the study have been collected from the secondary sources. Annual reports of the bank, relevant research publications and books were used for collecting data. The present study is envisaging on the reported Corporate Governance disclosure practices of the surveyed bank for the financial year 2014-2015. The present study is limited to a few parameters of good governance and also the study is based on a single financial year 2014-15.
Result

**Composition of Board of Directors**

As far as the composition of Board is concerned SBI has complied with provisions laid down in clause 49 of the Listing Agreement. There is an optimum combination of Executive and Non Executive Directors. The Board composition is in such a way that 5 Executive Directors and 10 Non Executive Directors. The chairman of SBI is an Executive Director.

**Separation of role of chairperson and CEO**

It has been observed that SBI has separated the role of chairperson and CEO and CMD

**Composition of audit Committee**

Audit committee of the board has 8 members of the Board of Directors, including 2 Whole Time Directors, 2 Official Directors and 4 non- Official, Non- Executive Independent Directors. The meetings of the committee are chaired by a Non- Executive Directors.

**Board Committee Meetings**

SBI has conducted a minimum 4 board meeting in each year with a gap not more than 4 months between any 3 board meetings. During the year 2014-15, 12 board meetings were held.

**Audit Committee meetings**

SBI has met more than 4 times in a year. During the year 2014-15, 11 meetings were held to review various matters. The constitution and quorum requirements were also complied with.
Disclosures

SBI has completed with the responsibility of disclosure as per the clause 49 of the Listing Agreement. Bank has disclosed all the relevant mandatory information in the leading newspapers and also published in websites. Annual report is sent to all the shareholders of the bank.

Composition of Remuneration Committee

Remuneration Committee of the Board was constituted on 22nd march 2007, for evaluating the performance of Whole Time Directors of the bank in connection with the payment of incentives, as per the scheme advised by Government of India. The committee consists of 4 members consisting of Government nominee Director, RBI nominee Director and 2 other Directors.

Corporate Social responsibility Committee

This committee was constituted on 2014 as a measure of good corporate governance to review the activities undertaken by bank under Corporate Social Responsibility policy. The committee has 7 members and Senior Managing Director on the committee is the chairman. During the year 2014-15, 2 meetings of the committee were held.

Code of Conduct

Senior management of SBI has affirmed compliance with the banks code of conduct for the financial year 2014-15. Declaration to this effected signed by the chairman and has been published in the Annual Report.

Corporate Governance Report

Conclusion

Good Governance is integral to the very existence of an institution. It inspires and strengthens investor’s confidence. SBI is committed to the best practices in the area of Corporate Governance. It is evident from the study that SBI has been complied with Corporate Governance practices with relation to various parameters like Board size, Board committee, Audit committee etc. all the mandatory requirements of SEBI under the clause 49 of Listing Agreement has been compiled by the bank and also true and full disclosure of all the relevant information is also ensured. Practice of Good Governance ensured effective management and control of business and enables the bank to maintain a high level of business ethics and to optimize the value for all its stakeholders.

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FUNGAL ALKALINE PROTEASE - A PROMISING ALTERNATIVE IN LEATHER INDUSTRY

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Abstract

The microbes in nature have enormous potentials and the ecological role played by these unnoticed groups is very significant. The enzymes secreted by the microorganism’s viz., bacteria, fungi etc. can utilize hair, hoof, nail, feather etc. as their sole carbon and nitrogen sources. The enzymatic degradation of keratin substrates by the fungal enzyme is focussed in dehairing process of the animal skin. Among eight of the fungal strains tested, high enzyme yielding Chrysosporium keratinophilum was selected for further activity on dehairing cattle hide. Optimal requirements for skin dehairing conditions by keratinase included time of reaction, reaction temperature, pH values and crude enzyme concentration. Experimental results revealed that optimal keratinase activity by standard assay of the selected fungal enzyme was exhibited at pH 9 for a contact time of 5 hr. at temperature 50 ºC. Enzymatic dehairing gives lengthier, stronger wool, which requires minimum washing afterwards. Hair gets removed along with epidermal layer and this makes the process of hair-loosening easier. The enzymatic dehairing is a more environmental friendly process. Instead of traditional chemical process, this capacity of the fungal enzyme can be substituted in dehairing.

Key words: Cattle hide, Dehairing, Chrysosporium keratinophilum, Leather, Solid state fermentation

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Introduction

Enzymes are vitally important to the existence of life. Current leather-processing procedures generate a considerable amount of chemical waste during all stages of processing and cause serious environmental pollution (Ludvik 2000). In the conventional pre-tanning process, depilation of animal hide is done by employing lime and sulphide. These two chemicals alone account for 70% of the total pollution in terms of biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS) and total suspended solids (TSS) Marsal et al., (1999). The alkaline nature of tannery effluents and the high sulphide content pollute ground water sources and cause serious health problems to the tannery workers and people living in the vicinity of leather-processing industries (Ramasami et al., 1999). A number of attempts have been made to find alternative methods for depilation of animal hide. The use of microbial enzymes, especially extracellular proteases have proved to be highly effective in depilating of animal hides (Puvanakrishnan and Dhar 1988) Though a number of bacterial and fungal strains are known to grow on hides, only a few of them have been shown to produce extracellular proteases with depilatory activity (Yates 1972, Nilegaonkar et al., 2007). In principle, the proteases having high depilatory properties with mild or no collagenolytic activity are considered to be the best proteases for depilating animal hide (Anbu et al., 2005, Friedrich et al., 2005, Giongo et al., 2007, Macedo et al., 2005). There are diversified forms of enzymes which play dynamic roles in different areas. Proteases belong to a group of proteolytic enzymes that are obtained by microbial fermentations and are meant to use in leather industry for dehairing, bating and soaking purposes. Their major use is in detergent industry too where they are used for breaking proteinaceous matter caused by body secretions, food stuffs and blood stains. These enzymes are obtained from plants, animals and
microbial sources. Animal and microbial proteases from fungi and bacteria are used in the pretanning processes of leather manufacture. The use of pure proteolytic enzymes for the removal of hair from animal hides dates back to the early 1900s (Röhm 1913). Until recently, most proteases used in enzymatic dehairing studies were bacterial in origin. Filamentous fungi, such as Aspergillus, have been the organism of choice for large scale production of bulk industrial enzymes, as the fungi can be grown on relatively inexpensive (agricultural waste) media and the fungi can secrete bulk quantities of enzymes (Bergquist et al., 2002). A proteolytic enzyme that had been isolated from Aspergillus tamarii was used to dehair goat skins (Dayanandan et al., 2003). Leather-making, is a by-product of the meat industry and reduces potential waste as well as contributes to economic growth (Germann 1999). The objective of this study is to develop an efficient- low cost and high yielding enzymatic dehairing system for cattle hides.

**Materials and methods**

**Isolation of fungus from soil**

Hair baiting technique was applied to isolate the fungus Chrysosporium keratinophilum. Sterile petri dishes with SDA agar was used to grow the fungus isolated from the soil baited with hair. It was then stored in SDA slants and kept at room temperature.

**Effects of different Solid Substrates**

Different solid substrates like rice bran, wheat bran, wheat flour, ground nut cake and coconut cake were used to study their effect on alkaline protease production. Fermentation was carried out at room temperature. The best solid substrate achieved by this step was wheat bran and it was selected for subsequent experiments.
Solid state fermentation

Solid state fermentation of *Chrysosporium keratinophilum* was carried out in 250ml. Erlenmeyer flasks. Fungal spores from the slants were used as inoculum for SSF. The activity of the enzyme was assayed using the sample collected from the culture media.

Alkaline protease Assay

Enzyme extraction and estimation of moisture content were carried out and the alkaline protease activity was determined (Lowry *et al.*, 1951). One unit of enzyme activity is defined as the amount of enzyme liberating one microgram of tyrosine per minute per ml. under the defined conditions.

Optimization of Fermentation process

Factors like selection of solid substrates, incubation temperature, incubation period and pH effecting the secretion of proteolytic enzyme under SSF were optimized.

Application of enzyme in dehairing process

The dehairing efficacy of the enzymes was assessed by applying the same on the Buffalo skin. The method adopted was dip method of enzymatic unhairing, the hides or skins were kept immersed in the enzyme solution at the required pH in sterilized petri dishes .Wet skin was selected and cut into two square pieces .They were washed thoroughly in soap water and tried. Two petri dishes were taken for the experimental set up. The sterilized skins were put into each plate. 20ml. of extracted enzyme was added to the first plate (experiment). 20 ml. of distilled water was added into the second plate. The skins were completely immersed in the enzyme. After every 2 hours interval the hairs we tried to remove from the skin using sterile forceps.
Results

Experimental results revealed that wheat bran acted as the better substrate in growing the fungus. Optimal protease activity by standard assay of the selected fungal enzyme was exhibited at pH 9.0 for a contact time of 5 hr. at temperature 50 °C. After 8 hrs. most of the hairs of the skin were removed. The skin in the control setup didn’t show any change.

![Figure 1. Activity of enzyme on different solid substrates](image1)

![Figure 2. Activity of enzyme on different pH substrates](image2)

![Figure 3. Activity of enzyme at different temperatures](image3)
Figure 4. Dehairing at different time intervals (a) 2hrs (b) 4hrs (c) 6hrs (d) 8hrs

Discussion

Enzymes are important in reducing both energy consumption and combating environmental pollution. Enzymatic dehairing in tanneries has been envisaged as an alternative to sulphides (Beynon and Bond 1989; Altschul et al., 1997). Alkaline proteases can be used which enables the swelling of hair roots, and the subsequent attack of protease on the hair follicle protein allowing easy removal of the hair (Gupta et al., 2002). The enzyme from Chrysosporium keratinophilum showed good dehairing capacity in the experiment. A large
proportion of the known alkaline proteases are derived from microorganisms, especially from fungal strains. Enzymatic unhairing accomplished by proteolytic enzymes is of great commercial importance contributing to more than 40% of the world’s commercially produced enzymes. Approximately 50% of the enzymes produced is used for industrial process (Pepper et al., 1963). Further, proteolytic enzymes are more efficient in enzymatic dehairing rather than amylolytic enzymes (Puvankrishanan 2003). The enzymes cause loosening of the hair, without damaging the fibrous collagen of dermis. Enzymatic dehairing has several advantages like significant reduction or even complete elimination of the use of sodium sulfide, total recovery of hair resulting good quality with good saleable value and creation of an ecologically conducive atmosphere for the workers.

**Conclusion**

The potential use of protease enzymes in leather processing eliminates the pollution causing chemicals such as sodium, lime and solvents. The study reports revealed that alkaline protease isolated from *Chrysosporium keratinophilum* has the potential to replace sodium sulfide in the routine dehairing process.

**References**


THE INFLUENCE OF CONTINUING EDUCATION PROGRAMME (CEP) IN THE QUALITY OF LIFE OF THE NEO LITERATE – A CASE STUDY OF ERNAKULAM DISTRICT IN KERALA

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Abstract

Kerala has the distinction of being a historic state in India so far as literacy development is concerned. It has the highest percentage of literacy amongst the states of India. The total literacy campaign and the continuing education programme is effectively implementing by the Kerala State Literacy Mission Authority (KSLMA) with the help of local administrative governments. The programme has launched on 2nd October 1998 in all the 14 districts of Kerala. The CEP provides lifelong learning facilities at various learning centers. The major Continuing Education Programmes are; Equivalency Education Programme, Income Generating Programme, Quality of Life Improvement Programme and Individual Interest Promotion Programme. The influence of CEP in the behavioural, social, political and economical life of the beneficiaries is studied with the help of the Questionnaire and Interview Schedule. The findings revealed that the programme of CEP has a positive change in behavioural, social, economic and political life of the beneficiaries. It has a significant influence and provides a multi dimensional development of the beneficiaries.

Key Words: Continuing Education Programmes, Equivalency Education, Income Generation, Quality of Life Improvement, Individual Interest Promotion

Introduction

Literacy is the only way that allows an individual to participate in contemporary social, economic and political development. The developing

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countries consider literacy as a pre-eminent requirement and gave central priority to it. Literacy is a basic human right and considered as a critical step to lifelong learning. This has been affirmed in a succession of mandates from the 1948 Universal Declaration of Human Rights, which declared under Article 26 that everyone has the right to education. Indian constitution incorporated right to education in the Directive principles of state policy and later in 2002 it became a fundamental right under article 21A. To scourge illiteracy is the primary mission of the government in the post independence period and the government has been formulated and implemented various programme to eradicate illiteracy such as NAEP, RELP, MPFL. The 3 major campaigns of NLM is Total Literacy Campaign, Post literacy campaign, Continuing educational programme.

The Scheme of Continuing Education (CE) was launched in 1998 as a fully funded centrally-sponsored scheme. The scheme initially envisaged 100 percent assistance to the states for the first three years of implementation. The State Governments were required to share 50 percent of the expenditure during the 4th and 5th years of the project, and thereafter take over total responsibility of the programme. The basic unit of the scheme was the Continuing Education Centre (CEC) with a Nodal Continuing Education Centre (NCEC) overseeing the working of a cluster of CECs. The beneficiaries of the programme were the neo-literates who have completed the literacy classes, school dropouts, pass out of primary schools and other members of the community who were interested in availing of the opportunities for lifelong learning. At present all over the state the (Kerala State Literacy Mission) KSLM has 4000 continuing centres.

The beneficiaries of the Continuing Education Programmes (CEP) are the neo-literates who have completed their literacy classes, school dropouts, pass out
of primary education and interested in availing opportunities for lifelong learning. The most important programme of the CEP is the equivalency programme in which more number of people participated. In this study, the effectiveness and evaluation of CEP were studied by conducting a survey of the participants in the Ernakulam district of Kerala.

Objectives is to study whether the participants of the CEP could

- Retain and sustain the benefits of total literacy and provide an opportunity to the neo literate to take their learning beyond basic literacy.
- Improve the living conditions and quality of life.
- Create an awareness about the spirit of democratic citizenship and improvement of environment
- Improve the economic conditions of the marginalized people

Methodology of the study

Descriptive method is used to find out the influence of CEP in the quality of life of the neo literate in Ernakulam district of Kerala. Questionnaire were prepared and distributed to the beneficiaries by visiting the centres. A face to face interview was also organized with the beneficiaries. The data collected are edited, coded and tabulated for the purpose of analysing and explanatory research strategy is also used. Respondents were learners of IVth equivalency VIIth equivalency and Xth equivalency. Among them a few beneficiaries were the participants of income generating programme too. This study seeks to examine the impact of the programme in the quality of life of the neo-literates and beneficiaries (table 1). Primary analysis was done by examining and studying the documents already availed and the literary
review. Illustration of the different programmes initiated by the literacy mission that helps to understand the effectiveness of the same is analyzed. The interactive sessions were organized with the officials of literacy mission and the neo literate who are the beneficiaries of the programme. Thirty continuing education centres from the district were selected and 60 respondents were taken to study.

Table 1. Variables considered under this study

<table>
<thead>
<tr>
<th>Dependant variables</th>
<th>Independent variables</th>
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<tbody>
<tr>
<td>Economic empowerment</td>
<td>Income generating programme</td>
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<tr>
<td></td>
<td>Employment generation</td>
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<td></td>
<td>Communication skill</td>
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<td></td>
<td>Self confidence</td>
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<td>Social empowerment</td>
<td>Relation with developmental agencies</td>
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<td></td>
<td>Health and hygiene</td>
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<td>Decision making ability</td>
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<td></td>
<td>Behavioural changes</td>
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<td>Exercising right to vote</td>
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<td>Political empowerment</td>
<td>Political participation</td>
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<td>Development of citizenship</td>
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</table>

The continuing education programme aims to provide formal education to all at school levels. This programme tries to attend the multifarious development of the learner. The most important initiative of the CEP is the equivalency programme. The effectiveness and evaluation were studied by conducting a survey amongst the 60 beneficiaries. They were learners of IVth equivalency, VIIth equivalency and Xth equivalency.
Table 2: Socio economic profile of the participants

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Particulars</th>
<th>Respondents from which data collected</th>
<th>Number</th>
<th>Percentage</th>
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<td>45 and above</td>
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<td></td>
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<td>Salesman/insurance</td>
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<td></td>
<td>Govt/Semigovt. Employees</td>
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<td>Christian</td>
<td></td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Muslim</td>
<td></td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Primary data

Table 3: Factors that motivated people to join CEP

<table>
<thead>
<tr>
<th>Factors that motivated people to join CEP</th>
<th>No. of persons</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquire Knowledge</td>
<td>35</td>
<td>58</td>
</tr>
<tr>
<td>Skill development</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Improve economic condition</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Improve the quality of life —socially and politically</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

During the survey, information on factors that motivated the members to join the programme were collected. More than half of the respondents were
joined the programme with a view to increase their knowledge. All the study materials are provided by the District literacy mission.

Results

Social empowerment of the neo literate

The social empowerment of every individual means equal status with others irrespective of any ground in the society. The social empowerment can be measured in terms of improvement in their communication skills, self confidence, decision making ability, the way to involve in social issues, their knowledge about health and hygiene and behavioural changes etc.

Table 4: Social empowerment of the respondents

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Variables</th>
<th>Pre-CEP (%)</th>
<th>Post CEP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Communication skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hesitate to talk</td>
<td>85</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Talks freely</td>
<td>3</td>
<td>81</td>
</tr>
<tr>
<td>2</td>
<td>Self confidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exudes self confidence and self esteem</td>
<td>28</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Helps neighbours</td>
<td>40</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Respectful treatment from family members</td>
<td>45</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Involve in the social issues actively</td>
<td>43</td>
<td>88</td>
</tr>
<tr>
<td>3</td>
<td>Health and hygiene</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Family health and hygiene</td>
<td>45</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Cleanliness of the surroundings</td>
<td>32</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Immunization programme</td>
<td>28</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>Awareness of epidemic and contagious diseases</td>
<td>30</td>
<td>98</td>
</tr>
<tr>
<td>4</td>
<td>Decision making</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Household assets and investments</td>
<td>34</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Selection of jobs</td>
<td>38</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>Education and marriage</td>
<td>28</td>
<td>83</td>
</tr>
<tr>
<td>5</td>
<td>Behavioural changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protest against social evils</td>
<td>36</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Domestic violence</td>
<td>29</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>Wage differentials</td>
<td>40</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Adulteration and black marketing</td>
<td>38</td>
<td>78</td>
</tr>
</tbody>
</table>
The communication skill of the respondents increased significantly. They agreed that the cultural activities and personality development classes helped them a lot in this regard. Participants realized the need to help their neighbours and had confidence to do. They experienced better treatment from their family members and their self-esteem increased. About 88% of the people are ready to involve in social issues and suggest solutions for these issues. Their involvement in the cultural and other programmes of the mission has provided a better quality of life to them by enhancing their self-confidence (Table 4).

Participation of the neo-literate in the CEP helped them to improve their awareness about the family health and hygiene. The mission has been conducting classes for the learners on matters of health and hygiene. The preraks organised classes with the help of health department to the learners on health, hygiene and protection of environment.

Different programmes of CEP help the respondents to improve their decision-making processes. The women’s role in the decision making role on household activities and on social matters like education and marriage of their children has improved considerably. The participation of the literacy programmes contributed to the emergence of positive attitudes and knowledge among the beneficiaries which help them to occupy the public sphere. They showed increased intolerance towards domestic violence and adulteration.

**Economic Empowerment of the neo-literate**

The Continuing education programme did not make a drastic change in the economic aspects of the respondents. Out of 60 interviewed only 12 members were the participants of the income generating programmes of the mission. The beneficiaries of the income generating programme were the employees in need of higher qualification for their career development. Drivers
engaged in this programme increased their communicative skill in English and they could effectively interact with the English speaking tourists and could generate more income.

**Political empowerment**

There is an assumption that if individuals are more exposed to information about their environment, especially the public institutions and the government they will be more efficient to intervene and thus make such bodies more responsive to their need. If individuals are engaged in political institutions and the decision making process of the polity an intimate connection between democracy and literacy would emerged (table 5).

**Table 5:** Political Empowerment of the respondents

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Variables</th>
<th>Pre-CEP (%)</th>
<th>Post CEP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Exercising Right to vote</td>
<td>No</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Understanding the Political policies of parties</td>
<td>No</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>Knowledge about the Constitution of India</td>
<td>No</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>Knowledge about the rights and duties of citizens</td>
<td>No</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>Knowledge about the political system</td>
<td>No</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Participation in Grama sabha</td>
<td>No</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td>Political participation</td>
<td>No</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>18</td>
</tr>
</tbody>
</table>

Source: Primary
Literacy programme helped to develop the citizenship and autonomous attitude of the adult learners. 96% of the respondents exercised their right to vote in the immediate general election after training. 80% of the beneficiaries agreed that the educational process helped them to exercise their voting right properly and consciously. They are exposed of the knowledge about the constitution, the rights and duties of a citizen which led to the higher level of participation in the panchayati raj system especially in Grama sabhas. The literacy programmes supported the individual to build the spirit of questioning the existing obstacles to one’s life and acquire a higher level of political participation. Participation in literacy programmes is associated with greater interest in national and community activities.

Table 6: Overall output of the CEP

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Benefits</th>
<th>Very Useful</th>
<th>Useful</th>
<th>Not useful</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number %</td>
<td>Number %</td>
<td>Number %</td>
</tr>
<tr>
<td>1</td>
<td>Identify the strength and weakness of the personality</td>
<td>46 77</td>
<td>14 23</td>
<td>- -</td>
</tr>
<tr>
<td>2</td>
<td>Social interaction</td>
<td>22 37</td>
<td>33 55</td>
<td>5 8</td>
</tr>
<tr>
<td>3</td>
<td>Skill development</td>
<td>30 50</td>
<td>26 43</td>
<td>4 7</td>
</tr>
<tr>
<td>4</td>
<td>Impart knowledge</td>
<td>55 91</td>
<td>5 8</td>
<td>- -</td>
</tr>
<tr>
<td>5</td>
<td>Political awareness</td>
<td>12 20</td>
<td>38 63</td>
<td>10 17</td>
</tr>
<tr>
<td>6</td>
<td>Social justice and equality</td>
<td>11 18</td>
<td>38 64</td>
<td>11 18</td>
</tr>
<tr>
<td>7</td>
<td>Self confidence</td>
<td>56 93</td>
<td>4 7</td>
<td>- -</td>
</tr>
<tr>
<td>8</td>
<td>Self reliance</td>
<td>42 70</td>
<td>18 30</td>
<td>- -</td>
</tr>
<tr>
<td>9</td>
<td>Self esteem</td>
<td>50 83</td>
<td>10 17</td>
<td>- -</td>
</tr>
<tr>
<td>10</td>
<td>Health and family welfare</td>
<td>51 85</td>
<td>9 15</td>
<td>- -</td>
</tr>
</tbody>
</table>

Source: Primary

Capacity building refers to the process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive and adapt. It considers the abilities in undertaking
socio-cultural and political activities and enhancing self esteem. It is reported that more than 90 percent of the respondents have acquired knowledge about social and political facts which helped them to improve their self confidence and self esteem. There was a significant increase in the awareness with respect to family welfare, health and hygiene. They realized the need for social justice and equality in all spheres of life which will help them to intervene in community matters more democratically. Their interaction with community has also increased which were exposed of them how to control the social and political institutions effectively and to develop their goals and identify the obstacles in their life (table 6).

**Conclusion**

The aim of the literacy programme in general and continuing programme in particular is to make provisions for continuing education which would put them at par with others and become aware of the causes of deprivation and moving towards amelioration of their condition by participating in the process of development. The involvement of the people in the activities of the continuing education programme (CEP) of the literacy mission have made significant social impact in their lives. CEP enhances their capacity to take decisions, increase communication skills, awareness of their rights and made them efficient to identify the social issues and also increased their self esteem. These entire factors are the indicators of social empowerment and in respect of the above factors a positive change is noticed in the perception of the beneficiaries. Participation in literacy programmes is associated with greater interest in national and community activities. The participants of the programme observed that CEC has helped them to become a good citizen and improve their social interaction. The political emancipation of the adults had also been much better. Evidence from literacy classes showed that learners
acquire information such as voting in an election, seeking information about candidates or issues, participating in discussion of political parties or social movement.

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SLMA/SDAE and NLM (2011)The Evaluation of Preparatory steps of the Continuing Education Programme of Literacy Missionion in Ernakulum district.


Aksharam, News letter, State Resource Centre Kerala, January 2012
GREEN BANKING INITIATIVES AND ITS CUSTOMER AWARENESS IN INDIAN PUBLIC SECTOR BANKS

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Abstract
Banking sector plays an important role in the economic growth of a nation. Sustaining development can best be achieved by allowing marketer to work within a framework of cost efficient and appropriate instruments. The problem relating to environment, maintaining the ecological balance and environmental sustainability has become issues for debate around the globe. The concept of green banking is a new concept. It is a paperless banking, which not only reduces the cost of banking activities but also helps in environment sustainability. Green banking promotes environmental friendly practices and reduces carbon footprint arising from banking activities. This study has been made to study the level of customer satisfaction and awareness regarding “green banking services” initiatives taken by various public sector banks in India. The study aims to identify the opinion and awareness of customers regards to green banking concept. It is necessary to identify the various initiatives taken by banks on the concept of green banking in order to influence the customer and make them user friendly.

Keywords: Green Banking, India, Public Sector banks

Introduction
Green banking is a proactive way of energy conservation and environmental protection. The ultimate benefit of green banking approach is the protection of the natural resources and the environment. With the help of green banking, banks can avoids paper work to the optimum level and focuses on electronic transactions like

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ATM, mobile banking etc. In India, Green banking is in its initial phase. Banks can utilize green banking as an opportunity to gain advantage in the market by creating a difference in their strategy making process. Banks need to be more active in communicating the green banking concept and its associated benefit to customers. They must focus on promoting the consciousness benefit of green banking to the employee who is in direct touch with the customers.

Electronic transactions not only aid towards sustainability but also provide convenience to the customers as well as to banks. Banking sector is generally considered as environment friendly in terms of emissions and pollutions. Internal environmental impact of the banking sector such as use of energy, paper and water are relatively low and clean. Environmental impact of banks is not physically related to their banking activities but with customer’s activities. Moreover to estimate environment management in the banking business is like risk management. It increases the enterprise value and lowers loss ratio as higher quality loan portfolio results in higher earnings. Thus encouraging environmentally responsible investment and prudent lending should be one of the responsibilities of the banking sector. Further, those industries which have already become green and those which are making serious attempts to grow green should be accord priority to lending by the banks. This method of finance can be called as green banking and effort by the banks to make the industries grow green and in the process restore the natural environment.

This concept of green banking will be mutually beneficial to the banks, industries and the economy. Not only green banking ensures the greening of industries but it will also facilitate in improving the asset quality of the banks in future. Internationally there is a growing concern about the role of banking and institutional investors for environmentally responsible/ socially responsible investment projects.
Green banking in India

Indian industry faces the challenges of controlling environmental impact of their business that is reducing pollution and emissions of their clients. Though government has been trying to address the issue by framing environmental legislations and encouraging industry to follow environmental technologies and practices, poor track records of enforcement and public awareness act as negative factor.

Green banking initiatives in public sector banks

There are 19 nationalized banks in India. The public sector banks are socially controlled and publically owned. It was done with the objective of giving a professional blend to bank management and provision of adequate credit for agricultural and rural sector, small industries exports and new class of entrepreneurs. When faced with tough competitions from private sectors and foreign banks, the public sector banks have reinvested themselves and have markedly improved their service and operational results. The important public sector banks which took measures to increase the awareness of customers in green banking are State Bank of India (SBI), Punjab National Bank (PNB) and Canara Bank.

The green banking Initiatives taken by SBI

1) Launched green channel counter facilities in the year 2010 in some of its branches and planning to extend it in more branches. It also initiated an environment friendly approach of paperless banking.

2) Collaboration with Suzlon Energy limited to use wind power at the place of thermal power in its business operations and currently using wind power in its most offices located in Gujarat, Tamil Nadu and Maharashtra.

3) Initiated the carbon disclosure project in the financial sector of India for the sake of environmental concern and safety.
Green banking Initiatives by PNB

1) Internet banking started by PNB in the year 2003-04
2) Debit card facilities started in the year 2002-03
3) Bank has started using energy efficient appliances and conducting electoral auditing in the offices
4) A separate green audit sheet is prepared by the bank to access importance of various green banking Institutions by the bank
5) Sanctioned 9 commercial project of green energy in 2010-2011

Green banking Initiatives by Canara Bank

1) Green banking initiatives such as international banking, Tele banking, and mobile banking, solar power bio metric ATMs etc. in rural areas
2) The bank providing loans for implementing solar lighting systems and till date bank has financed 50000 units, lending 5-8 lakhs to each unit

Significance of the study

As environmental sustainability is an important issue and green banking is a step in this regard. Hence there is need to study the green banking initiatives taken by the banking sectors and also to review the role of green banking in environmental sustainability.

Objectives

1) To identify the various initiative taken towards green banking by public sector banks
2) To analyse the demographic factors affecting green banking
3) To identify the various obstacles faced by the respondents in green banking services
Methodology

Both primary and secondary data were used for this study. Primary data were collected from respondents of selected public sector banks. The sample size was 75. Secondary data were collected from journals, online magazines, and reports of respective banks.

Results

The major users of green banking lie between ages 20-40 (69%) and 40-60 (16%). Out of 75 respondents 52% of respondents were male and 45% were female (Table 1).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 20</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>20-40</td>
<td>52</td>
<td>69</td>
</tr>
<tr>
<td>40-60</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Above 60</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>39</td>
<td>52</td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>48</td>
</tr>
</tbody>
</table>

Source: Primary Data

77% of customers of SBI are aware of green banking. It is clear that customers of SBI have much awareness about green banking whereas majority of customer’s of Canara bank and PNB were not aware of green banking (Table 2).

<table>
<thead>
<tr>
<th>Banks</th>
<th>Respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Bank of India</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aware</td>
<td>58</td>
<td>77</td>
</tr>
<tr>
<td>Not Aware</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Punjab National Bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aware</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Not Aware</td>
<td>58</td>
<td>77</td>
</tr>
<tr>
<td>Canara Bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aware</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Not Aware</td>
<td>69</td>
<td>92</td>
</tr>
</tbody>
</table>

Source: Primary Data
Most of the customers are aware of the important green banking initiatives such as green checking, online bill payment, cash deposit system etc. and most of the customers were not aware of green CD’s, measures to reduce wastage of paper and Clean Development Mechanism related services working on mitigating climate change (table 3).

Table 3: Initiatives taken towards green banking and its awareness among respondents

<table>
<thead>
<tr>
<th>Green initiatives</th>
<th>Aware</th>
<th>Not Aware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green checking</td>
<td>86 %</td>
<td>14 %</td>
</tr>
<tr>
<td>Green Loans</td>
<td>54 %</td>
<td>46 %</td>
</tr>
<tr>
<td>Green Mortgages</td>
<td>45 %</td>
<td>55 %</td>
</tr>
<tr>
<td>Green CD’s</td>
<td>36 %</td>
<td>64 %</td>
</tr>
<tr>
<td>Green controlled use of energy</td>
<td>66 %</td>
<td>34 %</td>
</tr>
<tr>
<td>Facilitates of establishment of regulations by which donate E-book to needy</td>
<td>64 %</td>
<td>36 %</td>
</tr>
<tr>
<td>Reduced wastage of papers and energy through net banking approach</td>
<td>34 %</td>
<td>33 %</td>
</tr>
<tr>
<td>Use of solar powered ATM’s</td>
<td>68 %</td>
<td>66 %</td>
</tr>
<tr>
<td>Energy – Efficient branches and loans</td>
<td>46 %</td>
<td>32 %</td>
</tr>
<tr>
<td>High efficiency lighting</td>
<td>55 %</td>
<td>54 %</td>
</tr>
<tr>
<td>Using recycle paper or recycle waste</td>
<td>46 %</td>
<td>56 %</td>
</tr>
<tr>
<td>Bonds and mutual funds meant for environmental investments</td>
<td>44 %</td>
<td>55 %</td>
</tr>
<tr>
<td>Clean Development Mechanism related services working on climate change.</td>
<td>25 %</td>
<td>75 %</td>
</tr>
<tr>
<td>50 % waiver in processing fee of cars that use alternate e-mode of energy</td>
<td>50 %</td>
<td>50 %</td>
</tr>
<tr>
<td>Conducting workshops and seminar for green banking</td>
<td>35 %</td>
<td>64 %</td>
</tr>
<tr>
<td>Bank environmental policy</td>
<td>81 %</td>
<td>19 %</td>
</tr>
<tr>
<td>Online bill payment</td>
<td>83 %</td>
<td>17 %</td>
</tr>
<tr>
<td>Cash Deposit System</td>
<td>76 %</td>
<td>24 %</td>
</tr>
<tr>
<td>E- investment services</td>
<td>31 %</td>
<td>69 %</td>
</tr>
<tr>
<td>Communication through press</td>
<td>35 %</td>
<td>64 %</td>
</tr>
</tbody>
</table>

Source: Primary Data
Most of the customers agree that they feel that technical issue (38%) is the major reason that pulls them away from using green banking initiatives. Lack of education and concerns about data security and privacy are the important obstacles of green banking (table 4).

<table>
<thead>
<tr>
<th>Obstacles</th>
<th>Difficult to operate</th>
<th>Not difficult to operate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data security and privacy</td>
<td>21%</td>
<td>79%</td>
</tr>
<tr>
<td>Lack of education</td>
<td>26%</td>
<td>74%</td>
</tr>
<tr>
<td>Technical issue</td>
<td>38%</td>
<td>62%</td>
</tr>
<tr>
<td>Traditional approach</td>
<td>13%</td>
<td>87%</td>
</tr>
<tr>
<td>Lack of infrastructure</td>
<td>14%</td>
<td>86%</td>
</tr>
</tbody>
</table>

Source: Primary Data

**Conclusion**

With go green mantra the banking sector too has adopted sustainable practices in all spheres of life. Green banking is an endeavor where banks have to work closely with government, NGO’s, IFIS/IGOS, central bank and business community to reach the goal. Adoption of green banking approach is more than just becoming environment-friendly as it associated with lots of benefits like reduction the risks as well as cost of the bank, enhancement of banks reputation, and contribution to the common good of environmental besides. In a broad sense, green banking serves the common commercial objective of the bank as well as the corporate responsibility. Thus it is important that Indian banks should realize their responsibilities towards the environment as well as the society, in order to compete and survive in the global market.
Reference


COMPARISON OF ANT DIVERSITY IN PADDY AGROECOSYSTEMS OF KUTTIPUZHA AND THOTTAKKATTUKARA OF ERNAKULAM DISTRICT

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Abstract

An attempt has been made to study the species composition of ants to assess ant diversity of paddy ecosystems, which is one of the major agroecosystem of Kerala. This study was carried out in two different paddy fields, paddy field (1) at Thottakattukara and paddy field (2) at Kuttipuzha for a period of three months from January to March 2016. Specimen collection was carried out by random quadrate sampling method. Brush method and hand picking method was adopted for collection of ants. A total of 16 species of ants belonging to 4 subfamilies were recorded from both the study areas. Paddy field 1 recorded 11 species belonging to 3 subfamilies. Paddy field 2 recorded 15 species belonging to 4 subfamilies. Nine species were found common in both study areas. In paddy field-1 ant species belonging to subfamily Formicinae was found to be dominant whereas in Paddy field-2 recorded ant species belonging to subfamily Myrmicinae was found to be dominant. Alpha diversity calculated by Shannon Wiener index (H’) revealed that field 2 (H’=2.65) showed a higher diversity index than the field 1(H’=2.35). In paddy field 1 Camponotus parius was the most abundant ant species followed by Pheidole species and paddy field 2 has Camponotus parius as the most abundant ant species followed by Pheidole affinis. T test revealed that the composition of ants was significantly different in the two paddy ecosystems (t=2.7212, df=24, P<0.05). A significant observation was that the colony density of ants was more along the field margin than the interior parts of the fields. Another remarkable observation was of Oecophylla smaragdina, an arboreal species generally associated with the mango trees and other citrus trees. It is the need of the hour, to explore the diversity of managed ecosystems such as paddy fields to throw light on better management practices of such agroecosystems to conserve the existing biodiversity.

Keywords: Ant, Agroecosystems, Alpha diversity, Rank abundance plot
Introduction

Ants could dominate ecosystems in a way unparalleled by any other organism. (La Salle and Gauld 1993). Their varied roles in ecosystems make them relevant in agroecosystems. Their species composition can be used as indicator of ecosystem health and functioning (Thiwari 2002). Ants occupy a variety of habitats including leaf litter, soil, trees, dead logs etc. Tramp species are even found in human modified habitats (Bharati 2008). Ants are also referred to as biological indicators. Species such as *Solenopsis geminate* is found in disturbed ecosystems (Savitha *et al.*, 2013). Hence the presence of such indicator species would reveal the condition of a given ecosystem. Efforts to preserve biodiversity have been focused primarily on remaining areas of natural ecosystems, but only 5% of the terrestrial environment is unmanaged and uninhabited (Western and Pearl 1989), and only 3.2% is protected in national parks (Reid and Miller 1989). Of the 95% of the world’s land devoted to managed ecosystems, approximately 50% is in agriculture (Western and Pearl 1989). These data suggest that more attention should be paid to understanding patterns of biodiversity in managed ecosystems and how species richness influences the functioning of these systems (Alison and Alexanders 1996). Three main habitat components, namely vegetation, litter and soil, can directly and indirectly shape the overall habitat complexity as perceived by invertebrates living in the soil, litter interface (Rios-Casanova *et al.*, 2006; Gibb and Parr 2013). The structural complexity of vegetation has been found to generally increase ant abundance and species richness (Langellotto and Denna 2004; De la Mora *et al.*, 2013).

Patterns of abundance and site selection of granivorous ant nests were investigated in extensive cereal crop lands of central Spain by Diaz (1991). Study conducted by Campbell (1998) on ant species assemblages were found to
differ significantly between the fields and the field margin. Ants species assemblages were correlated with soil variables, tillage practices, and insecticide use, suggesting that ants have potential as a biological indicator of agroecosystem condition. It was also found that the most common species in the cropped part of the field was *Pheidole bicarinata, Solenopsis sp*, an important species of fire ant was found more frequently in the field than in field margin.

Ants exhibit a greater resistance to pollutants in comparison to other invertebrates, especially to radioactivity (Torossian and Causse, 1968; Le Manse, and Bonavita-Cougourdam 1972). Ants are also resistant to industrial pollutants (Petal *et al.*, 1975). However, the density of ant colonies and their sizes decrease with increasing levels of pollution (Petal 1978a). An attempt has been made to study the species composition of ants to assess ant diversity of paddy ecosystems, which is a major agroecosystem of Kerala.

**Materials and methods**

The study on ant diversity in paddy fields of Thottakkattukara and Kuttipuzha in the Ernakulam district of Kerala was carried out for a period of three months from January to March, 2016. Sites were visited twice a month. Specimen collection was carried out early in the morning. Quadrate sampling method was adopted for the study. Quadrates of size 5x5 m were selected.

Brush method and hand picking methods were employed for collecting ants. The unmounted materials were stored in 70% alcohol in small bottles. The card mounted materials were preserved in insect boxes. Ant species were identified based on Bolten (1994) and Fauna of British India Bingham (1903).
Results

A total of 16 species of ants belonging to 4 subfamilies were recorded from both the study areas at Thottakattukara (Paddy field 1) and at Kuttipuzha (Paddy field 2). Paddy field 1 recorded 11 species belonging to 3 subfamilies. The recorded species were *Paratrechina longicornis*, *Camponotus parius*, *camponotus sericeus*, *Anoplolepis gracilipes*, *Oecophylla smaragdina*, *Diacamma rugosum*, *Pachycondyla melanaria*, *Meranoplus bicolor*, *Myrmicaria brunnea*, *Pheidole sykesii*, and *Tetramorium sp*.

Paddy field 2 recorded 15 species belonging to 4 subfamilies. The recorded species were *Camponotus mitis*, *Polyrhachis clypeata*, *Paratrechina longicornis*, *Camponotus parius*, *Anoplolepis gracilipes*, *Odontomachus haematodes*, *Diacamma rugosum*, *Pachycondyla melanaris*, *Meranoplus bicolor*, *Myrmicaria brunnea*, *Pheidole sp*, *Tetramorium sp*, *Solenopsis geminate*, *Pheidologeton affinis*, and *Tapinoma indicum*.

Nine species were found common in both study areas. The common species recorded were *Paratrechina longicornis*, *Camponotus parius*, *Anoplolepis gracilipes*, *Diacamma rugosum*, *Pachycondyla melanaris*, *Meranoplus bicolor*, *Myrmicaria brunnea*, *Pheidole sp*, *Tetramorium sp* (Table 1).

Rank abundance plot of paddy field 1 shows that *Camponotus parius* is the most abundant ant species followed by *Camponotus sericeus* and *Pheidole* species, whereas *Tetramorium sp* is the least abundant species. Rank abundance plot of paddy field 2 shows that *Camponotus parius* is the most abundant ant species followed by *Pheidole affinis*. *Myrmicaria brunnea* is the least abundant ant species of this field (figure 1a and b).
T test revealed that the composition of ants was significantly different in the two paddy ecosystems (t=2.7212, df=24, P<0.05).

**Sub families of ant species recorded**

Paddy field-1 at Thottakattukara recorded ant species belonging to 3 subfamilies. Subfamily Formicinae was found dominant with a species richness of 46%, followed by subfamily Myrmicinae (36%) and subfamily Ponerinae (18%).

Paddy field-2 at Kuttipuzha recorded ant species belonging to 4 subfamilies. Subfamily Myrmicinae was found dominant with a species richness of 40%, followed by subfamily Formicinae (33%), Ponerinae (20%) and Dolichoderinae (7%) (Figure 2a and b).

**Species richness and diversity of ants in the study habitat**

Paddy field-1 at Thottakattukara recorded 11 ant species and paddy field-2 at Kuttipuzha recorded 15 ant species. Alpha diversity calculated by Shannon Wiener index (H) revealed that field at Kuttipuzha (H’=2.5986) showed a higher diversity index than the field at Thottakattukara which had an index of (H’=2.35906). Species richness calculated by Simpson index again revealed that field at Kuttipuzha (D =0.080121) showed higher species richness than the field at Thottakattukara which had an index of (D =0.096428).

A significant observation in the current study was that the colony density of ants was more along the field margin than the interior parts of the fields. Another remarkable observation was of *Oecophylla smaragdina*, which is an arboreal species. This observation was due to the presence of many mango trees aside field 1. Most of the identified species are ground foragers. Ant nests were
found mainly along the earthen bunds. Though field 2 uses harmful pesticides and weedicides, it harbours more number of species than field 1, which uses least chemicals.

Table 1. Occurrence of ant species in the two study habitats

<table>
<thead>
<tr>
<th>Subfamily</th>
<th>Species</th>
<th>Presence of ant species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Field 1</td>
</tr>
<tr>
<td>Formicinae</td>
<td>Paratrechina longicornis</td>
<td>*</td>
</tr>
<tr>
<td>Formicinae</td>
<td>Camponotus parius</td>
<td>*</td>
</tr>
<tr>
<td>Formicinae</td>
<td>Camponotus sericeus</td>
<td>*</td>
</tr>
<tr>
<td>Formicinae</td>
<td>Anoplolepis gracilipes</td>
<td>*</td>
</tr>
<tr>
<td>Formicinae</td>
<td>Oecophylla smaragdina</td>
<td>*</td>
</tr>
<tr>
<td>Formicinae</td>
<td>Camponotus mitis</td>
<td>*</td>
</tr>
<tr>
<td>Formicinae</td>
<td>Polyrhachis clypeata</td>
<td></td>
</tr>
<tr>
<td>Ponerinae</td>
<td>Diacamma rugosum</td>
<td>*</td>
</tr>
<tr>
<td>Ponerinae</td>
<td>Pachycondyla melanaris</td>
<td>*</td>
</tr>
<tr>
<td>Ponerinae</td>
<td>Odontomachus haematodes</td>
<td>*</td>
</tr>
<tr>
<td>Myrmicinae</td>
<td>Meranoplus bicolor</td>
<td>*</td>
</tr>
<tr>
<td>Myrmicinae</td>
<td>Myrmicaria brunnea</td>
<td>*</td>
</tr>
<tr>
<td>Myrmicinae</td>
<td>Pheidole sykesii</td>
<td>*</td>
</tr>
<tr>
<td>Myrmicinae</td>
<td>Tetramorium sp</td>
<td>*</td>
</tr>
<tr>
<td>Myrmicinae</td>
<td>Pheidole sp</td>
<td>*</td>
</tr>
<tr>
<td>Myrmicinae</td>
<td>Solenopsis geminata</td>
<td></td>
</tr>
<tr>
<td>Myrmicinae</td>
<td>Pheidologeton affinis</td>
<td></td>
</tr>
<tr>
<td>Dolichoderinae</td>
<td>Tapinoma indicum</td>
<td></td>
</tr>
</tbody>
</table>

* Indicates presence of ant species
Figure 2. Rank abundance plot showing the abundance of ant species (a) field 1 (b) field 2.
Discussion

The current study revealed the diversity and ecology of ants in paddy agro ecosystems at Thottakattukara and Kuttipuzha. Keeping in view the large number of ant species identified (828 valid species) and described in India (Bharti and Alpert 2007), the number of ant species recorded in this study is considerably low. The two paddy agroecosystems in the present study adopted monoculture systems and this might have contributed to the decreased ant species diversity recorded in the study areas.

On comparing the species richness of ants in the two study areas, field 2 (paddy field at Kuttipuzha) recorded 15 species when compared to paddy field 1 at Thottakattukara, which recorded 11 species of ants. The higher species richness of field 2 may be attributed to the complexity of flora in the adjacent landscapes especially the outskirts of the paddy field, the earthen bund area. Many studies have reported that the structural complexity of vegetation would contribute to the increase in the species richness of ants (Langellotto and Denno 2004). The presence of complex vegetation cover surrounding the study area 2 attribute to the notably high species richness of ants recorded along the margins of field 2.
T test revealed that the composition of ants was significantly different in the two paddy ecosystems. This significant difference in diversity of ants was attributed to the varied influence of adjacent landscapes. Adjacent landscapes might play a role in shaping the structure of ant assemblages in the paddy ecosystems (Gibb and Holchuli 2002). Field 2 being a village area had highly diverse vegetation surrounding it, while field 1 being much closer to the National High Way-47 with adjoining residential areas had comparatively low vegetation cover surrounding it. The substantial differences in vegetation cover and urban influence near the two study areas indicated the significant variations of ant species richness in the above. When comparing the different subfamilies, subfamily Formicinae reported high species richness values. A similar study on ant diversity conducted in agricultural ecosystem in Vadodara district of Gujarat by Kumar and Misra (2008), also reported similar findings. Out of 5 subfamilies reported in their study, the most speciose was Formicinae in their agricultural ecosystem. This is in confirmation with our observation of more number of species of subfamily Formicinae than any other families. Subfamily Formicinae was thus found speciose in both the paddy fields under the current study.

Rank abundance plot reveals that Camponotus parius is the most abundant ant species in both the study areas followed by Pheidole species. Camponotus and Pheidole species were equally speciose in the agricultural ecosystem of Vadodara district (Kumar and Misra 2008). Both Camponotus and Pheidole species are categorised as genaralists and solitary foragers (Hunt 1974). This could probably be the reason for their abundance in both the present study areas.

Personal interviews with farmers revealed the use of harmful chemicals such as pesticides and weedicides. Paddy field 2 uses NPK and bone meal as
fertilizers and Fame (Flubendimide 39.35 %m/m SC) 20 ml/acre was used as a pesticide. Adora (Bisphyrribac Na 10% SC) 120ml/acre was also used as a weedicide. This may be one of the major contributing factors to low ant diversity in paddy agroecosystem when compared to the total identified ant species of India. Though field 2 uses harmful pesticides and insecticides, more number of ant species were recorded from it. These findings may indicate the greater resistance of ants to pollutants (Torossian and Causse 1968). They are also resistant to industrial pollutants probably due to the fact that only approximately 10 % of ants are outside the nest exposed to these negative effects (Petal, 1978a). The high species richness of ants in field 2 may be attributed to its greater resistance to harmful chemicals and also their safe abode in nests.

Presence of arboreal species indicates availability of suitable trees providing microhabitats for the specific species (Kashmira et. al., 2013). *Oecophylla smaragadina* is an arboreal species found associated with mango trees. The presence of *Oecophylla* sp. and mango trees as their suitable microhabitat elucidate their association in the current study in field 1.

In the current study, it was found that the colony density of ants was more along the margin than the interior parts of the fields. The structural complexity of vegetation (Langellatto and Denno 2004, De la Mora et al; 2013) along field margins could be the reason for such variation in colony density observation in the interior of the field and that in the margins. According to Wagner *et.al.*, (1997) ant nest soil contain much higher abundance of biomass. Ant nests found in the paddy agroecosystems under study can be assumed to improve the soil quality of the area.

It has been shown that agricultural practices such as heavy grazing, irrigation, drainage, fertilization, mowing, conventional tillage, ploughing and reseeding, reduce ant biodiversity and/or biomass and colony densities
(Kanowski 1956, Pisarski 1978; Diaz 1991; Perfecto and Snelling 1995; Radford et. al., 1995). Daily personal observations were made of the various activities in the study areas and it was found that various practices of irrigation, drainage, fertilization, mowing, ploughing etc were taking place in field 1 and field 2. These activities may have contributed to the low species richness of ants in the paddy fields under study. Nine species namely, *Camponotus sp. Pheidole sp.*, *Myrmicaria bruneae*, *Diacamma rugosum*, *Anoplolepis gracilipes*, *Tetramorium sp.* were commonly found in field 1 and field 2. Among these ant species *Pheidole sp.* and *Camponotus sp.* are categorized as generalists (Hunt 1974) and *Anoplolepis graciliepes* an invasive species (Bruhl et. al., 2003). The remaining species of ants can be assumed as common species of paddy ecosystems or ecosystems with low canopy cover.

**Conclusion**

A total of 16 species of ants belonging to 4 subfamilies were recorded from both the study areas at Thottakattukara (Paddy field 1) and at Kuttipuzha (Paddy field 2). A significant observation in the current study was that the colony density of ants was more along the field margin than the interior parts of the fields. Present study revealed the ant diversity of the two paddy fields and compared its species composition. Ecological remarks of ants in paddy agroecosystems were also drawn.

It is the need of the hour, to explore the diversity of managed ecosystems such as paddy fields to throw light on better management practices of such agroecosystems to conserve the existing biodiversity. Ant diversity studies could unravel several important species of ants that can be used as bioindicators and biocontrol agents. Hence more systematic studies in this direction are required.
Acknowledgement

I thank Lord Almighty for all the blessings that he has showered upon me to complete my work successfully. I am grateful to our beloved principal Dr. Thomas Mathew for providing all the facilities to do this work at Union Christian College, Aluva. I am indeed grateful to Mr. Sumesh S and Mr. Rabeesh T.P who has helped me to identify and take photographs of the collected ants for the study. I thank the principal of St. Xavier’s college Aluva for permitting me to utilize the facilities of the research lab. My special thanks to Dr. Anu Anto and Ms. Elizabeth V Mathew for their support. I thank my family and friends for the pain they have taken to help me complete this work.

Reference


Le Masne G and Bonavita-Cougourdan A (1972) Premiers résultats d'une irradiation pro-longée au césium sur les populations de fourmis en Haute-Provence. Ekologia Polska 20, 129±144.


A COMPARATIVE STUDY ON THE WETLAND AVIFAUNAL DIVERSITY OF SALIM ALI BIRD SANCTUARY, THATTEKKAD, KERALA

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Abstract

The wetland habitat of the Salim Ali Bird Sanctuary, Thattekkad is constituted by the catchment of Bhoothathankettu Dam which is an irrigation project. The annual drainage of water from the dam during monsoon months adversely affects the avifaunal population. Abundance and diversity of wetland avifauna of Salim Ali Bird Sanctuary was studied from 2000-2002 and from 2007-2009. Regular bird census were done by line transect method. The first study period recorded 25 species of wetland avifauna belonging to 12 families while the second study period reported 32 species belonging to 10 families. An increasing trend in the population of wetland birds were observed during the study. Family Ardeidae represented maximum wetland bird species which included 4 species of egrets, 3 species of herons and 3 species of bittern. Most of the wetland birds were residents or only local migrants. International migrants like Spotted Sandpiper, Common Snipe and Whiskered Tern and internal migrants like Large Egret were recorded during the study.

Key words: Wetland avifauna, Salim Ali Bird Sanctuary, International migrants

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Introduction

Salim Ali Bird Sanctuary described as the “richest bird habitat in Peninsular India” by Ali (1935) harbours both land birds and aquatic birds. The sanctuary is located in Kothamangalam taluk of Ernakulam district in Kerala and is bordered by Periyar and Kuttampuzha rivers on two sides and Kolombathode and Orulamthanni on the other two sides. Ali (1935) recorded 162 species of birds from the area and according to him, “No water birds were seen except Kingfishers, Ardeola grayii, Anhinga melanogaster and Motacilla maderaspatensis which were usually present in small numbers”. At that time there were no wetland habitats in the sanctuary except the riverine ecosystem. Later Sugathan and Aby (1996) reported 270 species of birds from the sanctuary and Sugathan (1999) recorded thirty species of water birds.

The catchment of Bhoothathankettu Dam, an irrigation project across river Periyar constitutes the wetland habitat of the sanctuary. The depth of water in the area varies widely from place to place and this water habitat is also not stable. Annual drainage of water is done in the dam for maintenance work and desilting during heavy monsoon months when irrigation water is not required for cash crops. This process makes the environment dry within a short period of one or two days resulting in severe habitat changes. Inorder to overcome the ecological problems due to water drainage, the sanctuary management constructed few ecofriendly check dams to retain water in certain areas. This became a part of the wetland habitat of the sanctuary. The idea for such a system was evolved from the one existing at Keoladeo National Park, Bharatpur. Several earthen bunds and sluice gates were constructed to maintain and regulate the water level in Keoladeo National Park (Vijayan 1991). This study gives a comparative account on the population fluctuations and diversity of wetland birds of the sanctuary during 2000-02 and 2007-09.
Methodology

Regular bird census were carried out fortnightly by line transect method. Counts were made in the morning hours and average population estimated. Identification of birds were done as per Ali and Ripely (1969) and classification based on Ripley (1982). Diversity analysis was done using Primer 7, version 7.0.8 by Clarke and Gorley (2015). Margalef richness, Pielou’s evenness and Shannon index were the indices used for analysis.

Study Area: About 5 km² area of the sanctuary is with water front constituted by the catchment of Bhoothathankettu Dam. Many inland water bodies are also part of it. For the present study 2 km² area of this aquatic habitat was selected.

Study Period: The study was carried out in two phases. The first study period included two years of study from July 2000 to June 2002 and the second study period commenced from July 2007 to June 2009.

Results and Discussion

During the first study period (2000-02) 25 species of wetland birds belonging to 12 families (table 1) were recorded, while the second study period (2007-09) recorded 32 species belong to 10 families (table 2). An increasing trend in the population of wetland birds were observed during the study. Family Ardeidae represented maximum wetland bird species which included 4 species of egrets, 3 species of herons and 3 species of bitterns. Family Jacanidae and Glareolidae were recorded only during the first study period. *Metopidius indicus* was recorded breeding in the area.

The wetland avifauna included waders, divers and swimmers and water edge birds. Darter and cormorants were the common divers of the area while herons and egrets represented the waders. Bitterns, snipes and sandpipers moved along water edge for food. The habitat also provided suitable hiding places for them.
<table>
<thead>
<tr>
<th></th>
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<tr>
<td>F: PODOCIPITIDAE</td>
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<tr>
<td>1 *Eophryngetes ruficollis</td>
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<td>5 *Eudocimus albus</td>
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<td>6 ***Bubulcus ibis</td>
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<td>7 **Egretta alba</td>
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<td>8 ***Egretta intermedia</td>
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<td>16 **Vanellus indicus</td>
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<td>17 **Vanellus miles</td>
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</tr>
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<td>18 **Capella gallinago</td>
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<td>19 ***Glareola pratincola</td>
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<tr>
<td>21 **Chlidonias niger</td>
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<td>22 **Alca atthis</td>
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<td>23 **Pelecanus conspicillatus</td>
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<td>24 **Haliaeetus leucoryphus</td>
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<tr>
<td>F: MOTACILLIDAE</td>
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<tr>
<td>25 *Motacilla alba</td>
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<td>0</td>
</tr>
</tbody>
</table>

**- Family  *- Resident  **- Migrant  ***- Local Migrant
Table 2: Wetland bird census 2007-2009

|        | 2007-2009 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1      | Podicipitidae | 0 | 0 | 0 | 2 | 3 | 5 | 1 | 2 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 2 | 1 | 0 | 0 |
| 2      | Phalacrocoracidae | 5 | 5 | 9 | 23 | 37 | 29 | 30 | 17 | 19 | 15 | 11 | 13 | 9 | 13 | 16 | 17 | 21 | 29 | 39 | 25 | 19 | 14 | 16 | 13 |
| 3      | Rhizostomidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4      | Ardeidae | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 6 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5      | Astrapornidae | 2 | 0 | 0 | 1 | 2 | 2 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6      | Ardeidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7      | Ardeidae | 19 | 11 | 16 | 17 | 13 | 21 | 17 | 19 | 15 | 11 | 13 | 5 | 7 | 3 | 9 | 11 | 14 | 15 | 14 | 13 | 17 | 15 | 7 | 9 |
| 8      | Ardeidae | 0 | 0 | 0 | 0 | 3 | 9 | 4 | 9 | 5 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 3 | 5 | 3 | 6 | 3 | 7 |
| 9      | Ardeidae | 0 | 0 | 0 | 0 | 5 | 1 | 2 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 1 |
| 10     | Ardeidae | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11     | Ardeidae | 0 | 0 | 0 | 0 | 2 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 |
| 12     | Ardeidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13     | Ardeidae | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14     | Ardeidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15     | Ciconiidae | 14 | 0 | 0 | 0 | 0 | 5 | 2 | 6 | 9 | 7 | 13 | 5 | 9 | 0 | 0 | 0 | 3 | 11 | 13 | 15 | 7 | 5 | 9 | 6 | 11 | 14 |
| 16     | Anatidae | 0 | 0 | 0 | 0 | 92 | 215 | 96 | 112 | 76 | 43 | 15 | 0 | 0 | 0 | 0 | 19 | 21 | 27 | 54 | 118 | 76 | 76 | 40 | 116 | 31 | 6 |
| 17     | Anatidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18     | Alcidae | 3 | 2 | 2 | 3 | 1 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 4 | 2 | 5 | 2 | 3 | 1 | 1 |
| 19     | Alcidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 0 | 2 | 0 | 0 | 0 | 0 |
| 20     | Alcidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21     | Alcidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22     | Alcidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23     | Alcidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24     | Alcidae | 0 | 0 | 1 | 1 | 2 | 1 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 1 | 2 | 0 | 0 | 0 |
| 25     | Alcidae | 4 | 2 | 3 | 2 | 2 | 4 | 3 | 1 | 2 | 3 | 2 | 4 | 2 | 4 | 1 | 3 | 2 | 4 | 2 | 2 | 3 | 3 | 2 |
| 26     | Alcidae | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 0 | 0 | 0 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| 27     | Alcidae | 3 | 5 | 2 | 4 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 4 | 5 | 2 | 4 | 2 | 4 | 4 | 3 |
| 28     | Alcidae | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29     | Alcidae | 0 | 0 | 0 | 0 | 0 | 7 | 7 | 9 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 30     | Alcidae | 0 | 0 | 0 | 0 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 7 | 4 | 0 | 0 | 0 | 0 |
| 31     | Alcidae | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32     | Alcidae | 0 | 0 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 |

F - Family  * - Resident  ** - Migrant  *** - Local Migrant
The study results reveal that the pattern of fluctuations in the abundance of individuals and species showed an increasing trend. The highest number was noticed during December, January, February or March and the lowest number during August or September (figure 1). Maximum number of species was observed during December and January (figure 2).

![Figure 1. Population fluctuation of wetland avifauna during the two study phases](image1)

![Figure 2. Number of wetland bird species recorded during the two study phases](image2)

An increase in population was observed from October to March during the study. This can be considered as a regular phenomenon as the wetland habitat has got established providing ample food and shelter to the birds. Some birds visit the area due to the disturbances in their regular feeding habitats like paddy fields and agricultural lands which undergo crop rotation works. Influx
of migratory birds was also recorded during this period. They included long distance international migrants like *Tringa glareola* and *Capella gallinago* and internal migrants like *Egretta alba* and *sterna aurantia*. Most of the wetland birds were resident or local migrant.

A pronounced increase was observed in the population of *Dendrocygna javanica*. Cormorants and herons were common in the area. *Anas poecilorhyncha* represents a rare visitor of the area. *Glareola lactea* was also sighted once during the study.

![Species diversity (Shannon H') index of wetland birds of the study area](image_url)

**Figure 3.** Species diversity (Shannon H’) index of wetland birds of the study area (a) study phase 1 (b) study phase 2
The study clearly reveals that the study area provides suitable habitat for wetland avifauna to survive. Availability of food, vegetation type, water depth, suitable hiding and breeding sites attracted avifauna to this area. Slight variations were observed in the diversity indices during the two study phases.

During 2000-2001 Shannon’s diversity (H’) was maximum in April (2.394) (figure 3a). Sixteen different species were recorded during this month. High species richness (3.593) and evenness (0.8636) contributed to higher diversity index. H’ was minimum in March (1.416) due to low species evenness (0.4998). In the consecutive year maximum diversity was in December (2.441) marked by the influx of migratory species and high species richness (3.565) and evenness (0.8616). A low diversity index was observed in March (1.035). Large groups of teals (Dendrocygna javanica) reached the study area during March both the years and moved along the floating vegetation of the area. Hence species evenness was very low in March (0.3822).

In the second study phase from 2007 July - 2009 June, high richness (3.545) and evenness (0.7310) in April resulted in maximum species diversity (2.113) during 2007-2008 and the incoming migratory population during November, added maximum diversity during 2008-2009 study period. July recorded minimum diversity during 2007-2008 and August during 2008-2009 (figure 1b) as evenness was low.

July, August and September months in general showed a decline in the population of wetland avifauna which coincides with the drainage of water from Bhoothathankettu dam. This seriously affects the avifauna due to habitat loss. Only the eco friendly checkdams constructed could maintain water level and support avifauna during this period. As the study indicates an increasing trend in wetland avifaunal population, it is necessary that more and more habitats
should be provided to support the avifaunal population especially during the monsoon months when water is drained out from the dam.

References


ASSESSMENT OF THE EFFECTIVENESS OF THREE DIFFERENT PROTOCOLS FOR THE ISOLATION OF METAGENOMIC DNA FROM MANGROVE SEDIMENTS

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Abstract

Microbial diversity represents our planet’s greatest, but least utilized resource for biotechnologically important products and processes. In the milieu of traditional approaches failing to represent the scope of our microbial diversity, culture independent approaches like metagenomics gain importance. The present study focused on evaluating the efficiency of three different methods for the isolation of metagenomic DNA from mangrove soil samples.

Key words: Metagenomics, DNA isolation, mangroves, culture-independent

Introduction

The standard culturing techniques account for 1% or less of the bacterial diversity in most environmental samples and therefore 99% microorganisms in nature typically remain uncultivated and consequently unexploited for their ecological functions (Amann et al., 1995). Metagenomics is a culture independent method which involves directly accessing the genomes of microorganisms in an environment that cannot be, or have not been cultured, by isolating their DNA, cloning it into culturable organisms and screening the resultant clones for the production of new chemicals.

The first step in any metagenomic study is the isolation of community DNA. This is a critical step as it carries all the information for further studies. The isolated DNA should be representative of all cells present in the sample and
should be ideal for generation of genomic libraries (Neelakanta and Sultana 2013). A major difficulty associated with the metagenome approach is the contamination of isolated DNA with polyphenolic compounds, which are copurified with the DNA. These compounds are difficult to remove, as the polyphenols also interfere with enzymatic modifications of the isolated DNA (Tsai and Olson 1992). Four key parameters that define the suitability of the DNA extracted by each method for subsequent metagenomics analysis have been identified as yield, purity, fragment size, and representativeness (Ekkers et al., 2012). The present study compares three different methods of isolating metagenomic DNA from mangrove sediments.

**Materials and methods**

**Collection of mangrove sediment sample**

Sediment samples were collected from mangrove and mangrove associated aquafarms, situated in different locations as per the details given in Table 1, in sterile polythene bags, tied well and brought to the laboratory in an icebox for further processing.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Sampling location</th>
<th>Sampling site</th>
<th>GPS coordinates</th>
</tr>
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<tbody>
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<td>Kannamaly</td>
<td>Mangrove</td>
<td>09°52′43.3″N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>76°15′50.6″E</td>
</tr>
<tr>
<td>2</td>
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<td>Kannamaly</td>
<td>Mangrove</td>
<td>09°52′48.3″N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>associated aquafarm</td>
<td>76°15′42.4″E</td>
</tr>
<tr>
<td>3</td>
<td>MGM</td>
<td>Mangalavanam</td>
<td>Mangrove</td>
<td>09°59′26.4″N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>76°16′27.2″E</td>
</tr>
</tbody>
</table>

**Extraction of metagenomic DNA using three different protocols**

Total or metagenomic DNA was extracted from the mangrove sediment samples following three different protocols that are frequently used. The yield and purity of DNA obtained by each protocol was compared.
Protocol I (Zhou et al., 1996)

Weighed 5 g of mangrove sediment sample, mixed with 13.5 mL of DNA extraction buffer, and 100 μL of proteinase K (10 mg/mL) (GeNei, Bengaluru, India) in Oakridge tubes by horizontal shaking (Scigenics Biotech, Chennai, India) at 225 rpm for 30 min at 37°C. After the shaking treatment, 1.5mL of 20% SDS (SRL, Mumbai, India) was added, and the samples were incubated in a 65°C water bath (MRC, Holon, Israel) for 2 h with gentle end-over-end inversions every 15 to 20 min.

The supernatants were collected after centrifugation at 6,000 x g (Sigma 3K30, Osterode, Germany) for 10 min at room temperature and transferred into 50mL centrifuge tubes. The soil pellets were extracted two more times by adding 4.5 mL of the DNA extraction buffer and 0.5 mL of 20% SDS, vortexed (Remi Cyclomixer, Mumbai, India) for 10 s, incubated at 65°C for 10 min, and centrifuged as before.

Supernatants from the three cycles of extractions were combined and mixed with an equal volume of chloroform: isoamyl alcohol (24:1 vol/vol). The aqueous phase was recovered by centrifugation and extraction was repeated two more times. DNA was precipitated with 0.6 volume of isopropanol (SRL) at room temperature for 1 h. The pellet of crude nucleic acids was obtained by centrifugation at 16,000 rpm for 20 min at room temperature, washed with cold 70% ethanol, and resuspended in sterile deionized water, to give a final volume of 200 μL.

Protocol II (Dong et al., 2006)

About 1 g of sediment sample, 0.35 g of glass beads (diameter 2.0 mm), and 300 μL of 0.1 M phosphate buffer (pH 8.0) were added to a microcentrifuge tube and mixed well by vortex (Remi). About 250 μL of SDS
lysis buffer was added and vortexed horizontally for 10 min at maximum speed using a Vortex Adapter. After centrifuging (Sigma) at 10,000rpm for 30 s, the supernatant was transferred into another microcentrifuge tube.

Protein was removed by adding 250 μL of chloroform : isoamyl alcohol (24:1 v/v), vortexed for 5 s, incubated at 48°C for 5 min, and centrifuged at 10,000rpm for 1 min. DNA was precipitated by adding 0.5 vol of 7.5 M ammonium acetate (SRL) and 1.0 vol of isopropanol to the supernatant. After incubation at -20°C for 15 min, DNA was pelleted at 12,000 rpm for 10 min and washed three times with 70% ethanol. After being air-dried, pellets were dissolved in 50 μL of 10 mM Tris (SRL), pH 8.0 and flocculated with 10 mM aluminium sulfate (SRL). The brownish precipitate of humic substances was removed by centrifuging at 10,000 rpm for 5 min.

**Protocol III** (Tsai and Olson 1991)

Sediment samples (1 g) were mixed with 2 mL of 120 mM sodium phosphate buffer (pH 8.0) by shaking at 150 rpm for 15 min. The slurry was pelleted by centrifugation at 6,000 rpm (Sigma) for 10 min. The pellet was washed again with phosphate buffer, resuspended in 2 mL of lysis solution, and incubated in a 37°C water bath (MRC) for 2 h with agitation at 20 to 30 min intervals, and then 2 mL of 0.1 M NaCl/0.5 M Tris-HCl (pH 8.0)/10% SDS was added.

Three cycles of freezing in liquid nitrogen and thawing in a 65°C water bath were conducted to release DNA from the microbial cells in the soil or sediments. 2 mL of tris saturated phenol (SRL) was added after the freeze-thaw cycles, and the sample was briefly vortexed to obtain an emulsion. The mixture was centrifuged at 6,000 rpm for 10 min. A 3 mL sample of the top aqueous layer was collected and mixed with equal volume of phenol: chloroform: isoamyl alcohol mixture (25:24:1) (HiMedia, Mumbai, India). A 2.5 mL portion of the resulting extract was
further extracted with an equal volume of chloroform mixture. Finally, nucleic acids in the extracted aqueous phase (2 mL) were precipitated with 2 mL of cold isopropanol at -20°C for 1 h. The pellet of crude nucleic acids was obtained by centrifugation at 10,000 rpm for 10 min and then air dried. The nucleic acid pellet was resuspended in 50 μL of TE buffer (pH 8.0).

**DNA isolation using kit**

UltraClean™ Soil DNA isolation kit (MoBio, CA, USA) was also used for the extraction and purification of DNA from the sediment sample following the manufacturer’s instructions. All steps, except beat beating, were performed for the purification of crude DNA extracts.

**Agarose gel electrophoresis** (Sambrook et al., 2000)

1% agarose (SRL) gel containing ethidium bromide (SRL) (0.5 μg/mL) was prepared in 1X TAE buffer. The DNA sample was mixed with 6X gel loading dye and loaded into the wells of the agarose gel along with the DNA marker Lambda DNA EcoR I/ Hind III double digest (GeNei). Electrophoresis was carried out at 80 V for 1 h (GeNei Mini Electrophoresis system, Bengaluru, India). The gel was visualized under ultraviolet illumination and gel pictures were captured using Gel documentation system (Syngene, CA, USA).

**DNA quantification** (Sambrook et al., 2000)

The DNA was quantified using a UV-Visible spectrophotometer (Shimadzu, Kyoto, Japan). The spectrophotometric readings were taken at wavelengths of 260 nm, 280 nm and 230 nm. The absorbance at 260 nm allows calculation of the concentration of nucleic acid in the sample. An absorbance value of 1 at 260 nm corresponds to approximately 50 μg/mL for double stranded DNA.
The ratio between the readings at 260 nm and 280 nm (OD\textsubscript{260}/OD\textsubscript{280}) and 260 nm and 230 nm (OD\textsubscript{260}/OD\textsubscript{230}) indicates the purity of the DNA. Pure preparation of DNA has OD\textsubscript{260}/OD\textsubscript{280} ratio in the range of 1.8-2.0, or else it indicates protein contamination. OD\textsubscript{260}/OD\textsubscript{230} ratio indicates humic acid contamination, for pure samples the ratio is the range of 1.2-2.0.

**Results**

Metagenomic DNA was isolated from sediments collected from Kannamaly mangrove (MGK), Kannamaly mangrove associated aquafarm (AQK) and Mangalavanam mangrove (MGM).

**Agarose gel electrophoresis of metagenomic DNA**

DNA isolated using three different protocols (Protocol I, Protocol II and Protocol III) were visualized on agarose gel along with the DNA marker Lambda DNA EcoRI/ Hind III double digest (GeNei, Bengaluru, India) (Figure 1).

![Agarose gel electrophoresis of metagenomic DNA](image)

**Figure 1:** Agarose gel (1%) electrophoresis of metagenomic DNA isolated from three samples using three different protocols.

Lane 1 - DNA marker; Lane 2 - MGK - Protocol I; Lane 3 - MGK - Protocol II; Lane 4 - MGK - Protocol III; Lane 5 - AQK - Protocol I; Lane 6 - AQK - Protocol II; Lane 7 - AQK - Protocol III; Lane 8 - MGM - Protocol I; Lane 9 - MGM - Protocol II; Lane 10 - MGM - Protocol III.
The DNA isolated from the three different samples using Protocol I appeared brightly on the gel (Lanes 2, 5 & 8) indicating good DNA yield. Among the three samples, DNA isolated from AQK seemed to be sheared which is observed as a long smear on the gel (Lane 5). The DNA isolated using protocol II appeared as a very faint band on the gel (Lanes 3, 6 & 9) representing poor DNA yield. Aluminium sulphate used in this protocol for the removal of humic contaminants may have degraded DNA and resulted in poor DNA yield. The DNA isolated using protocol III also appeared as a smear on the agarose gel (4, 7 & 10) for all samples analysed, which may be due to repeated freezing and thawing of the sample. Only Protocol I produced significant DNA yield with comparatively less shearing.

**Quantification of metagenomic DNA**

The concentration of DNA obtained from three samples (sediments collected from Kannamaly mangrove (MGK), Kannamaly mangrove associated aquafarm (AQK) and Mangalavanam mangrove (MGM) using the three different protocols was determined spectrophotometrically and is as represented in Figure 2.

![Figure 2: DNA yield from three different samples using three protocols](image-url)
It is evident that protocol I yielded more DNA than the other two methods irrespective of the sample type analysed. However, the DNA yield from Kannamaly mangrove (MGK) sediment was more (57.6 ± 2.26 μg/g sediment) than the other two samples, Kannamaly mangrove associated aquafarm (AQK) and Mangalavanam mangrove (MGM) yielding 45 ± 1.41μg/g and 41.2 ± 1.7μg/g DNA respectively. Protocol II gave poor DNA yield, with less than 13 μg/g for all samples, which is also apparent from the agarose gel. The DNA yield for protocol III was more than that for protocol II, in the range of 12 ± 0.7 μg/g to 26.25 ± 0.35 μg/g sediment, but less when compared to protocol I.

**Purity of metagenomic DNA**

The purity of DNA isolated from three different sediment samples using three different protocols was determined by estimating the ratio between the spectrophotometric readings at 260nm and 280nm (OD260/OD280) as well as between 260nm and 230nm (OD260/OD230).

The OD260/OD280 ratio of DNA isolated from three different sediment samples using the three different protocols are depicted in figure 3. The OD260/OD280 ratio gives an indication of protein contamination, with the ratio being in the range of 1.8-2.0 for pure samples. The OD260/OD280 ratio of DNA samples isolated utilizing Protocol II was in/near the range 1.8-2.0, indicating that it is more pure compared to the DNA obtained using other two methods. For DNA isolated using protocols I and III the OD260/OD280 ratio was above 2.25, indicating protein contamination in both these samples.
The OD$_{260}$/OD$_{230}$ ratio gives an indication of the associated humic acid contamination, with the ratio being in the range of 1.2-2.0 for pure samples. The OD$_{260}$/OD$_{230}$ ratio of DNA sample isolated according to Protocol II was in the range 1.33-1.52, indicating that the sample was devoid of humic contaminants (Figure 4). However for DNA isolated using protocols I and III, the OD$_{260}$/OD$_{230}$ ratio was below 1.1, indicating humic contamination. Aluminium sulphate used in the protocol II for removal of humic contaminants from the samples is absent in protocol I and protocol III.

**Figure 3:** Quality of DNA based on OD$_{260}$/OD$_{280}$ ratio of different samples

**Figure 4:** Quality of DNA based on OD$_{260}$/OD$_{230}$ ratio of different DNA samples
Metagenomic DNA isolation using kit

The DNA yield and purity obtained by the three different methods varied, with protocol I yielding more DNA, albeit with less purity. The DNA isolated by Protocol II was more pure, but yield was less than that obtained by Protocol I. Since the yield and purity of DNA isolated by three different methods was not satisfactory for downstream processes, DNA isolation of Kannamaly mangrove (MGK) sediment sample was also done using the commercially available kit (MoBio UltraClean™ soil DNA isolation kit, CA, USA) and was analysed on agarose gel (Figure 5).

![Agarose gel electrophoresis of DNA isolated using kit.](image)

**Figure 5:** Agarose gel electrophoresis of DNA isolated using kit.

Lane 1 – MGK DNA isolated by kit, Lane 2 – MGK DNA isolated by Protocol I, Lane 3 – MGK DNA isolated by Protocol I and purified using kit, Lane 4 – Lambda DNA *EcoR I/Hind III* double digest ladder (GeNei)

It was observed that the DNA yield was very low with the kit, which is seen very faintly on the gel (Lane 1). Consequently, the DNA isolated using Protocol I (Lane 2) was purified using the kit and seemed, brightly on the gel
(Lane 3) indicating good yield. The yield and purity of DNA obtained was determined spectrophotometrically and is depicted in Figure 6.

![Figure 6: Yield and Purity of DNA isolated by kit](image)

The concentration of DNA obtained using kit was 20.12 ± 1.16 µg/g sediment as compared to that obtained by protocol I (57.6 ± 2.26 µg/g sediment). But the DNA sample was of good quality, as the OD_{260}/OD_{280} and OD_{260}/OD_{230} (1.82 and 1.52 respectively) ratios were within the limits, indicating no protein or humic acid contamination. When DNA isolated using protocol I was purified using the kit, there was significant DNA yield (46.34 ± 1.62 µg/g sediment). Also, the OD_{260}/OD_{280} and OD_{260}/OD_{230} ratios (1.98 and 1.26 respectively) indicated purity of the isolated DNA.

**Discussion**

The metagenomic DNA was isolated from three different mangrove sediments collected from three different locales-Kannamaly mangrove (MGK), Kannamaly mangrove associated aquafarm (AQK) and Mangalavanam mangrove
(MGM), using three different protocols. The DNA yielded by Protocol I was more than that from the other two methods. Samplewise, more DNA was obtained from the Kannamaly mangrove (MGK) sediment (57.6 ± 2.26 μg/g sediment) than from the other two samples, with Kannamaly mangrove associated aquafarm (AQK) yielding 45 ± 1.41 μg/g, while 41.2 ± 1.7 μg/g was obtained from Mangalavanam mangrove (MGM). The variation in the yield may not only be due to the differences in the sample types, but also due to the differences in the physical and chemical processes employed in various stages in the extraction protocols.

These three protocols are extensively used for the isolation of DNA from soils that have very complex nature. All three methods are based on direct extraction methods, wherein the microbial cells are lysed in situ and this method is known to yield maximum DNA. In addition, the DNA isolation is completed within 6-7 hours. In each case, the yield and purity of the isolated DNA depends on various factors like the nature of soil sample, agents used for cell lysis, DNA precipitation method, and so on.

The purity of DNA isolated from the different sediment samples by these three protocols was also compared. The DNA isolated according to only Protocol II was more pure compared to that obtained by protocols I and III, wherein protein contamination was indicated by a higher OD260/OD280 ratio.

Protocol I was also used previously to isolate DNA from soil samples collected from hot springs in Himachal Pradesh, India, with a DNA yield of 1.94 μg/μL (Sharma et al., 2007). However the purity of the isolated DNA was poor and it was therefore further purified using Q-Sepharose. DNA isolated from soil samples collected from the Apharwat Mountain in the northwestern
Himalayas by the same method yielded 100 ng/g of soil (Sudan and Vakhlu, 2012) and since the purity was low, it was not used for cloning purpose.

The OD\textsubscript{260}/OD\textsubscript{230} ratio of DNA sample isolated from mangrove sediment according to Protocol II was in the range 1.33-1.52, indicating that the sample was devoid of humic contaminants compared to the DNA obtained using the other two methods in this study. For DNA isolated using protocols I and III the OD\textsubscript{260}/OD\textsubscript{230} ratio was below 1.1, indicating humic contamination. Protocol II uses aluminium sulphate and this may be responsible for removing the humic contaminants from the samples, a plausible reason for the reasonable purity of the DNA isolated by this method.

Isolation of DNA from compost soil of the rhizosphere of Clivia miniata using protocol II resulted in removal of humic substances to a greater extent as aluminium sulphate complexed with them and aided in its removal (Dong et al., 2006). But the disadvantage of the method was low DNA yield which might be due to the coprecipitation of DNA along with humic acids, as DNA and humic acid has similar physical and chemical characteristics.

Protocol III was developed for DNA isolation of subsurface soil samples from a gas manufacture site in Southern California (SC, USA) and sediment samples from a settling pond in Oak Ridge, Tenn. (ORT). DNA yielded by this method was of good quantity and with less shearing (Tsai and Olson, 1991). In this method lysozyme was used for cell wall lysis in combination with gentle freezing and thawing, hence consequentially DNA obtained was less sheared when compared to other methods.

The commercial kits essentially rely on silica gel spin columns for purification of the DNA. The MoBio\textsuperscript{TM} kit yielded a suitable DNA extract from
a peat sample (Schneegurt et al., 2003) and the procedure only took less than 2 hours.

The yield and purity of DNA from Kannamaly mangrove (MGK) obtained by the three different methods used was different. It was amply clear that comparatively more quantity of DNA but with less purity was obtained by Protocol I. The DNA isolated by Protocol II was more pure, even though the DNA yield was much less than that obtained by Protocol I, besides not being enough for downstream processes. Since the yield and purity of DNA isolated by the three different methods followed in this study was not satisfactorily good, DNA isolation of Kannamaly mangrove sediment (MGK) was also tried with the commercially available kit (MoBio™ kit). But, the DNA yield with the kit was very low. However the quality of the DNA obtained was far superior to that obtained by the three protocols. Since the yield of DNA by protocol I was highest, DNA isolated using protocol I was purified using the kit, resulting in significant DNA yield (46.34 ± 1.62 μg/g sediment). Also, the OD<sub>260</sub>/OD<sub>280</sub> and OD<sub>260</sub>/OD<sub>230</sub> ratios (1.98 and 1.26 respectively) of the DNA isolated and purified by this combination method indicated the DNA purity. Since purity of DNA is an important criteria for PCRability and for library construction, this method can be suitably used for metagenomic DNA.

Each protocol used for DNA isolation has its advantages as well as disadvantages. The protocol with high yield may not give highly pure DNA. The highly pure DNA obtained by a certain protocol may be extremely fragmented. Hence the choice of DNA isolation protocol has to be based on the goals of the study. The protocol giving highly pure DNA may be used for cloning purpose; the protocol with fragmented DNA may be used for hybridization studies and so on.
Conclusion

The metagenomic DNA was isolated from three different mangrove sediments using three commonly used protocols with minor modifications. The highest DNA yield was obtained with protocol I whereas DNA of maximum purity was obtained by protocol II, irrespective of the sample type. Among the three mangrove sediment samples, DNA isolated from Kannamaly mangrove (MGK) was of higher concentration than the other two samples.

Since the concentration and purity of DNA obtained by the three methods was not satisfactory or good enough for downstream processing, metagenomic DNA isolation from the Kannamaly mangrove sediment was also attempted using MoBio Ultraclean™ soil DNA isolation kit. The metagenomic DNA isolated using protocol I, but purified by the MoBio kit was satisfactorily good with respect to quantity and quality.

Acknowledgement

The first author acknowledges Cochin University of Science and Technology, Kerala, India and University Grants Commission, New Delhi, India for supporting the work with necessary facilities as well as financial support in the form of JRF and SRF.

References


EDUCATION AS RESISTANCE: ON LAUGHTER, SOME QUESTIONS AND MAHASWETA THE ‘DIDI’

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“I have written about so many children. And I write because I love children” (Mahasweta Devi). When she wrote, Mahasweta Devi used all her readings, memories, and direct experiences and acquired information, and always raised issues of politics, gender and class. For her, there was nothing to hide in her activism, politics and writings and left no gaps while doing so. This paper is an attempt to trace another side of Mahasweta Devi, a face which is less explored and appreciated for its worth. Her writings have received enthusiastic critical responses and have been seen from a number of different perspectives such as feminist, subaltern, peripheral, radical, Marxist and so on. However, a part of her oeuvre is often left over looked- Children’s Fiction.

An avatar of Mahasweta in her dark and unforgiving writing, fire-spitting and volatile with a cutting edge to her words, making human violence visible to the unseeing adult world is a familiar one. But there has always been another side to this non-conformist woman- one which was light and playful, lit up with fun and fantasy to catch the imagination of children. The Mahasweta that the world has come to know is a fierce warrior, a serious woman, an activist who accuses, condemns and rips open the hypocrisy of social system we live in. This Mahasweta has won the Jnanpith and Magsaysay awards and is the mother of the dispossessed. But the Mahasweta that we see in her children’s fiction is the ‘Khuku’, the eldest of the nine brothers and sisters in a close-knit family, reliving

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her childhood days, or the ‘Didi’, an elder sister to the adivasi children whom she taught in the tribal schools, or an “old woman” to her one time roommate Moyna! In these stories we see a Mahasweta who has taken a break from her awareness raising programmes to play with children, to swing with their fantasies, to give their imagination a nudge. Mahasweta started writing for children from 1965, in Mouchak, a well-established children’s literary magazine that she herself had read in her younger days. From 1975, her stories began to appear in Sandesh, another children’s magazine while Satyajit Ray was one of its editors (Sen 5).

Three of Mahasweta’s children’s short fictions are studied here. The first one is titled Etoa Munda Won the Battle: A Story about Tribal Life which is translated to English by the critic Meenakshi Mukherjee. It tells the story of Etoa Munda, a seven year old tribal boy who fights against heavy odds in his quest for acquiring education. The story vividly describes the customs and way of life of the Munda tribals with black and white photographs which aid. The story is set in the village called ‘Hathighar’ in West Bengal which was once named ‘Salgerya’ when it belonged to the tribals. Now the landlords- the Babus own the village and have taken everything from the tribals by making use of their illiteracy and lack of knowledge about the law and governmental system.

Etoa is a curious boy. He is enthusiastic to know the history of his ancestors, the story of his village and is fascinated about the fierce battle the school teacher talks about. He pauses on his way to the Babu’s house to listen to the school teacher describing about a battle every day. Etoa is a labourer at the Babu’s and dreams of joining the school. “Then the arrows darted through the air. The sky became dark with them. How can I describe that fierce battle!” Which is this battle the school-master talks about? Etoa doesn’t know. Is it the battle of the Mahabharata? Or the Ramayana?” (Devi 5).
Etoa too has to battle everyday to fill his gunny-sack; he is a scavenger. But it is a life battle he is unaware of. The story is about how Etoa wins his battle to get education despite all the hurdles that come on his way- the battle for the subaltern is the battle for education. And it is not just the tribal boy’s first steps towards learning the lessons of resistance through education, the story traces adivasi resistance in history also, on how the Santals fought against the British under the leadership of Sindhu and Kanhu, leading to the dispersal of the Santals all over the land upon losing the fight. Mangal, Etoa’s grandfather gives an account of how Birsa Munda, the Santal leader led his people against the British. Mahasweta writes:

After some years Birsa Munda was able to organize the Mundas to rebel against the British. That was another fierce battle. Arrows flew from our side; they shot with bullets. Finally we had to accept defeat, too. Like leaves before the wind, we scattered to different places in Orissa, Bihar, Bengal and Assam. We cleared forests to make new settlements. Today Mundas and Santals can be seen everywhere. (4)

It is such battles of the tribals that the school teacher is describing to his students to boost their confidence and mark their place in history. It is an act of remembering and reminding the past. On the otherhand, the landlord Moti Babu says it was a “big mistake” (20) for Mangal to send his son and now his grandson to school. However, the adivasis realize that “without proper education, there is little hope for the adivasis” (25). They have learned from the betrayal of the Babus that they are being exploited because of their illiteracy and lack of understanding about the law system. The teacher says “In the old days it was enough to have your bow and arrow. These days education is your weapon for survival” (38) and that education is the “first priority” (47).
Tragedy strikes in the life of Etoa when he is forced to abandon his schooling to find food when Mangal breaks his leg in an accident. However, when Mangal returns from hospital, he slaps Etoa hard and fires:

It would have been better if I’d died. So you’ve become a cowheard again! I so wanted to save you from being an illiterate farmhand, a slave of the Babus. Why didn’t you sell the jack fruit tree? Why didn’t you sell the goats? Why didn’t you go hungry till I returned? Why did you have to do this, Etoa? (55)

What overlaps the story is the image of Eklavya- for Etoa also, along with his ancestors like Birsa Munda, Kanhu and Sidhu is waging a battle from nothingness. What they truly possess is sheer determination not to give up. That determination is what separates children from adults. Further, if one searches for the ethnicity of Eklavya, the mythic character, he too would come out as a dispossessed adivasi boy only to be failed by his upper caste master. Etoa, the unprivileged boy too is weighed down by his landlord. Nonetheless he fights. His fight is akin to the fight of his people. Perhaps it remains unmarked in the official history that the first environmental, anti-colonial war against the British was fought by the Santals in India\(^ 1 \). Anti-colonial tribal insurgencies have occasionally been recorded and remembered. But ironically Birsa Munda’s statues throughout different states of India depicted him in shackles for nearly 116 years until recent times.

\(^1\) The Indian caste system has been influenced by several different outside influences and historical events throughout centuries, but British colonialism was the most pivotal occurrence that shaped and perpetuated the caste system. It placed the untouchables and the tribals on the lowest strata of societal divisions and branded them as criminals.
Etoa’s battle is waged against such shackles the civilized society’s hierarchies have laid on him. The subalterns are cut off from upward social mobility because they are denied education. Mahasweta’s story delineates the real problems faced by the tribal children in getting education despite the availability of bare minimum infrastructural facilities provided by the government. Mahasweta Devi writes that in tribals belts of Bihar, Jharkhand and Gujarat where she had worked very close to the tribals, the landscapes are generally hilly and schools are far away. High schools are even harder to reach. Therefore it is difficult for the teachers to reach pupils and for pupils to reach teachers. And for children like Etoa Munda who are real life figures without the protecting shadow of forefathers, education is a fierce battle to be fought against starvation.

However, such battles are fought with laughter on their face. A smile or laughter becomes a powerful weapon for the dispossessed against the authorities. Mahasweta was one of the rare souls who could say with a smile that their life was fulfilled. Against the ideologies of hatred she smiled, even in her roars of agitation there was laughter and as she turned tears into rebellions, laughter was there. The Mahasweta who is deemed to write complex ideas in
complex language wrote for children and about laughter too². We see Etoa laughing when Mangal says that he counts years by moon. All the tribals laugh when they recall how Gura sing, one among them, regained his land from the landlord who tricked him into putting his thumbprints on papers by giving him alcohol. Gura Sing’s testimony brings laughter of success and justice. There is an arc of smile when Mangal proclaims that the barbarians have united (63) and there is a smile of pride in Etoa as he hails the name of Birsa Munda- his battle has been won. The whole nature joins the tribals in their laughter- “The Dulang and Subararekha smiled and flowed... (11), the river, the sky, the grass all sparkled and laughed in the sun” (64). Thus, reading, education, knowledge and history emerge as tools of resistance.

In the beginning of the story we see Mangal exhausted with Etoa’s questions. He says: “You ask too much Etoa. Your father won’t have dared to ask so many questions” (2). This exploratory thirst, characteristic of children, gets magnified as we meet the protagonist of the next story- The Why-Why Girl. Mahasweta Devi writes, “All over India there are children, tribal and non-tribal, who always ask the question ‘why’?” and she chooses to tell one such girl’s story- a Shabar girl named Moyna. The Why-Why Girl is Mahasweta Devi’s first picture book and was first published in 2003. The story is autobiographical and Mahasweta Devi tells us how she meets Moyna, a ten year old and her pet mongoose. The little girl is so obsessed with finding answers to her unstoppable train of doubts and always asks “why?” The postmaster thus names her “why-why girl” (3).

² The smile we see in Etoa Munda’s story is similar to the smile one sees in Apu from Pather Panchali as he battles out with fate, poverty and his sister’s death and decides to live on with determination. It is likable to Bruno’s faint smile as he holds his father’s hand to lead him home as Bicycle Thieves ends. It also reminds one of little Salvatore’s innocent smile from Cinema Paradiso or that of Totto Chan’s. Those are the smiles against oppression, Fascism and power structures- smiles with politics and children with politics.
One fine morning Moyna declares that she would move in with Mahasweta. When her mother objects she says “Why not? It’s a big hut. How much space does one old woman need”, referring to Mahasweta (5). Moyna is neither humble to grateful towards her landlord. “Does he ever thank me? Why should I”, Moyna challenges (3). She did her work of tending the goats and came home in the evening. She hears from Mahasweta that all the answers to her whys are in the books and decides to learn to read and write. She tells other children what she had learned from the books. The story ends with Moyna, now an eighteen year old primary school teacher at Shabar Samiti, urging her students to ask questions. Moyna’s questions urges in breaking the unquestioning silence from the side of adults for resistance begins with questions of whys.

Education for the children in both the stories is a road to emancipation from bondages and feudal structures. Education for the subaltern, like Spivak observes, must be the effort to teach them democratic policies from below. “Upward social mobility is hard for the subaltern because of the long standing prejudices”; even the intelligent children are not given real education, thus closing the possibilities for a future leader or a future electorate (334). The positive signs of resistance learned through education attested by these stories are sowed as seeds to the child hearts who are the posterity to keep the flames alight.

It is this journey towards political correctness that Mahasweta dictates to her young readers in the third short story Nyadosh, the Incredible Cow. The story is autobiographical but is centred on a fish-eating, bone-licking, staircase-mounting, non-conformist, anti-establishment cow. The cow is named Nydosh (clumsy) and it belongs to Mahasweta Devi’s mother. It possesses all characteristics that a normal cow would lack- it eats up all the school textbooks of Mahasweta’s siblings, from grammar to English letter writing guides- “the
quickest way to study” (11)- like Mahasweta’s father observes. She says that Nydosh could have written her own autobiography if she had only eaten up a pen! Nydosh later starts a diet of fish and meat and develops a craving for onions and garlic, acquiring “legs as strong as a tiger’s” in the mean time (12). Mahasweta writes that Nydosh would possibly the “only cow in British ruled India to have police cases lodged against her (13) for she had the habit of pushing the Bihari Constables who climbed out after their dip in Ganga back into the river. Nydosh wanders around, refusing to be a domestic cow and lives in the court grounds where she delivers her calf. But no one gets to milk Nydosh. Later, the cow even gives a go at drinking palm wine and climbs to the terrace to watch the moon. She even chases away the Vet when she falls sick.

The story could be easily connected to the present beef politics and cow worshiping and where Dalits and Muslims are killed and arrested for storing or eating beef or for skinning a dead cow. At a time when the life of a cow becomes more precious than the life of a human being, Nyagdosh the Incredible Cow roams incredible indeed for its cow-less-ness. There is no Brahminism in Nyadosh, she lives a life of a non-Hindu and of a scavenger.

All the three stories discussed are connected because its protagonists are scavengers. They clean-up the mess left behind by the privileged classes. They are non-conformists who refuse to be domesticated and controlled. When the Dalits refuse to do the scavenging jobs, the corpses of the holy cows begins to rot and smell. The story of Nyadosh reads differently from the Hindu nationalist politics that polarize communities along religious lines and that which promote the image of ‘cow as mother’. In Etoa Munda won the Battle, the cow is presented as a friend of the adivasis, not their life denier. The politics of cow is reaching children.
When writing for grownups, Mahasweta is serious. But her stories for children are full of funny incidents and unforgettable characters. They show a bit of her childhood also. Fiction of this sort relies for its effect on its effect of the real. The plausibility of an Etoa Munda, or a Why-Why Girl is that they have existed as subalterns in a specific historical moment. Like Mahasweta, lately, many public figures have made an impression on Indian public life by engaging with their own community or ones they aligned with. Buffeted Tamil writer Perumal Murugan, the assassinated public intellectuals like Narendra Dabholkar, Govind Pansare and Malleshappa Madivalappa Kalburgi, all have intervened politically in the public discourse of their place foregrounding their communities and attempting to push the social envelope. What makes Mahasweta stand out is her refusal to be tied down- just like a child.

The world Mahasweta conjures up in these stories is inhabited by tender, real people and animals that are free-spirited and enthusiastic. They appear more civilized than anyone of us. They live one with nature and learn from nature. For Mahasweta, the first and fundamental right is the right to dream. And children are the category who is most denied of their dreams. Education provides the first step for the child to dream with open eyes, to laugh with full heart, and to question without fear. And Mahasweta never stopped dreaming. May be that is why Spivak in her obituary for Mahasweta wrote: “She seemed immortal. Yes, headstrong and childlike”.

References


ISSUES IN REVENUE GENERATION OF KERALA GOVERNMENT

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Abstract

The peculiar development experience of the Indian state of Kerala had attracted worldwide attention. Interventions made by government in social sector played an important role in realizing Kerala’s achievements in social development. But the present fiscal crisis faced by Kerala state government can potentially endanger the sustainability of these achievements. Additional revenue generation by Kerala state government is the solution to solve these problems. In this context, this paper tries to analyse the trends and patterns in revenue generation of Kerala government, identify some potentials for additional revenue generation and highlights some worrisome trends in composition of revenue of Kerala state government.

Keywords: Kerala government, Revenue, Tax Revenue, Non Tax Revenue.

Introduction

Inadequate revenue mobilization is one of the major factors responsible for Kerala’s fiscal crisis (George (1993, 1999), Sen (2012), George and Krishnakumar (2014)). This crisis can potentially threaten the sustainability of the world renowned Kerala experience of development. In this context, this paper tries to a) Understand the recent trends in revenue mobilization of Kerala

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Materials and Methods

The materials used in this paper are official secondary data sources pertaining to the study area. The main data sources used were reports of Kerala Public Expenditure Review Committee (various years) and Finance accounts, Government of Kerala (various years). Simple statistical tools like percentages and growth rates were the methods of analysis.

Result

Result of the study consists of growth/composition of various sources of revenue of Kerala state government. This study highlights the potential areas of additional revenue mobilization and also points out some worrisome trends in this regard. Studies conducted reveal that the growth rate of Total Revenue receipts (TRR) of Kerala government is declining (table 1). Tax is biggest component of TRR, followed by central transfers to Kerala and Non tax revenue. The share of Non tax revenue in TRR is increasing consistently, whereas the share of other 2 components shows a fluctuating trend (table 2).

| Table 1. Total Revenue Receipts (TRR) of Kerala government (Rs. in Crore) |
|-------------------------------------------------|----------------|----------------|----------------|----------------|----------------|
|                                                                                   | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
| **Total Revenue Receipts (TRR) (Rs. in Crore)**                                   |         |         |         |         |         |
|                                                                                   | 26109   | 30991   | 38010   | 44137   | 49177   |
| **Growth rate (%)**                                                               | 6.52    | 18.70   | 22.65   | 16.12   | 11.42   |

Source: KPERC reports, Finance accounts (GoK)
Table 2. Composition of Total Revenue Receipts (TRR) (Rs. in Crore)

<table>
<thead>
<tr>
<th></th>
<th>2009-10</th>
<th>2010-11</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>States own Tax as a</td>
<td>67.51</td>
<td>70.09</td>
<td>67.66</td>
<td>68.14</td>
<td>65.06</td>
</tr>
<tr>
<td>percent of TRR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non Tax Revenue as a</td>
<td>7.09</td>
<td>6.23</td>
<td>6.82</td>
<td>9.51</td>
<td>11.34</td>
</tr>
<tr>
<td>percent of TRR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Transfers as</td>
<td>25.40</td>
<td>23.68</td>
<td>25.52</td>
<td>22.34</td>
<td>23.60</td>
</tr>
<tr>
<td>percent of TRR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: KPERC reports, Finance accounts (GoK)

Table 3. Composition of Tax Revenue of Kerala government (Rs. in Crore)

<table>
<thead>
<tr>
<th></th>
<th>2009-10</th>
<th>2010-11</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Tax</td>
<td>73.65</td>
<td>73.86</td>
<td>74.52</td>
<td>75.77</td>
<td>78.69</td>
</tr>
<tr>
<td>Excise Duty</td>
<td>8.74</td>
<td>7.92</td>
<td>7.41</td>
<td>7.78</td>
<td>6.14</td>
</tr>
<tr>
<td>Motor Vehicle Tax</td>
<td>6.53</td>
<td>6.21</td>
<td>6.24</td>
<td>6.48</td>
<td>6.83</td>
</tr>
<tr>
<td>Stamp Duty &amp;</td>
<td>10.94</td>
<td>11.91</td>
<td>11.75</td>
<td>9.89</td>
<td>8.20</td>
</tr>
<tr>
<td>Registration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity Duty</td>
<td>0.14</td>
<td>0.10</td>
<td>0.08</td>
<td>0.08</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Source: KPERC reports, Finance accounts (GoK)

Sales tax remains as the single largest source of tax revenue in Kerala and its share in total tax revenue is increasing. Sales tax is not a progressive tax and it affects all sections of society equally. Hence heavy reliance on sales tax may contribute to price hike and will adversely affect on common man. Despite high liquor consumption in Kerala, the share of excise duty in total tax revenue remains low and shows a fluctuating trend. There is potential for additional revenue generation in this segment. There are no additional ethical issues here because government is already relying on high liquor consumption in Kerala to bolster its commodity tax collection.

Share of motor vehicle tax in total tax revenue is increasing but remains low. Government must try to increase the revenue from it. Such an effort will
also act as a deterrent to rapid growth of vehicle population in Kerala and will bring substantial ecological benefits. Share of stamp duty and registration in total tax revenue remains low and declining. This is an area that requires a clear policy and strategy. Either the government can cash on real estate deals or curb the same using a comprehensive stamp duty and registration policy. Share of electricity duty in total tax revenue is increasing. This is not desirable as it may have adverse impacts on both domestic and industrial users of electricity (table 3).

**Commodity Tax Collection in Kerala**

In the last 4 years, Commodity tax collected from sale of Indian Made Foreign Liquor (IMFL) occupies 1\textsuperscript{st} position in the ranks (table 4). It seems the government is taking advantage of higher liquor consumption (IMFL) in Kerala. This can be viewed from two perspectives. Either we can consider the high alcohol consumption in Kerala as given and say that it is prudent to make maximum revenue from it. Or we can say that it is unethical to rely on IMFL to bolster commodity tax revenue.

Commodity tax collected from sale of petroleum products occupies 2\textsuperscript{nd} position in the ranks mentioned in table 4. This again can be viewed from two perspectives. Either we can consider opine that higher tax revenue from petroleum products will contribute to overall price hike and adversely affect on common man. Alternatively, one can argue that a lower tax on petroleum products will lead to lower prices of petroleum products and this will deter the efforts to conserve these non renewable energy sources.

Commodity tax revenue from motor vehicles and jewelry figure prominently (table 4). This is a welcome trend as government is either trying to cash from some types of conspicuous consumption or trying to curb the same.
But at the same time many other non essential and luxury items are not taxed properly. This is clear from low rank of luxury tax. Government must try to augment the tax collection from non essential and luxury items.

Commodity tax collected from medicines occupies seventh rank in table 4. Relying on essential items like medicines to augment tax revenue is not desirable for the welfare of citizens. But higher revenue from sale of medicines can be either due to higher morbidity rate in Kerala or due to higher tax rate. To ascertain this, further enquiry is needed.

**Table 4. Sources of commodity Tax Collection In Kerala**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Year</th>
<th>2008-09</th>
<th>2009-10</th>
<th>2010-11</th>
<th>2011-12</th>
<th>2012-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Petroleum Products</td>
<td>IMFL</td>
<td>IMFL</td>
<td>IMFL</td>
<td>IMFL</td>
<td>IMFL</td>
</tr>
<tr>
<td>2</td>
<td>IMFL Petroleum Products</td>
<td>Petroleum Products</td>
<td>Petroleum Products</td>
<td>Petroleum Products</td>
<td>Petroleum Products</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Cement</td>
<td>Cement</td>
<td>Cement</td>
<td>Cement</td>
<td>Cement</td>
<td>Cement</td>
</tr>
<tr>
<td>5</td>
<td>Rubber</td>
<td>Rubber</td>
<td>Rubber</td>
<td>Rubber</td>
<td>Rubber</td>
<td>Rubber</td>
</tr>
<tr>
<td>6</td>
<td>Jewelry</td>
<td>Jewelry</td>
<td>Jewelry</td>
<td>Jewelry</td>
<td>Jewelry</td>
<td>Jewelry</td>
</tr>
<tr>
<td>7</td>
<td>Medicines</td>
<td>Iron and Steel</td>
<td>Medicines</td>
<td>Medicines</td>
<td>Medicines</td>
<td>Medicines</td>
</tr>
<tr>
<td>12</td>
<td>Luxury Tax</td>
<td>Electrical Goods</td>
<td>Chicken</td>
<td>Luxury Tax</td>
<td>Timber</td>
<td>Luxury Tax</td>
</tr>
<tr>
<td>13</td>
<td>Electrical Goods</td>
<td>Luxury Tax</td>
<td>Luxury Tax</td>
<td>Timber</td>
<td>Luxury Tax</td>
<td>Luxury Tax</td>
</tr>
<tr>
<td>14</td>
<td>Cardamom</td>
<td>Areca nut</td>
<td>Bakery Products</td>
<td>Bakery Products</td>
<td>Bakery Products</td>
<td>Bakery Products</td>
</tr>
<tr>
<td>15</td>
<td>Machinery</td>
<td>Machinery</td>
<td>Machinery</td>
<td>Sanitary ware</td>
<td>Tea</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Bakery Products</td>
<td>Bakery Products</td>
<td>Sanitary ware</td>
<td>Machinery</td>
<td>Areca nut</td>
<td></td>
</tr>
</tbody>
</table>

*Source: KPERC reports, Finance accounts (GoK)*
Non Tax Revenue (NTR) of Kerala Government

The revenue from general services is the largest component of non tax revenue, followed by economic services and social services (table 5). Share of general services and social services in NTR is increasing, even though the increase is small. At the same time the share of economic services in NTR is declining consistently and sharply.

Table 5  Percentage share of different components of Non Tax Revenue (NTR)

<table>
<thead>
<tr>
<th>Share in NTR</th>
<th>2009-10</th>
<th>2010-11</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>General services</td>
<td>54.20</td>
<td>49.32</td>
<td>62.67</td>
<td>73.98</td>
<td>75.85</td>
</tr>
<tr>
<td>Social service</td>
<td>10.12</td>
<td>11.98</td>
<td>10.48</td>
<td>6.93</td>
<td>7.57</td>
</tr>
<tr>
<td>Economic services</td>
<td>25.97</td>
<td>25.91</td>
<td>18.99</td>
<td>13.84</td>
<td>12.09</td>
</tr>
<tr>
<td>Interest receipts</td>
<td>8.21</td>
<td>8.86</td>
<td>5.25</td>
<td>4.10</td>
<td>2.67</td>
</tr>
<tr>
<td>Dividend and profit</td>
<td>1.46</td>
<td>3.88</td>
<td>2.59</td>
<td>1.14</td>
<td>1.81</td>
</tr>
</tbody>
</table>

Source: KPERC reports, Finance accounts (GoK)

Growth of NTR from different sources

There is a decline in growth of total NTR and NTR from General services after consistently increasing for 3 years (table 6). There is a sharp increase in revenue from social services in 2013-14 and the growth of revenue from social services was never negative. Whereas the growth of revenue from general and economic services do turned negative in various years.

Table 6. Percentage of growth of NTR from different sources

<table>
<thead>
<tr>
<th></th>
<th>2010-10</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non tax revenue (Total NTR)</td>
<td>4.24</td>
<td>34.25</td>
<td>61.97</td>
<td>32.79</td>
</tr>
<tr>
<td>General services</td>
<td>-5.14</td>
<td>70.58</td>
<td>91.19</td>
<td>36.15</td>
</tr>
<tr>
<td>Social service</td>
<td>23.34</td>
<td>17.44</td>
<td>7.19</td>
<td>45.08</td>
</tr>
<tr>
<td>Economic services</td>
<td>3.99</td>
<td>-1.63</td>
<td>18.03</td>
<td>16.01</td>
</tr>
<tr>
<td>Interest receipts</td>
<td>12.50</td>
<td>-20.47</td>
<td>26.47</td>
<td>-13.37</td>
</tr>
<tr>
<td>Dividend and profit</td>
<td>177.77</td>
<td>-10.67</td>
<td>-28.36</td>
<td>110.42</td>
</tr>
</tbody>
</table>

Source: KPERC reports, Finance accounts (GoK)
Non Tax Revenue (NTR) from Social vs. Economic Services

There is a peculiar trend in growth of NTR from different sources. The growth of revenue from general and economic services turned negative in various years but the growth of revenue from social services was never negative. Social services are not originally meant to operate with revenue – profit goals. But the revenue from the same never declined in recent years. A disaggregated analysis of this trend could be obtained by looking at the growth of revenue from different components of social services (table 7).

Table 7. Percentage of growth of NTR from different components of social services

<table>
<thead>
<tr>
<th></th>
<th>2010-11</th>
<th>2011-11</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social service (Total)</td>
<td>23.34</td>
<td>17.4426</td>
<td>7.188363</td>
<td>45.07692</td>
</tr>
<tr>
<td>Education, sports and culture</td>
<td>15.48</td>
<td>9.368163</td>
<td>10.79656</td>
<td>68.58702</td>
</tr>
<tr>
<td>Medical and public health</td>
<td>84.29</td>
<td>2.742317</td>
<td>33.28731</td>
<td>5.606629</td>
</tr>
<tr>
<td>Labour and employment</td>
<td>-18.63</td>
<td>297.33</td>
<td>-66.53</td>
<td>37.76</td>
</tr>
<tr>
<td>Others</td>
<td>-30.17</td>
<td>-28.97</td>
<td>67.38</td>
<td>-37.53</td>
</tr>
</tbody>
</table>

Source: KPERC reports, Finance accounts (GoK)

The growth of NTR from social services (total) is positive for all years. Growth of NTR from social services was more than 7% for all years. Growth of NTR from education/sports/culture is more than 9% for all years. NTR from health services is more than 2% for all years. But growth of NTR from labour, employment and other services do turn negative in some years.

NTR from sectors like health and education are showing consistent growth in recent years. This means that the money collected from people in Kerala to avail these services is increasing. Does it mean that people have to pay more education/health and other social services offered by government? If yes, then this is a trend that adversely affects the disadvantaged sections of
Kerala society. But to answer this question a detailed empirical investigation is required and that is beyond the scope of this paper.

Table 8. Percentage growth of NTR from Different Components of Economic Services

<table>
<thead>
<tr>
<th></th>
<th>2010-11</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic services (Total)</td>
<td>9.50</td>
<td>3.99</td>
<td>-1.63</td>
<td>18.03</td>
</tr>
<tr>
<td>Co operation</td>
<td>17.54</td>
<td>19.68</td>
<td>15.60</td>
<td>46.34</td>
</tr>
<tr>
<td>Non-ferrous mining</td>
<td>-2.63</td>
<td>16.63</td>
<td>4.61</td>
<td>12.46</td>
</tr>
<tr>
<td>Roads and Bridges</td>
<td>39.04</td>
<td>-0.26</td>
<td>-35.41</td>
<td>53.05</td>
</tr>
<tr>
<td>Others</td>
<td>-26.59</td>
<td>2.45</td>
<td>66.92</td>
<td>14.74</td>
</tr>
<tr>
<td>Forestry and wild life</td>
<td>21.94</td>
<td>0.48</td>
<td>-19.55</td>
<td>7.62</td>
</tr>
</tbody>
</table>

Source: KPERC reports, Finance accounts (GoK)

The growth of NTR from various types of economic services shows wide fluctuations over years (table 8). Two areas that require special mention are the revenue from co operative sector and non ferrous mining like quarry – sand mining. Revenue from co operative sector is increasing and its growth never turned negative in recent times. This is good for financial stability of co operative sector. But profit/financial stability is not the only goal of this sector. Co operative sector is supposed to act as an alternative to profiteering private enterprise by focusing on affordability of services it offer. So more enquiries are needed to know if the growth of revenue from co operative sector is achieved by compromising on the aims and objectives of co operative sector.

Another area that bestows considerable potential for revenue generation; given the boom in Kerala’s construction - realty sector is mining. But unfortunately the revenue from mining shows no steady growth in recent times. There are wide fluctuations in growth rate with instances of very high growth in one year followed by lower growth or negative growth in the next year. Clearly this sector offers a considerable scope for additional revenue generation to Kerala state.
Discussion and conclusion

This paper has tried to identify the areas that we need to focus to achieve the objective of additional revenue mobilization to Kerala government and also highlighted some trends in Kerala government’s revenue mobilization that are harmful to public welfare. Growth of TRR of Kerala govt. is declining. Tax is biggest component of TRR, followed by central transfers to Kerala and Nontax revenue, Growth of Tax revenue is increasing in Kerala and the growth of NTR is declining in Kerala. Revenue from general services is the largest component of non tax revenue, followed by economic services and social services

There is potential for additional tax revenue generation from excise duty, motor vehicle tax, stamp duty and commodity taxation of jewelry and other non essential items. Regarding non tax revenue the potential areas include areas like mining/quarrying.

It is noted that some of the trends in Kerala government’s revenue mobilization are harmful to public welfare. Reliance on non progressive taxes like sale tax for revenue mobilization is not desirable as it adversely affect rich and poor alike. Revenue from Electricity duty and commodity tax revenue from sale of petroleum products and medicines figure prominently in tax revenue of Kerala government. Relying on these essential goods/services to boost tax revenue may prove harmful to welfare of weaker sections of society. Regarding non tax revenue the biggest concern is the lower growth of NTR from economic services and higher growth of NTR from social services. It needs to be checked if this will result in a higher expenditure for public to use the social services like health and education that are provided by government.

Needless to say, increasing revenue of Kerala state government is important for sustaining the gains of Kerala experience of development. But
revenue generation is only a means to achieve the ultimate end of sustaining gains of Kerala experience of development. One of the important features of Kerala experience of development is the affordable social services provided by government. But recent trends in Kerala's revenue generation reveal that the revenue from these services is consistently increasing in recent years. It needs to be checked if government views this services as a means to increase revenue. If yes, it will adversely affect the welfare of poor. Reducing the affordability of publicly provided social services is detrimental to the very basic features of Kerala’s development experience. Instead, augmentation of revenue of Kerala state government may be achieved by focusing on other aspects that are emphasized by this study.

References


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