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Detection of Aflatoxin Producing *Aspergillus flavus* in Post-harvest Contaminated *Vigna ungulculata* Seeds

Ajay Kumar Gautam

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Abstract: The present study was carried out with a specific objective to study post-harvest spoilage of Lobhiya (*Vigna unguiculata*) seeds contaminated with *Aspergillus flavus*. Infected seeds were collected and cultured on potato dextrose agar (PDA) media, at 25±2 °C. *Aspergillus flavus* isolates were primarily characterized by its morphological and microscopic characteristics. Collected fungal isolates were also screened for their afaltoxigenic nature on preliminary basis and at molecular level. For preliminary screening, 5 mm disc of fungal culture was soaked with few drops of liquid ammonia. Color change from yellow pigment to plum-red with different intensities showed the mycotoxic nature of the fungus. DNA from fungal isolates was isolated and amplified using PCR with aflatoxin specific primers, apa-2, ver-1 and omt-1. Amplicons of 1032 bp, 895 bp and 596 bp were obtained in most of the isolates regardless of primer set used which was useful to differentiate between mycotoxic and nontoxic isolates of *A. flavus*. The isolation of aflatoxigenic strains of *A. flavus* during post-harvest period of lobhiya seeds raise a serious concern over the quality of seeds and a threat to heath of consumers. It was concluded that *Aspergillus flavus* is responsible for postharvest spolilage of Lobhiya (*Vigna unguiculata*).

Keywords: *Vigna unguiculata* (L.) Walp.), post-harvest spoilage, *Aspergillus flavus*, aflatoxins.

Introduction

Lobhiya (*Vigna unguiculata* (L.) Walp.) is an edible legume plant and an important bean of family Fabaceae, cultivated globally for its nutritive value and edible importance. The seeds are pale-colored with prominent black spot, so known as black eyed pea or bean. Nutritionally, the lobhiya seeds are energy rich, having a very good concentration of carbohydrates, fats, proteins, vitamins and essential micro and macro elements (Davis *et al*., 1991).

In September - October 2013, local agricultural fields of Himachal Pradesh were surveyed for the post-harvest spoilage of Lobhiya seeds. A clear-cut yellowish green fungal infection was noticed on the seed surface. Therefore, the present study was conducted to ascertain the strains of fungi isolated from post harvested seeds of *V. unguiculata*. Collected fungal isolates were also screened for their mycotoxic nature.

Materials and Methods

The Lobhiya seeds showing typical symptoms of fungal association were collected from different location of the Himachal Pradesh, a North Indian state. About 30 samples were collected from all the locations. To clarify this fungus, collected seed samples were carried to laboratory and examined carefully. Infected seeds were observed under hand lenses and dissecting microscope for morphological characteristics of associated pathogen. With the help of sterilized needle or spatula, yellowish green fungal pathogen was cultured aseptically on Potato Dextrose Agar (PDA) media, and incubated at 25±2°C in darkness for 4-5 days. The fungus grown on culture media was isolated consistently and characterized primarily by its morphological and microscopic characteristics.

The mycotoxin producing potential of collected isolates of *Aspergillus flavus* is

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preliminarily carried out as per the method described by Saito and Machida (1999). A 5mm disc of fungal culture was soaked with few drops of liquid ammonia and observe disc for the color changed.

The aflatoxin producing nature *A. flavus* isolates was also studied at molecular level. DNA from fungal isolates was isolated following CTAB method (Shapira *et al.*, 1996; Konietzny and Geriner, 2003) and amplified using PCR with aflatoxin specific primers, apa-2, ver-1 and omt-1 (Shapira *et al*., 1996; Konietzny and Geriner, 2003).

Results and Discussion

Fungi namely *Aspergillus flavus* was consistently found associated to the described symptoms on Lobhiya seeds. Initially, the fungus appeared as yellowish-green on seeds surface that invaded healthy seeds later on (Fig.1 A-B). On PDA medium, colonies were yellowish-green, entire margin with umbonate elevations, exudate absent, reverse colorless to yellow and moderate to rapid in growth. Mycelium white, branched, septate; conidiphore 600 to 800 µm in length, 15 to 20 µm in diameter, vesicle globose to subglobose; conidia 20 to 45 µm in size, yellowish green, smooth; phialides covering nearly entire vesicle, biseriate primary and secondary phialides 7 to 10 µm in size, cleistothecia observed. On the basis of morphological and cultural characteristics the fungus was identified as *A. flavus* (Fig. 1 C).

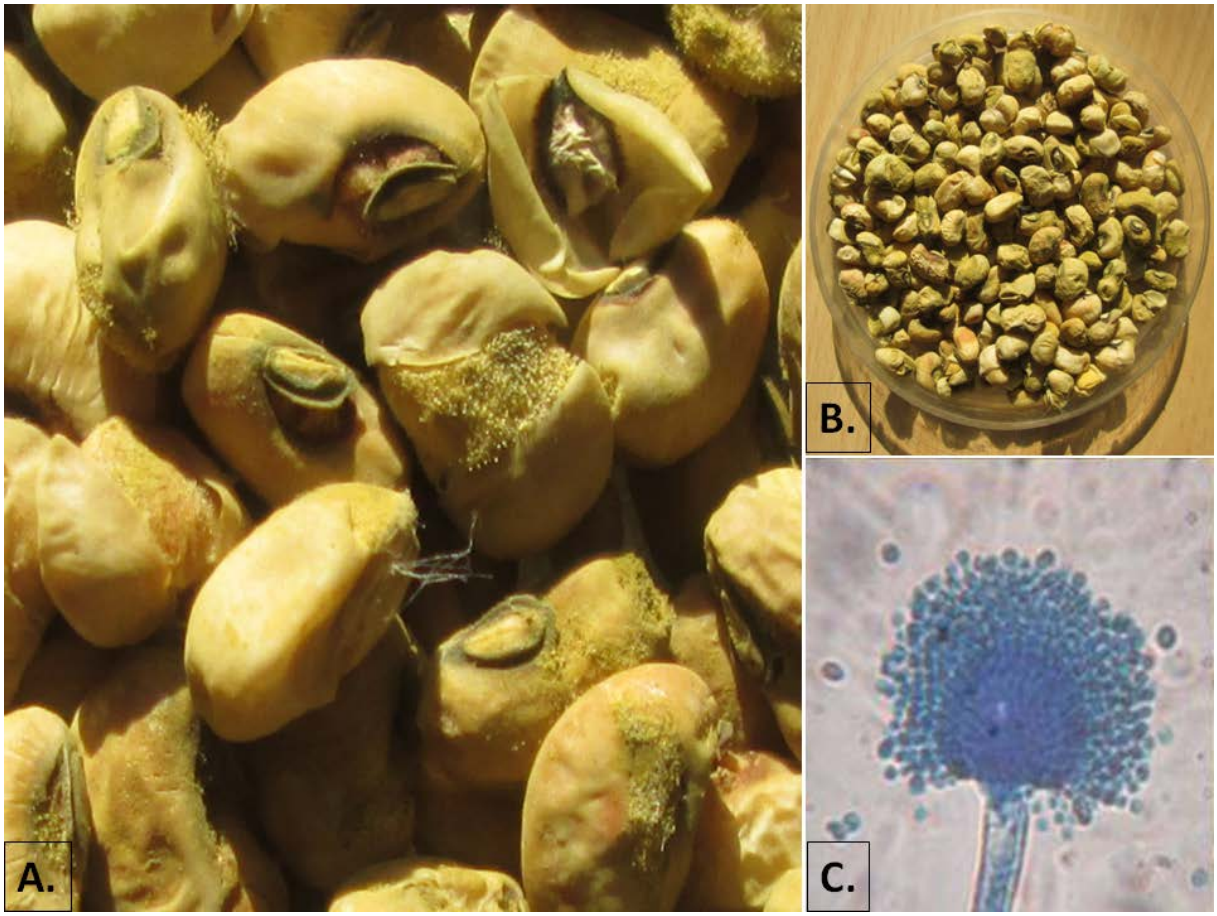

Figure 1. *Aspergillus flavus* associated with Lobhiya (*V. unguiculata*) seeds. **A-B.** Infected seeds; **C.** Microscopic view of *A. flavus*.

After exposure of *A. flavus* isolates to liquid ammonia, color changed from yellow pigment to plum-red with different intensities. This showed the mycotoxic nature of the fungus at preliminary level. In continuation, upon amplification of genomic DNA of *A. flavus* isolates with aflatoxin specific primers, apa-2, ver-1 and omt-1, amplicons of 1032 bp, 895 bp and 596 bp respectively, were obtained in most of the isolates regardless of primer set used. The results were useful in

determining the aflatoxigenic potential of *A. flavus* and also to differentiate between mycotoxic and nontoxic isolates of *A. flavus* (Figs. 2, 3).

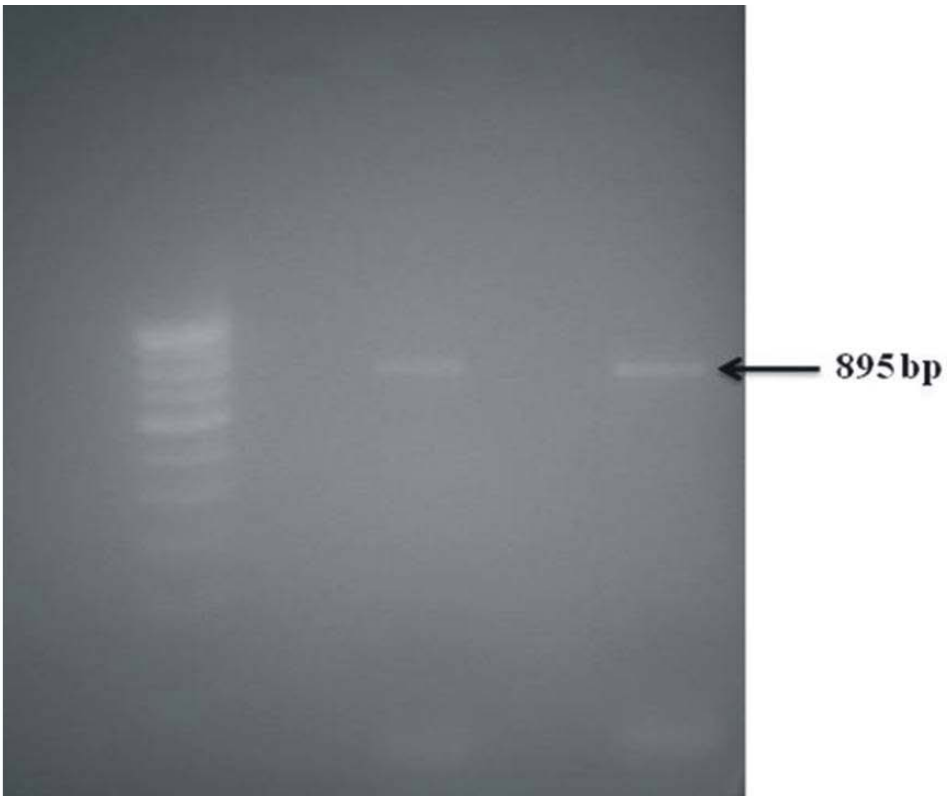

Fig. 2. PCR amplification of genomic DNA of *A. flavus* strains primed by ver-1, with 895 bp amplification.

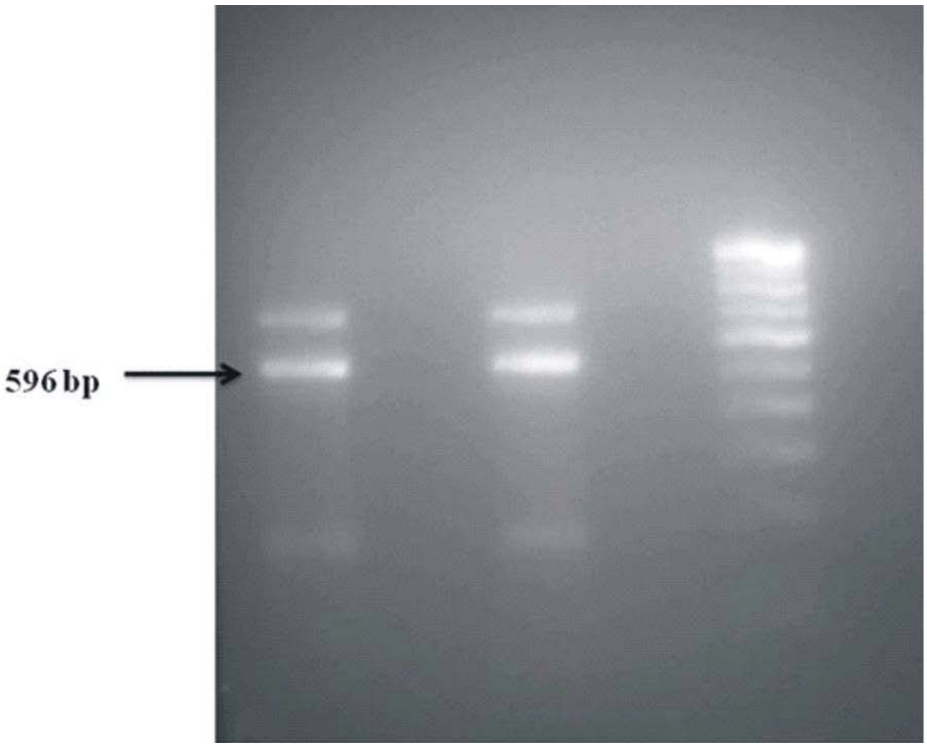

Figure 3. PCR amplification of genomic DNA of A. flavus strains primed by omt-1, with 596 bp amplification.

The findings of the present study showed that the *V. unguiculata* seeds were heavily contaminated by fungal species *A. flavus*, some of the isolates being highly toxigenic in nature. However, the association of *A. flavus* with *Vigna unguiculata* was reported earlier form South Africa (Kritzinger *et al*., 2003); West Africa (Houssou *et al.*, 2009), Nigeria (Fawole *et al.*, 2006), Egypt (Embaby *et al*., 2013) and even form India (Saad *et al*., 2008).

Since, aflatoxins are highly potent mycotoxins with immunosuppressive, carcinogenic and mutagenic nature. Therefore, isolation of aflatoxigenic strains of *A. flavus* during post-harvest period of lobhiya seeds raise a serious concern over the quality of seeds and a serious threat to heath of consumers. Such a contamination can be linked to harvest and storage conditions associated with the tropical climate.

Acknowledgement

The author thanks Head, Abhilashi Institute of Life Sciences Mandi (H.P.) for providing lab facilities and mycology and plant pathology laboratory, Jiwaji University Gwalior (M.P.) for helping in molecular characterization.

References

Davis D. W., E. A. Oelke, E. S. Oplinger, J. D. Doll, C. V. Hanson & D. H. Putnam. 1991. *Cowpea In alternative field crop manual*. University of Wisconsin - Madison, West Indies. http://www.hort.purdue.edu/newcrop/afm/cowpea.html (Last accessed 01.07. 2014).

Saito M. & S. Machida. 1999. A rapid identification method for aflatoxin producing strains of *A. flavus* and *A. parasiticus* by ammonia vapor. *Mycoscience* 40: 205 -211.

Fawole O. B., O. Ahmed & O. S. Balogun. 2006. Pathogenicity and cell wall-degrading enzyme activities of some fungal isolates from cowpea (*Vigna unguiculata* [L] Walp). *Biokemistri* 18 (1):45-51.

Houssou P. A., B. C. Ahohuendo, P. Fandohan, K. Kpodo, D. J. Hounhouigan & M. Jakobsen. 2009. Natural infection of cowpea (Vigna unguiculata (L.) Walp.) by toxigenic fungi and mycotoxin contamination in Benin, West Africa. *J Stored Prod Res* 45(1): 40-44.

Kritzinger Q, T. A. S. Aveling, W. F. O. Marasas, J. P. Rheeder, L. V. D. Westhuizen, G. S. Shephard. 2003. Mycoflora and Fuminisin mycotoxins associated with Cowpea [*Vigna unguiculata* (L.) Walp.] seeds. *J Agri Food Chem* 51: 2188-2192.

Saad S, Raghunathan AN, Shetty HS (1988) Seed mycoflora of Cowpea (*Vigna unguiculata* (L) Walp) and their pathogenic importance. *Seed Sci Technol* 16: 541-548.

Embaby EM, R. Mohamed, A. A. Mosaad, O. Hassan & M. M. Asmaa. 2013. Occurrence of toxigenic fungi and mycotoxins in some legume seeds. *J Agri Tech* 9(1):151-164.

Sustainability: an Approach in Planning to Raise the Quality of Life Through Open Space Development

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Abstract: A presentation of the notion of sustainable development through the eye of a town planner, by elucidating how open space development would change the character of the city and augment towards harmony in the socio-environmental chords of sustainable development. It is an attempt to put forward awareness about the sustainability and environmental risk to ultimately reconcile ecological, social and economic factors of society. It is an attempt to reflect on socio-environmental dimension of the open space planning by addressing urban metamorphosis.

Keywords: Sustainability, Urban metamorphosis, Environmental risk, Diversity, Open space development, Quality of life, People's participation

Introduction

Sustainability offers the judgment about ability of mankind to protect and protract the quality of life of future generation. Sustainable development comprehends the growth which respects the limits to environmental resources; maintains genetic diversity, and establishes optimum use of energy. Sustainability is synchronized with the basic principles of environmental law rendered by precaution, prevention, and remedy at source, along with use of the best available technology.

The research paper would present the notion of sustainable development through the eye of a town planner. By elucidating how an open space development would change the character of the city and augment towards harmony in the socio-environmental chords of sustainable development. It is an attempt to put forward the awareness about the sustainability and environmental risk to ultimately reconcile ecological, social and economic factors of society. It is an attempt to reflect on socio-environmental dimension of the open space planning by addressing urban metamorphosis.

The case study of one of the metropolitan city in India, covered in research paper, would emphasize on the relation between diversified social fabric and opportunities that an open space development offers to raise quality of life. India is the land of people who embrace variety of cultures, traditions, customs, and languages, beliefs, values, festivals, dances, music, art, and even clothing. Open space development would be the excellent platform to reflect collective knowledge of these diversified groups. Moreover, this would help encouraging the exotic series of panorama throughout the city in terms of social affairs, festivals, culture, art, architecture, visual art forms, movies, technology. The people's participation in the open space development execution would let them mark unlimited talent beyond a narrow privileged circle and from the widest possible base.

Sustainability

The World Commission on Environment and Development of the United Nations in 1983 defined sustainable development as: "paths of progress which meet the needs and aspirations of the present generation, without compromising the ability of future generations to meet their needs."

It is concurrent with the basic principles of environmental law portraying precaution, prevention, and remedy at source; polluter pays, along with use of the best available technology.

In order to achieve a global goal of sustainability, contribution from every human being to nation is essential; meaning both macro level and micro level planning steps should be established. To achieve sustainability one should improvise the capacity of living state, by adopting required changes, innovating techniques for survival and utilizing available resources wisely and efficiently. The focus of this research paper is on the physical parameters of development mainly open spaces and its relation to sustainability. The case study of one of the

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metropolitan city of India, 'Pune' has been carried out to evaluate the research assumption.

Urban form is the cause of urban meta-morphosis to great extent and vice-versa. The swelled built-up areas mainly in the urban areas of India are cramping open spaces in core areas. In order to face the challenges related to high density, load on infrastructure, traffic congestion, market demands, real estate, health hazards *etc*. city has to be planned. Open spaces are breathing spaces of cities. In order to make city breathe, it is important to clear up chocked arteries of the city and develop it further to grasp increasing population load.

Need of urban open spaces

India is expected to be the second largest manufacturing country in the next five years followed by the third ranked country Brazil, as per Deloitte Touche Tohmatsu Ltd (Deloitte). According to the Grant Thornton Global Dynamism Index, India is the fifth best country in the world for dynamic growing business. However, the other side of the coin prospects the influx of population in mainly the metropolitan cities as well as the percentage increase in population's demands; essentially in terms of infrastructure, housing and amenities. This indicates the definite rise on the burden on services like water, power and solid waste disposal over and above industrial waste disposal, and pollution management. Therefore, management of housing shortage along with severely stressed existing basic amenities like open space, one of the few existing basic amenities, would be the foremost challenge for planners. Considerably, one might speculate the need for open space in moderating and relaxing the load on urban morphology; as open space development brings about the development of society with respect to enhancement of social network and community interaction. So far, job opportunities in metropolitan cities is the major platform for people to communicate and cooperate with each other, which signifies the influx of diversified inhabitants in terms of the advancement towards dynamic, exotic, in unison, and balanced social environment. Social fabric is one of the significant backbones of historical human settlement that governs the developmental pattern worldwide. Hence, in true sense, open spaces would be the breathing spaces which could help balancing the social environment for urban fabric. Thus it is an attempt to address the socio-economic dimension of open space corridor development and contextualize it with the strength in disparity of social fabric.

India is the second largest populated country in the world. The land and water percentage i. e. most basic natural resources are unevenly distributed as far as geography is concerned. Previously, development was based on the settlement pattern, but the current scenario is more of a chaos, as the growth in the cities is unbearably taking place. Increasing number of metropolitan cities and rise of megacities in developing country like India indicates the growth rate of population and need of basic infrastructure, services and amenities in urban areas. Rural part of the country is still in the very backward stage and unaware of global growth and hesitant to move on because of ancestral property. This gives fare idea of social character of rural India. On the other hand, urban India is booming with technology, youth population, unemployment, pollution, unhygienic conditions, overly crowded city infrastructure and rushed life. This kind of lifestyle hardly offers one the quality of life. People living in the cities mostly spend their time in travelling from one place to another for office work or in the offices. The influx of Information Technology has increased the migration of youth from all over India to metro and mega cities of India. Pune is ranked the seventh metro city in India with population of 3,115,431, as per provisional reports of Census India. Although Pune city has population of 3,115,431; its urban population is 5,049,968, which includes Dehu, Dehu Road, Kirkee, Pimpri and Chinchwad, and Pune. This city faces scarcity of open spaces, making it more and more compact and uncomfortable to live in. The number of increasing vehicles in the city has reached up to 7000 vehicles/month, since the year 2002. Due to constant increase in floating and immigrant population, the air pollution has reach to maximum extent in the city and is now choking the metropolis in its own vehicular exhaust. At present, average air pollution levels in the city are rising to alarming concentrations contributed by 40 % vehicular pollution and toxic waste.

Introduction to study area and formulated methodology

Pune, being the eighth metropolitan city has its own distinct identity and urban character. With the passage of time, rapid natural growth of

population and influx of migrants and activity had overtaken physical development and physical growth of the city. Urbanization is a serious threat on urban open spaces. People's social and cultural behavior calls for developed open spaces with adequate facilities and infrastructure, and providing for recreational demands requires an open space system to suit the needs of various population groups. To provide opportunity for active and passive recreation, open space planning is required. It is therefore necessary to conduct a careful study of the existing open spaces in terms of their types, their development or degradation over the period of time and their effectiveness in contributing to the social, environmental and economic needs of the city. Major change was detected in the vacant land use category and significant change in agricultural and commercial use in last few years. Land use is the indirect reflection of land values, as the price in the fringe areas is much lower than the areas near central areas of the city. Presently, the increasing shift in the land values of urban fringe of Pune is identified, due to great demand. Also, analysis of existing land use pattern shows that the percentage of total land area allotted for recreation is insufficient to cater to the demands of growing population. Open spaces at the peripheral area of the Pune city offers opportunities as being developed as recreational spaces. Pune city is dotted with several plots of natural beauty, historical importance and religious significance. Encroachment of open spaces is the main issue observed in Pune. Illegal, haphazard occupied open spaces are destroying the scenic beauty of hilly areas. This is transforming the open spaces into hub of illegal activities. So the safety of open spaces has become the significant issue. Some open spaces are still unnoticed and some of them are experiencing impacts of uncontrolled visitors. The relentless trend of building development and the absence of enforcement of building regulations the city is headed towards taking the shape of a concrete jungle, affecting mass of open spaces. For sustainable existence of the city, planning of open spaces as a spearhead of urban planning is a must. In the existing physiographic setup, to promote open space management system, an integrated planning for organized open spaces is required.

Hence taking these factors into consideration, methodology is derived; which would clarify the significant path to achieve sustainable urban open spaces in Pune.

In addition to this, the classification of open spaces, their ownership, physiographic study, land cover, land price, soil quality, vegetation quality, land character, environmental threats, multiple suggestions by environmentalists and civic groups gave the current scenario of open spaces with reference to other predominant land uses in the city. Identifying the percentage of the open space and its class/category helped in analyzing quantitative as well as qualitative scenario in each ward of the city.

Observations, Identified Issues

As per secondary data, from the Pune Municipal Corporation (PMC), only 0.1Ha/l000 population area exists for gardens and parks. As per the planning standards, required area should be 0.2Ha/1000 population. Area under play-ground in PMC is only 0.02Ha/l000 population, where as in standards it should be 0.4Ha/ l000Population. This shows the scarcity of gardens and playgrounds in Pune. The 1987 development Plan had reserved 70 hectares of land in various parts of the city for playgrounds. However, till date, the PMC has acquired only 3.5 hectare of it (Sunday Times of India, Pune, 7 October 2012). From the above information, a vast difference can be analyzed in demand and supply. In the quantitative analysis it is observed that many of the gardens are below 0.5 Ha areas, which are not satisfying the need of all age groups, so a continuous large area or connected open space is required to serve all age group's need. The development of Mutha riverfront and projects related to hill encroachment are still on paper. Poor implementation of development plan due to financial and administrative constraints are some issues observed in Pune. With the changing time, health conscious generation demands for jogger's parks, technological advancement in facilities and infrastructure. Poor maintenance of infrastructure, disorganized places, inadequate landscape furniture, and play-equipment in park are some major problems. Also hawkers and beggars infest parks. No organized space is planned for hawkers near parks. The vehicular traffic has tremendously increased in Pune city but comparatively parking facilities are inadequate. So that people visiting garden, tend to park their vehicle on roadsides, which ultimately results in congestion.

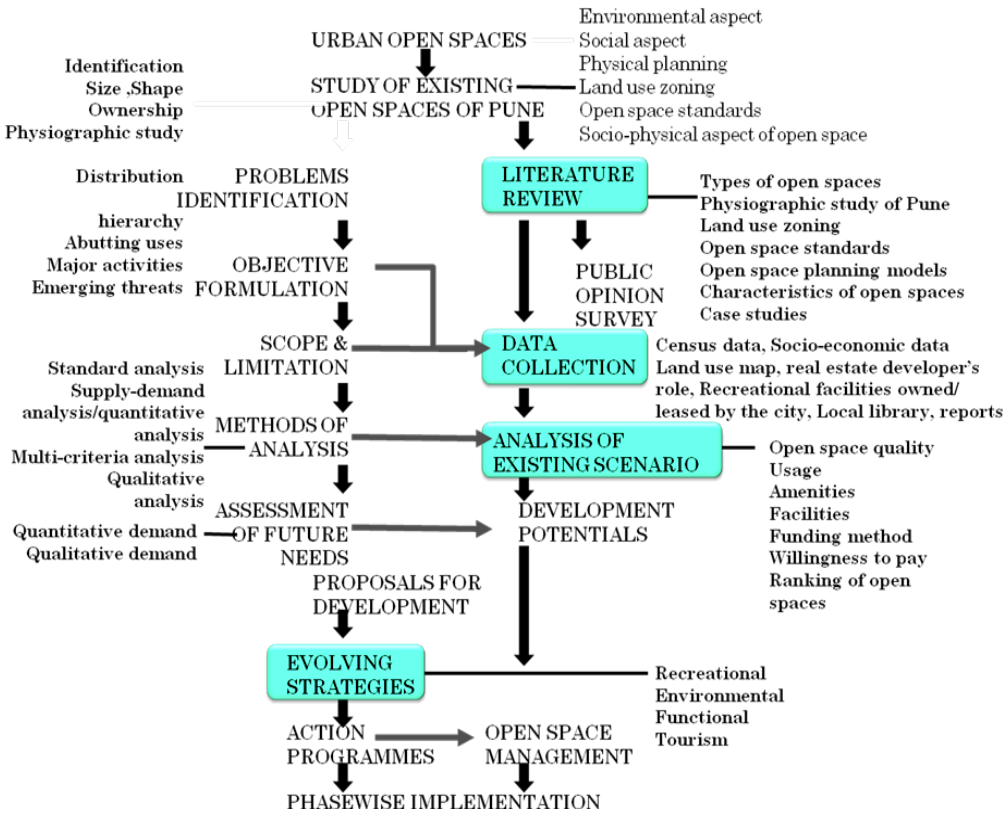

Figure1. Methodology- an approach.

Open space: definition, categories, hierarchy and activities

In order to understand the role of open space development in sustainability, it is important to first understand open space, its categories, hierarchy, and functions. The open space has been defined as an essential part of the urban heritage, a strong element in the architectural and aesthetic form of a city, plays an important educational role, ecologically significant, important for social interaction and community fostering, supportive of economic objectives and activities, helps in reducing the inherent tension and conflict in deprived parts on urban areas, provides for the recreational and leisure needs of a community has an economic value in that of environmental enhancement (Council of Europe, 1986). In addition to this, open space has been described from a user‘s point of view as being an arena that allows for different types of activities encompassing necessary, optional and social activities. (Geht, 1987).

Based on use or function of open spaces broad categories of open spaces could be natural, urban, recreational, cultural, utility open spaces. Further classification hence includes:

Agricultural lands, mines and quarries, borrow pits, forest area, watershed areas, significant geological features like river beds, streams, *etc*. as natural open spaces. Civic spaces, incidental open spaces, amenity green spaces as urban open spaces, parks and playgrounds as recreational open spaces. Historic sites, archeological preservation sites as cultural open spaces. Circulation and utility corridors, reserved open spaces for water lines, drains, power lines, garbage disposal areas as utility open spaces.

All these categories are well dispersed in Pune city and are serving or linked with different population catchment areas. Some are part of colonies and societies, where distance and time threshold is well served while planning open spaces; while in some part of the cities, mostly utility and recreational open spaces are encroached upon by temporary or permanent slums. So it does not ensure the purpose making people deprived of accessibility to these open spaces.

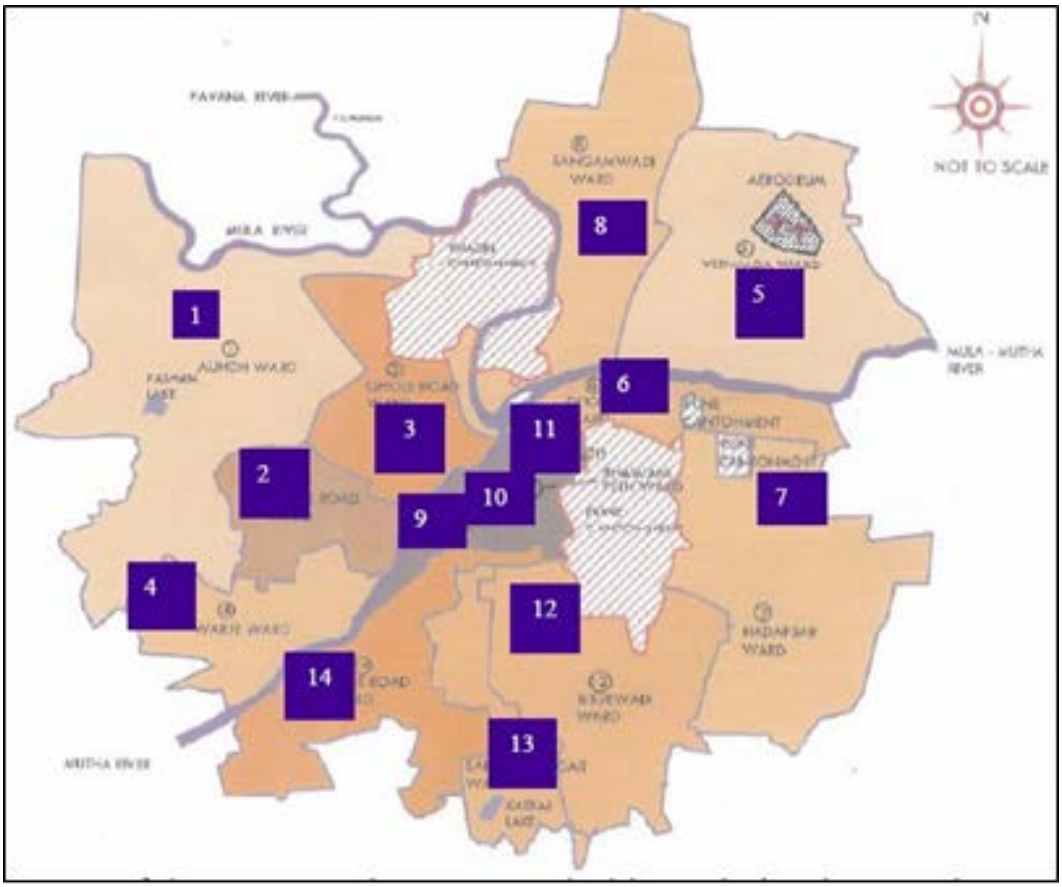

Figure 2. Pune: wards.

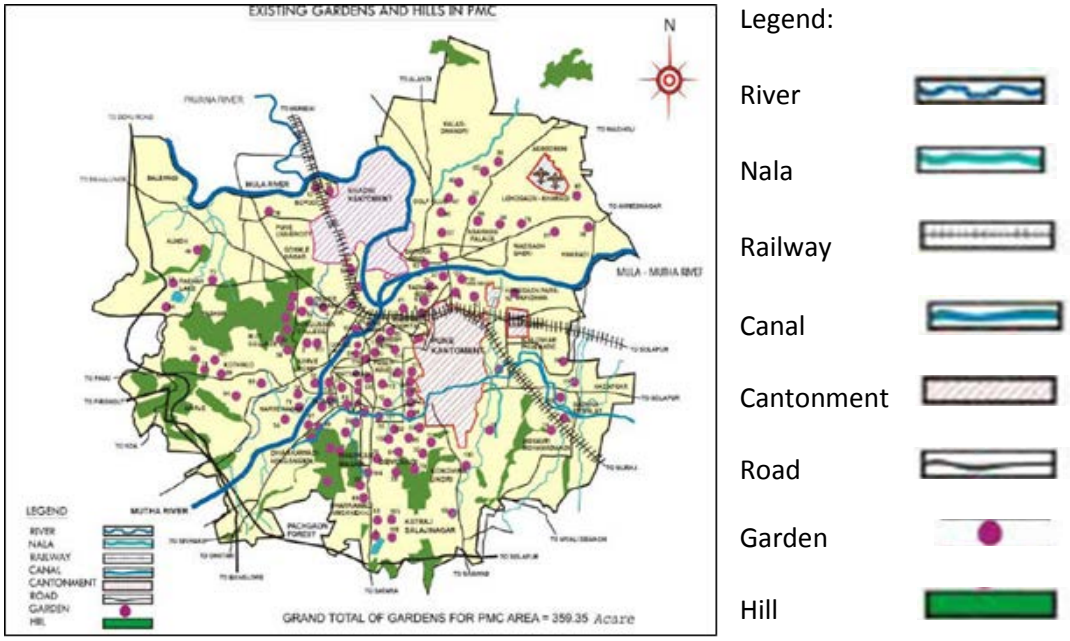

Figure 3. Pune: Existing open spaces.

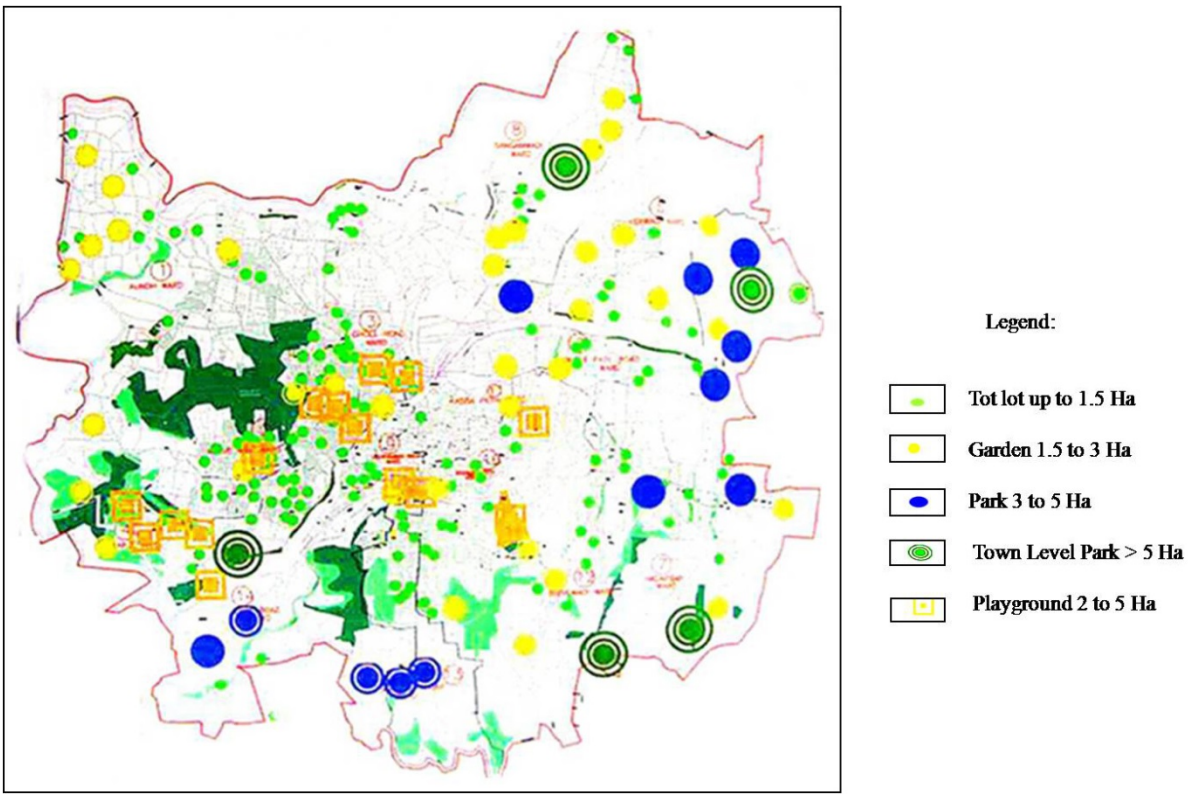

Figure 4. Pune: Existing open spaces areas wise distribution.

Analysis

The survey data helped in understanding the existing hierarchy of open spaces and their ward wise distribution in the city. This further helped in calculating ward wise need of open space.

The survey was carried out in order to analyze quantitative and qualitative aspects of open spaces and to find out the user group, their satisfaction of open spaces in Pune. Primary survey suggests that about 99% people agree to the need of open spaces and its development, out of which only 39% are ready to pay fees for the maintenance of open spaces. To understand the type of open space people like to visit often, activity performed and issues related to it, a priority ranking analysis was made. It has been observed that most of the user groups prefer visiting open spaces of regional and neighborhood scale (each 31%), while about 14% people visit cluster/colony level open spaces for various activities at different time of the week and day. These visitors include both males and females. According to different purposes open space was categorized and analyzed as per type, area, time, frequency.

Table 1. Existing and required area of gardens and playgrounds in Pune.

	Existing (area in Ha)	**Required** (area in Ha)
Park	338.71	602.15
Playground	70.87	1204.30
Total	409.58	1806.45
Park/1000 population	0.10	0.2
Playground/1000 population	0.02	0.4

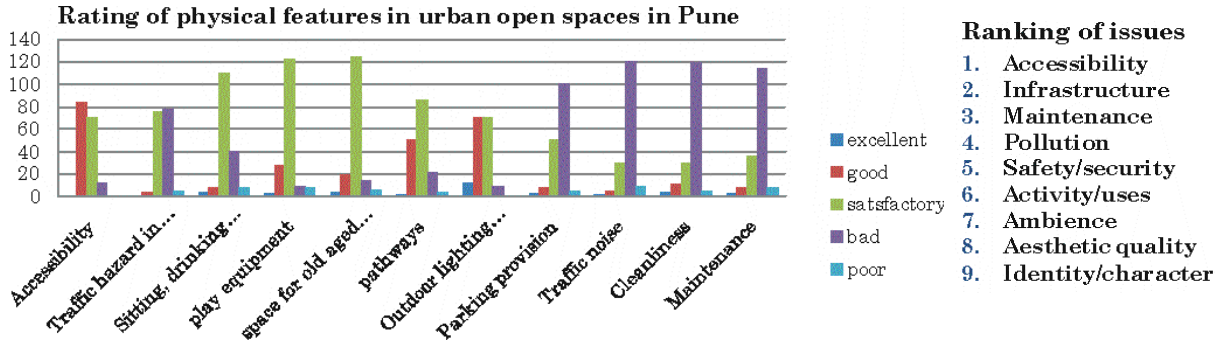

Figure 5. Rating and ranking of issues related to open spaces in Pune.

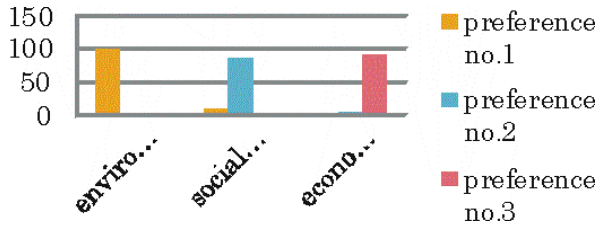

Figure 6. People preference to need of open spaces for various purposes.

Diversity: the strength of society embraced through open spaces

Diversity derives innovation and creativity in society. Pune city's culture revolves around different ethnic groups. Embracing the diversity through social mobility would encourage development of society. Open space development would be the excellent platform to experiment with. Social activities, festivals, concerts, art, exhibitions of diversified groups together would encourage the striking panorama throughout the city and definitely enhance the urban design of the city. People from different background when given a platform would come together, share their knowledge, culture and would come up with a new and broad perspective to life. Open space development program has potential to showcase the creative talent from various ethnic groups. The instigation of such active and passive activities has potential to attract market, so it would generate employment opportunities for many. Also, generated funds could be used for the maintenance of these public open spaces. Hence, this development program has the potential to change the face of the city by inclusive planning. Additionally, people's participation in the open space development execution would let them tap unlimited talent beyond a narrow privileged circle and from the widest possible base.

Need of Strategies, Guidelines, and Proposals

Urban open spaces not only affect the townscape, but also provide ecological diversity and form essential structural and functional elements to make cities and urban areas more livable. They are one of the crucial elements of all cities. Urban open spaces are also of vital importance with regards to their relevance for healthy citizen, social wellbeing, economic benefits and delivery of sustainable ideas which enhances the quality of urban life. Pune city is dotted with several spots of natural beauty, historical importance and religious significance. Maintaining the character, ambience and usability and also making it sustainable is the demand of time. Hence considering all above factors, proposals are suggested in terms of suitability and stability, using primary and secondary survey analysis. Broad proposals are based on zonal characteristics and recommend-ations for specific strategies, methods for conserving and managing the open spaces are suggested.

Local authority of Pune should plan to develop park and green spaces in each neighbourhood to make this city green, liveable and sustainable. Local authority should develop urban open spaces in Indian context , which could range from the vacant spaces between plots, wasteland along river banks, hilly areas, biodiversity parks, playgrounds, agricultural lands, civic open spaces, incidental open spaces, archaeological preservation sites, historical sites, garbage disposal areas, utility corridors. This physical entity of open space could be an expression of emptiness, chaos, entertainment, interaction etc. and could add to the sustainability as well as the image of the city. Theme parks, open space beautification projects, wilderness, biodiversity parks, use of biosphere reserve model and opportunistic model, public awareness about environmental and economic benefits, people's participation in planning process, all these ideas would help in sustaining the quality as well as quantity of urban open spaces in the city.

Physical Planning Strategies and Guidelines at the City Level

The amount of open spaces for active and passive recreation must be dependent upon the proposed or anticipated densities. Developed urban open spaces should be located near institutional land uses like schools, temples, churches, health centers, and cultural halls without disturbance by thorough traffic. Pedestrian's needs should be taken care of by providing adequate services, facilities along with maintaining ambience of the pathway. The pedestrian circulation areas should also be provided with adequate street furniture like lampposts, properly located dustbins, benches, paving, etc. along with seating spaces where so required. Directional signs, public safety, interpretations for educating users should be increasingly well thought and adequately provided.

Solution strategies for a sustainable open space management

I. Partnership / Program Solution Strategies

• Identifying and prioritizing open spaces based on location, size and usability sites within the City

• To promote and facilitate opportunities to develop events.

• Promoting more "in the Park" type of activities.

• Working with the Tourism Department to develop strategies throughout the year.

• Working in partnership with the different local community art groups.

• Encouraging active and passive activities in collaboration with governmental or non-governmental organizations in order to embrace diversity.

II. Design & Inventory Solution Strategies

• Highlighting recommendations for site up-gradation and infrastructure improvements

• Identifying locations and program opportunities for different seasonal activities. (*e.g*. Circus at the riverfront)

• Identifying locations and program opportunities for various company employees to work for maintenance of open spaces.

• Organizing adventure programs on the seasonal basis, to promote open space development within city.

III. Financial Sustainability

• Charging fees for using of the open spaces to support urban open space.

• Seeking out partnerships, alliances and sponsorships.

• Developing volunteer programs (*e.g*. adopt-a-park).

• Actively seeking donations and establish endowment funds.

• Generating revenue from bookings, special events, concession operations, lessons and programs, advertising, etc.

Conclusions

Urban morphology is molding the form of the urban open spaces from activity spaces to interaction spaces and finally, as breathing spaces. Strategies in terms of physical development, enhancement, public participation and response, financial management, design and inventory, integrated approach towards urban open spaces would give prospects about sustainability of urban open spaces. These strategies would also assist for facing issues like scarcity of organized urban open spaces, increased environmental hazards, and encroach-

ment problems. A change in the demographic composition of the society and impact of technological development on the sustenance of city are major dilemmas of the current time. Open space development is the augmentation towards resolving such problems. Open spaces truly is not just a physical entity; its development is the way to bridge the gap between diversified groups. It is a step forward to sustainable development.

References

Broussard, S. R., C. Washington-Ottombre, B. K. 2008. Attitudes toward policies to protect open space: A comparative study of government planning officials and the general public. *Landscape and Urban Planning* 86: 14–24.

Cho, S.-H., N. C. Poudyal & R. K. Roberts. 2007. Spatial analysis of the amenity value of green open space**.** *Ecological Economics* 66: 403-416.

Esbah, H, B. Deniz & E. A. Isolation trends of urban open spaces**.** *ISPRS proceedings.* http://www.isprs.org/proceedings/xxxvi/8-27/esbah02.pdf.

Francis, M. 1988. Negotiating between children and adult design values in open space projects**.** *Design studies* 9(2): 67-75.

Geoghegan, J. 2001. The value of open spaces in residential land use. *Pergamon-Land Use Policy* 19: 91-98.

Khobragade, S. Y. 2012. Planning for Sustainable Urban Open Space Corridor Development, Case Study of Pune**.** *61st NTCP Congress proceedings*, Ahmeda-bad. 528-535.

Maruani , T. & I. Amit-Cohen. 2007. Open space planning models: A review of approaches and methods. *Landscape and Urban Planning* 81(1-2): 1-13.

Mertens, E. 1999. Bioclimate and city planning} open space planning. Atmos-pheric Environment 33(24): 4115-4123.

Shekhar, S. 2007. Changing Space of Pune – A GIS perspective. Paper Ref NO: MWF PN 116-yr.2007-GIS@ development Map World Forum, Hydera-bad, India.

Sherer, P. M. 2006. *The Benefits of Parks: Why America Needs More City Parks and Open Space*. The Trust for Public Land, San Francisco 12-20.

Thompson, C. W. 2002. Urban open space in the 21st century. *Landscape and Urban Planning* 60: 59–72.

Van Dijk, T. & N. van der Wulp. 2010. Not in my open space: Anatomy of neighbourhood activism in defense of land use conversion. *Landscape and Urban Planning* 96(1): 19–28.

Interactive e-Learning system for Thalassemia: a Case of University Hospital in Thailand

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Abstract: Though most medical students are from top of the classes, it is no secret that gaining real-life work experience and advancing their careers require years of practical and hand-on experiences. To address the perceived skill and to bridge gaps, a first-hand solution is launched in the form of a prototype being developed that take a unique spin on e-Learning system with interactive content. The tool is tested with domain expert and various levels of medical students and their anonymity. The preliminary result is shown to be satisfactory for more coverage.

Keywords: e-Learning, Interactive Content, Prototype, Medical Studies, Anonymity

Introduction

E-Learning not only support a richer but also a more engaging educational experience than is the normal classroom. In this context it is tailored to additionally build key competencies experienced, medical professionals need to progress in their careers. Unfortunately, the subject contents are difficult to comprehend in today dynamic conditions. The traditional Learning Management System (LMS) is being complimented with the deployment of interactive content so that medical student level of accomplishment is increased apart from personal faculty guidance and peer-to-peer and student-to-faculty discussion community. To name a few, students may obtain practical experiences through scenario-based learning, guidance from general physician, an online discussion community and possibly volunteer mentors. As a blended learning, especially the newly qualified doctors, this can assist them to gain more insights to the topics in need as perceived by Goh *and Clapham (2014). Back and* et al. (2014) further complement this through his study finding that blended learning approach does improve teaching in a problem-based learning environment in orthopedics. Therefore, interactive content as part of a blended learning is to help students rapidly gain the profession that will help enhance not only their cases experience and their ability to apply new skills thereby enhancing performance and contributions.

Based on methods surveyed, this paper presents four underlying concepts used in the development of this prototype with emphasis on instructional design are (a) attention- arouse curiosity and sustain interest; (b) relevance- make tasks relevant to learner's needs and interests; (c) confidence- build on success and gain self-efficacy; and (d) satisfaction- provide extrinsic and intrinsic rewards. This paper omits the requirement elicitation, system development life cycle and other system related engineering aspects of the software development process and emphasized only on e-Learning methodology.

1.1.1 Instructional Design

A nine-step model proposed by Gagne (1985) help ensure effective learning. Those events of instruction include (a) Capturing learner's attention, (b) Informing learners of objectives, (c) Stimulating recall of prior learning, (d) Presenting the content, (e) Providing learning guidance, (f) Eliciting performance, (g) Assessing performance and (i) Enhancing retention and transferring to job. Later, Kearsley & Shneiderman (1999) offered the engagement theory stating that student have to be engaged meaningfully in the activities related to learning through interaction with others and worthwhile tasks facilitated and enabled by technologies. Norman (2004) argued that by engaging in the course where fun and pleasure are elusive concepts where there is no consensus (Monk *et al*., 2002). Thus, it is dependent on the context of the subject and per Gibbs (2004) effectiveness in designing devices and software so that they are more affective.

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1.1.2 Usability Principles

According to Constantine & Lockwood (1999), five aspects of usability to be considered are learnability, the ability to remember, efficiency in use, reliability in use, and user satisfaction. An example of a successful design can be found on Csikszentmihalyi (1990) called a flow state where learners are so focused on what at hand and that they are unaware of the time. There are other issues, for instance, detraction, feedback (Keller, 1983), internationalization and localization; British and American English, and student differences; age, gender, background or disabilities.

1.1.3 Selection of Media

Since the selection of media is the heart of a well-designed e-Learning course. Horn (1998) refers visual language to the tight integration of words and visual elements, including animation, cartoons and diagrams. As an important principle in the e-Learning design, graphics and interactive elements should be purposeful and aid in learning. Per Tufte (1990, 1992), visual representations are very powerful at conveying information as can audio and video. Based on learners' access to and familiarity with e-Learning, Roblyer & Ekhaml (2000) offers a rubric for assessing interactive qualities called the Media Selection Matrix. Though, Moss (2002) provides guidelines and suggestions to design to increase learning, particularly the exercises, this work is carried out based on instructions obtained from domain expert in the design of exercises.

1.1.4 Evaluation

Specifically, the evaluation is used to inform the design or revision of a product. There are, generally, series of steps are applicable in most forms of evaluation. They are (a) Evaluation criteria, (b) Data collection, (c) Data organization, (d) Data analysis, (e) Reporting and (f) Refining. In this section of this article, emphasis is given on usability evaluation and is already covered in the five usability principles outlined in the preceding section. Testing all these guideline ensures that learners can be successful. Therefore, no matter diverse set of technical skills learners may have, a well-designed and robust technology application will prove to be useful and usable for them.

1.1.5 Support for Learners

Anderson et al. (2001) pinpoints that students need to understand the importance of time management and distraction control. In most cases as described by Galusha (1997), the lack of student preparedness and support are major drawback. Technical barriers must be made a non-issue. By selecting the intuitive and flexible technology tools, coupled with technical training, it can reduce technical barriers. Moreover, students need to acquire more than a basic understanding of the use of the technology itself—they need to understand how to use it efficiently to support their learning tasks. For example, with a wealth of resources available with varying degrees of reputability, students need to learn good research skills, including good Internet search skills. Guidance may be needed on where to look for information (e.g., recommended data repositories) and to develop the ability to critically assess the information they find. A tutorial with an affiliated library service can help students hone these skills, and embedded links to reputable and relevant data resources can point students in the right direction for research projects. LeBaron and Miller (2004) identify the use of scaffolding in training students with use of technology tools. They describe the design and implementation of an icebreaker exercise for an online course. Lin (1999), who found that practice time to acquire skills needed in an online course had positive impacts on self-efficacy, interest, and commitment, advocates this kind of initial training. The reference to the group work is not discussed in this paper as the context for this preliminary work aims at individual and anonymity study.

Materials and Methods

A prototype is produced based on user requirement and detailed instruction. Initially, three scenes based on the general inquiry in order to screen the patient of a Thalassemia disease are constructed using Adobe ® Flash technology and form part of existing e-Learning system available in university hospital's intranet system. Present works are being carried out using Blender® attaching to MySQL database in order to replace the Adobe ® Flash technology and more scenes

are added. Figure 1-4 below and on next page depict screenshots of scene from a developed system. Audio provided as a background responses are not able to reproduce in this paper but are available as part of the interactive system.

The newly developed system is used to complement the existing Learning Management Systems with contributions in the area of interactive responses and subject matter comprehension.

Figure 1. Scene 3: Meet the doctor.

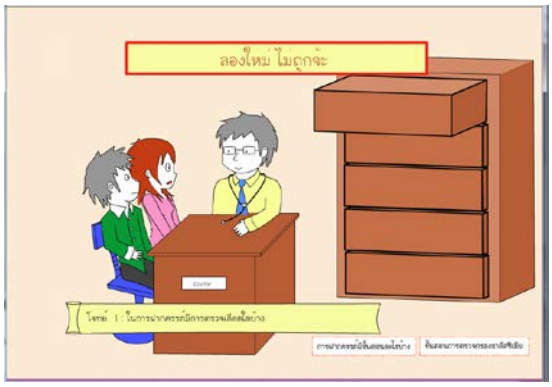

Figure 2. Scene 4: Question answered with a negative result.

Each scene requires users (in this regard, medical students) to interact with a system, and waits for a system response to do next. Provided that the student is keen on the general knowledge of the disease, the system will allow the student to proceed to next scenes. Otherwise, student will be asked if they would need any assistance or condensed materials to be read and understood before moving on to the next step. Initially the design is based on a gaming concept that offers a rewarding point for collection and future redemption. To avoid the pitfalls, typically most medical students will try to serve their challenging need, such motivation is given in the form of recognition through applauding sound instead.

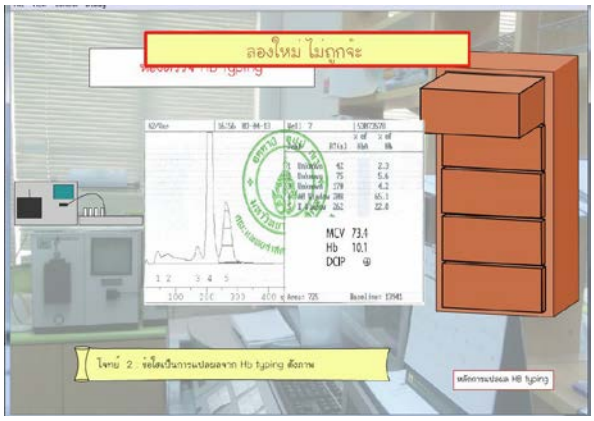

Figure 3. Scene 7: Question answered with a negative result.

Figure 4. Scene 11: Question needs an answer.

Results and Discussion

Another domain expert was invited to review and comment on a finished prototype with comments on a concern regarding intonation because the recorded voice was quite flat. The technical aspect for general inquiry, counseling and early diagnosis are in line with the given requirements. Three different groups of people were brought in for working with the interactive content. They are a Thalassemia nurse, an officer at Thalassemia unit and a fifth-year medical student. It was found through close observation that out of ten minutes target time for the three scenes, each made use six minutes without using any system help, fifteen minutes with system help and eight minutes without system help, respectively. Each one expressed his and her enjoyment by using this guided screening. At this stage, the formal evaluation is not carried out due

to the fact that more comprehensive and complete scenes are needed. Works in progress are nearly completed for official evaluation scheduled during August 2014.

Conclusions

The preliminary result is found to be quite satisfactory by both the users and the team. Further testing on all fifth year medical students is scheduled during incoming August 2014 intake so that a complete work on Thalassemia screening topic can be produced and implemented as part of the LMS. Also, gradually, bundling the interactive content with other internal medicine subject is possible using this proof of principle prototype. Since the work is constructed based on Blender ® which is available on most platform except for iOS system which runs on iPhone, iPad and McIntosh related operating system, the author and a team plan to have this work ported to such platform in the near future. By using this interactive as part of the blended learning system, the aim is to provide hand-on experiences through case-based reasoning and there might be rare cases that they are not being covered by the system.

Acknowledgements

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References

Anderson, T., L. Rourke, D. R. Garrison & W. Archer. 2001. Assessing teacher presence in a computer conferencing context. *Journal of Asynchronous Learning Networks* 5(2): 1-17.

Back, D. A., N. Haberstroh, A. Antolic, K. Sostmann, G. Schmidmaier & E. Hoff. 2014. Blended learning approach improves teaching in a problem-based learning environment in orthopedics-a pilot study. *BMC Medical Education* 14(1): 17.

Constantine, L. & L. Lockwood. 1999. *Software for use: A practical guide to the essential models and methods of usage-centered design*. Reading, MA: Addison-Wesley, Boston, 570 pp.

Csikszentmihalyi, M. 1990. *Flow: The psychology of optimal experience*. Harper and Row, New York. 336 pp.

Gagne, R. 1985. *The conditions of learning*. (4th ed.). Holt, Rinehart & Winston, New York. 361 pp.

Galusha, J. M. 1997. *Barriers to learning in distance education. Interpersonal Computing and Technology* 5(3-4): 6-14.

Gibbs, W. W. 2004. Why machines should fear. *Scientific American* 290: 37.

Goh, J., & M. Clapham. 2014. Attitude to e–learning among newly qualified doctors. *The clinical teacher* 11(1): 20-23.

Horn, R. E. 1998. *Visual language: Global communication for the 21st century*. Macro-Vu, Inc., Bainbridge Island, WA. 270 pp.

Kearsley, G., & B. Shneiderman. 1999. Engagement theory: A framework for technology-based teaching and learning. http://home.sprynet.com/~gkearsley/engage.htm (last accessed 30.4.2014)

Keller, J. M. 1987. Strategies for stimulating the motivation to learn. *Performance and Instruction* 26(8): 1-7.

LeBaron, J., & Miller, D. 2004. The teacher as agent provocateur: Strategies to promote community in online course settings. In T. Latomaa, J. Pohjonen, J. Pulkkinen, & M. Ruotsalainen (Eds.), eReflections—Ten years of educational technology studies at the University of Oulu. pp.109-125 http://herkules.oulu.fi/isbn9514276329/isbn9514276329.pdf (last accessed 30.4.2014).

Lin, C.- J. 1999. The effects of self-efficacy and task values on students' commitment and achievement in web-based instruction for Taiwan higher education. *Dissertation Abstracts International Section A: Humanities & Social Sciences* 60(6-A): 1905.

Monk, A., M. Hassenzahl., M. Blythe & D. Reed. 2002. Funology: Designing enjoyment. *SIGCHI Bulletin*. September/October 2002: 11.

Moss, C. 2002. Finding balance: The vices of our "versus". *First Monday* 7(1): http://firstmonday.org/ojs/index.php/fm/article/view/924/846 (last accessed 30.4.2014).

Norman, D. 2004. *Emotional design*. Basic Books. No significant Difference, New York. 257 pp.

Roblyer, M., & L. Ekhaml. 2000. How interactive are your distance courses? A rubric for assessing interaction in distance learning. *Online Journal of Distance Learning Administration,* 3(2): www.westga.edu/~distance/roblyer32.html (last accessed 30.4.2014).

Tufte, E. 1992. *The visual display of quantitative information*. Graphics Press, Chelshire, CT. 197 pp.

Wild Elephant Conservation Using Sound Waves to Obstruct Them from Plantations: a Case Study at Kui Buri District, Thailand

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Abstract: A trial of the 2,300-2,800 Hz band of frequency in sound waves were made more intense in decibels (dB), similar to a firecracker or firecracker ball was made for use of the local people to dislodge and/or obstruct wild elephants from agricultural areas (pineapple plantations) within Kui Buri District, Prachuap Khiri Khan Province, Thailand. The 3 point source was checked between 10 -50 meters, sound sources to the elephants in distances and loudness are as discussed later; firecracker balls were 151, 142, 138, 128, 119 decibels (dB), firecrackers were 99, 95, 91, 85, 72 dB, and the frequency of the sound waves (2,800 Hz) were 85, 80, 74, 70, 62 dB, respectively. The results can be analyzed through the laboratory and fundamentals of sound wave, anatomy and physiology of mammals, including comparisons to the standard sound intensities of the Acoustical Society of America (ASA). The energy and pressure of firecracker ball is strong and were transferred into some auditory mechanisms and behaviors of wild elephants. As a consequence, the elephant's auditory mechanism has been affected from the energy and pressure; at least 1 individual of wild elephant had shown sensorineural hearing loss in the case study, their behavior became more aggressive and more easily angered.

Keywords: Wild Elephant, Conservation, Sound Wave, Kui Buri District, Thailand

Introduction

Sound is a kind of energy and has been divided in loudness (decibel=dB) and frequency (hertz=Hz). Porges (1977) has explained a frequency of sound wave is very important to hearing and each frequency makes a different sound, pitch and usually loudness is produced from a lower frequency of sound wave but there is more energy, power and pressure. Whilemiddle and higher frequencies of sound wave have produced lower amounts of loudness, power, pressure / energy (Semal, 1964 and Beiser, 1964). Each vertebrate is different in its ability to hear, but regularity hears best at about 2,000 – 3,000 Hz and some vertebrates can receive both infrasonic, less than 30 Hz and ultrasonic, more than 18,000 Hz (Donail, 2001) bands of frequencies.

The ear as a sensory organ is more complex than other sensory organs. The sensory cells (hair cell) are located in the cochlea, but the cochlea not only serves to convert sound into a code of neural impulses in the auditory nerve, it also performs the first analysis of sounds that prepares sounds for further analyses in the auditory nervous system. The cochlea also compresses the amplitudes of sound, which makes it possible to code sounds within the very large range of sound intensities that is covered by normal hearing. Without such amplitude compression, the ear could not detect and analyze sounds in the intensity range of normal hearing (Moller, 2000).

In Kui Buri District, there are substantial pineapple plantations and they adjoin National Park areas. Thus, wild elephants roam from National Park into plantation for their food. All farmers, day after day, protect their farms by making noise from firecracker balls and firecrackers for obstruction and/or dislodgment. The study focus on the 2 purposes of studying consist of a confirming and monitoring some sound wave frequency by a functional generator and accessories (an instrument that produces a frequency of sound wave, 21 – 28 KHz) connected to a 60 Watt of amplifier from DC 12 volt battery connected to a loudspeaker to obstruct or dislodge a wild elephant from coming into the

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pineapple plantations and also to show the effect from 2 sound sources of loudness at each distance to show some auditory mechanism and behavioral reactions of wild elephants. Sound frequencies created by the machine can protect the hearing by lessening the effect of hearing loss in comparison to the firecracker and firecracker ball.

Materials and Methods

This study was conducted in a pineapple plantation in the vicinity of Pa-Yang Check-Point in Kui Buri National Park in Ban Ruam-Thai, Kui Buri District, Prachup Khiri Khan Province Thailand, 12° 8' 24.56" N 99° 38' 54.72" E (Figure1).

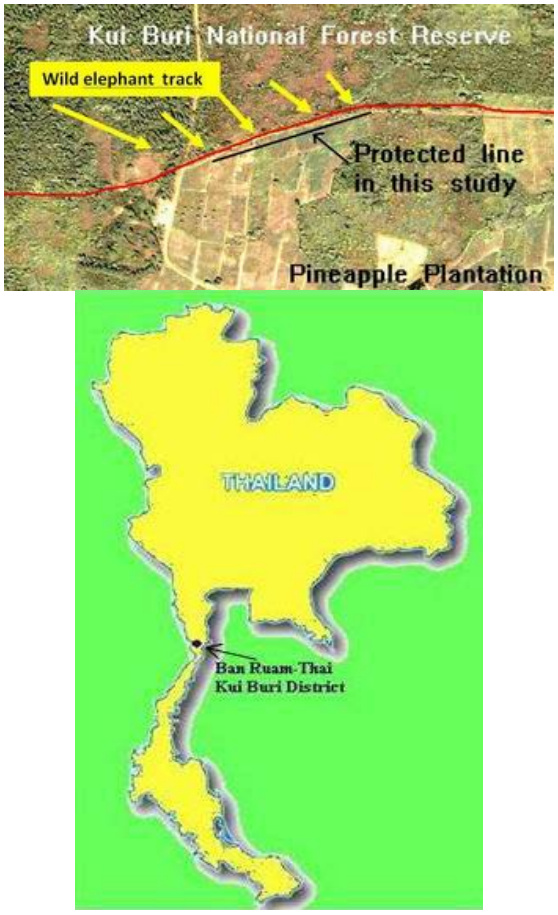

Figure 1. Shows the site and wild elephants track from Kui Buri National Park area adjoin the pineapple plantation and between them were obstructed by electric fence but were destroyed by wild elephants.

Whenever a wild elephant was heard or observed at approximately 30 - 50 meters of distances, suddenly the functional generator was opened. While standing by, wild elephants would be observed, the pattern of farmers and rangers to deter a wild elephant from the National Park to agricultural areas, and their pattern will be checked and recorded for loudness, energy and pressure in each distances, along with wild elephants' behavior.

Results

The 108 individuals from 44 times during on 06:00 pm to 05:00 am of a wild elephants were found through from the forest of National park nearby the study area on approximately 30-50 meter of distances. Their behavior was observed by a binocular and eye sign included listening. All of them were obstructed by the frequency of sound waves at 2,100-2,800 Hz (best on 2,600-2,800 Hz) and their reaction was to break and then break away far from study site. In the morning the distances were measured for rechecking and the sound source to wild elephants' vestige.

In observation of other methods to deter wild elephants there has been found proceeding by a farmers and a ranger of Kui Buri National Park and all are loudness making for detonating from firecracker ball, about 5 balls per a time and firecracker, more than 5 pieces per a time on 5-50 meter of distances from sound source to the wild elephants by catapult.

Figure 1 shows the site and wild elephants track from Kui Buri National Park area adjoin the pineapple plantation and between them were obstructed by electric fence but were destroyed by wild elephants.

The next step was that the different volumes of loudness were checked in electronic laboratory and their results were as follows on Table 1 and 2. Both of the tables show effects in the levels of sound source, maximum to minimum from firecracker balls, firecrackers, and the frequency of sound waves, respectively. Each loudness levels of the sound are released differently in energy, power, pressure, and they were transferred into the tympanic membrane to the middle ear and lastly to the internal ear. The internal ear consists of a series of cavities in the petrous part of the temporal bone but the cavity concerned with hearing is a cochlea and it is a very important organ because it contains a hair cells. The hair cell is a receptor of a power, energy, pressure, and frequency of sound and transfers this information to the auditory cortex of cerebellum and changes it into sound.

Loudness from detonating firecracker balls were powerfully transferred strong energy, power and pressure, shock waves to the tympanic membrane passed on to middle ear and hair cells in inner ear; thus, consequential impact of hearing loss is an action potential as a spatial summation.

Table 1. Loudness of sound sources, firecracker ball (Fb), firecracker (F) and frequency of sound wave were differentially compared at each distance.

Distances(m.)	Decibel = dB (A)									
	Fb	F	Frequency of Sound wave (KHz)							
			21	22	23	24	25	26	27	28
10	151	99	90	89	87	89	87	87	86	85
20	142	95	86	85	82	84	82	82	81	80
30	138	91	80	75	75	76	77	76	75	74
40	128	85	72	71	68	75	70	71	71	70
50	119	72	64	61	58	67	64	63	62	62

Table 2. Pressure (Newton), energy/power (Watt) were made from each loudness.

Pressure (N / m^2)	Power / Energy (W / m^2)	Loudness (dBA)
2×10^{-5}	1×10^{-12}	0
2×10^{-4}	1×10^{-10}	20
2×10^{-3}	1×10^{-8}	40
2×10^{-2}	1×10^{-6}	60
2×10^{-1}	1×10^{-4}	80
2	1×10^{-2}	100
20	1×10^{1}	120
200	1×10^{2}	140

Eventually, wild elephant had hearing loss or deafness because sensorineural and conductive hearing loss caused by the tympanic membrane being ripped, hair cells and basilar membranes being destroyed. These probable factors or circumstances that the wild elephants had received daily or over several occasions, resulted in their changed behavior, becoming aggressive and becoming easily angry. Thilosakulchai (2005) described conductive hearing loss is an impact from sensorinural hearing loss, caused by hair cells being destroyed. A powerful loudness of 100 dB or more can build and transfer a strong energy pressure, like shock waves, destroying

tympanic, basilar membranes and hair cells. Moreover, lower sound wave frequencies can build strong energy pressure and also can also travel more distant than middle or higher sound wave frequencies. Therefore, the strong energy can spread to all hair cells on cochlea and transfer the energy to the cerebellum, all resulting in bringing about different behavior.

Conversely, frequencies of sound waves created artificially were of a lower loudness than firecracker balls and firecrackers but obstructed and/or dislodged the wild elephants throughout the conduct of this study. This is because the frequencies stimulate the hair cell, little by little, making a disturbance. Furthermore, all important organs of auditory mechanism receive the effect less than the loudness and also all wild elephants never shown as an aggressive or angry. At least, 1 individual on 3 times of wild elephant in this study were found never move or frighten loudness from all sound source but suddenly move whenever it got a flashlight ,therefor likely to describe the wild elephant is unusually hearing and perhaps deaf.

Acknowledgements

The authors would like to thank as following persons who supported the fieldwork: Royal Initiative Project, Kui Buri National Park and the farmers who permitted us to live in the pineapple plantations, for data for studying which also included all data of wild elephants in the pine-apple plantation. The research was supported by the Research and Development Institute of Suan Sunandha Rajabhat University. Lastly, I would like to express thanks to Dr. Jarujin Nabhitabhata for recommendations and advising primary research, including to referring us to other locations for study.

References

Beiser, A. 1964. The Foundation of Physics. Addison-Wesley Publishing Company, Inc., Massachusetts. 594 pp.

Donald L. 2001. Vertebrates Biology. Mc Graw-Hill Publishing Company. New York. 530 pp.

Thilosakulchai, K. 2005. Central Nervous System Physiology. In: Physiology 3 (eds. Jiasakul, S., S. Lohsiriwat & W. Wattanapha), pp. 890-1063. Faculty of Medicine Siriraj Hospital, Mahidol University. Bangkok (in Thai).

Porges, G. 1977. Applied Acoustics. Edward Arnold (Publishes) Ltd, London. 180 pp.

Semat, H. 1964. Fundamentala of Physics. Holt, Rinehart and Winston Publishers, New York. 914 pp.

Moller. A. R. 2000. Hearing, Its Physiology and Pathophysiology. Academic Press. California. 515 pp.

Bird Diversity in Fruit Gardens in Bang Nang Li Sub-district, Amphawa District, Samut Songkram Province

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Abstract: This research is quantitative and qualitative explorative research. The purposes of this research was 1) to study bird species, feeding behavior, abundance and status in study area 2) to study activities in utilization of birds in the study site. The data was obtained by interviewing the owners of fruit gardens and field surveys of bird species, activities of birds in habitat utilization in three kinds of organic fruit gardens namely; lychee garden, coconut garden, and pomelo garden in Bang Nang Li Sub-district, Amphawa District, Samut Songkram Province from October 2012 – September 2013. The result of bird survey in 3 gardens found 31 families and 61 species of birds. 52 bird species were found the most in organic pomelo gardens. In feeding habitats, insectivorous, piscivorous, granivorous, nectrivorous birds and aquatic invertebrate feeding birds were found. Abundance level of birds in organic fruit gardens was at level 5. 23 bird species were frequently found. 43 bird species were found in November because migratory birds came to utilize the study site. According to the status of bird species, 48 resident bird species, 6 resident and 7 migrant bird species were found in organic fruit gardens. The birds' activities in fruit gardens were feeding and nesting.

Keywords: Samut Songkram Province, Fruit gardens, Bird diversity.

Introduction

Thailand is located in the tropical area of ecological biodiversity. Amphawa District is a district of Samut Songkram Province with Mae Klong River as the main river and several branch canals of the Mae Klong River. The area has fresh water, brackish water and salt water. It is called "City of Three Streams." With the fertile ecological system and with 3 water conditions, it is the source of diversity in bird species. Thepkorn (2006) said that around the canal, you may find the birds *i.e. Egretta garzetta* (Little Egret), *Orthotomus sutorius* (Common Tailor-bird), *Haliastur indus* (Brahminy Kite), *Pycnonotus blanfordi* (Streak-eared Bulbul). The prominent riverine flora is *Sonneratia caseo-laris* which is the habitat of many fireflies. Amphawa District has the advantage of the natural tourism. However, as a result from tourism with the ever increasing tourists, the materials and civilization from outside are brought into affecting the area. It is another cause of the changing lifestyle of the population in the community and it may negatively affect the domicile of bird species, which are less in number than in the past. Moreover, the database system of natural resources does not cover the study area. Bang Nang Li in Amphawa District in Samut Songkram Province has several canals with organic agriculture with fruit gardens. It aims to develop the area into a sustainable development area. Therefore, it must study the bird diversity in the fruit gardens of Bang Nang Li Sub-district, Samut Songkram Province to obtain a database of the bird species domiciled in organic fruit gardens for ecotourism. It is consistent with the National Economic and Social Development Plan Vol. 10 (B.E. 2550 – 2554) (2007-2011) in the strategy No. 4 focusing on the development on the basis of the variety of biological species; the stability of the resource base and environment by emphasis on the resource base; and good balance of the ecological system in order to maintain the good balance between the conservation, utilization and participation of resource management. Eco-tourism is a type of tourism which supports awareness of environment reservation. Eco-tourism should be considered about education

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and good awareness in ecosystem reservation together (Tourism authority of Thailand, 2002). Ecotourism activities are the tools in reservation of natural resources and biodiversity for sustainable development.

The aim of this study was to study bird species, feeding behavior, abundance, status and activities in utilization of birds in study area.

Figure 1. *Rhipidura javanica* and its nest.

Materials and Methods

A. Study area

The study area consisted of three kinds of 3 organic fruit gardens, namely: lychee gardens, coconut gardens, and pomelo gardens in Bang Nang Li Sub-district, Amphawa District, Samut Songkram Province from October 2012 – September 2013.

B. Research equipment

1.) Environment record forms for fruit gardens.
2.) Survey forms for bird species and activities in the utilization of fruit gardens.

C. Methodology

A research survey was conducted in Samut Songkram Province as follows:

1) The bird species survey was done with binoculars, camera and bird were identified according to Lekagul and Round (1991); Round and Kongthong (2009). The survey was conducted by spending time in the morning from the sunrise until 11:00 h and in the afternoon from 15:00h until the sunset for 5 months from October 2012 – September 2013, 2 days per month.

2) Analysis was made of the relative abundance by the mean of Pettingill (1969)

3) Classification was made of the feeding behavior, status and activities in the utilization of birds in study area.

Results and Discussion

A. Bird species, feeding behavior, abundance and status

From the study, it found that there were 31 families and 61 species of birds, with 52 species in pomelo gardens, 50 species in lychee gardens and 42 species in coconut groves.

According to feeding behavior, some bird species using the area for living stand still to catch aquatic animals for food, *i.e. Todirhamphus Chloris* (Collared Kingfisher), *Ardeola speciosa* (Javan Pond Heron), *Egretta garzetta* (Little Egret), *Alccdo atthis* (Common Kinfisher). Some species catch insects as food, *i.e. Cacomantis merulinus* (Plaintive Cuckoo), *Rhipidura javanica* (Pied Fan-tail), *Dicrurus macrocercus* (Black Drongo). Some species wait to snatch or catch insects for food, *i.e. Merops philippinus* (Blue-tailed Bee-eater), *Hirundo rustica* (Barn Swallow). Some species eat pollen or nectar as food, *i.e. Cinnyris jugularis* (Olive-backed Sunbird), *Anthreptes malacensis* (Brown-throated Sunbird) . Some species eat plant seeds as food, *i.e. Streptopelia tranquebarica* (Red Collared Dove), *Geopelia striata* (Zebra Dove). Some species eat fruit and insects, *i.e. Pycnonotus blanfordi* (Streak-eared Bulbul),*Crypsirina temia* (Racket-tailed Treepie).

From the study of abundance, it was found that 23 species are most abundant, 15 species are less abundant, *i.e. Hypothymis azurea* (Black-napped Monarch, *Aviceda leuphotes* (Black Baza,) *Lanius cristatus* (Brown Shrike), *etc.*

Figure 2. *Hypothymis azurea*.

According to bird species status, 48 species of resident birds, 7 species of migrant birds and 6 species of birds that are resident and migratory were found. The survey results are shown in Table 1 as follows:

Table 1. Bird species and bird status in Bang Nang Li Sub-district, Amphawa District, Samut Songkram Province from October 2012-September 2013.

Bird Status	Bird Species		
	pomelo garden	lychee garden	coconut groves
Resident	42	39	35
Migrant	4	5	2
Resident and Migrant	6	6	5
Total	52	50	42

From Table 1, it can be seen that in pomelo garden, 52 species are most often found. 42 species are resident, 4 species are migratory and 6 species are resident and migrant. The resident species are found in all three habitats, *i.e. Todirhamphus Chloris* (Collared Kingfisher), *Amaurornis phoenicurus* (White–breasted Waterhen), *Ardeola speciosa* (Javan Pond Heron),*Egretta garzetta* (Little Egret), *Rhipidura javanica* (Pied Fantail). The migrant species are *Halcyon pileata* Black-capped Kingfisher), *Coracina melaschistos* (Black-winged Cuckooshrike), *Alcedo atthis* (Common Kingfisher).

B. Activities of birds utilizing the study area

Bird activities in fruit gardens were feeding and nesting *i.e. Cinnyris jugularis* (Olive-backed Sunbird) , *Todirhamphus chloris* (Collared Kingfisher), *Lonchura striata* (White-rumped Munia), Brown-throated Sunbird *Anthreptes malacensis* (Brown-throated Sunbird), *Amaurornis phoenixcurus* (White-breasted Waterhen), *Rhipidura javanica* (Pied Fantail), *Cinnyris jugularis* (Olive-backed Sunbird). The survey results are shown in Figs 1-3.

Table 2: Bird similarity index of bird diversity in fruit gardens in Bang Nang Li Sub-district, Amphawa District, Samut Songkarm Province.

Fruit gardens	Bird Similarity Index
pomelo garden and lychee garden	0.843
lychee garden and coconut garden	0.848
pomelo garden and coconut garden	0.851

Figure 3. *Cinnyris jugularis* and its nest.

From Table 2, It is seen that the bird similarity index of 3 gardens are 0.843, 0.848 and 0.851 , showing that the number of bird species utilized in 3 areas are very similar because three garden 3 are kept in the same way without using chemical in getting rid of insects and weeds but using Biological fermentation. The water used in three gardens was from the sane canal. Similar bird species use these areas for feeding; insectivores *i.e*. Common Tailorbird *Orthotomus sutorius* (Common Tailorbird) *Cacomantis merulinus* (Plaintive Cuckoo), *Rhipiduru javanica* (Pied Fantail), *Dicrurus paradiseus* (Greater Racket-tailed Drongo); granivores i.e. *Lonchura punctulata* (Scaly-breasted Munia), *Lonchura striata* (White-rumped Munia); nectarivores *i.e*. *Cinnyris jugularis* (Olive-backed sunbird), *Anthreptes malacensis* (Brown-throated Sunbird); piscivores, *i.e*. *Egretta garzetta* (Little Egret), *Ardeola speciosa* (Javan Pond Heron), *Todirhamphus Chloris* (Collared Kingfisher), *Halcyon smyrmensis* (White-throated Kingfisher). Migratory birds utilizing the study area for feeding were *Alcedo atthis* (Common Kingfisher), *Halcyon pileata* (Black-capped Kingfisher),*Ficedula albicilla* (Taiga Flycatcher). The bird species affecting the garden was *Daaeum cruentatum* (Scarlet-backed Flowerpecker) which was the cause of parasites on the trees of the garden.

Conclusions

Organic gardening is suitable for bird diversity in their utilization of those habitats in feeding and nesting. Other benefits are that birds are valuable for agriculture in pollination, plant seed dispersion and preying on insects that are harmful to crops. Organic gardening should be supported in the communities to preserve local biodiversity. Birds could indicate the fertileness and safety of each residential area (Phattara-

phittaya, 1996). In addition, the causes of bird detection in each interval are different because the season is the influential factor for the appearance of the bird. In the rainy season, if it rains heavily, the rain becomes an obstacle to the bird's ability to fly and other activities (Pettingill, 1969). In addition, bird appearance is relative to the species and local quantity of food (Sukwong, *et al*., 1975).

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References

Lekagul, Boonsong & P.D. Round. 1991. A guide to the Birds of Thailand. Saha Karn Bhaet Co, Ltd., Bangkok. 457 pp.

Office of Natural Resources and Environmental Policy and Planning. 1997. National policy and plan for sustainable development of Thailand. Kasetsart University Bangkok.

Pettingill, O. S. 1950. A Laboratory and Field Manual of Ornithology. 7 ed. Burgess Publishing Company, Minnesota. 380 pp.

Phattaraphittaya, S. 1996. Variety of birds at Kamang Field, Wild Animal Protection Zone Phu Khiew, Results after release of birds into the nature in the year 1987 and 1989 Master Degree Thesis, Graduate College, Kasetsart University. 88 pp. (in Thai).

Round, P. D. & V. Kongthong. 2009 Birds of Laem Pakbia. Amarin Printing and Publication, Nonthaburi. 288 pp.

Sukwong S., P. Dhamanitayukul & S. Pongumphai. 1975. Phenoloy and Seasonal Growth of Dry Dipterocarp Forestry Tree Species. Kasetsart Journal. 9: 105-114 (in Thai).

Thepkorn, W. 2010. Riverine forest: Affiliate forest of the mangrove forest, Bangkok Metropolis: Thai Romklao Co. Ltd. 47 pp. (in Thai).

Tourism Authority of Thailand. 2002. Meeting agenda of ecotourism workshop, Bangkok: Reservation Department. pp. 38-55. (in Thai).

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