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Sectional Chairpersons' Addresses
Popular Lectures
Theme Seminar Presentations

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Editor's Note

The Jaffna Science Association (JSA), which was established in 1991 by the founder president late Professor A.Thurairajah, has been functioning with the aim of disseminating scientific knowledge among the students and general public in the northern region. It has been carrying out various activities including School Science Programme, guest lectures, workshops, seminars, JSA annual session, and publication of journals and magazine.

The key objectives of the JSA annual sessions are to educate people on latest advancements in science and to encourage researchers in publishing their research findings. Further, a theme relevant to the region is identified every year focusing on a crucial issue. The seminars and popular talks are organised based on thus identified theme. Additionally, two research proceedings are published each year; one contains the presidential address, the chairpersons' address, popular lectures and theme seminar presentations that were conducted in the previous year, and the other contains the abstracts of research papers that were presented in the respective year.

This proceeding contains the presidential address, the chairpersons' address, popular lectures and theme seminar presentations delivered in the 19th JSA annual sessions. The sessions were held on 04th, 05th and 09th of April 2012 on the theme of "Climate Change" at the library auditorium in the University of Jaffna. These sessions were organised by the nineteenth executive committee of JSA.

It is a privilege to be the editor for the proceedings of Jaffna Science Association this year and I wish to thank the distinguished speakers for their contribution and cooperation in compiling this volume. I strongly believe that this volume of the proceedings will be beneficial to the people in the region and will immensely facilitate in attaining the aim of Jaffna Science Association.

Mr. K. Sarveswaran
Chief Editor / Jaffna Science Association
17 April 2013

Department of Computer Science,
University of Jaffna,
Sri Lanka.

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Increasing the Efficiency of Photosynthesis: A Genetic Engineering Approach

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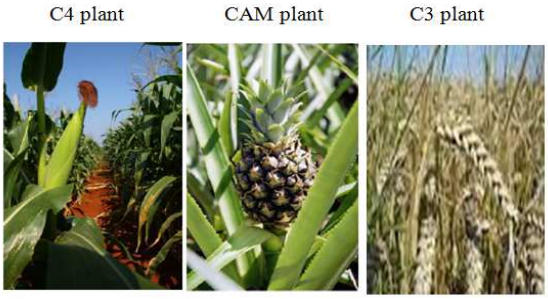
Introduction

Photosynthesis is a process that usually takes place in plants. It can be defined as the preparation of sugar in presence of carbon dioxide, water, sunlight and chlorophyll.

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{Sunlight}} \underset{\text{(glucose)}}{C_6H_{12}O_6} + 6O_2$$

The two stage process of photosynthesis can be classified as follows. The first stage requires light and therefore called light-dependant reaction (occurs in thylakoids of chloroplast). Light reaction results in the production of ATP and NADPH. The second stage does not require light (but can occur in the presence of light) and therefore called light-independent reaction (occurs in storma of chloroplast). Dark reaction fixes CO_2 when it is accepted by RuBP to form 2 molecules of a 3C compound 3-phosphoglycerate. A series of reactions occur called Calvin cycle.



(http://tinyurl.com/c4-cam-c3)

There are three reported types of photosynthesis and they are C3, C4 and Crassulacean Acid Metabolism (CAM). In C3 plants the CO_2 is first incorporated into a 3-carbon compound whereas in C4 plants CO_2 is first incorporated into a 4-carbon compound. In case of CAM the CO_2 is stored in the form of an acid before use in photosynthesis.

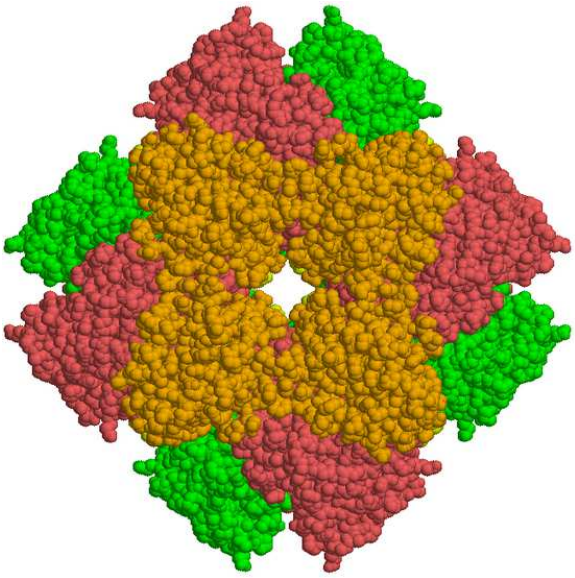
Adaptive Value

- When compared to C4 and CAM plants C3 plants are more efficient under cool and moist conditions.
- Under high light intensity and high temperature C4 plant photosynthesizes faster than C3 plants as CO_2 is delivered directly to Ribulose-1,5-bisphosphate carboxylase oxygenase (RuBisCO) (Sage and Kubien, 2007).
- PEP Carboxylase brings in CO_2 faster and so does not need to keep stomata open so long resulting in better water use efficiency.
- C4 plants exhibit higher water and nitrogen efficiencies compared to C3 plants which results in an increased dry matter production
- Due to the closure of stomata at night CAM plants have better water use efficiency under arid conditions and when conditions are extremely arid they can have their stomata closed all day.

About 80% of the plant species are C3 plants. The limitation to photosynthetic CO_2 assimilation in C3 plants in hot dry environment is dominated by Rubisco because CO_2 availability is restricted and photorespiration is simulated. Monteith (1977) has shown that 30% of the carbohydrate formed in C3 photosynthesis is lost through photorespiration.

Rubisco

A model for the structure of rubisco in chloroplasts from higher plants. Rubisco consists of 8 large (L) and 8 small (S) subunits arranged as 4 dimers. (R.Bergmann 2001).



This is the key and rate-limiting enzyme involved in photosynthetic carbon assimilation. All Rubisco (560 kDa) enzymes are multimeric. Two different types of subunit/chains occur. In many cases is consists of 8 Large (50-55 kDa) and 8 small (12-18 kDa) subunits. Based on the presence or absence of the small subunit - two major forms are present. Form 1 is present in plants, algae (excluding certain dinoflagellates) and some bacteria - contains small and large subunits - Hexadecameric structure. Form 2 is present in some other bacteria and dinoflagellates - contains only large subunits. Unlike the simpler bacterial gene, genes for the L8S8 molecule from higher plants are present in two different genomes. The gene for the L subunit is part of the chloroplast genome, whereas the S subunits are coded by the nuclear genome

Approaches by genetic engineering

- Increase the catalytic activity/ CO_2 affinity
- Reduce the rate of oxygenation activity/ O_2 affinity by modifying Rubisco genes (Spreitzer and Salvucci, 2002)
- Rubisco genes from bacteria to tobacco (Whitney and Andrews, 2001 a)
- Expressing the Rubisco small chain from chloroplast DNA (Parry et al., 2003)
- Over-expressing the Rubisco activase
- Site directed mutagenesis
- Simple CO_2 concentrating enzymes from cyanobacteria have been engineered into maize (Ku, 2008).
- Introducing E.coli genes for Trehalose synthesis (improve stress tolerance in tobacco and rice (Pilon-Smits et al., 1998 and Garg et al., 2002)
- Engineering the enzymes of C4 plants in the leaves of C3 plants such as rice, wheat, potato and tobacco (Maize C4 genes introduced into C3 wheat (Ku, 2008))

Limitations

- One part of the protein is expressed by nuclear genome and the other by plastid genome
- Assembling of the S and L subunits into a functional enzyme after manipulation
- Requires sufficient expression
- Post-translational modification
- Interaction with chaperonins
- Interaction with Rubisco activase

Conclusion

Genetic improvement of the photosynthesis efficiency by the application of recombinant DNA technologies could be considered as a step forward in intensification of breeding for a "Changing World"

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Informatics: An Emerging Discipline of the Information Age

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Introduction

Informatics is the *science of information*. It studies the representation, processing, and communication of information in natural and artificial systems. Since computers, individuals and organizations all process information, informatics has computational, cognitive and social aspects. It can be perceived as *studying how to design a system that delivers the right information, to the right person in the right place and time, in the right way*. It also develops its own conceptual and theoretical foundations, and utilizes foundations developed in other fields as well (Lesk, 1997; Lyman and Varian, 2000).

It is obvious that we live in a data-centric world. People are more concerned in capturing and packaging data in creative ways. *Informatics* is the study of how we collect, store, manipulate, retrieve, and visualize data. The real winners in this 21st century will be the ones who have the tools to transform data into information and then into knowledge.

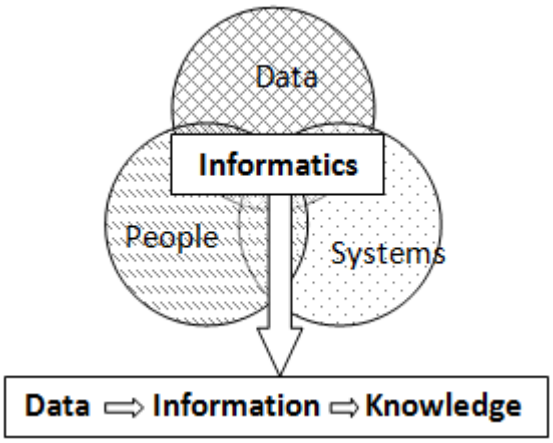


Fig.-1: Diagrammatic representation of the discipline *Informatics*

(http://www.farinhansford.com/gerald/classes/cpi101)

For example, Table 1 shows how representations of data (gene number, NDC value) developed by informaticists allow simple data to be linked with useful information and a rich set of knowledge resources.

Table-1: Biomedical examples of data, information and knowledge

Data (single points of observation)	Gene number 606822	NDC (National Drug Code) 0006-0661-68
Information (providing meaning for data)	This gene encodes for a copper-transporting ATPase	This is trientine, a drug used to treat Wilson disease
Knowledge (interpretation of information)	A defect in this gene causes Wilson disease, which causes liver and neuropsychiatric disease	Pharmacology, administration, dosage, and warnings associated with trientine

Informatics makes it possible to develop much more sophisticated tools for researchers, professionals, and public to make sense of data (such as laboratory values or gene expression data) and to draw new inferences that will advance science.

Informatics - Etymology and Morphology

The word *'informatik'* was initially coined by a German computer scientist called Karl Steinbuch in 1957, by publishing a paper titled *Informatics: automatic information processing*. This term *'informatik'* is the direct translation of English ***Computer science***. Later in 1962, *'informatique'* in French and *'informatica'* in Italian, Spanish, Romanian, Portuguese and Dutch languages were proposed, refereeing to the ***application***

of computers to store and process information (Dreyfus, 1962; Bauer, 1996). This new term was adopted across Western Europe, except in English. Mikhailov *et al.* advocated the Russian term *'informatika'* (1966), and the English *'informatics'* (1967), as names for the ***theory of scientific information*** (Mikhailov *et al., 1967*).

Phonologically, the term *informatics* combines elements from both *information* and *automatic* to describe the science of automating information interactions. It strengthen semantic appeal (e.g. politics, linguistics, economics), and the meaning extends to encompass both the science of information and the practice of information processing.

Informatics – Definition and subsequent Amendments

After the development of the term *informatics*, several discussions and debates were held among professional to broaden the meaning of the term. Eventually, the following definition was proposed, by including study of the use of information technology in various disciplines and the interaction between the technology and human organizational structures.

> *Informatics is the discipline of science which investigates the structure and properties of scientific information, as well as the regularities of scientific information activity, its theory, history, methodology and organisation* (Mikhailov *et al., 1967*)

Later, this definition has been modified to incorporate the following three suggestions:

- Restriction to scientific information is removed, in order to include business informatics, legal informatics, social informatics, etc.
- Since most of the information is now digitally stored, computation now plays a vital role in informatics (Gorn, 1983; Lesk, 1997; Lyman and Varian, 2000).
- Representation, processing and communication of information are added as objects of investigation, since they have been recognised as fundamental to any scientific account of information.

As a whole, taking ***information*** as the central focus of study, then, distinguishes ***informatics***, which includes study of biological and social mechanisms of information processing, from ***computer science***, where digital computation plays an important role. Further, in the study of representation and communication, informatics encompasses the study of communication using gesture, speech and language, as well as digital communications and networking.

This led to the study of informatics that has computational, cognitive and social aspects, including study of the social impact of information technologies. Friedman's (2009) *"fundamental theorem"* of biomedical informatics predicts that a patient, clinician, or researcher working in partnership with an information resource is more effective than that same person unassisted (Figure 2).

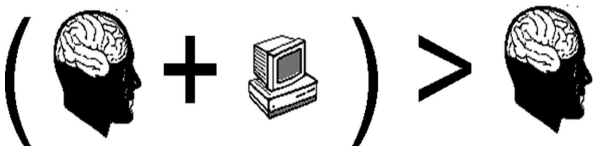


Fig.-2: Friedman's *"fundamental theorem"* of biomedical informatics (Friedman, 2009)

Thereby, in informatics, our mission is to study whether we have made people better. If we find that we have not attained the intended goals, then we have to revise the information resource, in the hope that a modified version will be more effective and successful.

Evolution of the discipline

While tracing the evolution of this discipline, the root of the discipline was found in the field of ***library science***. In the field of library science, organisation of library materials is one of the prime objective and basic function, which is based on the content of the materials and known as *organisation of information/knowledge*. Over the years, a discipline deals with the processes of storing and transferring information was emerged, in

order to develop techniques and devices to aid in the handling of information. This discipline known as ***information science*** developed in parallel to library science. Then, transition from library science through ***Documentation*** to ***Library and Information Science*** occurred, which was largely influenced by Information *theory* and *Information technologies*. Eventually, ***Library Information Science*** emerged as a discipline in 1970s.

Later, an umbrella term was coined as ***information studies*** to include library and information science (LIS) and allied fields (such as information theory, information management, information technology, etc.). ***Informatics*** is used as a compound, in conjunction with the name of a discipline, as in *bio-informatics*, *health informatics*, *medical informatics*, etc., it denotes the specialization of informatics to the management and processing of data, information and knowledge in the named discipline.

When we tried to do a web search using the terms related to informatics (occurring more or less frequently), the following priority areas in the discipline informatics were identified. The number of documents retrieved for each search term is presented in Table 2, against the name of the area.

Table-2: Web search done using the terms related to informatics (March 2012)

Search term	**Search results in Google (March 2012)**
Bioinformatics	34,700,000
Bio informatics	853,000
Informatics	24,700,000
Health informatics	14,200,000
Medical informatics	9,000,000
Geoinformatics	3,360,000
Geo informatics	239,000
Neuroinformatics	3,260,000
Nursing informatics	755,000
Business informatics	432,000
Commercial informatics	2,030
Chemoinformatics	420,000
Chemical informatics	196,000
Molecular informatics	360,000
Social informatics	280,000
Legal informatics	234,000
Dental informatics	97,600
Mobile informatics	21,340

This result reveals that bioinformatics is the leading area in informatics. Then, next to informatics, health/medical informatics is the priority area in informatics.

Branches of the discipline informatics

Some of the branches of the discipline informatics are listed below. However, the list is longer than this and continues to grow.

- Health informatics/ medical informatics
- Bioinformatics
- Bio-medical informatics
- Chemical informatics/ chemo informatics
- Molecular informatics
- Nursing informatics
- Translational informatics
- Geo informatics
- Ocean informatics
- Social informatics
- Educational informatics
- Urban informatics
- Business informatics
- Legal informatics
- Museum informatics
- Library informatics

In the following section, some of these branches are discussed in detail.

Medical/ Health informatics

In the Western world, the term *informatics* was first widely used in the context of *medical/health informatics*. Health informatics is the study of how technology, particularly artificial intelligence, computer science, and information science relates to the medical field. This field of study is typically

applied to clinical care, nursing, public health, and biomedical research (Hersh, 2009). It is defined as the *knowledge, skills and tools which enable information to be collected, managed, used and shared safely to support the delivery of healthcare and promote health* (Hersh, 2002). This concept is illustrated in Figure 3, which shows how the generic sciences of health care, information and computer technology interact to create the domain of Health Informatics.

Health informatics is a non-exclusionary term that includes all health-related informatics sub-disciplines. Looking into the future it is expected that the need for professionals in this market will keep rising. People interested in pursuing this type of career are smart to educate themselves now to take advantage of the future potential. As such, a wide range of health informatics sub-specialties (e.g., clinical informatics, bioinformatics, nursing informatics, veterinary informatics, dental informatics, public health informatics, etc.), which are increasingly becoming degree programs in demand.

Bioinformatics and Biomedical informatics

The field of *bioinformatics* has emerged in recent years in response to the rapid advancement in the research arena of molecular biology and genomics. Bioinformatics provides researchers with the tools, information technologies, and analytical methodologies needed to manage the large volumes of data generated by novel types of research. Figure 4 shows, central to both medical informatics and bioinformatics is the collection and analysis of information. While medical informatics is more concerned with structures and algorithms for the manipulation of the data and how it can be applied in healthcare, bioinformatics is more concerned with the data itself and its biological implications (Shortliffe and Cimino,2006).

By integrating bioinformatics and medical informatics, *biomedical Informatics* offers unique infrastructure, tools, techniques and applications that bridge these areas. This facilitates the sharing of data and information across diverse disciplines. Biomedical

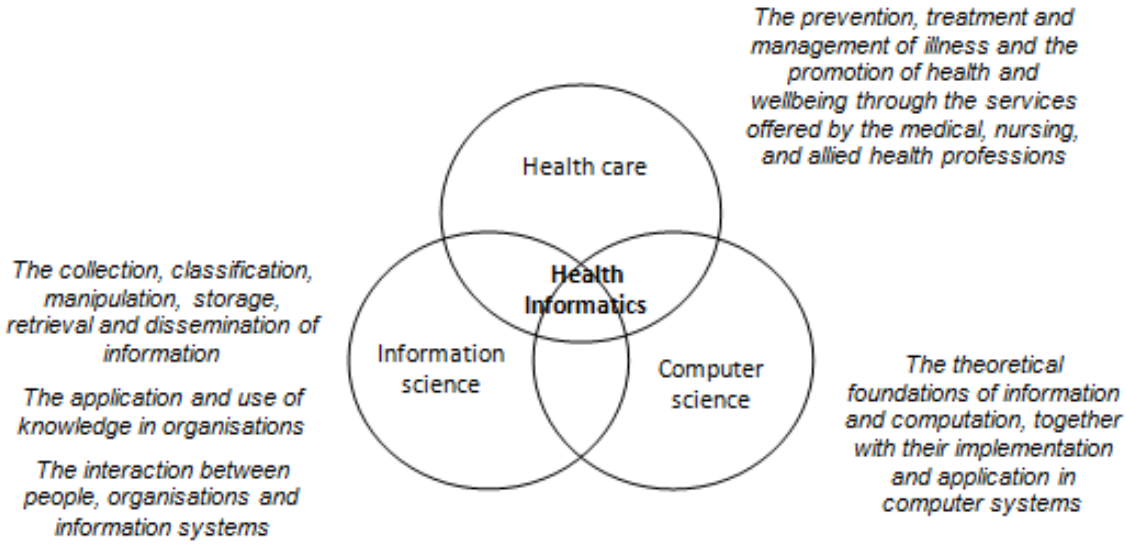


Fig.-3: Health informatics

informatics provides the tools and skills needed for the development and application of new technology for improving patient care, medical education, health sciences and management for healthcare/hospital systems.

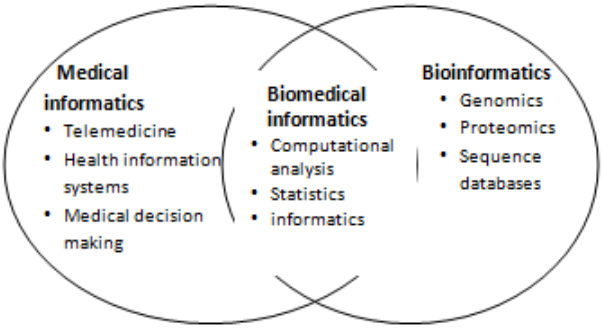
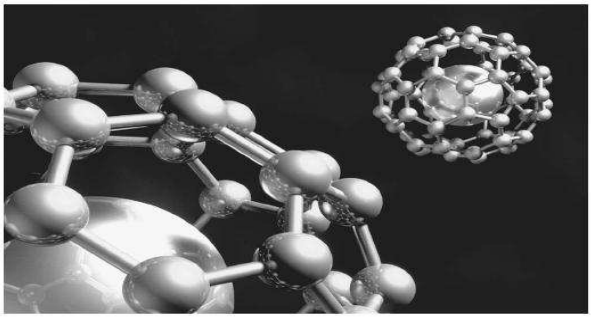


Fig.-4: Relationship between medical informatics and bioinformatics

Chemical informatics

As with many new disciplines, the field of *chemical informatics* has neither a precise name nor a clear definition. It is variously called cheminformatics, chemoinformatics, and molecular informatics, among other terms. It encompasses the description, acquisition, visualization, management, and use of chemical information.



Fig,-5: Chemical informatics

A more narrow definition excludes the text-handling aspects of chemical information such as database searching and treats only the manipulation of two- and three-dimensional structural information (Figure 5).

It is, however, generally agreed that cheminformatics (to use the currently most popular term) is indeed a legitimate new field in which chemistry, information science and computer science intersect strongly. Those employed in this field develop new substances, materials, and processes by organizing, analyzing, and visualizing the information available to them. Although the present focus of cheminformatics is mainly drug development, it has potential widespread applications in other areas, such as polymers, Computer-generated molecular structures, food science, and materials science (Brown, 1998).

Educational informatics

Educational informatics is an interdisciplinary field given recent impetus by rapid developments in the use of the Internet as both an information environment and an environment for learning and teaching (Figure 6). It has two main areas of concern:

- to understand the effects on people of using digital information resources, services, systems, environments and communications media for learning and education;
- to contribute to the development of practical knowledge of relevance to diverse forms of learning/education using information and communication technology (ICT) and digital resources.

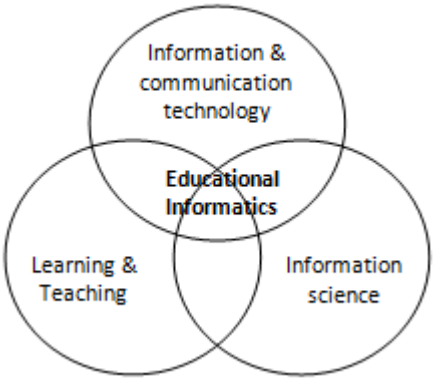


Fig.-6: Educational informatics

It is a growing area of research activity in the education field (Ford, 2008).

Ocean informatics

Ocean Informatics is an initiative establishing distributed local information environments at a variety of institutions. The work of Ocean Informatics is represented as the union of oceanography, information science and social science domains (Figure 7).

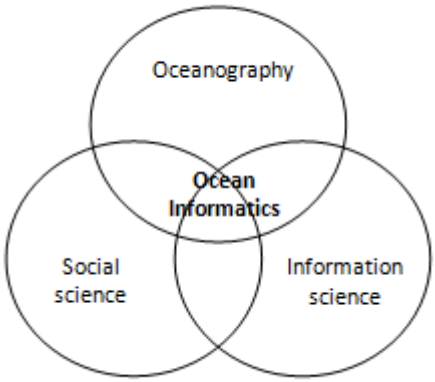


Fig.-7: Ocean informatics (http://oceaninformatics.ucsd.edu/)

Ocean Informatics is a community of practice emerging to meet the challenges of articulating requirements and designing complex systems of information that support heterogeneous data collections and diverse local practices.

Social informatics

Concerns for social informatics are different from computer science, library science, information science or even communication, and yet all of these areas were a part of the picture. Mainly the focus is on the intersections of people, information and technology and that the mission involved the *social aspects* of information (Penniman, 2005).

Urban informatics

Urban Informatics as a discipline is primarily concerned with bridging the gap between needs and issues of people in the urban context, and opportunities provided by ICT. It involves both studying and understanding socio-cultural aspects of people, space and place and also solution-finding through planning, designing, building and evaluating innovative technology artefacts (Bilandzic and Venable, 2011).

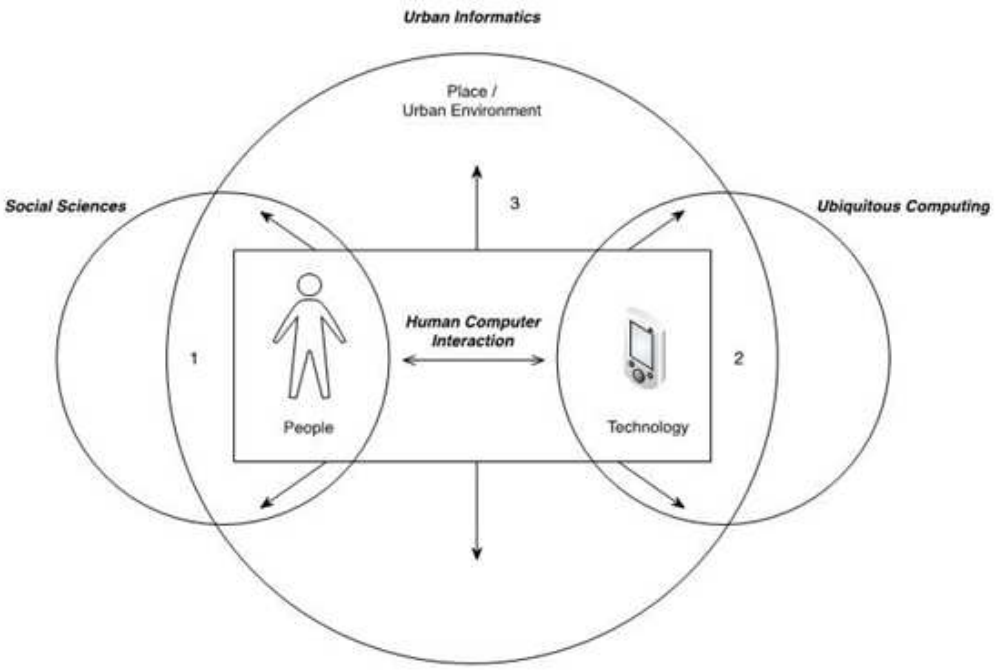


Fig.-8: Urban informatics covers topics, methods and issues across social, technology and design- oriented sciences applied in the urban context (Bilandzic and Venable, 2011).

Urban Informatics embodies an *inter-disciplinary approach to understand the city as an ecology that consists of technological, social, and architectural layers.* It covers topics, methods and issues across social, technology and design-oriented sciences applied in the urban context.

Translational informatics

Translational informatics is simply research informatics applied to translational research. It accelerates translation of scientific discoveries from the bench to medical care at the bedside, improving the health of the community. It helps the development of storage, analytic, and interpretive methods to optimize the transformation of increasingly voluminous biomedical data into proactive, predictive, preventative, and participatory health.

Translational bioinformatics includes research on the development of novel techniques for the integration of biological and clinical data and the evolution of clinical informatics methodology to encompass biological observations. The end product of translational bioinformatics is newly found knowledge from these integrative efforts that can be disseminated to a variety of stakeholders, including biomedical scientists, clinicians, and patients (Butte, 2008).

Further, it is interesting to note that the discipline informatics influence in changing the life pattern of individuals, too. In earlier days, information was with the subject specialists and only instructions were given. Subsequently, subject specialists tried to educate the clients with their professional knowledge, which is not understandable by the clients. With the advent of ICT, clients gather information without the help of subject specialists, which may not be reliable all the time. At present, informatics plays a major role in providing the right information, to the right person, at the right time, in a right way.

Change in the paradigm of library profession

At this juncture, it would be appropriate to discuss the role need to be played by the libraries and librarians in the information age. Earlier, libraries were known as ***store houses*** of documents. Later, they evolved as centres with borrowing facilities of documents and called as ***libraries***. Now, the paradigm shift shows that these centres are improved to the status of ***information centres***, in order to provide the needed information. In this connection, the role of ***Custodian*** also changed as ***Librarian*** and currently to the status of ***Information professional.***

The present day Information professionals are expected to act as (Ramos, 2007):

- Information broker for both print and electronic media - Identifies, retrieves, organises, repackages and provides electronic access to digital information sources
- Technology application leader - Collaborates with IT Services to design and evaluate systems that would facilitate e-access
- Facilitator - Makes access easier, e.g. provides network access, purchases software & e-journal licenses
- Educator - Trains library users on Internet use
- Innovator/Website designer - Designs the library's web page and searches and evaluates information resources to be linked to the site, manages the organisational web site
- Database manager - Searches via online databases
- Collaborator - Expands collaboration, not just with fellow librarians but with IT people, the community, etc.
- Policy maker - Develops or participates in the development of an information policy for an organisation
- Business manager - Negotiates with publishers and aggregators for the most advantageous license agreements for e-journals and databases
- Image maker - Project a positive image to the outside world by adding value to the library

Conclusion

Technologies underlying the digital storage, processing and communication of information are improving relentlessly. The combination of digitization and global connectivity makes data available in unprecedented volume. We can be sure that technological changes will continue to revolutionize the ways we manage, share, and analyse data, and will provide new ways of transforming data into information and knowledge. In fact, our ability to find answers to the most pressing problems of today, such as global warming, climate change and disease prevention, depends on our abilities to develop innovative methods in informatics. We all hope that this would be facilitated by the new *"information schools"* that are emerging from traditional library schools or evolving from computer science schools that are embracing informatics concepts.

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Tuberculosis Control – Northern Sri Lankan Experience

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Tuberculosis control activities are synchronized by WHO, implementing DOTS. The estimated incidence of all forms of TB, estimated prevalence of all forms of TB mortality all continue to show a downward trend in the world.

Northern Sri Lanka experience in tuberculosis control is beneficial for community health care workers especially in a conflict area. We had almost paralyzed health system for tuberculosis care. Chest hospital is still in high security zone since 1990. We had several difficulties getting drugs. We kept the drugs in three different places during the war time and we had also 3 months buffer stock.

Chest ward was shelled at DH Chavakachcheri in 2000. Chest clinic, Jaffna was shelled in 2006 and Chest clinic was affected by "Nisha cyclone" disaster in 2008.

Following advocacy communication channels in Tamil were used for social mobilization activities.

- Leaflets
- Posters
- Bill boards
- Books
- Cultural events/Infotainment
- World Wide Web

Table-1: Mile stones/Achievements in Jaffna District

Mile stones/Achievements		Year
01	Establishing Chest Clinic in a New Building	2005
02	Implementing DOTS	2005
03	Introduction of Adult FDC drugs	2006
04	Establishing Branch Clinics	2006
05	Establishing Microscopic centers	2007
06	Introduction of Paediatric FDC	2008
07	Introduction of Electronic Recording and Reporting	2011
08	Implementing PAL Approach	2012

Table-2: Jaffna District TB Data 2005 - 2012

Year	Pulmonary Tuberculosis		EPTB	Total
	Positive	Negative		
2005	171	83	107	361
2006	102	103	75	280
2007	133	271	77	481
2008	120	195	65	380
2009	97	178	73	348
2010	118	201	101	420
2011	115	134	105	354
2012	121	80	118	319
Total	977	1245	721	2943

The war has an impact on TB. The impact of war shall be categorized into Direct Impact and Indirect Impact. Following are some of the factors that can be considered as Direct and Indirect factors.

1. Direct Impact
   - Overcrowding, poor ventilation – due to forced displacement
   - Stress and Psychosocial problem – alcoholism
   - Scarring lung – post war Pneumanoultramicroscopicsilicovolcanoconiosis
   - Defaulters
2. Indirect Impact
   - Lack of health facilities Hospital/Chest ward or infrastructure – Chest hospital in high security zone since 1990
   - Poverty and malnutrition
   - Improper settlement of Force Displaced People(FDP)

Following activities have been planned to control TB in this region.

- Establishing Regional culture laboratory
- Constructing chest wards or re-opening chest hospital (K.K.S.)
- Microfinance development for families- with TB
- Operational Research (Study on the dietary habits of Tuberculosis patients treated at Chest Clinic, Jaffna)
- Management late on TB introduction
- Recombinant BCG vaccination

Discussion

An estimated "one third" TB cases remain "unreported". Such cases are of particular concern, because they perpetuate the continued disease transmission in the community.

At the same time, "addressing social determinants of health" in one of the challenging components in TB control. Health systems that are involved in TB control must therefore be strengthened urgently. The physical, social and financial barriers that prevent affected persons from accessing the needed care and service must overcome.

In this context, it is important to recognize that improvement in the overall social and economic development of a country will contribute importantly in its long-term, sustained success in TB "elimination" or "eradication". Indeed, a comprehensive and holistic package of interventions for TB control must involve "multisectoral" and "multidisciplinary" efforts.

Practical approach to lung health (PAL) is useful in the management of TB patients as the patients are managed through a "Syndromic approach" that educates them appropriately.

Achievements can be successfully maintained in the long term through national health systems based on the Primary Health Care (PHC) approach. Tuberculosis is a disease of poverty, having strong social and economic determinants. However, tuberculosis is essentially a disease of poverty, and unless we research the poorest of the poor, and focus on prevention and education, we cannot hope to eliminate the disease. The hurdles faced by national TB programmes in eliminating TB are often social and economic factors as much as health factors: poverty, stigma, polluted and crowded living and working environments, displacement, poor nutrition, as well as difficulty in accessing quality diagnosis and treatment. There are also logistical and technical issues-there is an urgent need for better ataries and greater availability of improved diagnostics.

A comprehensive and holistic package of interventions for TB control must involve "multisectoral" and "multidisciplinary" efforts. The basic issue involving the following areas must tackled first for TB control.

- Universal case detection of all forms of TB
- Introduction of new and more effective laboratory
- Increasing access to quality DOTS service
- Effective infection control, both in and outside institutions
- Availability of quality TB drugs those are affordable to individuals, families, community and the government
- Drugs those are accessible to all patients who need them. In particular, the rational use of anti-TB drugs must be promoted

Agnihotra Homa and Climate Change

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Introduction

Climate change has become recognized as the foremost environmental problem of the twenty-first century. Not only will climate change potentially affect the multibillion dollar energy strategies of countries worldwide, but it also could seriously affect many species, including our own. There are different causes for climate change. They can be classified under two great topics. They are natural and human causes.

The natural causes that make climate change are numerous. The following natural causes are found to be the most influencing ones.

The earth's climate is influenced and changed through natural causes such as

- volcanic eruptions
- Ocean current
- The earth's orbital changes
- Solar variations

It is very astonishing to see that the man made causes for climate change exceeds the ones that are caused naturally.

The earth's climate is influenced and changed through Human causes such as

- **Man-made greenhouse gases:**
  It has been demonstrated beyond reasonable doubt that the climate is changing due to man-made greenhouse gases. We are already committed to future substantial change over the next 30 years and change is likely to accelerate over the rest of the 21st century.
- **Environmental pollution:**
  Environmental pollution is the contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected".

- **The Atmospheric Carbon Dioxide Concentration**
  The most recent assessment report from the Intergovernmental Panel on Climate Change (IPCC) says the atmospheric carbon dioxide concentration in the pre-industrial era was 280 ppm. Right now the level has risen to 375 ppm, a 30% increase. It is predicted that the level will be 450 ppm in 2050 resulting in 1.8-3ºC increase in temperature eventually. Therefore, global warming will produce a sharp upswing followed by a deep plunge into a glacial period several thousands years from now. A myriad of potential impacts such as increased cyclone intensity; melting of polar iceberg and glaciers; increased salinity and changes in oceanic currents sea level rise and inundation of low lying cities like Venice, Cairo, New Orleans, Lagos, Amsterdam, etc.; coral bleaching and mortality of coral

reef; colonization of invasive species and species migration; changes in ecosystem; mass extinction; ozone layer depletion; water shortage; and spreading of diseases -- is predicted.

The most recent assessment report from the Intergovernmental Panel on Climate Change (IPCC) says that the earth's average temperature has risen by 0.74 degrees in the period from 1906 to 2005, and that the average temperature will continue to rise.

At present the concentration of CO2 in the atmosphere is about 385 ppm (parts per million).

Before industrialization it was about 280 ppm. Analyses of air contained in ice from the Antarctic ice cap show that there is far more CO2 in the air today than at any time in the last650,000years. According to the UK Government the main contributors of manmade causes of climate change in the UK are:

- 4% of carbon emissions come from industrial processes
- 7% come from agriculture – for example methane emissions from livestock and manure, and nitrous oxide emissions from chemical fertilizers 21% carbon emissions from transport 65% come from the use of fuel to generate energy (excluding transport) About 40% of carbon emissions in the UK are the result of decisions taken directly by individuals. The biggest sources of emissions for most people are likely to be: energy use in the home (the main use is heating)
- driving a car
- air travel

Agriculture:

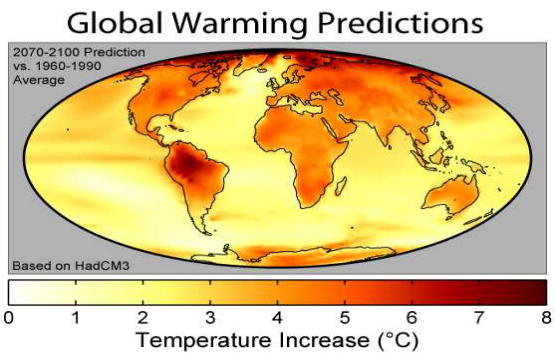
According to the Intergovernmental Panel on Climate Change, the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture. Agriculture has been shown to produce significant effects on climate change, primarily through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide**.** Another contributing cause of climate change is when agriculture alters the Earth's land cover, which can change its ability to absorb or reflect heat and light. Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide.

Deforestation:

It is important, first to understand what a precious resource rainforests play in our world. They form part of a delicate ecosystem that has taken millions of years to evolve. Rainforests every year help to absorb almost 20% of man made CO2 emissions therefore deforestation can be classed as a major contributor to the causes of climate change. Cutting down rainforests faster than they can be replaced has a devastating effect on the carbon emission cycle producing an extra 17% of greenhouse gases. Remember trees absorb CO2. More deforestation means more CO2 build up in the atmosphere. Deforestation by means of cutting down and burning these tropical rainforests usually pave the way for agriculture and industry which often produce even more CO2.

Warming of the Earth:

"There is strong evidence that the warming of the Earth over the last half-century has been caused largely by human activity, such as the burning of fossil fuels and changes in land use including agriculture and deforestation.



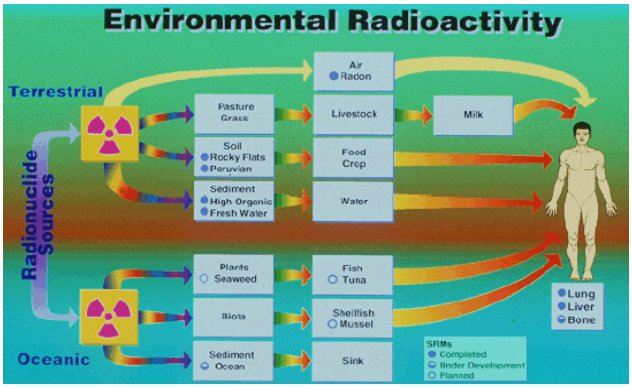
Global Warming may also affect wildlife and species that cannot survive in warmer environments may become extinct. Finally, human health is also at stake, as global Climate Change may result in the spreading of certain diseases such as malaria, the

flooding of major cities, a greater risk of heat stroke for individuals, and poor air quality. Antarctic penguins on ice floes suffer and fight for existence. Global warming has threatened the survival of the polar animals.

The biological components of our environment have evolved in harmony with the physical and climatic surroundings. The presence, characteristics, structure and behavior of both individual organisms and co-assemblages, or communities, of organisms are largely determined by climate. The ability of natural communities to adapt to changing climate and nature of community change is of utmost importance to the survival of man.

Energy challenges

It is indisputable that human combustion of fossil fuels for energy is causing global climate change that threatens the very survival of our civilization. It is equally indisputable that our civilization is dependent upon cheap, reliable, and widely distributed energy for both mobile and stationary utilization. The obvious conclusion would be to decrease our reliance upon fossil fuels, and to seek energy from alternate sources. But neither solution is as simple, or effective, as it appears.



What's wrong With the Planet?

Nature, which is considered Divine, is preserved and protected not really for any religious or fanatic reasons but for the very survival of the mankind. On the contrary modern science and technology aims at exploiting Nature for all our requirements both basic as well as so called comforts. It is these comforts that are causing enormous discontent to the man and damage to the Nature.

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The tip of the Antarctic ice sheet is melting faster than before, the snow on the Kilimanjaro mountain is beginning to melt, and sandstorms are more violent than the past… The planet upon which we depend on our survival is currently suffering the problems of global warming.

A New System is needed

A new system is needed that fosters sustainable, low carbon and resource productive innovation - short, medium and long-term. Designers, innovators, investors, entrepreneurs, consumers and governments all have a role to play in the change that is needed. Modern science takes care of improving the quality of soil and water but not the atmosphere. Ancient science of Agnihotra Homa reveals that more than 75 per cent nutrition to the plants comes from the atmosphere. If the atmosphere is made more nutritious and fragrant by Homa, a type of protective coating comes on the plants and therefore pests and diseases do not thrive. Respiration process hastens and the toxic effect of choking and death due to atmospheric toxins is reduced.

Agnihotra Homa and Climate Change

Agnihotra is the ancient Yagna or homa originated in India. Agnihotra is a healing fire from the ancient science of Ayurveda. It is a process of purifying the atmosphere through a specially prepared fire performed at sunrise and sunset daily.

Agnihotra pyramid

For the procedure of the healing Agnihotra fire, a **copper pyramid** of prescribed form is used. Copper and gold are the only metals that have healing properties, according to knowledge of all ancient traditions. According to the science of Homa therapy, there is only a minimal difference between the healing properties of gold and copper when they are in the pyramid-shaped form in which the Agnihotra fire is performed. The pyramid form and the copper act as a generator of negative ions when the necessary components are burned; these ions have a harmonizing effect on the environment and a positive effect on the well-being of people.

The fire is prepared in a small copper pyramid of specific size and shape. Brown rice, dried cow dung (manure) and ghee (clarified unsalted butter) are the substances burned. Exactly at sunrise or sunset the mantras are spoken and a small amount of rice and ghee is given to the fire.

Through burning organic substances in a pyramid-formed copper vessel, valuable purifying and harmonizing energies arise. These are directed into the atmosphere and are also contained in the remaining ash. This highly energized ash is very successfully employed as organic fertilizer in farming at Homa-Hof Heiligenberg

Shri Gajanan Maharaj of Shivapuri, Akkalkot Solapur

Although the practice of 'Agnihotra fire' was known in India since ancient times, it was Shri Gajanan Maharaj of Shivapuri, Akkalkot in Solapur district of Maharashtra who rejuvenated the practice of daily performance of Agnihotra in 1944 and opened the flood gates to all, irrespective of caste, creed, religion, sex of the performer. He directed his disciple Shri Vasant Paranjape to spread Agnihotra message in the world who visited more than 180 countries to spread the message and knowledge of Agnihotra. Shri Paranjape said "if you test 'Agnihotra fire' with an oscilloscope, you will notice a special sound coming from the fire. It is the sound that heals although there are other things also. Fire produces sound but it also reacts to sound. The act of chanting mantra creates a resonance effect which invigorates the cells of plants, leading to better reproductive cycles.

Now practiced in 75 countries

It is now practiced in 75 countries and the leader among them is South American Republic of Peru. Four Agricultural universities in India, namely Tamil Nadu Agricultural University, Coimbatore, CSA Himachal Pradesh Agricultural University, Palampur and University of Agricultural Sciences, Dharwad in Karnataka have started experiments on HOF since the past 5-6years.

At sunrise, the many fires, electricities, ethers and more subtle energies emanating from the sun extend all the way to the earth and produce a flooding effect at those coordinates where the sun is said to rise. This flood of life-sustaining energies (prana) enlivens and purifies everything in its path, destroying what is impure in its wake - it causes all life to rejoice. At sunrise it can be heard as music. The morning Agnihotra mantra is the essence of that music. Tremendous amounts of energy are gathered around the Agnihotra copper pyramid just at Agnihotra time. A magnetic-type field is created, which neutralizes negative energies and reinforces positive energies.

Agnihotra

A few years back a devastating accident took place at Bhopal which is known as

Bhopal Gas Tragedy. The tragic incident occurred on the night of December 3, 1984 when the poisonous MIC gas leaked from Union Carbide factory at BhopalThousands of people died in that tragedy. In a radius of 3km from the point leakage nobody had survived except a few. Surprisingly, scientists started investigating this issue and revealed a shocking truth. They come to know that all the survivors and their families were regularly performing agnihotra homa in their house. This makes us realize the greatness of agnihotra. Hundreds of people died and thousands were hospitalized but there were two families – those of Shri Sohan Lal S Khushwaha and Shri M.L. Rathore, living about one mile away from the plant who came out unscathed. These families were regularly performing agnihotra (havan). In these families nobody died, nobody was even hospitalized despite being present in the area worst affected by the leakage of the toxic gas. This observation implies that agnihotra is a proven antidote to pollution. (English Daily-"The Hindu' of 4-5-85; news item under the heading 'Vedic Way to Beat Pollution') Union Carbide Factory in West Weginia in US came to know this and they donated lakhs of dollars to do research for this "Homa effect" in West Werginia University

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of dollars to do reserch for this "Homa effect" in West Werginia University

When the Chernobyl nuclear accident happened in 1986, I had a farm near Graz in Austria. The Austrian Government immediately issued that every farmer had to bring in milk and fodder for testing for radioactivity. When I did this, the inspectors were shocked, because they found only normal radioactivity levels in our milk and fodder samples while all the farmers in the surrounding area had high doses in their samples. The inspectors said it was not possible to have normal radioactivity after Chernobyl and is there anything special that I do on my farm?

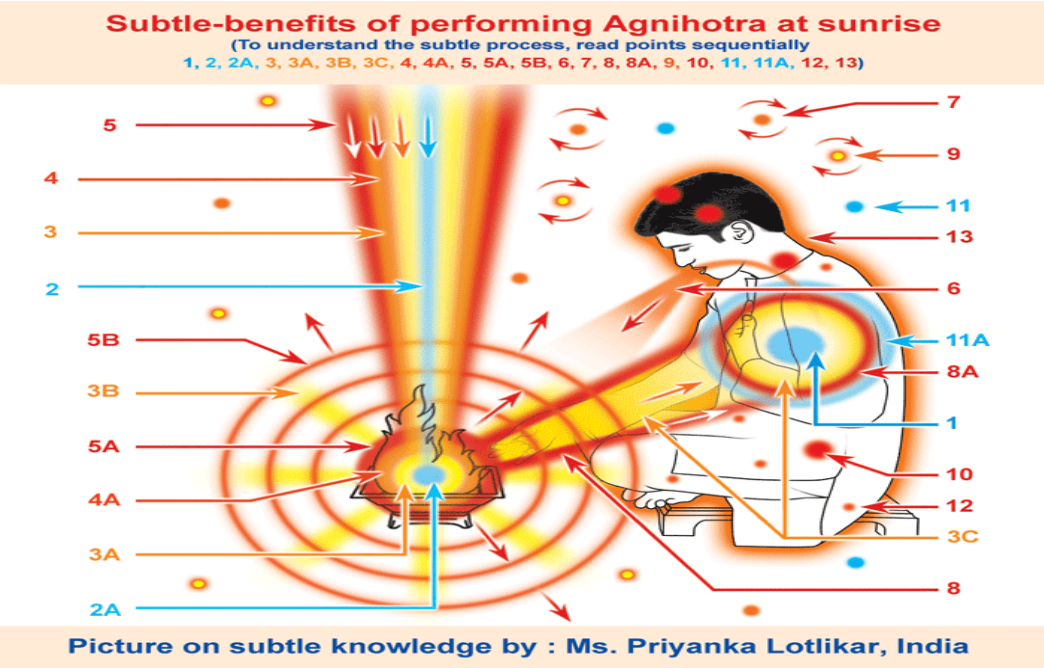
I told them that my farm was using ancient Ayurveda technology to grow food which is now presented as HOMA Organic Farming Technology

Some 20 years ago, the most serious accident in nuclear history changed the lives of many. Massive amounts of radioactive materials were released into the environment resulting in a radioactive cloud that spread over much of Europe.

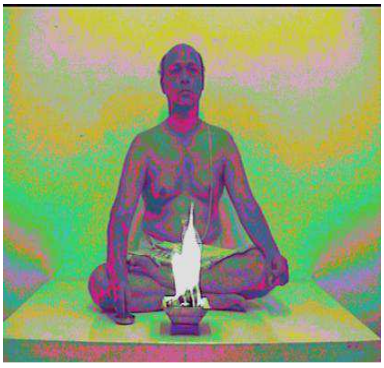
The greatest contamination occurred around the reactor in areas that are now part of Belarus, Russia, and Ukraine. On April 26, 1986, the operating crew planned to test whether the Reactor No. 4 turbines could produce enough energy to keep the coolant pumps running until the emergency diesel generator was activated in case of an external power loss. During the test, power surged unexpectedly, causing an explosion and driving temperatures in the reactor to more than 2,000 degrees Celsius—melting the fuel rods, igniting the reactor's graphite covering, and releasing a cloud of radiation into the atmosphere.

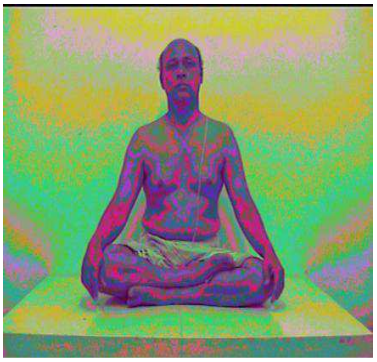
Agnihotra Purifies the Atmosphere of Pollutants and Neutralizes Harmful Radiation.

A magnetic-type field is created which neutralizes negative energies and reinforces positive energies. Therefore, a positive pattern is created by one who does Agnihotra merely by his/her performance. Agnihotra purifies the atmosphere of pollutants and neutralizes harmful radiation. The resultant atmosphere gives nourishment to plant life.



This research study analyses the changes and effects of Agnihotra, an ancient Indian fire ceremony, which is used to purify areas and improve people's health. The Agnihotra ceremonies were conducted for a month by Agnihotra Academy from Shivapuri Akkalkot India, during August 2003. PIP Energy Field Imaging was used to record the effects and determine any changes with before, during and after readings of the Agnihotra practice. This research was prepared by Ms D Takawale of CBS and edited by Prof J Rogerson, under the overall guidance of Dr.Thornton WJA Streeter,D.Sc. Founder, Energy Centre at The World Peace Centre MIT College, Pune India.





Investigation of Agnihotra on the 'Performer'

PIP Imaging indicates healthier areas with a mixture of lighter, brighter, balanced and more harmonious patterns, symmetry and colour, both on and surrounding the subject's body. Diseased and stressed areas are shown in „focal points. of distorted, darker and congested pools of blocked energy, which leak and disperse into the surrounding energy field. When interpreting PIP Images focus on the darker focal points and low colours, usually found in pit of lungs, throat and lower abdomen. The thicker congested dark red bands relate to blockages in the physical energy flow, while thinner symmetrical red lines relate to a more balanced flow of the meridians.

In the first scan above „Before Agnihotra., the performer of the ceremony has a relatively dark body and surrounding energy field reading, compared to those in therefore indicates the most „low energy., shown as darker congested colours in focal points and thick bands, mainly in the throat, lung and abdominal areas. also indicates the lowest energy absorption and transference rate, which is the body.s ability to draw in higher, brighter colours and frequencies and its efficiency to ground the lower, darker ones.

In During Agnihotra,. notice how the congested pools and bands seen in , increase in brightness, vibrancy and improved transference rates. The energy blocks dissipate during the ceremony. shows the most significant increase of both body and surrounding energy fields, and the highest rates of energy absorption and transference. Notice the grounding and dispersing of the darker congested focal points of low energy and the increased size and vibrancy of the energy field. After Agnihotra, shows slightly less vibrancy and rate of transference compared to and higher rates compared to PIP indicates that the Agnihotra performer's body following the ceremony increases in vibrancy, absorption and transference rates, which correspond to an improvement in his feeling and well-being.

Conclusion

- Agnihotra is an ancient science given in Sanskrit language at the time of creation. Sanskrit was never anyone's mother tongue; it is a language of

vibration. We can make changes in the atmosphere with Sanskrit mantras and fire prepared with specific organic substances, timed to the sunrise/sunset biorhythm. Protection against Radiation

- According to Soviet scientists.
- Agnihotra ash is the only absolutely pure substance which can work directly against radioactivity on humans, plants and animals.
- The elements of Agnihotra ash do not become radioactive.
- Agnihotra and Agnihotra ash have the potential to be the solution for radioactivity.
- The newly absorbed non-radioactive elements will by and by replace the radioactive substances which we had absorbed in earlier time and which our body had stored

Impact of Climate Change and Salinization on Vector Mosquitoes – An Overview with Special Reference to the Jaffna Peninsula

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Introduction

Mosquito vectors transmit important human parasitic and arboviral diseases such as malaria, filariasis and dengue. Approximately 5% of mosquito species are adapted to undergo preimaginal development in brackish and saline waters (water with <0.5 ppt or parts per thousand, 0.5–30 and >30 ppt salt are termed fresh, brackish, and saline respectively). Minimizing human-mosquito contact and reducing vector populations by the application of insecticides and through eliminating preimaginal development sites are the major components of mosquito-borne disease control programs. On-going global changes attributable to various human activities, e.g. changes in climate, healthcare, land use, pollution, population movements, and urbanization, can significantly alter the rates of transmission of mosquito-borne diseases in most parts of the world (Sutherst, 2004). Climate change parameters most often considered for their impact on mosquitoes are temperature, rainfall, and humidity, but others such as atmospheric particle pollution and wind can also have an impact. We recently proposed that a rise in sea levels can increase the prevalence of many vector-borne diseases in coastal zones (Ramasamy and Surendran, 2011).

We hypothesize that mosquito-borne disease transmission in coastal areas are not only influenced by global climate change causing alterations in temperature, rainfall, and humidity, but also rising sea levels (Ramasamy and Surendran, 2011). The Intergovernmental Panel for Climate Change has predicted that global warming will raise sea levels by 18–59 cm by the end of the twenty-first century through the melting of glaciers and polar ice as well as the thermal expansion of seawater (Nicholls et al., 2007; United Nations Intergovernmental Panel on Climate Change, 2007). Rising sea levels will affect the extent of saline or brackish coastal water bodies including estuaries, lagoons, marshes, and mangroves that provide preimaginal development sites for salinity-tolerant mosquito species in coastal areas. Models suggest that the salinity of estuarine systems will rise and their boundaries move further inland with more pronounced tidal water flows into rivers (Nicholls et al., 2007). A proportion of coastal wetlands such as salt marshes and mangroves will become inundated by the sea but this will be compensated for by additional saline wetlands being formed further inland (Nicholls et al., 2007). Rising sea levels, and higher water withdrawal rates from freshwater aquifers near the coast by expanding populations will increase saltwater intrusion in the aquifers (Food and Agricultural Organisation, 2007).

Because of the slow rate of rise in sea levels due to global warming, and confounding factors such as improvements in disease prevention and treatment, it has not yet been possible to observe an impact of rising sea levels on mosquito vectors and their transmitted diseases. However the December 2004 Asian tsunami provided relevant examples that suggest that such effects can indeed occur. The density of *An. sundaicus* s.l., a widespread malaria vector along Asian coasts (Surendran et al., 2010; Sinka et al., 2011), increased in the Andaman and Nicobar islands following the intrusion of sea water inland, and this was accompanied by a rise in the incidence of falciparum malaria in the islands (Krishnamoorthy et al., 2005). New brackish water habitats that were

created by the tsunami led to freshwater breeding mosquitoes adapting to undergo preimaginal development in them, e.g., larvae of typical freshwater mosquitoes *An. stephensi* and *An. culicifacies*, were found in newly formed brackish water bodies immediately after the 2004 tsunami in India (Gunasekaran et al., 2005). *An. culicifacies* larvae were also observed for the first time in brackish water bodies near the coast in eastern Sri Lanka, 5 years after the tsunami although a relationship to the inundation caused by the tsunami could not be established (Jude et al., 2010). Mosquitoes are highly adaptable as shown by their ability to exploit a variety of ecological niches and rapidly develop insecticide resistance. It is therefore likely that, given adequate selective pressure most, if not all, fresh water mosquito vector species can adapt to oviposit and undergo preimaginal development in brackish water.

Brackish water breeding adaptations of *Aedes aegypti* and *Aedes albopictus*

We recently showed however that *Ae. aegypti* and *Ae. albopictus* are able to oviposit and undergo preimaginal development in collections of brackish water in unused wells, abandoned boats, disposable plastic, and glass food and beverage containers in coastal Sri Lanka and Brunei Darussalam (Ramasamy et al., 2011). We hypothesized that brackish water development may be an adaptive response to the almost exclusive application of *Aedes* larvae control measures (with insecticides such as temephos and *Bacillus thuringiensis* toxin) to freshwater habitats and the elimination of such habitats in the urban and peri-urban environment (Ramasamy et al., 2011). Furthermore, the brackish water *Ae. Aegypti* larval sites were found close to areas of high dengue incidence in the city of Jaffna in the Jaffna peninsula of northern Sri Lanka suggesting that they may play a role in the transmission of dengue in coastal zones (Ramasamy et al., 2011). In a limited survey of domestic brackish water wells in a coastal division of Jaffna city, ~25% of brackish water wells (n = 110) were found to have *Ae. aegypti* larvae (Surendran et al., 2012). Household wells are usually exempt from dengue control measures because they are not considered to be significant preimaginal development sites. Our findings are the first to show that brackish water domestic wells are a habitat for the development of mosquito vectors of dengue. We therefore hypothesize that the *Aedes* mosquitoes emerging from such hitherto unrecognized habitats, that are not targeted by larval source reduction programs, may at least be partly responsible for the failure to eliminate dengue in Sri Lanka.

Jaffna Peninsula – A model to investigate the impact of salinization on mosquitoes

There is evidence to suggest that the larvae of *Ae. aegypti* and *Ae. albopictus* in the Jaffna peninsula, where there is greater salinization of ground water compared to Batticaloa in mainland east Sri Lanka, are more tolerant of salinity than in Batticaloa (Ramasamy et al., 2011). These conclusions were drawn from examining the tolerance of first and third instar larvae, derived from eggs in freshwater ovitraps, to different salinities, with emergence of adults as the end point (Ramasamy et al., 2011). The greater salinization of ground water in Jaffna peninsula is the result of a combination of factors – its predominant limestone geology (Rajasooriyar et al., 2002), a high and increasing population density, and growing use of water from inland limestone aquifers for agriculture and domestic consumption. Rising sea levels are expected to further exacerbate ground water salinization in the relatively flat peninsula.

The Jaffna peninsula is located at the apex of northern Sri Lanka. Jaffna is traditionally an agricultural area with an extensive coastline. It is largely composed of sedimentary limestone of the Miocene period (Rajasooriyar et al., 2002), has a maximum altitude of 10.4 m and contains many lagoons and other sea water inlets. Almost all locations in the peninsula are <10 km from the sea, lagoon, or other sea water inlets. Therefore the entire peninsula may be considered to be a coastal zone. Open wells sunk in the limestone aquifers in Jaffna are

normally recharged during the North-East monsoon rains in the months from October to December. Water from wells is used for drinking and domestic, agricultural, and industrial purposes at an increasing rate. Many areas in Jaffna city have piped fresh water derived from deep artesian wells from Thirunelvely in the center of the peninsula. However brackish water from wells in the coastal areas of the city is used for watering gardens and washing. Jaffna has a high and increasing population density estimated presently to be 700 persons per km^2 in a total peninsular area of 1130 km^2. Increasing salinization and nitrate pollution of ground water in the peninsula, and salinization in the outlying populated islands, is a serious problem in the Jaffna district (Nagarajah et al., 1988).

The Jaffna district has traditionally been an endemic area for malaria. There was a high incidence of malaria in the 1990s with an estimated peak of ~10,000 cases per 100,000 persons per year in 1998. Population estimates for this period were not accurate due to large-scale displacement and migration caused by civil war. There was a sharp decline in malaria cases after 2002 and no local transmission has been reported since 2007. A study of land use patterns, socio-economic status, and vector breeding identified certain coastal areas to have a high risk of malaria in the peninsula (Kannathasan et al., 2009). The anopheline mosquito species distribution in cattle-baited collections in the district in 2005–2006 was *An. culicifacies* 0.5%, *An. subpictus* 46%, *An. varuna* 4%, *An. nigerrimus* 44%, and *An. pallidus* 5.5% (Kannathasan et al., 2008). Of the three *An. subpictus* sibling species, B, C, and D, collected in the peninsula at the time, the more salinity-tolerant species B was predominant accounting for ≥65% of the *An. subpictus* collection (Kannathasan et al., 2008).

A similar study carried out to assess public perception toward malaria, targeting 157 households living in high risk and low risk areas, showed that knowledge of the involvement of mosquito in malaria was high among all populations (Kannathasan et al., 2008). Knowledge of preimaginal mosquito development habitats was greater in high risk (90%) than low risk (70%) malarial areas. It may be surmised that disease burden and the public awareness programs have significantly influenced public perceptions on the mode of transmission of chikungunya and malaria. The impacts of the present dengue control measures and public education programs on in Jaffna have not yet been similarly evaluated. Furthermore, the recent findings that malaria and dengue vectors are able to tolerate salinity variations and undergo preimaginal development in brackish waters (Jude et al., 2010; Surendran et al., 2010, 2011; Ramasamy et al., 2011) have yet to lead to the development of appropriate new vector control strategies by health authorities. Specific issues regarding insecticidal control may arise in the context of its application to brackish water larval habitats. Larvicides successfully used in fresh water habitats may not always have the same efficacy in brackish water. For example, *Bacillus thuringiensis* a soil dwelling bacterium commonly used in the dengue vector control program in Jaffna, is less effective at salinities in the range of 8–14 ppt against *Ae. aegypti* larvae (Jude et al., 2012). This is relevant because *Ae. aegypti* and *Ae. albopictus* larvae were detected in brackish water of up to 15 ppt salinity in coastal zones of Sri Lanka (Ramasamy et al., 2011).

The limited data available in Sri Lanka suggest that the temperature in the country has increased by 0.14°C per decade in the period 1930–2000. Rainfall has shown a decreasing trend, with 2% decrease in Jaffna in this period (Premalal, 2010). Decreasing rainfall is expected to increase the ground water salinization by reducing the rate of recharge with fresh water. The Jaffna peninsula is composed of four administrative divisions (Figure 6) with Valikamam being the most populous. A relief map of Valikamam showing the elevation above mean sea level is presented in Figure 7. This suggests that the predicted 18–59 cm (~0.5–2 feet) rise in sea levels by the end of this century (Nicholls et al., 2007; United Nations Intergovernmental Panel on Climate Change, 2007), may markedly increase

salinization of inland freshwater aquifers and wells in the peninsula (Food and Agricultural Organisation, 2007). Domestic wells and ponds near the coast will become more brackish. These developments can influence mosquito vector prevalence, distribution and ecology, and promote further adaptation of fresh water vectors to undergo preimaginal development in brackish waters. Such changes will need to be monitored closely by health authorities.

Conclusion

There is an important need to raise awareness among the health authorities and other relevant government sectors on the health risks associated with mosquito vectors developing in brackish water, particularly in the context of rising sea levels and stalinization due to global warming. The development of appropriate preventive and mitigating measures will be necessary in local, national, and global levels. More research into salinity-tolerant mosquito vectors, particularly with regard to their changing bionomics is needed to develop better control measures. We propose that the Jaffna peninsula constitutes a useful case study for the impact of global climate change and rising sea levels on mosquito vector populations and disease transmission in tropical coastal zones.

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Environmental Impacts of Climate Change: Key Issues & Mitigating Efforts

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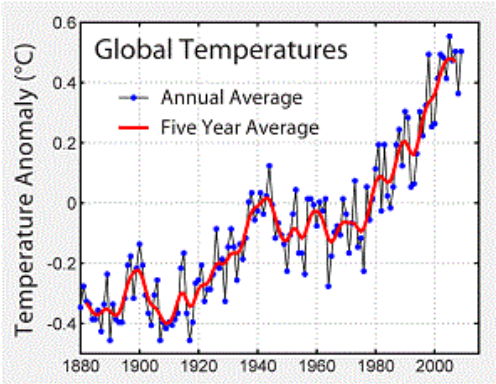
Introduction

The process by which the Earth regulates its own temperature is known as the ***natural greenhouse effect***. The planet's surface absorbs light energy from the sun and then re-radiates it out as heat energy, which is trapped by greenhouse gases such as CO_2 and CH_4 in the atmosphere. If there was no greenhouse effect at all, the planet's temperature would have been similar to that of the moon, which has no atmosphere. Equally, raising the concentrations of greenhouse gases in the atmosphere starts the planet on the road to overheating.

Global Temperature Rise

In February 2007, the Intergovernmental Panel on Climate Change (IPCC) confirmed that Earth's rising temperature and associated climatic anomalies are the result of human activities that have been discharging gases into the atmosphere since the industrial revolution.



Global Temperature Anomaly, IPCC

Even if we had stopped releasing greenhouse gases into the air after 2000, a temperature rise of 0.1 °C/year would still have been unavoidable because of the length of time they remain in the atmosphere. CO_2 can linger for a hundred years. Hence, even if we manage to keep CO_2 levels not more than 550 ppm, we could still experience a global temperature rise of 2-4 °C by the end of the century.

Scientists believe that, as Earth warms as a result of human-induced climate change, a ***runaway greenhouse effect*** could be triggered and the world's temperature spiral would be moved upwards. If a planet absorbs more energy from the sun than it radiates back into space, it experiences a runaway greenhouse effect. It works as follows: As sea surface temperatures rise above 27 °C, evaporation releases a critical amount of water vapour, one of the most efficient greenhouse gases, into the atmosphere. This absorbs infrared radiation from the sun, through the greenhouse effect, and warms the planet further. As the process repeats itself, the planet gets hotter and hotter.

Environmental Impacts

The Earth's ecosystems sustain human societies by providing water, food and other resources. Climate change is already tinkering with many of these natural systems; the extent to which this will continue or accelerate in the coming years depends on our efforts to reduce levels of greenhouse gases.

Without rapid and extensive mitigating action, scientists anticipate continued changes in sea level, water resources, productivity and structure of natural ecosystems, productivity of land used for agriculture, weather patterns and human health.

1. Glacial retreat

As a result of the perpetually chilly conditions, glaciers dominate the geography of the poles. There are two

types of glacier: ice sheets, which flow out in all directions from a central point, and valley glaciers, which flow downhill from an upland source. A significant proportion of the world's freshwater is locked up in these glaciers.

A study conducted by the University of Texas, USA, in 2006 found the Greenland ice sheet was melting three times faster than it had been five years before. Scientists have predicted that if the temperature rises by 3 ºC, a slow thaw will set in the Greenland ice sheet, releasing water into the North Atlantic and summer sea ice could completely disappear from the Arctic.

In addition to the polar ice, there are glaciers that form under cold conditions at altitude. The IPCC has defined mountain glaciers as one of the best natural indicators of global warming. The Mount Kilimanjaro in Tanzania has lost 80% of its ice since 1912; in the Himalayas, which have the largest concentration of glaciers outside the polar ice caps, 67% are in rapid retreat.

Retreating Gangotri Glacier, Himalayas

2. Sea-level rise

Thirteen of the 15 largest cities in the world are located in coastal areas. Sea-level rise and an increase in the intensity of cyclones could displace tens of millions of people in low-lying coastal areas.

Several small island nations, including the Maldives in the Indian Ocean and the Marshall islands and Tuvalu in the Pacific, could face extinction within this century if rates of sea-level rise accelerate. The first inhabited island to fall foul of the encroaching ocean was Lohachara, situated at the mouth of the Ganges. It disappeared from satellite images in late 2006. Its inhabitants fled to Sagar, a neighbouring island, which has already lost 3,035 hectares to the rising waters.

Lohachara (before disappearance)

Vietnam's Mekong river delta, which plays an important role in the Vietnamese economy, has been severely affected during this century by unusually large floods. Further sea-level rise is likely to increase the risk of flooding and extend the area affected by saltwater intrusion. Bangladesh and Singapore are also highly vulnerable to sea-level rise.

3. Water stress and water scarcity

Humans are able to exploit only 0.08% of the entire world's water. 70% of this water is used in agriculture, and much of it is wasted through inefficient irrigation schemes. Our dietary tastes also make us wasteful of water.

With rising global population, an increase in the number of countries suffering from either water stress (less than 1,700 m^3 of water/person/year) or water scarcity (less than 1,000 m^3 of water/person/year) has been observed. Around one-third of the world's population presently live in

countries that are water stressed. The UN anticipates around 34 countries will slip from water stress to scarcity by 2025. Of these countries, just over two-thirds are located in the Middle East.

As climate change and rising populations conspire to increase the pressure on water supplies in the coming years, water wars are likely to affect not only Middle Eastern countries, but also Africa, India, China and Bangladesh. Further, some of the least equipped countries will be forced to deal with flooding, water shortages and agricultural land turning to desert.

4. Impacts on wildlife

The wildlife from the poles to the tropics is being affected by climate change. Species migrations, extinctions and changes in populations, range, seasonal and reproductive behaviour are among a plethora of responses that have been recorded.

Although the amount of sea ice has changed little across the whole of Antarctica since the late 1970s, the winter ice off the Antarctic peninsula has declined. This has triggered different species of penguin to shift south to find new breeding grounds.

The world's 19 populations of polar bears are spread across the Arctic and depend on sea ice to live, hunt and breed.

Polar bear, Endangered species

With the Arctic warming at more than twice the rate of the rest of the world, Arctic sea ice is expected to disappear completely in summer before the end of the century. As a result, the polar bears, the world's largest bears, are now seriously threatened with extinction.

5. Impacts on agriculture

A warming world has the potential to both increase and decrease crop yields. A few degrees of warming will probably boost yields at temperate latitudes, but heat greater than this will generally cut yields.

It has been predicted that moderate climate change in the early decades of the century will increase yields of rain-fed agriculture in parts of North America by between 5 and 20%. Actions such as altering sowing times and choosing those cultivars that thrive in the heat could help to avoid dwindling harvests.

In the tropics, where dry land agriculture predominates, yields are likely to decrease with even a minimal warming, and increasingly sparse rainfall will have an even more adverse effect. Changes to management methods will probably make little difference at low latitudes. Most studies suggest that a mean annual temperature increase of 2.5 ºC or greater will push food prices up globally due to decline in agriculture.

6. Extreme weather events

An increasing number of extreme weather events such as floods, droughts, storms, heat waves and hurricanes, which most scientists agree are consistent with climate change, are taking their toll on communities around the world. Frequency and intensity of these events will escalate with further rise in temperature.

The death toll resulting from the extreme drought and heat wave that hit Europe in the summer of 2003 reached 35,000, affecting mostly elderly people.

In 2005, hurricane Katrina struck Louisiana and Mississippi causing one of

the most destructive disasters in US history.

Hurricane Katrina in 2005

Hurricane Wilma devastated Yucatan, Mexico, before striking Florida.

In 2006, Australia's worst drought in a century wiped out 35% of its annual income from grain.

Rising temperatures, together with more frequent floods, affect farmers' ability to produce crops in Sri Lanka; in coastal areas, salination due to seawater intrusion forced some families to abandon fields for the first time in centuries.

Field abandoned due to salination

7. Impacts on health

Changes to weather patterns may prompt a number of adverse impacts on health. Changes in the frequency of intense hot spells and cold snaps, regular extreme events such as floods and droughts, and fluctuations in air pollution will influence directly while changes to ecosystems altering the distribution of infectious diseases, levels of malnutrition and local food production will affect indirectly.

The increased frequency and intensity of extreme events such as heat waves, storms, floods, droughts and cyclones may result in loss of life, serious illness and injury. Changes in food supply resulting from climate change are likely to affect the nutrition and health of poorer sections of society.

Further, higher temperatures and changes to rainfall will alter the distribution of infectious diseases spread by blood-feeding insects such as ticks and mosquitoes. These include malaria, dengue fever, leishmaniasis, various types of mosquito- and tick-borne encephalitis. Presently, 40% of the world population lives in malarial locations. The models suggest that the climate change scenarios over the coming century will increase the number of people living in transmission areas for malaria and dengue fever, and may boost the incidence of various water- and food-borne infectious diseases.

Mitigating Efforts

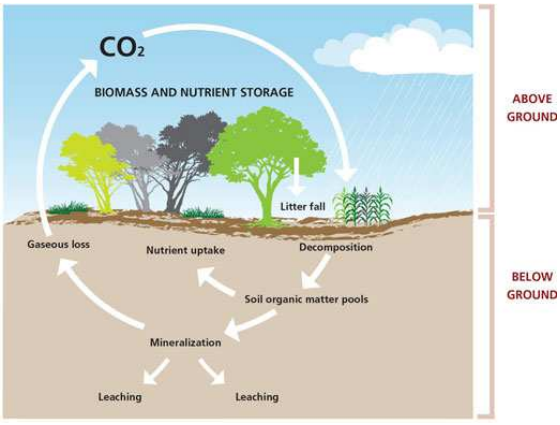
The ***UN Framework Convention on Climate Change (UNFCCC)*** came into force in 1994 with the aim of achieving stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system. Further, it intended that such a level should be achieved with time to allow ecosystems to adapt naturally to climate change, ensure food production is not threatened, and enable economic development to advance in a sustainable manner. Even though the framework did not set mandatory limits on greenhouse gas emissions for individual nations and was legally non-binding, it included provisions for updates.

The main update is the ***Kyoto Protocol***, which came into effect in February 2005 and set targets for emissions of six greenhouse gases: CO_2, CH_4, N_2O, SF_6,

HFCs and PFCs. The targets range from -8 to +10% of the country's individual 1990 emissions levels with a view of reducing their overall emissions of such gases by at least 5% below existing 1990 levels during the commitment period 2008-2012.

Under the Kyoto Protocol, three flexibility mechanisms, namely Joint Implementation, Clean Development Mechanism and Emissions Trading, were proposed to help countries to reach their emissions targets. The ***Joint Implementation*** enables developed nations to invest in emissions reducing activities in other industrialized countries. This is beneficial if action taken on their home turf would be more costly. The ***Clean Development Mechanism*** allows industrialized nations to invest in emissions slashing schemes in developing countries in order to help boost developing countries' sustainable development. The ***Emissions Trading*** allows nations whose carbon emissions are below their Kyoto target to sell carbon credits to countries whose emissions exceed their targets.

However, the Kyoto Protocol failed to deliver substantial cuts in greenhouse gas emissions. Hence, many people believed the global system for switching to a low-carbon economy needs to be rethought. A better method, which has gained wide support, is to cut emissions of CO_2 by spreading the load across a portfolio of technologies as follows:



Carbon sequestration

- Eliminating deforestation and doubling the rate of new forest planting
- Increasing wind electricity capacity by 50%
- Capturing and storing carbon from coal plants
- Producing current coal-based electricity at twice the efficiency
- Increasing hydrogen fuel production from fossil sources by a factor of 10
- Using best efficiency practices in all residential and commercial buildings
- Doubling fuel economy on the world's cars
- Increasing ethanol production by 50%
- Installing 700 times the current capacity of solar power
- Tripling the world's nuclear capacity

Renewable energy sources

Most scientists are under no illusions that meeting the challenge posed by climate change will be easy. Keeping further global warming below the danger threshold requires an initial flattening out and then decreasing CO_2 emissions and an absolute decrease in non-CO_2 greenhouse emissions, particularly CH_4, CO and black carbon aerosols. The belief still exists that the human race is up to the greatest challenge it has ever faced, but time is fast slipping away.

காலநிலை மாற்றமும், சமூக - பொருளாதார துறைகளில் அதன் தாக்கமும்

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காலநிலை மாற்றம் பிரதானமாக மனிதனால் தூண்டப்பட்ட, உலகளாவியரீதியில் பாரதூரமான சூழல் பிரச்சினையாகும். காலநிலை மாற்றத்தின் முக்கிய அங்கமான பூகோள வெப்பமடைதலினால், வெப்பநிலை அதிகரிப்பு, அதிகரித்த வரட்சி, அளவுக்கதிகமான மழைவீழ்ச்சி மற்றும் கடல்மட்டம் உயர்தல் போன்ற இயற்கை அனர்த்தங்கள் ஏற்படுகின்றன. அண்மைக்காலத்தில், இயற்கை அனர்த்தங்கள் உலகளாவியரீதியிலும், இலங்கையிலும் பாரிய சமூக-பொருளாதார பாதிப்புக்களை ஏற்படுத்திவருகின்றன. அவற்றில் முக்கியமானவையாக தொழில் இழப்பு, வேலைவாய்ப்பின்மை அதிகரிப்பு, வருமான இழப்பு மற்றும் அரசியல் அமைதியின்மை என்பன முக்கியமானவை.

காலநிலையும், காலநிலை மாற்றமும்

யாதேனும் ஓரிடத்தில், அல்லது பிரதேசத்தின் வெப்பநிலை, மழைவீழ்ச்சி, வளிமண்டல அமுக்கம், காற்று ஆகிய வானிலைக்கூறுகளின் நீண்டகால (30 வருடகால) சராசரிப்பெறுமானமே, அவ்விடத்தின் அல்லது பிரதேசத்தின் காலநிலை எனப்படும். வாநிலைக்கூறுகளை பகுத்தாராய்கையில் குறைந்தபட்சம் ஒரு தசாப்தகாலத்துள் அல்லது ஒரு வருடத்துள் மேற்பட்ட காலத்துள் தரவுகளில் தெள்ளத்தெளிவான அதிகரிப்போ அல்லது குறைவோ காணப்படுமாயின் அது காலநிலை மாற்றம் எனப்படும்.

காலநிலைமாற்றத்தால் பாதிக்கப்படும் துறைகள்

காலநிலைமாற்றத்தால் விவசாயம், கால் நடைவளர்ப்பு, வனத்துறை, மீன்பிடித்துறை, சுகாதாரம், கரையோரச்சூழல், உயிர்ப் பல்வகைமை மற்றும் மனித வாழிடங்கள் போன்றன கடுமையான பாதிப்புக்கு உள்ளாகின்றன. இவற்றிற்கு மேலதிகமாக சக்தி, கட்டுமானத்துறை, காப்புறுதி, சுற்றுலாத்துறை, பொழுதுபோக்குத்துறை என்பனவும் காலநிலை மாற்றத்துக்கு உணர்திறனுடையவையாகக் காணப்படுகின்றன. காலநிலைமாற்றத்தால் இத்துறைகளைச்சார்ந்த மக்களின் சமூக-பொருளாதாரமும் பாதிப்புக்குள்ளாகின்றது.

விவசாயத்துறையில் காலநிலை மாற்றத்தின் தாக்கம்

வெப்பநிலை அதிகரிப்பினால், தேயிலை, கரும்பு, சோளம், நெல், கௌபி, பாசிப்பயறு, உருளைக்கிழங்கு போன்ற பயிர்களின் விளைச்சல் குறைகின்றது. கடும் வரட்சியானது பயிர்ச்செய்கை நிலங்களை விவசாயத்திற்கு பொருத்த மற்றதாக மாற்றுகின்றது. அத்துடன் பயிர்களின் பரம்பலும் பாதிக்கப்படுகின்றது. நீர்வளங்களின் பற்றாக்குறையானது, விவசாயிகளை பயிர்நிலங்களை கைவிட நிர்ப்பந்திக்கின்றது. பாலைவனமாதல் ஊக்குவிக்கப்படுகின்றது.
மிகக்குறைந்தளவிலான காநிலைமாற்றம்கூட உணவு அறுவடையில் பெரும் தாக்கத்தை ஏற்படுத்தும்.

2080 ஆம் ஆண்டளவில் 80 மில்லியன் மக்கள், குறிப்பாக ஆபிரிக்ககண்ட நாடுகளில் வாழும் மக்கள் பசியால் வாடுவரென விஞ்ஞானிகள் எதிர்வு கூறுகின்றனர். காலநிலைமாற்ற பாதிப்புக்களான வரட்சி, வெள்ளப்பெருக்கு, மற்றும் பெருமளவில் பரவும் பயிர் நோய்களினால் ஆபிரிக்க விவசாயிகள் பாதிக்கப்படுகின்றனர். யேர்மனியில் 1990 – 2006 காலப்பகுதியில் கடுமையான காலநிலையால் 8 பில்லியன் யூரோ வரையிலான அறுவடை இழப்பு ஏற்பட்டது. அதேபோன்று பிரான்சில் காலநிலை மாற்றத்தால் பாதிக்கப்பட்ட திராட்சைப் பழங்களில் இருந்து பெறப்பட்ட வைனின் தரம் குறைவாகக்காணப்பட்டது.

ஊலகளாவிய மீன்பிடிப்பொருளாதாரத்தில் காலநிலைமாற்றத்தின் செல்வாக்கு

அளவுக்கதிகமான மீன்பிடி, நீர்நிலைகள் மாசடைதல் மற்றும் கடல்வாழ் உயிரினங்களின் வாழிடங்கள் அழிவடை தல் காரணமாக உலகளாவிய சமுத்திர மீன்பிடியானது பாதிக்கப்பட்டுவருகின்றது. இதற்கு மேலதிகமாக காலநிலை மாற்றத்தாலும் பாதிக்கப்படுகின்றது.

சுகாதாரத்துறையில் ஏற்படும் பாதிப்புக்கள்

காலநிலை மாற்றத்தினால் காற்றின்தரம் பாதிக்கப்படுகின்றது. இதனால் சுவாச நோய்கள் ஏற்படுகின்றன. காலநிலையுடன் தொடர்பான இறப்புக்கள் அதிகரிக்கின்றன.

தோற்றுநோய்கள் பரவும்வீதம் அதிகரிக் கின்றது.

நீர் தேங்குதல் மற்றும் நீரின் கலங்கல்தன்மை காரணமாக பூச்சிகள், பீடைகள் பெருகுவதன்காரணமாக சுகாதாரப்பிரச்சினைகள் ஏற்படும். மனிதவாழ்க்கைக்கு சுவாத்தியமான பிரதேசங்களில் அதிகரித்த ஈரப்பதன் மற்றும் வெப்பநிலை குறைதல் காரணமாக மனித உற்பத்தித்திறன் குறைவடைகின்றது.

அதிகரித்த காற்று காரணமாக மணல் சூறாவளி ஏற்பட்டு, கரையோர கட்டுமாணங்கள் ஆபத்தை எதிர்நோக்கு கின்றன. அதிகரித்த காற்று காரணமாகவும், காற்றின் வேகம் காரணமாகவும் சகாராப் பாலைவன தூசுக்களால் ஐரோப்பிய நாடுகள் சுகாதார மற்றும் பொருளாதாரப் பிரச்சினைகளை எதிர்நோக்குகின்றன.

காடுகளும் காலநிலைமாற்றமும்

காலநிலை மாற்றம் காரணமாக காடுகளின் உள்ளடக்கம், புவியியல் பரம்பல், காடுகளின் சுகாதாரம் மற்றும் உற்பத்தின் திறன் என்பன பாதிப்புக்குள்ளாகின்றன.

துருவப்பகுதிகளில் ஏற்படும் பாதிப்புக்கள்

காலநிலை மாற்றத்தினால் துருவப்பகுதியல் வாழும் மக்களின் உட்கட்டுமானங்கள் பாதிக்கப்படுகின்றன. ஆட்டிக்சமுத்திரத் திலுள்ள பனிக்கட்டிகள் உருகுவதனால் புதிய கப்பல் பாதைகள் திறக்கப்படுவது காலநிலை மாற்றத்தினால் ஏற்படும் நன்மையாகும்.

காலநிலை மாற்றத்தால் ஏற்படும் சமூக-பொருளாதார பாதிப்புக்கள்

- வெள்ளப்பெருக்கு, உவர்நீர் உட்புகுதல் காரணமாக கரையோர வலயத்தில் வாழும் மக்கள் தமது காணிகளையும், வீடுகளையும் கை விட்டு வெளியேறவேண்டி ஏற்படு கின்றது.
- ஏரிகளின் சூழல்தொகுதிகள் மாற்றமடைவதனால் மீன்பிடி குறை வடைகின்றது. இதனால் அதிகள விலான மீனவர்களும் அவர்களில் தங்கி வாழ்பவர்களும் அங்கிருந்து வெளியேறவேண்டி ஏற்படுகின்றது.
- சுற்றுலாக்கடற்கரைகள் இழக்கப்படு கின்றன. இதனால் சுற்றுலாப்பயணி களின் எண்ணிக்கை குறைவு ஏற்படுகின்றது. சுற்றுலாத்துறையில் தங்கிவாழும் தனியாட்களும், சமூகங்களும் தமது வாழ்விடங் களை கைவிட்டு வேறு இடங் களுக்கு தொழில்தேடிச்செல்ல வேண்டி ஏற்படுகின்றது.
- அதிகரித்த உவர்நீர் உட்புகுதலின் காரணமாக தொல்பொருளியல் இடங்கள் பாதிப்புக்குள்ளாகின்றன. இதனால் சுற்றுலாத்துறை பாதிக்கப்படுகின்றது. இதன்காரண மாக இவ்விடங்களில் வாழ்பவர்கள் சமூக-பொருளாதாரரீதியில் பாதிக்கப் படுகின்றார்கள். ஊலகளாவிய ரீதியில் முக்கியத்துவம்வாய்ந்த தொல்பொருட்களான எகிப்திய பிரமிட்டுக்கள், அதிகரித்த வெப்ப நிலை மற்றும் ஈரலிப்பு அதிகரிப்பு காரணமாக பாதிப்புக்குள்ளாகின்றன.
- அதிகரித்த வேலையின்மையானது அரசியல் மற்றும் மக்கள் அமைதி யின்மையை ஏற்படுத்துகின்றது.
- காலநிலை மாற்றத்தால் பல்வேறு தொழில்துறையில் இருப்பவர்களும் தொழில்களை இழப்பதனால் ஐரோப்பிய நாடுகளுக்கு குடிபெயர் கின்றனர். இதனால் அந்நாடுகள் பல்வேறு பிரச்சனைகளை எதிர் நோக்குகின்றன.
- நாடுகளுக்கு பொதுவான நீர் வளங்கள் குறைவடைவதனால், நாடுகளிடையில் நீர்வளங்களை பங்கிடுவதில் பிரச்சினை ஏற்பட்டு, அரசியல் அமைதியின்மை ஏற்படு கின்றது.
- நாடுகளுக்கிடையிலும், நாட்டி னுள்ளும் வருமானத்தில் சமனில் லாத்தன்மை ஏற்படுகின்றது.
- அதிகரித்த வெப்பநிலை வேறுபாடு மற்றும் சீரற்ற வானிலை காரண மாக வீதிகள், புகையிரதப்பாதை கள், நீர்க்குழாய்கள் போன்றன பாதிப்புக்குள்ளாவதால், அவற்றின் பராமரிப்புச்செலவு அதிகரிக்கின்றது.

தற்கால உலக சவால்களில் மிக முக்கியமானதாக காலநிலை மாற்றமும் அதனால் ஏற்படும் பாதிப்புக்களும் விளங்குகின்றன. அவற்றிலிருந்து பாது காத்துக்கொள்வதற்கான முன்னேற்பாடு களை மேற்கொள்ளவேண்டியது நம் அனைவரதும் பொறுப்பாகும்.

Responsible Aquaculture to Avoid Future Environmental Hazards and Disasters

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Aquaculture Development & Techniques

For over 3,000 years, fish have been farmed in China, a country that continues to dominate the industry by producing 83% of the world's aquaculture output. Other key producers include India (6%), Philippines (4%), Indonesia (3%), Republic of Korea (2%), and Bangladesh (1%), a list overwhelmingly concentrated in the developing world. Everything from sea cucumbers to sea horses is farmed, but the vast majority of production is carp, accounting for approximately 50% of aquaculture production measured as weight or value. The fin fish farming production over the globe from selected countries are as follows in terms of tones per year; India-490,000, Indonesia–139,840, Phillippines–124,000, Taiwan–80,000, Bangaladesh – 76,485, Nigeria-75,000, Vietnam-30,000, Medagaskar-17,392, Israel-12,169, Bazil-12,000, Sri Lanka – 7,659, Egypt-7,000, Mexico-7,000, Malaysia-6,559, Zaire-5,000, Cuba-4,500, Hong Kong- 4,019. The top cultured species include kelp, oysters, shrimp and salmon. Salmon mariculture is often carried out in temperate countries in floating cages, but the fish farming industry is concentrated inland in tropical countries, with over 15 million tonnes of fish produced in freshwater systems compared to 9.7 million tonnes produced at sea. The remaining 1.6 million tonnes is produced in brackish water ponds mainly shrimps. Seaweed farming accounts for another 7.7 million tonnes.

There is an increase in the global population it demands heavy on animal protein such as fish(cheaper). In Sri Lanka it remain the same the demand for fish and fishery products increasing, if the demand is not met with commercial catch we will go for import and alternatively we would like to try for aquaculture option too (Table1).

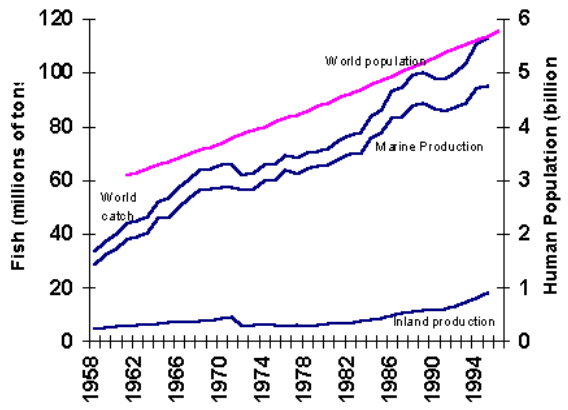


Fig.1: The graph shows the human population and total fish production world wide

Farming unlike hunting based on two important factors,

a) control of fish growth using water control methods, fertilization, climate protection and

b) the prospect of artificial reproduction of fish.

Variety	Quantity (M ton)	Value in Laks
Sardines	12.75	10,8182
Tuna	37,214	93,10,358
Mackerel	146,986,344	238,722,872
Small varieties	176,64	62,283
Preserved for long term use	18611,36	48,27,408
Fish Chunks	36	46,527
Others	16	11,027

Table-1: The fish products import to Sri Lanka in 2010 (Sri Lanka customs)

It is often believed that it calls for no more attention than stocking fish in the pond and

attain the harvest after some period. It, however, is not so and demand attention at every stage of growth. It is now well established that if a fish farmer pays as much as attention to his pond as agriculturist does to his/her land, it can be much more paying. Selection of suitable pond for different fish size, stocking appropriate combination of fish in optimum numbers, checking their well-being and growth at intervals, eliminating their enemies and ensuring adequate food in ponds are important steps to ensure satisfactory harvest of fish.

The fish farming in tropical countries can be utilized with advantage to develop the industry, which employs a wide variety of water bodies and can be made to provide bumper yield of healthy and good food fish through application of suitable developmental and management techniques. Among the various fishery management measures, fish farming in impounded waters is relatively easy means of stepping up cheap animal protein food in a limited period of time with very little capital out lay and equipment . Extensive fish culture will help to a very large extent in bringing out regional self sufficiency in fish supplies on the inland areas where means of transport of perishable products like fish have not yet been developed to the desired extent. It is hoped that the information now available to the fish farmers will enable them to bring about considerable improvement in fish culture practices and to obtain higher yields of fish from their ponds.

It has been said,

"Give a man a fish, and he will have food for a day. Teach him to raise fish, and he will have food for the rest of his life".

There are a variety of production systems around the world, including ponds, tanks, raceways, and cages or "netpens". There are variations in technique, but there are only two significant differences: a) water processing and b) feeding regime. By economic necessity, most inland facilities use a flow-through system where water is diverted from surface water (lakes, rivers) or from natural underground reservoirs (aquifers) this is where problems are faced. In many parts of the United States, aquaculture has been legally classified as a beneficial, nonconsumptive use of water, but in some states, the trout industry's raceways require huge quantities of freshwater which combine with drought to result in reduction levels of the aquifer. Recirculating systems only require periodic additions to top-up the water level, but the accompanying cost of filtration or aeration to maintain water quality restricts implementation. For cultured species held in natural water bodies, restrictions generally reflect site selection because water quality is heavily dependent on natural currents in and around the farm.

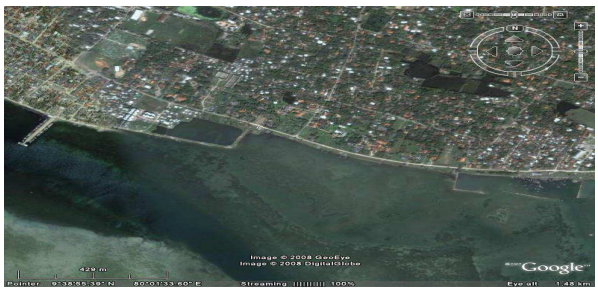


Fig.-2: Aerial view from Goggle earth Northern area Kurunagar an abandoned shrimp famr closer to housing scheme and to the fish landing centre.

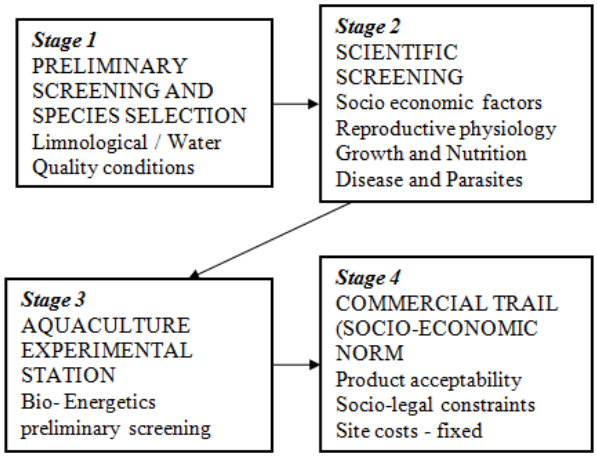


Fig.-2: Factors for success of fish culture enterprise

Although water resource issues are significant, there is a great deal of environmental concern focused on feeding techniques. The source of food for all aquaculture species can be divided into: 1) the use of artificial feed (aquafeed) in finfish and some shellfish operations, 2) provision of natural food (e.g. phytoplankton) in shellfish

operations(shrimp and muscles), and 3) a combination of natural and artificial feed. Whether inland or coastal, any operation that relies on artificial feed to grow fish faces the quandary of increasing production at the expense of increasing pollution from farm effluent. By way of increasing nutrients to the wild water and results in increase in nitrates and phosphates lead to blooming at last.

Aquaculture Effluent: Pollution of Inland & Coastal Waters

In 1989, a sudden and catastrophic collapse of wild sea trout populations in areas close to salmon rearing cages in Ireland gave aquaculture critics and focus for protest. Similarly the crash in shrimp farming industry after ten years from the first established shrimp farm in 1980 Thailand experienced. In the context of Sri Lanka first shrimp farm established in Kokkadicholai in 1970s by converting productive paddy land to shrimp farm and we had a good lesson from it now the same area is abandoned and salt deposits can be seen to the top where we could not able to grow paddy in the salinated soils, even the biotechnology could not come with the solution of salt resistance paddy variety Although a link between fish farming and the decline of natural stocks cannot always be established, some environmental effects are clear. Unlike mollusc farming, many species of fin fish depend on a diet of artificial feed in pellet form. This feed is broadcast onto the surface of the water, and is consumed by the fish as it settles through the water column. Because not all the feed is eaten, a great deal of feed can reach the bottom where it is eaten by the benthos or decomposed by microorganisms. This alteration of the natural food web structure can significantly impact the local environment.

Many studies have implicated overfeeding in fish farms as the cause of changes in benthic community structure because a high food supply may favourable to some organisms over others. Moreover, sedentary animals may die in water depleted of oxygen resulting from microbial decomposition, while the mobile population may migrate to other areas. Antibiotics and other therapeutic chemicals added to feed (e.g. Ivermectin, Terramycin and Romet-30) can affect organisms for which they were not intended when the drugs are released and the uneaten pellets decompose. Nonetheless, many drugs used in fish farms have been found to have minimal deleterious effects on the aquatic environment. Feed additives, however, are not the only source of potentially toxic compounds in culture operations. A variety of chemicals are used to inhibit the growth of organisms which foul netting and other structures, reducing water flow through the cages.

Eutrophication

An increasingly significant effect of intensive fish culture is eutrophication of the water surrounding rearing pens or the rivers/lagoons receiving aquaculture effluent. Fish excretion and fecal wastes combine with nutrients released from the breakdown of excess feed to raise nutrient levels well above normal, creating an ideal environment for algal blooms to form. To compound the problem, most feed is formulated to contain more nutrients than necessary for most applications. In Scotland, an estimated 50,000 tonnes of untreated and contaminated waste generated from salmon farming goes directly into the sea, equivalent to the sewage waste of a population of up to three quarters of Scotland's population. Once the resulting algal blooms die, they settle to the bottom where their decomposition depletes the oxygen further. Before they die, there is a possibility that algal toxins produced can be produced.

Although many species of phytoplankton can benefit from an increased nutrient supply, certain species are noxious or even toxic to other marine organisms and to humans. The spines of some diatoms (e.g. *Chaetoceros* sp) can irritate the gills of fish, causing decreased production or even death. More importantly, blooms ("red tides") of certain species such as *Chattonella* sp often produce biological toxins that can kill other organisms Neurotoxins produced by several algal species can be concentrated in filter-feeding bivalves such as mussels and oysters, and further accumulated inside the cephalothorax of

shrimps creating a serious health risk to people consuming contaminated shellfish (e.g. paralytic shellfish poisoning).

Fish is low in fat and considered a healthy alternative to other meats, but consumers cannot ignore the potential health risks of cultured/wild caught species, just as they must not ignore the risks associated with terrestrial agriculture (intensified use of (biocides) - pesticides, weedicides). In addition to shellfish contaminated with toxic algae, cultured seafood also pose additional concerns such as disease transmission. Most fish pathogens are not hazardous to humans, but some fish pathogens such as *Streptococcus* bacteria can infect humans. But there are incidences where no harm happened to take place in human perhaps from the fish virus or fish fungus in the case of Epizootic Ulcerated Fish (EUS). High levels of antibiotics and genetically-engineered components in fish feed (e.g. soya additives) can also pose risks.

Pollution Control

Although aquaculture development has often occurred outside a regulatory framework in the past, government oversight in both the seafood quality control level, and addressing the basic problem of pollution generated by culture operations in the so called developing countries. The impact of coastal aquaculture depends on a number of physical, chemical and biological factors, most notably the local hydrodynamics. In areas of high currents, waste accumulation is minimized by hydrodynamics. Excess nutrients aren't eliminated, but the lower level of waste is more easily assimilated into the local food web. Water movement also helps to replenish anoxic water with oxygen-rich water from surrounding areas. Accordingly, site selection is a primary factor in the mitigation of coastal pollution. There are numerous studies taken place and have developed mathematical models to predict the hydrodynamics around culture operations to optimize selection. Despite potential net entanglements with marine mammals and conflict with traditional trawling grounds, these operations can take advantage of waste dilution from offshore currents and deeper water.

Aquaculture effluent from inland operations can be treated much more effectively than coastal operations because the outflow can be controlled, and therefore treated, in much the same way as municipal sewage treatment. In addition, an aquaculture company in Japan has developed an odourless, environment friendly organic fish waste treatment system which uses a colony of micro-organisms active at high temperature to process up to 5 tonnes of fish waste daily. Coastal operations can also take advantage of innovative techniques to reduce pollution. In China, polyculture of scallops, sea cucumbers and kelp reduces eutrophication and the use of toxic antifouling compounds. Nutrients from scallop excreta are used by kelp, which used to require the addition of tonnes of fertilizers. Antifouling compounds and herbicides can be reduced because sea cucumbers feed on organisms which foul nets and other structures. For shrimp and catfish culture, deeper ponds can be constructed to reduce weed growth to further limit herbicide use and permit the grass carp and common carp to be cultured as polyculture than monoculture.

Culturing finfish with mussels, oysters and other filter feeders can minimize feed accumulation, as can the reformulation of feed and design of new feed delivery systems. Pellets are no longer packed with more nutrition than the target fish can possibly use, and feed pellets are designed to stay longer in the water column, rather than rapidly sink to the bottom where they become unavailable to the target species. Drugs added to feeds to combat diseases can be reduced by enclosing fish in what are essentially bags, rather than nets, and by vaccinating individual fish. Many techniques are being developed to minimize environmental impact but the most basic and cost-effective pollution control is implementation of an efficient aquaculture management system. Unfortunately, many operations continue to have a lack of trained manpower, resulting in waste and misapplication of chemicals.

Using Natural Fish Stocks to Feed Aquaculture Systems

Ironically, fish culture is dependent on a diet of wild fish because fish meal and fish oils

from natural stocks are the primary components of artificial compounded feed (aquafeed). It can be argued, therefore, that aquaculture cannot provide an alternative to fishing unless only herbivorous fish and shellfish are farmed. However, the source of the fish meal is pelagic fish such as tuna and mackerel, species normally consumed by humans. Additional fish meal comes from by catch which would otherwise be discarded as waste. Nonetheless, it is not clear that the conversion of "trash fish" into human food via aquaculture is preferential over using fish meal in piggery and poultry.

As farms intensify, there is a growing trend toward the increased use of aquafeed. Almost 31,000,000 megatonnes (MT) of the world's total wild fisheries production is used for animal feed each year, 15% of which is used in fish feed. Feed is specially formulated to ensure high conversion efficiencies, (amount of feed needed to produced one pound of animal), and in general, aquatic animals are far more efficient at feed conversion than terrestrial animals. Given these facts, the strategy of feeding fish to fish seems logical, however it should be noted that only a few percent of feed for piggery and poultry is composed of fish meal, compared with 70% for finfish and shellfish, and inefficient practices can lead to a great deal of waste. Growing a pound of salmon may require 3-5 pounds of wild fish, and between 1985 and 1995 the world's shrimp farmers used 36 million tons of wild fish to produced just 7.2 million tons of shrimp. In general, the quantity of input of natural fish stocks exceeds outputs in terms of farmed fishery products.

A potential solution would be to shift culture operations of herbivorous species such as tilapia, catfish, carp, oysters and clams which rely little on artificial feeding. Unfortunately, the vast majority of world aquaculture production is already concentrated on these species, and it is much more lucrative to grow salmon, eel and shrimp that rely heavily on fish meal or fresh fish feed. There have been gains made in substituting terrestrial animal byproduct meals, plant oilseed and grain legume meals, and cereal byproduct meals for fish meal but dependence on natural fish stocks for aquaculture feed will be slow to disappear.

Impacts on Natural Stocks

Clearly, feeding fish to fish leads to a net loss of protein in a protein deficient world and impacts directly on natural stocks of endemic stocks/species, but aquaculture may also have an indirect effect on the natural environment. Almost all marine or brackish water culture is dependent upon natural fisheries for some aspect of operations. Although more and more hatcheries are being constructed to provide seed specially the post larvae of 25 days old in case of shrimp farming (shellfish) and finfish culture, most hatchery operators or farmers still capture wild animals for broodstock or for a source of larvae. In some cases, collection of wild-caught shrimp larvae to stock ponds has destroyed thousands of other larval species. The large-scale problems caused by global warming and the El Nino phenomenon. The El Nino of 1997-1998 is considered to be the second strongest "warm event" in the tropical and subtropical Pacific this century. The shift in water temperature caused a severe decline in biomass and total production of small pelagic fish leading to altered food webs and a shortage of fish meal and fish oil.

Introduction of Alien Species

Release of tilapia in Sri Lanka in 1953 for to reduce malnutrition has lead to the loss of food, native habitat, and spawning areas for native/endemic species. This culminates in the loss of endemic species especially fresh water fish initially and now the same tilapia reached coastal marine fringes from fresh water via brackish water. *Tilapia* sp is assumed to be an aquatic chicken cautious approach in needed in approaching this kind of problem.

Although ship ballast water is often the cause of introduced species, the importing of non-indigenous animals for culture can also introduce diseases and non-target organisms. The Japanese oyster drill and a predatory flatworm were introduced to North America with the Pacific oyster (*Crassostrea gigas*), thereby contributing to the decline of west

coast native oyster stocks. French shellfish farmers have been warned not to import the American oyster (*Crassostrea virginica*) or the Pacific oyster from Canada because of possible parasitic disease transmission from *Haplosporidium nelsoni*, *Haplosporidium costale*, *Mikocytos mackini* and *Perkinsus marinus*. Similarly the myxosporean parasite introduced into USA from the Japanese eel.

Whether the cultured species is native or not, culture operations do introduce a high concentration of potential prey which may significantly alter the local ecology. Birds, seals, crabs, and starfish can significantly predate farmed species. Recent popularization of bream farming may not be advisable as long as the cages are secured to not to release any of the holding species into wild, if is reached wild the voracious carnivorous nature lead to the decline of endemic herbivores. Covering fish pens with nets is extremely expensive and is effective only for avian predators. Inland and coastal operators often resort to killing predators such as fish and crabs the farmers use tea seed cake which is not environmentally friendly.

Habitat Destruction: Mangrove Forests

Nowhere are the negative impacts on the natural environment more apparent than with shrimp farming and the associated destruction of mangrove forests. In Asia, over 400,000 hectares of mangroves have been converted into brackish water aquaculture for the rearing of shrimp. Farmed shrimp boost a developing country's foreign exchange earnings, but the loss of sensitive habitat is difficult to reconcile.

Tropical mangroves, a habitat critical to erosion prevention, fish feeding, breeding and nursing area, maintain coastal water quality. Mangrove forests have also provided a sustainable and renewable resource of firewood, timber, pulp, and charcoal for local communities. To construct dyked ponds for shrimp farming, these habitats are razed and restoration is extremely difficult.

Unfortunately, shrimp ponds are often profitable only temporarily as they are subject to disease and to downward shifts in the shrimp market. Growing political pressure in western countries may restrict the shrimp market in response to consumers' avoidance of environmentally-unfriendly products. More significantly, Japan's economy is experiencing difficulty at present, and Japan is the world's largest market for shrimp; when the market falls, ponds are abandoned as what faced in Thailand, Vietnam etc. A return to traditional fishing is not always possible because the lost mangroves no longer serve as nursery areas which are critical for the recruitment of many wild fish stocks. Unemployment prospects cannot always balanced for short-term gains. It is clear that socio-economic effects are as important as pollution and ecological damage when evaluating the sustainability of aquaculture.

The Future of Aquaculture

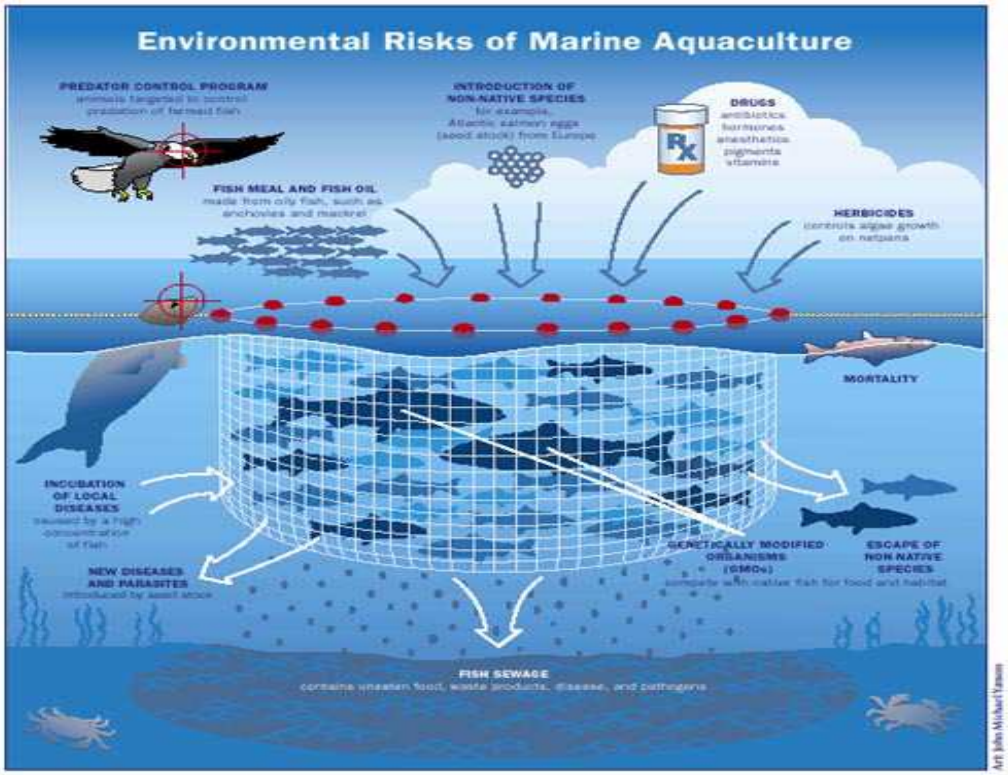
Aquaculture will continue to be one of the most viable methods to supply growing world population needs, but the challenge to maintain profitability and environmental compatibility is daunting task. Growth of aquaculture was fueled initially by governments for foreign economic earnings , but many governments have started to implement strict regulatory guidelines addressing environmental and social issues to ensure sustainability.

Sri Lanka made progress in the establishment of legal and regulatory frameworks which are starting to have a positive effect on aquaculture development similar to Canada, Australia, Brazil and other countries.

Despite such progress, there are still major aquaculture producing countries that do not have appropriate legal frameworks and policies for aquaculture. Often, governments fail to provide the needed economic, legal, and social support to ensure economic and environmental sustainability. Where governments were initially integral to development, contraction of government involvement is now prevalent, resulting in increased privatization and corresponding social conflicts. While social issues are notoriously intractable, water quality problems are not. New technologies such as recirculating and offshore systems hold promise for lessening the impact of aquaculture on the surrounding environment,

but many countries cannot take advantage of these expensive innovations. Technology alone cannot determine the approach for sustainability; aquaculture development must adapt to the needs and capacities of developing countries. Politically, food production will remain an overriding priority, and aquaculture will continue to grow. Models must be developed to clearly predict whether the socio-economic benefits of aquaculture are worth the environmental cost.

- Aquaculture development is intrinsically dependant on water quality and quantity;
- A balance needs to be found between the continuation of existing farm activities and the conservation of existing natural resources;
- There is great concern about water and land (often coastal) availability, in terms of competing water/land uses;
- Aquaculture involves production from (usually) publicly regulated resources *i.e.* that the public most often holds or manages directly or indirectly (water, coastal land, foreshore, wetland, *etc*.);
- Concerns about the necessity of producing a commodity ready for consumption in the domestic or foreign market.



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Problem Based Learning

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Dear Chairperson, Guests, Colleagues and Students,

I want to share my experience about an interesting method of learning i.e. Problem based Learning.

First, I will share my difficulties as a medical student; then explain the basis of problem based learning and its benefits; then given an example to prove that this method is useful in learning subjects other than medicine and finally confirm that I myself successfully practice this method to teach medical students.

Dear friends,

As a medical student, I found it extremely difficult to learn the subject in the medical curriculum because; the method of learning was very boring.

Most of the time we were given lectures which gave too much information within a very short period. I could not understand why we had to learn all that information and therefore, could not concentrate on the subjects. This resulted in poor memory and poor performance in the examinations. This also made me feel guilty of not doing well in examinations and I was depressed and bored until we were given opportunity to see patients with problems.

This had changed the whole picture. Learning based on clinical problems became very interesting and I started to enjoy my student period.

Dear friends, I am sure that you all would have had similar experience while learning in schools and Universities. The knowledge gained by the traditional learning methods such as lectures would have been forgotten soon after the examinations over. However, if you have learnt something while trying to solve any problem in your life you will never forget what you have learnt.

This is the basis of problem based learning.

Rather than giving theoretical knowledge on a subject, the learner is given a problem and requested to understand and try to solve it. During the process of understanding that problem many questions such as why, how, when etc. need to be answered by learning the relevant subjects.

This is usually done in small groups. The members of the group brainstorm to formulate questions which are necessary to understand and solve the problem. Then they find the answers to those experienced people, searching via the Internet etc. Learning based on this method is obviously very interesting and the learner could enjoy this type of learning better than attending a lecture or a tutorial class.

Dear friends,

You may think that this type of learning – based on problems suitable for medical subjects and not suitable for other subjects. It is not so. Any subject could be learnt better based on this method.

To explain this, I will give you an example from a different field which could be used as problem, based which on learning is possible.

Problem:

"*A girl of 16 years was found to be pregnant when she was taken to the hospital with a complaint of vomiting. She was shocked to hear the news! The mother of this girl was a 35 years old widow and was working as a manual labourer. She had three more children younger than the pregnant girl*"

While trying to understand the above problem many questions which are not related to medicine need to be answered!

E.g.

- What you be the reaction of the mother?
- How will the younger children react?
- How will the relatives and neighbours treat this family?
- How are the possible solutions to this problem?
- What is the law about a girl of 16 years getting pregnant?
- Is there any risk of either the girl or her mother committing suicide?
- What are the social factors responsible for her pregnancy?
- How will the economic status of the family affect this problem?
- Was it possible to prevent this problem?

This above are only a few examples of the possible questions that need to be answered to understand the above problem. Many more questions will arise during the process of solving it.

The search for answers to these questions will result in learning the relevant subjects. The knowledge obtained by this method of learning is meaningful and will last in the memory for a long period!

Dear friends, I can compare this type of problem based learning to the growth of a tree from a seed.

The problem is a seed; the questions generated while trying to understand the problem can be compared to the roots of the tree. The knowledge obtained by searching for the answers to these questions can be compared to the braches, leaves flowers and fruits of the tree. The brain of the learner can be compared to the soil in which the tree of the knowledge grows. Without strong roots a tree cannot survive long. Similarly the tree of knowledge cannot last long without strong roots of questions.

Dear friends, in conclusions I have started the lecture by telling my own experience as a student and the difficulties I faced with the traditional learning methods. Then, I explained the basis of basis of better method of learning i.e. problem based learning.

I also gave an example to provide that this method of learning can be used to learn subjects other than medicine. At the end, I have compared this type of learning to the growth of a tree. This I believe will help you to remember my lecture.

Finally, I will confirm that learning based on problems has made my teaching to medical students much interesting and enjoyable!

Why do not you try this method and see the benefits yourself!