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Participatory housing adaptive design to contribute a solution of the harmful effects of dust indoors: Agua Prieta, Sonora, México case of study

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Abstract

A participatory process of housing design plays an important role in the adaptation of the society to climate change. The development of a model of adaptation into a healthier home by assessing the negative effect of dust is an example of the importance of applying an environmental risk assessment as a source of information for an individual design. The participatory design may reflect the needs of the household members to avoid environmental hazards and to adapt the house to the specific characteristics of the inhabitants. An individual unit (household) within a semi-arid region deserves to assess the specific environmental exposures that the dust might carry and potentially impact the population. The adaptation is a methodological assisted plan that rely on Sustainable Livelihood Framework as a way to describe the needs and potential strengths to optimized the adaptation strategies; Vulnerability Assessment; Environmental Air Quality Stress inventory for the hazard identification; and Human Health Risk Paradigm to correlate the characteristics of the people with their susceptibility facing environmental exposures; Specific control identification of housing design and adaptive techniques. The commitment of this research is to generate a participatory based process of housing design that contributes to solve the affectation that dust cause on human health also considering the improvement of the performance and energy consumption of mechanical systems for temperature and air exchange.

Keywords: Adaptation, Healthy Homes, Participatory Design, Air Quality, Dust, Housing Design, Climate Change.

1. Introduction

Adaptation strategies are effective alternatives to avoid negative impact of environmental stresses. In this literature review the objective is to find the most important effects of Indoor Air Quality on houses. A stressor is the human and/or natural caused environmental impact to the ecosystem and its extended influence on species and human population. The identification of environmental stressors is valuable to clearly involve the correspondent stakeholders and engage those in actions strengthen currents adaptation plans and future initiatives that, in an optimistic way, could even apply to policy recommendation.

Indoor Air Quality is impacted by the consequences of landscape degradation and deforestation including urbanization as the most aggressive contributor of releases from vehicle exhaust, industrial pollutants, garbage dumpsters, and soil gas such as radon, underground storage tanks, or pesticides (EPA, 2012). De-hydration of stagnant water will become a stressor on Air Quality by adding microbial particles (Mohamed Ebtessam, 1997). The values designated to measure the impact of environmental stresses is proposed as a combination of number of stresses happening around a cluster population plus the health effects of the exposure of those stresses founded.

The construction of indicators to measure adaptation capacity of population shall be a result of the analysis of livelihoods and vulnerability. Both analyses demand an accurate collection and interpretation of people's perceptions about their assets, and the assessment of their ability to change their behavior in response to cope with their changing circumstances. A participatory process is proposed to integrate stakeholders not only to get consensus but to share a vision of necessary adaptations to avoid negative environmental conditions, in this case addressing Indoor Air Quality for healthy and economic factors.

There is a need for better and more interactive ways to measure and monitor the impacts of adaptation and development programs and projects (Danielsen et al. 2005). Therefore a process of participatory design in the arid region of Agua Prieta, Sonora, Mexico is a tool for poverty alleviation, improvement of livelihoods and project design and implementation is proposed to engage community members along with their own expectations, aspirations and concerns to build Indicators. The characteristic of this border region are meaningful for its social and economic challenge.

The significance of the participatory process is the approach to a complex problem of measuring wellbeing within the household having as stressor the presence of continuous population growth due to immigration, causing land degradation and water stress; both expanding the exposure to poor air quality.

Having on mind that Agua Prieta occupies a semi-arid region between the Chihuahua and Sonoran deserts, temperature comfort and the affordability of it is important for the inhabitants and should be considered in the design proposes.

2. Participatory design process

A house is the place that limits the family's territory, therefore the participation of household members is essential for the shared responsibility on its design and the expectative that the home should accomplish. It is also the chance to get minorities involved in decisions that commonly exclude them (such as women, children or the elderly).

Some of the design determinants that are expected to be defined by the participation of the family are the uses and importance of the elements of the house (living room, bedrooms, kitchen, and so on). From the choice of the land to the orientation, construction materials, and future plans to increase or decrease the number of household members, the multiplicity of opinions is the best way to make future steps.

The characteristics of the participatory approach help to realize the individual strategies to cope with environmental conditions. Examples are observed in everyday situations where each member of the family has a particular way to solve complications. An example is when mothers arrange furniture differently to sleep by the kid with high temperature is one of the simplest

strategies that, for its sporadic periodicity is not observed in any model of house. But what is happening when the risk of facing an environmental stress, such as flooding, is the house prepared or design, not only to save the integrity of household members, but to avoid expensive damaging on the assets? Having, for instance, the entrances, kitchen and even living room furniture at ground level, represent, perhaps, the mainstream model of houses, but with only two feet of water level the furniture will be reached, the main entrance blocked, the garbage cans floating, and the food into the refrigerator unreachable and/or contaminated. The options are many; consensus regarding the strategies to avoid this situation needs to be reached through the participation of all members.

Another scope of the participatory process is the involvement of community, local authorities, even NGO's and small business or providers of, for example, construction materials, local services and infrastructure administrators. In the case of Agua Prieta, being a border city between Mexico and United States, the extended family, NGO's, social services providers, and migrants are also source of stakeholders involved in decision making in housing development.

3. Air Quality stressors

Environmental stressors identified in the border region between US-Mexico are in the range of variability of the dry and wet seasons that suggests severity of events and a lack of capability to resist droughts and floods (Garfin et al., 2013). Other are heat waves that stress the more when preceded by a long period of drought, a side of the effects on human and natural environments, the connection between the compaction of soil after periods of drought, make an excellent path for floods and runoff speed during intense storms.

Other impacts, also related to Climate Change, are those in land use and land cover, human and nature. The combination of land degradation and severe wind is associated with acute air quality and deforestation. Along with the pollution from vehicles and other emitters, there are many particles that are related to an increase in Climate Change airborne particles. The origins of those particles are wildfires, dust storms, and pollen (MOLHAVE, 1991). Air Quality from microbial particles expands even across continents. Microbial particles are originated from mold, industrial discharges, contaminated outdoor air including vehicle exhaust, pollen, or industrial pollutants, nearby source emissions like garbage dumpsters, and soil gas, for example: radon, underground storage tanks, or pesticides(MOLHAVE, 1991) (BALLUZ ET AL, 2001) (BASS ET AL, 2001).

Pesticide is the most prominent Air Quality stressor, specifically DDT that has been banned in United States since 1972 is still in use for Mexican agriculture due to its low cost. This example is one among many that emerge from the complexity created by the need of agricultural products to fight poverty, but also the subsistence directly remediated by the consumption of the products from locals (Leichenko & O'brien, 2013).

The proliferation air quality stressor follow the path for particle deposition and human exposures from particles suspended in breathable air (BASS ET AL, 2001), the contamination of food or drinking water, or absorption through the skin. DDT is regarded to be a cause, for example, of Lupus (BALLUZ ET AL, 2001) and its intrusion to the interior of houses is of main concern.

4. Agua Prieta

Agua Prieta is a semi-arid region of the Northwest of the Chihuahua desert. This region is a minor port of entry to US (Dillon 2000) but with significance for being surrounded by rivers. The city is developing in a grid; the subdivision is by “solares” (pieces of land 7 x 10 meters on average).

The Mexican Constitution in its article 27 and as part of the successes of the Mexican Revolution stipulates that the land belong to whoever worked on it. The extended version of this constitutional article protects water access and the state is obligated to provide basic infrastructure to preserve local and traditional economic activities such as farming, commercialization of products and has the right to self-governance by community entities named “Ejidos” (COVARRUBIAS 2011).

The area of 3,631.65 km² has the official land use code of ejido (ranching) with a central area of urban center that allows the head of the municipal council to set along with infrastructure and services. The development of this place is suffering a transformation of needs on society that has pushed the configuration toward a generalized quasi-urban center. This transformation is led by Global Change and Migration by a double exposure (economic and climatic) mainly motivated by pressures in the hometown of people where economic problems in rural areas of developing countries are increased by the environmental effects of climate change. Extreme climate conditions that impact crops and livestock contribute to increasing food prices influencing people to migrate to the U.S. (Deheza 2011).

This phenomenon (that is not new) is causing urbanization. The strategies behind human movements are poverty reduction and restoration of the 5 fundamental categories of categories: physical, economic, natural, social, and human.

In the Census Data of Mexico provided by INEGI (National Institute of Economics, Geography and Statistics) the border between Mexico and the US is experiencing two patterns of population growth: natural and social. The natural growth is from birth rate and social growth that is the addition of extended family, including marriages, and immigrants. Along the border, the dependency ratio of the population that is not in the labor force is 58.0% (51.6 % infants less than 16 and 6.4 % more than 65). The number of member of the nuclear family has declined, the average family size is 4, but the average number of members of the household is 8. (bnuno2012). Those numbers indicate that the household is either receiving extended family or migrants who will constitute as part of the adaptation strategy implied on human movements.

In terms of economic activities, the border region has, on the one hand ranching (agriculture + livestock) and in another hand the maquiladora industry (WILDER ET AL, 2012). Both activities are facing a decline of its production and demand. Agriculture is mostly for local consumption, and livestock and its derivate products are for statewide sale. Nevertheless as part of the adaptive capacity of the population, a third option has been established and “services” became a source of income.

Agua Prieta is an ideal place for ranching also attractive because of the link with USA, especially since NAFTA, the Free Trade Agreement gave Agua Prieta a big boost towards development (INCA2010), the settlement of maquiladoras and the enforcement of the border ignited the population growth that now is taking over the traditional economic activities moving the city to a mixed use development, full of services for immigrants and other related profitable uses.

Programs, policies and strategies from the local, State, and Federal government are given under the legal regime of “ejido” and prioritize NAFTA over local priorities (Dillon 2000).

Maquiladoras began as a successful effort for employment opportunities that has diminished due to competition from China (DEHEZA 2011) (WILDER ET AL, 2012) . Up today industry is suffering for budget cuts lowering the opportunity to keep operating as proper. Therefore, releases to the environment are worse over time due the lack of maintenance polluting water bodies and air quality. The contamination is produced by the suspended solids, fumes, vapors, and rising temperature on both, water and air.

The dynamic of the social, environmental, and development changes of the region are responsive to a local reality that is determined by the need of survival and the adaptation of new exterior influences that local must deal with (Bryant 1998) (Escobar 1999). People of Agua Prieta have developed several strategies to use their assets wisely, as services are profitable and ranching is not a viable economic strategy anymore. The local economy have developed a modern alternative based on the development of the place to which are linked (Escobar 1999), in this case, the urbanization and abandonment of ranching.

The strategies to fight the unfair income rate in the area that are indifferent to the abandonment of land are: Commoditization of the capitals (assets) as alternative for poverty alleviation by adapting the house into a mixed use (house+retail) that allows people to have extra income due the demand of rooms and services. Facing Climate Change, the people look for having enough money to install air conditioner, double windows, paved roads, carpet in the living room, etc, such as the people on the another side of the border.

5. Outcomes

The current situation of Agua Prieta is built on the knowledge obtained by the everyday struggle over resources and capitals. As Robbins 2000 remarks, this knowledge is more substantial and meaningful in the frame of local politics and in Agua Prieta is even overwriting land ownership regime and distribution of budget from state.

The outcomes perceived by the exchange of commodities are:

- Money gained from renting rooms, laundry, cooking, cleaning, etc.
- Soliciting and selling small items on streets.
- Extended family living in the same house contributing to have more income, more variety of skills, shared responsibility on paying utility and property taxes.

Vulnerability of the population in Agua Prieta

The population of AP is facing a variety of exposures. The impact on the vulnerability is defined by the extent of its impact on livelihood indicators.

From the environmental exposures: Contamination and depletion of water bodies due to the water usage from the Maquiladoras and the discharge of polluted water back to rivers. This usage contributes to the lack of water for livestock crop, irrigation, and human consumption. Degradation of riparian areas from the depletion of water sources is a problem for local flora and fauna, the life cycle for local habitat is damaged already (El Informador 2012). Desertification experienced due to water depletion and, most importantly, urbanization which has negative

consequences on the environment (Appeal 1976). Warming and cooling environmental effects of Land use change are also an issue as the development is growing without an adequate planning (CGate2010). Immigration for Climate Change result in urbanization, desertification, and loss of agricultural areas diminished the supply of food and income opportunities (Deheza2011).

Exposures to poverty in Agua Prieta where the overall numbers are: 7.1% of the population suffering extreme poverty less than 1 dollar a day, and 39% suffering moderated poverty less than 2 dollars a day (World Bank). Other conditions that define poverty are:

- 12.8% do not have complete elementary school
- 0.36% do not have connection to the sewer system
- 2.9% without electricity
- 0.95% do not receive tap water
- 34.1% are living in overcrowded household
- 2.5% are living in houses with dirt floors
- 41.4 % with no access to health care
- 53.6% do not have Social Security Benefits
- 2.5% are food insecure

Exposures to immigration is mainly about the role of borders as a place for movement where confrontation between locals and migrates creates tension due the increase of dependency of economy (Cunninham&Heyman). Exchange of commodities cycle in Agua Prieta is: no clients, no sales; more migrants equals more clients; more migrants equals more competition for resources, services and income opportunities. The border community has an official population of 70,303. According to the 2005 census, the undocumented migrant population accounts for as many as 50,000 additional residents who that arrived in the last 20 years (Blessed 2010).

Adaptive capacity

The top 3 adaptation strategies for social reorganization facing the listed exposures in Agua Prieta are:

- Sharing the household with extended family and renters
- Transforming the land into house, and house into mixed used
- Crossing the border to US

6. Sustainable Livelihoods Approach (SLA)

Following Bond and Mukherjee (2002) and Aldrich and Sayer (2007), using the “Sustainable Livelihoods Framework” (Ellis 2000) to help define and organize indicators were livelihood includes the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutional and social relations) that together determine the living gained by the individual or household.

Human Capital

Agua Prieta has 48 % of the population between 16 and 65 that is the “productive” piece of population that is typically in the labor force. From this group it is experienced a 12.8 of people with no more that elementary education.

Dependency Ratio 58.0% of the population that typically is not in the labor force

- 51.6 % infants less than 16
- 6.4 % more than 65

The National Income Survey of Household Based Expenses and the National Advisory Board of Population published that on 2008 the extended families rate growth experienced an increment of 22% and the nature of this increment are organizational difficulties to manage the independent living of individual people, in special those who are over 65. Analyzing deeply, some more detail about this adjacent of extended families indicate that:

- 1 out of 10 Head of Household went back to their parents’ house
- 28% of the households have the head’s parents living in their houses
- 15% of the Head of Households have people with no blood relationship living on their property
- The number of member of the nuclear family has declined, the average family is 4, but average number of member of the household is 8.

(BNuno2012)

Economic Capital

The more people at home, more economic activity and income chances, following the information cited on the Human Assets description indicate very strong relationship between the population growth and economy of households.

The 38% of the people with economic activity (which is the 57.5% of the people between 16-65) earn less than \$123.00 pesos = 9 dollars per day and

- Ranching (agriculture + livestock) is decreasing every year, the remaining activities are agriculture for local consumption, and livestock and derivate products are for statewide sale.
- Maquiladora principal production: clothing, equipment for hospitals, electronics, furniture, computer parts, building materials.
- Services and home based business: rooms for rent, corner stores, arts and crafts, etc.

Natural Capital

- 3,780 ha agriculture
- 356,682 ha livestock
- 3,665 ha of plots that has change the land use code into urban center
- Río de Sonora, Río Bavispe, Punta De Agua y San Pedro.

Physical Capital

Agua Prieta has 3617.66 km² of territories from where 90% of the territory ejido land use mode divided by 7 allotments managed by cooperatives.

Social Capital

The city has several social based institutions that consistently help the population in needs such as social justice, health prevention and treatments, education, capacitation, and especially those that attend side effects of immigration.

In the area of housing, there are two main social programs that provide people with the possibility of have a house. The National Workers Housing Fund works as a small based saving account that, depending upon the income of the workers, creates a fund that might be used to buy or build a home. In order to be benefited by this fund, the person should be a formally employed worker of an affiliated employer and apply for the acquisition of a legal land or house. The State program, for home improvement, supported by the Federal Government, thru the State Commission of Housing is a 50-50 partnership with home owners that provide either material or labor for improvements at legalized housed under Residential Land Use. This program has had different names but generally is working since the 90's nationwide. In a different prospective, political parties and other social organization (such as but not limited to cooperatives) help people to apply to the Land Use Code change in order to be able to either legalize the land and get the state support for improvement, or to access to the Workers Fund. Sadly, a great amount of people do not work for an affiliated employer. The alternative then is to save money at a household level to build a home as is possible.

7. Developing livelihoods indicators

The participatory processes identified key themes, concerns and hopes, relating to each category of livelihood assets.

TABLE 1 Developing livelihoods indicators		Contributions from household to participatory house design		
	capital	outputs	contribution	
Human Capital	10 % of Head of Household get back to their parents house	more overall income more participants	yes	
	28% of the household have extended family		yes	
	15% have renters with no blood relationship		yes	
Economic Capital	38% pop with economic activity	income	yes	
	Dependency ratio is 58%	people less than 16 and more than 65 who sell or offer services=income	yes	
Natural Capital	3,780 ha agriculture	declining	no applicable	
	356,682 ha livestock	declining	no applicable	
	3,665 ha of plots that has change the land use code into urban center	increasing	yes future	
Physical Capital	3617.66 km2 of land	owned by individuals organized in cooperatives	yes	
Social Capital	State and federal programs	50 to 100 % cost of house or improvements	yes	
	NGO's	outreach	yes	
	Family + extended family	social and economic support	yes	
	Cooperatives	outreach	yes	

From the review of the data founded on census and official sources from local and state government, the livelihood analysis in table 1 show that per each capital in is an outcome that in some degree contributes with the availability to change the house configuration. From the Human capital it is noticeable that the strategies adopted by the community increase the participation of household members in the decision making process. It is also a reliable way to increase the availability of money to be invested on physical changes.

The Human and Economic Capitals are tied since the more people at home, the more income opportunities. Within the Natural Capitals is only the land use change over the original farming use the one that will provide of more parcels for future development. This value applies to the Physical Capital too.

Social Capital is the source of possibilities for an organized development of participatory based projects. The partnership between state and social institutions is one of the most promising alternatives for adaptation. Table 1 demonstrates how each Social Capital has an implication on housing configuration.

8. Vulnerability assessment

Table 2 describes the sequence that the Indoor Air Quality follows. From the exposure that the people in Agua Prieta are currently facing to the strategies developed. The impact on outdoor and indoor AQ responds differently depending upon the implication of either environment, for example: degradation of riparian areas has a considerable impact on outdoor AQ but is not worsen the interior condition of a house, whereas the increment of household members has no impact of outdoor air quality but increase the risk of face more pollutants inside the houses. For this last case, the index value “low” implicates the secondary effect of the increment of people is resulting on sprawl.

TABLE 2 Building Vulnerability analysis indicators		EXPOSURE IDENTIFICATION			
	exposure	strategy	impact on Air Quality	Impact on AQ Indoors	
Environment	depletion of water bodies	quit from farming	medium	medium	
	degradation of riparian areas		medium	low	
	desertification	urbanize the land get processed/comercial products	high	high	
	extreme dry and wet seasons		high	high	
	extreme heat and cooling seasons		medium	high	
	immigration*		medium	medium	
Poverty**	31% of pop with >2 dlrs/day	densify the property	low	high	
	34.1% living in overcrowded household	rent a property	low		
	41.4 % with no access to health care	mixed used the property	low		
	53.6% do not have Social Security Benefits	cross the border sell or offer services	low		
Immigration	confrontation	crossing the border sell of offer services	low	medium	
	economic dependancy		low		
	sprawl		low		
	lack of jobs, services and infrastructure		low		

*as a result of extreme climatic conditions in the hometown
 ** only indexes above of 30% of the population affected by the exposure

9. Implication of dust on human exposures at home

Indoor environments are isolated volumes where, in this case, houses have partitions and openings that basically affect the movement of air and that is of great importance because air is the vehicle of pollutants and is also main factor of movement of its particles from surface to surface.

The presence of dust as fact of Ingestion and inhalation is of great importance when thinking on, not only cleaning procedures but also in interior design from where houses is meaningful because the family members are of the variety of the populations and no for a selected people that use labs and other air flow designed environments. Children, elder people, people with disabilities, and so on... Another fact to consider is that in houses we also do different activities that might increase the exposure to dust such as food preparation and accumulation in places that are reachable to children, having also the accumulation of dust on places for deep breathing such as bedrooms. (Paustenbach, 1997)

The EPA has been ranked indoor pollution as high environmental risk because of the content that has being found such as household chemicals, tabaco smoke and other pollutants and allergens. Home pollutants might result on retarded growth, learning disabilities, allergies, cancer, nervous system damage, and other illnesses.

10. Dust Fact Sheet

- Steady state of dust:
- Suspended and re-suspended particles, surfaces in the homes, and on the skin
- Routes of dust: Inhalation, non-dietary ingestion, ingestion of particles adhering to food, as well as by absorption through the skin.

11. Dust and its proven health implications related with the specific vulnerabilities in Agua Prieta:

Fossil fuels exhaust: main trigger for Asthma that is a respiratory disorder that increases, and sometimes is directly caused by air pollution. Some of the effects of the urbanization is the increase on exposure to pollutant with high content of chemicals that affect people with asthma due inflammation of the respiratory track and other implications. Example such as Diesel exhaust particles which is a major component of traffic has been proved as a detonator of hyper-responsiveness of the airway to air pollution in humans. Chemical pollutant also might enhance allergic sensitization and inflammation associated with its ability to generate oxidative stress promoting inflammatory host responses worsens the asthma attacks prevalence and severity (Lee, 2013).

Pesticides: Indoor dust in a promoter of Nitric Acid, Beryllium, Aluminum, and Molybdenum digestion because are small particles that get into households by attachments on clothing and shoes, wind carried, or on fresh food (Beamer, 2012). These pollutants are applied also to residential pesticides becoming a potential exposure to people in special children via inadvertent ingestion. (Butte, 2002).

Dust mites: small animals that came from the family of the spiders and eat dead cells, because of this fact, they are always populating the accumulations of dead cell on dust and can become also in a vehicle of particles. House dust mites have an important role as their feces Der p1 are a potent allergen (Gaynor, 1998).

Grass pollen: This agent acts mainly outdoors but due the pathways that dust takes to get into households, it is present in a close environment reaching people easier and the affectation is year round because the cleaning patterns do not completely erase the pollen track.

12. Human Health Risk Paradigm

In order to measure the risk that humans face to Indoor Air Quality in specific to dust, the table 3 organize the most important trigger for negative dust content indoors a long with the indicator that gives a quantitative value to the exposure to each element. To build the indicator it is important to integrate the three characteristics for a particulate of dust: size, shape, and origin.

Size determines the feasibility of the particle to reach the interior of human body. Understanding that the more dipper in the organism, more possibilities to create a chronic disease. Shape describes the kind of deposition and the damage that can make in the tissue. Origin stands for the human ability to adapt to the presence of a particle and its impact.

For the integration if the result of table 3 in the participatory process, the highest number will represent the most important issue to address, and the sequence that the indicators is result of will give multiple discussion points to the participants during the process.

TABLE 3-a Human Health Paradigm		Health implication of exposure to dust								
	manifested on	by	pathway	effect	house feature related	human activity related	particle size	particle shape	particle origen	Indicator
fossil fuel exhaust	chemical content of air	urbanization	inhalation	Asthma Emphysema cancer	doors, windows, leakages, chimnes, attached garages	transportation	pm 0.1	shape	chemical	8
pesticides	chemical content of air	agriculture house keeping	inhalation absortion ingestion	poisoning	doors, windows, leakages, chimnes	carring on clothes, shoes, food preparation, water storage	pm 2.5	flakes	chemical	8
	chemical content on fresh food									
	deposition on water									
dust mites	accumulation of dead cells	humans	inhalation ingestion	allergies	bed rooms, living rooms	hygene	pm 5.0	variates	natural	6
	deposition of Der p1									
grass pollen	organic matter on air	nature	inhalation	allergies	doors, windows, leakages, chimnes	carring on clothes, shoes, food preparation, water storage	pm 10	variates	natural	5
discussion within participatory process							Vulnerability Idicator			

TABLE3-b		
size index		
pm 0.1 = ultrafine	pulmonary deposition	risk value 4
pm 2.5 = fine	tracheobronchial deposition	risk value 3
pm 5.0 = midium	nasal deposition	risk value 2
pm 10=big	nasal deposition	risk value 1
shape index		
flake	stick	risk value 1
spheric	roll	risk value 2
undetermined	variates	risk value 3
fiber	attaches	risk value 4
origen index		
natural	human can adapt	risk value 1
chemical	human is not likely to adapt	risk value 2

13. Participatory design task

Develop of livelihood indicators and Vulnerability Analysis should be individualized to the specific household. The specificity of the capitals will reflect the particular indicator of each family helping on decision making towards house participatory design. Some of the bullet point on the survey should include:

- Home inspection (indoor and outdoor)
- Record of personal activities (smoking or personal hygiene)
- Housekeeping products (deodorizers, cleaning materials, or dust)
- Maintenance activities (remodeling, new furniture/carpet, or pest control)
- Miscellaneous: Emissions from office equipment (photocopier machines, VDTs) cars, power plants, etc.
- Office supplies (toners, carbonless paper products)
- Liquid spills or leaks
- Room occupant load
- Thermal and/or humidity comfort

A comprehensive survey will define the Human Health Paradigm creating values for the specific situation at home.

14. Conclusion

Poor housing conditions in low-income homes, such as overcrowding and housing disrepair, are associated with pest infestations and dust infiltration increasing residues indoors (Butte, 2002).

Averaged age of the inhabitants, economic activities, cleaning procedures, and some other factors are related with the characteristics of the households and the exposures that a border city faces may be considered to create a specific plan to adapt a house accordingly.

The participatory process develop in this article, is comprehensive analysis of an specific situation that is experienced in a semi-arid region that also have social riots and pressures.

The variety of strategies to succeed on a house design relies on the availability to capture the more descriptive indicators possible to build a better judgment of the participants. The process presented is considering the essential facts of a responsible design which are: human exposures, household capabilities, and scientific knowledge.

Once these series of steps are done, the possibilities of having a participant's discussion on medullar decisions is endless and so the possibility to solve people's hopes and inspiration.

The expected outcomes from a participatory design process are: a responsible distribution of the space, the awareness of health related issues, the identification of risk, the management of the real adaptation capacities of the household, and the set of future goals for uses, behavior and collaboration. The ideal result will be a sustainable design that addresses people's economic capacity of maintenance within a healthy environment.

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