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Theoretical Orientation of Community based Disaster Risk Management

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Abstract- Adapting to effects of climate change and disaster risk reduction at present requires that the community at risk takes a leading role. This paper presents a theoretical underpinning of community based disaster risk reduction and management (CBDRRM). Ideally it is government's responsibility to reduce vulnerability in communities. So far emergency response effort is the main approach being used. While the community has been perceived as the powerless recipient of support in times of a disaster. The community have the capacity, knowledge and skills of understanding their daily hazards they are exposed to but it is the influence support from outside the community that make them less willing to apply their local coping strategies to address disasters and hazards they are exposed to. The article presents a theoretical orientation for community based disaster risk reduction and management.

Keywords: hazards, exposure, vulnerability, capacity and community participation .

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Theoretical Orientation of Community based Disaster Risk Management

Adrian Phiri ^α, Dewald Van Nierkerk ^σ & Elize S. van Eeden ^ρ

Abstract- Adapting to effects of climate change and disaster risk reduction at present requires that the community at risk takes a leading role. This paper presents a theoretical underpinning of community based disaster risk reduction and management (CBDRM). Ideally it is government's responsibility to reduce vulnerability in communities. So far emergency response effort is the main approach being used. While the community has been perceived as the powerless recipient of support in times of a disaster. The community have the capacity, knowledge and skills of understanding their daily hazards they are exposed to but it is the influence support from outside the community that make them less willing to apply their local coping strategies to address disasters and hazards they are exposed to. The article presents a theoretical orientation for community based disaster risk reduction and management.

Keywords: hazards, exposure, vulnerability, capacity and community participation.

1. INTRODUCTION

The paradigm shift of disaster management from reactive emergency approach to proactive disaster risk reduction approach as identified by Abarquez and Murshed, (2004) presents a justification to the emergency of community participation rather than external emergency support. The starting point of community understating of hazards and disasters is through Participatory Rapid Appraisal (PRA) and Community Driven Development (CDD) in community mobilisation and local development. The paradigm shift in disaster management from the traditional relief and emergency response approach to the proactive disaster risk reduction approach is very critical to empower the community at risk. The paper concludes by highlighting community based risk reduction model as a sustainable approach of reducing disaster risks.

a) Background

The lack of comprehensive governance and legal framework usually (top-down approach) contributes to the failure to set clear disaster risk reduction targets for communities-at-risk (Holloway,

2003; Pelling and Wisner, 2009). Furthermore, governments or nations must ensure that Disaster Risk Reduction (DRR) is a national and local priority through community participation so that local needs are met (Priority for action No.1 of the Hyogo Framework of Action (UNISDR, 2004).

The most effective way to reduce disaster risks in informal settlements is to work with the local people to identify and analyse their vulnerability and capacities, and to develop and implement a disaster risk management action plan which will support them in their progress towards sustainable living (Venton and Hansford, 2006). Development efforts and strategies in CBDRM are focused on helping the poor and supporting them to become increasingly self-reliant in dealing with many of the disaster risks they face in their daily life (Allen, 2006; IFRC, 2009:59).

b) Historical perspective of CBDRM

The history of disaster management dates as far back as around two hundred years and beyond, to when the federal government in the West (United States of America) participated in disaster activities that were related to war (Drabek, 1991; Mc Entire, 2007). After the Second World War, the community based disaster risk reduction model received recognition at national and local levels by planning professionals. It was called the professional model or Comprehensive Disaster Management (CDM). However, since 1945, debates on disaster research have identified some inadequacies in the Comprehensive Emergency Management (CEM), as overlooking the *social constructs* of disaster reduction (Newport and Jawahar, 2003; Trim, 2004). The difference between CEM and CDM concentrated on emergency relief operations while CDM addressed social constructs which expose communities to disaster risks.

In the mid-1980s, the comprehensive disaster management approach was perceived by many scholars as being top-down, expert-led and a technology driven approach. This approach was alleged to have failed to address community's needs and priorities of reducing vulnerabilities among the poor (Maskery, 1989). It focussed on addressing the vulnerability of communities at the expense of the local community coping capacities. The United Nations International Decade for Natural Disaster Reduction (UN-IDNDR, 1990 - 1999) conference resolved to

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change this approach in disaster management from post-disaster relief and rescue to pre-disaster mitigation and preparedness efforts. This was to empower local communities, governments, NGOs and civil society organisations in the disaster management decision-making processes. Emergency relief projects are not sustainable in the long run. Ever since then, governments and NGOs have been putting tremendous efforts into reducing vulnerability by enhancing sustainability in reconstruction and rehabilitation by disaster management programmes (Shaw, Gupta and Sharma, 2003).

During the 1990s, practitioners and policy makers rapidly adopted Community based Disaster Risk Management (CBDRM) as an alternative to top-down interventionist approaches in disaster management (Heijmans, 2009; Allen, 2006). So far, research has shown that Community based Disaster Risk Reduction Approaches (CBDRA) yield the best results and the most trustworthy primary data to help understand the disaster risk profile of communities (Anderson and Woodrow, 1998; Abarquez and Murshed, 2004; UNDP, 2009: 2; Pelling and Wisner, 2009). For the purpose of this study, the terms Community based Disaster Management and Disaster Reduction Approaches (CBDRM/CBDRA) are used interchangeably as they emphasise the context of community. Disaster risk management implies a general process of addressing disaster risks while the approach is specific in terms of methodology. Of late, community based 'bottom-up' approaches to disaster risk reduction have become a common strategy for development at local level (Uitto and Shaw, 2006). Over the last twenty years (1994-2014) or so, 'top - down' emergency response approaches in disaster risk reduction alone have failed to address the local needs of vulnerable communities (Shaw, 2011). In whatever form a disaster occurs, it needs to be managed, and society needs to prepare for it by either reducing its impact or by recovering from it. The management of disasters in the past focused on emergency response. Emphasis was on relief and emergency supplies for disaster victims. People affected by disasters were regarded as being vulnerable and passive victims or recipients of aid and not as potential resources for development, capable of sustaining their own livelihood (Heijmans, 2009; 2004).

Evidence shows that most top-down disaster risk management and response programmes have failed to address the specific local needs of vulnerable communities (Abarquez and Murshed, 2004). Programmes that ignore the potential of local knowledge, resources and capacities have in some cases even increased people's vulnerability. However, grassroots or local level strategies should be linked to appropriate top-down strategies and government interventions (Anderson and Woodrow, 1998; DFID,

2005; Fraser *et al.*, 2006). Successful community based DRR interventions create resilient communities, whilst reducing vulnerability through development projects (UNDP, 2004; UNISDR, 2004; DFID, 2005). In this regard, the use of community's capacity and resources is crucial to ensure wide acceptance, ownership, participation and sustainability of DRR programs (Shaw *et al.*, 2011). The community is, after all, the key factor and primary beneficiary of DRR interventions.

Research conducted on the approaches used in managing disasters in the recent past has shown that disaster mitigation is becoming more and more community based (Twiggy and Bhatt, 1998; Quarantelli, 1989; Mileti, 2001 and Shaw and Okazaki, 2003). It has become imperative to put more effort in incorporating disaster risk management aspects into the holistic development planning for communities. As Maskrey (1989) rightly points out, disaster (risk) management should not be treated as a single issue but should be incorporated into the socio-economic activities of local people. CBDRM approaches improve the position of impoverished, vulnerable, disaster-affected people by addressing the root causes of their vulnerability, and by recognising their fundamental right to participate in decisions that have an impact on their lives (UNISDR, 2005; ADPC, 2004; Li, 2002).

II. COMMUNITY VULNERABILITY TO DISASTERS

Disasters affect people at different levels based on their capacity and vulnerability to withstand them. According to the International Strategy for Disaster Reduction (ISDR), (2009), vulnerability refers to long-term factors and conditions that adversely affect the ability of a community to respond to, cope with or recover from the damaging effects of the occurrence of hazards or disaster events. Furthermore, Mileti, (1999) and McEntire, (2001) argue that whether one considers a community, an individual, the economy or a structure, vulnerability depends upon the coping capacity relative to the impending impact of a hazard. Generally, poverty is an underlying cause of vulnerability in most communities and informal settlements in particular. The poor are particularly vulnerable to disasters due to their already limited access to sustainable daily livelihood assets such as food security and access to basic services of shelter, water and sanitation.

The poor in urban areas are exposed to disaster risks due to factors such as increasing levels of unemployment and lower wages, higher prices of basic goods, subsequent limited food security, and residing in densely populated locations with poorly built houses on land that places them at risk (UNDP, 2013; UNISDR, 2004, p.xi). The UNHABITAT (2007) Report confirms the assertion that the poor do not intentionally take action to reduce their exposure to environmental risks. This is

because they are consumed in their immediate demands for survival amidst high levels of poverty. A vulnerable community has no capacity to use local resources or get adequate support outside their locality to manage disaster risks.

Vulnerability is not only a natural phenomenon of lacking capacity, but also a result of an entire range of constantly changing biophysical, social, economic, cultural, political and even psychological factors that shape people's lives and create the environment in which they live (Clark *et al.*, 2000; Twigg, 2001:6 and Kizilay, 2010).

a) Disaster risk reduction and the community

Communities become susceptible to disaster risks because they lack the ability to use available skills and resources to manage disaster risks they are exposed to. Coping capacities therefore contribute to the reduction of disaster risks and building resilience through active participation of the affected community (UNISDR, 2009; Blakie, 1994; Mileti, 1999). Traditionally, disaster management interventions were framed as emergency approaches that overlooked the role a local community could play in reducing vulnerability (Abarquez and Murshed, 2004). During disaster events, some support institutions view vulnerable communities as victims and beneficiaries of relief supplies with no capacity to help themselves (Wisner *et al.*, 2007).

In assessing the coping strategies, interventions should start with the community's assets. Instead of concentrating on community problems that ought to be solved, or physical infrastructure that should be fixed, the focus should be on identifying the strengths of the local community (Schpper and Pelling, 2006). There has to be collaboration among stakeholders, the community, the government and development based organisations present in the community. Capacity can also refer to human resource development of skills, attitudes and values at both individual and community level. It goes beyond the usual training and technical assistance to the ability to deliver or implement measures better (Alsop and Kurey, 2005; Moore, 1995). Disaster risk reduction initiatives should therefore concentrate on building the capacity of the local community. However, this does not mean that technical and financial assistance should be left for the community alone to source. The government and other stakeholders should supplement efforts made by the community. It is, after all, the responsibility of the government (DMMU) to provide a safety net for its vulnerable citizens (GRZ, 2005).

Disaster stricken communities, especially those in informal settlements, receive inadequate attention from the government. However, local communities have internal social and economic structures that help them sustain their livelihood. The resources and the skills that people possess might not allow them to have more

control over shaping their own future and coping with disaster risks (Abarquez and Murshed, 2004). Coping capacity has to do with what a community possesses locally, as well as the potential for external support. Promoting community participation - particularly among those who live in disaster prone areas and the vulnerable members - must be prioritised so that they can adapt and cope with disaster risks locally.

A community is vulnerable to disaster risks if there is a high probability of occurrence of an event and its negative consequences (UNISDR, 2009). A disaster risk from the community's perspective can be defined as the probability of harmful consequences, or expected losses (lives lost, damage to property and/or the environment, livelihood lost, and the disruption of economic activities or social systems) due to the interaction between humans, hazards, and vulnerable conditions (UNISDR, 2002:24). Disaster risk reduction intervention therefore takes a multi-disciplinary approach. They recognise the importance of links between socio- economic and political interaction and hazards and the wider environment (Lewis, 1999; Wisner *et al.*, 2004; Tran and Shaw, 2007).

Disaster risks are expressed in a variety of contexts. For instance, flooding may cause damage to physical infrastructure as well as an outbreak of water borne illnesses such as diarrhoea and cholera. Exposure to disaster risks is usually associated with failure by a community to cope with particular hazardous events. Sayers *et al.*, (2002:36-38) define risk as the probability of an event occurring, linked to its possible consequences (Dilley and Boudreau, 2001; Tobin and Montz 1997:282 and UNISDR, 2007), on the other hand, define risk as a function of the relationship between hazards to which a household is exposed and the household's vulnerability (V) to that specific hazard (H).

$$\text{Disaster Risk (R)} = \text{hazard (H)} \times \text{vulnerability (V)}$$

(Wisner *et al.*, 2004).

The risk notation by Wisner *et al.*, (2004) above, views vulnerability as the determining factor in the exposure of a community to disaster risks. Risk situations normally depend on the level of social, economic or geographical status of a community. A poor community with limited access to economic opportunities will find themselves settled in a location that is fragile and disaster prone and normally illegally obtained. DRR interventions should focus on reducing vulnerability of communities from severe shocks and preventing hazards from becoming disasters (Christian Aid, 2009; DFID, 2006).

Vulnerability of informal settlements to hazards is a common phenomenon (Mulenga, 2003). Informal settlements become vulnerable to disaster risks by virtue of their residences located in marginal areas with geographical, topographical and hydro geological

characteristics that make them unsafe for settlement (Oxfam, 2007). A hazard originates from “human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage” (UNISDR, 2009; Wisner *et al.*, 2007:5; SADC,2003:12). Such settlements are located on marginal lands with no proper land use planning, poor physical infrastructure such as substandard housing units with limited basic services provided (ECZ, 2008: 118). This is common in most informal settlements in developing countries (World Bank, 2001). Mitchell (2001) considers hazards to be a result of human ecological interaction that can generate a disaster. Typical examples of hazards can include: poorly constructed housing units, lack of access to safe water and sanitation facilities and marginal locations. Community vulnerability to disaster risks can be divided into three categories: physical/ material, social and attitudinal/ motivational (Anderson and Woodrow, 1990).

Physical vulnerability relates to the fact that poor people usually include those people with limited material resources to help them cope with disasters. The poor in most cases reside on marginal lands; they do not have any savings or insurance; they are in poor health, often harsh environments, directly dependent on local ecosystems services (Tyler, 2006; Prevention Consortium, 2008:9).

Social vulnerability is associated with communities that are marginalised in economic terms. People who are economically stable are more secure than the poorest when disasters occur (Oxfam, 2007).

Attitudinal or motivational vulnerability refers to the community's lack of confidence to adopt DRR interventions as noted by Pelling, (2007). This is the most common cause of continuous vulnerability and exposure of communities settled on marginal land or informal settlements. They usually lack confidence to sustain themselves and find lasting solutions to their problems. Despite interventions that may be in place such as evacuation to safer land, people will usually return to the risk homeland (Abarquez and Murshed, 2006; Nchito, 2007).

b) Community participation and response to DRR

In the context of disaster risk reduction and management, a community is understood as people living in one geographical area, in close proximity, and who share common interests, values, services and problems (Yoon, 2005; Abarquez and Murshed, 2004). They may be exposed to similar disasters and perform similar socio-economic activities to ensure their livelihood. Furthermore, a community can be a group of people affected by a disaster who can also assist each other to mitigate hazards and reduce vulnerability within their locality.

Lack of community participation in DRR interventions in dealing with disaster risk affecting them may at times make the community dependent on relief and emergency supplies. Community participation in DRR has of late been preferred as an effective approach to reducing exposure to disaster risks.

c) From emergency relief to community participation

During the World Conference on Disaster Reduction (UNISDR, 2005) held in Kobe Japan in 2005, the Hyogo Framework for Action (HFA) 2005-2015 was adopted. Its main goal was to build resilience in nations and communities to cope with disasters and subsequently achieving substantive reduction in loss of human lives by 2015 (UNISDR, 2004). The HFA outlined five areas of priorities for action as well as guiding principles and practical means for achieving disaster resilience for vulnerable communities in the context of sustainable development. These include:

- i. making disaster risk reduction a national priority;
- ii. knowing the risk and taking action;
- iii. building understanding and awareness;
- iv. reducing risk factors; and
- v. being prepared and ready to act.

The main thrust of the HFA lies in identifying ways was of building resilience in nations and communities to deal with disaster risks.

Today, barely a week goes by without news about a major disaster that results in death and destruction (Oxfam, 2007). These could be natural disasters or human-made disasters. Disasters wipe out developmental projects and slow down the pace of socioeconomic development, especially in developing countries with limited capacities (World Bank, 2001). It has been argued that disasters are a reflection of poor development planning (UNDP, 2004: 9; Pelling, 2003). The government has the responsibility to provide basic needs for the people such as infrastructure, roads, safe water and sanitation services. However, failure by governments to provide basic needs is the root cause of extreme poverty and vulnerability in least developed countries (World Bank, 2001). The prevalence of disasters is often attributed to natural forces that are beyond human control. Climate change has been identified as a major driver of disasters facing the globe today and will likely increase, resulting in massive losses, especially in developing nations (Warner and Ore 2006; IPCC 2009; Aalst, 2007). It must be noted that disasters not only reveal underlying social, economic, political and environmental problems, but contribute to worsening them (UNEP/ISDR, 2007). Disasters pose serious challenges to development by eroding well-deserved gains in terms of political, social and educational progress, including infrastructure and technological development. In most developing countries, natural disasters have constituted a heavy drag on development by undoing decades of

development efforts and reverse gains in poverty reduction (Nakagawa and Shaw, 2004; Nchito, 2007; UNISDR, 2008; Schipper and Pelling, 2006).

Community based development approaches are a fundamental form of empowerment of the local community and a compelling strategy for enforcing the transmission of ideas and claims from the bottom up to the top level (Allen, 2006). The approach is now viewed as a promising tool in achieving the goals of self-reliance and self-determination which are vital for community development (Uitto and Shaw, 2006; Ayers and Huq, 2009). Research has also shown that community disaster plans yield the best results and the most trustworthy primary data in understanding the disaster risk profiles of communities (Abarquez and Murshed, 2004; UNDP, 2007; 2009;2; Holloway *et al.*, 2008; Pelling and Wisner, 2009). Scholars Van Riet and Van Niekerk, (2012) describe Community Based Disaster Risk Assessment (CBDRA) as direct participatory actions taken by the at-risk communities aimed at applying local knowledge and experiences to analyse their own coping capacities. It involves mobilisation of local resources to develop tools and strategies for DRR, and to find possible lasting solutions for building resilience in communities.

In summary, Van Riet and Van Niekerk (2012) argue that DRR fundamentally implies reducing the socio-political, political, environmental and economic vulnerability of a community to natural and anthropogenic hazards such as droughts, floods and fires among others. Community based disaster risk reduction transforms a community by making it safer and more resilient (Pelling, 2007). This is done by assessing and monitoring risks that a community may be exposed to. The community at-risk is actively involved in the planning and decision making process about DRR. Pelling (2007) further suggests that both communities and local authorities (government) need capacity building and resources to manage and reduce exposure to disaster risk. This should be done through the sharing of information through raising funds to increase resources to assist with the implementation of DRR interventions.

d) *Creating a community that is disaster resilient*

A resilient community is one that has the capacity to absorb forces through adaptation and a community that can maintain certain basic functions and structures during disastrous events (Twigg, 2005). However, key questions one may ask are: *why is local community participation important in disaster risk reduction? What necessitated the shift from community based approaches to reactive disaster management by the governments and NGOs?*

Community based disaster risk management approaches have been adopted because they aim at building resilient communities. They raise people's

awareness of disaster risks, using intimate local knowledge, and they recognise pre-existing local structures, capacities and institutions (Heijmans, 2009; Wisner *et al.*, 2004; Tran and Shaw, 2007). More effort has been put into incorporating disaster management aspects into the holistic development of communities. As Maskrey (1989) points out, disaster management should not be treated as a single issue, but should be incorporated into the socio-economic activities of the local people. DRR activities should therefore assist communities to avoid, lessen or transfer the adverse effects of hazards. This has to be done with activities and measures for prevention, mitigation and preparedness. These measures include various activities, projects and programmes that the communities may identify after assessing and analysing the risks that they face. The community based approach is an ongoing process aimed at reducing vulnerability to natural hazards across all levels of society and socio-economic sectors. Its effectiveness depends on the need to recognise the cardinal role of the community in economic planning and policy making. The approach supports the inclusion of local knowledge and mitigation strategies to reduce vulnerability (Baumwoll, 2008; Allen, 2006).

Building resilient communities implies concentrating on the community's ability to reduce their own disaster risk. Communities directly vulnerable to hazards are the best placed to identify solutions for risk reduction (Wisner *et al.*, 2004). However, grassroots strategies should be linked with appropriate top - down strategies and local government interventions (Anderson and Woodrow, 1998; DFID, 2005; Fraser *et al.*, 2006). This ensures the sustainability of the approach that is adopted by the community and enables access to outside knowledge and skills that may assist in vulnerability reduction. Successful DRR activities create resilient communities whilst ensuring vulnerability is not increased through developmental efforts or other externally initiated activity (UNDP, 2004; UNISDR, 2004; DFID, 2005). This is possible only if the community at-risk actively participate in the DRR interventions.

c) *Community engagement in disaster risk reduction/development*

Chen *et al.*, (2006) argue that through a community based participatory approach, community members would learn how to analyse their vulnerable conditions and find ways of reducing disaster risks affecting them. Furthermore, there is a need to establish community organisation structures responsible for implementing DRRM risk management activities. Tenets of effective community participation are based on six key principles of community participatory approaches. These include: inclusion, equal partnership, transparency, sharing power, sharing responsibility,

empowerment and cooperation in the community (Table 2).

Table 1: Key Principles of Community Participatory Approach

Inclusion	Include all or representatives of all groups who would be vulnerable to disaster risks.
Equal Partnership	Recognising that every person has a skill, ability and initiative and has equal right to participate in the process regardless of their status.
Transparency	All participants must help to create a climate conducive to open communication and to building dialogue.
Sharing Power	Authority and power must be balanced evenly between all stakeholders to avoid the domination of one party.
Sharing responsibility	Stakeholders have equal responsibility for decisions that are made, and each should have clear responsibilities within each process.
Empowerment	local community special skills are encouraged to take responsibility for tasks within their speciality, but should also encourage others to be involved in order to promote mutual learning and empowerment.
Cooperation	Cooperation is very important; sharing everybody's strength reduces everybody's weaknesses.

Adapted from Egger and Majeres 1998; Wisner, 2005

III. SUSTAINABLE DEVELOPMENT AND DRR

These principles form a basis for the sustainable development and effective implementation of community owned development interventions (Table 2). Participation entails a shift in power from the traditional developmental agents (government and NGOs) to the local communities in need of uplifting their lives and aspirations (Sandström, 1994; Sen, 2000).

Despite attempts to move away from the top-down approaches of development planning, participatory approach faces a lot of challenges. One major challenge is scaling-up, given that DRR-related community knowledge is mostly scattered, fragmented, and often not well-documented (Shaw *et al.*, 2011).

There is a need for development agencies to explore partnerships between the local government, private sector, NGOs and community groups in order to upgrade indigenous knowledge systems from the current state of undocumented subjective practices to a respected body of applicable and useful knowledge (Osti, 2004).

Botes and Van Rensburg, (2000) identify key impediments to community participation in developmental activities. Many developmental projects are initiated by outsiders; thus, depending largely on development professionals for implementation and monitoring. Outsiders therefore claim to be the development experts whose role is to transfer knowledge and ideas to the vulnerable community. The community is seen as passive recipients and beneficiaries who depend on outsiders for capacity building in terms of knowledge and skills (GNDR, 2009; Hagelsteen, 2009).

This leads to their [outsiders] dominance in decision making and the implementation of programmes. As a result, many development programmes end up being externally driven rather than community driven (Provention, 2007).

Although development experts may question the capacity of local people to understand what they want and what is likely to be in their best interest (Schipper and Pelling, 2007; Chambers, 2008), many local community members often do not want to participate actively in imposed interventions because of past experiences where their expectations were not fulfilled (Wenger *et al.*, 2002). This situation undervalues the input and experiences of non-professionals or the community as a whole. Community participation in disaster risk reduction focuses on the community's ability to reduce their own disaster risk by identifying those directly impacted by hazards, viewing the community as being best placed to identify solutions for risk reduction (Wisner *et al.*, 2004).

However, grassroots strategies are linked with appropriate top-down strategies and local government interventions (Anderson and Woodrow, 1998; DFID, 2005; Fraser *et al.*, 2006). Critical factors to achieving a significant level of impact include the capacity of those taking actions (facilitators and the community), the information available at the local level and funding support for adaptation initiatives (Mc Gray *et al.*, 2007; IFRC and Pro Vention Consortium, 2009). This ensures the sustainability of any interventions adopted and enables access to outside knowledge which may assist in vulnerability reduction.

The emerging crisis in environmental risks and human security in African cities can be related to failure in social contracts. The contract is a much debated concept (Pelling and Dill, 2008), used to represent the balance of rights and responsibilities in society, including entitlements to basic needs which should be provided by the government. Community participation is often seen by governments as a means of legitimising the political system and as a form of social control. The state in most cases capitalises on the vulnerability of the community to win votes in the political arena. Governments, especially during the election periods, introduce a number of developmental projects in

response to the needs of the populace to gain political mileage (Davidson *et al.*, 2007; Morgan, 1993:6, in Botes and Van Rensburg, 2000). Such interventions include promises of improvements in the construction of infrastructure, provision of safe water and sanitation, including employment opportunities. These are usually short-term promises aimed at undermining the community's abilities in governing themselves. After elections are over, the community is unfortunately left at the same level of poverty and vulnerability to disaster risks as before (Walia, 2008:69). The general focus of DRR is enhancing the skills, knowledge and capacities of local communities through community development initiatives (GNDR, 2009; Hagelsteen, 2009).

IV. COMMUNITY BASED DISASTER RISK REDUCTION METHODOLOGY

There are multiple actors involved in the community based disaster risk reduction and management process. Basically two broad categories are involved: the insiders and the outsiders (Torrente *et al.*, 2008). Insiders refer to those individuals, organizations and stakeholders who are located within the community while outsiders are those located outside of the community. Both groups of actors however aim at reducing community vulnerability and enhance its capacities for disaster risk management (Torrente *et al.*, 2008).

The community based disaster risk reduction and management approach is beneficial to the local community. Holloway (2007) states that well-structured community based plans adhere to six principles that subsequently benefit the community at risk. External agents come with a pool of skills and knowledge and material and financial resources. The aim of outsiders in CBDRRM is to offer sustainable solutions to alleviate the vulnerability of the community to various kinds of hazards and disaster risks.

Holloway (2007) identifies the following six principles of CBDRRM:

- Create sense of ownership;
- Build local capacity;
- Collaboration amongst different stakeholders (NGOs, academic, government and community); Discourage swift campaigns and rapid drive assessment;
- Strengthen local livelihoods; and
- Participate in learning activities in the community.

The aim of community based disaster risk reduction is to create a sense of responsibility for intervention in implementing DRR activities by those who are at risk.

a) *Create sense of ownership of risk*

Vulnerable communities often lack awareness of the disaster risks they are exposed to (Abarquez and

Murshed, 2004; Rajiv *et al.*, 2012:1634; Pelling and Wisner, 2009). For instance, in Kanyama settlement, the citizens are involved in settling on flood-prone areas, drinking water from shallow open wells, building unsafe housing units which exposes them to risks in case of heavy rainfall (ECZ, 2000; CARE, 2011). However, residents find themselves in these precarious conditions not by choice but by circumstance. Poverty has been known as the major driving force of vulnerability to disasters (World Bank, 2001:146). Poor people settle in unplanned informal settlements on the periphery of major cities with the hope of opportunities for a decent standard of living in the city (Chibwe, 2011; Habasonda, 2012; World Bank, 2001). At times they could be aware of disaster risks but have no coping capacity and no mechanism to move to safer locations. There is a need to build local capacity in the community exposed to disaster risks (DiMP, 2005). Once the local community fully understands the disaster risks they are exposed to it is easier for them to participate in interventions from outside.

b) *Build local capacity*

It is essential to create awareness of the importance of building the local community's capacity to cope with disaster risks in the local community (ISDR, 2004; World Bank, 2001:146). Wisner (2005: 9) defines CBDRA as a method of self-assessment to determine coping and capacity against the impact of hazards. He states that CBDRA is about evaluating the coping capacity of a community in the face of a certain disaster or hazard. Therefore, the community at-risk must be helped with skills and knowledge about disaster risks they are exposed to. Any institution planning DRR activities should first identify influential members and key development agent players in the community before coming up with programmes. Women, children and the aged are the most vulnerable and must as such be involved in finding solutions to disaster risk reduction issues.

UNDP (2010) views DRR as a complex, cross-cutting issue that requires an interdisciplinary and multi-sectoral approach by bringing together the knowledge, skills and resources from different stakeholders.

c) *Collaboration among stakeholders*

Disaster affects people in different ways depending on their capacity and location (Wisner *et al.*, 2004; Allen, 2006). Disaster risk reduction requires a multi-sectoral approach (Perry and Liddell, 2003). All institutions and organisations working in a community must be involved in coming up with solutions. Sectors such as health, education, food security, agriculture and infrastructure development must all come on board. The community, however, takes the central stage (Holloway, 2007; Abarquez and Murshed, 2004; Anderson and Woodrow, 1998). Lack of collaboration in disaster risk reduction interventions may lead to duplication of efforts

to the community. There would for instance be an oversupply of relief commodities while other essential needs such as shelter and livelihoods are missing. One of the possible solutions is to come up with participatory initiatives which encourage community participation in DRR campaigns. Interventions done in a hurry only make the vulnerable community helpless once DRR support is withdrawn (Drinkwater, 2001). Rapid responses must be encouraged in effective DRR management.

d) Discourage swift campaigns and rapid assessments

The traditional reactive approach of disaster management encourages dependence of victim community on relief supplies rather than preparedness and sustainable development (Rajiv *et al.*, 2012:1634). When the community at-risk is fully involved chances of success will increase, and the mismanagement of resources are reduced (IFRCS, 2001). Community based disaster risk reduction makes the community part and parcel of the risk assessment and awareness campaigns (Abarquez and Murshed, 2004; UNDP, 2007; 2009: 2; Holloway *et al.*, 2008).

e) Strengthen local livelihoods

In order to implement an effective community based disaster risk reduction project, it is essential that significant efforts are undertaken at local level (Van Riet and Van Niekerk, 2012:2) to raise the awareness of communities and ensure that an appropriate level of skills and knowledge is passed on to the people before, during and after disasters (Pelling, 2007; GNDR, 2009; Hagelsteen, 2009). A community that is adequately prepared is likely to be resilient to disaster risks in future.

f) Sustainability and participatory approach

The challenge of DRR interventions today has been the lack of sustainability by the recipients of support. Communities in disaster-prone locations have in most cases relied on relief as part of their livelihood. After being affected by a disaster, victims in most cases still continue residing in the original disaster-prone settlements (Nchito, 2007). Community based disaster risk reduction approaches in this case focuses on making vulnerable communities become resilient. Sustainability is achieved by involving the community in assessing their exposure and vulnerability to disaster risks (Wisner, 2005).

V. MODEL FOR CBDRRM APPROACH

Vulnerability of communities is a combination of the socio-economic, physical, environmental and geographical profiles of the community (Van Riet and Van Niekerk, 2012; Todes, 2011). The responsibility is in the hands of the community at-risk to take action to reduce vulnerability and exposure to disaster risks. The

background of disaster management approaches came as a result of the need for community participation in addressing their vulnerability and exposure to disaster risks (Twigg, 2007).

Focus is on one approach by Imelda Abarquez and Zubair Murshed (2004) of the Asian Disaster Preparedness Centre (ADPC), *Titled: Community – Based Disaster Risk Management*. The stages, starting with outsiders, form part of the comprehensive disaster management under community based disaster risk reduction. The process of the community based disaster risk reduction model follows the seven stages (Figure 2). These stages may not be conclusive but can be adapted from stage one, if applicable, depending on the level of engagement with the community.

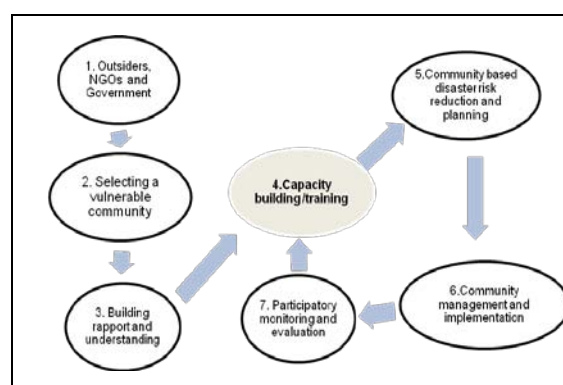


Figure 1: A Model for Community based Disaster Risk Reduction and Management

(Adapted from Asian Disaster Preparedness Centre, ADPC, 2009:17)

a) Outsiders (NGOs and Government)

Outsiders (this includes the government, NGOs and agencies) start by identifying a community vulnerable to disaster risks. This could be after a disaster struck a community and a lot of destruction was caused. Through participatory methodologies a community is involved in analysing its vulnerability and initiating DRR interventions. The role of the outsider is basically facilitation and capacity building of the local community towards vulnerability reduction (Torrent *et al.*, 2008). They support efforts by the community to reduce vulnerabilities and to enhance community capacities in the long term. This is done through providing technical, material, financial and political support, including participatory approaches in engaging the communities. By participating in community based DRR activities, local people not only become trained to improve awareness to better prepare for disasters, but also take part in the physical construction of structures. They also benefit through participation, and gain improved knowledge (Wenger *et al.*, 2002).

b) Selecting the vulnerable community

The criteria for identifying a vulnerable community depend on various factors other than exposure of the community to disaster risks. These factors include severity of exposure to devastating disaster risks, poverty status of the community, and readiness and willingness of the community to participate in disaster risk reduction activities (Cooke and Kothari, 2001). However, the criteria given is not exhaustive; other factors may also be considered, including the government's legal framework on services provision.

In order to encourage the participation of the community in developmental projects, a relationship has to be created between the outside institution and the community at-risk. The next section looks at building rapport and understanding with members of the community at-risk.

c) Building rapport and understanding

After the vulnerable community is identified, the next stage is to appreciate the local social relationship and background of the community. The focus is on analyzing the socio-economic status of the local people and identifying the most vulnerable members. The aim is to ensure active participation of all. Rapport building gives outside partners a clear picture of the skills level and status of and problems faced within the community (Chambers, 1997). After building rapport with the community, the next step is to build the capacity of the community in understanding disaster risk reduction management.

d) Capacity-building

Before the capacity of the community's disaster management preparedness can be built, the capacity of a community has to be assessed. Capacity is measured in terms of local resources, skills and knowledge within the community. According to Mwanamwambwa, (2009), Participatory Capacity and Vulnerability Assessment (PCVA), Participatory Needs Analysis and Assessments (PANA) are CBDRM strategies that help in the sustainability of DRR programs (White and Pettit, 2004). The participatory disaster risk assessment is conducted by the local authorities with the involvement of local people, community leaders and subject experts from outside. It is through this assessment that the community's available local resources, local knowledge, prevention, mitigation and response strategies are identified. Participatory tools are used in understanding the local capacities through training of trainers.

After the capacity of the community has been built, the actual community based disaster risk reduction planning process commences.

e) Community based risk reduction and management planning

After the capacity building stage, with vulnerabilities identified, the community - together with

the outsider NGOs and government - are engaged in CBDRM planning (Aberquez and Murshed, 2004). Local disaster risk reduction plans are formulated. The plans are community-owned, hence their implementation is localised using local resources. It is expected that the community will do the work without necessarily focusing on payment. During the process of CBDRM other interventions include implementation and Participatory Monitoring and Evaluation (PME).

f) Community management and implementation

Community based implementation involves both structured and non-structured activities which include: early warning, community training, construction and rehabilitation of infrastructure. The community, together with the outsiders, ensures that the activities are implemented as planned. Where lapses occur during the implementation, the outsider continues with capacity-building and closing knowledge gaps (Chambers, 2008).

g) Participatory monitoring and evaluation

The main aim of monitoring and evaluation is to provide checks and balances to ensure the sustainability of community based disaster risk reduction interventions. The community based organisation takes the responsibility for the overall implementation of the DRR activities at local level (Hagelsteen, 2009). Furthermore, PME involves the participation of key actors namely: local community, development agencies, local government and other stakeholders in measuring the progress made, and identifying necessary follow-up actions. Harmony among the stakeholders in PME is an important factor for the success of CBDRM.

The model (Figure 2) could be used to analyse community based disaster risk reduction interventions in informal settlements by the insiders - the community - and the outsiders - the government and NGOs.

VI. CONCLUSION

Theoretically, CBDRM approach is a more sustainable approach in managing disaster risks. It recognises that the community at-risk has the best knowledge and understands their vulnerability better than outsiders. The exposure and susceptibility of a community depends on a number of factors such as environmental, social, cultural, economical and historical factors. In accordance with the theoretical framework, disaster management agencies and nations lack comprehensive governance and legal frameworks and usually apply the top-down approaches of emergency responses. These result in failure to set clear disaster risk reduction targets for communities-at-risk to reduce their exposure and vulnerability. Effectively, disaster risks in informal settlements can be reduced by working with the local people to identify and

analyse their vulnerability and capacities, and to develop and implement a disaster risk management action plan which will support them in their progress towards sustainable living.

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Delhi Slums Under 3-D Fire

By Col Retd Pk Chaturvedi

Abstract- A disaster is any occurrence that causes damage, ecological disruption, loss of human life, or deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area. The Slum and informal settlement households are living in poor dwelling conditions. In these settlements, one side congested area forces them to have fire related activities in unsafe conditions. Other side, without Government notification on their legality of living in Slum areas, they are not provided with common living conditions available with other members of society. On top of all 'the Sword of Eviction' is seen even during day dreaming by these poor habitants. Their identity linked with residence keeps them and their growing kids in state of inferiority and depression. To mitigate damages by fire-disaster, recovery, rehabilitation, and development efforts require enormous funds that, amidst insufficient contingency funds, are taken out from other development programmes of city that are planned or underway, thereby impeding development efforts. Therefore, it is important that disaster mitigation programmes are made an integral part of developmental programmes of Delhi. At the same time, efforts to enhance the capacities of communities and coping systems at various levels and sectors towards self-reliance and selfsufficiency in managing disasters effectively and must be sustainable. It is immediate requirement to recognise ownership of slum habitants and proper housing is provided to them with government plans.

Keywords: urbanization, slum, location of facility, fire, planning, strategy, accessibility, disaster, relief development, governance, sustainable, district administration.

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"Slums are litmus tests for innate cultural strengths and weaknesses. Those people whose cultures can harbor extensive slum life without decomposing will be, relatively speaking, the future's winners. Those whose cultures cannot will be the future's victims." (Kaplan, 1994)

1. INTRODUCTION

Human beings live in an environment to which they are physically and constitutionally attuned and depend on it for their survival. In the course of living in this environment, the physical environment may influence or be influenced by the social behaviour of the human beings (Dunlap and Catton in Buttel, 1987). While living in this environment human beings have been successfully able to adjust/ adapt to the pressures exerted on them by nature and their way of living. They did so by modifying their behaviour and surroundings to adjust to daily hazards. However, they have not been as

successful in adjusting to less frequent events (Coppola, 2007).

What are these crisis events that affect or disrupt normal social life of the people who otherwise adjust well with the surrounding environment? These crisis events are disasters. The term disaster is derived from the Italian roots dis- and astro, meaning "away from the stars" or in other words an event to be blamed on an unfortunate astrological configuration (*ib.id*).

India faces disasters of different types and people have been struggling to overcome the disasters that strike with periodic regularity. Fire has also been a major cause. Disaster Management geared to make a paradigm change from response and calamity relief to disaster prevention, preparation and mitigation. Another significant change is to move from largely government instituted disaster management to public private partnership and community based disaster management. In this regard, significant changes have been made. India probably has the world's oldest disaster relief code which started in 1880. This relief code provides details of the relief to be given by the government to the affected people.

Past experience of relief operations, it was strongly felt that the resources from external agencies arrive at least 06 to 12 hours later than the occurrence of disasters. Further, the priority is given by local commanders to those casualties that appear to have more chances of survival. While most of the casualties can be saved by local assistance during initial reaction time, lot of efforts are needed to look into the issue and administer local activities in initial stage of the disaster or even preparedness in disaster prone localities. There is a paradigm shift from reactive approach of mitigation and relief to proactive approach of planned rehabilitation and development. Relief and rehabilitation may be temporary measures necessary for returning to pre-existing levels of development cooperation. Once disaster hostilities cease, moving into recovery and early development type assistance may be hampered by a lack or incapacity of local authorities and the prevailing need for socio-psychological coping with the past.

The Census (2001) of India has defined Slum as "a compact area of at least 300 populations or about 60-70 households of poorly built congested tenements, in unhygienic environment, usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities". The slum population in India was counted as 42.58 million during 2001 census spread over 640 cities/ towns, which was 15 per cent of the

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urban population and 23.1 per cent of the cities/ towns' population reporting slum. The life in slums is human disaster, yet the slum population is growing with alarming rate all over the world but more so in developing countries. In a report titled "The Challenge of Slums", the United Nations Human Settlements Program (*UN-HABITAT 2003*) reported that one billion people, approximately one third of the world's urban dwellers and a sixth of all humanity live in slums. India alone constitute about one third of the global slum population. The report has warned that the population of the world's slums will double to two billion people within 30 years. These studies have helped in understanding "The Challenge of Slums" and rapid unplanned urban expansion.

II. SLUMS IN DELHI

Slums are the result of the gap between the demand and the legal and formal supply in the housing market. Slums are considered to be the result of multiple deprivations such as illegal land tenure, deficient environment and inadequate shelter (Chauhan Akhtar, 2009). According to Census of India 2011, 66% of towns in India have slums, with 17.4% of urban households. However, this estimate omits the households not covered under definition of slum even if living in poor dwelling conditions than those living in defined slums. These informal settlements also have quality of life and infrastructure similar to those of slums (PRIA, 2014).

People in these areas of low socio economic status are generally at higher risk of heat-related morbidity. The area distribution of households (HH) with and without separate space for cooking is main drawback of living condition. The average covered area of the slum house per HH is just about 108 sq ft. To stay with a family of average size of 4.5 with all HH belongings in such a tiny space depicts the miserable life the slum dwellers lead. As regards housing condition about half of them live in pucca houses and remaining in semi pucca/ kuchcha house (*Report, Delhi Urban Shelter Improvement board, 2014*).

In the next two decades more people will seek residence in slums, which are already vulnerable and continues to lose life, property and livelihood due to fire disasters in slums. Migrant's first stay as shelter less starts with a stay at the workplace like restaurant, shop, factory, workshop, construction site and ends on the pavement or in a night shelter or with their relatives. However, the economic and housing conditions of the relatives already settled in Delhi may put limits to the type and duration of the help extended as far as accommodation is concerned. After an initial stay upon his arrival in a slum hut or one-room tenement with his parents or relatives, they are compelled to leave due to lack of space and to stay in a night shelter or a pavement dwelling area. The persons working in the

occupation also play an appreciable role in introducing him to a new work, including sometimes showing him cheap (or free) and convenient places to sleep, cooking food on the pavement in small groups for their dinner Dupont & Tingal D, 1997).

Besides, the slum dwellers that move to such shanties from essentially different disaster-prone areas of the country mostly fall victim to unrelenting exploitation and poverty. They live in such shanties due to no other affordable/ available shelter in the city and usually lack any awareness about fire safety (*Ministry of Homes Affairs-Director General Civil Defence, 2011*).

Slums are also work place causing fire hazards. To know the cause of accidental fire in kitchen, it is important to know what kind of stove/cooking oven are used in slums like kitchen-gas, electric heater, kerosene stove or firewood burner. The stove is the number one cause of fire hazards, which may destroy entire house especially in slums areas where there are thatched roof or other inflammable materials like straw kept near the kitchen. A burner remains hot and until it cools off, it can be very dangerous. The oven using wood can be dangerous because burning embers remain for longer time. When lighting the fire on a wooden fuel oven, sparks may fly to the thatched roof. Even after the cooking is over, the remaining fire may not be extinguished off by sprinkling water. Inflammable article like kerosene are mostly placed very near to the kitchen fire. It was noticed that JJ Cluster habitants are most vulnerable to fire and fire incidences are very frequent there. Lack of water supply added more criticality to disaster response to fire in Delhi Slums. In the past, such occurrences were more in JJ clusters and habitants in fire prone conditions. These slums are in neighborhood of areas having costly and modern developed installations which are receiving huge damages due to such fire. Thus it is imperative to have a capability of quick roll out of a infrastructure with features to make it suited for disaster management tasks. Important ones are assessing damage and needs, coordination of resources, establishing command and control, implementing incident reporting/response systems, efficient distribution of aid and crisis communications.

III. PAST FIRES IN DELHI SLUMS

The Delhi has so far witnessed a number of slum fires, many of which ended up claiming dozens of lives. In the past, on Apr 12, 2013, a fire broke out in a slum cluster in outer Delhi gutting approximately 400 hutments, fire brigade officials said. The blaze was reported at the slum in Bawana area. Fire fighters reached the spot after an intense struggle to get there through narrow passages that link the slum to the main road. Moreover, by the time they brought the fire under control, it devoured all the belongings of more than

2,000 poor people who lived there. Reportedly, the area lacked adequate source of water, a scenario, regrettably, common to every city slum, resulting in disruption to fire-fighting operations. Fortunately, as most of the dwellers were outside for work and others somehow managed to get out, no casualties were reported.

Nearly 1,000 slums were gutted after a high voltage electricity line that fell on a slum cluster triggered a massive fire in East Delhi's Ghazipur on Thursday afternoon. Police officials said the fire broke out around 2.50 pm. Nearly 25 fire tenders were rushed to the spot and took two hours to bring the blaze under control, Fire department officials said. One person was charred to death while another seriously injured when a fire broke out in a slum cluster in east Delhi after an electric wire fell on it in the wee hours of Sunday. The incident took place in the slum cluster located behind Ankur apartment in Patparganj at around 2:50 am, a senior fire brigade official said. Seven fire tenders were rushed to the spot which doused the blaze within an hour. One person died while another was seriously injured in the incident. "The blaze broke out after an electric wire caught fire and fell on it," the official said. Earlier on April 8, around 600 hutments were gutted when a major power transmission line fell down on a slum in Ghazipur. (Press Trust of India, Tuesday November 12, 2013).

A massive fire engulfed Jai Hind slum in Vasant Kunj area of South Delhi on Friday, 25th April, 2014. This camp exists at a distance of approximately 500m from main road and is on DDA land. DDA has also constructed boundary wall to restrict/contain further expansion/encroachment of this land. It is also informed by locals that encroachers on this land were removed by DDA in year 2010. This is newly found group of approximately 1500 shanties of tin shed and have uniform type of construction that is tin sheet walls and roof and is located at Vasant Kunj behind main road Masoodpur. The dwellers of this camp are mostly rag pickers, kabaries and stacking the waste papers, gattas, plastic sheets, plastic bags etc. nearby their tin sheds as well as inside. Majority of them are migrants and settled here in last few years. The fire was reported at 8.30 in the morning.

On Jan 11, 2016, three children, including a six-month-old boy, were charred to death while another suffered serious burns after a fire broke out in east Delhi's Usmanpur area gutting about 25 huts. Ten fire tenders were rushed to the spot but the blaze had claimed the children's lives by the time the police or firemen reached the spot. Officials said the fire seemed to have broken out from an angeethi (wooden stove) being used in one of the houses.

On April 16, 2016, a fire broke out in a scrap dump in a Dwarka sector 3 slum cluster in Delhi, a fire

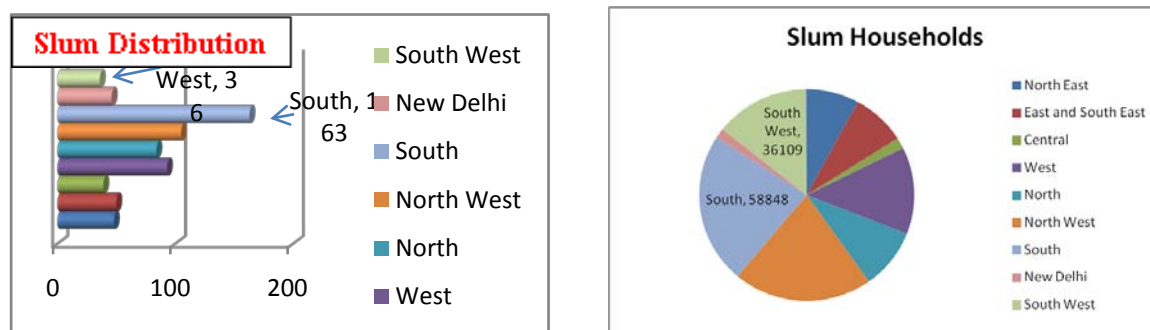
official said. No casualty has been reported. The fire occurred around 10.08 am, the official said. "At least 20 fire tenders were rushed to the site and it took about one-and-a-half hour to douse the flames," the official said.

On November 8, 2016, over 800 people were rendered homeless after a massive fire gutted more than 300 *jhuggis* at a slum in north Delhi's Sadar Bazar on Monday evening. While the trigger for the blaze remains to be probed, the police said the presence of a large amount of plastic and scrap in the *jhuggis* helped the flames to spread rapidly. The *jhuggis* are located near the railway tracks close to the Sadar Bazar market. While small shops operate out of many of these *jhuggis*, these are some distance away from the main market. As soon as the fire began, almost all the residents rushed out of their huts. Some tried to douse the flames using water from pumps in nearby buildings, but it had little impact. Two persons—a boy and a man—suffered burns. They, however, did not require hospitalisation. Around 6.45 p.m., the fire department was alerted. "A few fire tenders who were stationed close to the slum reached there in quick time," said Atul Garg, Chief Fire Officer, Delhi Fire Services. However, other fire tenders dispatched to the site either found themselves stuck in traffic jams near the New Delhi railway station or faced difficulties in negotiating congested lanes in Lahori Gate area. Fire fighters and the police also faced difficulties in managing the crowd as a number of locals as well as visitors to the Sadar Bazar market gathered at the site to witness the operations.

In fact, the manner in which shanties in a slum generally huddle together preventing adequate air and light from entering the area is well enough to constantly expose a slum to fire, slum dwellers those move to such shanties from essentially different disaster-prone areas of the country, falling victim to unrelenting exploitation and poverty. When they lend in such shanties due to no other affordable/ available shelter in the city, usually lack any awareness about fire safety (MHA-DGCD, 2011).

IV. METHODOLOGY

Research methodology for the present study is based on the examination of secondary and empirical data. The twin sources have been collected and duly tabulated, collated, and analysed for deriving major conclusions. This study aims at understanding the problems of slum fire disaster management in Delhi. To pursue the research study, the districts of South and South-West Delhi have been undertaken. This study is based on 20 slum clusters in South-West and South district of Delhi covering about 4.9 per cent of total households living in the slums of Delhi and 16.7 percent in different location of these two districts of Delhi.



Source: Compiles by Researcher

Fig. 1: Slum Distribution and Slum Household in Delhi

The study has used both quantitative and qualitative methods of data collection. A structured schedule was developed to seek information from field collected data, write-ups in books, seminar and conference papers, census reports including the basic statistics available with government organizations like Delhi Urban Shelter Improvement Board (DUSIB), Municipal Corporation Delhi (MCD), Delhi Fire Service (DFS), Delhi Development Authority (DDA), Government of NCT of Delhi (GNCTD), Union Ministry of Urban Development (GOI), Planning Commission (GOI), and UNDP/UNESCO. The data and information procured

from these sources were scanned and analyzed for correlations with primary survey data.

Meetings were also held with the elected Counsellors, MLAs, and local Slum Welfare Associations to understand their strengths and difficulties, as well as to elicit their views on various aspects of the issue. Open discussions and interviews with the State, district, mohallah officials, NGOs, Slum welfare association/leaders, etc., were also held. This helped in identifying bottlenecks in the existing system to deal with avoiding or minimising fire disasters in Slums and provided insights for policy suggestions.

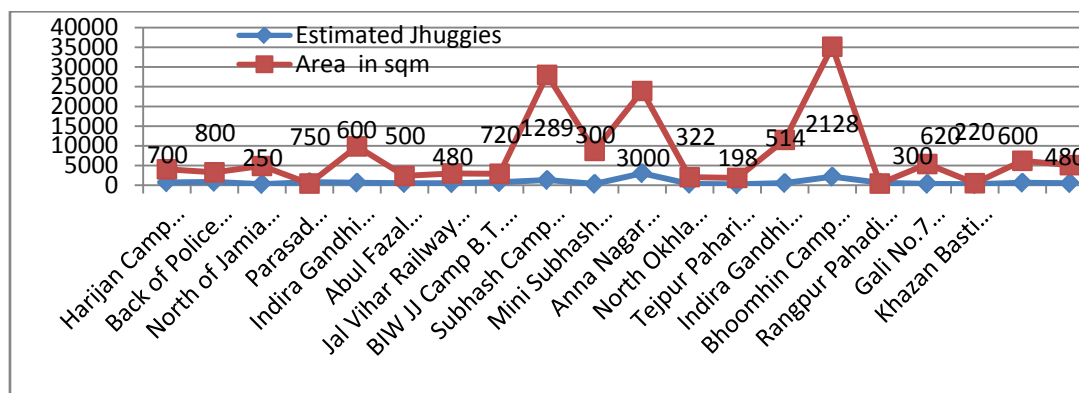
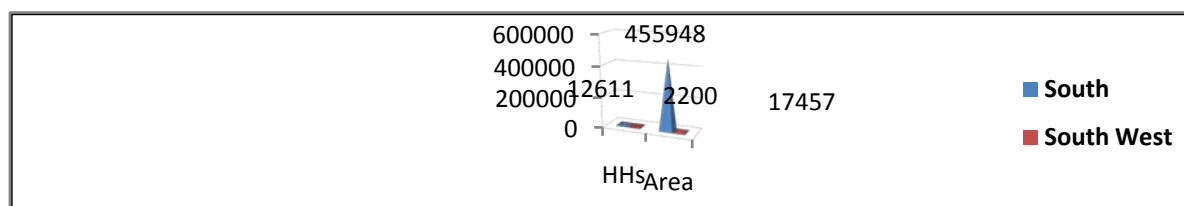


Fig. 2: HH in Numbers Distributions in Slums

There are few slums densely populated. Reference serial number 16 and 18 of above table, 620 HHs on 390 sq mtr area and 220 HHs on 477 sq mtr

area respectively, these slums are in worst condition and vulnerable for hazard.



Compiled by: Researcher

Fig. 3: HH in Numbers and Area in Sq mtr

The survey data and information is collected from the selected respondents. The qualitative data (six focus group discussions of 20 each and 6 individual interviews, and purposively sampled participants from 101 individual household (61 in South District and 20 in

South West District gathered. For analysis, the questioner response is collated to form a compiled data sheet for further analysis of collected information and presented in a table. The sequence of factors to be analysed are listed for both the districts and

representation is computed to percentage response to the issue. The data collected from slum habitants is presented below in Table.

Table 1: Compilation of Data Sheet – Slum Survey

Issues	Details	Survey South	% South	Survey S-W	% S-W	Total Average %
		81		20		101
House	Kuchcha	6	7.44	2	10	8
	Semi Permanent	34	42.16	9	45	43
	Bricks and RCC	30	37.2	7	35	37
Roof	Grass-Thatched	3	3.72	1	5	4
	Tent-Tarpaulin	4	4.96	1	5	5
	Wooden	4	4.96	1	5	5
	Asbestos/Tin Sheet	27	33.48	7	35	34
	Tiled	1	1.24	0	0	1
	RCC Slab	38	47.12	9	45	47
Kitchen Fuel	Do you have Kitchen	27	33.48	8	80	35
	Cow Dung	2	2.48	1	5	3
	Fire Wood	19	23.56	5	25	24
	Coal	2	2.48	1	5	3
	Electricity	4	4.96	1	5	5
	LPG	53	65.72	12	60	65
Water	Tubewell	9	11.16	2	10	11
	Municipal/DJB	6	7.44	2	10	8
	Own arrangement	2	2.48	0	0	2
	Public hydrant	47	58.28	12	60	59
	Tanker	4	4.96	2	10	6
Electricity	Public Meter	39	48.36	10	50	49
	Individual Metered	10	12.4	3	15	13
	Un authorized	25	31	6	30	31
	No supply	2	2.48	1	5	3
Approach Road	RMC	24	29.76	7	35	31
	Metalled	20	24.8	5	25	25
	Path	15	18.6	4	20	19
	Lane	11	13.64	2	10	13
	None	9	11.16	2	10	11
Medical/ Health	In Location near Slum	25	31	5	25	30
service	In Municipal Ward	50	62	10	50	60
	Mobile Van	5	6.2	5	25	10
	Landline /wireless	20	24.8	5	25	25
Telephone	Mobile	45	55.8	12	60	57
	No	9	11.16	3	15	12

Fire Brigade	Response in ten Minutes	20	24.8	4	20	24
	After ten Minutes	55	68.2	9	45	64
	Not arrived/ or arrived after fire extinguished	6	7.44	7	35	13
Duration of Stay	Less than 1 Years	2	2.4	1	5	3
	One Yr to less than 2 years	8	9.92	2	10	10
	2 Years or More	70	86.8	17	85	87
Previous Incidence seen	Same Slum	8	9.92	5	25	13
	Other Place	56	69.44	12	60	68
Reason for Fire incidence	Casualness	11	13.64	3	15	14
	Intentional by outsider	8	9.92	2	10	10
	Accidental	58	71.92	14	70	72
	Do not Know	3	3.72	1	5	4
Govt/ NGO Program	yes	4	4.96	1	5	5
	No	58	71.92	14	70	72
	You were asked	0	0	0	0	0
	Are you willing to participate	69	85.56	18	90	87

Compiled by: Researcher

V. HOUSING STATUS AND TYPE OF STRUCTURE

Land is an important economic resource and the ownership of such economic resource is important for every family and household. Urban poor gets 60% of his source of income from the formal sector which he directly and indirectly contributes to city level GDP. As an economic contributor he has the aspiration to land ownership. However, migrants in initial stage hardly have survival means and their savings towards land/House can only be thought of after a foot-hold is established In Delhi. Therefore maximum tries to have egress by unauthorized route or rental gate. Presently, only 1% of the slum households have Patta, which is an important document, given by Tehsildar for land ownerships. 1% Households with Patta usually live in Pucca houses. 4% of the households have Possession Certificate document. 28% and 35% live in Public and Private Encroached Land do not have any proper

ownership. These houses may be Kachcha and Semi Pucca homes, around 33% would be Kachcha and 66% is Semi Pucca. 19% of the households live in rented slum homes which can be of any form. These rented and other forms of homes can be in any form like pucca, semi-pucca or Kuchcha. This general pattern of Delhi is not seen in South and S-W Districts. Average 37 percent are in Pucca houses. The main problems are with unauthorized and rental habitants, who are not in a position to upgrade their living conditions due to uncertainty of their stay in these houses. The HHs with pucca construction is not on any laid down bye-laws for their safety or having access for support needed in hazard. House layout, inside also, is not having proper ventilation or light. Such slums need to be relocated even if they have to be upgraded in-situ for proper layout within laid down norms and bye laws.

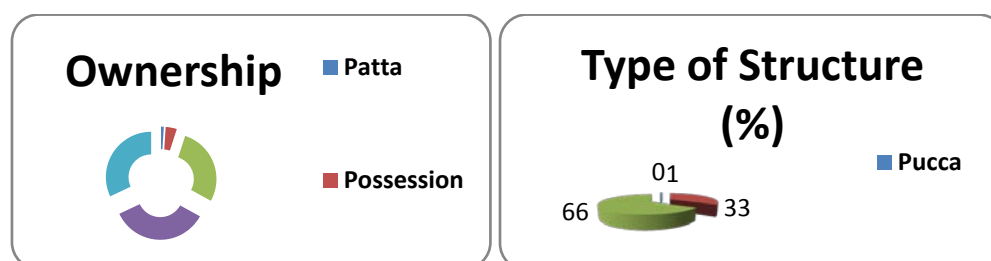
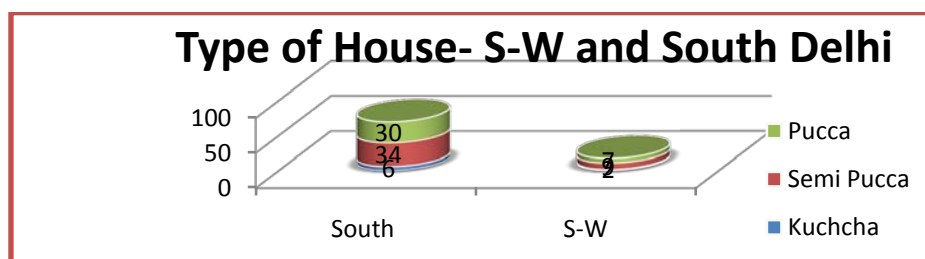


Fig. 4-A: Ownership and Type of Structure



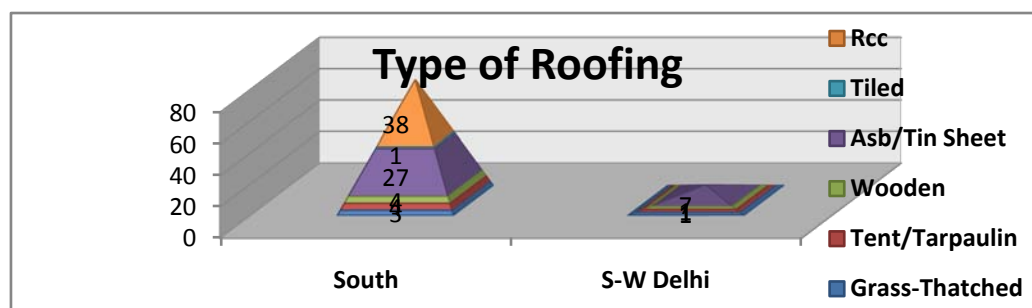
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Fig. 4-B: Type of Structures- S & S-W

a) Roofing Material

The slum-dwellers use minimum building materials to create their living space. They use easily available local building materials. Often they use old and used tin sheets, timber rafters, joists and posts, country tiles, plastic sheets and other recycled materials. However, their limited technical expertise is put to the best creative use to meet their shelter needs. Not only the type of structure is main concern but also roofing material is main cause for fire. Other than stone or RCC/Brick reinforced roof, Grass/ thatched or wood material are itself inflammable. Due to financial deficiencies in supporting expenditure in one go, slum dwellers construct their houses in stages and therefore

Roofing is left for next phase of construction. If during first stage, it is hoped to start second phase early, the roof is kept with low cost material and vulnerability is created even if it being a pucca house. As far as South and S-W districts are concern, only 48 percent are having safe roofing material out of 37 percent pucca and 43 percent semi pucca houses. 13 percent having Grass/ thatched or tarpaulin/ tent or wooden roofing are in critical condition from fire hazard point of view. It is further seen that even though houses are reported in pucca or with RCC roofing but extensions at top floor are provided with temporary materials and extended to HHs on nominal rents and it is difficult to account them in their relevant category.



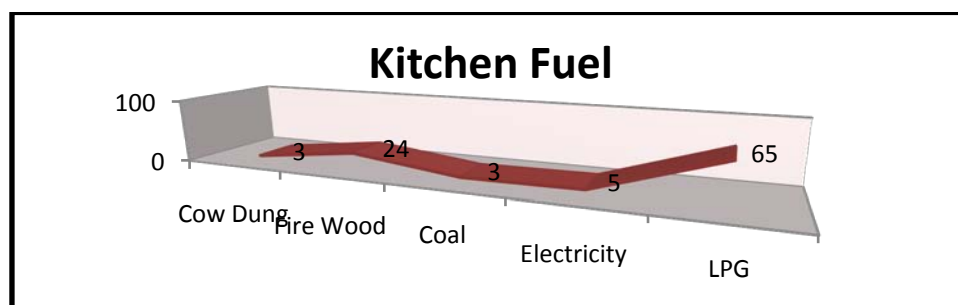
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Fig. 5: Roofing Materials

b) Fuel for Kitchen

The average covered area of the slum house per HH is just about 108 sq ft. To stay with a family of average size of 5 with all households belongings in such a tiny space depicts the miserable life the slum dwellers lead. Condition of slum houses due to limited area forces to manage the living without kitchen and toilets. As a result, make shift arrangements are made for cooking. Generally open Chula is made outside the covered area if fire-wood or cow dung is used. Coal and Firewood is still used as fuel by 1.1 per cent and 1.3 per cent of the households respectively. Cow dung is used by 0.5 per cent of the households. In rainy season, such arrangements are restricted inside congested available space only. Remnants and semi burnt fuel is sensitive cause for fire hazard. For cooking, 5 percent

dependent on electricity and 65 percent use LPG. Non availability of K-Oil, delay in refill of gas cylinders and interrupted supply of electricity also forces to easily available source as wood and cow dung. The cooling period needed for burner after use is also overlooked by most of the users particularly if space and time is constraint for these slum habitants. The distribution of kitchen fuel used by slums is shown below.



Compiled by: Researcher

Fig 6: Fuel for Kitchen

c) Source of Water

As per survey discussed earlier, In Delhi, 455 Slums have one or the other source of drinking water and remaining reported not having any such facility. Such persons fetch water from the adjacent localities. Only 211 reported regular water supply by Delhi Jal board. In 55.77 per cent not receiving regular supply, the frequency of water supply is reported by 76.69 per cent, twice daily in 24 hour and thrice daily reported by

14.29 per cent. In South and S-W districts, the status is similar. 59 percent are dependent on public hydrants and 6 percent on tanker water supplied by DJB having no schedule. Out of remaining 35 percent, only 8 percent have regular supply by DJB. Even though 11 percent have tube well supply but generally it has been declared illegal by notifications of Ground Water Board due to depleting water table. For fire fighting, one cannot depend on local source at all.

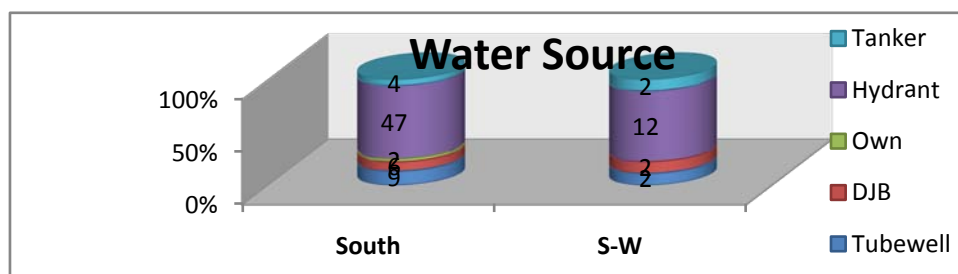
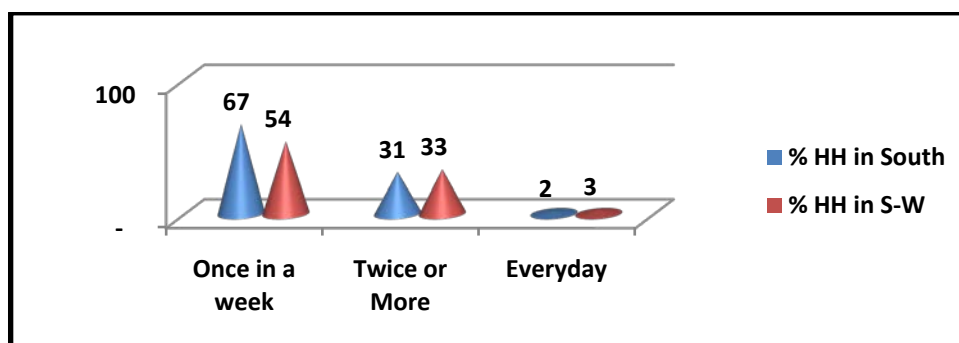


Fig 7: Water sources in Slums of South and S-W Districts



Compiled by: Researcher

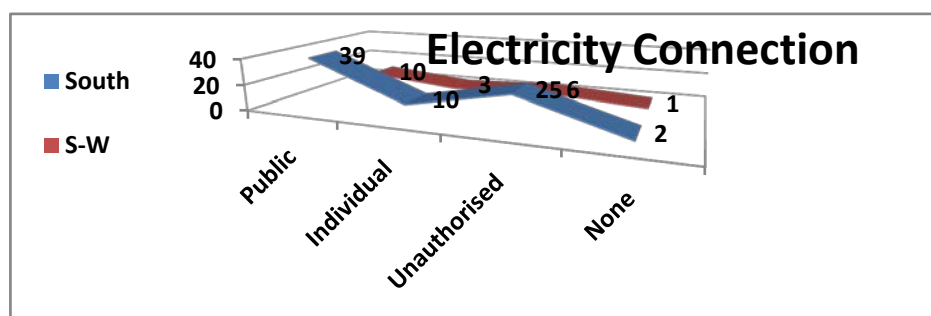
Fig 8: Duration of Water supply in South and S-W Districts

d) Electricity Connection

Only 44 per cent of the total slums have street lighting inside the slums causing inconvenience for the slum dwellers that do not have such facility. The average number of hours of load shedding during summer is reported at 2.43 during summer and 0.90 in winter. Firstly this problem is making life unsafe in Slums in general and to girls, female and old persons in particular. It forces habitants to use unsafe means for

lighting as well as for cooking. Approximately 31 percent are having un authorized connections and 3 percent have no source of electricity. 49 percent have public metered supply and 13 percent have individual connections shown by Fig 9. In general, slums earmarked for dislocation or eviction, no one want to spend the money for up gradation. HH are not interested for spending money in getting electric connection nor does state government provide

organised electric poles or distribution scheme in these slums.



Compiled by: Researcher

Fig. 9: Electric sources in Slums of South and S-W Districts

e) Approach Road

The quality of roads inside the slums in Delhi is not that bad. 51.5 per cent slums have roads of mixed type which includes cement concrete road, bitumen road and kutchha roads. 31.24 per cent slums have cemented concrete roads. Only 3.14 per cent slums

have kuchcha roads. In S and S-W, 43 percent have Kuchcha roads as shown in Fig 4.11. Due to more lanes, the move of fire tender in slums is difficult in south west district. Further density of slums vs area also, restricts the availability of approach roads for fire tender in case of requirement

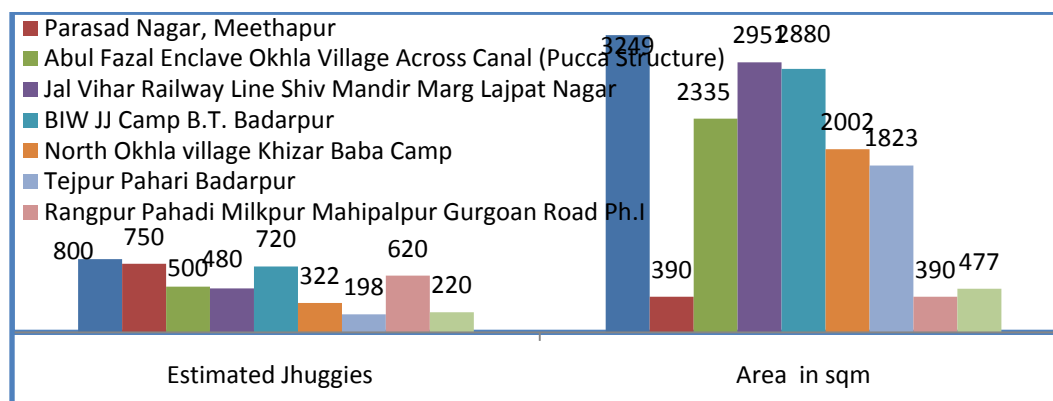
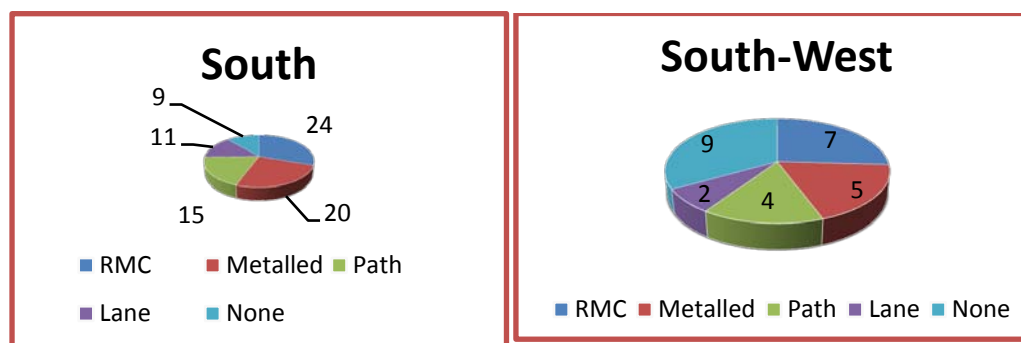


Fig. 10: Slum occupied Area Vs Slum HHs of South and S-W Delhi



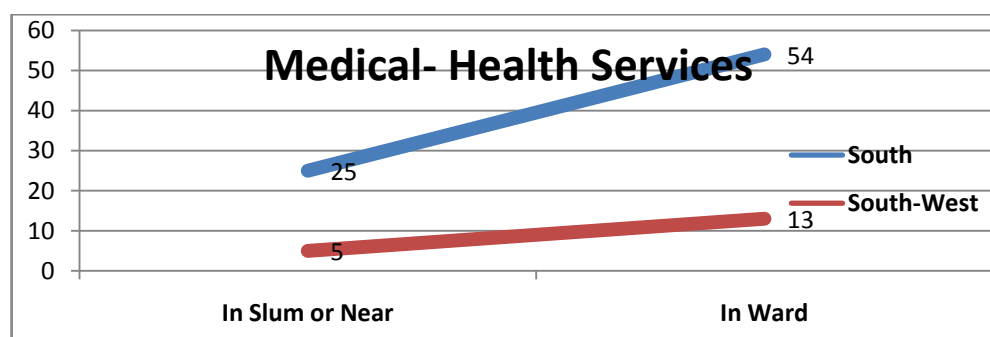
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Fig. 11: Road availability in Slums of South and S-W Delhi

f) Medical/Health Facilities

The facilities of Medical and health is generally negligible. Either they have to go up to 5 kms in ward having some arrangements or weekly mobile facilities are made available with a doctor for few hours only. In

emergency, there is no organized known services available and it is main cause of common concern. Various modes of services utilised by these house old is shown in Fig 12 below.



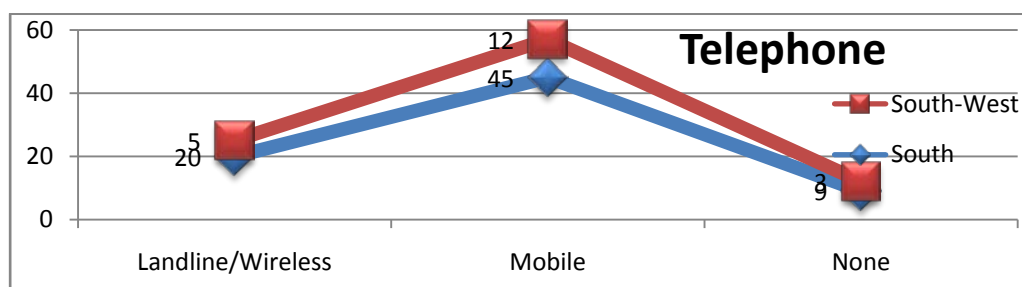
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Fig. 12: Health Facilities in Slums of S and S-W Districts

g) Telephone

In any disaster particularly fire, what matters most is the time gap between the fire and the response that follows. Most of the damage to lives and properties occur during this period. Therefore, besides government agencies, response should start where the fire strikes. For prompt communication in emergency, telephone is utilized by common people. Even though mobile is now

available with majority. However landline or wireless is available with 25 percent in both of these slums. 57 percent uses mobile in both these districts while 12 percent HH have no means of communication. As far as fire related issues are concern, this is not a point for serious consideration. If that response comes from an organized local group, then the loss of lives and assets can be minimized.



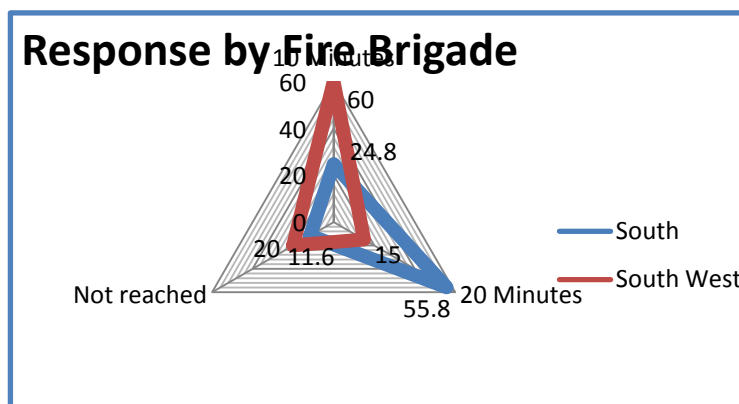
Compiled by: Researcher

Fig. 13: Telephone availability in S and S-W Slums

h) Fire Brigade

Even though Delhi Fire Service is responsible for entire Delhi. But due to various reasons prevention issues are not enforceable in slum areas. Further due to narrow lanes their response time is very high. Over and above the basic source of fire hydrants are generally not

available in prescribed distance of incidence locations. Survey confirms this problem. Only 64 percent reported that fire brigade could reach after 10 minutes of reporting. 13 percent reported that it never reached their location when fire broke in front of them.



Compiled by: Researcher

Fig. 14: Fire Brigade Availability

VI. DURATION OF STAY

This aspect is related to belongingness of habitants to their houses as well as to their slum area. Government policies also defines the right of getting a place for shelter based on the time dweller has spent in that house. During survey it is revealed that only 3 percent are the ones who have less than 1 year stay in the location and 10 percent having stay between one to two years. However these 13 percent are categories

under non authorised HHs, who cannot get benefit of slum upgradation house. Therefore these people are obstructing government plans. To make plan implementable, all habitants have to be addressed. As per judicial order, without an alternative arrangement, HH cannot be removed or evicted, HH having their presence after 2014 cannot be provided any assistance. 87 percent have to live without basic amenities.

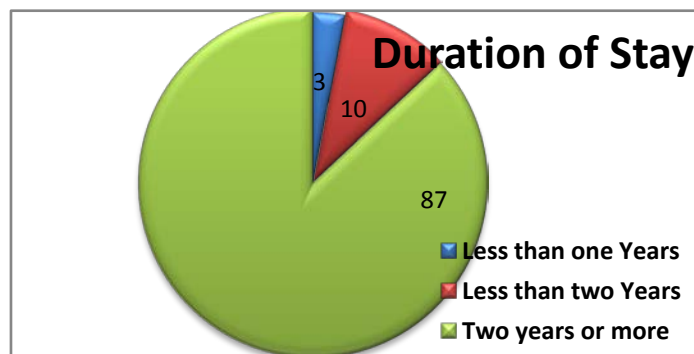
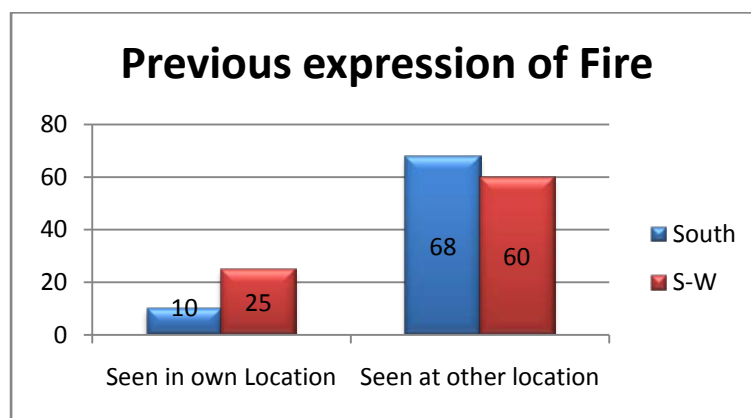


Fig.15: Longevity of HH in Slum Area

Previous Fire Incidences

It is important to note that the fire disasters are local events and the better solutions can be developed from the local environment and habitants of the slum. The lessons from the past events have major contribution for future plan. To develop an awareness in order to cope up with disasters and reconstruct the affected community as a disaster resilience community,

the past experience is re-capitulated. To find the details of habitants having firsthand experience of previous fire disaster, the survey revealed that 78 percent habitants of south district slums and 85 percent of S-W district slums have seen after math of fire disaster. In S-W slums even 25 percent have experience of fire damages in their own slum. These people can contribute to reduce vulnerability in their locations.



Compiled by: Researcher

Fig. 16: Previous Impression of Fire Disaster in Slum

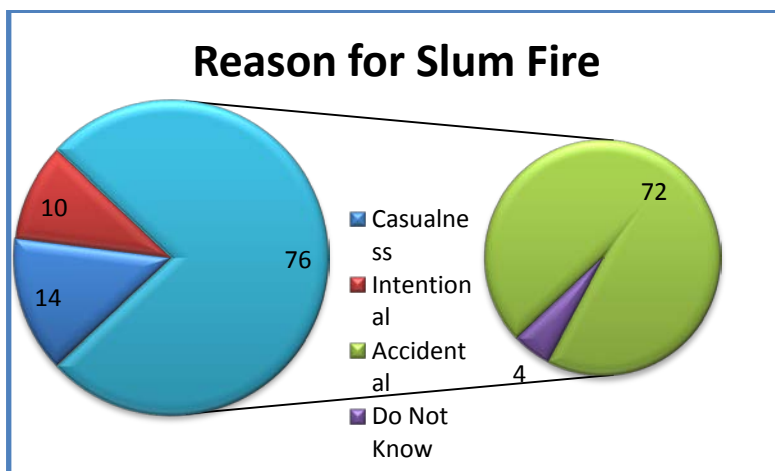
a) Reasons best felt by Habitants

Sustainability of disaster preparedness lies in addressing vulnerability conditions and changing their context, while organizing slum communities to deal with fire disasters. The extent also depends upon prevailing social and economic conditions and it's consequential effect on habitants activities within a given slum. If the

reason can be identified then, one may think to avoid the cause to safe guard against such repetition. With this as a aim, slum survey tried to collect the understanding of habitants for likely causes and expected mitigation action. It is found that 76 percent felt that fire is due to casualness of HHs and resulted as accidents reported by 72 percent. However it is further

noted that 10 percent felt that it is intentional by local politicians or muscle carriers to get the areas vacated. Intentional fire should not be accepted by any one nor to

be supported or encouraged by any 'Tabka' of society. The case study of Bangalore fire confirms intentional fire of slum by anti social elements.



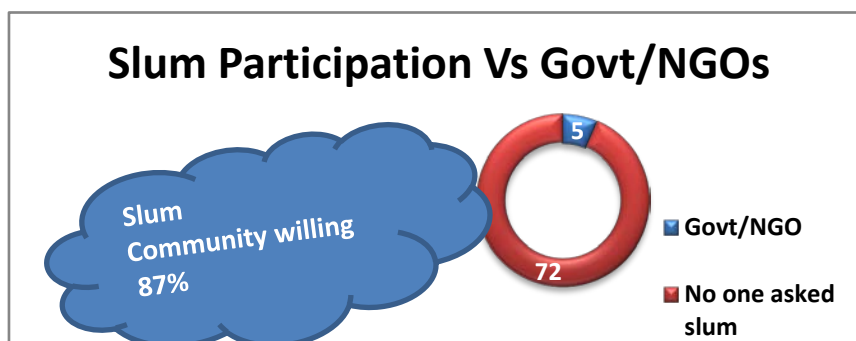
Compiled by: Researcher

Fig. 17: Reasons felt by locals

b) Govt/NGOs Response and Community Participation

Slums are not notified yet, therefore any plan requiring proper funds are less prioritized. Mitigation plans of the slum community and Mohallas demands priority under various development schemes administered by Urban Local Bodies or Government. Further it needs slum community participation. Survey

confirms that in these slums, such interaction was minimal (5 percent reported some activities in past). 72 percent reported that no one approached them in past. Such a figure is alarming and concerned officials attention is needed. While 87 percent are willing habitants to participate for development activities.



Compiled by: Researcher

Fig. 18: Slum Participation in Mitigation

c) Government and other agencies response to fire disasters

The threat of eviction without any compensation is real insecurity of tenure. The shelter remains unsecure even after decades of residing in it, the dwelling cannot

be used as collateral to obtain credit, and lack of address proof limits participation in government schemes as well as in the economic mainstream (Mathur OP, op.cit). The Survey data with Govt/ NGO officials is placed below.

Table 2: Interview with Public Representatives/ Government/NGO officials

Details	South and South West Slums
Fire Incidence in past	Most of them witnessed all incidences and actively participated. Reason is ignorance of habitants.
How do you participated in fire mitigation	Actively involved for relief operations only. No activity seen for long term plans. No govt plan/ rehabilitation scheme in force.
RRD ?	All Knows RRD and still looking for such scheme to be implemented.

Any Plan	Local committee formed and training to educate and awareness programs organized.
Any Suggestions	Local/ common building bye laws and govt in-situ slum development schemes need to be initiated immediately.
Government Action	Even though DUSIB, DJB and NDMC, MCDs and cantonment board are maintaining the slums but their is no long term plans by either of them

Source: Compiled by Researcher

The Panchayati Raj as 'Institutions of self-government' is recognised by constitution through 73rd and 74th amendments. The amendment has also laid down necessary guidelines for the structure of their composition, powers, functions, devolution of finances, regular holding of elections and reservation of seats for weaker sections including women. These local bodies can be effective instruments in tackling slum disasters through early warning system, relief distribution, providing shelter to the victims, medical assistance etc. There are various institutional stakeholders also involved in disaster management at various levels in the country. These include the police and para-military forces, civil defence and home-guards, fire services, ex-servicemen, NGOs, public and private sector enterprises, and media. In urban development plan, there is no land allotment for removal/ redevelopment/ resettlement of slum with a dedicated fund.

VII. EMPIRICAL FINDINGS

It is also found that neither proper bye laws exists for their construction and maintenance nor Fire prevention systems are adequate for slum areas. Government plans do also not exist.

But, majority has got electric connections and habitants are motivated to actively participate in all development plans. The main source of fire has not got awareness to have separate place for kitchen relative activities.

NGOs are active in all slums and in few slums, Self help Groups are created. People have been educated to understand the importance of their participation. Water and health facilities need improvement.

a) House quality

Due to type of Construction and material used for superstructure, the houses of these households are more likely to be destroyed during fire. The structures are built according to older style, without any building codes. Most of it has used lower quality construction materials and methods, and hardly maintained (Bolin and Bolton, 1986). Lower income households have fewer resources on which to construct their houses therefore construction is in stages. They also take longer to transition through these stages of housing, sometimes resides in semi-constructed/ damaged portions for extended periods of time (Girard and Peacock, 1997). In other cases, they are forced to

accept as these structure as permanent what originally was intended as temporary housing (Peacock, et al., 1987).

A study commissioned by some NGO in 2010 spoke about ignition and flammability of materials used in jhuggi construction. These clusters were found to be accident-prone and likely to go up in flames anytime. The experimental study, carried out by professor S R Kale from the mechanical engineering department of IIT-Delhi, examined how different structures reacted to fire attacks in various orientations and with different sources of ignition. Typically, a slum consists of mats, sacks, plastic and wooden columns that impart structural integrity. Fires in such settlements are quite common and result in considerable loss of property and life, the report noted. It pointed out that the materials used were flammable and even a spark could trigger a fire.

The study found that commonly used cane mats ignite easily and burn rapidly. Black plastic sheets used to cover the mat structures and also as roof, also catch fire easily and keep burning. Moreover, burning of these sheets gives off globules of burning plastic at regular intervals. The report recommended that salt and mud coatings could reduce the flammability of mats, as shown by experiments. Dunu Roy from Hazards Centre blamed shoddy urban planning for the fires. "Most huts are built in dense settlements that are contiguous and huddled together. Since there are no gaps, fire spreads rapidly. Planning and housing for the poor is the answer. When there is uncertainty over the continuity of a slum, a poor man will not invest in its safety."

Shivani Chaudhry, executive director, Housing and Land Rights Network, pointed to the government's failure to invest in adequate low-cost housing. "People need to live close to their workplaces. Scores of residents are forced to live in slums, many of which are considered 'illegal' by the state or not 'recognized'. The state's refusal to invest in these settlements and provide the minimum standard of basic services, such as water, electricity, sanitation, affects residents," said Chaudhry. HLRN cites the government's failure to protect the human rights of slum-dwellers as a violation of the Constitution and judgments of the Supreme Court that have upheld the right to housing as a human right and an extension of the right to life.

The study suggests that informal settlement dwellers play positive roles in urban economy as well as urban life apart from a few known adverse roles. Their

contribution to urban GDP, and some of the "difficult to replace" nature of jobs they are engaged in, makes them an integral productive economic agent of the urban economy. As the services provided to this section of population are often considered as favour to the community rather than their basic right, the approach and attitude of the authorities needs to be re-examined. Certainly the informal settlement dwellers deserve the basic facilities that other urban dwellers enjoy as their right. This needs to be translated into policies by the policy makers and opinion leaders of the country (PRIA, 2013).

b) Intentional fire to frighten residents

From the interviews with the residents of the few slums, the researcher has arrived at the conclusion that the few slums were intentionally set on fire by persons having interest in the land on which the slums had settled. These fires have destroyed everything that the poor slum residents had including vessels, pots, clothes, blankets, money, etc. Within a few hours, structures that have been built by the poor incrementally over years are flattened. There is little time to save anything. Whatever little documents these family have, including ration cards, voter cards, etc are also generally lost in the fire. The residents also claimed that in addition several pushcarts and vegetables and fruits for sale were also destroyed by the fire. They even said that those on the road side who had small shops selling cigarettes, sweets, etc. and even these were destroyed. Researcher has found that the lands on which these slums are located have several other interested parties who could be behind the fires. The end effect of the fire is to instill fear in the minds of the slum dwellers and force them to vacate the land. The fire is just one way of forcing the slum dwellers off the land. In various interviews the researcher came across various other tactics including threatening, physical violence using goondas, abusing the women, teasing women, etc. to force them off the land. This is an issue that needs immediate tackling.

The researcher is of the impression that the offence of intentionally setting fire to a slum which houses dalits predominantly also attracts the provisions of the Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, 1989. As was found, the slums have been set on fire by certain persons with the intention of evicting the slum dwellers. The lands on which these slums are located have been the reason for dispute between these persons and the slum dwellers. Considering these facts it is necessary to invoke these provisions of the Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, 1989 against those guilty of setting these slums of fires.

It is a matter of shame that the residents of the slums live under such circumstances especially considering that they have contributed towards metro

city development by building countless houses, schools, hospitals, colleges, etc. they cannot afford decent houses for themselves and the government does not find it necessary to fulfill their needs.

c) Judicial / Constitutional Backing

These slum dwellers have a constitutionally guaranteed Right to Shelter which the government has to fulfill. In various cases, the Supreme Court has enlarged the meaning of life under Article 21 of the Constitution to include within its ambit, the right to shelter. Upholding the importance of the right to a decent environment and a reasonable accommodation, in *Shantistar Builders v. Narayan Khimalal Totame* (1990) 1 SCC 520: AIR 1990 SC 630, the Court held that, "The right to life would take within its sweep the right to food, the right to clothing, the right to decent environment and a reasonable accommodation to live in. The difference between the need of an animal and a human being for shelter has to be kept in view. For the animal it is the bare protection of the body, for a human being it has to be a suitable accommodation which would allow him to grow in every aspect - physical, mental and intellectual. The Constitution aims at ensuring fuller development of every child. That would be possible only if the child is in a proper home. It is not necessary that every citizen must be ensured of living in a well-built comfortable house but a reasonable home particularly for people in India can even be mud-built thatched house or a mud-built fireproof accommodation". In *Chameli Singh v. State of U. P.*, a Bench of three Judges of this Court had considered and held that the right to shelter is a fundamental right available to every citizen and it was read into Article 21 of the Constitution of India as encompassing within its ambit, the right to shelter to make the right to life more meaningful. In para 8 it has been held thus: "In any organised society, right to live as a human being is not ensured by meeting only the animal needs of man. It is secured only when he is assured of all facilities to develop himself and is freed from restrictions which inhibit his growth. All human rights are designed to achieve this object. Right to live guaranteed in any civilised society implies the right to food, water, decent environment, education, medical care and shelter. The right to shelter, therefore, does not mean a mere right to a roof over one's head but right to all the infrastructure necessary to enable them to live and develop as a human being. Right to shelter when used as an essential requisite to the right to live should be deemed to have been guaranteed as a fundamental right. As is enjoined in the Directive Principles, the State should be deemed to be under an obligation to secure it for its citizens, of course subject to its economic budgeting. In a democratic society as a member of the organised civic community one should have permanent shelter so as to a physically, mentally and intellectually equip

oneself to improve his excellence as a useful citizen as enjoined in the Fundamental Duties and to be a useful citizen and equal participant in democracy. The ultimate object of making a man equipped with a right to dignity of person and equality of status is to enable him to develop himself into a cultured being. Want of decent residence, therefore, frustrates the very object of the constitutional animation of right to equality, economic justice, fundamental right to residence, dignity of person and right to live itself."

d) *Socio-Economic Community Issue*

A wide range of socioeconomic factors are associated with increased vulnerability. Areas with high crime rates, low social capital, and socially isolated individuals had increased vulnerability. People in areas of low socioeconomic status are generally at higher risk of heat-related morbidity and mortality due to higher prevalence of chronic diseases. Protective measures are often less available for those of lower socioeconomic status. Other groups, like the homeless and outdoor workers, are particularly vulnerable because of their living situation and being more acutely exposed to heat hazards. Older persons may also often be isolated and living alone, and this may increase vulnerability. The distribution of households with and without separate space for cooking is main drawback. Even fuel for fire is also main cause of concern.

e) *Missing coordination between stake holders*

With the immensity and complexity of the disaster problem, no stakeholder could effectively address the problem alone. Cooperation in disaster reduction activities among governments at national and local levels, non-governmental organizations and various sectors of the communities is essential. The broadened participation of relevant sectors, such as environment, finance, industry, transport, construction, agriculture, education, health, and media among others, in disaster reduction activities, allows for greater understanding of local vulnerabilities and risk to disasters and integration of actions of stakeholders.

The effectiveness of disaster risk management interventions could be ensured when the community and people at risk are directly involved in the disaster risk management process. It is also critical that any disaster risk management plan is dynamic and remains relevant to the community and the roles and contributions of the members are defined. Through the participative approach, the determination of risks and the intervention measures are not imposed on the community, but rather accomplished by the very people concerned. Following measures are missing-

- i. Empowerment to the poor and women, to overcome established boundaries and limitations
- ii. Funds/subsidies of state-led programs are not seen.

- iii. New relationship between grassroots groups, social organisations, and the private and public sectors is not seen.
- iv. A community led reconstruction to development strategy is based on the premise that communities can be mobilized around rebuilding efforts. Collective action around rebuilding – whether it is houses, schools or community centers, involves people in sharing of skills, resources, materials, benefits and ideas, and therefore is a shift from disaster to sustainable development.
- v. By building confidence in people's decision-making capacities, firstly people receive on time information on their entitlements, understand safety features and develop firsthand knowledge about local and new materials. Develop capacities to access cash and materials resources, and are part of community self monitoring mechanisms if and when they are established.
- vi. Empowering women's self help groups to play a key role in mobilizing communities, addressing women's issues, enhancing participation of women in rehabilitation. Specific to the reconstruction program, women's can play a key role in reaching out information, Promoting safe construction practice, monitoring relief and reconstruction, ensuring earthquake resistant standards and providing feedback to administration.

f) *Lacking support from Delhi Fire Department*

CAG commented in it's report on DFS-GNCTD that planning and preparedness for fire prevention undertaken and achieved by DFS was not commensurate with the size and complexity of a megacity like Delhi. It neither maintained a comprehensive database of areas, population under respective fire stations and geographical mapping nor was it aware of the number of high rise buildings in Delhi and the status of NOCs/FSCs issued to such buildings. DFS was suffering from shortages of resources too, particularly of operational staff and fire tenders/ bousers. Available Communication equipments are inadequate and outdated, hampering the performance of DFS. As per SFAC norms, the response time of a maximum of three minutes should be achieved in all high hazard zones and closely built up areas, and it should not exceed five minutes for other areas. DFS did not maintain manual data of actual response time, but uploaded fire reports on its website with details of response time.

g) *Lacking financial planning of governments for slum eradication*

DUSIB has submitted a voluminous slum-free city action plan (SFCAP) to Delhi government for approval. While the board has proposed various measures to rehabilitate Delhi's slum-dwellers, one of the main objectives is freeing up nearly 200 hectares of

land. The DUSIB plan will take at least six years to be implemented, subject to being approved by the Delhi government and subsequently by the Union Ministry of Urban Development. The data that the board collected in order to prepare a housing strategy for the slums, however, reveals the grim reality of depriving slum-dwellers of their dignity, also poses the perennial risk of exposing the residents to infections and diseases.

While the SFCAP deals with the all-round problems that the administration will have to tackle while making the city slum-free, it enlists a number of improvement and curative strategies to better the infrastructure and facilities available to slum dwellers. These include the existing physical infrastructure within and in the vicinity of slums and proposed relocation areas including connectivity infrastructure like road network, other transport network, water supply, sewerage, drainage, electricity and communication networks, solid waste management facilities and other physical infrastructure facilities. "Social infrastructure facilities (community toilets/baths, informal sector markets, livelihood centre, pre-schools, child care centre, schools, health centres, health, banking, community halls etc.)"

In the course of making the SFCAP, DUSIB also gathered information based on various parameters that compose the slum population of Delhi.

The board has prepared a housing strategy that will accommodate all slum dwellers in Delhi and create an extra EWS (economically weaker sections) housing stock estimated to be about 1,47,357 flats. The plan, according to DUSIB, will free up 197.23 hectares (about 500 acres) of land encroached upon by slums that is likely to fetch a price of Rs 14,526 crore. Its report states: "It is proposed to build a total of approximately 3.6 lakh dwelling units during the five years of implementation of RAY (centrally-funded Rajiv Awas Yojana) in Delhi. The total projected cost for housing is Rs 37,235 crore which is calculated without adding any price escalation. During the first year, it is proposed to build 23,755 dwelling units at an estimated cost of Rs 2,494 crore." This cover entire Delhi having 9 districts including South and S-W districts, which are scope of this thesis.

VIII. RECOMMENDATIONS

The RRD approach confirms that development can only sustain if disaster mitigation is built into the development process. Further mitigation has to be across all sectors of development. It advocates that investments in mitigation are much more cost effective than expenditure on relief and rehabilitation. Therefore following activities needs to be visited in detail:-

a) *Slum Free City Plan of Delhi*

In 1962, Delhi Govt had set up a special cell under Slum Area (Improvement and Clearance) Act

1956, for infrastructure and utility services support to slum area and to rehabilitate slum clusters as the Slum & JJ Wing. The Slum & JJ Wing of erstwhile MCD/DDA was created into a board under chairmanship of hon'ble CM of Delhi, in 2010, and renamed as Delhi Urban Shelter Improvement Board (DUSIB). DUSIB is responsible for providing/managing/co-ordinating for infrastructure and civic services in JJ clusters of Delhi. DUSIB is also nodal agency for resettlement/rehabilitation of slum clusters in Delhi. In 2009, the Government of India launched Rajiv Awas Yojna (RAY) for making India slum free. GNCTD is required to prepare a slum free strategy for the whole city. The Ministry of Housing and Urban Poverty Alleviation (HUPA), Govt. of India has appointed DUSIB as the nodal agency for Slum Free City Planning for Delhi by GNCTD. Currently, 675 JJ clusters have been identified, with about 3,06,600 jhuggis occupying about 700 hectares of land in Delhi. The JJ clusters are spread on land owned by DUSIB, MCD, NDMC, and Central Government agencies e.g. Railway, DDA (50% land), Delhi Cantonment Board, CPWD/L&DO etc. Delhi has multiplicity of authorities, multiple government bodies own lands, and control planning, approvals, allocation of land etc. These authorities are not under control of Delhi Govt. Thus, Delhi Govt. constrained unlike other state governments. It is expected that approx. 3,30,867 dwelling units will be built on tenable & semi tenable land presently occupied by JJ clusters, and about 210 hac. of land will be freed. In present proposal, considering projects under JNNURM and DUs on available vacant land, 453959 DUs will be made available against present 306602 households in various slums. Capital earned by this free land should be able to fund the development of surplus EWS housing on the tenable land parcels, presently occupied by JJ clusters. Commercial exploitation of the freed land may be able to fund the entire project of making Delhi slum free. All the Slum lands, irrespective of land owning agencies, and powers regarding preparation/approval of rehabilitation/ approval for construction plan including approval for land use change if any, should be transferred to DUSIB by making necessary Act by Centre/ State Govt. The present Act of DUSIB needs to be amended (DUSIB SFCPoD, 2015).

b) *Slum Community Participation*

The effectiveness of fire risk management interventions could be ensured when the community and people of slums who are at risk are directly involved in the fire risk management process. It is also critical that any such plan is dynamic and remains relevant to that slum community. Through this approach, the determination of risks and the intervention measures are not imposed on the slum community, but rather accomplished by the very people concerned. Moreover, greater emphasis is placed on local knowledge and the indigenous ways of knowing, rather than on expert knowledge and technologies. This shifts focus from

hazards to socio-economic vulnerability (poverty, development, etc.) of the communities at risk. Further, it allows problems defined correctly and accordingly responsive measures are designed and implemented. Slum habitants respond to disasters more efficiently and effectively with existing local resources. Community based-activities increase the community's capacity and people's potential for reducing their vulnerability to fire disasters.

- i. *Stack-holder's responsibilities*- Besides trained civil and military personnel, strengthening of existing institutional arrangements and systems is required to make the initial response to fire more effective and professional.
- c) *Funding Mechanism with development linked mitigation*

India's 10th Five Year Plan noted that the urban slum population is growing despite sharp reductions in poverty and rising incomes. The central and several state governments recognized the need for intervention by initiating, or enlarging existing urban housing and other slum subsidy programs. With this in mind, the Government of India (GOI) has requested a loan from the World Bank to implement a more effective strategy and delivery mechanism for the financing of urban slum improvement and sanitation provision in underserved areas.

In order to support the GOI to achieve the goals delineated in 10th Five-year Development Plan concerning slum improvement and poverty alleviation in urban areas, the Bank has agreed to consider a program that will focus on

d) *Act to cover techno-legal requirements*

Office of the Divisional Commissioner has requested various line departments to nominate experienced engineers to constitute a hazard safety cell within the department. NDMC, DDA and MCD have already constituted Hazard Safety Cells within their departments. Other legal provisions are as follows:-

- Amendment in Urban Development Legislations / Regulations / Bye-laws for incorporating "multi-hazard safety" provisions: A committee constituted by MHA, headed by National Seismic Advisor, Prof. A.S. Arya, has suggested in its report to incorporate Disaster Management provisions in urban development legislations, regulations/bye-laws, by making suitable amendments in Building bye-laws, master plan etc.
- DDA is looking into the existing provisions and preparing text incorporating Multi Hazard Safety provisions in the Master Plan for Delhi -2021.
- MCD has put up a draft of the new building byelaws, in which amendments as per the recommendations made by the National Expert Committee have been incorporated.

e) *Strengthen fire services*

The fire prevention wing is headed by a Deputy Chief Fire Officer and assisted by a Divisional Officer and Station Officers. But all this actions are not covering slums and their habitants. What is needed now is-

- Risk of safety and security of people can be ensured only when the affected slum communities determine their priorities and control the use of resources to reduce vulnerability to fire hazard.
- Building innovations that are evolved by the poor to cope with the crisis can be sustained if they are supported with resources and capacities. Standard safety norms and building codes are developed (in relation to local skills, materials and resources). Alternative institutional arrangements to ensure resources allocated for the widespread awareness of safe building techniques.
- In order to further strengthen the capacity for response, the fire services are proposed to be developed into multi hazard response units. It is proposed to provide rescue tenders in addition to fire tenders to each fire unit and fill up all gaps upto sub divisional level.

ACRONYMS

AUDP: Asian Urban Disaster Mitigation Program
 BMPTC: Building Material Promotion and Training Council
 CBDM: Community Based Disaster Management
 CBO: Community Based Organization
 CGDR: Centre for Global Development Research
 CPWD: Central Public Works Department
 CSE: Centre for Science and Education
 CUSEC: Central United States Earthquake Consortium
 DDA: Delhi Development Authority
 DFS: Delhi Fire Service
 DJB: Delhi Jal Board
 DM: Disaster Management
 DMA: Disaster Management Act
 DRM: Disaster Relief Management
 DRR: Disaster Risk Reduction
 FEMA: Federal Emergency Management Agency
 GOI: Government of India
 I&FC: Irrigation & Flood Control
 JJC: Jhuggi Jhopri Clusters
 MCD: Municipal Corporation of Delhi
 MHA: Ministry of Homes Affairs
 MLA: Member of Legislative Assembly
 MP: Member of Parliament
 NDMA: National Disaster Management Authority
 NDMC: New Delhi Municipal Corporation
 NDPL: North Delhi Power Limited
 NDRF: National Disaster Relief Fund
 NGO: Non-government organization
 PMB: Project Management Board
 PWD: Public Works Department

RRD: Relief Rehabilitation and Development
 SDRF: State Disaster Relief Fund
 UN: United Nation
 UN/ISDR: United Nations International Strategy for
 Disaster Reduction
 UNDP: United Nations Development Program

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Determinants of Choice Decision for Adoption of Conservation Intervention Practices: The Case of Mt. Damota Sub-Watershed, Wolaita Zone, Ethiopia

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Abstract- Factors affecting choice decision are location specific and it is also important to look into farmers' decision on conservation practices for which they are aware of. This study was undertaken in Mt. Damota sub-watershed, which is among the degraded site in the woreda as well in the zone. The study mainly investigated how farmers' decide on conservation practices and what determines their decision. The data was collected from 103 randomly and proportionately selected households from two PAs and six villages by using stratified random sampling techniques where wealth status was used for the stratification. The relevant data were generated using a combination of methods; structured questionnaire, key informants and group discussion methods as well as secondary data sources. Descriptive statistics with appropriate statistical tests and binary logistic regression model were used to analyses the data. The study findings from ch-square test showed that the farmers' choice decision was positively and significantly correlated to family size, educational status, social position, source and distance of farmland, tenure security, off-farm income, training, extension and credit service. Factors such as age, sex, farm size, farming experience, number of farm plots, slope gradient and soil type were not significant. The model output showed that factors such as; education, training; tenure security.

Keywords: *determinants, adoption, soil erosion, swc, decision.*

GJHSS-B Classification : *FOR Code: 040699p*



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Abstract- Factors affecting choice decision are location specific and it is also important to look into farmers' decision on conservation practices for which they are aware of. This study was undertaken in Mt. Damota sub-watershed, which is among the degraded site in the woreda as well in the zone. The study mainly investigated how farmers' decide on conservation practices and what determines their decision. The data was collected from 103 randomly and proportionately selected households from two PAs and six villages by using stratified random sampling techniques where wealth status was used for the stratification. The relevant data were generated using a combination of methods; structured questionnaire, key informants and group discussion methods as well as secondary data sources. Descriptive statistics with appropriate statistical tests and binary logistic regression model were used to analyses the data. The study findings from ch-square test showed that the farmers' choice decision was positively and significantly correlated to family size, educational status, social position, source and distance of farmland, tenure security, off-farm income, training, extension and credit service. Factors such as age, sex, farm size, farming experience, number of farm plots, slope gradient and soil type were not significant. The model output showed that factors such as; education, training; tenure security; source of land; perception on effectiveness of technology; and off-farm income have significantly influenced farmers' choice decision of conservation. The study concludes that future SWC policies and strategies should focus on differences in such variables in the design, promotion and implementation of conservation practices.

Keywords; *determinants, adoption, soil erosion, swc, decision.*

I. INTRODUCTION

Poor and inappropriate land management is the main cause of physical and chemical degradation of cultivated land. Soil degradation is the most serious environmental problem affecting Sub-Saharan Africa (SSA) (FAO, 1999).

Ethiopia has been described as one of the most serious soil erosion areas in the world. The poor soil management and land use practices are the causes of high soil erosion rate (Nigussie & Fekadu, 2003).

Repeated problems of drought and food insecurity have been attributed at least partly to this phenomenon of soil erosion. Almost 75% of the Ethiopian highlands were estimated to need soil conservation measures of one sort or another if they are to support sustained cultivation (Wood, 1990). The ever-increasing food deficiency and severity of famine problems in the country seem to confirm forecast. Therefore, to minimize the problem of soil erosion and the resulting degradation, proper soil management aiming at improving the condition of the soil by integrating soil erosion mitigating practices with strategic policies that can enhance agricultural productivity, and thus have positive impact upon growth perspective (Adugna, 2008).

Considering of the intensity of problems, SWC practices were implemented in many parts of the highlands during the 1970s till present. They have been introduced in some degraded and food deficit areas mainly through food-for-work productive safety net programs which concentrated on structural types and of these the most common were the *fanya juu* and soil bunds (Belay, 1992). Hundreds and thousands of kilometers of *fanya juu* and soil bunds were constructed on croplands. However, reports indicated that these conservation structures have not been adopted and continuously used by the farmers (Yeraswork, 2000; Fitsum et al, 2002). The limited adoption and expansion of soil and water conservation practices is not only due to technical problem, rather mainly due to a socio-economic problem with many constraints playing a great role (Habtamu, 2006). Detail investigation of the local level biophysical and socio-economic realities is essential to understand empirically the diverse socio economic variables affecting farmers' conservation decision (Woldeamlak, 2006; Bekele, 1998). This may help as to understand why possible solutions might not be successful to sustain soil conservation and land productivity. Awareness on the existence of a problem is the point of departure in seeking a solution to solve a problem (Zerfu, 1996). As in (Tesfaye, 2003) it is

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essential to know if and when farmers practice what they know and what they perceive about soil erosion.

The study site is one of highly populated area in the country and as well in Zone; with population density of 781 persons per km² and this resulted in vulnerability of the natural resources to be poorly managed. The farmers' practiced various traditional and introduced SWC practices to halt the problem but still there is a gap in activities to be taken to sustain environmental resources.

The overall objective this study was to assess the factors affecting farmers' choice decision to conservation intervention practices in the site.

II. RESEARCH METHODOLOGY

a) Study Site Description

Wolaita zone is located in SNNPRS and is approximately located between 6.4° -7.1° N longitude and 37.4° -38.2° E latitude part of the world. It shares the boundary with Kambata- Tambaro zone in the north, Dawuro zone in the west, Gamo-Gofa zone in the south, Hadiya zone in North west, Sidama zone in the east, and Oromia region in the south east and it shares Lake Abaya with Gamo-Gofa and Sidama zones (Kassahun, 2009). Mount Damota is located in Wolaita Zone, at 390 km (via Shashamane) and 327 km (via Butajira) southwest of Addis Ababa, the capital city of Ethiopia. It is located at the junction of three weredas of Wolaita Zone (Damot Gale in the east and north, Soddo Zuria in the south and west and Bolosso Sore in the west and north) with a total size of about 5862 ha (WZARDD, 2009). Mt. Damota is a source of many streams and rivers flowing to different woredas in radial pattern and it is reaching the highest peak about 2955 m and is locally called "*Wolaita Tuussa*" to mean the *pillar* of Wolaita (Abiraham, 2010). It can be referred to as roof of Wolaita (a water tower of Wolaita) since it has many streams originating from it and its significant influence on the climate of several Kebele administrations surrounding it (Figure S1).

b) Materials and Methods

A combination of methods was used to collect relevant data. Primary data was collected during the study by using various techniques such as face-to-face interview; transect walk, direct observation, key informant and focus group discussion and triangulation. As part of the primary data, information also was collected through structured questionnaire from woreda agricultural experts, Kebele leaders, SWC supervisors and DAs accordingly (Figure S2).

Secondary sources of information employed in this study include published materials such as reports, plans, official records, project proposals and reports, research papers and websites and these sources were used carefully by counter checking for their authenticity/accuracy/validity.

c) Sampling Procedure

Among seven PAs in the watershed, two PAs (Woshy and Wandara) were selected purposefully based on the severity of soil erosion and intensive conservation intervention practices implemented in the area for this research work. Then three villages were selected from each PAs based on the criteria mentioned above, accordingly a total of 6(six) villages were selected from the two PAs for this study. The record of total households (1470HHs) living in the study area which was also categorized according to their wealth status (A" for rich,"B" for medium and "C" for poor) was obtained from the kebeles administration. This classification was based on local criteria such as (livestock number, farm size, income source and capital or cash in hand. A sample size of 7 %(seven) was considered to be sufficient and representative to achieve the objectives of the study. Simple random sampling technique was used to draw individual sample household proportional to the population of villages for in-depth interview through structured questionnaire. Accordingly a total of 103HHs were included.

d) Method of Data Analysis

The collected data was reorganized and fed into appropriate statistical tools such as descriptive statistics (i.e. percentage, figure, table, chart, mean value, graphs), Cross tabulation Chi-square test, and with the use of regression model (binary logistic model) fed into SPSS software.

e) Model specification (Econometrics results of Binary logistic model)

Next to descriptive statistics, econometric model was used to study the relationship between variables empirically. Binary logit regression model which holds discrete and continuous explanatory variables was used to analyze factors affecting choice decision of farmers to adopt improved conservation measures.

This section deals with factors, which affect farmers' decision on conservation intervention practices. To identify these factors some statistical model was selected and fed into SPSS software. For this work, choice decision is defined by considering the implementation of introduced conservation intervention practices (mainly soil bund, grass strip and fanya juu) on farmers' plots. A farmer is considered adopter; if she/he implemented at least one of the practices in one of her/his plots and non- adopter; those farmers who never practiced any of them in any of their plots. Considering from this angle, the farmers were classified into two categories: adopter and non- adopter of the technology.

On the bases of theoretical background and review of literature on related studies, Binary logistic model was employed for this study to estimate the effect of hypothesized explanatory variables on farmers'

decision on conservation intervention practices. The dependent variable is choice decision of SWC intervention practices.

Various tests of multicollinearity were conducted and hence variables were found free from the problem of serious multicollinearity. As indicated in (Table S5), the results of the binary logit model showed that, among the 15 hypothesized explanatory variables; educational status of HHs, training, off-farm activities, tenure security, source of land, and effectiveness of SWC were found to be significantly related to the choice decision of conservation intervention practices and each of these variables are discussed under.

III. RESULTS AND DISCUSSION

a) Socio-economic profile of the study area

i. Age and Sex Composition

The age composition of a family is worth mentioning as it is a characteristic that has implication on the availability of labor for the various activities undertaken by the family. The chi-square test result showed that there was no significant mean difference on age ($P=0.59$; $\chi^2=31.6$) and sex ($P=0.59$; $\chi^2=0.289$) on conservation intervention practices between adopters and non-adopters and this implies that sex and age have no influence on choice decision to be adopters or non-adopters in the site. The result a beat contradicts the findings of others such as (Eleni, 2008; Getachew, 2005& Fikru, 2009).

b) Family Size and Educational Status

Family size and composition affect the amount of labor available for farm, off-farm and household activities and also determines the demand for food (Table S1).

The chi-square test result showed that there was statistically significance mean difference on family size on conservation practices between adopters and non-adopters at $P<0.1$ levels and it disagrees with the works of (Amsalu, 2006; Fikru, 2009) found insignificant difference.

Education enables farmers to tackle land degradation using various ways of soil fertility improving practices, traditional and introduced soil conserving technologies. The empirical result shows that the educational status of farmers in the study area is considerably low. In the area as a whole, significant share (about 46%) of the household heads were illiterate. Eleni, 2008; Adugna, 2008 & Fikru, 2009 also said the largest proportion is illiterate (no formal education). From the remaining 54%, about 10% of them have taken religious education, 28% have attended grades 1-6, 15% have attended from grade 7-10 and the remaining 1% have attended grade 11 and above.

The chi-square test result showed that there was statistically significance mean difference at $P<0.05$

levels ($P=0.042$; $\chi^2=8.143$) on education among adopters and non-adopters.

As hypothesized, educational status (*EDUC*) of household heads was found to be significantly and positively correlated with the choice decision of conservation practices. This is attributable to the fact that education reflects acquired knowledge of env'tal amenities and educated farmers tend to spend more time and money on land management practices. The finding was in agreement with (Ervin & Ervin, 1982; Bekele & Holden, 1998; Tegegne, 1999; Krishana *et al*, 2008, Fikru, 2009). The results showed that as farmers' education level increases by one extra unit, the probability of choice decision of practices increases by a factor of 3.9 (Table S5).

c) Social Position and Farming Experience

Many farmers were involved in different social and administrative responsibilities with or without salary in the society. The survey result indicated that 55% of the sample respondents were involved in various responsibilities in the society such as *kebeles* executive membership (4%), being cadre (9%), religious leadership (10%), edir and social committee (21%) and some are participated in more than one responsibility (11%). The chi-square test result showed that there was statistically significance mean difference on social position on conservation practices between adopters and non-adopters at $P<0.05$ levels ($P=0.008$; $\chi^2=15.6$).

From discussions, it was shown that farmers those have ample experience were more interested and committed to invest on conservation practices and to take care of their land and (Adugna, 2008) also confirmed this. The chi-square test result showed that there was no statistically significance mean difference with the farming experience between adopters and non-adopters.

d) Farm Size and Source of Farmland

As in most of the highlands of the country; the landholding of farmers in the study area is very small. Minimum and maximum sizes of landholding were 0.06 and 1.75 ha, the average being 0.5ha with the standard deviation of 0.3 ha.

Regarding ownership and sources of farmland, the survey result showed that more than 53% of the plots were inherited from family, 15% of the fields were distributed by PA leaders and nearly 22% of the fields were either rented or newly purchased by the current farmer and 10% were through sharecropping. The chi-square test result showed that there was statistically significance mean difference with the source of farmland at $P<0.05$ levels ($P=0.01$; $\chi^2=8.34$) and there is no significant mean difference with farm size between adopters and non-adopters and it is contrary to the findings of (Fikru, 2009). The way how farmers' access land (*SOURLAND*) was correlated significantly and

positively with farmers' choice decision of conservation practices. This is because besides the shortage of resource, farmers were not secure for sharecropped and rented plots. The finding is in agreement with Fitsum & Holden, 2003; Holden *et al*, 2002; Atakilte, 2003; Getachew, 2005 and Berhanu & Swinton, 2003. The probability of the farmer to choice decision that inherited cultivation land (owned farmland) is 2.53 times that of farmer that accessed for share cropping or renting (Table S5).

e) *Distance of the Farm Land from the Residence area*

It is assumed easier for the farmers to take care (to construct & maintain conservation structures) of the plots near their homes than those are far away. Manure is difficult to transport to distant fields since the field needs bulky manure. The scattered and far away fields are one of the factors that discourage farmers from deciding and using SWC measures. Shiferaw & Holden, 1998 found that some farmers undertake SWC work during the evening, making it difficult to go to the fields that are located far from the home. The chi-square test result showed that there was statistically significance mean difference on distance of farmland from the residence between adopters and non-adopters at $P < 0.05$ level.

f) *Slope Gradient of the Farm Plots*

Slope is one of the farm attributes that aggravate soil erosion problem. The farm slope gradient of the sampled households in the study area classified by sampled respondents as steep slope (*dagetama*), medium steep (*mekakelenya daget*), and flat slope (*medama*).

The chi-square test was conducted and the result showed that there was no statistically significance difference on slope of farmland on conservation practices between adopters and non-adopters. Similar results were found by Bekele & Holden 1998; Tesfaye, 2003 & Paulos *et al*, 2004).

g) *Fertility Status of the Plots*

Respondents have also classified their own plot fertility into three categories: low, medium and high. From a total of 178 farm plots respondents classified 22%, 64% and 14 % as low, medium and highly fertile soils respectively (Table S3). From transect walk and discussions, the fertile plots are more protected than the unproductive ones because of their profitability after investment on them.

h) *Farmers' understanding of the Practices and Associated Problems*

In order to learn farmers' general opinions about the conservation intervention practices (i.e. soil bund, fanya juu and grass strip), they were asked to identify if there is a problem related to the practices. Farmers' responses show different weights for these six problems (Table S4).

This result agrees with (Long, 2003) findings. These problems could be the possible reasons that the majority of the respondents who had soil bunds modified and adapted into their own ways. Farmers underlined that the disadvantages of soil bunds should be tolerated in view of the protection they give to their farm plots. The view on the disadvantage of the soil bund was shared both with those farmers who use soil bund as conservation strategy and who do not have any bunds on their farm plots. The result is in line with the finding of (Tesfaye, 2003).

i) *Land Tenure Issue*

Different questions were posed to the sampled respondents in the study area to understand their perception of the absence of individualized property right on their decision on conservation intervention practices. The questions concern in the area of land ownership and the use of it throughout lifetime. As the survey result showed, 69% and 62% of the respondents responded "yes, off course" and the remaining 31% and 38% respectively said no and as a reason they put various reasons such as the land belongs to government, stop farming in near future, the land will be redistributed, and some said land will be taken away by the government at any time. Though thus respondents knew that the land belongs to the government and they have only use right, no respondent put the insecurity of land as reason for not using conservation intervention practices that enhance land productivity.

The cross tabulation chi-square result showed there was statistically significant difference for the question of "land belongingness" at $P < 0.05$ significance level ($P = 0.012$; $\chi^2 = 6.350$) and no significant mean difference for the use of land throughout life time ($P = 0.102$; $\chi^2 = 2.676$) among the adopters and non-adopters.

In a more general term, having the confidence of their land to inherit to their children makes a farmer to invest on his/her farm and to take care of it. About 86% of the respondents have an expectation to inherit their farm to their children. The result of chi-square showed that there was no a significant difference on their expectation to inherit their land to their children between adopters and non-adopters ($P = 0.123$; $\chi^2 = 2.383$). This means having the confidence to inherit to their children has no influence whether to be adopters or non-adopters in the site and it contradicts the works of other persons such as (Abera, 2003; Bekele & Drake, 2003) that found it was statistically significant.

Farmers' perceptions of security of land (*LANDSECU*) they cultivate was significantly associated with choice decision to conservation intervention practices. It influences farmers' choice decision by influencing sense of responsibility and length of planning horizon of the household. It is in agreement

with (Woldeamlak, 2003; Yeraswork, 2000; Wood, 1990; Atakilte, 2003; Gebremedhin & Swinton, 2003) and disagrees with Bekele, 1998 & Long, 2003. As from the model output as there is more land tenure security, it will increase the probability of farmer's choice decision of conservation practices by 15.6% (Table S5).

j) Off-farm activities

Off-farm activities such as labor work and trade were also considered as other sources of household incomes in the study area. The result of chi-square analysis showed that there was statistically significant difference on the off-farm activities on intervention practices among the non-adopters and adopters at $P < 0.1$ levels. As in (Amsalu, 2006) Off-farm activities may have a negative effect on the decision behavior of SWC due to reduced labor availability. When the farmer and family members are more involved in off-farm activities, the time spent on their farmland will be limited and hence the family is discouraged from being involved in construction and maintenance of SWC structures. On the other hand, Habtamu, 2006 & Fikru, 2009 off-farm activities can be a source of income and might encourage investment in farming and SWC.

As hypothesized, off-farm income (*OFFINCO*) of the household is found to have a very significant and negative correlation with the conservation practices. This may be explained by the negative relationship between the conservation practices and off-farm income activities. Other similar studies reveal the same results (Ervin & Ervin, 1982; Gebremedhin & Swinton, 2003; Semgalawe & Folmer 2000; Pender & Kerr, 1998; Bekele & Holden, 1998). As observed from the result, an increase in off-farm income will decrease the probability of farmer's choice decision of conservation practices by 2.6% (Table S5).

k) Distance to market

The nature and development of markets for factors of production (land, labour) inputs and outputs can play a major role in determining patterns of land use and land management.

With respect to distance to markets the survey result showed that, 44% of the farmers responded the location of market is far from their residence, 37% responded as very far and only 19% said closer to their residence. The result of chi-square analysis showed there was no statistically significant mean difference on the distance of markets from their home among the non-adopters and adopters.

IV. INSTITUTIONAL SUPPORT

a) Training on Conservation Practices

Empowering farmers to have a new how of soil degradation and how to halt it through training has a great contribution in conserving soil resources. It was reported that, currently government (Productive safety

net program and other projects) and also NGOs working in the area provide technical and material support including short and long term trainings concerning erosion hazards and intervention measures. Farmers of the area received regular technical advice from DAs or other soil conservation technicians.

In the site, the majorities 66% and 58% have taken long and short term training respectively and the remaining have not participated in any form of training related to erosion and conservation intervention practices respectively. The chi-square test result showed that statistically significant mean difference on training conservation practices at $P < 0.05$ significant level between adopters and non-adopters ($P = 0.000$, $\chi^2 = 15.699$).

Access to training (*TRAIN*) in various times on hazards of erosion and intervention practices is highly significantly correlated with choice decision. Training influences farmer's decision to adopt various practices by enabling farmers to get adequate information that is useful incentive for choice decision. Previous studies indicated that farmers that are more informed assess the impact of soil erosion better than their counterparts that are not (Traoré *et al*, 1998; Sain & Barreto, 1996). As observed from the model result, as farmers get training on SWC and related activities, the probability of using improved SWC practices increases by a factor of 6.6% in the study area (Table S5).

b) Agricultural Extension Services

The information obtained and the knowledge and skills gained through extension message and contents accelerates farmer's decision on conservation practices. BoARD is the responsible organization to give agricultural extension services to the farmers in the rural area. The organization has a structure that extend down to Peasant Association (PA) level. From the result of survey, about 85% of the respondents have reported that they have access to extension services. The service is mostly given on crop and animal production and little attention was given to conservation practices. Development Agents who undertake the extension service at grass root level also confirmed this. The chi-square test result showed that there was a statistically significance mean difference on extension services among the adopters and non-adopters ($P = 0.007$, $\chi^2 = 7.391$).

c) Access to credit

Credit is use to improve the ability of households at critical times of the year to buy inputs. From the total of 103 sampled respondents who were asked whether they received credit or not, about 63% reported that they had received agricultural credit in the past years and they also mentioned the sources where they access i.e. government, NGOs, relatives and the combination in the form of fertilizer credit, seed credit,

livestock and incentives for SWC practices and 40% of farmers use credit for conservation practices. The output of cross tabulation chi-square test showed that there was a statistically significant difference among adopters and non-adopters on credit services ($P=0.001$, $\chi^2=10.989$).

V. CONCLUSIONS

Farmers' conservation intervention decisions whether to use conservation practices are shaped by several factors and are mainly determined by the particular location. In this regards, this work assessed farmers' decision on intervention practices and concerned factors in Mt Damota sub-watershed. The study has tried to look into the socio-economic, physical, institutional and other related factors. This study focused on three major conservation intervention practices (grass strip, fanya juu and soil bund). From the total respondents, about 72% of the sample households practiced at least one type of this practices on their farm; which indicated that most of the farmers in the study area are adopters of the technology.

The cross-tabulation chi-square test result showed that, the farmers' choice decision of conservation intervention practices was positively and significantly influenced by the respondents' educational status, social position, source and distance of farmland, training, tenure security, extension and credit service at $P<0.05$ levels and family size and off-farm income at $P<0.1$ levels; where as it is not influenced by the age, sex, farm size, farming experience, number of farm plots, slope gradient and soil type in the site.

Results of the model showed that among these hypothesized explanatory variables six variables were found to be significantly related to the farmers' choice decision on practices; educational status, training, off-farm activities, source of land, and tenure security .

With regard to strategies and programs by concerned bodies in SWC practices, it is concluded that considering the importance and difference in the above mentioned variables in the design, promotion and implementation of SWC practices leads to effectiveness and productivity; unless and otherwise it is unlikely to be effective.

a) Future line of Work

Based on the findings, the following points are forwarded for future work:

- ✚ An institutional support on conservation practices should get due attention by the planners and other concerned bodies for effective conservation and agricultural development in short and long time intervals.
- ✚ There is a need that extension planners should give attention to activities, which focus on the complementarities of both the conservation strategies of land management and income

generating activities in long run. (e.g., Employment generating scheme during slack period of the year).

- ✚ Detail identification of both techniques (traditional & introduced) and further studies on their effectiveness and productivity is essential and attention and technical support should also be given and extended to land husbandry.

- ✚ Educational status and family size are significantly and positively related to decision. So; attention should be given to education access in the site in short and long run. Controlling the increase in the family size should be of priority and Policy related to family planning, education and other means of reducing family size will help to reduce land degradation and increase crop production and per capita income.

Competing Interest

The author declares that there is no competing interest on this publication.

Authors' Contributions

Merkineh Mesene has designed the research, collected field data, analyzed and prepared the report.

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APPENDICES

Table 1: Appendix S1: Family size of HHs

Family size	Woshy (44HHs)		Wandara (59HHs)		Total(103HHs)	
		%		%	N	%
<2	0	0	1	2	1	1
3-5	17	39	20	34	37	36
6-10	24	54	37	62	61	59
>10	3	7	1	2	4	4
mean						7
SD						2
χ^2						16.2*

Note: SD- standard deviations, N-sample size

**is significant at less than 10% probability level. Source: FieldSurvey*

Table 2: Appendix S2: Slope gradient classification

Gradient class	Woshy (44HHs)				Wandara (59HHs)				Total (103HHs)	
	P1	P2	P3	P4	P1	P2	P3	P4	total	%
Flat	10	2	2	0	17	6	0	0	37	20
Medium	13	11	2	1	23	11	9	1	71	40
Steep	20	9	6	2	19	10	3	3	72	40

Source: Field survey

Table 3: Appendix S3:Fertility status

Fertilit	Woshy (44HHs)				Wandara (59HHs)				Total(103HHs)	
	P1	P2	P3	P4	P1	P2	P3	P4	N	%
Low	6	6	4	3	3	10	4	4	40	22
Mediu	33	11	3	0	45	13	6	3	114	64
High	3	3	1	0	12	3	3	0	25	14

Source: Field survey

Table 4: Appendix S4 : Problems associated with practices

Problem related to practices	Frequencies of respondents		
	Grass strip (%)	Fanya juu (%)	Soil bunds (%)
Require large labour	6	15	22
Reduce farm (plot) size	2	14	19
Difficult to implement	6	12	16
Lack of grass species (seedling)	15	-	-
Difficult to turn oxen	-	10	11
Sources of rodents	-	8	12
No problem	7	2	6

Source: Field survey

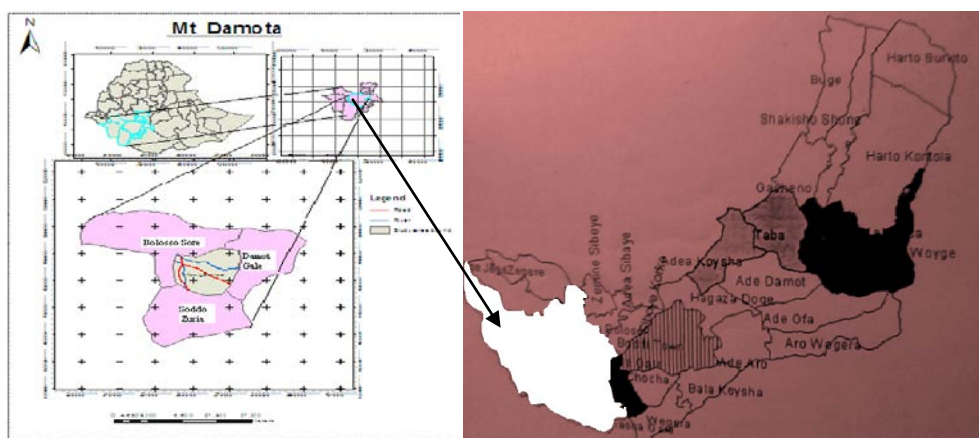
Table 5: Appendix S5: The maximum likelihood estimates of the binary logit model

Variable code	Estimated coefficient (B)	Standard error (S.E.)	Wald statistics	Degree of freedom (df)	Significant level (Sig.)	Odds ratio Exp(B)
SEX	-0.960	2.290	0.176	1	0.675	0.383
AGE	-0.256	0.175	2.131	1	0.144	0.774
EDUC	1.363	0.642	4.510	1	0.034*	3.907
FAMLSIZE	-27.495	4.019E4	0.000	1	0.999	0.000
FARMEXP	-5.813	3.720	2.442	1	0.118	0.003
FARMSIZE	8.136	6.899	1.391	1	0.238	3.415E3
PERCSH	-23.233	1.828E4	0.000	1	0.999	0.000
TRAIN	2.717	1.166	5.426	1	.020**	0.066
EXTENS	-1.970	2.119	0.865	1	0.352	0.139
CREDTS	-7.420	5.135	2.089	1	0.148	0.001
LANDSECU	1.861	0.886	4.411	1	0.036**	0.156
OFFINCO	-3.665	1.486	6.081	1	0.014*	0.026
FARMDIS	-0.145	1.294	0.012	1	0.911	0.865
SOURLAND	0.926	0.382	5.874	1	0.015*	2.525
EFFECT	3.607	1.199	9.054	1	0.003*	3.666
Constant	67.540	2.212E4	0.000	1	0.998	2.150E29

Notes: Exp (B) shows the predicted changes in odds for a unit increase in the predictor

*and **Significant at 0.1 and 0.05 level, respectively.

Appendix S6: Location of study site



Source: Field photo by the researcher

Appendix S7: Discussion with Key Informants





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Repercusión Del Uso Del Automóvil Sobre La Movilidad Urbana En La Gran Área Metropolitana De Costa Rica

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Abstract- This article try to unsderstand how the cuture of the mobility based in motoring is intensifying in a country like Costa Rica, having how point of begin the fact of the public politics make the urban planeation for the circulation of the motorized transport, that have repercussions not only in the urban mobility but also in the life quality in general, specially in the Gran Área Metropolitana (GAM), where the consent to investment, becomes in the fact that promove the individual mobilization of the persons, further damaging the movement in collective and non-motorized transport. In this sense the organization of the public politics, ends up deteriorating the urban spaces, and also the plans of sustantability and urban rehabilitation, in a country that will try to be a place with carbon neutral in the 2020 decade, increasing year by year the number of motorized vehicles, reaching numbers of 2.5 vehicles by person per capita, that impact the urban mobility and the enviroment. This reflection is made using data from the Ministerio de Obras Públicas y Transportes (M OPT), Instituto de Estadística y Censo (INEC), Poder Judicial y Registro Nacional. The analysis, comfirm, how the use of the car, is a model of transport that resing to the colective commitment in the society, when exist a need for awareness by the public authorities, in the compromise for have a sustainable, adequate and efficient transport system.

Keywords: *car cultura, colective transport, urban mobility, urban planification, public politics.*

GJHSS-B Classification: *FOR Code: 049999*



REPERCUSIÓDELUSODEL AUTOMVIL SOBRELAMOVILIDADURBANAENLAGRAN REAMETROPOLITANADE COSTARICA

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Repercusión Del Uso Del Automóvil Sobre La Movilidad Urbana En La Gran Área Metropolitana De Costa Rica

Diego Armando Céspedes Álvarez

Resumen- Este artículo busca comprender como, la cultura del automóvil se intensifica en un país como Costa Rica, a partir de que políticas públicas direccionan la planificación urbana para su circulación, transporte motorizado, que repercute no solo sobre la movilidad urbana, sino la calidad de vida en general, en especial en la Gran Área Metropolitana (GAM), donde el consentimiento al investimento, es tornado para que las personas deban se movilizar de forma individual, perjudicando aún más la circulación en transporte colectivo y el no motorizado. En este sentido su organización, acaba por deteriorar los espacios urbanos, así como los planes de sustentabilidad y rehabilitación urbana, en un país que busca para la década de 2020 ser carbono neutro, aumentando anualmente la flota vehicular, llegando a números per cápita de 2.8 vehículo/persona, impactando sobre la movilidad urbana y el ambiente. Esta reflexión es realizada mediante datos del Ministerio de Obras Públicas y Transportes (MOPT), Instituto de Estadística y Censos (INEC), Poder Judicial y Registro Nacional. Así el analice realizado, confirma, como el uso del automóvil, es un modelo de transporte que renuncia al compromiso colectivo en la sociedad, habiendo una necesidad de conciencia por parte de los poderes públicos, en el compromiso de tener un sistema de transporte sustentable adecuado y eficiente.

Palabras claves: cultura del automóvil, transporte colectivo, movilidad urbana, planificación urbana, políticas públicas.

Abstract- This article try to unsderstand how the cuture of the mobility based in motoring is intensifying in a country like Costa Rica, having how point of begin the fact of the public politics make the urban planeation for the circulation of the motorized transport, that have repercussions not only in the urban mobility but also in the life quality in general, specially in the Gran Área Metropolitana (GAM), where the consent to investment, becomes in the fact that promote the individual mobilization of the persons, further damaging the movement in collective and non-motorized transport. In this sense the organization of the public politics, ends up deteriorating the urban spaces, and also the plans of sustantability and urban rehabilitation, in a country that will try to be a place with carbon neutral in the 2020 decade, increasing year by year the number of motorized vehicles, reaching numbers of 2.5 vehicles by person per capita, that impact the urban mobility and the enviroment. This reflection is made using data from the Ministerio de Obras Públicas y Transportes (MOPT), Instituto de Estadística y Censo (INEC), Poder Judicial y

Registro Nacional. The analysis, comfirm, how the use of the car, is a model of transport that resing to the colective commitment in the society, when exist a need for awareness by the public authorities, in the compromise for have a sustainable, adequate and efficient transport system.

Keywords: car cultura, colective transport, urban mobility, urban planification, public politics.

I. INTRODUCCIÓN

En los últimos años, la prioridad de movilidad urbana motorizada en un país como Costa Rica, sobre todo en la Gran Área Metropolitana (GAM), ha venido ocasionando un detrimento en el transporte colectivo, además de una pérdida de espacio público a favor de la movilidad no motorizada (andar a pie y de bicicleta), afectando la calidad de vida urbana de los ciudadanos y el ambiente.

Este problema de cómo las ciudades se han venido organizando, se ha esparcido como una epidemia por todos los centros urbanos, constituyendo actualmente un tema que por décadas no se le ha dado solución, planificación urbana que ha dado prioridad en términos de espacio – tiempo a la locomoción del automóvil.

Asimismo, a como se fue agravando el problema, centros urbanos de importancia en la GAM, se destaca por tener diariamente grandes problemas de congestionamientos y espacios públicos ocupados por estacionamientos de vehículos, con la función de pasar su mayor tiempo en movimiento estático, afectando las condiciones de vida y la busca de tener más espacio público para las personas caminar con seguridad e saludablemente.

El aumento de la flota vehicular en poco más de un periodo de quince años y la ideología modernista de ser dependiente de un automóvil privado, coloca a las ciudades en un conflicto entre la planificación y la humanización urbana de las ciudades, con problemas de inseguridad, contaminación sónica, producción de CO₂, entre otros, considerándose la planificación urbana deteriorada en el fin de no considerar las ciudades como espacios públicos urbanos de encuentro, relacionamiento e de intercambio entre personas.

El desafío de tener ciudades caminables, seguras y prosperas, son la nueva perspectiva que todo

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ciudadano desea, con un diseño urbano en detrimento del uso del automóvil, posibilita el hacer de las actividades a pie o de bicicleta, como el nuevo lujo urbano en términos de estatus social: caminar por la ciudad sin automóviles, pero, la repercusiones del uso del automóvil sobre la movilidad urbana se ha direccionado en otro sentido.

Para buscar dar una solución a este problema, es necesario un proyecto urbano adecuado que beneficie las personas y no así el aumento de la circulación de más personas dentro de un automóvil, considerando el sistema de transporte colectivo de alta capacidad como prioridad en los proyectos de movilidad urbana, así como el mejorar las áreas urbanas caminables, con aceras amplias, con sombra, seguras, bien iluminadas y atracciones, un diseño urbano para andar de bicicleta y a pie, que beneficia el tener una ciudad con altos índices de calidad de vida.

II. EL USO DEL AUTOMÓVIL

La Gran Área Metropolitana, es una región de Costa Rica, localizada su gran parte en el valle central, constituida por cuatro provincias, San José, Alajuela, Cartago y Heredia, territorio que concentra más del 50% del total de los habitantes del país. De ese total, 32% se encuentra en San José y 19,7% en Alajuela, datos estimados por el Instituto Nacional de Estadísticas y Censos (INEC), con base en el censo 2011, con una población de 4 301 712 distribuidos en los 51 100 kilómetros cuadrados del territorio nacional.

Esta región metropolitana, se caracteriza por haber favorecido el desenvolvimiento urbano de forma poco adecuada, expandiéndose horizontal e dispersa, crecimiento conurbano conectado primordialmente por una red viaria nacional, superposición de un proceso de gentrificación del centro de la capital y sub-centros a la

periferia, característico en las grandes ciudades de América Latina, en su mayoría por un inadecuado planeamiento urbano.

Esa evidencia en la configuración espacial, como proceso de la globalización económica, ha manifestado una obsolescencia que dificulta los desplazamientos de sus habitantes, ya que su organización de forma en mancha de aceite y dispersa aumenta el tráfico de vehículos y el movimiento pendular entre el local de vivienda y de trabajo. Además de la pérdida de tiempo en los desplazamientos por la ciudad, posibilita de multiplicarse los accidentes de tránsito y los problemas a causa de contaminantes sónicos y de dióxido de carbono.

Como región, el GAM se reglamenta a partir de diferentes planos de desarrollo y planificación, con la finalidad de regular las actividades en el uso del suelo, un instrumento legal y metodológico que adecua el crecimiento urbano a las condiciones geográficas del territorio con ejes intermodales integrados, por un sistema de ciudades que fueron unidas físicamente por consecuencia del crecimiento, a través de un sistema viario radial.

La dependencia del automóvil en la movilidad de las personas, ha repercutido sobre la calidad de vida de los ciudadanos, afectando la percepción de cómo enfrentar la realización de actividades cotidianas sobre el espacio urbano, ya que muchos de los viajes que se efectúan dentro de la GAM en distancias entre los 10km que pueden demorar tiempos absurdos de 1hora a 3horas, en velocidades que rondan los 5 a 10km/h.

El área urbana GAM fue, por un largo periodo, interconectada por el funcionamiento del transporte ferroviario de carga y de pasajeros, conectando los centros urbanos importantes, así como las ciudades intermedias, como se observa en la figura 1.

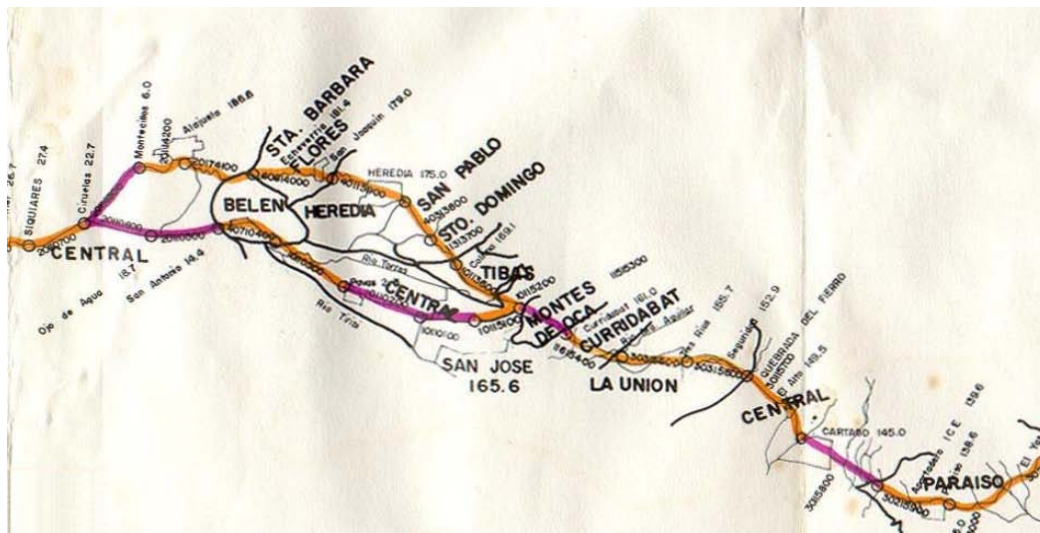


Figura 1: Rede ferroviária na Costa Rica

Fuente: Instituto Geográfico Nacional de Costa Rica (IGN) y Ministério de Obras Públicas y Transportes (MOPT), 2016.

La ineficiencia en la planificación del transporte ferroviario trajo en la gestión del presidente José María Figueres (1994 – 1998) la suspensión de la circulación de este modo de transporte que, en 1995, transportaba pasajeros y cargas de la capital a los puertos de Limón (Caribe) y Puntarenas (Pacífico), como señala el Banco Mundial (2005), un hecho que se dio en gran parte de América Latina, un retroceso que se dio por intereses privados, donde más tarde, para años actuales su fuerza política incentivaría a la industria automovilística.

En Costa Rica, gracias a la escogencia de políticas públicas y carencia de planificación adecuada,

torno el plan de tener un automóvil como principal medio de transporte, a una situación que lo coloca entre las estadísticas de los países desarrollados.

Según Molina (2015), la flota de automóviles privados supera las 800mil unidades de los casi 1.4 millones de toda la flota vehicular del país, tornando la circulación del transporte privado el mayor contribuyente en las emisiones de gases en Costa Rica, creciendo el 914% si se compara las últimas tres décadas, observar tabla 1.

Tabla 1: Costa Rica: Vehículos automotores en circulación per cápita

Ano	Vehículos	Populación	Media per cápita
1995	446.123	3 428 278	7,68
2000	677.757	3 872 349	5,71
2005	875.907	4 215 248	4,81
2010	1.161.731	4 533 894	3,90
2014	1.399.238	4.757.606	3,40

Fuente: Molina, A. 2015; MOPT. 2015. Elaboración: Diego Armando Céspedes Álvarez

Esa situación, coloca a Costa Rica para el año 2014 con crecimiento medio anual de 1 vehículo por cada 3,40 habitantes. Según el Registro Nacional (2016), para el año 2015 fue registrado un vehículo por cada 2,43 personas, en una población de 4 832 234, llevando a tener para el 2015 una flota de 1 987 244 vehículos, incidiendo sobre lo planificado e colapsando la infraestructura viaria, principalmente en la GAM.

Eso trae características en el flujo vehicular con proporciones que impactan la forma de movilidad, un crecimiento sin control que trae consigo una planificación obsoleta en el plan de tener una movilidad urbana sustentable, deteriorando los espacios públicos y los desplazamientos de las personas.

Esa estrategia política crea nuevos espacios para la acumulación capitalista que se acompaña de una industria automovilística que toma partida en el sistema consumista mundial, una dinámica que acaba con la estructuración urbana de las grandes ciudades para satisfacción del uso del transporte privado (HARVEY, 2005).

III. MOVILIDAD URBANA

La disputa por el espacio es las áreas urbanas ten llevado a usuarios de la bicicleta, del automóvil, buses y pedestres a una lucha cotidiana por acceder al espacio público de forma jerárquica, un problema que se debe a como las ciudades se fueron organizando y estructurando, quedando de segundo plano la prioridad la escala de las personas, sino que liberándose espacio público urbano para la circulación del transporte motorizado.

El transporte motorizado por su parte, debe ser visto como medio de transporte, en fin que beneficie el acceso de las personas en la realización de las actividades y no un objeto de consumo de importancia para circular en la ciudad. Uno de los problemas, es la circulación del automóvil en busca de estacionamientos dentro del núcleo urbano, cerca a los centros comerciales para caminar menos. Ese problema, según Speck (2012), determina la muerte de muchas ciudades, condición que, sí se permite tener una ciudad caminable, en cual esos estacionamientos se podrían utilizar para otras actividades en beneficio de las ciudades, como áreas de atendimento, ejemplos restaurantes abiertos que sirva a los ciudadanos en sus tiempos libres.

La movilidad urbana sustentable en las ciudades es uno de los desafíos para la planificación urbana, así como para la mejoría de las ciudades, en la busca de volver a estos centros urbanos calidad de vida de manera que se dé igualitariamente, es decir integrando todos los grupos sociales.

La diferencia de territorios entre países, sea cultural, política o administrativa, es algo que puede ser una piedra para la aplicación de propuestas que toman la escala humana, con la incorporación de lo colectivo sobre lo individual, pero cuando se habla de movilidad urbana sustentable e inclusiva, se implanta un tema de necesidad, ya que toda gestión urbana debe seguir este camino, o bien entre el bienestar social, en fin de combatir todos aquellos problemas que se fueron agravando con la implantación imperialista del consumo y uso del automóvil.

El arquitecto Gehl (2013), considera que mudar la cara de las ciudades tiene solución si las pensamos desde la escala humana, tomando todos los lugares con la misma importancia. No precisamos eliminar la circulación del automóvil por completo, sino más bien junto a una planificación urbana adecuada, definir los parámetros donde en la pirámide de movilidad, el peatón sea lo primero que se piensa.

EL mismo autor considera que, el diseño urbano debe ofrecer a la sociedad toda la adecuación posible, donde se integre el espacio urbano con los sistemas de transporte público masivo, así como otras opciones como el uso de la bicicleta, esta última un medio de transporte que da vida a las ciudades, entre el cuerpo y objeto.

Speck en su obra "Walkable City" (2013), detalla el porqué, el peatón debe ser de prioridad en los espacios urbanos, como la esencia de la prosperidad de todas las ciudades, en el cual, los que debemos ser status social seamos las personas que caminamos y no tener un vehículo propio motorizado en tránsito por la ciudad, dando muerte a esos espacios que fueron creados para la relación entre las personas e intercambios.

Álvarez (2016) considera que los espacios urbanos han sido deteriorados por los automóviles y la inadecuada planificación, que permitió que las ciudades se expandieran de forma desordenada y confusas, con la idea que no importa la distancia, en carro todos podemos llegar a cualquier destino.

Maricato (2013) afirma que los automóviles son sumados a las carencias del transporte colectivo, doblándose en las ciudades su número, gracias a la

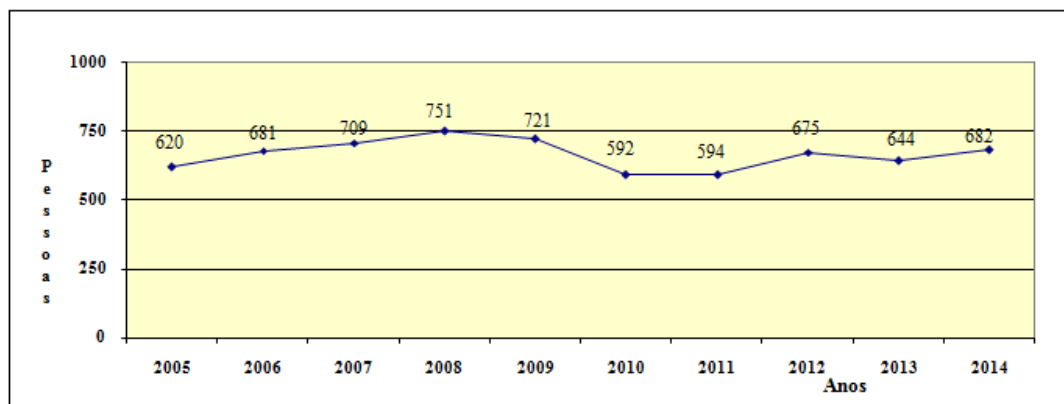
poca importancia que se le dio a los desplazamientos colectivos. Esos investimentos han afectado a todos los territorios urbanos, siendo en la contemporánea estructuración el desafío más difícil de combatir, pero que puede ser atendida si se trabaja con un diseño urbano para las personas.

En Costa Rica la deterioración urbana es ocasionada en gran medida por la flota vehicular en circulación, con influencia de desplazamientos de personas del centro a la periferia o suburbios, como un hecho de ocupación del espacio en las áreas urbanas y que a como aumenta la distancia, aumentan los problemas sobre la movilidad.

Esas distancias ven ocasionando que muchas de las personas deban adquirir un segundo vehículo, sea carro o una motocicleta, tornándose una imagen característica para poder transitar e realizar las siguientes actividades, debido a que el sistema de transporte público posee muchas carencias en su infraestructura, con flotas deterioradas y poco modernas, que correspondan a las necesidades de todos los usuarios, además de altos costos en las tarifas, poca accesibilidad y con una estructura de terminales y paraderos inadecuadas.

Los accidentes de tránsito es otro tema que ven afectando la movilidad de las personas en las vías públicas, principalmente por irresponsabilidades de las personas que conducen vehículos privados. Según Poder Judicial (2014) en la década del 2005 – 2014 las estadísticas de muertes en el sitio oscilan entre los 600 a 700 fallecimientos de personas por año, observar gráfico 1.

Gráfico 1: Número de personas fallecidas por accidente de tránsito en Costa Rica (2005 - 2014)



Fuente: Anuario del Poder Judicial, República de Costa Rica, 2014.

Por incidencia de tránsito, las estadísticas anuales, el mayor número de muertes en tránsito en función del tipo de usuario se da por los de las motocicletas, un vehículo privado que por motivos de renta y acceso, viene incrementando su circulación, relacionando su fatalidad al atropello de un carro.

Según el Poder judicial (2014) en el 2014 la muerte de motociclistas se sumaron 254 víctimas fatales, de las cuales otras 188 fueron peatones, núcleo problemático que viene siendo afectado por la inseguridad en las vías públicas de Costa Rica e imprudencias de los motoristas. Datos para el municipio central de San José, ocurrieron 42 de las 151 en toda la

provincia, resultado a la elevada flota vehicular y número de pedestres que deben andar por aceras mal diseñadas, ocurriendo el 42% de muertes en sitio de peatones y 34% motociclistas, siendo la ciudad capital la que más registra muertes de tránsito.

La reactivación del tren urbano ha sido olvidada por muchos años en Costa Rica, lo que fue provocando al pasar del tiempo problemas que no debían haber pasado si la planificación urbana y las políticas públicas no siguieran un modelo individualista e deteriorado el sistema de transporte colectivo y de alta capacidad.

Para el año 2005 con la reactivación de un trecho de vía entre Pavas – Freses Curridabat, en la administración del presidente Abel Pacheco, se activa un sistema de movilidad para desplazar pasajeros y liberar los congestionamientos urbanos. Para el 2009 en la administración de Oscar Arias, a través de diferentes propuestas, se reactiva el trecho de San José a Heredia, ciudad localizada a unos 10km aproximados, vía radial que pasa por grandes embotellamientos en los últimos años al 2016, movilizand 1,10 millones de pasajeros anualmente (INCOFER, 2016).

Al año 2016, se ha liberado trechos de vía férrea importantes para la movilidad urbana en la GAM, con propuestas de recuperación de vías donde la circulación de automóviles ha llegado a estar en colapso y afectando miles de personas por problemas de organización e una cultura que desea su libertad estar de forma individual dentro de un automóvil.

Incentivar la cultura del tren es de suma importancia para la movilidad urbana, pero en Costa Rica la liberación de espacio gracias a usuarios que utilizan ahora el tren ocasiona un efecto contrario, resistiendo a la cultura del automóvil, en la busca de seguridad, confort y salud pública.

Eso es dado a que la circulación de los autobuses debe compartir espacio en las vías con los carros, con pocas vías exclusivas, además las condiciones de los buses son precarias. Por otro lado el tener solo una vía férrea a un sentido afecta los tiempos de desplazamientos en los trenes, quedando detenidos por tiempos, en la espera que el tren que viene de sentido contrario ultrapase, ocasionando que muchos de los usuarios aún prefieran usar el carro y hacer de su destino a su placer y necesidad.

El transporte colectivo en tiempos actuales debe ser pensado de la mejor manera posible, ya que él debe abarcar una serie de factores, sean ambientales, físicos, económicos, políticos y sociales; elementos que son de grande importancia en la rehabilitación de peatones perdidos y no seguir experimentando modelos equivocados “[...] castrações a que os indivíduos estão submetidos diariamente nas sociedades hierárquicas.” (LUDD, 2005, p. 21).

Los medios de transporte viarios son, de hecho, una necesidad que la organización territorial de las ciudades fue adquiriendo por inducción del sistema

capitalista, como una realidad construida en el control y gestión territorial de oportunidades que la reorganización en el espacio genero en el tiempo, asumiendo el protagonismo en la jerarquía sobre lo adecuado.

Esa jerarquía esta y continuará encima del desenvolvimiento del sistema de transporte colectivo, expandiendo las ciudades a su placer, sin se preocupar con una planificación adecuada e inteligente. Ludd (2005) interpreta esta situación como una “modernidade depressiva” que está en las manos de un consumo capitalista; un síntoma que la sociedad tiene en su dinámica urbana; un empobrecimiento en la jerarquía de un lugar que se relaciona en un infinito de sistemas e ecosistemas urbanos y desconsidera la calidad de vida y el desarrollo humano.

El uso del automóvil, ha sido un objeto que fue expresando una alta gama de cualidades y elementos sobre la cultura latino-americana, un tema que fue explorado con poco rigor para ser aplicado en los planes de ordenamiento urbano desde una literatura urbanística en el pensamiento colectivo y el bienestar social.

IV. CONSIDERACIONES

Comprometerse a pensar todas las dimensiones que permitan la articulación estratégica, es considerar una tendencia de debate público, adoptar una representación que facilite una comprensión de un proceso en detrimento con la identidad cultural del automóvil.

La investigación debe integrar una construcción teórica en la práctica, reconociendo la responsabilidad de una planificación urbana, que favorezca una necesidad espacial de las ciudades. El revivir a los espacios urbanos públicos una integridad social, económica y ambiental, mostrando una oportunidad que ciudades como las europeas ven como el punto de desenvolvimiento.

Desde el punto de vista práctico, se debe implementar toda una estrategia de implementación en busca de proponer decisiones, elaborando un instrumento que asegure su operación. Para ello, se debe considerar una participación pública y la responsabilidad de autoridades locales, en este caso el centro municipal escogido y autoridades competentes.

En Costa Rica, la inadecuada planificación urbana y expansión de la Gran Área Metropolitana, es un ejemplo de lo ocurrido en muchas de las ciudades de América Latina, con la prioridad al atendimento de las necesidad de libertar que dio el uso y consumo del automóvil, estancando las políticas de desarrollo y mejoría para el transporte colectivo y el no motorizado, todo eso gracias a una cultura del automóvil que dejo de preocupar con las verdades necesidades sociales y ambientales.

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Socioeconomic Driving Forces of Land use/Cover Dynamics and its Implications in Wallecha Watershed, Southern Ethiopia

By Barana Babiso

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Abstract- The objective of this study was to examine land use/cover dynamics and its implications in Wallecha Watershed, Southern Ethiopia. The study referred to have applied perceptions' analyses, descriptive statistics, semi-structured and face to face interviews to identify the causes of the changes. The study showed, high population pressure, which in turn leads to increasing demand for land and trees and change in farming systems, poor institutional and socio-economic settings, lack of land tenure security and inappropriate land use practices were identified as the reasons for the changes. Thus, it was understood that LU/LC is inevitable; that it was occurred at all times in the past, are presently ongoing, and are likely to continue in the future. The changes in LU/LC in the study watershed have both positive (degrading) and negative (enhancing) impacts on particular environmental and ecological changes of the watershed.

Keywords: *land use/cover, dynamics, expansion, driving forces, wallecha watershed.*

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Socioeconomic Driving Forces of Land use/Cover Dynamics and its Implications in Wallecha Watershed, Southern Ethiopia

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I. INTRODUCTION

Land is one of the major factors of production along with labor and capital and an essential input for housing and food production. Thus, land use is the backbone of agricultural economies and provides substantial economic and social benefits. Land use change is necessary and essential for economic development and social progress.

Driving forces are defined by Holman *et al.* (2008) as causes of environmental change which are exogenous to the region. This may be anthropogenic induced climate change, national and international policies or socioeconomic changes. Driving forces are the forces which cause observed landscape change. Briefly, driving forces are the factors which cause changes in a system. They may be social, economical or ecological and may have positive or negative influences.

A number of LULC dynamics' studies have been carried in the south west part of Ethiopia at catchment, zone, watershed and village levels. In Gibe valley, the land use changes were perceived to be caused by the combined effects of drought and migration, changes in settlement and land tenure policy, and changes in the severity of the livestock disease, try

panosomosis (Robin *et al.*, 2000). High population pressure, which in turn leads to increasing demand for land and trees, poor institutional and socioeconomic settings, lack of land tenure security and poor infrastructure development were identified as the reasons for the changes in Silte zone (Daniel, 2008). These village case studies in parts of the south west Ethiopia identified large scale plantations expansion, communities' crop field expansion, lack of clear land use plan, change in farming system due to population growth as the causes of the changes. In Awassa watershed, which is located in the south central rift valley of Ethiopia, forest land use change was studied from the perspective of socio-political and geographical factors. The causes for the decline were attributed to geographic properties, socio-political changes, population growth, unstable land tenure principles, agricultural development, and the improvement of transport capacity (Dessie and Christiansson, 2008). The studies referred to have applied perceptions' analyses, descriptive statistics, semi-structured and face to face interviews to identify the causes of the changes.

As a result, this study is used to analyze the effect of different hypothesized socio-economic drivers on shares of agricultural land, forest land, and grassland and shrub land uses in the Southern Nations and Nationalities Region of Ethiopia. In this paper the researcher intended to a) discuss the state of the socioeconomic driving forces, b) present the implications socioeconomic drivers on sustainable land management of and, c) propose a standard procedure to study driving forces of landscape change.

II. DESCRIPTION OF THE STUDY AREA

a) Location

The Wallecha catchment is found in the Southern highlands of Ethiopia, within the Wolaita Zone, Southern Ethiopia and forms the middle course of Bilate drainage system. Astronomically, the watershed is located between 6°53'30" and 7°4'30" N Latitude and 37°48'0" and 37°59'0"E (Fig. 1). It is found within the edge of southern Main Ethiopian Rift System, North-west of Lake Abaya in Southern Nations Nationalities People's Regional State. More specifically, the watershed lays in Damot Gale Woreda, located at 350km south of Addis Ababa and 153km southwest of Hawassa, capital of SNNPR.

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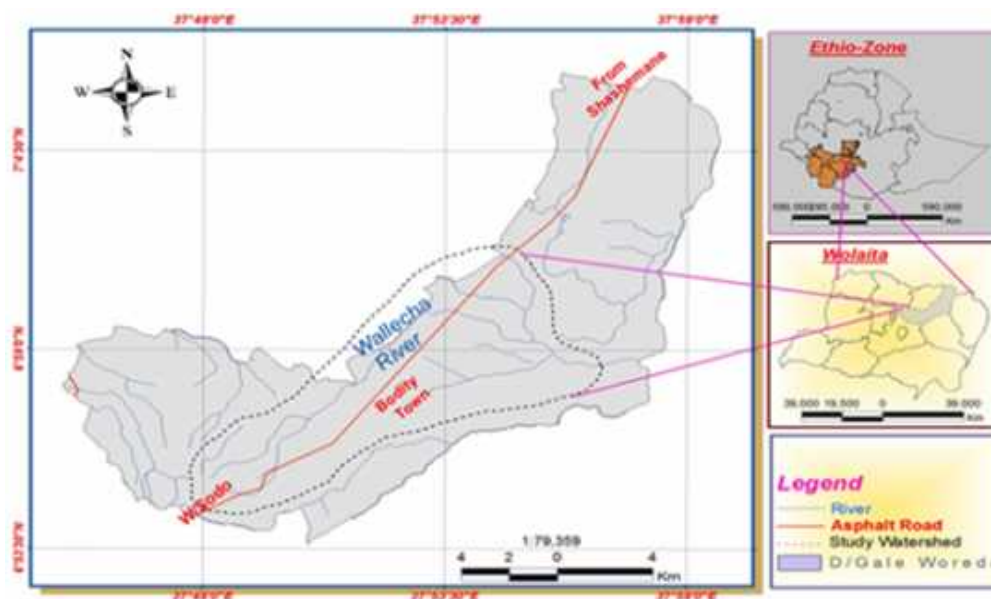


Fig.1: Location Map of Wallecha Watershed (Source: Extracted from Ethio-GIS)

b) Climate

According to MOA (1998) Agro-Climatic Zone classification, Damot Gale *Woreda* in general and the study watershed in particular experience moist Dega (humid temperate) and wet Weyna dega (humid subtropical) agro-climatic zones. According to the traditional agro-climatic zonation, which is based on overlaying rainfall, temperature and altitude, the area that lies above 2300 m and accounts for about 10.8 percent of the total area falls within wet *dega* agroclimatic zone, while the remaining 89.2 percent that has elevation between 1751 and 2300 m lies within the wet *weina dega* agro-climatic zone (Fig.2). However, these diversified landforms are highly interactive and related to each other via drainage systems and socio-cultural condition.

The annual average rainfall is around 1185 mm, and the mean annual temperatures fluctuate between 16 and 21°C all along the year (Fig. 3, and 4). The main rainy season is from April to September and presents a bimodal scheme every year. The mean annual temperature of the study area varies from 21°C in the rift valley floor to 16°C on the escarpment mainly due to variations in altitude. This climate enables a Length of Growing Period of almost 300 days. That's why Wolaita farmers carry out two cycles of seasonal cropping (the *gaba* during the short rainy season from February to July and the *sila* during the long rainy season from August to December) and sometimes an inter season cycle from December to March. The principal feature of rainfall in most parts of the study watershed is its seasonal character, poor distribution and variability from year to year (Fig. 3 and 4

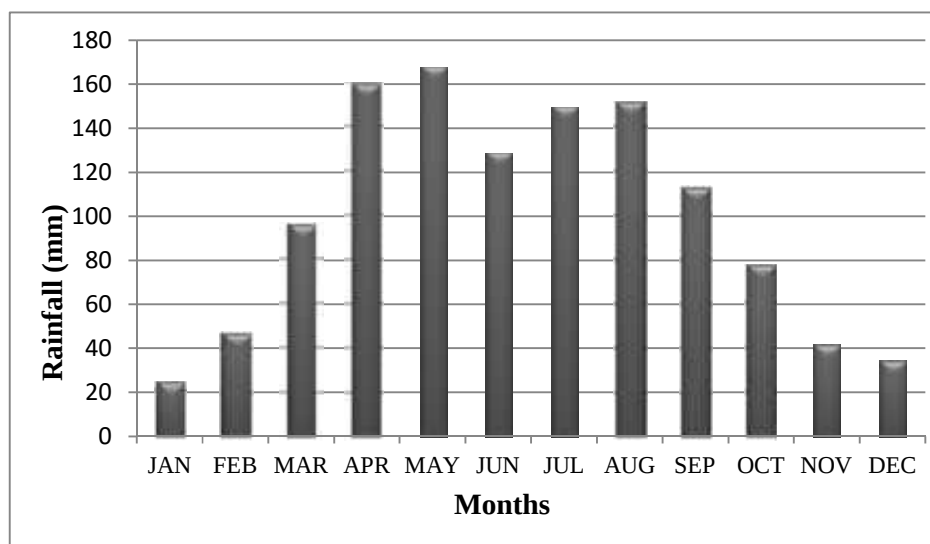


Fig.2: Mean monthly rainfall pattern for the study area recorded at Bodity station from 1976-2012.

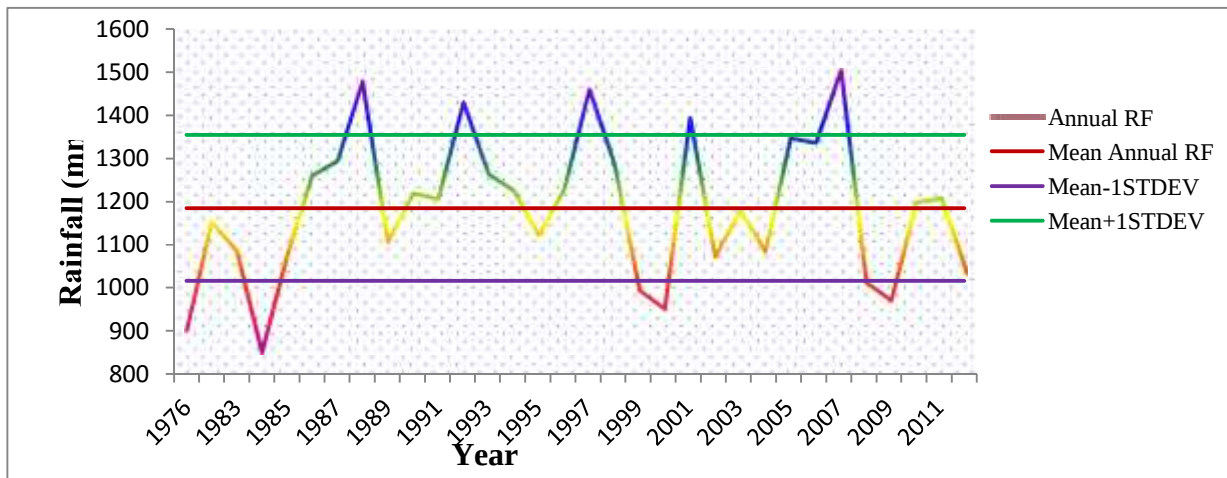


Fig.3: Annual rainfall variability for the study area recorded at Bodity station (1976-2012)

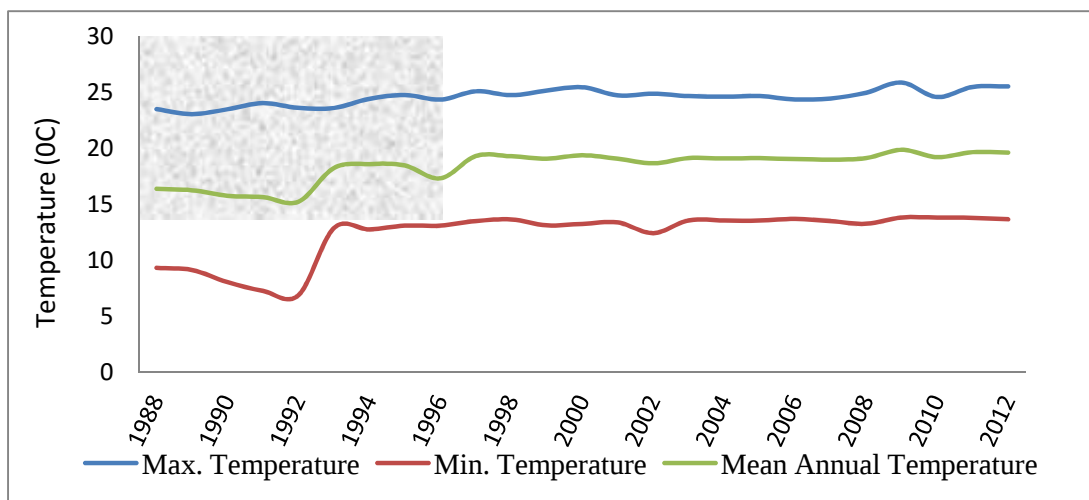


Fig.4: Mean annual temperature distribution recorded at Bodity station (1988-2012)

c) Socio-economic Aspects of the Watershed

i. Population and Settlement Pattern

Demographic factors play an important role in the evaluation of the current as well as the potential land use, which is the product of interaction of man with land. High population pressure is a reflection of the incidence of poverty and at the same time a key factor in accelerating deterioration of the natural resources base, particularly forest (EFAP, 1994). According to the 2007 Ethiopian Population and Housing Census, the Woreda is the most populated in Wolaita zone with a total population of 154, 610 and of which 51 percent were women (CSA, 2008). As to WBoFED (2013) report, currently the study watershed has a total population of 68238, of which nearly 86 percent lives in moist *weina dega* (Table1).

The Woreda has estimated population density of settlement exceeding 781 persons per km² which is greater than the zonal average 349 people per km², and is one of the highest densities in Ethiopia. The growth rate would be higher than 3 percent, with an estimate of the doubling of the population from here to 24 years, which suggests that the site is "a full world which is going on filling" (Le Gal and Molinier, 2006). The area is characterized by high population density that reduced average individual land holding to less than 0.5 ha. According to CSA (2007) the working and life unity of this population is nuclear; on average, families are made up of 6 to 7 persons. Moreover, the rural population of this region is very young; 60 percent of the population is less than 20 years old.

Table 1: Population distribution in the watershed, 2012 (Source: WBo FED, 2013)

S.N	AEZ	N ^o of KFA's	Area (ha)	Area (%)	HH	Population size	Population (%)
1	Moist Dega	2	1904.5	18.8	1486	9711	14.24
2	Moist Weina Dega	8	8211.5	81.2	5497	58527	85.76
	Total	10	10116	100	6983	68238	100

Moreover, according to the regional statistics, the ratio of working farm population to non-working farm population is very weak (0.9 agricultural labourer for one non-working people). It indicates that the great part of the income earned by an agricultural worker will be devoted to meet not only its needs but also those for non-working people (less than 15 years old children, and old people) who depend on him. It will be very difficult to save or to reinvest what has been produced. This in turn created new demands for additional space, food and other resources.

ii. *Farming System and Crop production*

The farming system in the study watershed is of subsistence type. The demographic pressure and shortage of farmland has forced farmers to adopt continuous cropping systems abandoning completely even seasonal fallowing. Farmers of the study area pointed out that continuous cultivation of land are the only coping strategy they adopt to provide food for their families. It has been confirmed that the area is recurrently hit by food insecurity mainly because of population pressure, environmental degradation, erratic nature of rainfall; land shortage and lack of modern agricultural implements and input.

iii. *Land use Pattern*

The land use in the study watershed is based on mixed rain-fed agriculture. More specifically, it is *enset*-coffee live stock system that combines annual and perennial crops with livestock production (Le Gal and Molinier, 2006). The typical household land use exhibits a spatial pattern in which homes are ringed with *enset*, coffee, fruit trees and spices. Farmers plant these crops closer to their houses for ease of fertilization with manure and household refuse. Distant fields are occupied by grains, root crops, grazing fields and woodlots.

III. METHODS

a) *Data Sources and Methods of Collection*

Identifying the pattern of LU/LC and its implication on the landscape was analyzed by using biophysical and socioeconomic survey data. For this research, the necessary data were collected from both primary and secondary sources. They were derived through using questionnaires for structured interviews, semi-structured interviews for indepth face-to-face interviews with key informants, guiding questions for FGD, and checklists for field observation.

Data collection was done through a methodological triangulation; this entailed the use of multiple methods to study a phenomenon or a problem.

b) *Sampling Techniques*

The three selected *Kebele* Farmers Association (KFAs) where socio-economic survey was conducted in the study watershed include: areas belong to high altitudes (Woshi Gale), middle altitudes (Fate) and lower

altitudes (Ade Damot). A total of 145 households (HHs) were selected. The selected sample size was regarded sufficient because more than 5 percent of the study population was included.

The sample (n=51) was 7.43 percent of the 686 HHs in Woshi-Gale; (n=42) was 7.39 percent of 568 HHs in Fate whereas it formed 7.54 percent of 689 HHs in Ade Damot KFAs were taken proportionally. Given the relative homogeneity of the subsistence farms in the two agro climatic zones in terms of physical environmental factors and resource endowments, the sample size of each agro climatic zone would be reasonably representative of the population it stood for. Moreover, knowledgeable key informants were included into the study through purposive sampling technique.

c) *Data Analysis*

The analytical approach initiated with a background study on literatures (Fig.5). Then a meeting was held with Wallecha watershed committees and KFA representatives. The meeting was aimed to define the key drivers of the LU/LC change that are susceptible to be affected by any of the elements generated by human activity, exploring the main driving forces affecting the environment, societal response (policy measures) to such unwanted impacts and to consider local people viewpoints about the watershed.

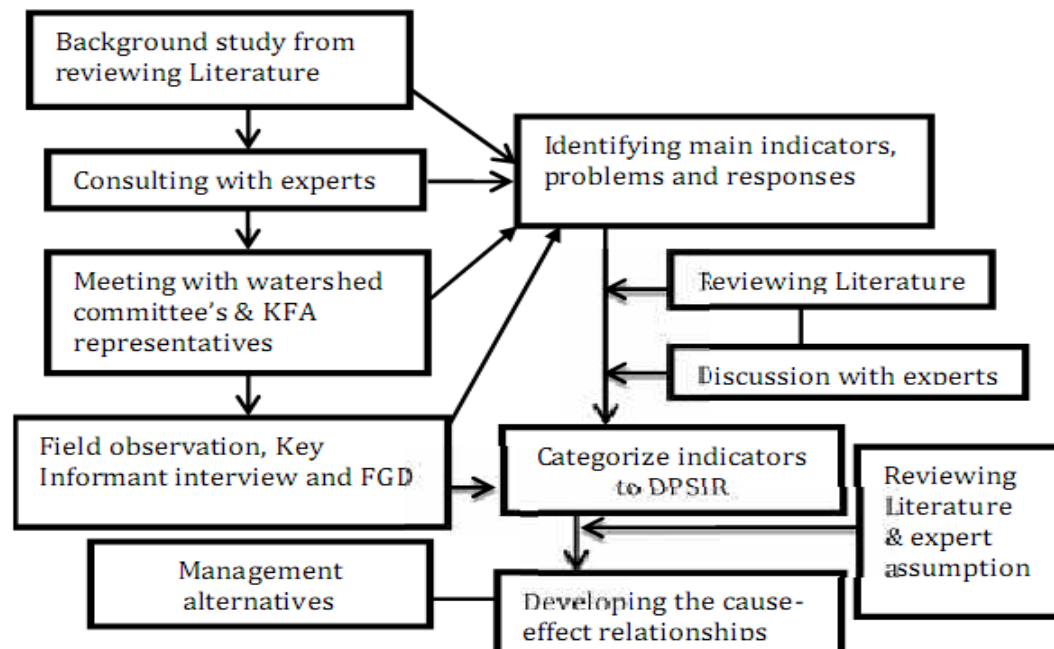


Fig. 5: Analytical flow chart for socioeconomic drivers of LULC

IV. RESULTS AND DISCUSSION

a) Socioeconomic characteristics of the respondents as a factor for LU/LC Changes

i. Demographic Characteristics

Socio-economic characteristics are believed to be the major determinant factors in land management practices, of which land use/land cover change is one. Studies of household lifecycles (demographic composition) in the tropical Africa have been linked to satellite data revealing the role of gender and age structure of households in deforestation trajectories (McGinley, 2008).

As indicated in Table 2, 145 sample households from the three KFAs were studied, of which 38 (27%) were female headed. They better represent as

compared to the percentage of female-headed households in SNNPR (23.3%) as well as the country as a whole (24.7%) (CSA, 2008). As indicated in the table 2, household heads in their (25-64) age group make up 85.5 percent of the total sample households. These age groups of household heads are better experienced in land management practices as compared to the other two age groups. As revealed in FGD, young household's heads rapidly deforest their property in their first five years of forest occupation as they seek to establish their farms and provide subsistence for the household. They steadily reduce the annual rates of deforestation with length of occupation, shifting land uses to more permanent crops (enset, sugarcane) and pasture.

Table 2: Demographic composition of the sample households

Variables		Woshi-Gale (Upper)	Fate (Middle)	Ade (Lower)	Damot	Total	%
Sex	Male	40	29	38		106	73
	Female	11	13	14		38	27
	Total	51	42	52		145	100
Age	<25	5	2	8		15	10.3
	25-64	42	40	42		124	85.5
	60-above	4	0	2		6	4.2
	Total	51	42	52		145	100
Marital status	Married	45	38	46		129	89
	Divorce/ed	4	2	3		9	6.2
	Widow	2	2	3		7	4.8
	Total	51	42	52		145	100
Household size	< 15	186	147	173		506	50
	16-64	174	143	181		498	49.4
	>65	4	0	2		6	0.6
	Total	364	290	356		1010	100

Source: Field survey, 2013

Nearly 90 percent of the household heads are married while the remaining few are widowed, and divorced. The total population of the sample KFAs has been 1010, of which 506 (50%) were aged less than 15 and 498 (49.4%) adults; with a dependency ratio of 102.8 percent. The average family size in the area was 6.97, which is higher than national average (5.4) and majority of households (85%) have 6-10 members in the family, though there exist disparity throughout the studied KFAs. In traditional society under which the farm economy and consumption tends to be mainly Family-centered; the per capita food availability declines when the number of consumer increases. This is, in fact, one of the reasons for blaming rapid population growth and the resultant large family size.

Therefore, under condition of degraded soil, diminished holdings and obsolete production techniques coupled with large family size, especially dependent family members can do nothing for increasing agricultural production.

However, according to the perception of village elders, large family size is considered to be an asset for the households; since children at the early ages engaged in looking after cattle, fetching water and fuel wood.

ii. *Household asset ownership and technology use at Wallecha watershed*

As indicated in Table 3, assets such as educational attainment of household head, size of land and labor, size of livestock and input uses are the critical factors that affect wise use of resource, farm economic performance and influences food production. It is

hypothesized that education would have a great influence for the awareness of farmers regarding the land use land cover change issues. In the study watershed, educational attainment of the household heads was varies at KFA level, though it was nearly 50 percent for literate and illiterate at an aggregate level.

Hence, it is assumed that households' food security and size of landholding have a strong positive relation. In the study area, the mean holding size per households was 0.43 ha, which is much less than the national average. Thus, the holding sizes were very small, which indicates high population pressure on existing land resources. Majority of respondents from three parts of the watershed, 49 percent in upper altitude, 48.7 percent in mid altitude and 44.2 in the lower altitude had farm sizes in the range of 0.25 to 0.5 ha. A relatively small proportion (30%) of the total respondents indicated that their farm size was more than 0.5 ha (Fig.6 and Table 3) even though, slight differences in landholdings was observed at the different parts of the watershed.

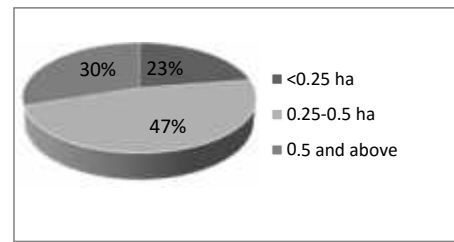


Fig. 6: Landholding's of sampled households (Source: Field survey, 2013)

Table 3: Household asset ownership and technology use in sampled KFAs

Variables	Woshi-Gale (upper)	Fate (middle)	Ade Damot (Lower)	Total (%)
Educational level of HH (%)				
Can't read and write	55	38	44	46
Read and write	45	62	56	54
Land holding (%)				
<0.25	23.5	26.8	17.3	22.5
0.25-0.5	49	48.7	44.2	47.3
0.5 and above	27.5	24.5	38.5	30.2
Number of plots (%)				
1	29.4	41.5	32.7	34.5
2-3	57	51.2	42.3	50.2
4 and above	13.6	7.3	25	15.3
Livestock holding (%)				
<3	37	49	50	45.3
3-5	48	40	45	44.3
5 and above	15	11	5	10.4
Use of agricultural input				
Chemical fertilizer	40	54	50	48
Improved seed varieties	24	36	35	31.6
Compost and manure	36	10	15	20.4

Source: Field survey, 2013

The average numbers of fragmented plots a farmer owned and managed were 2.17. Land fragmentation is a constraint to land management and the intensity of cultivation. This was clearly observed in the study area, where peasants planted *enset* around their homesteads and invested more in their *enset* fields. A great majority (90%) of respondents stated that their holdings had decreased over the previous 26 years, for several reasons: 35 percent of the respondents reported that the 1975 land reform and its consequent land redistribution was one of the main factors, while 20 percent attributed the decrease to soil erosion and gully expansion, and 45 percent to increased population pressure.

At present, the main way to gain access to land in the study area is by inheritance and share cropping. Moreover, as indicated by key informant (Molliso Ade, the chairman of Fate KFA) there was also a redistribution of communal grassland performed in 2007 to farmers in order to provide land to those who were landless. However, land inheritance is weakening since land shares are too small to be shared. During the interviews of this study, old persons were asked to compare farmland sizes of the past with present sizes. They stated that 60 years ago when they were children a significant portion of the land was covered by forest and grass – unlike today. The extent of cultivated land had enormously increased over time. In particular, steep slopes and lowlands had not been cultivated earlier.

Older people suggested that the extent of cultivated land at present is larger than during the Imperial and the *Dergue* periods.

iii. Farming systems in the study watershed

A farming system is taken to be an organized decision-making unit in which crop and/or livestock production is carried out with the purpose of satisfying the farmers. Farm as a unit, transfers input into agricultural output and which undergoes changes over time. In the process of adapting cropping patterns and farming techniques to the natural, economic and socio-

political conditions of each location and the aims of the farmers, distinct farming systems are developed (FAO, 2006). Moreover, a vital factor that has led to the changes in the pattern of LU/LC is the traditional nature (i.e. inappropriate land use) of the farming system in the study watershed.

a. Crop Production

Crop production is an important farming practice adopted invariably by every farmer in the Wallecha watershed. Due to shortage of land, farmers are compelled to shift from extensification to intensification by increasing labour and other inputs. However, poor farmers do not have access to fertilizers due to its high prices. It is revealed in key informant interview, (Woysa Wonago, aged 68 years), stated that in the previous days growing of barley (*hordium vulgare*), and *enset* (*enset ventricosum*) in high altitudes is the dominant cropping pattern in the area. But currently in response to the changing climatic condition, declining soil fertility and shrinking farm size peas, beans and wheat are phasing out of the cropping pattern at the expense of sweet potato, taro (*boyna*) and other HYVs. The driving forces for the expansion of “taro” would be its resistance to harsh climatic condition, and promising yield in less fertile soil, and its large potential to cover household food supply compared to other cereals.

b. Livestock Production

In mixed farming practices, both livestock and crop productions are carried out simultaneously. Livestock plays an important role in supplementing the livelihood of rural community especially in those areas practicing sedentary agriculture. Besides, livestock is considered as a means of security and coping method during crop failure and natural calamities. Livestock statistics in all KFAs of Wallecha watershed was 327,615 (*Woreda* Agricultural Office, 2013), but due to increasing human population and shortage of grazing land, per capita livestock was below the optimal size to sustain a sedentary community.

Table 4: Livestock Density in Wallecha Watershed, 2013 (Source: WAO, 2013)

Livestock	Number	TLU*	Density/ha	LSU/ha
Cattle	128,300	128,300	12.68	12.68
Donkey	15134	9837.1	1.49	0.97
Horse	5265	5265	0.52	0.52
Mule	4572	5257.8	0.45	0.52
Sheep	78,568	11,785.2	7.76	1.16
Goat	56,795	8,519.25	5.6	0.84
Poultry	38,981	194.9	3.85	0.19
Total	327,615	169,159.25	32.35	16.88

* TLU values are given as each cattle = 1, mule = 1.15, horse = 1, donkey = 0.65, sheep = 0.15, goat = 0.15 and Poultry = 0.005 (Ramakrishna and Asefa, 2002)

Based on the livestock census stated in Table 4, the aggregate stocking level (16.88 LSU per hectare) was more than the carrying capacity of the study area. According to FAO, (1986), the size of grazing land required per livestock unit (TLU) is 1.5 ha. If we consider FAO's estimate, the total grazing land required to the number of livestock unit in the study area should be 253,738.87 hectares. This is more than 25 folds from what is currently available in the study area (10,116.72 ha). Therefore, in order to support the present livestock population in Wallecha watershed need additional 243,622.15 hectares of grazing land. Perhaps, the number of livestock is increasing with the population that resulted in extremely devastating effect on vegetation and soil quality in the watershed.

According to 62 percent of the respondents, the main factor behind the shortage of livestock feed was the expansion of cropland, 18 percent claimed it was the expansion of gullies, while 20 percent claimed that drought was the major cause. Generally, livestock grazing system is based on the cut-and-carry system, utilizing maize leaves and stalks and chopped *enset* leaves and stems as well.

From the ongoing analysis it was evident that the grass lands are over-stocked and deteriorated beyond the carrying capacity and it became the major cause for severe environmental deterioration in the watershed. This condition further aggravates condition of over grazing and soil erosion on the rangelands. The condition was clearly seen in the analysis of satellite

images that shrubs and grassland has decreased by 15.62 (1.35%) per annum during the studied period from 1984-2010 on the same watershed by (Barana B. *et al.*, 2013).

iv. *Driving Forces for LU/LC Change in Wallecha Watershed*

LU/LC change is the result of the interplay of a complex set of drivers that range from natural processes to human intervention. Ethiopia has made three national population and housing surveys in 1984, 1994 and 2007. The population size of the watershed was 25,925 in 1984, 36,006 in 1994, and 59,026 in 2007. An attempt was made to estimate current population size of the watershed and it is found about 68238. The growth rates were calculated on the bases of exponential growth with the growth rate of 3.28, 3.8 and 2.9 percent between 1984-1994, 1994-2007 and 2007-2012 respectively (Table 5; Equation 1). Between 1984 and 2012 the population size in the watershed increased from 25,925 to 68238 which imply that the population more than doubled in size within 28 years. The age dependency ratio was 102.8 percent of which the young accounted 97.57 percent and 4.85 percent for old aged. This indicates that nearly half of the population is young and economically dependent. Hence, human pressure on land resources is not only high but may also continue to be high in the likely future.

Table 5: Population size of Wallecha watershed between 1984 and 2012.

Year	Population Size	Growth Rate
1984*	25925	-
1994*	36006	3.28
2007*	59026	3.8
s2012**	68238	2.9

The growth rates were calculated on the bases of the assumption of exponential growth:

$$r = (1/t \log P_2/P_1) \times 100 \dots \dots \dots \text{Equation 1}$$

Log e

Where r = growth rate e = approximately 2.72
 P1= initial population t= no. years between P1& P2.
 P2=final year population

Change in population size is the result of either natural increase or in-migration. As can be seen from Table 5, the rate of population increase in the study district has been considerable. Wallecha watershed encompasses Bodity and Shanto towns, which are the market and administrative centres. This eventually triggered the inflow of population to the town. It is evident that at present many developing countries are experiencing fast rates of urbanization, which is partly explained by population increase. Ethiopia is also

experiencing a similar trend. One of the measures of urbanization is population size. This fast increasing population is resulting in mounting need for forest and other natural resource products such as wood for fuel, construction. Thus, the unprecedented urban population increase has resulted in resource loss and degradation emanating from corresponding increase in demand for natural resources. Apart from the natural growth, migration and resettlements (villagization) program of the then government in 1980s have further pressure on

the natural forest and had a great impact. Research findings at international and national levels reveal that population dynamics in combination with other factors have profound effects on land use/cover changes (Bewket, 2002; Aklilu, 2006). Thus population growth was certainly the greatest driving force in the observed land use/land cover dynamics.

The land tenure issues in Ethiopia in general and the study watershed in particular is uncertain about farmers' security of rights to the land which in turn led for short-term needs than long-term yield. Moreover, the land tenure system which prevailed after the 1975 land reform gave land users use rights only (Daniel, 2008). This resulted in ecological damage, inappropriate or over-intensive land use and poor land management practices that aggravated LU/LC change. Perhaps, it is an imperative for policy making to design an incentive structure that would reduce forest clearing as access factors are improved and consider land tenure systems that improve security of title to and ownership of land for local communities.

High population pressure, which in turn leads to increasing demand for land and trees, poor institutional and socioeconomic settings, lack of land tenure security and inappropriate land use practices were identified as the reasons for the changes. Thus, this study identified tree plantations expansion, communities' crop field expansion, lack of clear land use plan, and change in farming system due to population growth as the causes of the changes. This result is in line with the findings of Daniel (2008) and Abate (2011) in the parts of South Western Ethiopia and Borena Woreda in the last 31 years in the Southern Wello respectively.

v. Implications of LU/LC changes in Wallecha Watershed

The LU/LC is inevitable; that it was occurred at all times in the past, are presently ongoing, and are likely to continue in the future. The changes in LU/LC in the study watershed have both positive (degrading) and negative (enhancing) impacts on particular environmental and ecological changes of the watershed. Potentially, LU/LC may have **positive** changes and it is partly socially acceptable by the people in the study watershed to fulfill their livelihood. The changes also lead to improvements in soil management and increase in the value added to the land with the increasing population pressure. It was reported that many people plant trees to stop the expansion of gullies into their cropland and grazing areas and thereby they also met their household needs for fuel wood and other necessities. Based on the satellite image analysis on the same watershed, from 2000 to 2010, 61.8 percent of degraded lands were changed into cultivated land (Barana B. *et al.*, 2013). The responses refer to the rehabilitation measures due to the scarcity of cultivable land taken by farmers to alleviate the adverse effects of LU/LC change on their livelihood and the environment. These implications are in a good agreement with that of

Daniel (2008) the case in the Upper Dijo River catchment at Silt Zone.

Taking into account the highly erosive rainfall and rugged topography of the terrain in the area, removal of vegetation cover in the landscape affected the hydrological processes and by implication increases the risk of soil erosion. It became clear from the group discussions that farmers are able to identify soil degradation (loss of soil nutrients and erosion) by reduced yields and followed by poor crop performance. Along the high altitudes group discussion with village elders revealed that the increasing need for fuel wood and farmland forest covers were badly damaged beyond natural regeneration rate. Thus alpine woody covers subsequently gave way to short mountain grass covers. Discussion result further confirmed that before 30 years, current cover types (short grasses and remnant bamboo forest) was occupied by highland forests, bush of herbs, thickets that sheltered numerous wild lives; suggesting that the rate of forest degradation in the area was substantial. In addition to field survey, FGD confirmed that Bamboo (*Arundinaria alpuria*), Kosso (*Hagenia abyssinica*), Kulkual (*Euphorbia abyssinica*) and Zigba (*Podocarpus falcatus*) trees have been under great threat and are highly disturbed and encroached by cultivators. Regarding food crops, beans, peas (*Pisum sativum*) and other cereals and lentils (*Lens culinaris*) are phasing out by farmers due to their vulnerability to climatic conditions and attacks by pests and wild animals. In the aspiration to develop a SLM on the basis of agriculture and other natural resources, one must recognize the use of environment to produce goods and service, that degradation of any biological resource (in this study, reduction in forest and shrubs and grasslands) is not a sustainable practice. In fact, it is the natural resource base that enables many poor people, particularly those living in vulnerable ecosystems, to avert risks and insecurities today by diversifying their sources of livelihood.

From the findings it is recognized that there is a change in the environment which is clearly related to changes in the utilization of the land resources. As the farm households in the study watershed mostly depend on the agricultural sector, the agricultural developments and attempts to improve the livelihood given rise to changes in LU/LC. At times, these changes have beneficial while at other times they had negative and cause adverse impacts on the environment and people's livelihoods.

V. CONCLUSION

Socio-economic characteristics are believed to be the major determinant factors in land management practices, of which land use/land cover change is one. High population pressure, which in turn leads to increasing demand for land and trees, poor institutional and socioeconomic settings, lack of land tenure security

and inappropriate land use practices were identified as the reasons for the changes. Thus, this study identified tree plantations expansion, communities' crop field expansion, lack of clear land use plan, and change in farming system due to population growth as the causes of the changes. In sum, land use change provides many economic and social benefits, but comes at a substantial economic cost to society. Land conservation is a critical element in achieving long-term economic growth and sustainable development. Land-use change is arguably the most pervasive socioeconomic force driving changes and degradation of ecosystems. Deforestation, urban development, agriculture, and other human activities have substantially altered the Earth's landscape. Such disturbance of the land affects important ecosystem processes and services, which can have wide-ranging and long-term consequences. Therefore, sustainable development policies must address driving forces responsible for these changes, not only for the sustainable management of land resources and regional development.

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Spatio - Environmental Dimension of Residential Landuse Change Along Taiwo Road, Ilorin, Nigeria

By Olanrewaju Samson Olaitan

Ladoke Akintola University

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Keywords: land use, environmental dimension, spatial pattern.

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Keywords: land use, environmental dimension, spatial pattern.

1. INTRODUCTION

Human existence and survival has witnessed series of changes and transitions over time. This is especially evident in the trend and pattern of the global demography which ranges from a mega scale of temporal increase in global population, to the micro level of variation in the distribution of population across continental and developmental lane. Human environmental dynamics is based on three critical dimensions: time, space and decision making (Bello and Arowosegbe, 2014). It reflects success of various

stages of human adaptation processes, globalization and technological advancement evidenced in reduced mortality, increased fertility, and increased in birth rate among others. *It took hundreds of thousands of years for the world population to grow to 1 billion – then in just another 200 years or so, it grew sevenfold. In 2011, the global population reached the 7 billion mark, and today, it stands at about 7.3 billion (UNFPA, 2016).* This dynamics has not left out the urban- rural dichotomy as the current estimate of the United Nations revealed that the globe is now an urbanised haven. *In recent years, the world has become more than one-half urban for the first time in history (54.5 percent in 2016).....more than 70 percent of the world's population lives in urban areas with less than 500,000 residents or in rural areas. Approximately one quarter (23.9 percent) of the world population lives in urban areas of 1,000,000 population or more. Less than 30 percent (28.6 percent) lives in urban areas with 500,000 or more population. More than 70 percent of the world's population lives outside urban areas with 500,000 or more residents (Demographia World Urban Areas, 2016)* The continuous efflux of migrants of diverse socio economic characteristics as well as their associated factors is not the focus of this paper but their continuous dependence on usually limited and high competitive urban resources is the orient to which this paper points.

Land is one of three major factors of production in classical economics (along with labour and capital) and an essential input for housing and food production. (JunJie Wu, 2008). Despite its advantageous and life supporting characteristics, human unguided use of land has altered the structure and functioning of ecosystem (Fabiya, 2006). Land, like every other resource in the urban area is usually of limited supply, high demand thus exorbitant price. Hence uses align themselves within the highly competitive urban space based on their ability to afford the price in anticipation for optimised returns. However, since urban centres grow usually out of existing rural or sub urban centres with dependence on another urban area, landuses in urban centres in their pre-urban times are usually residential. However, as the economic value of land increase possibly through the introduction of social services (e.g roads, schools, administrative) or growth pole factors (such as

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industries among others) uses which cannot afford the economic requirement of these lands, transits to new uses that can afford it. This is conceptualized by (McGranahan et al, 2005) as global environmental change. These changes which are inclusive of transition in urban landuse patterns stand to reflect the response of landusers to a number of institutional, economic, social and biophysical factors affecting transactions in land and the physical process of construction of buildings. It is worthy of note that these factors are usually interwoven, interactive and complicated. Decisions relating to landuse transitions interact at different organizational levels, and in a dynamic way to produce complex patterns of urban landuse (Ademola, 2006).

Landuse changes are common phenomenon in any spatial development process. It is a necessary ingredient for economic development and social growth (JunJie Wu, 2008). It reflects man's thinking and survival attempt over time. For instance, globally, evident landuse changes are transition from agricultural land to built-up Area. While transition can take other patterns, its rate in urban centre is usually sporadic and evident. Infact, Yuri, (2009) observes that the most landuse transition in urban areas is from residential land use possibly to commercial land use. In some other cases to accommodate both previous use (residential) and new use (commercial), mixed development are usually introduced. These uses sometimes are usually not compatible especially with increase in the scale of commercial activities which can lead to environmental challenges for both land users. These challenges include air pollution, theft, noise pollution emanating from generators and other activities. Indeed, Landuse changes does not come without cost (Jun Jie Wu, 2008). Conversion of residential land use to another in Nigeria is a reflection of poor enforcement of the existing planning regulations (Olusina, 2008).

Taiwo road as the core of Ilorin Metropolis is not excluded from the scenario painted above as mere observation of the buildings along these roads show a complex interwoven pattern of residential, commercial and mixed development in no particular observable spatial order. Since the occurrence of landuse changes brings about questions on how the occurrence of land use changes took place and what are the strong factors that cause them to happen (JunJie Wu, 2008; Owioye and Ogunleye, 2015), it is necessary to understand the change process in cities; its agent and beneficiaries which can be useful indicators in planning for functional cities (Fabiye, 2006). It is against this background that this study evaluates the spatio- environmental dimensions of residential land use conversion along Taiwo road in Ilorin Metropolis with the aim of proffering recommendation that will aid the achievement of sustainable urbanization in the area.

II. LITERATURE REVIEW

The concept of landuse change has been widely researched (Hald, 2009; Abiodun et al, 2011; Ogungbemi, 2012). Landuse Changes is the change of the use of land or buildings there on for a purpose which is different from that for which the land or building was originally zoned and intended for as Change of use as a concept tiptoed into development control arena by the fact that it is now regarded as development following an official endorsement or approval of the relevant development control department for any land development (Hald, 2009). Thus, change in use is occasioned by number of factors. Such factors are mostly, economic in nature (Ogungbemi, 2012). Landuse Change is an indirect consequence of economic growth (Fabiye, 2006). It is a reflection of the eventual decision of landowners dependent on the expected value of each option to the owner (Owoeye and Ogunleye, 2015). It is any development or use which is different from the use last approved by the planning authority while he described material change in use as the physical alteration of existing zoning conforming structure. Earth surface is being significantly altered by man and this has had a profound effect upon the natural environment thus resulting into an observable pattern in the landuse over time (Abiodun, Olaleye, Dokai and Odunaiya, 2011).

Man continues to explore and exploit the natural resources in his environment and this has brought immense contribution to observable changes in land. Human alteration of the terrestrial surface of the earth are unprecedented in their pace, magnitude and spatial reach, of these, none are more important than changes in landuse and landcover as this has altered the structure and functioning of the ecosystem (Fabiye, 2006). The magnitude of land use change varies with the time being examined as well as with the geographical area (Abiodun et al 2011). The assessment of these changes depends on the area, the land use types being considered, the spatial groupings, and the data sets used. In order to effectively address the issue of landuse changes process, a well-founded knowledge of underlying causes and driving forces is need (Rima, 2011; Oduwaye, 2015 both cited by Owioye and Ogunleye, 2015).

III. THE STUDY AREA

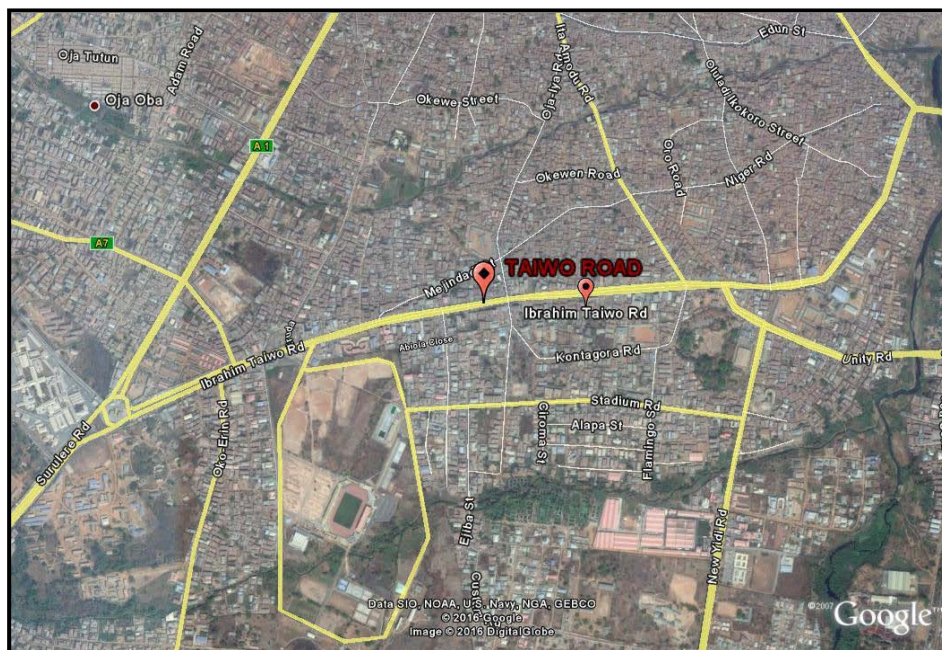
Ilorin in the North Central geo-political zone is one of the largest cities in Nigeria. The capital of Kwara State was founded by the Yoruba, one of the three largest ethnic groups in Nigeria in the Year 1450. The centrality of Ilorin within coordinates 8°30'N 4°33'E makes it to be easily accessible to all parts of the country by air, road transport or rail. Ilorin occupies an area of about 100km² (Oyegun, 1992).

Demographically, the first estimate of the population of Ilorin after the establishment of the British Colonial administration was made in 1911 and this put the population at 36,343. The 1953 census indicated the town's population to be 40,994. This plate rose to 208,546 in the 1963 census. The population census of 1991 put the population of Ilorin at 532,088. The plate was projected with the annual growth rate of 2.84 percent to be 606,533 in 1996 (National Population Commission, 1994). According to 2006 National population Census, Ilorin's population plate was put at 777,667 people (National Population Commission Extract, 2006). Presently, Ilorin Metropolis cut across three Local government Areas, namely Ilorin West, Ilorin East and Ilorin South Local government Areas and it has about twenty political wards. Hence, in itself

The major land uses in Ilorin, Kwara state are residential, commercial, institutional, transportation and agricultural. The residential area covers 52%, transportation, 19%, while Institutional land use covers 12%. In the past, the land consumption rate in hectares of urban land use in Ilorin was about 0.0007, but increased to 0.006 in 1963, 0.007 in 1973 and reached 0.01 in 1982. This increase in land consumption rate indicates a new development in landuse pattern, which graduates with time, (Olorunfemi, 1981). In terms of the type and density of land use, these vary among the three local government areas in Ilorin (Kwara State Master Plan, 1990).

The traditional centre of the city (Oke – lele, Pakata, Adangba, Omoda, Ajikobi, Oloje, Gegele, Sanni-Okin, Eruda, Balogun Fulani, Alanamu, Ita – Adu,

etc) comprises mainly old compound and tenement houses interspersed with block of flats all of high-density category. Medium density areas are found at Oloje, Kulende, Irewolede, Ganmo, Gaa-Akanbi, Elekoyangan, Taiwo Road, Polytechnic permanent site campus along Jebba road and the Mandate estate. They are characterized by two, three and four – bedroom bungalows, and extensions and modifications to create extra spaces to accommodate more people. Low-density areas are found in the GRA, Adewole Estate, Sabo-Oke GRA, Ahmadu Bello way/Government House area, Asa Dam, Pipeline road, part of Unilorin permanent site area where the houses are mainly detached bungalows of two to five bedrooms, duplex and masionettes. Asa dam road, Gaa – Imam along Ajase – Iporoad and Western Reservoir road, the peripheral suburbs of new development comprising areas like Ogidi along Ilorin-Kaiama road to the west, Sobi Barracks, Alagbado along Ilorin-Shao road to the north and Agunbelowo, Olorunsogo, Odota, Eyenkorin etc. along Ilorin-Lagos road to the south west. Ilorin has many financial institutions which include Banks, Insurance Companies, Co-operative societies etc. and educational Institutions such as University of Ilorin, Kwara State Polytechnic, College of Education, School of Nursing and numerous Primary and Post Primary Institutions, Television Stations, Radio Station, etc. The commercial land use spread across the metropolitan areas of the city. The traditional Central Business Districts in Taiwo road, Unity road, Muritala Mohammed, Post Office and Challenge remains prominent in the city.



Source: Google Earth, 2016

Plate 1: Aerial Imagery of Taiwo road, Ilori

IV. RESEARCH METHODOLOGY

This study utilized a survey approach. Only quantitative data were obtained and utilized. Structured questionnaires were administered to residents located along Taiwo road in Ilorin Metropolis. To determine, the houses to be utilized for questionnaire administration, the spatial extent of Taiwo road was initially delineated on Google earth pro. Thereafter, buildings within 300 hundred meters on both sides of the road were further delineated and counted. Buildings within this delineated boundary were further stratified into 100 meters. Hence, three strata (A, B and C) were carved out of the delineated area. This was done to enable the determination of the distance decay effects of Taiwo road on landuse characteristics of adjoining land. In each stratum on both sides of the road, 15 questionnaires were administered to randomly selected buildings; in all, 90 questionnaires were administered. In each building, questionnaire was administered to the available oldest respondent (beyond 18 years of age). Information sought with administered questionnaires bothers on landuse characteristics of stratum, building conversion, causative factors as well as its environmental effects. Information obtained was subjected to both descriptive and inferential statistics. Descriptive statics utilized for the study includes measure of central tendencies (such as mean and standard deviation) as well as generation of weighted indices through linear interpolation of 5 point likhertscale for measuring of factors responsible for conversion of residential landuse. Pearson Chi square was used to evaluate the relationship between use of buildings

across strata while Analysis of Variance was used to analyse the differences in the average annual rent of building across strata. Lastly, the relationship between building use and annual rent was assessed with the Analysis of Variance.

V. DISCUSSION OF FINDINGS

This section explicitly presents the findings from field survey

a) Respondents Knowledge Of The Building And Area

This sub-section ascertains the level of respondent's knowledge of the historical pattern of the use of building being occupied. Also, it is believed that older respondents tend to be enriched with information that has to do with the landuse trend of the area. From Table 1, it is evident that 38.9% of the respondents has occupied there current buildings for about 10 years while less than 3% of the respondents has occupied their current building for a period lesser than a year. However, little proportion of the residents (4.4%) has resided in the building for more than 16 years. Others are 35.6% that has occupied their current buildings for almost 5 years, 18.9% that has occupied their buildings for almost 15 years. Generally, as revealed in Table 1, larger percentage of respondents has ample knowledge of the building they occupy. This is derived as an aggregate of above 50% of the respondents has lived in their buildings for more than 5 years. This makes the respondents a good historian of the landuse trend of the study area.

Table 1: Year of Occupation of Building

Year of Occupation	Frequency	Percentage
1 year and below	2	2.2
2-5 years	32	35.6
6-10years	35	38.9
11-15years	17	18.9
16 years and above	4	4.4
Total	90	100.0

Source: Authors survey, 2016

b) Building Characteristics

Landuse as defined in this context is building based. As the purpose for which a building is used determines the name of landuse to be allocated for it. For instance, building completely utilised for habitation is referred to as residential landuse, buildings utilised for transaction of business as well as other commercial dealings is conceptualized as commercial landuse Others are industrial landuse which are buildings utilised for production or/and conversion of raw material

into semi- finished/ finished products. Meanwhile, mixed landuse which is predominant in Africa is a combination of two or more uses within a building (these may be complimentary or non-complimentary).

c) Plot Size

The Minimum plot size in the study area is 450 meter square while the maximum is 1800 meter square (Table 2). However, the average plot size for any development is 750 meter square. This informs that land availability is limited along this route hence

developments are structural rather than lateral. This is ascertained as the buildings of two storeys and above is dominant in the area (Plate 2 and 3). The Plot size of

buildings in the study area did not differ from what is obtainable in different urban centres due to scarcity of land and its associated competition.

Table 2: Plot Size

	N	Minimum	Maximum	Range	Mean	Std. Deviation
plot size	90	450.00	1800.00	1350	756.3889	382.60199

d) Average annual rent of building

Predominately, the average annual rent of buildings in the study area (as revealed in Table 3) is within the range of N100,000.00 to N200,000.00. This implies that the monthly cost of a building will be within the range of N10,000.00 to N20,000.00. Infact, a good proportion (15.2%) of the sampled buildings annually

cost beyond N500, 000.00. This is comparatively higher compared to buildings in other part of the metropolis where monthly cost of room is within N24 ,000.00 to N30,00.00 per month . The inability of residential landuse to afford this rent (due to their non-economical characteristics) makes them to automatically transit to uses that can afford their pay.

Table 3: Average Annual Rent of Buildings

Average annual rent	Frequency	Percentage
N100,000.00 and below	0	0
N100,001.00 -N200,000.00	38	42.1
N200,001.00 - N300,000.00	8	8.9
N400,001.00-N500,000.00	7	7.8
N500,000.00 and above	14	15.2
Total	90	100.0

Source: Authors work, 2016

e) Average annual rent of building across strata

From a descriptive perspective evident in Table 4, there is an obvious variation in the average annual rental values of buildings in the respective strata. For buildings within 100 meters, the average annual value is N748, 000.00 $\pm$ 1078701SD, this declined to an average annual rental value of N145,800.00 $\pm$ 15385SD for buildings within 200 meters to the road and a sharp fall in price to N79,993.00 $\pm$ 37103SD for buildings within 300. This decline informs that there is difference in the cost of land and associated buildings with respect to

their distance to the road. To ascertain the distance decay effect of road on the rental value of buildings in the study area, Analysis of Variance was used implored. This was used to evaluate the variation in the average annual rental value of buildings across stratum. From Table 5, the F value of 10.409 confirms that there is difference in the average annual of rent of buildings with respect to their respective distance to the road. The p-value of 0.000 which is lesser than the α -value of 0.05 ascertains that the variation as explained by the F- value is statistically significant.

Table 4: Average Annual Rental Value of Buildings across Strata

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
within 100 meters	30	748003.8760	1078701.57543	196943.06189	345210.0880	1150797.6640	1800.00	5.00E+006
within 200 meters	30	145800.0000	84271.07329	15385.72259	114332.6641	177267.3359	24000.00	450000.00
within 300 meters	30	79933.3333	37103.70679	6774.17906	66078.5815	93788.0851	32000.00	200000.00
Total	90	324579.0698	687964.33147	72517.80788	180487.7302	468670.4094	1800.00	5.00E+006

Source: Authors work, 2016

Table 5: Analysis of Variance Summary for Variation in Annual Rental Value of Buildings across Strata

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8133061759473.589	2	4066530879736.794	10.409	.000
Within Groups	33990186242851.996	87	390691795894.851		
Total	42123248002325.586	89			

Source: Authors work, 2016

f) Storey of Building

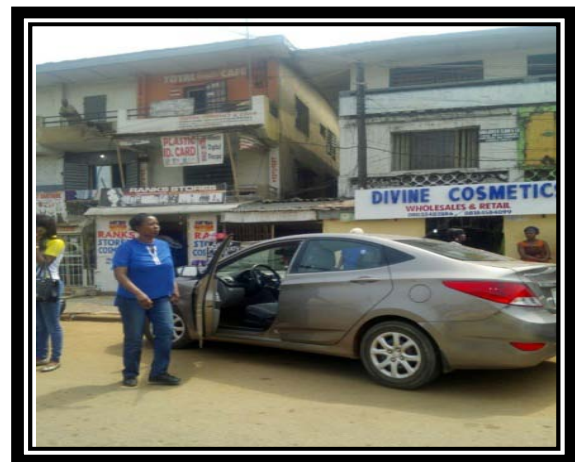
To optimise return from use of land especially at the sight of scarce land, developers in the study area depends on development of high rise buildings. (i.e storey buildings). This is inferred as all (100%) the sampled buildings are storey buildings (1.e buildings with more than one floor). However, as revealed in Table 6 and typified in Plate 2 and 3, 1 storey building

dominates the study area as it accounts for 83.3% of the total sampled houses. This is distantly followed by 2 storey buildings which accounts for 14.4% of the sampled buildings. Meanwhile a mere proportion of 2.2% of buildings in the study area is 3 storey while none of the building is 4 storey and above. The implications of this include increase in the density (human per space) of the area.

Table 6: Storey of Building

Storey of Building	Frequency	Percentage
No storey	0	0
1 storey	74	83.3
2 storey	13	14.4
3 storey	2	2.2
4 storey and above	0	0
Total	90	100

Source: Authors work, 2016



Source: Authors work, 2016

Plate 2 and 3: Sets of storey buildings in the study Area

g) Previous use of Building

It is evident from table below that there are temporal changes in the use of buildings (invariably landuse) in the study area. Specifically, there is a change in the proportion of buildings converted from residential purposes to other purposes in the study area within the period of 10 years. In the year 2005, about 43% of the sampled buildings were used for solely residential purpose; this decreased to 25.5% in the year 2010 and further slide 16.6% in the year 2016. These buildings were converted for other uses which are mostly commercial and mixed uses. It is further revealed in Table 7 that buildings utilised for commercial purposes increased from 30% in 2005 to 36.6% in 2016. Conversion of buildings from residential to commercial which is evident in the study area reflects no cognisance of spatial planning. This is deduced as most of these

developments (i.e conversion of use of building) were done without obtaining planning permits from appropriate town planning offices. As evident in Plate 4 and 5, residential building transition features conversion of rooms for warehouses, shops and stores among others while at the extreme reconstruction for commercial purpose. This scenario reflects development control officials negligence among others. Another use that has witnessed building gain is mixed landuse which usually is a mixture of residential landuse and commercial landuse (street trades and corner shops). This is a growing phenomenon in the study area as one can hardly see a residential building without one of its room converted for business purpose or its frontage used as display centres.

Table 7: Temporal Use of Building

Landuse	2005		2010		2016	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Residential	39	43.3	23	25.5	15	16.6
Commercial	27	30.0	25	27.7	33	36.6
Industrial	3	3.3	5	5.6	4	4.4
Mixed	21	23.3	37	41.2	38	42.2
Abandoned	0	0	0	0	0	0
Total	90	100	90	100	90	100

Source: Authors survey, 2016

Plate 4 and 5: Residential Building respectively converted to mixed and commercial land



Source: Authors survey, 2016

h) Use of building across strata

There is variation in the use of buildings across strata. The noticeable pattern is that dominant use within 100 meters to Taiwo road is Commercial landuse. This aside from physical observation is informed as (76.7%)

of buildings within the area is solely for commercial purposes. Meanwhile as the distance increases from road network, there is high occurrence of other landuses (i.e residential and mixed). For instance, at 100 meters distance to road network, 10.0% of landuse is

committed to mixed development. This increased to 40.0% at 200 meters but declined to 23.3% at 300 meters. While the factor associated with mixed landuse decline in 300 meters away from the road is traceable to increase in the proportion of residential development (i.e 23.3%), developers or estate agents prefers to use buildings that are directly adjoining to roads for shops,

as these use possesses optimised financial returns comparatively to other uses in the zone. The chi-square value of 12.38 reported on Table 8 informs that there is a variation in the use of land across strata; however, the p-value of 0.054 which is greater than the α -value of 0.050 implies that this variation is not statistically significant.

Table 8: Use of building across Strata

			use of building				Total
			residential	Commercial	industrial	mixed	
zone of area	within 100 meters	Count	4	23	0	3	30
		% within zone of area	13.3%	76.7%	0.0%	10.0%	100.0%
		% within use of building	26.7%	46.0%	0.0%	13.6%	33.3%
		% of Total	4.4%	25.6%	0.0%	3.3%	33.3%
	within 200 meters	Count	4	13	1	12	30
		% within zone of area	13.3%	43.3%	3.3%	40.0%	100.0%
		% within use of building	26.7%	26.0%	33.3%	54.5%	33.3%
		% of Total	4.4%	14.4%	1.1%	13.3%	33.3%
	within 300 meters	Count	7	14	2	7	30
		% within zone of area	23.3%	46.7%	6.7%	23.3%	100.0%
		% within use of building	46.7%	28.0%	66.7%	31.8%	33.3%
		% of Total	7.8%	15.6%	2.2%	7.8%	33.3%
Total	Count	15	50	3	22	90	
	% within zone of area	16.7%	55.6%	3.3%	24.4%	100.0%	
	% within use of building	100.0%	100.0%	100.0%	100.0%	100.0%	
	% of Total	16.7%	55.6%	3.3%	24.4%	100.0%	

$$X^2 = 12.38; p = 0.054$$

Source: Authors work, 2016

i) Factors responsible for Residential use conversion

This subsection examines the possible factors responsible for unguided conversion of residential landuses to commercial and mixed landuse. It is however worthy of note that these factors are systemic and organic. From Table 9, it can be deduced that the major factor responsible for transition from residential use to other use is the presence of Taiwo road as it accounts for a deviation index of 0.20. The road which serve as both growth pole factor and transportation route has attract to itself different commercial landuses which compete for space to enjoy both access and mobile customers. This led to increase in commercial activities (0.15) such as banks, sales outlets which are able to afford the rental cost of land.

The agglomeration of these commercial activities as well as their desire for enjoyment of its associated benefits make them to continuously increase thereby causing an increase in demand for commercial properties (0.002) as well as optimising investment returns (0.06) for developers and landlords who will prefer to convert the landuses to accommodate uses that can optimise their profits. It is however unfortunate that these takes place in the sight of poor development control (0.1) exhibited by physical planning experts and other urban gatekeepers in different government ministries. It is in response to these set of interconnected factors that residential uses fizzles out for both commercial and mixed landuses.

Table 9: Factos responsible for Residential Use conversion

S/N	Variables	Ratings					Factors Index				
		5 SA	4 A	3 U	2 D	1 SD	FWW	NR(F)	FWW/ NR (F)	X	D ²
1	Presence of Main Road	424	24	0	0	0	448	90	4.97	0.20	0.040
2	Increase in	357	84	0	0	0	441	90	4.90		0.029

	commercial activities										
3	Optimizing investment return	264	168	0	0	0	432	90	4.79	0.06	0.004
4	Meeting up with current economic reality	348	63	0	0	0	411	90	4.57	-0.16	0.026
5	Intra-Urban Migration	284	134	0	0	0	418	90	4.65	0.08	0.006
6	Increase in family size	67	344	0	0	0	411	90	4.57	-0.16	0.026
7	Increase in demand for commercial properties	411	12	0	0	0	423	90	4.71	0.02	0.0004
8	Poor Development Control	201	224	0	0	0	425	90	4.72	0.01	0.0001
TOTAL									37.88	4.73	

Source: Authors work, 2016

j) Environmental Dimension of Residential Landuse Conversion

This subsection examines the environmental implication of landuse conversion. From Table 10, it is evident that the predominant effect of residential landuse conversion in the study area is noise as it accounts for a weighted value of 4.64. Reportage of noise as an effect is not least expected as most of the commercial activities carried out in the study area (especially in mixture with residential landuse) generate noise. For instance, generators used at business centres and sales shop among others generate noise during the day. Another notable environmental effect is Lack of potable water (4.62). This situation is worsened

as existing water supply facilities (government boreholes and public water works) have deteriorated hence water shortage is rampant. Due to this shortage, residents depend on purchase of water from private vendors (usually called mallams) or depend on well water around their vicinity. The seasonality of well water alongside questions bothering on its quality are issues that stares at the face of residents. Although, this is an amplified effect of other environmental problems such as housing shortage (4.15), High Occupancy ratio (3.95). As a result of these complexities, residents are faced with other environmental problems such as poor sanitation (4.59) and poor aesthetics (4.38).

Table 10: Environmental Dimension of Residential Landuse conversion

Factors	SA	A	U	D	SD	WMS	RANKING
Housing Shortage	50	16	10	0	14	4.15	9 th
Poor Aesthetics	54	35	0	0	1	4.38	6 th
Noise	65	22	1	2	0	4.64	1 st
Waste generation	45	20	10	15	10	3.82	11 th
Lack of Potable water	60	24	4	1	1	4.62	2 nd
Poor road	30	10	2	35	23	2.99	12 th
Poor drainage	45	28	0	0	17	4.20	8 th
Poor Sanitation	63	18	1	2	6	4.59	4 th
High crime rate	60	20	0	9	1	4.55	5 th
High Occupancy ratio	52	5	4	0	19	3.95	10 th
Air pollution	40	39	5	3	3	4.31	7 th
Epileptic power supply	60	23	5	2	0	4.61	3 rd

Note: Strongly Agreed=SA, Agreed =A, Undecided=U, Disagreed=D, Strongly Disagreed=SD

Source: Authors work, 2016

VI. CONCLUSION AND RECOMMENDATION

From the foregoing, it is evident that there is an intricate relationship between urbanization, landuse change and environmental deterioration. This then answer in part rhetoric questions bothering on the situation of urban centres in Nigeria as haven of environmental ills, because, as urban centres become urbanised in the sight of unguarded development, environmental challenges emanates thereby creating

more of problems than envisaged. While the environmental realities of urbanization (inclusive of landuse changes) continues to stare us in the face, how then do we ensure that landuse changes are carried out in the overall interests of advancing sustainable development? Also, how will sanity be restored to the economic viable Taiwo road in Ilorin? These can be achieved by the following.

1. *Awareness on the need of development Permit for Change of Use:* there is every need for massive awareness using several medium such as media prints, radio and television programmes on the need for development for every change of use. Education changes perception and attitude towards phenomenon, hence when developers and landlords are educated, their attitude will positively change.
2. *Environmental Impact of Project during Planning:* there is every need to extensively carry out environmental impact analysis of any social infrastructure (such as roads) before it is carried out. This will help in the fixation of systems and methods towards reducing or averting any potential environmental impacts of projects.
3. *Environmental Auditing:* Environmental audit of developments along Taiwo road should be carried out, this will help ascertain in quantitative terms, the extent of environmental damage (inclusive of landuse change) that has been done in the area. This will be the basis on which policy direction will be made.
4. *Establishment of Focused Relevant Government Agencies:* Government agencies such as Capital Territory/ Metropolitan Development Authority; Building Control Agency should be established in Kwara State with strict focus on the ensuring compliance with building codes as well as zoning in the metropolitan area. This agency when established should survey the study area, then proceed on resubmission of development plans for approval. Using this method, updated landuse information about the study area can be generated and control will be enabled.
5. *Development of Landuse Contingency Plan:* Since these development are more of irreversible (especially places where total conversion has taken place), contingency landuse plan for the study area should be developed to cater for the existing situation as well as chart a course for future landuse pattern of the metropolis.
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Linking Relief-Rehabilitation-Development Against Disaster

By Col Pk Chaturvedi

Introduction- A disaster means that appalling disturbance / change which brings with it great damage, misery and death when it occurs and leaves a legacy of destruction that has to be overcome. Although disasters have enormous damaging capacity, there exist considerable evidence of the efforts made by human beings to survive in extreme events such as earthquakes or hurricanes or fires and these evidences are observed throughout ancient to modern history of human civilization. In contemporary societies, warnings and repercussions of disasters has been superintended by various organizations in various forms. International aid-agencies such as the World Bank (WB), United Nations Development Programme (UNDP), Canadian International Development Agency (CIDA), and United States Agency for International Development (USAID) etc. emphasize through their Disaster Relief Program (DRM) on the involvement of community for development purposes and long term sustainability (UNDP-DRM, 2002-09).

However, disasters could be reduced if not prevented. With today's advancements in science and technology, including early warning and forecasting of natural phenomena together with innovative approaches and strategies for enhancing local capacities, the impact of natural hazards somehow be predicted and mitigated. Also, its detrimental effects on populations can also be reduced and the communities can be protected adequately.

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Linking Relief-Rehabilitation-Development Against Disaster

Col Pk Chaturvedi

I. INTRODUCTION

A disaster means that appalling disturbance / change which brings with it great damage, misery and death when it occurs and leaves a legacy of destruction that has to be overcome. Although disasters have enormous damaging capacity, there exist considerable evidence of the efforts made by human beings to survive in extreme events such as earthquakes or hurricanes or fires and these evidences are observed throughout ancient to modern history of human civilization. In contemporary societies, warnings and repercussions of disasters has been superintended by various organizations in various forms. International aid-agencies such as the World Bank (WB), *United Nations Development Programme* (UNDP), *Canadian International Development Agency* (CIDA), and *United States Agency for International Development* (USAID) etc. emphasize through their Disaster Relief Program (DRM) on the involvement of community for development purposes and long term sustainability (*UNDP-DRM, 2002-09*).

However, disasters could be reduced if not prevented. With today's advancements in science and technology, including early warning and forecasting of natural phenomena together with innovative approaches and strategies for enhancing local capacities, the impact of natural hazards somehow be predicted and mitigated. Also, its detrimental effects on populations can also be reduced and the communities can be protected adequately.

Disaster recovery and rehabilitation efforts require enormous funds that, amidst insufficient contingency funds, are taken out from other development programmes that are planned or are underway, thereby impeding development efforts (*Building Material and Technology Promotion Council, 1996*). Therefore, it is important that disaster mitigation programmes are made an integral part of developmental programmes. At the same time, efforts to enhance the capacities of communities and coping systems at various levels towards self-reliance and self-sufficiency must be sustained. The tools for assessing relief requirements and analyzing capacities and vulnerabilities have to be further developed, fine-tuned and promulgated among aid providers and disaster management practitioners (*Centre for Science and Environment (CSE)-Case Study, Nov 2013*).

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II. IMPACT OF DISASTER

Disasters leave harm and damage to people, infrastructure, economies and the environment hence the goals of sustainable development get hindered. The disaster management framework has promoted a comprehensive approach that embraces disaster response and also prevention, preparedness and recovery activities. However, much of the focus has been concentrated upon disaster response planning relatively lesser activities have been undertaken on disaster prevention, including the examination of the underlying causes of disasters. As the potential of the occurrence of a disaster increases, the coping mechanisms of many societies tend to become less effective. Moreover, vulnerability to such risks tends to increase due to the mismatch between faster speeds of urbanization compared to that of building infrastructures to cope with the urbanization. It results from the coupling of independent risk sources, i.e. interaction of natural hazards with technological, lifestyle, and social risks and transition of people from rural to urban areas; increase of mobility and cultural de-rooting i.e. loss of traditional management capabilities; increase of social pressure and conflicts and insufficient management capacity for mitigation and contingency management (*UNDP-Project Management Board (PMB), 2002*).

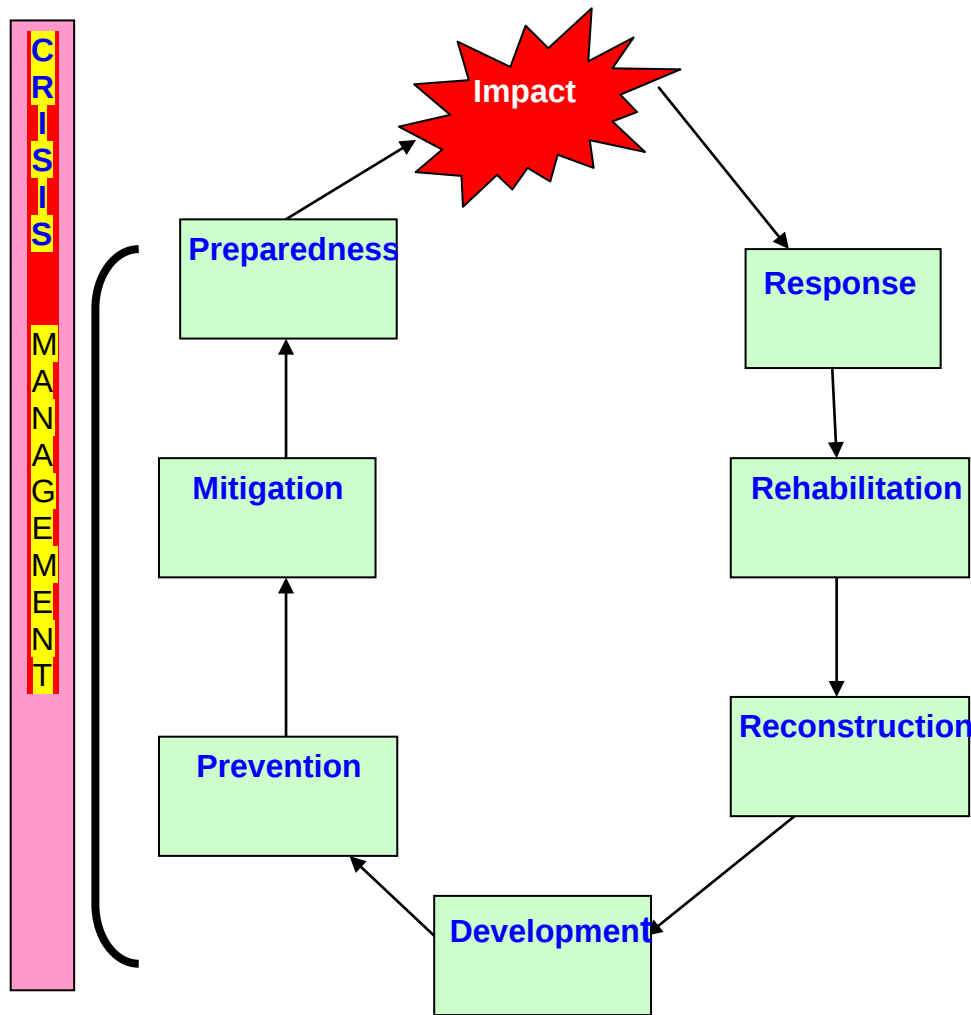


Fig.1: Impact of disaster can be represented linking various stages as shown below:-
Flow Diagram – Disaster Impact

III. DISASTER MITIGATION IN INDIA

India faces disasters of different types and people have been struggling to overcome the disasters that strike with periodic regularity. During the years 1990-1999, there were 59,846 reported deaths, while 315,125,127 people were affected by various disasters in the country. During the years 2000- 2009, there were 64,478 people killed and 659,134,721 people were affected by various disasters in India, indicating an increase in both deaths and the impact of disasters (World Disaster Report 2010). The country is more vulnerable to disasters, such as droughts, earthquakes, floods, avalanches, cyclones, landslides, etc, Major natural disasters that India has experienced includes Uttar Kashi Earthquake (1991), Latur Earthquake (1993), Super cyclone in Orissa (1999), Bhuj Earthquake in Gujarat (2001), South Asia Tsunami (2004) (Chandran 2004), Kosi floods 2008 (NDRF 2008).

Disaster Management geared to make a paradigm change from response and calamity relief to disaster prevention, preparation and mitigation. Another significant change is to move from largely government instituted disaster management to public private partnership and community based disaster management. In this regard, significant changes have been made. India probably has the world's oldest disaster relief code which started in 1880. This relief code provides details of the relief to be given by the government to the affected people. India has been following five year national plans although they are not on a rolling basis. The Tenth Five-Year Plan 2002-2007 for the first time had a detailed chapter entitled Disaster Management-Development Perspective. The plan emphasized the fact that development cannot be sustainable without mitigation being built into the development process. Disaster mitigation and prevention were adopted as essential component of the

development strategy. The Eleventh Five Year Plan 2007-2012 (*Planning Commission, 2008*) states:-

"The development process needs to be sensitive towards disaster prevention, preparedness and mitigation. Disaster management has therefore emerged as a high priority for the country. Going beyond the historical focus on relief and rehabilitation after the event, there is a need to look ahead and plan for disaster preparedness and mitigation in order to ensure that periodic shocks to our development efforts are minimized."

The Eleventh Five Year Plan (op.cit) aims at consolidating the process by giving impetus to projects and programs that develop and nurture the culture of safety and it also concentrates upon the idea of integration of disaster prevention and mitigation into the development process. The guidance and direction to achieve this paradigm shift will need to flow from National Disaster Management Authority (NDMA), and in the true spirit of the Disaster Management Act, 2005 to all stakeholders including State Governments and Union Territories, right up to the Panchyati Raj (Local administration by five locally elected citizens) Institutions. Communities at large will need to be mobilized to achieve this common objective as they are the first responders. Even the best of isolated efforts will not bear fruit unless they are part of an overall, well-considered approach. Also responsibilities of all stakeholders need to be clearly spelt out and accountability and sustainability factored in.

While participating in these relief operations, it was strongly felt that the resources from external agencies arrive at least 06 to 12 hours later than the occurrence of disasters. Further, the priority is given by local commanders to those casualties that appear to have more chances of survival. While most of the casualties can be saved by local assistance during initial reaction time, lot of efforts are needed to look into the issue and administer local activities in initial stage of the disaster or even preparedness in disaster prone localities. There is a paradigm shift from reactive approach of mitigation and relief to proactive approach of planned rehabilitation and development.

IV. LINKING RELIEF, REHABILITATION AND DEVELOPMENT (LRRD)

Conceptual thinking about LRRD already started in the 1980s. The most broadly associated idea with LRRD is that both humanitarian relief and development assistance should be structured in a way that reduce the need for humanitarian aid and promote developmental objectives before, during and after emergencies. Relief and rehabilitation may be temporary measures necessary for returning to pre-existing levels of development cooperation. Once disaster hostilities

cease, moving into recovery and early development type assistance may be hampered by a lack or incapacity of local authorities and the prevailing need for socio-psychological coping with the past. How to apply relief, rehabilitation and development measures simultaneously over an extended period is analysed and placed in this thesis.

A number of studies focus on developing risk reduction approaches (Paton, 2003 & Camilleri, 2003), vulnerability reduction (Hellstrom, 2005; McEntire, 2001), and developing more comprehensive disaster management approaches (McEntire, op.cit). However, very few studies reflect on developing effective monitoring tools in order to understand the vulnerable communities post-disaster, which could form the basis for sustainable reconstruction (Birkmann & Fernando, 2007). The urban or rural planners and disaster managers need coordination at the operational level and strategic coordination at the policy level (Bennett et al., 2006). Most of the development projects are completed in urgency within the stipulated time frame, without actually investigating the long term benefits of such projects or developing effective monitoring systems for the programs. Time and again it has been stressed that disasters stems from human and societal changes which translates into vulnerability (Blaikie, 1994; McEntire, op.cit; UN/ISDR, 2005 & Baumwoll, 2008). Therefore, disaster planning is linked to community development and planning.

The case studies by Mitin Bhat (Disaster Mitigation initiative), and of Ramesh Mohopatra (2009), on 'Tsunami affected fishing community in Tamil Nadu coast' have brought community related issues and advantages to involve community for rehabilitation and development.

DGEP, 2012 during European Parliament policy briefing on 'Linking relief, rehabilitation and development: Towards more effective aid' states that the basic idea of LRRD is to link short-term relief measures with longer term development programmes in order to create synergies and provide a more sustainable response to crisis situations. As stated in the Principles of Good Humanitarian Donor ship, humanitarian assistance should be provided in 'ways that are supportive of recovery and long-term development, striving to ensure support, where appropriate, to the maintenance and return of sustainable livelihoods and transitions from humanitarian relief to recovery and development'. In turn, well-designed development cooperation programmes should reduce the need for emergency relief, and LRRD development activities should include measures for conflict prevention, disaster risk reduction, disaster preparedness and the development of early warning systems.

VENRO, 2006 working paper on LRRD states that fluid transition from relief to rehabilitation and development co-operation justified to describe the respective phases, methodical approaches and terminologies involved. The immediate goal of relief is to secure survival and provide those affected with the most vital support as quickly as possible. Salvage and rescue, shelter, protection, food aid, water supply and emergency medical care are of top priority. This stage of relief may last for a couple of weeks up to several months, and even longer in the case of what are referred to as chronic crises. As a rule, this is to the detriment of project planning but must not be used as an excuse not to make a need assessment and do the corresponding project planning.

Voice-Concord position paper - LRRD (2012) is confirming that LRRD is an acceptable approach for Slum disaster management. A larger investment in Disaster Risk Reduction (DRR) in development programmes is an essential component in LRRD, and more importantly in reducing the need for emergency responses. At the same time, DRR mainstreaming and activities which lay the ground for DRR in development should continue to be supported under the Humanitarian Aid instrument. This paper strongly supports the work of this research.

In India, funds for emergent requirement are taken out from other development programme are highlighted by *Building Material and Technology Promotion Council, 1996*. Based on land zoning, Report of the expert Group on Natural Disaster Prevention, Preparedness and Mitigation having bearing on Housing and Related Infrastructure aspects of fire hazards, has helped in bringing important lessons in this research.

Investment in Disaster Risk Reduction (DRR) in development programme is an essential component in rehabilitation and development, and more importantly in reducing the need for emergency responses. At the same time, activities which lay the ground for DRR in development should continue to be supported under the Humanitarian Aid instrument. NGOs have separate humanitarian and development departments. Funding constraints reinforce the gap, as donors may choose to only fund (a part of) one 'phase'. This can lead to projects which are suddenly discontinued because an 'emergency phase' is ending in the donor's view, or to long term programme which no longer make sense because a disaster has completely changed the local situation in the 'development phase'. Such trends need to be checked in time (VOICE, op.cit).

Conceptual thinking about LRRD started in the 1980s, having idea that both humanitarian relief and development assistance should be structured in ways that reduce the need for humanitarian aid and promote developmental objectives before, during and after emergencies. The implementation of LRRD led to the

emergence of two approaches, i.e. continuum and contiguum. In the continuum approach, the succession of relief, rehabilitation, and development, based on the assumption of a linear sequence before-during-after the disaster. In contiguum approach, simultaneous occurrence of humanitarian aid, rehabilitation and development, is carried out in order to respond effectively to all aspects and areas of the disaster. LRRD under the contiguum approach requires both NGOs and the Govt to expand their activities facilitating co-operation, in order to prevent crises, and to contribute to the long term stability and well-being of society (Karlos PA, 2002). LRRD interventions, regardless of the size or character of a disaster (sudden, recurrent or ongoing natural hazards or conflict), is need of time. Effective LRRD can address the poverty that disasters and conflicts generate (or intensify) by laying the groundwork for sustainable development during humanitarian interventions.

Long term programmes may be in the best position to respond to forecasts of a crisis, as development NGOs are on the ground, have established links with communities and government bodies and have staff and partner organisations in place. If a crisis is up coming, they can act upon early warning signals and adapt their programme where necessary. Once a crisis reaches a certain threshold, a more substantial humanitarian intervention may become necessary. Moreover, development funding needs to be dispersed quicker in situations where LRRD is needed as the current practice is far too slow for this purpose. Disaster preparedness will save money: "It is much more cost effective to prevent and prepare for a crisis than to wait for it to happen (VOICE, op.cit).

Aid agencies and government authorities on the ground have to take context-specific actions in relation to key needs of affected populations. The coordination among all actors: local authorities, donors, Govt agencies, local civil society and NGOs are very difficult. This involves field-level coordination between all actors but also, internal coordination between different departments of aid agencies, governmental authorities and donors.

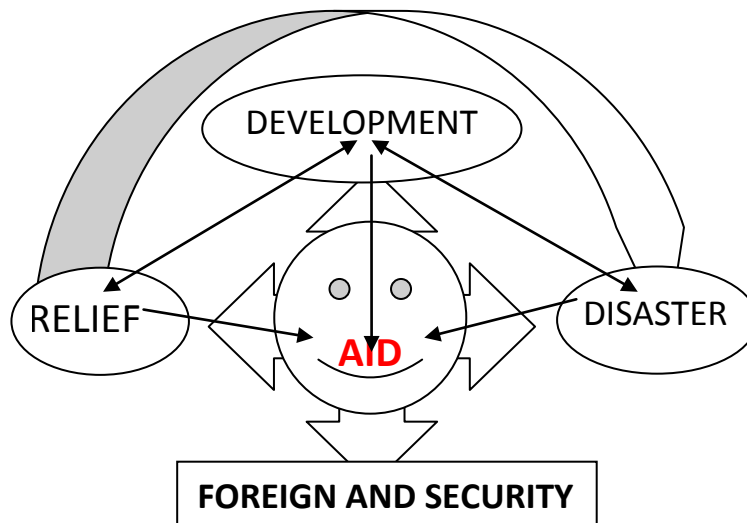
V. INTERRELATIONSHIP BETWEEN DRR AND RRD APPROACHES

At all level, disasters are now viewed as opportunities for sustainable development. However, recently, post-disaster reconstruction efforts and community based development initiatives were lacking resources. Simultaneous projects are launched by numerous local state and central government organizations for housing and infrastructure construction, repairs, for livelihoods creation and for a range of other social programs. However, affected

communities are totally unaware of the long term benefits of such initiatives.

Thus, there is possibly a need for a common platform for post- disaster development. Numerous communities were unable to adapt to the new environment after the relocation. They returned to their original homes within the few months of after the relocation that lead them to further vulnerability. This shows a failure of the system that targets capacity building and sustainable development for communities. Development initiatives undertaken by either the local government or the aid agencies lack cultural sensitivity. It is also identified that there is a need for coordination at the operational level (who does, what and where) and

strategic coordination at the policy level. The indigenous knowledge should be considered in the process of disaster reduction, by educating, preparing and consulting communities before a disaster occurs. A larger investment in Disaster Risk Reduction (DRR) in development programmes is an essential component in LRRD, and more importantly in reducing the need for emergency responses. At the same time, DRR mainstreaming and activities which lay the ground for DRR in development should continue to be supported under the Humanitarian Aid instrument (Voice-Concord, op.cit). LRRD can have six key relationships between aid and disaster (Lindahl, (1996):-



Source: Chaturvedi

Fig. 2: Illustration: Inter-relationship

A more recent addition to this list of key relationships is between relief and peace-building activities (Mancino et al, 2001). The 'second generation' of the debate identified by Macrae and Harmer (2004) raises the issue of relationships to a higher and more political level, to do with the links between aid, foreign

and security policy. But as far as slum fire is concerned, it does not need such international level aid or security. Slum fire impact is heavily dependent on how slum society is structured and development programme or humanitarian assistance aid funding is made available.

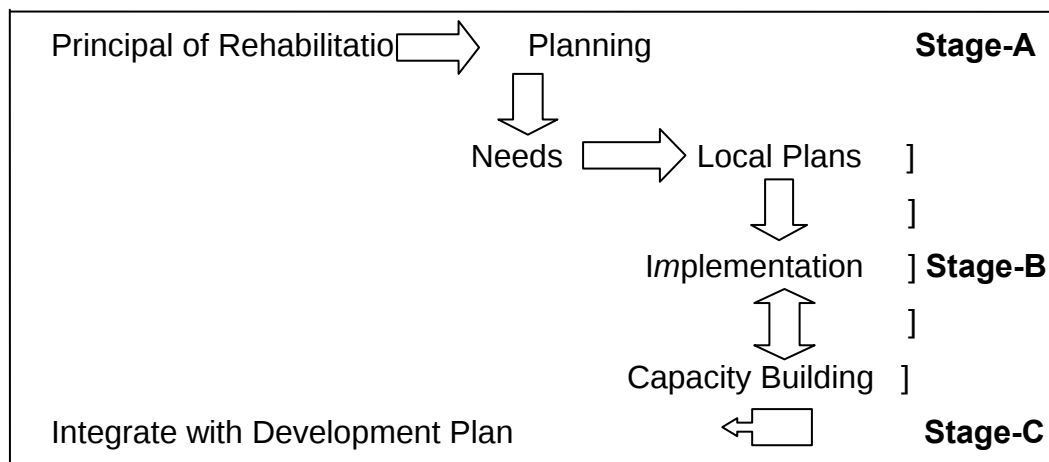


Source: <http://4.bp.blogspot.com/FFGUnHgvrHQ/U9tp7KXGbtI>

Fig. 3: From Shock to Development

By developing integrated strategies having mixed dget for relief projects and development projects, promoting capacity building of local populations by providing substantial resources in order to achieve it, RRD may be more effective. Governments have to dedicate substantial resources to crisis/disaster warning systems, or to tackle problems before they get out of

hand. The activities for Development can be segregated in three stages as depicted below.



Source: Compiled by Chaturvedi

Fig. 4: Illustration: Flow Chart-Stages to Development to Ensure Sustainability

According to VOICE (op.cit), the disaster prevention/ risk reduction; rehabilitation measures focuses on restoring the status quo ante and promoting the existing potentials as well as aims to achieve qualitative and sustainable improvements in the living conditions of those affected. Running project phases is not divided. If it is not possible for a single organisation to implement the different phases of a project, co-ordination with other organisations working on a complementary basis is sought to integrate capabilities aimed at comprehensive improvements in living conditions.

Missing coordination between stake holders- With the immensity and complexity of the disaster problem, no stakeholder could effectively address the problem alone. Cooperation in disaster reduction activities among governments at national and local levels, non-governmental organizations and various sectors of the communities is essential. The broadened participation of relevant sectors, such as environment, finance, industry, transport, construction, agriculture, education, health, and media among others, in disaster reduction activities, allows for greater understanding of local vulnerabilities and risk to disasters and integration of actions of stakeholders.

The effectiveness of disaster risk management interventions could be ensured when the community and people at risk are directly involved in the disaster risk management process. It is also critical that any disaster risk management plan is dynamic and remains relevant to the community and the roles and contributions of the members are defined. Through the participative approach, the determination of risks and the intervention measures are not imposed on the community, but rather accomplished by the very people concerned. Moreover, greater emphasis is placed on local knowledge and the indigenous ways of knowing,

rather than on expert knowledge and technologies. Also, community based-activities tend to be multi sectoral, thereby reinforcing local organizations, and enhancing consciousness, awareness and critical appraisal of disaster risks and their inter-dependence. Altogether, they increase the community's capacity and people's potential for reducing their vulnerability to disasters. Following measures are missing-

- i. Empowerment to the poor and women, to overcome established boundaries and limitations
- ii. Funds/subsidies of state-led programs are not seen.
- iii. New relationship between grassroots groups, social organisations, and the private and public sectors is not seen.
- iv. Institutionalization of innovations, implying the breaking of and making of new sets of social and political norms and rules.
- v. A community led reconstruction to development strategy is based on the premise that communities can be mobilized around rebuilding efforts. Collective action around rebuilding – whether it is houses, schools or community centers, involves people in sharing of skills, resources, materials, benefits and ideas, and therefore is a shift from disaster to sustainable development.
- vi. By building confidence in people's decision-making capacities, firstly people receive on time information on their entitlements, understand safety features and develop firsthand knowledge about local and new materials. Develop capacities to access cash and materials resources, and are part of community self monitoring mechanisms if and when they are established.
- vii. To strengthening community institutions, there is a need to ensure that village committees are formed after disaster to play an intermediary role between

- govt, and communities. The key role in ensuring information and assistance reaches at every stage - finalizing list of beneficiaries, compensation, damage assessment, housing assistance, etc.
- viii. Empowering women's self help groups to play a key role in mobilizing communities, addressing women's issues, enhancing participation of women in rehabilitation. Specific to the reconstruction program, women's can play a key role in reaching out information, Promoting safe construction practice, monitoring relief and reconstruction, ensuring earthquake resistant standards and providing feedback to administration.

VI. RECOMMENDATIONS

The RRD approach confirms that development can only sustain if disaster mitigation is built into the development process. Further mitigation has to be across all sectors of development. It advocates that investments in mitigation are much more cost effective than expenditure on relief and rehabilitation.

Funding Mechanism with development linked mitigation - India's 10th Five Year Plan noted that the urban slum population is growing despite sharp reductions in poverty and rising incomes. The central and several state governments recognized the need for intervention by initiating, or enlarging existing urban housing and other slum subsidy programs. With this in mind, the Government of India (GOI) has requested a loan from the World Bank to implement a more effective strategy and delivery mechanism for the financing of urban slum improvement and sanitation provision in underserved areas.

In order to support the GOI to achieve the goals delineated in 10th Five-year Development Plan concerning slum improvement and poverty alleviation in urban areas, the Bank has agreed to consider a program that will focus on

- i. Refining the national policy framework for the upgrading of urban slums and sanitation in underserved areas in India;
- ii. Working with the states and various beneficiaries to establish a methodology which measures program performance of both the GOI and the states, and identifies concrete monitorable steps that can be taken to improve this performance;
- iii. Developing appropriate monitoring mechanisms to enable the evaluation and modification or redesign of the programs which would improve the transparency, efficiency, administrative simplicity, and targeting of the assistance;
- iv. Developing funding schemes for slum improvement and sanitation that could provide incentives so that resources are used more effectively and the program reach expanded. In doing so, the program will:

- a) Contribute to poverty alleviation in the poorest urban areas in India;
- b) Strengthen human capital in poor neighborhoods by increasing community participation in planning, delivery and maintenance of public works and services;
- c) Improve the efficacy of the use of more than \$400 million of annual government expenditures on these programs

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Review on the Role and Implications of Wetlands to Climate Change

By Merkineh Mesene

Wolaita sodo univeristy

Introduction- Three of the world's greatest challenges over the coming decades will be biodiversity loss, climate change, and water stress (World Bank, 2008). Global climate change is undoubtedly the most pervasive, complex and challenging of the global environmental issues facing contemporary society and it affects all aspects of development. The effects of climate change are local and vary among systems, sectors and regions. Although many natural and economic sectors will be affected by climate change, impacts on agriculture and water availability will have the greatest potential to negatively affect the livelihoods of the poor in rural areas, as well as national economic growth in the least-developed countries, especially for the people of sub-Saharan Africa (SSA) (Roetter et al., 2002).

The high dependence of the economies and rural people of SSA upon rain fed agriculture, the prevalence of poverty and food insecurity and limited development of institutional and infrastructural capacities makes coping with natural climate variability a perennial challenge. This challenge is being magnified by global climate change (Cline, 2007; Lobell et al., 2008). Expanding agriculture leads to habitat loss and fragmentation, drainage of wetlands, and impacts on freshwater and marine ecosystems through sedimentation and pollution and is one of the greatest threats to biodiversity worldwide (World Bank, 2008).

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Review on the Role and Implications of Wetlands to Climate Change

Merkinah Mesene

I. INTRODUCTION

Three of the world's greatest challenges over the coming decades will be biodiversity loss, climate change, and water stress (World Bank, 2008). Global climate change is undoubtedly the most pervasive, complex and challenging of the global environmental issues facing contemporary society and it affects all aspects of development. The effects of climate change are local and vary among systems, sectors and regions. Although many natural and economic sectors will be affected by climate change, impacts on agriculture and water availability will have the greatest potential to negatively affect the livelihoods of the poor in rural areas, as well as national economic growth in the least-developed countries, especially for the people of sub-Saharan Africa (SSA) (Roetter et al., 2002).

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a) Green House Gases (GHGs) and Global Warming

Increasing concentrations of GHGs in the earth's atmosphere are expected to warm the earth and cause other, less easily predicted, changes in climate and finally leads to what is so called Global warming (Lal, 2004). Global warming refers to climate change that causes an increase in the average temp of the lower atmosphere. It can have many different causes, but it is most commonly associated with human interference, specifically the release of excessive amounts of GHGs such as CO₂, CH₄, nitrous oxide (N₂O), SO₂, water vapour, and fluorinated gases, act like a GHG around the earth. This means that they let the heat from the sun

into the atmosphere, but do not allow the heat to escape back into space. The more GHGs there are, the larger percentage of heat that is trapped inside the earth's surface which leads to what is called global warming (Howard, 2003).

Human activities, especially the burning of fossil fuels such as coal, oil, and gas, have caused a substantial increase in the concentration of CO₂ in the atmosphere. Potential adverse impacts include sea-level rise; increased frequency and intensity of wildfires, floods, droughts, and tropical storms; changes in the amount, timing, and distribution of rain, snow, and runoff; and disturbance of coastal marine and other ecosystems. Rising atmospheric CO₂ is also increasing the absorption of CO₂ by seawater, causing the ocean to become more acidic, with potentially disruptive effects on marine plankton and coral reefs. Technically and economically feasible strategies are needed to mitigate the consequences of increased atmospheric CO₂. However, existing CO₂ uptake mechanisms (carbon "sinks") are insufficient to offset/ compensate/ balance/ counteract the accelerating pace of emissions related to human activities (USGS, 2008).

b) Wetlands

Wetlands are ecosystems or units of the landscape, ecologically situated at the interface between land and water and they optimize the attributes of both terrestrial and aquatic ecosystems. They are among the world's most biologically productive and diverse ecosystems. However, this transitional status contributes to wetlands being among the most threatened of the Earth's natural environments. Traditionally perceived as wastelands, wetlands have a long history of being drained and converted to other "productive" uses (Abebe & Geheb, 2003). The Ramsar Convention recognizes five major wetland systems (Ramsar Convention Bureau, 1997), while others identify up to seven main groupings (Dugan, 1990). The major Ramsar groupings are: Marine (coastal wetlands); Estuarine (deltas, tidal marshes, and mangroves); Lacustrine (lakes and associated wetlands); Riverine (rivers, streams and associated wetlands); and Palustrine (marshes, swamps and bogs). The Ramsar Convention on Wetlands provides the most universally comprehensive definition of wetlands as: "areas of marsh, fen, peat land or water, whether natural or

artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters" (Ramsar, 1998).

Wetlands occur in every country, from tundra to the tropics. While the global extent of wetlands is not known exactly, the World Conservation Monitoring Centre has suggested an estimate of about 570 million ha, roughly 6 per cent of the Earth's land surface (Maltby, 1986; WCMC, 1992).

According to World Bank (2008), Ecosystems are not all equal either in their value for biodiversity conservation or their role in carbon storage and other ecosystem services. Wetlands provide many ecosystem services that are critical to reduce the vulnerability of communities to climate change in general and to extreme weather events in particular. Protecting existing wetlands and restoring degraded wetlands provides an opportunity to enhance mitigation actions. Peat lands and marshes contain large stores of carbon. In recent decades, drainage and conversion to agricultural lands and climate change has changed peatlands from a global carbon sink to a global carbon source. Avoiding degradation of peatlands, swamps, and wetlands is a beneficial mitigation option.

c) Wetland Degradation, Conservation Efforts and their current status

Wetlands encompass a significant proportion of the area of the planet and the majorities are utilized by people for some or other purpose. Many of these uses are sustainable and are compatible with the concept of conservation and wise use of wetlands. Many other activities associated with economic, urban and water resources developments characteristically lead to permanent loss of wetland area and degradation of wetland quality and function (Pritchard, 2009).

Degradation of wetlands and disturbance of their anaerobic environment lead to a higher rate of decomposition of the large amount of carbon stored in them and thus release GHGs to the atmosphere. Therefore, protecting wetlands is a practical way of retaining the existing carbon reserves and thus avoiding emission of carbon dioxide and GHGs (Shalu et al, 2009; Yarrow, 2009).

According to Moser *et al.* (1996) report *"the world may have lost 50% (half of) of the wetlands as a result of increasing pressure for conversion to alternative land use particularly drainage for agricultural production is the principal cause."*

Yarrow (2009) also said that agriculture and development are the main/principal causes for the destruction and degradation of wetlands. We have already lost 50% globally and still losing wetlands, especially in developing countries and climate change will become one of the major drivers of ecosystem loss

during this century and will intensify the impacts of the other drivers.

General strategies for land and water management practices adopted to reduce the impacts of climate change on wetlands include; better control the drainage of wetlands, prevent additional stresses and fragmentation, create upland setbacks and buffers, control exotics, protect low flows and residual water, control extraction of peat, restore and create wetlands, conduct stocking and captive breeding and conduct regional inventories and prepare management plans for wetlands at great risk from climate change (Rubey, 2010; and Kusler, 2006).

d) The Global Importance of Wetlands (Values and Functions)

There is a broad and growing recognition that wetlands are critically important ecosystems that provide globally significant environmental, social and economic benefits. Among the most biologically productive of ecosystems, they support exceptional levels of biodiversity, purify and moderate water resources and provide food, fiber and water security for local communities (Ramsar, 1997; Woodward & Wu, 2001).

As in Ramsar STRP (2005); Pritchard (2009); Ramsar (1997); Wetlands deliver a wide range of critical services. These include food, fibre, water supply, water purification, regulation of water flows, coast protection, carbon storage, regulation of sediments, biodiversity, pollination, tourism, recreation and cultural services. Their benefits to people are essential for the future security of humankind, and this depends on maintenance of their extent, natural functioning and ecological character. Increasing demand for and over-use of, water is jeopardizing human well-being and the environment. Access to safe water, human health, food production, economic development and geopolitical stability are made less secure by the degradation of wetlands, driven by the rapidly widening gap between water demand and supply.

In Ramsar (1997): wetlands are important, and sometimes essential, for the health, welfare and safety of people who live in or near them. Among the world's most productive and biologically and functionally diverse environments, they provide a wide array of benefits. The interaction of physical, chemical and biological components of wetlands, which optimizes the attributes of both terrestrial and aquatic ecosystems, enables wetlands to perform many ecosystem functions, for example: water storage; storm protection and flood mitigation; shoreline stabilization and erosion control; groundwater recharge (the movement of water from the wetland down into the underground aquifer); groundwater discharge (the movement of water upward to become surface water in a wetland); water

purification; retention of nutrients; retention of sediments; retention of pollutants; and stabilization of local climate conditions, particularly rainfall and temperature.

Wetlands provide tremendous economic benefits, water supply (quantity and quality); Fisheries; Agriculture, through the maintenance of water tables; Timber production; Energy resources, such as peat and plant matter; Wildlife resources; Transport and Recreation and tourism opportunities (Ramsar, 1997).

As in Ramsar World wetlands day (2009); and MEA (2005); Wetlands deliver a wide range of ecosystem services that contribute to human well-being, such as fish and fiber, water supply, water purification, climate regulation, flood regulation, coastal protection, recreational opportunities, and increasingly tourism. Wetland ecosystems, including rivers, lakes, marshes, rice fields, and coastal areas, provide many services that contribute to human well-being and poverty alleviation. Some groups of people, particularly those living near wetlands, are highly dependent on these services and are directly harmed by their degradation. Two of the most important wetland ecosystem services affecting human well-being involve fish supply and water availability.

As in MEA (2005), and Woodward & Wu (2001) Although the influence of a wetland on the hydrological cycle is site-specific; Wetlands deliver a wide array of hydrological services—for instance, swamps, lakes, and marshes assist with flood mitigation, promote groundwater recharge, and regulate river flows but the nature and value of these services differs across wetland types. Wetlands provide various hydrological services as follows: gross water balance, flow regulation, flood-related services, pollution control and detoxification, groundwater services and river flow and hydrological regime variability.

II. WETLANDS AND CLIMATE CHANGE

Wetlands are vital parts of the natural landscapes whose biodiversity and ecosystem services on which humans depend, are threatened by the likely impacts of climate change (Ramsar, 2009). Globally, the negative impacts of climate change on wetland systems are expected to outweigh the benefits (Bates et al, 2008). Degradation and loss of wetlands make climate change worse and leave people more vulnerable to climate change impacts such as floods, droughts and famine. Many climate change policy responses for more water storage and transfers, as well as energy generation, if poorly implemented, may deleteriously impact on wetlands. Climate change is increasing uncertainty in water management and making it more difficult to close the gap between water demand and supply. We will increasingly feel the effects of climate change most directly through changes in the

distribution and availability of water, increasing pressures on the health of wetlands. Restoring wetlands and maintaining hydrological cycles is of utmost importance in responses for addressing climate change, flood mitigation, water supply, food provision and biodiversity conservation (Ramsar, 2009 and Patterson, 1999).

Wetlands are among the ecosystem which will be most affected by even small changes in climate and resulting changes in hydrologic regimes such as sea level rise and decreased surface and ground water level. Many wetlands will be destroyed, rare and endangered plants and animals will be threatened. Some of the climate change factors that will affect wetlands are as follows; Increase in oxygen, increase in air, water and soil temp, changes in the amounts and timing of precipitation, intensification of climatological events, lengthened growing season in northern latitudes and sea level rise (Kusler, 2006 & Rubey, 2010).

a) *The Impacts of Climate Change on Wetlands*

Rubey (2010), Kusler (1999), and Kusler (2006); listed the following seven likely impacts of climate change factors on wetland ecosystems:

Increased productivity due to increased CO₂: Increased CO₂ will increase the primary productivity of most wetland plants except where sunlight, precipitation, or temperature is a limiting factor. Increase in primary productivity would enhance the habitat value of some wetlands although some shift in plant and animal species might also be expected and variations in responses. There are indications that this increased productivity will also result in increased methane emissions.

1. *Wetland changes due to decreased frosts:* The natural ranges of both natural and invasive wetland plant species are killed by frost actions.
2. *Wetland changes due to decreased precipitation:* Impacts will be particularly great where precipitation remains steady or decreases. Increases in temperature combined with reductions in precipitation will likely reduce surface and ground water levels in wetlands, destroying or reducing in size many wetlands. Lowered water levels will result in release of carbon and methane.
3. *Wetland changes due to increased precipitation:* Increased precipitation will result in increased ground water levels and increased water levels in wetlands and lakes. Shifts in wetland type may also occur with associated vegetation changes. This will likely to further result in: an increase in size of some freshwater wetlands due to the inundation or saturation, an increase in the number of depressionals, flats, lake fringe, riverine, and slope wetlands (i.e. some will appear where they have not

been before) and a shift in wetland type and associated vegetation and fauna.

4. *Wetland changes due to an increase in severe Meteorological events:* All wetland systems are, to a greater or lesser extent, already subject to disturbance by extreme rainfall, flooding, and high winds. Increased frequency of extreme events may, however, cause irreversible damage to some wetland systems that are already stressed. Extreme events may also combine with sea level rise to increase shoreline erosion and land loss in coastal areas.
5. *Wetland changes due to sea level rise:* Projected sea level rises of 0.09 to 0.88 meters by 2100 combined with coastal subsidence in some areas will likely have severe impact on coastal and estuarine wetlands. There will be wetland losses where there is insufficient plant growth and sediment deposition to equal sea level rise and coastal or estuarine wetlands can not migrate inland. So that Rapid, substantial changes in sea level pose significant threats to coastal and estuarine wetlands.
6. *Wetland changes due to increase in temperature:* Increased air, water and soil temperature could have both direct and indirect impacts upon wetland plants and animals. The IPCC has concluded more generally that the "composition and geographic distribution of many ecosystems will shift as individual spp respond to changes in climate, there will likely be reductions in biological diversity and in the goods and services that ecosystems provide." (IPCC, 2007). Temp increases will likely result in the melting of permafrost, increased decomposition rates, and releasing CO₂ and changing methane and nitrous oxide emissions and creating open water wetlands or aquatic ecosystems and there will be significant indirect effects of temp, evaporation, and transpiration increases. These will likely result less runoff (unless compensated by increased rainfall), less infiltration, and lowered ground water levels.

The degradation and loss of wetlands is more rapid than rates for other ecosystems (Ramsar STRP, 2005). Similarly, the status of both freshwater and, to a lesser extent, coastal species is deteriorating faster than that of species in other ecosystems. These trends have primarily been driven by land conversion and infrastructure development, water abstraction, eutrophication, pollution and over-exploitation. There are a number of broad, interrelated economic reasons, including perverse subsidies, why wetlands continue to be lost and degraded. This is leading to a reduction in the delivery of wetland ecosystem services, yet demand for these same services are projected to increase (Pritchard, 2009, Ramsar STRP, 2005, Lar, 2007)).

According to Kussler (2006), and Rubey (2010) Wetland ecosystems will be more severely impacted by climate change (in comparison with many terrestrial ecosystems) for three several reasons:

- ✚ Flora and Fauna in wetlands are especially sensitive to small, permanent changes in water levels while similar small changes in water levels often have less impact upon rivers, streams, and lakes.
- ✚ Wetlands have often been fragmented and cutoff hydrologically and ecologically from other wetlands and aquatic ecosystems by dams, dikes, fills, roads, drainage, and other landscape level alterations. Due to this fragmentation, wetland plants and animals can not naturally "migrate" to other locations over time in response to temperature and water level changes. Similarly, many coastal or estuarine wetlands will be unable to move inland in response to sea level rise, due to construction of dikes, levees, fills, or other development which fix the landward boundary.
- ✚ Many wetlands are already severely stressed due to hydrologic changes, water pollution, changes in sediment regimes, and other activities of mankind. These stresses have lowered biodiversity in wetlands. Reduced numbers of types of plants and animals makes the wetlands more vulnerable to small changes in temperature and water regimes.
- ✚ Impacts will vary depending upon the types, magnitudes and rate of changes in temperature, precipitation, hydroperiod, and other factors and the plant and animal spp in a wetland.

b) *Types of Wetlands that will be most affected by Climate Change*

Rubey (2010), Roulet (2000), and Kussler (2006), listed seven wetland types that are likely to be substantially impacted by climate change:

1. *Coastal and Estuarine wetlands:* coastal and estuarine wetlands may be destroyed if sea level rise exceeds the rate of deposition and inland migration is not possible.
2. *Tundra(permafrost) wetlands and other open tundra wetlands:* Areas of permafrost wetland may be melted and converted to open water by temp increases. Water levels in other open peatlands may be invaded by boreal forests.
3. *Wetland boreal forests:* Climate change is likely to have significant impact upon boreal forests through the loss of boreal forests, invasion of tree lines into tundra areas, increased fire, and increased pest outbreaks. A combination of temp increase and the lowering of groundwater tables may expose peat and organic soils to oxidation. However, increases in CO₂ may also result in increased forest vegetation.
4. *Alpine wetlands near the tops of mountains:* Even small amounts of warming may destroy "relic" plant

and animal spp in alpine wetlands since there will be little opportunity to migrate to other locations.

5. *Prairie potholes*: Reductions in wetland size and the disappearance of some wetlands can be expected with substantial increases in temp and only modest increases in precipitation in the prairie pothole region. Waterfowl production may be reduced with the reduced precipitation in the spring or fall and reduced water levels when migrations occur even if overall precipitation levels do not change.
6. *Playas, Vernal pools, other seasonal wetlands*: Temporary, shallow wetlands will be particularly sensitive to increases in temp and increased evaporation and transpiration. They will also be sensitive to decreases or increases in precipitation.
7. *Other depressional, slope, flats, river, and lake fringe wetlands*: Some drying, decrease in wetland size, and conversion to uplands can be expected for most of freshwater wetlands where precipitation is decreased or remains steady while temp are substantially increased since these wetlands are very sensitive to small changes in groundwater levels. However, there may be exceptions such as the great lakes where lowering of water levels may expose wide flats or benches which will be colonized by wetland vegetation.

c) *Wetland functions that will be most affected by Climate Change*

The impact of climate change on the services and goods wetlands provide for society will vary by type of wetland and by function/value. As suggested by (Rubbey, 2010; Kussler, 2006 and Smith, 1995), the various wetland functions that may be most affected with changing climate are listed below

1. *Fisheries production*: with rising water temperature in lakes, streams and wetlands, reduction in the numbers of cold water fish (e.g. trout) and increase in warm water fish such as bass may be expected. With rapid sea level rise and destruction of salt marshes which can not migrate inland, reduced yields of ocean and estuarine fish species which depend upon coastal and estuarine wetlands for rearing or food chain support may also be expected.
2. *Shellfish production*: a reduction in the size of coastal and estuarine wetlands and adjacent "flats" and increases in water depths will reduce shellfish production.
3. *Waterfowl production*: increased temperature with only slightly increased precipitation in the prairie pothole region will convert some wetlands to dry land, reduce others in size, and shift marshes with standing water to saturated during the spring and fall may adversely affect waterfowl even if precipitation remains constant.
4. *Habitat for rare and endangered species*: the role of wetlands throughout the nation as habitat for rare and endangered species may be compromised wherever species are dependant upon specific hydrologic and temperature conditions and flora and fauna cannot migrate to new locations. This is particularly true for systems that are already stressed by water pollution and human-induced alterations and are highly fragmented. Species extinctions and Biodiversity loss are probable; species range and ecosystems structures will also change. Further damage due to invasions by exotic species with northward extension of ranges is also likely.
5. *Food chain support*: destruction of coastal and estuarine wetlands by rapid sea level rise would result in loss of detritus and other food chain support for estuarine and coastal fish, shellfish, and other fauna. On the other hand, some increase in food chain support might be expected in some situations due to increased primary productivity resulting from increases in CO₂ (assuming that there are not other limiting factors).
6. *Water quality buffering and pollution control*: destruction of coastal and estuarine wetlands due to sea level rise would result in loss of their water quality pollution control functions. Similar losses would occur where depressional, slope, flats, and river and lake fringe wetlands are diminished in size or destroyed by lowered ground or surface water elevations due to reduced precipitation and/or increased temperature.
7. On the other hand, some increase in water quality buffering could occur for freshwater wetlands due to CO₂ induced increases in the density and amounts of vegetation (assuming adequate water levels to maintain wetlands and lack of other limiting factors). Some wetlands would increase in size and numbers in areas of increased rainfall.
8. *Wave attenuation and erosion control*: the destruction of coastal and estuarine wetlands by sea level rise would expose back-lying lands to added increased density of wetland trees and other vegetation due to increased CO₂ might also enhance the wave attenuation and erosion control functions of surviving estuarine, coastal, and freshwater wetlands.
9. *Production of forestry products and natural crops*: increased CO₂ will result in increased growth of trees and other natural wetland crops such as wild rice, and cranberries if such increases are not "limited" by phosphorous, nitrogen, or other limiting factors. Nevertheless, there could also be loss of coastal, estuarine, and freshwater wetlands and the forestry products they produce by sea level

rise, increased severe meteorological events, and decreased precipitation in some instances. For example, bottomland hardwoods are particularly susceptible to hurricanes.

10. *Carbon storage and sequestering*: increased CO₂ could result in increased plant growth in wetlands and the potential for increased carbon sequestration where there are not other limiting factors. But, the carbon storage and sequestering role of tundra wetlands could also be reduced by the melting of permafrost, drainage and the subsequent release of CO₂ and other atmospheric gases. Carbon storage and sequestering by northern, nonpermafrost peatlands would also likely be reduced by a combination of increased temp and reduced ground and surface water levels, causing oxidation of the peat.
11. *Flood conveyance and storage*: the flood conveyance and flood storage roles of wetlands for major (infrequent) flood events would probably not be substantially affected by climate change since these roles depend more upon wetland configuration and size than biotic factors. However, increased vegetation growth due to increases in CO₂ might reduce flood conveyance capacity for riverine wetlands by increasing the "roughness" of wetland-dominated floodplains. Sediment loadings due to increased severe meteorological events could also fill depressional, riverine and other wetland types with resulting reduction in flood conveyance and flood storage capability.

III. THE ROLE OF WETLANDS ON CLIMATE CHANGE

According to Shalu et al (2009), Wetlands are among the most important natural resources on earth that provide a potential sink for atmospheric carbon but if not managed properly, they become a source of greenhouse gases.

Wetlands are vulnerable to human-induced climate change but, if managed well, their ecosystems and biodiversity play a key role in the mitigation and adaptation of climate change and will be important in helping humans to adapt to climate change through their critical role in ensuring water and food security. As a result, caring for wetlands is considered as of the solution to climate change (STRP, 2009; IPCC, 2007).

Wetland ecosystems are essential for climate change adaptation. Water and well-functioning wetlands play a key role in responding to climate change and in regulating natural climatic processes (through the water cycle, maintenance of biodiversity, reduced GHG emissions, and buffering of impacts). Conservation and wise use of wetlands help to reduce the negative

economic, social and ecological effects (Ramsar, 2009). Wetlands lessen the impact of extreme weather events due to climate change:—healthy wetlands absorb floods, decreasing the incidence and severities of catastrophic flooding—coastal wetlands protect ecosystems and communities from storms and sea-level rise—Wetlands are crucial freshwater reservoirs in regions where climate change increases drought (Schlesinger, 1997).

a) *Wetlands as Sources and Sinks*

While wetlands constitute a major carbon reservoir, they can function as either greenhouse gas sinks or sources depending on their type, their use and ambient conditions. Some wetlands are characteristically sources and others are sinks. Some have a different role at different times as determined by hydrology. In some wetland types there is a tradeoff/substitution/exchange between being a carbon sink and a methane source (Pritchard, 2009). Carbon sinks are ecosystems (the main ones being soil, oceans and forests) that store CO₂ in water, sediment, wood, roots, leaves and the soil.

Oceans are natural CO₂ sinks, and represent the largest active carbon sink on Earth, consuming 93% of the world's CO₂. CO₂ dissolves in sea water before being transported in organic and inorganic forms from the sea surface to the ocean's interior. Currently, approximately one third of anthropogenic (man made) emissions are estimated to be entering the ocean (Earth Watch Institute, 2007).

i. *Greenhouse Gas Emissions*

Wetlands play a crucial role in regulating exchanges to/from the atmosphere of the naturally-produced gases involved in "greenhouse" effects, namely water vapour, carbon dioxide, methane, nitrous oxide (all associated with warming) and sulphur dioxide (associated with cooling). They tend to be sinks for carbon and nitrogen, and sources for methane and sulphur compounds, but situations vary widely from place to place, from time to time, and between wetland types (Ramsar, 2009). Wetland land-use, and discharge, treatment and re-use of waste water can all have profound effects on emissions and hence on the success of mitigation and adaptation strategies. The most robust generalization is that degradation and disturbance of naturally-functioning wetlands is a major cause of increased carbon emissions (Ramsar Secretariat et al, 2007).

One of the best documented dimensions of this relates to peat lands, where the delicate balance between anaerobic production and aerobic decay causes them readily to switch from carbon sinks to sources following human interventions. Peatland degradation is now a major and growing cause of anthropogenic carbon dioxide emissions, with drainage,

fires and extraction (Parish et al, 2008; Patterson & Kussler, 1999).

ii. *Carbon Sequestration*

It is the term describing processes that remove carbon from the atmosphere. To help mitigate climate change, conservation management to enhance natural sequestration processes is being explored (Earth Watch Institute, 2007). The term is used to describe both natural and deliberate processes by which CO_2 is either removed from the atmosphere or diverted from emission sources and stored in the ocean, terrestrial environments (vegetation, soils, and sediments), and geologic formations (USGS, 2008). A variety of means of artificially capturing and storing carbon as well as of enhancing natural sequestration processes, are being explored. The main natural process is photosynthesis by plants and single-celled organisms (Howard, 2003).

The world's oceans are the primary long-term sink for human-caused CO_2 emissions, currently accounting for a global net uptake of about 2 gigatons of carbon annually. This uptake is not a result of deliberate sequestration, but occurs naturally through chemical reactions between seawater and CO_2 in the atmosphere. While absorbing atmospheric CO_2 , these reactions cause the oceans to become more acidic. Laboratory and field measurements indicate that CO_2 -induced acidification may eventually cause the rate of dissolution of carbonate to exceed its rate of formation in these ecosystems. The impacts of ocean acidification and deliberate ocean fertilization on coastal and marine food webs and other resources are poorly understood (USGS, 2008, Earth Watch Institute, 2007).

iii. *Carbon Capture (CC) and Storage*

It is a plan to mitigate climate change by artificially capturing CO_2 from large point sources such as power plants and subsequently storing it away safely instead of releasing it into the atmosphere (Howard, 2003).

It is the interplay/interaction between water logging, high plant productivity, sequestration of carbon in the soil, and production of carbon dioxide and methane that makes wetlands one of the most important terrestrial surfaces in climate change; complicated by the fact that different wetland types have markedly different greenhouse gas and carbon balance profiles (Patterson, 1999). Climate change may itself of course also affect the wetland carbon sink, although the direction of the effect is uncertain due to the number of climate-related contributing factors and the range of possible responses (Ramsar, 2009). Sources estimate that wetlands account for about one-third of terrestrial carbon stores (Ramsar, 1997). There is however a dearth of consolidated information on the role and importance of different types of wetlands and in different parts of the world in carbon sequestration and storage.

It has been claimed that restoration of wetlands offers a return on investment up to 100 times that of alternative carbon mitigation investments (Ramsar Secretariat et al, 2007).

Peatlands are the most important long-term carbon store in the terrestrial biosphere. Although covering only 3% of the world's land area, peatlands contain as much carbon (400-700 Gt) as all terrestrial biomass, twice as much as all global forest biomass, and about the same amount as is in the atmosphere (Parish et al, 2008). Intact peatlands can store up to 1,300 tons of carbon per hectare, compared to 500-700 tons in old-growth forests. They account for the majority of all carbon stored in wetland biomes worldwide. This would, if all converted to carbon dioxide, increase the atmospheric concentration of CO_2 (Pena, 2008).

Although peatlands are known to be an overall sink for carbon, and in many regions are still actively sequestering it (Ramsar, 2009), initial studies produced a confusing picture of this, with some sites appearing as carbon sinks and others as sources.

Peatland degradation is now a major and growing cause of loss of global carbon storage capacity. Any action that would avoid degradation of these wetlands would therefore be a beneficial mitigation option. Mitigation is the most that can probably happen in the short-term as the current plant species are largely incapable of increasing production in response to higher temperatures and atmospheric CO_2 concentrations (Erwin, 2009). Wetlands International (2008b) report similar results indicating that relatively minor investments have significant emission reduction impacts. Carbon sequestration benefits should result from restoration of areas of other wetland types too (e.g. mangroves, salt marshes, floodplain marshes).

CH_4 emissions from wetlands are controlled by water table position and soil (peat or sediment) temperature. A drop in water table position decreases CH_4 production and increases CH_4 oxidation, thereby decreasing emissions. Depending on water table position, emission of CH_4 from peat lands is between 0.5 and 50 g $\text{CH}_4\text{-C}/\text{m}^2/\text{yr}$. (Hengeveld and Beaulieu, 1999).

iv. *Sea level rise*

Coastal wetlands will play a major part in strategies for dealing with problems created by sea level rise. Mangrove forests, coral reefs and tidal flats can attenuate wave-energy and contribute to coast defences in a more cost-effective way than hard defences, providing enhanced protection against increasingly frequent storm-events as well as rising sea levels (Wetlands International, 2008a).

In addition to physical damage, inundation (causing loss of productive or otherwise valuable areas), upstream and underground salinisation (causing loss of freshwater supplies) and other impacts can also be

lessened through maintenance or restoration of naturally-functioning coastal hydrology and wetland ecosystems. Moreover, land-use change and hydrological modifications anywhere in a water catchment or river basin may have downstream impacts which interact in the coastal zone with sea level rise risk factors. Integrated planning (as advocated in many technical and policy guidance materials adopted over the years under the Ramsar Convention in particular) is essential here (Bates et al, 2008).

b) Wetland Carbon Stocks

Wetlands cover 6 per cent of the world's land surface but contain 14 per cent of the terrestrial biosphere carbon pool. There is a significant amount of carbon stored in wetland soils, peats, litter, and vegetation (globally estimated 500-700GT). The amount stored in wetlands may approach the total amount of atmospheric carbon (estimated at 753GT) (IPCC, 2002). Of various wetland types, peatland has been recognized worldwide as highly important for carbon storage since it accounts for nearly 50% of the terrestrial carbon storage with only 3% cover of world's land area i.e. Peatlands contain the most carbon (Guo & Gifford, 2002; Multiby & Immiriz, 1993). However, coastal wetlands, prairie potholes, river and lake fringing wetlands and other wetland types may also contain significant amounts of carbon. In addition, coastal salt marshes and mangroves are considered the most important marine ecosystems for carbon sequestration. When peat lands are included, as is the case in the Ramsar wetland definition, wetlands represent the largest component of the terrestrial biosphere carbon pool (Dixon and Krankina, 1995).

The terrestrial biosphere is estimated to contain a carbon pool of 1943 Gt. Wetlands constitute a large global C reservoir at 230 Gt, exceeding agroeco systems (150 Gt) and temperate forests (159 Gt). Significant peat deposits are co-located with forests at high latitudes and are accounted for in the forests/tundra total of 559 Gt (Dixon and Krankina, 1995). According to Zoltai and Martikainen (1996), peatlands hold soil carbon stocks of 541 Gt, which accounts for 34.6 per cent of total terrestrial carbon. When peatlands are segregated, they account for one half times more carbon than tropical rainforests (Immirizi and Maltby, 1992). Per unit area, wetlands have the largest soil carbon stocks in the world (WBGU, 1998).

The share of tropical wetlands in global wetland area is estimated between 30 per cent and 50 per cent if rice-growing areas are included. Excluding rice farmland, the proportion of tropical wetlands ranges between 10 per cent and 30 per cent. Despite their small share in total wetland area, the carbon stocks of tropical wetlands are of a magnitude similar to those of wetlands of the Northern Hemisphere. This is because their

stocks per unit area are several times larger, both in the biomass and the soil compartment. The carbon stocks of tropical wetlands are seriously endangered, especially by land-use changes to rice cultivation (WBGU, 1998).

c) Mechanism of Carbon Storage in Wetlands

As in Ramsar (1997) Wetland ecosystems have unique characteristics as they are the sources of cultural, economic and biological diversity. These unique characteristics affect carbon dynamics and there are few mechanisms that aid in carbon storage in wetland ecosystem. In mechanism photosynthesis, wetland trees and other plants convert atmospheric carbon dioxide into biomass. Hence carbon may be temporarily stored in wetland trees and plants and the living material which feed upon them, and detritus including fallen plants and animals which feed upon them. Many wetland plants are known to use atmospheric carbon dioxide for their main C source, and their death/decay and ultimate settlement at a wetland bottom can have profound effect on C sequestration. Even this mechanism of storage through photosynthesis depends along the latitudinal gradient as growth of vegetation is slow for high latitude wetlands with less sun, nutrient and colder temperature (Shalu et al, 2009; Roulet, 2000).

Secondly, carbon rich sediment are trapped and stored that are brought along floods, hurricanes or even drained from watershed sources. However, long term storage is often limited due to rapid decomposition processes and rerelease of C to the atmosphere such as in case of paddy fields. Hence, wetlands are dynamic ecosystem where significant quantities of C from both wetland and non-wetland sources may also be trapped and stored in wetland sediments (Shalu et al, 2009; <http://www.unep.or.jp/ietc/>).

The balance between carbon input (organic matter production) and output (decomposition etc.) and the resulting storage of carbon in wetlands depend on several factors such as the topography and the geological position of wetland; the hydrological regime; the type of plant present; the temperature and moisture of the soil; pH and the morphology. Thus clearly carbon accumulation in wetlands is a complicated process influenced by many factors (Yarrow, 2009). There is a strong relation between climate and soil carbon pools where organic carbon content decreases with increasing temperatures, because decomposition rates doubles with every 10°C increase in temperature (Schlensinger 1997). Tropical wetlands store 80% more carbon than temperate wetlands (Bernal, 2008).

d) Wetlands Role in Climate Change Adaptation and Mitigation

Wetlands play an important role in the regulation of global climate basically in two ways:

through mitigation and adaptation. Their role in climate change mitigation is in two critical ways; management of GHGs and physically buffering climate change impacts. They act as significant carbon sinks and their restoration and creation will serve as carbon store/sinks and increase sequestration of CO₂ (MUNDITAS, 2008).

Mitigation, through reducing GHG emissions, largely concerns the protection and promotion of carbon sinks, through land-use and habitat management and also involves the encouragement of the use of non-carbon or carbon-neutral energy sources, and the improvement of energy efficiency (Berry et al., 2009).

IPCC (2002) defined mitigation as an anthropogenic intervention to reduce net greenhouse gas emissions that would lessen the pressure on natural and human systems from climate change. Mitigation options include the reduction of greenhouse gas emissions through the reduction of fossil-fuel use, reductions of land-based emissions via conservation of existing large pools in ecosystems, and/or the increase in the rate of carbon uptake by ecosystems.

Wetland ecosystems (including peatlands) also represent important natural carbon stores, and their restoration must be an essential component in climate change mitigation strategies. A recent report documents that carbon emissions from disturbed peatlands are equivalent to almost 8% of global emissions from fossil fuel burning. This is the most concentrated source of land-use related carbon emissions, produced on only 0.2% of the earth's land area. Based on these findings, the IPCC has subsequently concluded that the "restoration of drained and degraded peatlands is one of the key low-cost greenhouse gases mitigation strategies." Due to the rapid rate of vegetative growth and improved hydrology, wetland restoration is perhaps the most efficient (low-cost) method for sequestering carbon and reducing emissions in the short term (Bernal, 2008).

In terms of adaptation, wetlands and other well-functioning coastal ecosystems (i.e. dunes, mangroves and coral reefs) provide a critical bioshield against rising sea levels, the increased frequency and intensity of storms as well as fluctuating sea surface temperatures that result from climate change (SER,2007; IPCC, 2007). The world's biodiversity is adapting to climate change at large. However, there are limits to adaptation in natural ecosystems, small changes in climate may be disruptive and, beyond certain thresholds, natural systems may be unable to adapt at all (Dawson et al., 2008). Adaptation principles include promoting activities to reduce direct and indirect impacts, increase resilience and accommodate change. Measures that support these principles include: direct management; promoting dispersal of species; increasing available habitat, promoting ecosystem functioning; optimizing

sectoral responses, and continuing to reduce pressures not linked to climate change.

SCBD (2009) defined ecosystem-based adaptation as the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change. Ecosystem-based adaptation uses the range of opportunities for the sustainable management, conservation, and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change.

IV. ETHIOPIAN WETLANDS AND CLIMATE CHANGE

Ethiopia, with its different geological formations and climatic conditions, is endowed with considerable water resources and wetland ecosystems, including twelve river basins, eight major lakes, many swamps, floodplains and man-made reservoirs. With the exception of coastal and marine-related wetlands and extensive swamp-forest complexes, all forms of wetlands are represented in Ethiopia. These include alpine formations, riverine, lacustrine, palustrine and floodplain wetlands (EFAP, 1989). Hillman and Abebe (1993) estimate that wetlands cover 1.14% of the total landmass of the country, while forests cover approximately 2%.

According to NMA (2007) and Nigist (2009), developing countries in general and least developed countries like Ethiopia in particular are more vulnerable to the adverse impacts of climate variability and change. This is due to their low adaptive capacity and high sensitivity of their socio-economic systems to climate variability and change. Current climate variability is already imposing a significant challenge to Ethiopia by affecting food security, water and energy supply, poverty reduction and sustainable development efforts, as well as by causing natural resource degradation and natural disasters.

The concept of vulnerability is a very complex one. Causes for vulnerability of Ethiopia to climate variability and change include very high dependence on rain fed agriculture which is very sensitive to climate variability and change, under-development of water resources, low health service coverage, high population growth rate, low economic development level, low adaptive capacity, inadequate road infrastructure in drought prone areas, weak institutions, lack of awareness, etc (NMA, 2007).

Climate related hazards in Ethiopia include drought, floods, heavy rains, strong winds, frost, heat waves (high temperatures), lightning; etc. Ethiopia has twelve major river basins, including the Blue Nile. Its

riparian systems, combined with its eleven major lakes, make Ethiopia the “water tower” of Northeast Africa. Climate change is projected to cause a drying of wetlands (affecting threatened bird species breeding sites). Although, Ethiopia has relatively abundant water, it has one of the lowest reservoir storage capacities in the world: 50 cubic meters per person compared with 4,700 in Australia (World Bank, 2008).

V. SUMMARY AND CONCLUSION

Wetlands are among the world's most important assets, providing the basis for human survival and development, and contribute to global biodiversity. Among their significant functions, they reduce the greenhouse effect (through their capacity for sequestering and retaining carbon); stabilize microclimates; provide tourism/recreation and water transport opportunities; retain and purify agrochemicals, toxicants and sediments; minimize natural disasters such as drought and floods; recharge ground water; and contribute to the hydrological characteristics of aquatic ecosystems. They also generate various products such as water supply, fisheries, wildlife, forest and agricultural resources. This all explicitly show the significance of protecting the wetlands ecosystems for climate change adaptation, biodiversity conservation and combating desertification and mitigate the effects of drought.

Wetland ecosystems, their biodiversity and the services on which humans depend, are threatened by the likely impacts of climate change in spite of their importance for climate change mitigation and adaptation.

Wetlands may affect the atmospheric carbon cycle in four ways. Firstly, many wetlands especially boreal and tropical peatlands have highly variable carbon and these wetlands may release carbon if water level is lowered or management practices results in oxidation of soils. Secondly, the entrance of CO₂ into a wetland system is via photosynthesis by wetland plants giving it the ability to alter its concentration in the atmosphere by sequestering this carbon in the soil. Thirdly, wetlands are prone to trap carbon rich sediments from watershed sources and may also release dissolved carbon into adjacent ecosystem. This in turn affects both sequestration and emission rates of carbon. Lastly, wetlands are also known to contribute in the release of methane to the atmosphere even in the absence of climate change (Shalu et al, 2009).

Degradation of wetlands and disturbance of their anaerobic environment lead to a higher rate of decomposition of the large amount of carbon stored in them and thus release GHGs to the atmosphere. Therefore, protecting wetlands is a practical way of retaining the existing carbon reserves and thus avoiding emission of carbon dioxide and other GHGs. Wetland

biodiversity, ecosystems and species are indeed under threat from the impacts of climate change, but proper management of wetlands can reduce these impacts. It is urgent that the international community recognizes the crucial importance of wetlands to mitigate climate change (through reducing Greenhouse Gases). Equally, adaptation measures for wetlands (which deal with the impacts of climate change) are critically important to human welfare. From words to actions: policies, planning and implementation related to climate change, at all levels from global to local, should recognize and incorporate the role and importance of wetland ecosystems.

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Hydroelectric Power Auto with Torque Peripheral to the Wheels

By Luigi antonio Pezone

Abstract- The current state of the art of means of transport was affected by heat engines, which predominated, for the absence of viable renewable energy with small dimensions. But the invention of the pump with double separate supply until the impeller has allowed the pressurized hydropower invention, with recycling water, which can replace thermal engines. Certainly it is more cumbersome, but immensely cheaper and nonpolluting. From the point of view of the electro-mechanical means of transport that will use the pressurized hydropower, are simplified, eliminating in addition to heat engines the fuel tank, the mufflers and exhaust pipes, the engine cooling system, the transmission shafts, the exchange gears, clutch, differential. The hydroelectricelectronic system, which will be used, does not need of fuels and even of heavy and expensive batteries lithium accumulators with little shipping autonomy, which involve considerable disposal costs and the use of materials in the process of exhaustion. The hydroelectric means of transport will cost less of the existing means of transport for the absence of many of the components mentioned above but also because the motion transmission by electric-electronic means is much more economical than the mechanical, without sacrificing the safety on the road. In fact, the four-wheel drive of the wheels may be of series and all the wheels powered and controlled individually. Also the control of the differential speed in the curves and the braking system (ABS) may be incorporated in the motors that turn the wheels by transmitting the driving torque to the periphery and not in the center of the wheels as in the existing vehicles.

GJHSS-B Classification: FOR Code: 040699



Strictly as per the compliance and regulations of:



Hydroelectric Power Auto with Torque Peripheral to the Wheels

Luigi antonio Pezone

Abstract- The current state of the art of means of transport was affected by heat engines, which predominated, for the absence of viable renewable energy with small dimensions. But the invention of the pump with double separate supply until the impeller has allowed the pressurized hydropower invention, with recycling water, which can replace thermal engines. Certainly it is more cumbersome, but immensely cheaper and nonpolluting. From the point of view of the electro-mechanical means of transport that will use the pressurized hydropower, are simplified, eliminating in addition to heat engines the fuel tank, the mufflers and exhaust pipes, the engine cooling system, the transmission shafts, the exchange gears, clutch, differential. The hydroelectric-electronic system, which will be used, does not need of fuels and even of heavy and expensive batteries lithium accumulators with little shipping autonomy, which involve considerable disposal costs and the use of materials in the process of exhaustion. The hydroelectric means of transport will cost less of the existing means of transport for the absence of many of the components mentioned above but also because the motion transmission by electric-electronic means is much more economical than the mechanical, without sacrificing the safety on the road. In fact, the four-wheel drive of the wheels may be of series and all the wheels powered and controlled individually. Also the control of the differential speed in the curves and the braking system (ABS) may be incorporated in the motors that turn the wheels by transmitting the driving torque to the periphery and not in the center of the wheels as in the existing vehicles. This allows to reduce the power required according to the transmission ratio between the ring gear mounted to the periphery of the wheel rim and the pinion keyed to the shaft of the electric motor that turns the wheel, but also according to the force-transmitting arm, which coincides with the radius of the rim on which the tire wheel is mounted. In the hydroelectric vehicle the reduction in power is not imported for the purpose of energy consumption, since the energy is produced without the outlay of money for the fuels, but to reduce the size of the electro-mechanical equipment, and especially to reduce the volume of the tanks which will be incorporated in the means of transport. By the pumps with the dual separate supply up to the impeller, we can work around the autoclave pressure, without having to restore, by inserting in the 'water recycling circuit water which has produced the energy, consuming a small part of the energy produced by the group turbine - alternator. The drive control of the pump motors and the drive wheels allows managing instant by instant the energy that must be produced based on consumption required by the vehicle.

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I. DESCRIPTION

The world waits anxiously renewable energy, clean and with high yields by the science that soon followed. All have focused on the study of alternative energies such as nuclear, hydrogen transformation into fuel, as solar or wind power, hydroelectric power with the hydraulic jump. But these energies are not applicable on public transport, which produce large urban air pollution, which is the most harmful to the life of men. At present, the problem of global warming has led to an incredible race between automakers to create fully electric cars or hybrid engines, which with high costs partially approach problems, both environmental and technical. But the means of transport that use batteries merely replace the main engine leaving all the mechanics of the same transmission. So we can not say that are sustainable means to the high cost of the batteries and the cars, but also for environmental charges involving the disposal of used batteries. But the batteries are not even practical, allowing autonomy of a hundred kilometers and long stops for charging. Moreover, the large thermal power plants also serve equally to charge the batteries of the car, although they continue to not be compatible with the environment, not only for air pollution, but also for the heat, which heats the water serving for cooling turbines and condensers. They are not compatible with the environment even large tankers that ply the seas and the big pipelines. Even the biological energy is thermal energy, but the only problem is to solve the reduction of CO₂, while the other polluting components continue to exist, continue to exist as the electricity distribution networks involving other energy losses structural and considerable costs, more security problems for the high voltages necessary to transport. In addition, the undergrounding of electricity transmission lines complicates the construction of modern cities with metro lines and auto purifying water and air. All these technical incongruities, energy, environmental, Machiavellian reasoning, may have a justified only if there was an economic advantage to produce thermal energy, nuclear, biological, solar, wind, but this advantage exists only because hydropower with the recycling of 'water has never been produced, in the fixed and mobile version. It seems that nobody wants to produce it, since no one has invested a euro in this direction. But hydropower with water recycling, even without money

and trials it has also grown in the fixed and mobile version, virtually, because, until now, the laws of physics and hydraulics were not used at all possible aspects. Above all, has not been taken into account the position of the surface energy of water within the same basin, the energy of the artificial position produced from the compressed air in a tank, the internal circulation in a volume of water with a 'high static pressure, which is not influenced by this pressure, being the incompressible water. It been sufficient to study new hydraulic circuits taking into account these elements to change completely, for the better, the whole industrial plant, civil, environmental, even though the world has not noticed anything, because those who did wrong plant design of the present and past pretend not to understand, including the science World and the large multinationals. To successfully exploit the air and water feature you need to edit simultaneously with equipment and pumps and if you also want to produce energy, include also hydraulic turbine system, which for over one hundred fifty years working independently, exploiting natural kinetic energies. And even before rudimentary turbine with wooden blades, for thousands of years they have allowed grinding grain in the mills. But these solutions have not required a great inventiveness. Hydroelectric car simply shows that the field of hydraulic applications has serious responsibilities against global warming, because he had the solution at hand and has not sought, while the thermodynamic industry has made every effort, but environmental miracles not they can do if they are wrong the basic principles to be exploited to produce sustainable energy and environmentally compatible. Hybrid cars and battery are palliatives. First we will need admit mistakes by all the experts, including environmental and energy policy makers and then will

be able to start a new industrial policy, environment, energy and transport.

II. BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 shows the arrangement of maximum of the hydroelectric plant in the car engine hood, where they are visible in particular the technical devices which have allowed to reduce to a minimum the overall dimensions. In particular way is important for the use of a well pump used as a turbine, feeding it to the opposite direction with respect to the way in which it is used the pump (All pumps powered the contrary can be used as turbines), but, in this case, a submersible pump saves much space being inserted directly into the tank where it must discharge the water to be recycled. Another precaution is the arrangement angle of the alternating current generator, arranged above, after the pump shaft having prolonged until coming out through the supply curve by means of a bushing containing a ring of mechanical seal or stuffing box. Even for the entry of water into the pressurized tank is used a pump with a double separate supply obtained from a single-stage pump for the well, which allows it to be installed in the water, coupled at an angle, by means of a diverter conical gears 90 degrees, to an alternating current motor, inferiorly placed, prior extension shaft that runs through the supply double curve by means of a bushing with a mechanical seal or stuffing box. Probably, these solutions will be universalized in all means of transportation that will use the hydro engine, although they will have more space available: trucks, buses, trains, ships and airplanes. Nobody sorry travel without consuming money for fuels and lubricating oils, regardless of pollution.

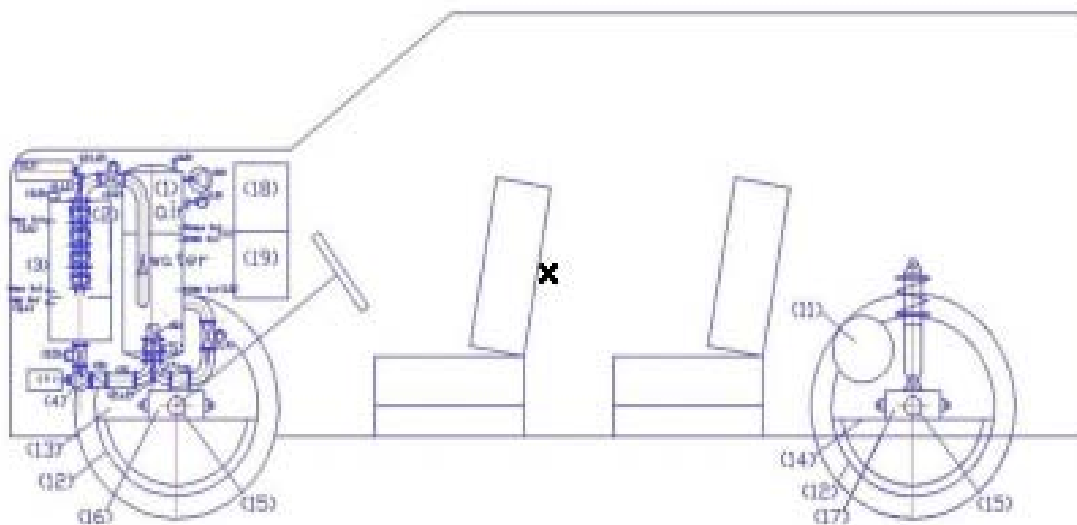


Fig. 1

FIG. 2 shows a section of the pump with double separate supply until the impeller which allows energy miracle connecting two different hydraulic systems: One is generous in energy production that uses the energy of the compressed air on water and one thrifty in the phase

of recovery of the same water (lp = low pressure), which is inserted directly into the impeller in rotation, of the pressurized water recycling circuit (hp = high pressure) without the opposition affected by the hydrostatic pressure.

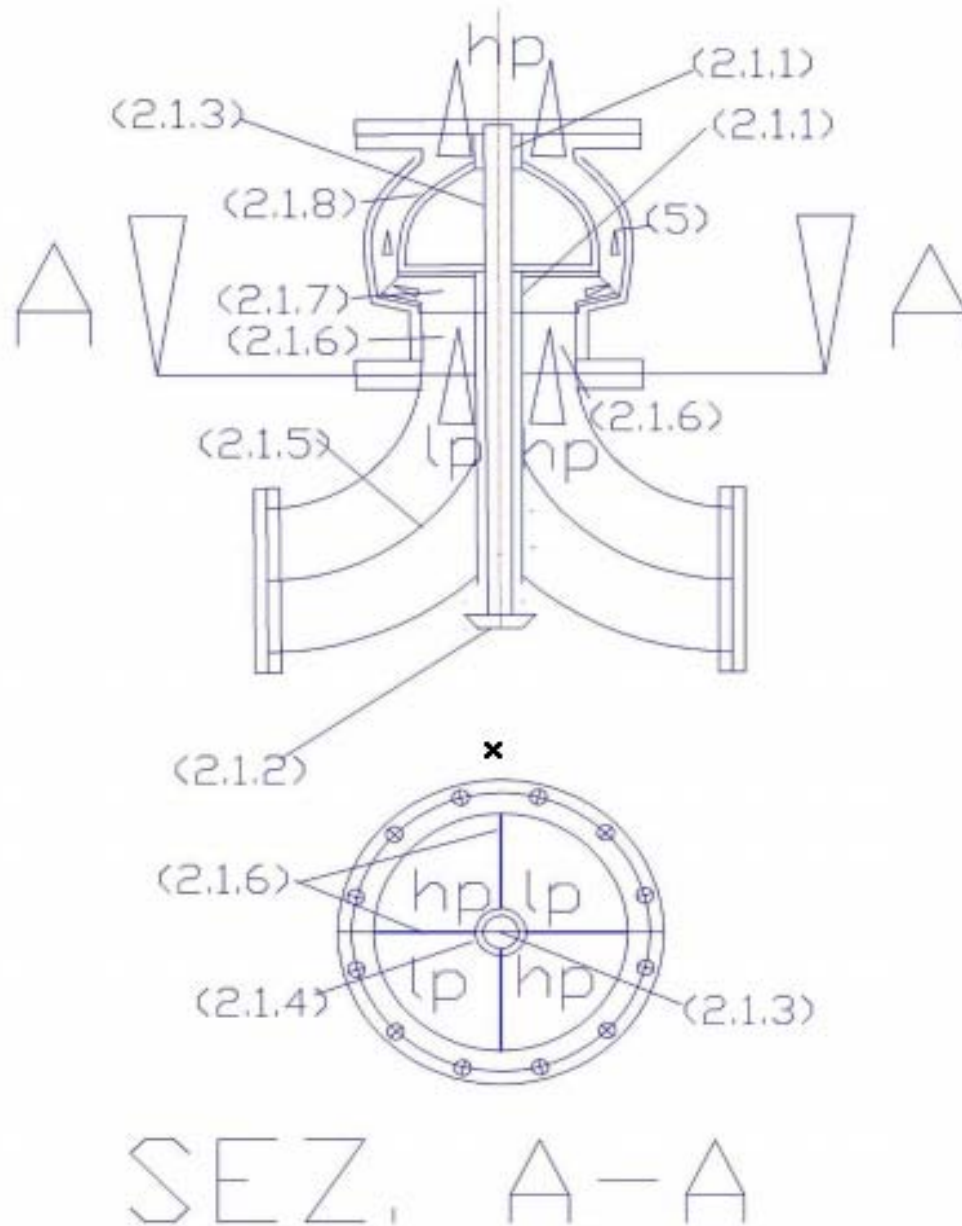


Fig. 2

FIG. 3 schematically shows the mounting section of the shaft (15) which no longer receive motion from the heat engine through the gearbox and differential, but it will be a simple fixed shaft, as the drive takes place through the modified rim, the motor 11, supported by the supports (13 - 14), connected to the axles (16 - 17). It is not necessary to get into other details in which the automakers have very advanced experiences to find the right solutions.

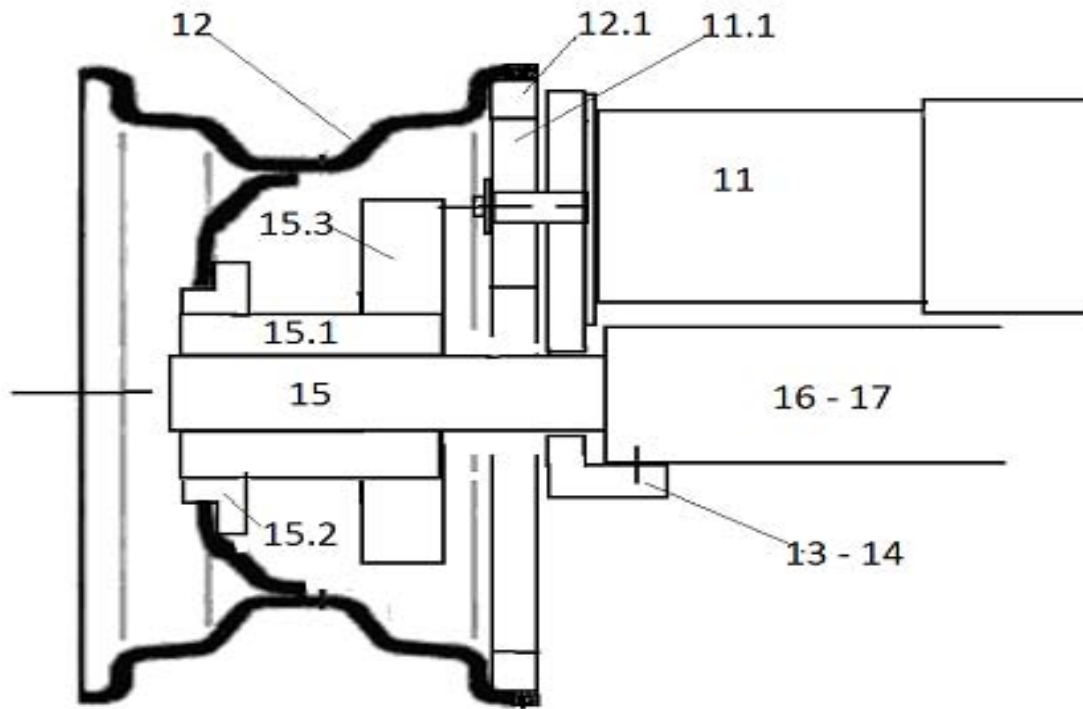


Fig. 3

Legend of FIG. 1, 2, 3 : (1) autoclave pressurized tank; (1.1) level regulator with capacitive probes; (1.2) safety valve; (1.3) manometer with shut-off valve; (1.4) motorized valve flow control with position transmitter; (1.5) pressure or flow transmitter; (1.6) minimum level probe in the start system; (2) pump used as a turbine (pat); (2.1) alternating current generator; (2.1.1) bushing with sealing ring; (2.1.2) angle diverter with conical gears; (2.1.3) transmission shaft; (2.1.4) transmission shaft protection tube (2.1.5) double curve with septa crossed separators in low pressure (LP) and high pressure (hp); (2.1.6) septa separators of flow; (2.1.7) closed type; (2.1.8) Diffuser of the pump; (2.2) motorized valve to supply turbine with flow adjustment; (3) water transit tank at atmospheric pressure and containment pat; (3.1) motorized valve to feed pressurized water network; (3.2) motorized valve bypass supply at low pressure; (3.3) air valves; (3.4) Water level control with capacitance probes; (3.5) motorized valve for water supply at low pressure; (3.6) maximum level probe in the start system; (4) electric pump to supply in low pressure (5) electric pump with double separate supply until the impeller; (6) pump drive motor, with variable speed, controlled by an inverter; (7) double curve with septa crossed separators in low pressure (LP) and high pressure (hp); (7.1) septa to flow separators; (8) check valve. (9) flow diverter stub pipe; (10) electrocompressor; (11) self braking engine with variable revs (11.1) sprocket gears; (12) wheel rim; 12.1

ring gear; (13) motorization support of front wheel; (14) motorization support of rear wheel; (15) stationary shaft; (15.1) bearing; (15.2) wheel rim mounting flange; 15.3 brake disc; (16) front Axle; (17) rear axle; (18) electric command and control panel; (19) heat pump for summer and winter air conditioning.

In the world of environment and energy it is also needed strategic inventions that cut across all sectors as the recent invention of the pumps with double separate supply until the impeller. To understand the functioning of how this type of pump, it can be observed FIG. 2, and imagine the center of the impeller supplied by four sectors separated by 90 degrees cruise. Two are supplied in low pressure and two high pressure, possibly arranged diagonally to balance the hydraulic thrust on the bearings. Furthermore, observing the FIG.1, it is necessary to make a distinction between the static and dynamic pressure of system. The static pressure is the pressure supplied by the compressed air cushion and with the valve (1.4) open, spreads on the right side of the pump with double separate supply also entering into the impeller. The dynamic pressure, or kinetic energy, is that which circulates the water inside the tubes and autoclave. In open circuit on the left side of the autoclave. To circulate the water is sufficient to open the valve (2.2) and the air pressure circulates the water in the turbine, but the air pressure decreases as it expands the volume of air and the water comes out from the circuit. While to circulate the water on the right side

of the pump with the double separate supply up to the impeller, it is necessary to open the valve (1.4) and to move the pump since the static pressure already fills the entire circuit, also coming into the impeller, but without the movement of the pump the water is not circulating for obvious reasons. However, it is sufficient to provide the pump the prevalence of a few cm of water column to overcome the pressure loss of the check valve, since the static pressure does not oppose the kinetic energy developed internally to the stored volume of water. So, we can have a static pressure of 12 bar and a dynamic pressure of 0.25 bar. But the movement on the right side (looking at FIG. 1) does not produce energy, being only an internal recycling in the stored water volume. To produce energy we must use the circuit on the left side of the autoclave passing through the pump used as a turbine (2) and insert with a low energy cost the water free of static pressure in the autoclave tank, that the current state of the art requires a pump with a prevalence that wins the static pressure and the pressure drop, then a higher prevalence to 12.5 bar. This is the reason why hydropower with water recycling has never been produced. With the pump with double separate supply until to the impeller we can achieve this application with a very low energy cost that seems impossible, because coming from the suction side of the pump that is already full of water statically pressurized from the autoclave, we get around the opposition of pressure hydrostatic, as if it were an internal circulation to the pressurized volume of water. In fact, the suction pipe of the pump, which comes from the left side (open) and from the right side (closed) is divided into four fixed and separate sectors (as seen from FIG.2), therefore, when the impeller rotates, advances towards the autoclave the water present in the impeller and produces in each quarter of the sector of the supply pipe a depression which favors the entry of water into the impeller both from right side, both from the left side. As soon as the inlet water is involved by centrifugal acceleration towards the periphery, produced by the fins of the impeller which is proportional to the square of the angular velocity, and in the radius of rotation, according to coefficients that depend on the type of impeller. But the important characteristic of the pump with the dual separate power supply is one that the rotation forces the impeller to receive in succession in the same quarter of the impeller, the water sucked from the four separate sectors. Not simultaneously, as is the case with pumps that have only one power supply. Therefore, the water of open circuit (no static pressure) and the water of the closed circuit (with the static pressure of the autoclave), alternates in the same location and with the same direction (toward the impeller exit). This functioning implies that the flow rates are added together, while the total pressure (static plus dynamic) spreads in the entire outlet section, according to the principle of Pascal. Obviously, since the static

pressure is only transmitted from the right side of the system, for not having drops in pressure in the pump with the dual separate supply, the passage sections must be dimensioned, for the transmission of the entire flow rate and pressure. This simple modification of the pump allows us to retrieve with costs infinitesimal the water that has produced energy in the pump used as a hydraulic turbine which is located on the left side of the system and reinsert it in the pressurized water recycling of the tank circuit, without that occurs the pressure drop due to the expansion of the air cushion, which occurs in normal autoclaves, whose restoring, would require energy both from the pumps that the compressors. In fact, the autoclave system was not born to produce energy, but to limit the number of starts of the pump motors, by providing for a few minutes to the hydraulic system, which consumes water, the volume of water stored by means of the expansion of the cushion of air. It is obvious, that the same system can be used to produce energy if the water exits the autoclave circuit (to produce energy) and go back simultaneously by another input, without changing the internal volume. Obviously, the return of water in pressurized autoclave must not be with the force of a multistage pump, which consumes more energy than it produced, giving reason to skeptics who ironically call "perpetual motion" hydropower with water recycling. Skeptics have been right only because it lacked the pump invention with double separate supply until to the impeller. In fact, if the separation of the flow does not reach inside the impeller and if this is not rotating, the system does not work, relying on the dynamic pressure to bypass the static pressure. In the hydropower system of the car the valve (2.2), which feeds the pump used as a turbine, must be strictly closed when the car is not in operation, otherwise they are not the conditions for starting the system. In the car hydroelectric plant of FIG.1, we expand the air cushion only in the starting phase of the hydraulic motor, to reduce battery costs for starting and possible three-phase UPS group. During normal operation, the water coming out from the autoclave must be perfectly in a quantity equal to that which enters into the left mouth of the pump with the double feeding, without stopping in the tank (3) and without accelerating the flow, while the mouth the right is used only to pressurized water recycling from the air cushion (the recycling pump works with a very low prevalence merely to recycle the water in the same volume without lift or win the compressed air cushion pressure). Today these adjustments are possible by establishing a priori limit the oscillation of the water level in the two side by side tanks, either by means of adjustments of the valves, both of the speed of the pump motors, while the decrease of the air pressure is regulated by a pressure switch that drives the compressor at the minimum variation. Thus, at rated operating conditions, not happening the variation of volume of water in the

pressurized tank, do not happen the expansion of the air cushion, therefore, no power is consumed to compress the air cushion. However, the water that comes out from the autoclave also receives the pressure required to produce energy in the turbine. Obviously, the energy absorption cannot be eliminated completely, but it consumes only a very small percentage of the current energies that absorb the hydraulic systems that need to raise the water or compress the air cushions. Since the drive motors of the variable speed pumps, this system can produce the energy that serves to a means of carrying a full load, no load, in the various phases of operation, simply by pressing the acceleration pedal of the vehicle. In fact, the control unit (18) distributes the flow of energy to the electric circuit of the means of transport, which, in the case of a car, is mainly composed, by two or four AC motors (11) three-phase or single phase, by the heat pump for the summer and winter conditioning and auxiliary circuits in low-voltage direct current, which feeds, in particular the valve that intercepts the turbine (2.2), the starter battery, little larger than the current batteries.

Fig. 3 shows in a very schematic way as is the transmission of motion to the drive wheels in hydroelectric power car, where the torque is applied to the periphery of each rim, by means of a transmission cylindrical teeth between a ring (12.1) and a spool (11.1). The fixed part of the transmission will be the new support of support of the front wheel motor drive (13) and rear (14 in the case of four-wheel drive). This support is in the form of half disk, also acts as a protective casing of the gear transmission and ensures the same oscillation of the current wheels, adjusting the convergence, the connection with the steering system and suspension, the flange on which port is mounted the electric motor (11) which carries the sprocket (11.1), and is crossed from the shaft (15) with the rotation of the bearing which carries the brake disk, the flange on which is mounted the rim (12) which is supported cantilevered from front axle (16), equipped with an articulated frame to allow for minimum turning radii, or rigid rear from the axle.

This change of the motion transmission system allows to eliminate the gearbox with relative differential, since the reduction of revolutions of the wheel relative to the engine will take place by means of the transmission ratio between the ring gear, integral with the wheel rim, and the braking three-phase asynchronous motor car that makes the spool. But it is also advisable increase the diameter of the wheels, as it would reduce even further the footprint and cost of the hydroelectric system. By way of example, with the pitch diameter of about 600 mm and that of the crown of 200 mm spool we have a reduction ratio of revolutions of the engine equal to 3. But what's even more important is the fact that by applying the driving force on the pitch diameter of the wheel rim and not on the axis of the wheel (as is

currently), multiply the torque to the transmission arm, therefore, we reduce to 1/3 the force required for the motion transmission, and whereas the rubberized part of full load wheel is 10 cm high where applies the resisting torque, also improve the acceleration of the means of transport with a low number of revolutions and torque.

If we start from a two-pole electric motor that performs 2840 revolutions per minute, the maximum speed of the wheel device will be 946.6 rpm, with the outer diameter of tyred wheels 0.8 m (2.512 m) circumference, we have a velocity hourly maximum of 2,378 m / min, equivalent to 142.6 km / h. With the present system, which has the transmission gears connected to the central motor of the transmitted power value is always the same for any gear, both on the engine to the drive wheels; this is due to the fact that the power is given by the pair by the number of revolutions and the torque resistant and are applied on the same axis of rotation, for which the torque increases when the number of revolutions decreases and conversely. With the electric transmission, adjusted with inverter, the transmitted power is not the same but gradual, also, the application of the driving force of a rotating arm which approaches the resistant arm, which is applied on the tire tread, globally reduces the total absorption, both at minimum both at maximum rpm.

Making an approximate calculation of the forces opposing the movement of wheel loaders, for a vehicle fully loaded weighs 2000 kg can take the following values:

Rolling resistance on asphalt (20 kg / 1000 kg) = 40 kg;

Aerodynamic resistance (Eiffel formula) $K * S * V^2$, where $k = 0.0054$ for $v = 142 \text{ km / h}$ $S = 2 \text{ m}^2 = 218 \text{ kg}$

inertia resistance for the supposed acceleration of 1 m / s^2 ($1000 * 1/2 * t * g \text{ ka}$), where $ka = 1.2 = 244 \text{ kg}$

Considering the total resistance to the motion of calculated kg 502 (40 + 218 + 244), calculate the total power necessary to the translation $P = F * v \text{ (m / s) / 1000}$ in kw = $39,44 * 502/1000 = 19,8 \text{ KW}$.

This calculation is consistent with the powers of electric cars with lithium batteries that car manufacturers are putting on the market. There is a noticeable difference with the corresponding internal combustion engine of the same model of car, the power of which is about four or five times the battery power. This difference, in part is due to the fact that for reasons of cost will limit the performance of the electric car, but is mainly due to the low efficiency of heat engines, which stands at approximately 35% of the lower calorific value of the fuel.

Therefore, it can be said that thermal engines are practical to make but are polluting and with low yields. While electric cars, having little service autonomy,

are impractical and expensive. Instead, we are at year zero for hydroelectric car that could have the best returns from an environmental and energy point of view, because, as above written, do not require fuels and installed electrical power can be significantly reduced by applying torque to the the periphery of the wheel rims and increasing the diameter, decreasing the energy equipment cost and size of the hydroelectric plant.

Suppose to realize a small plant with pressurized autoclave which produces energy for the car by the weight of 2000 kg, above hypothesized by means of an alternating current generator (2.1) coupled to a pump used as a turbine (pat), that is able to produce the energy calculated above. Which, as written above, applied to the periphery of the wheel rims with a gear transmission and electric motors, it is reduced to 1/3 of the calculated one ($19.8 / 3 = 6.6$ Kw).

Assuming to make a four-wheel drive vehicle, we will apply to each wheel brake three-phase asynchronous motor car two-pole, 2.2 kW with a functioning DC brake. The brake is supplied by a rectifier located inside the terminal box. The rectifier is provided with protective devices against surges. The cooling fan is placed in the rear of the engine. The salient features of the self-braking motors with dc brake, are extremely quiet during braking, the progressivity when starting and stopping the engine. This allows to control the wheels on each occasion by means of the motors and to prevent overheating of the brake discs, which intervene only in emergency cases. The self-braking motors are particularly suitable to be supplied by an inverter, in our case are provided with a double shaft projection and with the speed detection device, of the angular position (encoder), to integrate the functions necessary to the system ABS braking and the differential speed in the curves, which today are made, certainly with higher costs, separately, on rotating wheels and brake. In fact, the small drive motors from 2.2 kw braked with a braking torque of about 20 Nm certainly are not able to restrain the moving mass of a means of transport by T 2, therefore, the present braking system must be preserved, but the small slowdowns and small braking can be managed by these engines, which allow gradual accelerations and decelerations. Also being connected directly to the rotation of each wheel of the vehicle, the ABS control electronics can be transferred in the same, as well as the control of the speed of the wheels in the curves. In fact, having electronic control sensors scattered mechanical parts is not very functional. And 'certainly better to place them in electric motors, which can be easily replaced and overhauled.

The protection of coils can be pushed up to the immersion (IP67) resistance depending on the use intended for the vehicle. L 'hydroelectric plant which will be combined with this means of transport will produce about 10 Kw / h for more safety margins in performance. Then, an installed power less than half of an electric car,

lower costs, and a range of endless path. In addition, the car becomes an incredible tool for work and leisure also becoming mobile generator.

To realize the hydroelectric plant, the choices can be many, but let's take advantage of a pressurized air cushion of 120 m of water column and an electric pump used as a turbine with a capacity of 12.5 L / s. Assuming the yield is 0.70, applying the formula $P_u = \eta * Q * H_u / 102$, we have an energy output of 10.29 kW ($0.70 * 12.5 * 120/102$).

Assigning to the pump with double separate supply a prevalence of 1.0 m and a 0.6 yield, the power absorbed by the same, which leads a double flow of that which passes into the turbine, calculated by the formula $1 * 25/102 * 0,6 = 0.40$ kW. While the additional circulation pump (3.6), with a flow rate equal to half, suppository with the same yield and prevalence absorbs half of the energy calculated for the double feed pump (0,20 Kw). In this case the relationship between energy expenditure and yield is 17.15 ($10.29 / 0.60$).

In fact, the load losses in the valves, in the turbine, the special pieces and losses at the outlet, are all absorbed by the dynamic pressures that develop in the pipes that feed the pump under a positive hydrostatic pressure, from both sides, while in discharge not we appreciable losses of load, not exceeding the water level (which is incompressible). No wonder with this result, whereas compressed gases are accumulators of more powerful energy, flexible and cost of electrical energy storage. One can easily understand that with the help of the compressed air cushion and the small power requested by the valves motors and pumps is very simple to start the system with no starter motor. But the departure will be a little slower, having to carry out more operations before starting an energy production system. But this occurs only at the first start, then there is no need to stop the hydropower engine every small station, no consuming fuel and no producing pollution. If we leave the car in motion only increase the hours of the pumps, motors, turbines and alternators and mechanical wear. As written above, in the hydroelectric engine start-up will take place by means of the expansion of the air cushion, but if the volume of water that can accumulate is not sufficient to completely overcome the departure to alternator scheme, the system is integrated with a group of three-phase UPS (UPS) with battery, rectifier, alternator, loaded by the energy produced during exercise. In fact, during the starting phase, the system control circuit, is an exception to the rule and allows the expansion of the air cushion, until to a minimum level (1.6) by using the accumulated water between the two levels to start the rotation the turbine gradually, as the valve (2.2) with a DC motor, opens. When the water reaches the minimum level (1.6), calculated so that the water does not completely fill the tank (3), controlled by the maximum

level (3.6), also open the valves (1.4 and 3.5) and make low the two pumps (4 and 5). When the plant is operational, gradually, the control system brings the water level in the pressurized tank to the nominal position (1.1), varying the pump speed and the position of the valves, to allow to easily carry out a new restart of vehicle.

In the phase of steady state operation, the air cushion, after recovery at the higher level, controlled by the regulator (1.1), does not expand, thus all the water returns into the autoclave through the two inlets of the pump with double separate supply. In fact, the double separate supply until to the impeller, allows to have very similar flow rates by means of the adjustment of the valves (1.4, 2.2, 3.5) and the revolutions of the pump (4), despite the difference in static pressure existing on supply. Therefore, we can estimate that 50% of the total flow of the pump with the dual separate supply (5) passes from the right side (that is a simple recycling) and 50% from the left side (through the pump used as a turbine), producing power. In fact, the turbine discharge the water in the tank (3), from which, the low-pressure pump (4), the check valve (8), the stub flow diverter (9), the double curve with separator baffles, feeding the left side of the pump with double separate power supply (5). The energy expenditure provided to the pump (4), estimated hereinafter, is not that which would be required if we had used the usual hydraulic and electric circuits and to return the water into the autoclave, but only the one to reach the ' water in the pump impeller with dual supply. Who will bring the water inside the autoclave is the circuit on the right side of the pump, where the static pressures on the suction and delivery, are in balance and thus the direction of the water flow depends only on the rotation of the impeller. Consequently, also the water that comes from the left side fits into this flow, not only because the impeller is common, but also because the partitions (2.1.6) arriving lap the profile of the impeller, act as anti-return valve. Furthermore, the rotation does get into every fourth of the cruise sector shown in FIG. 2 in water succession in high and low pressure ($h_p + l_p$) that having the same direction are added together, they do not contrast, also in accordance with Pascal's law which states that the pressure expands in all directions (when it is static). When there is a unidirectional flow, conditioned by the rotation of a pump, the walls of the pipes and check valves the dynamic pressure is forced to expand in the direction of flow.

Fig. 1 schematically illustrates a realistic arrangement of this system on a car to the current state by retrieving from the market the necessary elements for the handicraft construction of the hydroelectric motor and the relative transformation of the motion transmission to the driving wheels. The hydroelectric plant is supported by a fixed structure (not visible from the drawing) Autonomous, connected to the car body.

Indeed, in contrast to the heat engine, the hydraulic motor must not transmit mechanical stresses. The mechanical forces of the transmission are concentrated only near to the drive wheels and axle connected to the body by means of shock absorbers and antivibration supports.

Obviously, producing specifically for the transport sector pumps, turbines, valves in a short time, you will have less cumbersome solutions. The margins for improvement are very many, using higher quality materials, operating pressures, selected on a case by case basis, to the upper limit of about 37 bar at temperatures order liquefies the air. On the other hand, the large series production which involves the transport sector, has already done wonders struck a measure of quality of components, also investigated as a function of the very little space available in a motor hood.

The only problems that the industry has been unable to resolve were the CO2 zeroing, the removal of fine particles, and the expenses that the fuels involved. The hydroelectric engine these very serious unsolvable problems for heat engines solved them before birth. As written above, even if it seems impossible, this system produces energy without consuming water that recirculates between the two tanks. Instead, it consumes a small amount of compressed air, which solubilized in the water of the autoclave, is released into the atmosphere when the water is vented to atmospheric pressure in the tank (3), but this phenomenon is quantifiable in milligrams per liter of gas water (nitrogen, oxygen, CO2) according to Dalton's law of which is provided below the main formulas (extracted from the scientific literature) and personal considerations that explain the concepts, without considering the merits of the calculations:

In fact, in a mixture of ideal gases contained in a volume V and the temperature T, the molecules of each gas molecules behave independently from the other gases; as a consequence of this is that the pressure exerted by the gaseous mixture on the walls of the container and on the water surface is given by:

$$: p = \frac{RT}{V} \sum_i \eta_i$$

where, R is a constant equal to 0.0821;, ... represent the number of moles of each component of the mixture. This law is valid under the conditions by which it is valid the ideal gas law is approximated at moderate pressures, but becomes more and more accurate as the pressure is lowered. By defining the molar fraction as the ratio between the number of moles of the ith component and the number $\sum_i \eta_i$ Total of moles present:

$$x_i = \frac{\eta_i}{\sum_i \eta_i}$$

It is obtained that in a mixture of ideal gases, the partial pressure of each component is given by the total

pressure multiplied by the mole fraction of that component:

$$p_i = \eta_i \frac{p}{\sum_i \eta_i} = r_i p.$$

In essence, for each gas present in the air is possible to calculate what percentage is solubilized in water at the working pressure, but for practical purposes, the energy that will spend to compress the air will be a small expense, since the air compressed, not ever coming out from the volume of the tank (1) has only small pressure fluctuations, and once it reached the saturation point not dissolves more air. One that is consumed is due to the lower water solubilisation of the gas, at atmospheric pressure. In fact, when the water passes through the tank (3), provided with air vents, releases a small portion of air, which becomes insoluble to the atmospheric pressure, which comes through the vent (3.3). But, obviously, the transit times in this tank are very narrow and the complete air expulsion process can not occur, because, immediately falls into the water tank (1) where the gas can not escape from the surface of water, returning again to the maximum solubilization conditions.

Obviously, to maintain constant water levels of the two tanks is required a computerized management of the degree of opening of the motorized valves (1.4 - 2.2 - 3.5), of which, at least the one that feeds the turbine must be powered at 24 volts DC, having also be operated in the initial system start phase, when the plant does not produce any energy.

The heart of the hydroelectric vehicle is the pump with the double separate supply until to the impeller (5) shown in FIG. 2, without which it would not be possible to circumvent the pressure of the autoclave (1). But it is also important to the way in which it feeds the pump that has to start from a certain distance from the pump, so that in the inlet section of the pump have four separate streams of which two high pressure (hp) and two low-pressure (lp), possibly arranged diagonally. In order that this separation of the flows can take place it is necessary to start from the flow diverting (9) logs since the double curve with separator baffles (7), must already receive the channeled flow in the correct position, so that it can cross them, feeding the four internal areas to the impeller in the correct way. Then, the half-curves of the particular (7) using only half of the passage section, already arranged diagonally, that flow in only one input section of the pump already divided into four sectors without flow interruption up to the fins of the impeller, which in this the application will be closed. In the plant proposed the head of the pump to be assigned to the pump with double separate supply, serves to overcome the resistance of the check valve (8) and to include, together with the water recycled, all the water that comes out of the open circuit (which passes through the turbine) back into the reservoir (1).

Therefore the pump with double separate supply (5) carry out five functions:

1. permit the water low pressure of the left side, thrust from the pump (4), to enter in the impeller of the dual separate supply pump until the impeller (5);
2. permit the circulation water in the high static pressure on the right side which do not circulate without the rotation of the impeller, since the pressure upstream and downstream of the pump it would not be in static equilibrium;
3. permit the sum of the two flow separated in the rotating impeller (which do not come together, but succeeded one another in each quarter of the input section for each revolution the impeller);
4. permit the expansion of the total pressure coming from the right side in the pump body according to the principle of Pascal (Although the static pressure is in equilibrium, the dynamic produced by the pump with the dual separate supply, allows the circulation of water within the volume of water accumulated with a small head of the pump, since the pump delivery and the suction coincide at least on one of the two suction mouths. Therefore, the dynamic pressure produced by the pump is added to that static and expands in the flow direction, pushing also the water coming from the left side of the pump with separate supply, which alone would not have the force to enter and to cross the autoclave.
5. permit to overcome the pressure loss of the check valve (8) with the head of the pump that depends on the type of impeller and pump body used.

If these five operations take place, as written above, it does not vary the volume of water inside the pressurized tank. Therefore, we should not restore the pressure of the air cushion, and being the shortest paths, we have no appreciable fixed pressure drop, apart from the ones we produce spontaneously for adjusting the flow rate and levels through the choking of the valves during start-up and of slow speed and torque. None of these functions requires a precise load loss, apart from the check valve (8), which depends on the speed of the water and at the maximum can be up to 0.5 m, therefore in the indicative calculation of the absorbed power of the pumps (4 and 5) during normal service has been provided for the prevalence of 1 m water column, estimating an average absorption, respectively of 0,20 and 0,40 kw, that is not the installed power, obviously superior, having the pumps variable speed also face major and minor absorption conditions. However, the value is indicative of the fact that with a small energy consumed by the plant, you can develop and consume energy much higher than using different hydraulic regimes and the energy storage unit which is the air cushion. This system is not covered under any theory of scientists as Euler, Bernoulli, Newton, Stokes,

Leibniz, Heisenberg, Carnot, Fick, Hamilton, who in so many have legislated laws on energy conservation refers to isolated systems, mechanical, hydraulic, thermal, chemical, physical.

It can be said that the hydro engine is a practical application that respects these principles, but at the same time it exceeds the limits creating an open system that transfers energy from one system to another, without arriving at the mass energies much more powerful, but difficult to control by man, begun, starting from the Einstein studies.

Industrial applicability. These optimistic technical considerations on the production of energy that some call "produced out of nothing", are not hopes but certainties, upheld by the same construction technique of hydraulic pumps, in particular, from the multi-stage, with closed impeller, which are used in this application, both with the function of turbine, both with the pump function with the dual separate supply until to the impeller. In fact, the technique of construction of such pumps and machining precision, allow to get to construct pumps with a prevalence of up to hundred bars. We do not need to get to these heads, but this shows, what has been stated in this description, that is, that the rotation the impeller, performs the anti-return function from the left side of the pump with the double separate supply (FIG.1), fed with the lower static pressure. In fact, in the current multistage pumps, you may not reach the pressures that are achieved, if the rotating impeller and the machining accuracy would not be able to perform a powerful anti-return function, since the losses of water through the yokes of coupling between the stationary and rotating parts, would prevent the pressure increase from one stage to another. Therefore, implicitly, we already have the confirmation of successful with very low costs to recover the water and reinsert it into the pressurized tank, following the way of the second mouth of separate suction until to the impeller, while the other mouth recycle with very low manometric head water equipped with high static pressure, using the same impeller. For the above, it can be stated that does not exist in the world an application longer valid from the industrial and economic point of view. In addition, we need to do some simple considerations on returns between the current thermal-mechanical-electronic system applied to mobile transport and the hydraulic-electrical-mechanical-electronic which aims to realize the transport of the future. worst performance. Furthermore, from the economic point of view, a transmission of electrical energy is much cheaper than a mechanical transmission, but other economies are made on the transmission of torque, that could be brought to the periphery of the drive wheels, can lead to lower installed power of 80% compared to thermal power, as energy calculations above.

So, all the economies achievable with the mechanical simplification and the torque transmission device, at the end, lead not only to lower the costs, but also to reduce the main defect of the hydroelectric solution, that is the dimensions of the plant, especially of reservoirs serving for water and compressed air containment.

As it is shown in FIG.1 showing a car that might look like an SUV (Sport Utility Vehicle). Having to settle in the current hood hydroelectric plant, the current state of the equipment needed for a hydro-electric engine does not allow you to use cars with smaller spaces. In the future SUV and other land transport, in addition to the diesel tank and the relative power supply circuit, it also deletes the exhaust mufflers, the gearbox and differential. All the wheels can become independent driving and the wide and linear speed adjustment. The autoclave plant weight, in large part, is compensated by the mechanical parts eliminated. In cases of accidents there is the danger of the outbreak of the fuel tank. Therefore, one could say that, in addition to benefits, environmental, economic, security also would benefit.

What has allowed to reduce the size of the system and to add it in the hood of a car it has been the idea of reducing the power required by means of the traction device applied to wheel rims that have been added to that of using the submerged pumps as turbines and pumps with double separate supply, also submersible, which can be inserted in the volume of water stored at atmospheric and pressurized. Also it is very well served the idea of coupling the pumps and the turbines by diverters with angular bevel gear, to reduce the height of the plants. Without such solutions it would not have been possible to present this patent application, unless the plant had not occupied a large of the passenger compartment.

For the moment, whereas there are not yet on the market the main elements necessary to produce this type of transportation, with Fig. 1 proves that even with the current technology, not specifically designed, hydropower car is not a utopia, but a more concrete, practical and economic, of the current cars on the road and those that the automotive industry is going to market because the main problem of the car and transport in general, was and is the energy source, which must be clean and sustainable economy.

Many other measures that will develop the automakers will allow further reduce the size of the hydroelectric plants that will replace the thermal power, and therefore, make the car hydropower even more acceptable from the point of view of aesthetics.

Before the whole world basasse its fossil energy development was necessary to ensure that there were no better solutions. Today you need to find the courage to change, including by the automakers. Do not pretend that this invention does not exist, as is happening on the

part of energy producers and by water, public and private operators, who do not admit mistakes, are silent on the fixed versions, non-pressurized, hydraulic applications using the pumps with the dual separate supply until to the impeller, also to produce energy during the phase of lifting of the water, is to distribute, both to defend territories from high waters, both for desalinizzarle, both to cleanse them. Too many important people pretend to want progress cleaning up the environment and sustainable economy, instead works against. it has not been realized nor funded any project described on <http://www.spawhe.eu> website because Spawhe is the website of a pensioner, without political, economic, and proposes comprehensive solutions that cut across the lobby mono disciplinary, scientific and technological, that do not cooperate with each other, but work together to hide the transverse solutions to leave things as they are. But as shown by this patent application also a car can become a global and sustainable plant, transversely choosing the solutions needed. As Frederick Taylor said that could be called the father of modern industry "there are many ways to produce an object, but only one is the best" This concept should be extended especially to the choice of cross-cutting strategic inventions, neglected by the advent of the industrial age.



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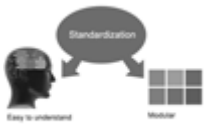
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Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than $1.4 \times 10^{-3} \text{ m}^3$, or 4 mm somewhat than $4 \times 10^{-3} \text{ m}$. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

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Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

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Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art. A few tips for deciding as strategically as possible about keyword search:



- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

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The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

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Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

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Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

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TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

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12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

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21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.



27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

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Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

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A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

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Mistakes to evade

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In every sections of your document

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- Align the primary line of each section
- Present your points in sound order
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An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

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- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

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- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
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Approach:

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- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
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Approach:

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- Resources and methods are not a set of information.
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The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently. You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.



Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
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- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
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Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
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- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
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- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

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Topics	Grades		
	A-B	C-D	E-F
<i>Abstract</i>	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
<i>Introduction</i>	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
<i>Methods and Procedures</i>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
<i>Result</i>	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
<i>Discussion</i>	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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