

**COMMUNITY UNIVERSITY PARTNERSHIPS**

**(CUP)**

**INLAND EMPIRE**

**ENVIRONMENTAL QUALITY PARADIGM**

**by**

**LAL S. MIAN, Ph.D.**

**CUP Fellow**

**Department of Health Science and Human Ecology  
California State University, San Bernardino**

**and**

**CUP MEMBERS**

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## 1. INTRODUCTION

The service area of the California State University- San Bernardino includes mainly the counties of San Bernardino and Riverside, known as the Inland Empire. The valley floor of both counties houses roughly over 80% of the total human population. It is also considered as one of the fastest growing areas of southern California. The Inland Empire has a population of 3.88 million with an annual growth rate of 5% since 1994 (San Bernardino County 2000).

Owing to its growing population and development needs, environmental health and safety issues take center stage in terms of livability and the total environment. Major areas of health concerns, therefore, include air quality, water pollution, soil contamination and biological, chemical and spatial issues. The unhealthful air quality in this area has been no secret for the past several decades. Similarly, ground water, tainted with industrial pollutants, has been found along the Santa Ana River and adjoining areas. Soil pollution with both agricultural chemicals and industrial pollutants, including lactates from landfills and hazardous material disposal sites, can be a matter of serious concerns. Last but not least, the daily challenges facing the Inland Empire communities include food sanitation, water hygiene, vector-borne diseases, hazardous materials, solid and liquid wastes, and quality housing, to name a few.

In view of the foregoing conditions, a community-university partnership was formed to address some of these issues, utilizing both the university and community resources and expertise. The Partnership's charge was to identify, analyze and spell out key parameters to be developed as measurable indices to evaluate progress in each of the environmental health areas. The present report, therefore, describes an environmental quality model for the Inland Empire, shedding light on individual environmental health elements such as air quality, water quality, food sanitation, housing, vector-borne diseases, solid waste management, hazardous material management and recreational health.

## 2. QUALITY INDICATORS

Quality indicators, whether qualitative or quantitative, are used to measure known quality parameters. In this report, quantitative or numerical rather than qualitative or alphabetical indicators are given preference. For simplicity and uniformity, these indicators are designated on a scale of one to five, one being good, two moderate, three fair, four unhealthful and five hazardous. These indicators or indices can be static when described at one particular point in time such as air quality index on July 1, 1999. When considered over a period of time such as air quality index for the period of 1990-95, it is described as comparative quality index. Quality indices are defined as functions of individual attributes of the quality parameters in question (Jaenicke and Lengnick 1999). The attributes used in measuring individual quality indicators are listed in the following general categories:

1. Emergencies--human fatality, injury, epidemic and epizootic, property loss, etc.
2. Incidence of pathogen activity, property damage, etc.
3. Potential for natural and man-made disasters-- earthquake, windstorms, fires, etc.
4. Lack of preventive/regulatory resources
5. Any other factor-- lack of amenable socio-economic and political environment.

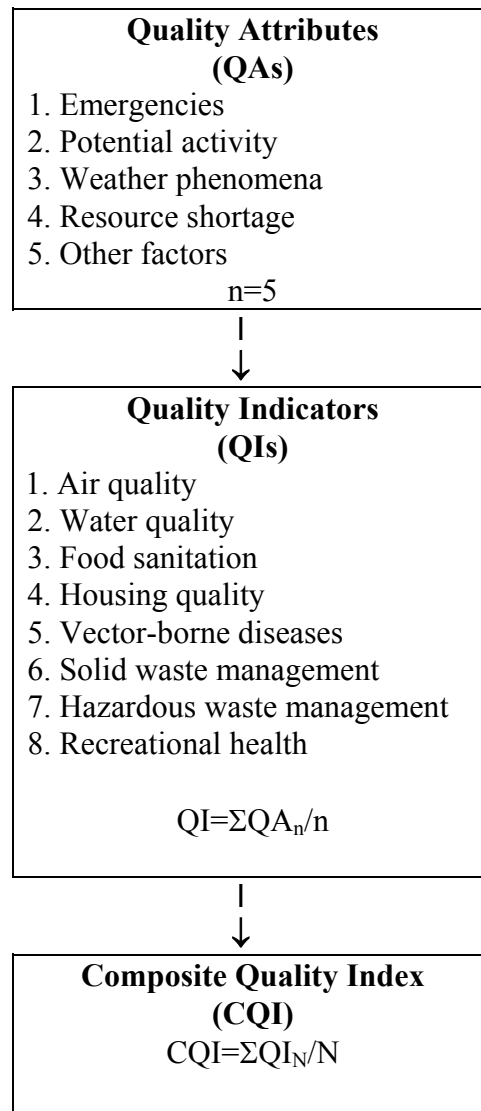
Environmental quality, a composite term, refers to the sum total of quality of various components of the environment such as air, water, soil, resident flora and fauna, including human habitats. From the environmental health perspective, however, it includes various elements such as air quality, water hygiene, food sanitation, housing conditions, vector-borne diseases, recreational health, solid and hazardous waste management and radiological health. The state of environmental quality may be viewed as actual or perceived. Based on perception, the state of quality may appear favorable, whereas in reality, it can be actually hazardous. As part of this actual or perceived view of the environmental health quality of the Inland Empire, the Partnership conducted a cursory survey by circulating a questionnaire to the two counties and 20 incorporated cities. The survey response rate was 73% and the overall quality rating of the general environment was 13% excellent, 50% good, 25% fair and 6% poor (Table 1). As expected air quality had the highest (13%) rating of poor quality. Other individual elements—water quality, food sanitation, housing, pests and diseases, and solid waste facilities, all had quality ratings ranging between fair and excellent. Park and open space, an accessory to the housing and recreational health, had 19% poor rating. The survey had a small sample size with participants as local governmental agencies. It provides a crude view of the quality of our environment as perceived by local agency personnel. A survey with an appreciably large sample size (in hundreds or thousands) representing the area residents, may provide a more convincing rating of environmental quality, based on public perception.

In developing a quality index for the area, the following model was used as illustrated by a flowchart in Figure 1.

**Table 1. Results of a survey on the rating of environmental conditions in the Inland Empire during July 2000 (IEEP 2000).**

<b>Number of responses (%) to quality rating</b>					
Element	Excellent	Good	Fair	Poor	Total <sup>a/</sup>
Air quality	3(19)	7 (44)	4 (25)	2 (13)	14 (64)
Water quality	3 (19)	9 (56)	3 (19)	0 (0)	15 (68)
Food sanitation	5 (31)	6 (38)	2 (13)	0 (0)	13 (59)
Housing	3 (19)	8 (50)	4 (25)	0 (0)	15 (68)
Pests & disease	4 (25)	6 (38)	3 (19)	0 (0)	13 (59)
Solid waste	4 (25)	10 (63)	1 (6)	0 (0)	15 (68)
Park/open space	3 (19)	6 (38)	4 (25)	3 (19)	16 (73)
General environment	2 (13)	8 (50)	4 (25)	1 (6)	15 (68)

<sup>a/</sup> A total of 22 local government bodies—two Inland Empire counties and 20 incorporated cities, were mailed the survey questionnaire. Only 16 of them responded.



**Figure 1. A flowchart showing developmental sequence of the Paradigm.**

### 3. QUALITY INDICES BY ELEMENT

The quality of a given environment is affected by changes in one or more of its components. Sometimes the magnitude of change in one component may be so high that it may not only have a profound impact on other components, but may drastically effect the total overall quality of that environment. It is, therefore, germane to discuss quality indices of individual components, referred to here as elements. In our environmental quality paradigm, the emphasis is placed on different environmental health elements. The quality indices by element are discussed under separate titles such as air quality, water quality, food sanitation, housing, vector-borne diseases, solid waste management, hazardous material management and recreational health.

### 4. AIR QUALITY

Air quality of the Inland Empire is regulated by two state special districts namely, South Coast Air Quality Management District (SCAQMD) and Mojave Desert Air Quality Management District (MDAQMD). The former monitors the air quality in the Los Angeles basin, whereas the latter covers the remaining Inland Empire desert areas all the way to the Colorado River. Besides indigenous sources, the area's air quality has been affected by emissions emanating from both stationary and mobile sources of pollution in the adjoining Los Angeles and Orange counties. The air quality is monitored at approximately 20 sites to measure the criteria air pollutants such as particulate matter (PM<sub>10</sub>), oxides of nitrogen (NO<sub>x</sub>), oxides of sulfur (SO<sub>x</sub>), carbon monoxide (CO), ozone (O<sub>3</sub>) and lead (Pb). Notwithstanding appreciable improvement in the criteria attainment of PM<sub>10</sub> in recent years, the smaller PM<sub>2.5</sub> has been receiving increasing attention due to its higher health effects. Ozone, the primary component of smog, is formed from volatile organic compounds and NO<sub>x</sub> in the presence of sunlight and exacerbated by hot weather and atmospheric inversion. Therefore, monitoring of ozone levels has been the focus of air quality of the Inland Empire. Based on this indicator, air quality is considered unhealthy when the ozone level exceeds 0.12 ppm or 100 aqi (air quality index). A health advisory is declared when the ozone level reaches 0.15 ppm or 138 aqi, advising ozone susceptible individuals to avoid outdoor activity. A Stage 1 episode occurs at the ozone level of 0.20 ppm or 200 aqi. At this stage, air quality is considered very unhealthy, urging everyone to avoid vigorous outdoor activity. According to SCAQMD, the Southland has experienced a significant improvement by reducing ozone pollution during the past 15 years (1985-2000). The number of days per year above the federal standard for ozone, 0.12 ppm averaged over one hour, decreased from 159 in 1985 to 40 in 2000. Similarly, the number of health advisories and Stage 1 episodes has declined from 138 and 82, respectively, in 1985 to 19 and 0 in 2000 (SCAQMD 2000).

During the past five years, 1998 turned out to be the smoggiest, resulting in 12 stage 1 episodes. Nine of these episodes were in the San Bernardino Mountains with one each in



Riverside, San Bernardino valley and San Gabriel valley (SCAQMD 1998). The 1998 season was a typical La Nina weather pattern with dry hot summer conditions. Except for 1998, stage 1 episodes in the central San Bernardino Mountains declined from 73 in 1978 to only one in 1997. There are no data available on the number of fatalities caused by acute exposure to ambient air pollutants in this area, however, the long-term effects on health are well established.

Based on the forgoing discussion and data on ambient air quality, the quality model on this element is tabulated here.

#### **Air Quality Model**

<b>Attribute</b>	<b>Quality Rating</b>	<b>Quality Index Scale</b>
Emergencies	1	1=Good
Above standard pollution exceedance	5	2=Moderate
Potential weather phenomena	5	3=Unhealthful limited
Lack of regulatory resources	1	4=Unhealthful
Other factors	1	5=Hazardous
Total points	13	
Mean quality index	2.6	

The above model shows a mean index of 2.6, which on the index scale means moderate quality. With no emergencies resulting in the loss of life or property, there were days with smog levels exceeding the federal standard and resulting in health advisories. Weather phenomena especially the 1998 La Nina, atmospheric inversions and windstorms are potentially important in evaluating the area's air quality.

## 5. WATER QUALITY

Water is the most expensive commodity considered most essential to both animal and plant life. Whether above- or under-ground, it is subject to contamination and pollution through natural sources and man-made activities. Atmospheric pollutants and their return to earth through rainwater and dumping of toxic wastes through man's actions, can result in water pollution. Naturally occurring substances in the earth crust such as arsenic, chromium, for example, can result in ground water pollution, especially in our desert communities. Ground water pollution with toxic hydrocarbons in the Santa Ana wash at Mentone and Cajon wash at Verdemon (San Bernardino) and pollutants from the Stringfellow Acid Pits in Riverside, are well publicized. The presence of these pollutants certainly raises questions as to their impacts on our drinking well water quality. Like elsewhere in the state, water quality in our area is regulated by local jurisdictions, consisting of county water programs or special water districts, depending on the size of the water system. Water systems, with less than 200 service connections, are regulated by county environmental health program. Systems with more than 200 connections are managed by special districts. Besides the two counties in the Inland Empire, there are a number of special water districts such as the Chino Valley, Corona, Riverside, Eastern Municipal, San Bernardino Valley, East Valley, Big Bear, Hi- Desert, and Mojave municipal water district, to name a few. Information provided by San Bernardino County was used in developing the quality model presented here.

### Water Quality Model

Attribute	Quality Rating	Quality Index Scale
Emergencies: Water-borne illness outbreaks	5	1=Good
Ground-water pollution	5	2=Moderate
Sewage spills	5	3=Fair
Lack of inspection staff	1	4=Unhealthful
Any other factor affecting water quality	1	5=Hazardous
Total points	17	
Mean quality index	3.4	

The mean quality index is 3.4, which on the index scale means fair quality. There were several water-borne illness outbreaks with no fatalities. Both water pollution and sewage spills were reported during the past five years. There were also conflicting water standards between state agencies.

## 6. FOOD SANITATION

Food sanitation is one of the foremost elements of environmental health. Sanitation, whether at the outside or inside of a commercial food serving place, food storage, temperature control, worker's hygiene, cleanliness of food preparation, serving and dining areas, and wholesomeness of food material itself, all constitute food sanitation. Unsanitary conditions can result in the outbreaks of food-borne illnesses. These illnesses are caused by a variety of organisms. Among the bacterial pathogens, for example, various species of *Salmonella* are responsible for four million cases of gastrointestinal diseases nationwide each year (Nadakavukaren , 2000).

In the Inland Empire County of San Bernardino, there were five outbreaks of food-borne illnesses during 1999. County-wide there are 7,000 food places and each needs to be inspected twice a year for compliance with the county code. The number of places failing the food inspection was 35 per month and the number being closed for health code violations was 10 per year. The data presented here are comparable with those of Riverside County. The data available from San Bernardino County were used in tabulating the quality model as follows:

### Food Quality Model

Attribute	Quality Rating	Quality Index Scale
Emergencies	5	1=Good
Violations/Closures	5	2=Moderate
Potential adverse conditions	1	3=Fair
Lack of inspection staff	5	4=Unhealthful
Any other factor	1	5=Hazardous
Total points	17	
Mean quality index	3.4	

The mean quality index is 3.4, meaning fair quality on the index scale. During the period, although there were no deaths, there were outbreaks of food-borne illness. Also, a significant number of restaurants failed the health inspection and those posing immediate health threat had to be closed. Due to vacancy factor, lack of adequate inspection staff, the agency could not meet the rate of two inspections/year in some of the cases.

## 7. HOUSING

Housing, also referred to residential environment, includes single-family dwellings, multi-family dwellings, hotels, motels, hospital, nursing homes, mental health facilities, mobile home parks, detention facilities, organized camps and campgrounds. The quality and maintenance of individual residential environments bear a strong impact on the general quality of a neighborhood. Both existing and new constructions are subject to various regulations such as housing, plumbing, electrical, building and safety. In the Inland Empire, both Riverside and San Bernardino counties have housing regulations under their county codes, for unincorporated county areas. Incorporated cities of these counties have their own ordinances or have adopted from their respective county codes. As a representative sample, the data from the San Bernardino County Housing Program were used in developing the quality model below.

### **Housing Quality Model**

<b>Attribute</b>	<b>Quality Rating</b>	<b>Quality Index Scale</b>
Blight areas, damaged/lost properties	5	1=Good
Substandard housing	5	2=Moderate
Inadequate affordable housing	1	3=Fair
Lack of inspection staff	5	4=Unhealthful
Any other factor- socio-political	1	5=Hazardous
Total points	17	
Mean quality index	3.4	

The mean quality index of 3.4 means a fair housing quality. Based on the data, pockets of blight and substandard housing conditions, especially in the multi-family dwellings, have been reported. The county housing program faces lack of inadequate inspection personnel to cope with needed inspections in accordance with the county code.

## **8. VECTOR-BORNE DISEASES**

The Inland Empire probably reports more vectors and vector-borne diseases than any other place in the state. These include, for example, mosquito-borne encephalitides-Saint

Louis encephalitis and western equine encephalomyelitis (Mian 1996); flea transmitted plague (Mian and Hitchcock 1998) and murine typhus; tick-borne Lyme disease, relapsing fever; and rodent-borne Hantavirus and arenavirus diseases (VBDS-CDHS 1998). Recently two new insects of public health importance, the Africanized honey bee (AHB) and the red imported fire ant (RIFA), have colonized the area. The former has caused several multiple stinging episodes including fatalities in human and animals in the area.

Except for some cities with no vector control services at all, the Inland Empire is served by county vector control programs as well as three well-established special districts namely, Coachella Valley Mosquito and Vector Control District, Northwest Mosquito and Vector Control District and West Valley Mosquito and Vector Control District. Most of these agencies are adequately staffed and equipped to face the daily challenges of vector-borne disease control. Due to funding constraints at some agencies, the services offered are in adequate. It is imperative, however, to always evaluate and enhance resources and be prepared to face new emerging or re-emerging vector-borne pathogens. Emerging problems during the past three years, for example, have been AHB, RIFA and arenaviruses.

Based on the data for last five years, the following model summarizes rating for various attributes for this element in the Inland Empire.

### **Vector-Borne Disease Quality Model**

Attribute	Quality Rating	Quality Index Scale
Emergencies: Human cases and fatalities	5	1=Good
Routine vector-pathogen activity	5	2=Moderate
Potential disasters	2	3=Fair
Lack of field staff and resources	2	4=Unhealthful
Any other factor	1	5=Hazardous
Total points	15	
Mean quality index	3.0	

The above model has a quality index of 3, meaning fair on the quality index scale. Besides the occurrence of human cases and some fatalities, vectors and enzootic activity of pathogens are reported almost every year. The total or partial lack of services in certain areas is of a public health concern. Potential inclement wet weather, especially, the recent El Nino, resulted in abundant vegetation and breeding sources for disease vectors, thereby increasing the risk of vector-borne disease transmission.

## **9. SOLID WASTE MANAGEMENT**

The Inland Empire is served by a number of permitted sanitary landfills, scattered throughout the region. In recent years, efforts to segregate recyclables from other refuse have culminated in some volume reduction, but not enough to cope with the growing

population and area development. Besides domestic waste and biosolids from wastewater treatment plants, used tire storage and disposal have further complicated the overall solid waste management in the area. During the past five years, there were no fatalities or even illnesses directly related to solid waste operations in the area. No major odor, bio-aerosol and leachate problems, or performance standard violations, were known to be associated with landfill operations. The local enforcement agencies of both counties along with city programs seem to have experienced no major technical or inspection staff shortages to monitor solid waste disposal sites. Based on available information, a quality model is given here.

### **Solid Waste Quality Model**

<b>Attribute</b>	<b>Quality Rating</b>	<b>Quality Index Scale</b>
Emergencies: Injuries, fatalities	1	1=Good
Performance standards violations	2	2=Moderate
Potential weather factors	1	3=Fair
Lack of inspection staff	1	4=Unhealthful
Spatial, socio-economic, political factors	5	5=Hazardous
Total points	10	
Mean quality index	2	

The quality index of 2 gives solid waste management a moderate quality rating. However, there are some serious concerns regarding the shrinking number and life of landfills and spatial needs for new ones. Also, socio-economic and political factors do have an impact on solid waste management issues.

## **10. HAZARDOUS MATERIAL MANAGEMENT**

The subject of hazardous material management, within the environmental health science, is relatively new, having for the most part flourished during the last 30 years or so. In recent years, however, hazardous material programs were transferred to county fire

departments. In the Inland Empire, the San Bernardino and Riverside counties have their own hazardous material programs. The area has both small and large quantity generators. Moreover, the area is exposed to hazardous materials being transported through the ground networks of roads and railroads traversing across in many directions. During the past five years, there have been injuries and fatalities due to fire, explosions and spills, associated with illegal drug lab operations, train derailment and other accidents. Based on available information, a generalized model is developed as follows:

### **Hazardous Materials Quality Model**

<b>Attribute</b>	<b>Quality Rating</b>	<b>Quality Index Scale</b>
Emergencies: Injuries, fatalities	5	1=Good
Low level spills, accidents	5	2=Moderate
Potential hazards	1	3=Fair
Lack of response personnel	1	4=Unhealthful
Any other factor	1	5=Hazardous
Total points	13	
Mean quality index	2.6	

The above model shows a quality index of 2.6 or moderate. The injuries and fatalities were caused by accidents. Similarly, low-level spills or accidents are always a possibility whether the hazardous material is at the site or in transit. The availability of a qualified response team is a plus to the index on hazardous material management.

## **11. RECREATIONAL HEALTH**

Recreational health encompasses the health and safety of people engaged in the enjoyment of time at various facilities of skiing, swimming, camping, playing and other sports. From the local agency's perspective, recreational health efforts are directed more

towards the inspection of public swimming pools. In the Inland Empire, San Bernardino alone has 2,600 public swimming pools. Inspection of these pools is carried out to safeguard the health and well being of people using these facilities. Besides being a drowning hazard, unmaintained pools can become sources of pathogenic organisms as well as mosquito breeding. Based on the data on swimming pools provided by San Bernardino County, there were 4 drownings in the last five years. Due to funding constraints, about 300 of the 2,600 pools could not be inspected. The pool closure rate due to health code violations was 300 per month during the summer months. Based on these data, a quality model is developed as follows:

### **Recreational Health Model**

Attribute	Quality Rating	Quality Index Scale
Emergencies--drowning	4	1=Good
Inspections failures, code violations	5	2=Moderate
Potential problems-green pools	1	3=Fair
Lack of inspection personnel	5	4=Unhealthful
Any other- non-funded mandates	1	5=Hazardous
Total points	16	
Mean quality index	3.2	

The model shows a quality rating of 3.2, which on the index scale falls between fair and unhealthful. Several cases of drowning, high inspection failure rate and lack of inspection personnel are matters of concern, notwithstanding state non-funded mandates regarding ground fault interrupters at pools with lights and split main drain requirement for wading pools.

## **12. COMPOSITE QUALITY INDEX**

A composite quality index of a given environment is the sum total of the quality functions of its individual components at a given point in time, using the comparative quality index approach (Jaenicke and Lengnick 1999). Therefore, quality indices



developed for each element, were used in calculating the overall quality index of the Inland Empire in the following model:

### Composite Quality Index

Element	Quality Index	Quality Index Scale
Air quality	2.6	1=Good
Water quality	3.4	2=Moderate
Food sanitation	3.4	3=Fair
Housing	3.4	4=Unhealthful
Vector-borne diseases	3.0	5=Hazardous
Solid waste management	2.0	
Hazardous waste management	2.6	
Recreational health	3.2	
Total	23.6	
Composite quality index	2.9	

The above model shows a mean quality index of 2.9, which is defined as fair to moderate quality. In order to improve the overall quality, individual areas such as food, housing and recreational, could be helped by additional funding to meet their staffing needs. As a whole, most if not all, areas have their established public educational programs. The recommendation here would be that there is always room for improvement. Public education should be an integral part of mandate of each element of environmental health.

### 13. SUMMARY

Efforts to develop a quality paradigm for the Inland Empire were undertaken by a community university partnership in 2000. The community partners included the San

Bernardino County Department of Public Health--Division of Environmental Health Services, Mojave Desert Air Quality Management District, Coachella Valley, Northwest and West Valley Mosquito and Vector Control Districts, and Inland Empire Economic Partnership (IEEP). IEEP carried out the sustainable communities survey involving county and city governments. The results of this survey rated the Inland Empire general environment as 94% --from fair to excellent. The survey included individual elements of environmental health such as air quality, water quality, food sanitation, housing, pest and diseases, solid and hazardous waste management.

As a precursor to the overall quality index, quality models for individual elements were first developed, using data from various quality attributes. Based on the last five-year data on quality attributes for each element, the quality indices by element were 2.6 for air quality, 3.4 each for water quality, food sanitation, housing, 3.0 for vector-borne diseases, 2.0 for solid waste management, 2.6 for hazardous material management and 3.2 for recreational health. Based on the sum total of individual elements, the composite quality index for the Inland Empire was 2.9, fair to moderate quality. For interpretation of the numerical indices, a quality index scale was designed to read 1= good, 2=moderate, 3=fair, 4=unhealthful and 5=hazardous.

The paradigm developed and presented in this report is the first of its kind for this area. It can be revised and modified from time to time as the conditions warrant. It is not a fixed forecast for the future, but a comparative quality model based on events that took place in a given time span.

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