Working Paper on Social-Ecological Resilience Series
No. 2008-004

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RIHN Research Project E-04

Research Institute for Humanity and Nature (RIHN)
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Email: lawrence.flint@gmail.com

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Abstract

People have made unprecedented demands on ecosystems in recent decades to meet growing demands for food, water, fibre and energy. These demands have placed pressure on ecosystem balances, depleted the ability of the natural environment to replace biocapacity consumed and weakened the capacity to deliver ecosystem services such as purification of air and water, waste disposal and aesthetically pleasing environments. There is an apparent tension between the aspirations of social and economic development and environmental sustainability.

Direct drivers of change that engender a reduction in ecosystem goods and services include habitat change, invasive species, over exploitation, pollution and, climate variability and change. These processes threaten to diminish socio-ecological resilience and heighten sensitivity to both environmental and socio-economic change.

This paper seeks to discuss the scientific ways in which socio-ecological vulnerability and resilience can be examined, in particular the inter disciplinarity of approach necessary to address these wide ranging issues. It will also analyse the nature of socio-ecological resilience and adaptation to vulnerability. This is contextualised in a discussion covering the historical and contemporary production of politico-economic and socio-cultural dynamics affecting resilience.

The study considers floodplain ecosystems, sites of human settlement, productivity and the appearance of 'hydraulic civilisations'. An example discussed here is the Bulozi 'natural' floodplain of the Upper Zambezi Valley in western Zambia, currently exhibiting biophysical and socio-economic change.
This floodplain was populated by the ancestors of the present Lozi peoples who, using the ecological goods and services offered by the plain, produced a strong and vibrant politico-economy that became dominant in the region, using surplus food with which to specialise, raise an army and take advantage of economic opportunities.

Today Bulozi is an arena of relative underdevelopment and this condition may become exacerbated by increasing climate dynamics, but these act only as additional stressors to socially created vulnerabilities that became entrenched over time. The paper identifies the production of vulnerability in Bulozi and the adaptive capacity required to increase resilience.

It also discusses recent activities in the domain of community adaptation to climate change and concludes that people's capacity to adapt to exogenous and endogenous pressures and maintain the integrity of the socio-ecological system (SES) depends much on their ability to engage with stressors from a position of autochthonous 'ownership'. It depends also on their ability to access new capabilities and diversify productive activities so that society can regain a sense of momentum, control and motivation to enhance living standards whilst conserving the integrity of the SES.

Keywords
Vulnerability, resilience, community adaptation, climate change, floodplain, socio-ecological system, ecosystem management

急激な環境変動下の社会生態レジリアンス
－ザンベジ河上流渓谷氾濫源における気候変動への適応

Lawrence S Flint
Enda Tiers Monde - Programme Energie, Dakar, Senegal
lawrence.flint@gmail.com

要旨

近年、食料、水、繊維、エネルギーの需要拡大を満たすため、人々はいまだかつてない供給を生態システムから求めるようになった。これらの需要は生態系のバランスに圧力を与え、自然環境が許容量を取り戻す能力を減少させ、大気・水の浄化作用、廃棄物の処理、アメニティ等の生態系サービスを供与する能力を弱体化させた。社会経済開発と環境持続可能性との間に明らかな緊張関係が存在している。

生態系の財とサービスの減少を引き起こした直接的な原因は、生息地の変化、外来種の侵入、過度の収奪、汚染や気候変動と変化などである。これらのプロセスは社会生態的レジリアンス喪失の脅威を与え、環境と社会経済変化の双方に対する感受性を高める。

本報告では、社会経済の脆弱性とレジリアンスを検討する科学的方法、特にこれら広範囲の問題に対する学際的アプローチについて議論する。また、脆弱性に対する社会経済レジリアンスと適応の本質を分析する。レジリアンスに影響を与えている政治経済、社会文化的ネットワークとダイナミズムについて歴史的、現代的生産の文脈の中で議論することによって説明される。

経済活動と「河川文明」を擁する人間の居住地域である氾濫原生態システムを研究の対象とする。事例として現在生物物理的、社会経済的変化を示しているザンビア西部ザンベジ河上流渓谷の Bulozi「自然」氾濫原に焦点を当てる。この氾濫原は現在の Lozi 民の祖先が居住し、彼らは生態財とサービスを氾濫原から得、強力で活気に満ちた政治経済を生み出してこの地域を独占し、余剰食料を使うことができ、また軍を擁し経済的機会を享受した。

今日、Bulozi は低開発の地域とされており、この状況は気候の変動によって悪化しているが、気候変動は長い年月の間に社会的に蓄積された脆弱性に対しては追加の要因となるのみである。本報告では Bulozi の脆弱性の原因とレジリアンスを高めるための適応的能力を議論する。

人々が外的内的圧力に対して適応し、社会生態システム(SES)のバランスを維持する能力は、彼らが在地的「所有」の立場から問題に対処する能力に依存している。同時に、社会生態システム(SES)のバランスを保全しながら、生活水準を向上する機運、コントロール、動機の感覚を社会が再び取り戻すことは、現在の生産行為を修正し、生産活動を多様化する彼らの能力に依存している。

キーワード：　脆弱性、レジリアンス、コミュニティの適応、気候変動、氾濫原、社会・生態システム、生態システム管理

1.0 Introduction

Ecosystems and ecological goods and services in Africa are coming under increasing pressure as demands for social and economic development come into tension with environmental sustainability. African ecosystems come under stress for several reasons. Firstly, large proportions of the population of African countries rely primarily on ecosystem services for their survival. Secondly, increasing pressure is being brought to bear by governments reeling in the first decade of the twenty-first century from a combination of focusing of export efforts on primary commodities such as export crops and the soaring cost of food imports, demanding more food to be grown locally. Thirdly, since colonial times there has been an exodus of power and administration out of the productive cores of ecosystems leaving them vulnerable to the ravages of external exploitation and increasingly damaging practices by those desperate to eke a living from ecological goods and services, a point reinforced by Salih (2000) and Kousis (1998).

In this process, indigenous knowledge networks and coping strategies have been overlooked and ignored as unsustainable exploitation and damage to ecosystems are perpetrated. Governments, meanwhile, whilst assuming control of ecosystem management via ministries of environment, agriculture, fisheries and tourism, mostly do not possess the knowledge and skills to conduct the sustainable management of these often fragile physical environments. The ability to police the ecosystem has migrated together with precolonial centrality of power and wealth, to remote and indeterminate places, firstly colonial metropoles and secondly, postcolonial capitals, and this has substantially diminished resilience. Indeed, the role of the state has frequently come into question as an appropriate institution in governing ecosystems (Abbott et al. 2007, Adams and Mulligan 2003, Hulme and Murphee 2001).

Increasing climate change and other vectors of socio-ecological change are therefore able to have a more devastating impact than would have been the case had the power to police the ecosystem from a socio-ecological point of view been allowed to remain. Thus a central argument of this paper is that socio-ecological resilience will be improved if management and administration of ecosystems are re-focused on local communities and their responsible leaderships, a dynamic referred to by Abbott et al. (2007) as “community based natural resource management” (CBNRM), also addressed by Agrawal and Gibson (1999) and Barrow and Murphee (2001).

Floodplain ecosystems are some of the most vulnerable of these physical environments given their dependence on inputs and processes generated and mediated outside of the floodplain. In this context one may consider various degrees of hydro-power development, creation of artificial lakes, channel modification, irrigation systems, land drainage and use of floodplain lands for a variety of agricultural and other socio-economic uses. Gordon (2003) distinguishes between the floodplains of the developed world, most of which have been considerably modified, employing Tockner and Stanford's (2002) terminology of “functionally extinct” with those of Africa, many of which retain 'natural' functionality.

However, many of Africa's floodplains have also been considerably modified through dam and barrage building and this may be observed on the Nile (Aswan), Senegal (Manantali and Diama barrage), Zambezi (Kariba and Cabora Basa), Orange, (Vaal and Lesotho Highlands Project), Kunene (Ruacana) and Volta (Akasombo) to name some major developments. These projects were all conceived to serve macro-economic ambitions concerned with the generation of electricity for cities and industry, with hoped-for attraction of foreign direct investment, and also to promote large-scale irrigated commercial agriculture schemes. Most of these schemes have failed to deliver the desired results whilst ecological goods and services have been seriously diminished in the areas affected by these grand projects and

societal structures have broken down as a result of displacement and alienation of small-scale indigenous economic activity.

There are, however, riverine systems in Africa containing so-called 'natural' floodplain ecosystems and this working paper looks at some aspects of functionality and resilience both from a social and ecological viewpoint. Like all ecosystems, floodplain ecosystems are undergoing constant change. However, in the semi-arid tropical belt of Africa, floodplain ecosystems are undergoing change at a rapid rate as a result of population and conflict dynamics, macroeconomic demands and changes related to climatic processes impacting water availability and biodiversity.

A central theme of the paper is that socio-ecological vulnerability is not specifically to climate change or any other discrete process but rather to sets of social and physical, but mostly these are different social dynamics that have combined over time and space to produce vulnerability, or low resilience upon which processes such as increasing climate variability are able to impact so easily. This contextualises the oft-repeated statement that climate change will affect Africa more than other parts of the world. It is not just a result of geographical location or poor practices or the fact that the developed world has produced 98% of the greenhouse gases that now conspire to impact on all the world through what is popularly termed 'climate change' although these are all factors. It is because some are better equipped to deal with the impacts than others.

This working paper will describe and, at times, try to conceptualise the way in which rural and semi-urban communities in the Upper Zambezi Valley floodplain region of Western Zambia cope with and adapt to environmental change, a process that takes place in the arena of increasing fragility of ecological good and services. These include migration of labour and talent to remote locations, influx of refugees from conflict zones in Angola who attempt to utilise the floodplain for subsistence with little knowledge of local ecological conditions or traditional production systems, and intensification of exploitation of natural resources such as fish and timber rendering these ecological goods incapable of sustaining their status in the ecosystem balance. In particular, the paper will look at how coping strategies have fared in the face of increasing climate variability. Some focus will be given to awareness-raising of the issue of climate variability and change and local interpretations and meanings attached to this phenomenon before describing local impacts and adaptation strategies.

The work will seek, particularly, to identify social (political, economic and cultural) stressors that contribute to vulnerability upon which increasing climate dynamics act and, without consideration of which, effective adaptation strategies cannot be formulated. These will be mapped and considered in context with the climatological and geo/biophysical dynamics of the region which will be described and contextualised with the limited data available.

Throughout this work, the concept of the socio-ecological system (SES) is employed. This term is used to describe ecosystem functionality as deriving from sets of natural and socio-economic processes that cannot be divorced from one another as one impacts and amends the other. People have been a composite element of ecosystems but are not always recognised as such. To do so requires a high degree of holistic interdisciplinary analysis.

The socio-ecological history of the Upper Zambezi Valley floodplain (henceforth referred to by its local name, Bulozi),[1] has been one of constant change, mostly in response to climate variability, while local coping and management strategies have understood and taken into account the uncertainties caused by this constant state of flux. Historical climate variability has been characterised by regular seasonal shifts, a single annual rainy season and an intra-decadal cyclical pattern of rainfall. However, in recent decades, climate variability has taken on increased velocity, intensity and unpredictability raising levels of uncertainty and confusion for livelihood operators and threatening the integrity of the ecological balance in terms of biodiversity and hydrological functions.

This notion of threat to the ecological balance has been cross-cut by the increasing pace of social change that has had equally intense impacts on the ecological system and these reflect the intrusion of the global economy from the time of the Slave Trade, through mercantilist trade, formal colonialism, and informal or neo-colonialism, a feature of post-independence political economies employed in Africa from the 1950s onwards. These phases have witnessed several modes of economic regulation including, mercantilist capitalism, the command economies of the colonial era and the "dependency theory" paradigm (1890 to 1964 and 1970-1990), and the modernisation/neo-classical market economy approach supported in the early years of the First Republic (1964-1972) and throughout the Third Republic of Zambia from 1990 onwards.

Since the turn of the twentieth century when the European world economy became almost global, politico-economic processes such as colonialism and market liberalism, cross-cut by conflict and intensifying migratory flows, have conspired to weaken and destroy self-sufficiency in food and essential services in Africa, and disturbed local ecosystem balances to the point that local populations, reduced often to fragile subsistence, are vulnerable to small changes in climate that impact their immediate world of survival and livelihoods. The Structural Adjustment Programmes (SAPs) of the Bretton Woods Institutions (BWIs) helped to drive underdevelopment and increase inequalities, but it must be recognised that economic vulnerability was already deeply embedded in sub-Saharan Africa long before these admittedly mistaken policies were devised.

Despite an apparently negative set of indicators, meanwhile, local Bulozi communities display strong mental resilience and determination to retain their base in floodplain regions even though many have shifted to the eastern plain margins and others have lost the most productive members of their families to urban areas and even to South Africa in the search for wealth to return to families in Bulozi. There is a determination to hang on to land distributed under the tenure system whereby families were allocated land in the past by successive royal authorities even though they may not be currently exploited to their full capacity. Determination to stay in Bulozi is also mediated by a powerful and deeply embedded sense of identity, socially constructed and imbued by historical notions of nation, power and wealth, a mental landscape infused by vivid images of Bulozi and iconic cultural symbols such as the Kingship that are intimately tied to the land. This is entrenched by past alienation from the nascent Zambian nation-state which was seen by many as predatory, a dynamic partially responsible for provoking a turn to cultural identity and citizenship and the production of a "golden past" to invest in for membership.

[1] Bulozi literally means 'of the Lozi people'; hence home of the Lozi people. It is a name given to the floodplain as are Lyondo and Ngulu. Bulozi can also refer to a wider geographical area taking in all the lands under Lozi influence.

Thus, the capacity to adapt to rapid environmental change, partly as a result of increasing climate dynamics is heightened by strong mental capacity and cultural identity/citizenship that inspires hope and enthusiasm for adaptation where conditions might otherwise lead to despondency and out-migration. However, the way in which adaptation is attempted is crucial to the potential for positive outcomes and this issue is connected to notions of ownership and responsibility which mediate the motivation and inspiration necessary for adaptation to have an enduring and sustainable impact on conditions of underdevelopment.

The structure of this work comprises an introduction, a contextual background in which historical themes feature strongly, a focus on geophysical and biophysical aspects of the floodplain, an analysis of relevant climate dynamics and their impacts and a study of social change. The section on socio-economic dynamics is a focal point of the work as it is argued that without a proper understanding of socio-ecological resilience and concomitant assessment of adaptive capacity, the development of an effective and sustainable adaptation strategy is not possible. These different strands of information are then fused together in an integrated analysis that is supported by evidence from community adaptation work to date in four village clusters in the Bulozi floodplain and prospects for the future.

2.0 Socio-ecological context

Vulnerability and resilience are apposite terms, which is to say that both describe a similar dynamic condition, viewed from opposite ends of a descriptive scale. However, both terms are largely subjective and are blurred in definition, thus they only really make sense when used in comparative contexts. The use of the expression 'socio-ecological vulnerability and resilience…' in the title of this paper suggests the ability of humans and the ecosystems in which they live to resist change brought about by external and internal impacts that threaten the balance, stability and cohesion of the socio-ecological system [SES]. This definition closely resembles that applied by Adger (2006) to sensitivity.

2.1 *The Socio-Ecological System (SES)*

Socio-ecological systems are characterised by variable human and physical inputs, processes and outputs. The nature of the processes is such that it is hard to maintain human or physical discretion as all processes interact and impact on each other. A brief summary of the system flow is shown in Figure 1 which also locates vulnerability and adaptation in a cycle by which vulnerability is an output and adaptation, if it exists, becomes an input to the system.

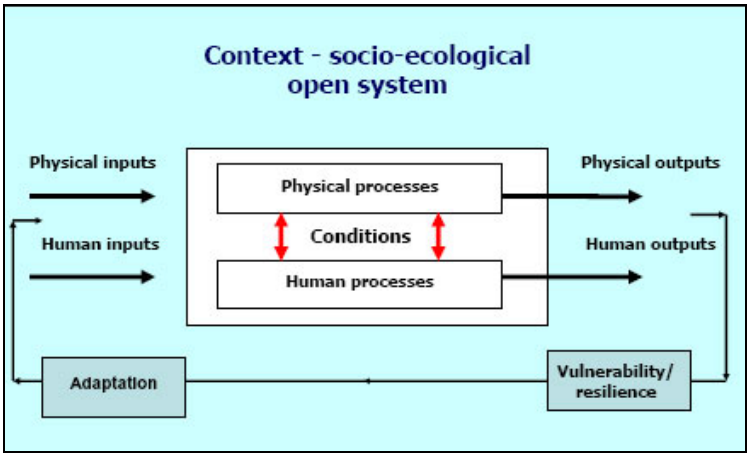

Figure 1: Suggested flow in socio-ecological open system showing vulnerability/resilience as an output which together with any adaptation, feed back onto the system as inputs.

Socio-ecological vulnerability and resilience in the Upper Zambezi Valley floodplain (Bulozi) is similarly mediated by human (social) and physical (bio/geophysical) dynamics. Climate change and variability are hazards that have inspired coping strategies since humans first started settling in numbers in the floodplain. These coping strategies have, however, come under threat at various points across the temporal and spatial floodplain spectrum, usually as a result of climatological or hydrological changes and extremes or as a result of socio-economic activity such as political formation, war and economic exploitation of ecosystem goods and services. Thus, climate variability in the contemporary era, whilst of serious and escalating proportions, is just one of many historical dynamics that have impacted socio-ecological resilience.

To properly understand the nature of the SES at any point in time or space, the relationship between socio-ecological resilience, ecosystem change and politico-economic processes must be examined. The argument employed here is that levels of socio-ecological resilience are primarily mediated by the nature, capacity and location of ecosystem management. This, in turn, is articulated by institutional capacity and by the ability, need and volition to administer ecological goods and services, particularly water.

Furthermore, in an arena where survival and socio-economic development are premised largely on the maintenance of specific vital ecological goods and services, populations are vulnerable to politico-economic systems whose cores are located externally. In so many cases, ecosystem governance has been subsumed by central government located in national capitals whose *modus operandi* is premised on satisfying the needs of constituencies located primarily in urban areas. Here, the organs of governance are mediated by economic power, often wielded by urban ('comprador') elites who collude with external market forces to the detriment of local ecosystem interests, both rural and urban. In this regard, the formation and maintenance of seemingly irreducible import economies act against local ecosystem interests and weak institutional capacity finds itself in collusion with this alienating process by default rather than design.

Thus urban elites and national governments respond to the demands of powerful intervening external interest groups such as trans-national corporations and the aforementioned BWIs (World Bank and International Monetary Fund) in the pursuance and adherence to Structural Adjustment Programmes (SAPs). Premised on rectifying macroeconomic distortion caused by politico-economic processes inherent to colonial and neo-colonial politico-economic dynamics these, in fact, primarily enfranchise and enrich urban elite interests in deference to socio-ecological concerns. These urban-based interests, including national governments, also generally display low knowledge of local ecosystems and environmental stressors, for example, often imagining floodplains as wasted spaces that need to be 'modernised' in the same way as their inhabitants.

Two examples are quoted here. The first concerns the attitude of the Namibian government, in the 1990s, to the planned Epupa Falls hydroelectric project (a scheme that now appears to have been dropped, despite support from powerful foreign industrial interests), where local Himba people who had been successfully managing the fragile environment south of the Kunene River were described by government ministers based in the capital Windhoek, enraged by criticism of its support for the scheme, as 'primitive' (IRIN Jan 18 2008). Similarly, the Botswana government has also been the subject of international criticism for its ejection of San/Basarwa peoples from their ancestral homeland, the Central Kalahari Game Reserve, where they have survived in a harmonious relationship with the environment. Their interests, and those of their ecosystem were placed second to national economic development fuelled by powerful diamond mining interests. This kind of economic

development is rarely of value to local people displaced from their ecosystem environments, nor does sustainable economic growth ensue from the exploitation of a primary commodity with a finite lifespan and no related secondary industrial processes. Several more examples could be used to demonstrate this dynamic and it is not suggested that agencies of governance set out to deliberately ignore the interests of the SES. Rather, the fragility and lack of diversification in support base of institutional capacity dictates actions that cater to the constituency on which that capacity depends for its survival.

These processes act as a barrier to rural development, and to maintenance of socio-ecological resilience in floodplains and other ecosystems. They exacerbate social divisions (wealth, power, class, gender) and drive rural-urban bias, for example in the distribution of social welfare and capital investment, hence the migration of the best and brightest individuals to seek wealth and opportunities in cities and other countries. Such processes tend to entrench less responsible governance of the SES as natural environments are exploited in unsustainable ways, as in the granting of permission for unsustainable biofuel plantations that lead to serious ecosystem degradation and societal breakdown among affected peoples, often with the collaboration of impoverished local people. Similarly, the logging of hardwoods in western Zambia, a clandestine, uncontrolled activity, that is devastating the *brachystegia* woodland plateau SES, is mostly carried out by local people in response to offers of short-term gain by traders from urban areas.

Thus, it can be seen that poor or insufficient external management and administration of ecosystems and debilitating socio-economic practices that result in net loss of biocapacity with little or no local value-added, lead to depletion of ecological goods and services, loss of biodiversity and higher ecological fragility (vulnerability to change). It is upon these social and ecological vulnerabilities that increasing climate variability acts.

2.2 *Bulozi floodplain, Western Zambia*

In Western Zambia, researchers and writers over the past hundred years have been faced with the paradox of a large floodplain ecosystem with potential for food production far in excess of local requirements and a population enduring fragile human security, in particular with regard to food and energy (Flint 2007, Maclean 1965, Peters 1960, Trapnell and Clothier 1957, Van Gils 1988, Van Horn 1977). There would appear to be little logic for this state of affairs in terms of available ecosystem goods and services. Initially one might point to physical remoteness from markets, very poorly developed local market, and a colonialist and postcolonialist demographic dynamic that continues to suck human capital out of the floodplain and transfers it to external centres of capitalist value extraction.

Indeed, the poor condition of the social economy of Western Province today is the collective product of historical politico-economic processes. These have been exacerbated in recent decades by a state apparatus in both Second and Third Zambian Republics (1972-1990 and 1990 onwards), espousing essentially opposite economic ideologies (dependency command and neo-liberal market) which both ended up impoverishing already vulnerable rural populations. This has been to the detriment and expense of the Zambian nation-building project because in regions such as the Bulozi floodplain and its surroundings there is high potential for food production surplus to local needs that would go far in helping to increase national food self-sufficiency and self-confidence. Instead, local agriculture is characterised by:

- lack of technology (hands and hoes instead of ox-drawn or mechanised ploughing and lack of energy to support technological advance;

- large-scale reliance on rain-fed agriculture limiting productive potential with increasing problems of water scarcity in a region where the water table is rarely far below the surface;
- lack of affordable veterinary services, and market infrastructure for livestock in a region ideal for livestock rearing but whose livestock interests are geared largely by traditional cultural dynamics
- remoteness from markets and a disproportionately low rate of investment in infrastructure such as roads and telecommunications
- lower than average prices for agricultural and livestock produce (perhaps reflecting transport costs to the main markets)
- low information on better seed varieties, new cropping techniques, new breeds of livestock and rearing, and aquaculture technologies
- lack of labour due to high rates of migration
- traditional system of land ownership and tenure that privileges small, subsistence farming against organised agriculture

These problems reflect a region-wide socio-economic frailty, especially in the face of national macroeconomic priorities that compound ecosystem vulnerability. Recent planning and construction of new roads has been designed largely with national macroeconomic agendas in mind. Thus, the renovation of the Katima-Livingstone road in 2004 was intended to catalyse exports from Copperbelt and Katanga regions to the port of Walvis Bay in Namibia, and the as yet uncompleted Mongu-Kalabo road to access Angola, a road designed in the context of a new Zambian-Angolan politico-economic initiative to improve relations and create a road-rail network to the ports of Benguela and Lobito, once again to respond to national macro-economic aspirations. Locally, these roads are presented as government's beneficence to local people but can present both threats and opportunities. Certainly, better communications equates to economic opportunity although this too readily applies to external interests that have capital to deploy. They introduce new people, goods, money and information but also import social ills such as crime, new disease, exploitation of the physical environment and cultural pollution to an already vulnerable socio-ecological environment. In addition to this they provide convenient arteries for the removal of ecological goods such as timber and local people seeking opportunities in cities and countries elsewhere.

Poor provision and distribution of fresh water and sanitation (despite high underground water storage) and poor nutrition, particularly in the floodplain region, lead to increased prevalence and virulence of diseases such as malaria, which has been traditionally prevalent in the region but which seems to be claiming more victims than previously remembered, tuberculosis which is seeing something of a resurgence, and HIV-AIDS which worsens the impact of other diseases and creates largely unmeasured havoc amongst local communities, ravaging the most productive population.

Poor education facilities, leads to migration of the "brightest and the best" to access facilities elsewhere. This is compounded by generally low attendance at secondary and tertiary levels with few facilities available (this applies particularly to girls and women who remain primarily responsible for productive activities and reproduction of family and culture but who lack access to decision making). Apart from an extension department of the University of Zambia in Mongu, there are no tertiary education facilities in the Province.

It is true to say that the current Zambian state, until the recent boom in copper prices, was economically moribund and felt it had to concentrate resources in the urban and mining areas, without whose popular support, the government felt vulnerable. A large part of the explanation for socio-economic vulnerability, therefore, lies with the disconnection between

the state's politico-economic agenda and rural aspirations and potentialities. The irony remains that rural regions and specific ecosystems such as the Bulozi floodplain and surrounding area could so easily help to support some of the larger state aspirations given a higher priority for investment and development. Since 2000, a gradually progressive set of policies at central government level and increasing urban poverty has led to a reappraisal in the way that rural regions are perceived and a certain amount of decentralisation of development activity but this process is insufficient presently to reverse the trend of underdevelopment rampant in remote rural areas of Zambia.

A key issue in tackling low resilience and fragility of ecosystems and ecosystem services such as forestry, water, fisheries, fertile land, flora and fauna is the loss of management and administration. Here I refer to management in three distinct but interconnected senses: of resources (capital and infrastructure); of skills and technologies (indigenous and imported through transfer); and of knowledgeable people (personnel, training, organisational and governance). Lack of management and organisational skills is, I argue, one of the most serious constraints facing rural regions in developing countries and a prime causal factor of low resilience.

Management does not necessarily correlate with governance, the latter serving a mostly political agenda. Management here is understood as an essentially economic organisational function that can be enabled by political forces to enable good SES management. Management can be carried out by local civil society through their representative leaderships or by persons or groups appointed by the community to achieve goals set by the community. Correcting the scarcity of good management is not easy, meanwhile, due to lack of funding and poor perceptions of rural areas on the part of suitably qualified individuals. In the case of Bulozi, most of the available management pool are made up of retirees from careers in various sectors who lack resources, mobility and the cognitive flexibility to deploy new knowledge to best effect.

There are also, as yet, insufficiently considered issues of local morale and uncertainty, heightened by dynamics such as conflict and refugee influx, increasing demographic trends, and perceptions of outside places and lifestyles as better alternatives to a "traditional" life in rural regions. These issues feed into a somewhat imprecise postcoloniality in which perceptions of capacity and resilience are informed by a sense of life in a supposedly decolonised space in which psychological conditionalities and perceptions of self and others, that developed under colonial rule, persist to the present day. These are reinforced by social and economic underdevelopment, lack of confidence in the post-independence state and the loss of importance of local hierarchies of power and knowledge.

Bulozi's economic resilience and adaptive capacity has been mediated, constrained and weakened by its interaction with external centres of governance over the last 100 years. Here it is important to remember that the Lozi kingdom had become a self-sustaining politico-economic entity before the arrival of colonialism. By the early nineteenth century (just before being temporarily overthrown by the Makololo), the Lozi state had become the most powerful and wealthy in the sub-region, a position it lost and regained during the nineteenth century but which was eroded considerably in the twentieth. Self-sufficiency and politico-economic centrality was lost as a result of British colonialism and after independence, during the virtual one-party state of Zambia's Second Republic and the Structural Adjustment policies pursued in the Third Republic from 1991 onwards.

Western Province's historical vulnerability has been authored largely by external relations, which is significant, given its geographical isolation.[2] These took the form of invasion by a mixed horde led by a Sotho elite (known locally as Makololo) in the 1830s that disrupted the social and political economy; an externally based colonial political economy that saw value only in people for taxation and migrant labour; and a suspicious nationalist state that viewed the province as, simultaneously, a threat to its sovereignty and unworthy of development.

Barotseland entered into Zambia's independence in 1964 under Litunga Mwanawina III, representing the traditional ruling elite.[3] The decision was unpopular among the Lozi aristocracy who rightly perceived a diminishing role and income for themselves but was supported at the time by the disaffected underbelly of Lozi society that sought an improvement in living conditions. This demonstrates a growing disconnection between the traditional ruling class and the mass of the people, a condition fostered by British colonial policies of divide and rule and the denial of development.

For the first few years after independence, things did indeed start to improve for Zambia's agricultural production as the government pursued welfarist policies and introduced marketing boards that guaranteed to buy the produce of farmers, even from remote areas, at a guaranteed price. These welfarist policies largely flourished on the back of strong prices for Zambia's main export commodity, copper.

Western Province enjoyed mixed success during this period, benefiting a little from the new services offered such as state veterinary services and the construction of an abattoir which encouraged cattle breeding and trading (the province's main money earner). In 1966, however, the government banned recruitment of labour to South Africa's mines which had provided remittances on which many Lozi families *and* the Barotse Royal Establishment (BRE) had become reliant without providing any economic alternatives.

This was exacerbated by embroiling Western Province in the freedom struggles of other countries and, in particular, allowing the establishment of bases of the South West African Peoples Organisation (SWAPO) which attracted the wrath of the forces of the apartheid regime in South Africa based in what is now Namibia (Flint 2003). These two dynamics devastated the rural subsistence economy in Western Province and resulted in the displacement of people and communities, a trauma that is still remembered in the south which was worst hit. Lozi feeling towards the government of Kaunda rapidly became negative as promises of development failed to arrive and, instead, the region was plunged into chaos and instability.

After the 1970s, when copper started to decline heavily in price, the national public purse tightened very quickly to the disadvantage of rural areas, particularly those furthest away from Lusaka and the "Line of Rail". The imposition by Kaunda of a one-party state in 1971 served only to increase the sense of isolation in Western Province from the main Zambian politico-economy and its remoteness from declining markets for its products, all agricultural. Quite simply, demand and resources to both invest in institutions and infrastructure and purchase the produce of Western Province collapsed under top-heavy state controlled

[2] Western Province is the name given to the old rump of Barotseland, including Bulozi, now contained within Zambia's borders. It became common currency the province after the abrogation of the Barotseland Agreement in 1969.

[3] The Luyi kingdom or empire was called Rotse or Lotse by the Makololo and the people took the name Barotse (also Malozi), living in a land called Barotseland. At independence the Barotseland protectorate became Barotse Province and in 1969, Western Province, Zambia.

parastatal bodies controlled by and serving interests external to Western Province. Unsurprisingly perhaps, during this period, Lozi peoples focused ever more strongly on the notion of a 'golden past' and on ecological goods and services that had served faithfully over the generations, reproducing culture and a sense of status.

Today, Western Province, as the central rump of what used to be the Lozi Empire, is renowned for its poverty in relation to other parts of Zambia, its lack of economic development and its vulnerability to exogenous and endogenous shocks. Zambia suffers low agricultural productivity among a large and relatively dense rural population (Grimm et al. 2007) and nowhere is this more the case than in Western Province where agricultural productivity is poor in relation to the rest of the country and where only around 12% of the population is urbanised. That said, Western Zambia and particularly the Bulozi floodplain have potential for agricultural growth although this is periodically undermined by climatic variability, the prices of imported food and the well-being of Zambia's principal economic activity, mining, which has indirect impacts on demand and prices for agricultural produce.

3.0 River and floodplain system

Rivers may reasonably be considered in terms of main channel and floodplain (Welcomme 1975). The main channel is the principal conduit for flow and reserve of water during the low water phase, the floodplain forming a substantial potential reservoir during the high water phase. The relationship between the two components of river systems is important if one is to consider the socio-ecological nature and balance of the river basins.

3.1 *Upper Zambezi River*

At around 2,700 km from source to ocean, the Zambezi is the fourth longest river in Africa whilst the area of its basin at 1.3 million km^2, is populated by roughly 25.5 million people (Hoekstra et al. 2000). It is the largest African river emptying into the Indian Ocean. It is generally divided into three distinct systems based on distinct biophysical properties, 'Upper' from Source to Victoria Falls, 'Middle' from Victoria Falls to Kariba and 'Lower' from Kariba to the mouth on the Indian Ocean coast. The Upper Zambezi Basin covering around 500,000 km^2 (Winsemius et al. 2006) (see Figure 2) has been described as one of the world's most complex due to the many intermittent feeder rivers and streams (see Figure 3) and the flood regulating effects of the Bulozi floodplain, the focus of this study, and the Chobe swamps.

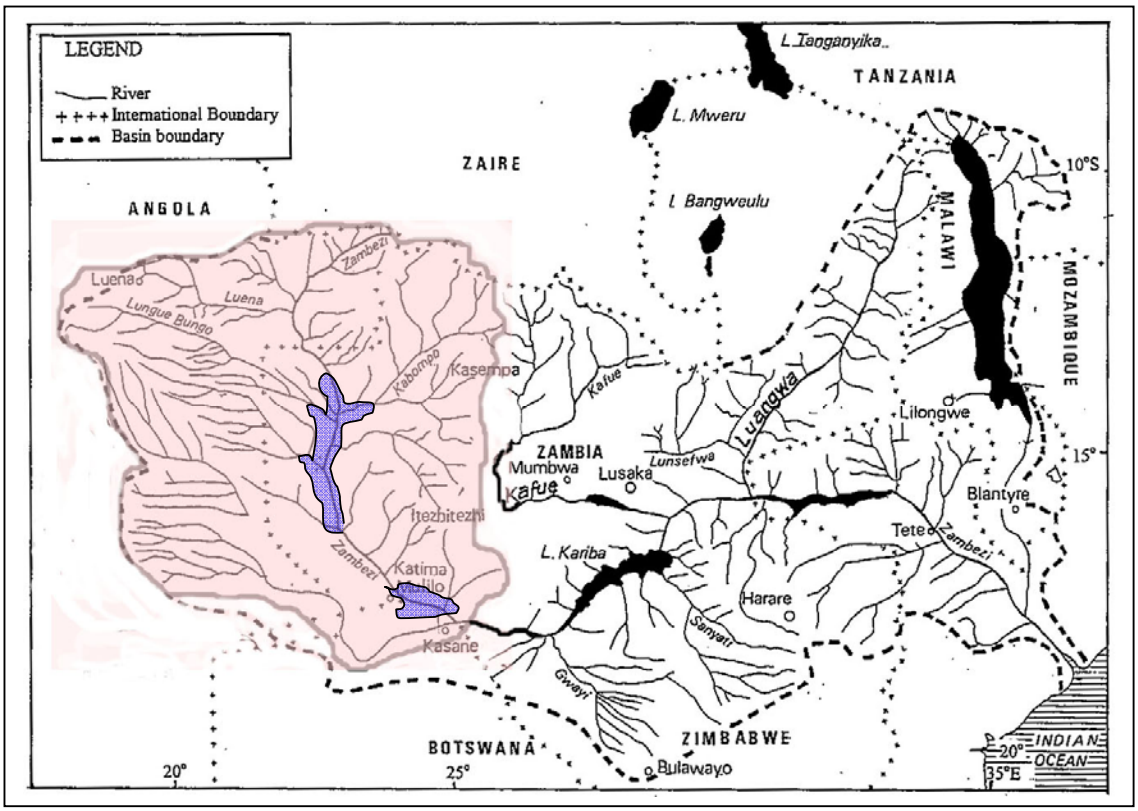

Figure 2 Zambezi Basin showing Upper Basin shaded in mauve and floodplain areas in blue – Bulozi to north and eastern Caprivi to south (original map from Shahin 2002)

As intimated earlier, the Upper Zambezi River is often regarded as 'free flow', 'natural' or 'active' as there are no artificial dams or channel modifications to regulate the flow, which is subject to substantial seasonal variation. In the middle of the wet season, water discharge over the Victoria Falls can amount to 9,100 m^3/s while by the end of the dry season it can diminish to as little as 350 m^3/s.

The riparian zones of the upper river include two vast and shallow floodplains which are governed by very low gradients and high evaporation (Winsemius et al. 2006). Throughout the year, new channels open and close throughout the course of the main channel with the rise and fall in water levels, while in the floodplains, ox-bow lakes are a frequent occurrence as the course of the main stream meanders, migrates and divides (see Figure 4).

The Upper Zambezi is an example of an 'active' riverine system while the main stream in the Bulozi floodplain is a gaining stream according to Lindbo and Richardson's (2001) classification. This is to say that for most of the year, groundwater discharges into the main channel, an unusual feature in semi-arid tropical areas where, in many cases the water table drops so low during the dry season that the main channel becomes a losing stream, discharging water into the plain. The explanation for the situation in Bulozi is the seepage zones that bring water into the plain from the wooded uplands all year round.

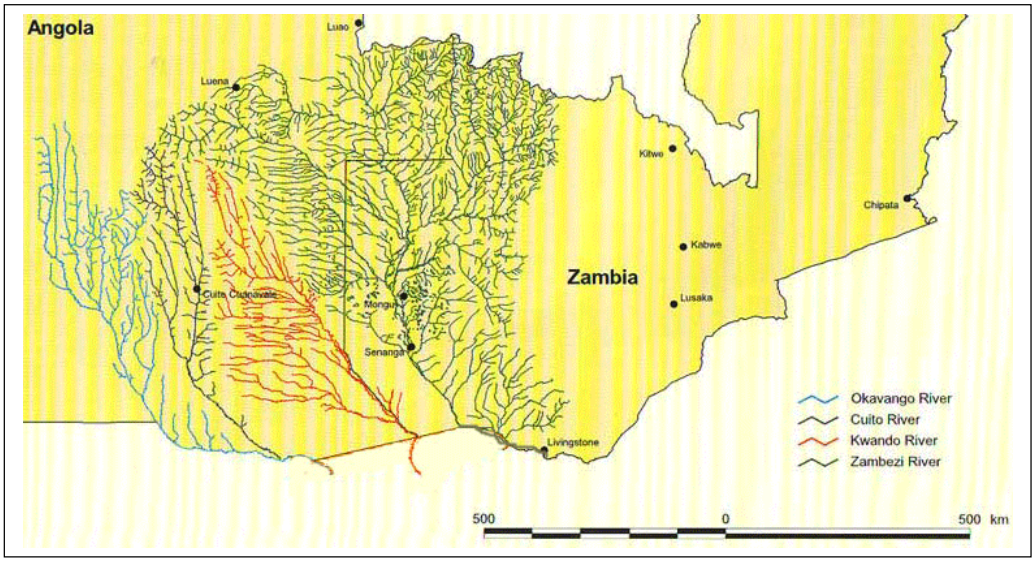

Figure 3 Dendritic complexity of Upper Zambezi Basin showing Upper Zambezi, Cuando/Linyanti/Chobe and Okavango/Kwito networks (adapted from Mendelsohn and Roberts 1997)

Figure 4 1950s photograph of Caprivi floodplain near to Linyanti at height of annual inundation with numerous surface water elements (main channel of Cuando [also known as Chobe and Linyanti] in foreground); clear boundary between floodplain and surrounding upland can be seen on left (photo from author's private collection).

The geomorphology of the Upper basin is considerably older than the Middle or Lower and is almost totally overlain by thick layers of Kalahari sand with very little outcropping rock. Much of the land is flat with low gradients. Rates of evaporation, particularly in the dambos, pans and floodplains proper, are very high, particularly whilst surface water exists (see Figures 5 and 6). The sand is generally of fine particles and is very porous so that the floodplains, in particular form a giant potential storage.

Figure 5 Google Earth image showing variety of post-flood surface water features at the confluence of Zambezi main channel and Luanginga in the central Bulozi floodplain and surrounding surface water features

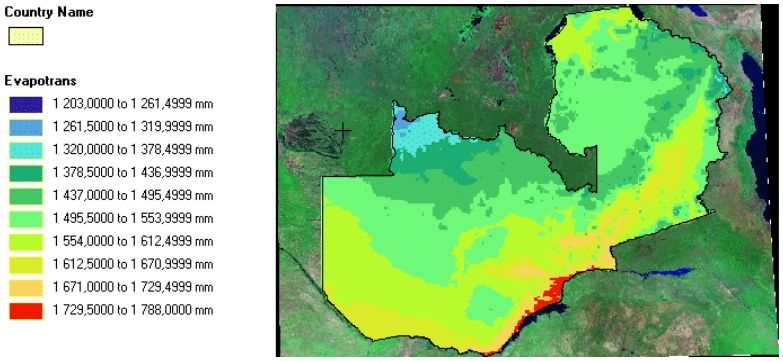

Figure 6 Chart of evapotranspiration rates in Zambia with highest rates being recorded in main riverine areas including Upper and Middle Zambezi Valley (Source: AWhere Spatial Information Systems (TM))

3.2 *Floodplains*

3.2.1 *The importance of floodplains to human settlement*

In terms of early African settlement, as in other parts of the world, the most desired and competed over locations were those offering core ecological goods and services (water, forestry, nutrient-rich soils, manageable climate etc.) ease of transportation, closeness of markets and natural features to afford a viable defence. Hydrological features, in particular floodplains, lakeshores and river deltas became favoured locations for sedentary agriculture and settlement. They were also likely to be the subject of competition and so success at exploiting and maintaining control in these areas indicated potentially high socio-ecological resilience.

Floodplains are 'areas that are periodically inundated by the lateral overflow of rivers or lakes and/or by direct precipitation or groundwater. The surface of the plain alternates between terrestrial and aquatic environments (Junk et al. 1989). It may also be considered as the area of seasonal wetland that flanks the main channel and receives excess flow during the wet season (Welcomme 1975). The floodplain is normally dry when waters retreat but may

also include numbers of temporary and permanent water bodies. Floodplains may be grassland or forested habitat although in most areas it is used for agriculture, wildlife and grazing of livestock during the dry season (Welcomme 2003)

Floodplains are unique because they do not depend on upstream processing inefficiencies of organic matter, although their nutrient pool is influenced by periodic lateral exchange of water and sediments with the main channel. In unaltered large river systems with floodplains in the subtropical, tropical or temperate belt, the overwhelming bulk of the riverine animal biomass derives directly from production within the floodplains and not from downstream transport of organic material produced elsewhere in the system.

Flood pulse is the major factor controlling production of biota in the floodplain. In a large unmodified river system the pulse is likely to be regular which is good for production of nutrients that fish can feed on. The longer the pulse, the higher the production. The pulse is accompanied by a dynamic edge effect, which extends a 'moving littoral' throughout the floodplain (Junk et al. 1989). The moving littoral prevents prolonged stagnation and allows rapid recycling of organic matter and nutrients thereby resulting in higher productivity. A floodplain has unique properties that may be considered to comprise a specific ecosystem.

The Niger Valley in West Africa centred on the floodplain delta now located in Mali, became the location for early African towns such as Tomboctou, Djenne and Mopti, termini for trans-Saharan trade and centres of education and commerce. The floodplain also became the productive focus of the Mali, Songhai and Ghana empires. The Nile valley formed the focus of Ancient Egyptian and Nubian civilisations whilst parts of the Great Lakes region are known as the "cradle of mankind". Around the world, these same hydrological features have been home to various "hydraulic civilisations" and past empires located in tropical semi-arid and arid regions including Mesopotamia, the Indus civilisation, China (north and south), and Latin America (Maya and Inca).

Floodplains are perhaps the most biodiverse and potentially productive of all hydrological features and, in the tropical semi-arid zones of Africa, became the scenes for settlement, agriculture, trade, education, and wars. Floodplains form fairly easily identifiable and bounded ecosystems as they display substantially different geomorphological and biophysical features to surrounding regions in the river basin. This helps to explain why, as bounded physical features they figure strongly in the imaginations of people who know and inhabit them, forming vivid mental landscapes.

Floodplains in the developing world face a somewhat different set of challenges to those in developed countries. Most floodplains in highly developed countries have become what Tockner and Stanford (2002) refer to as "functionally extinct" due to high levels of human interference including drainage and channel modification. Meanwhile, 'natural' floodplains are among the most biologically productive and diverse ecosystems. By 'natural' what is meant here is when the hydrological and ecological integrity of both the plain and stream network feeding into the plain have not been modified by human interference. However, it is also fair to suggest that there are no ecosystems apart perhaps from some polar regions where humans have not had some impact on the ecosystem balance.

As in other African socio-ecological systems, in African floodplains, relatively dense populations live interdependently with their biophysical environments. One can explain this phenomenon partly by understanding African peoples' location in the periphery of the capitalist world economy where social and economic development takes place in the absence of industrial and associative processes. Meanwhile, due to this interdependency, changes in

the ecological system of floodplains have great impact on the quality of life of peoples within and below the plain system. Demographic processes in Africa (increasing migratory flows plus increasing population and density) and related socio-economic impacts can be considered to be a root cause of land and water use conflicts requiring the application of adaptive planning and management mechanisms.

Floodplains, then, are important areas for settlement, water services, agriculture and biodiversity almost everywhere in the world and Africa is no exception. Over the centuries African peoples have learned to use floodplains for their own benefit, not only due to the proximity of water but also on account of the fertility of the plain after deposition of nutrient-rich sediments at each inundation. These areas have become of central importance to local economies and societies, yet they are not often well appreciated by agencies of governance who may view floodplains and other wetland areas as wasted land that needs 'developing'. Careless development of expensive hydro-electric schemes (usually financed by outside interests), channel modification and draining of wetlands are a regular feature of external decision-making affecting not only the productivity of wetland ecosystems but ecological goods and services utilised by communities over wide areas.

3.2.2 *Bulozi floodplain hydrological description*

The floodplain, known locally as Bulozi, Lyondo and Ngulu, is an integral and unique component of the Upper Zambezi Valley, situated wholly in western Zambia, measuring roughly 200 km in length and 70 km at its widest point. The southern end of the plain is controlled by outcropping basalt which has resisted channelling and acts as an effective dam on the river causing water to back up into the floodplain. Bulozi is a shallow floodplain area with very gradual gradient consisting of tens of metres deep Kalahari sand interspersed with clay outcrops referred to by Winsemius et al. (2006: 341) refer to as 'an enormous phreatic groundwater reservoir'.

This vast area of wetland covers around 10,700 km^2 including 7,200 km^2 of floodplain proper, around 200 km^2 of perennial or seasonal swamp (Parker 2000 and Timberlake et al. 1998) and around 800 km^2 of floodplain margin where flood conditions prevail for three to four months of the year and where seepage from uplands combine to enhance fertility. The Upper Zambezi Valley in the floodplain region is an active riverine system which like the term free-flow above, refers to an unmodified channel upstream (Lindbo and Richardson 2001).

The Bulozi floodplain ecosystem responds to a strong flood pulse that pours substantial quantities of water into the plain in normal years. Due to the very low gradient, this allows for a very gradual, receding littoral giving rise to substantial drop of sediment load, coarse particles close to the main channel and fine towards the plain margins, with nutrient to fuel fish spawning, and production of grasses fit for livestock grazing and several tracts of cultivable land. It is this process of strong flood pulse and slowly receding littoral that has enabled the peoples of the floodplain in the past, to take advantage of the biocapacity potential and become self-sufficient in food.

The floodplain acts as a sponge, filtering nutrients and minimalising run-off to such a degree through percolation, evaporation and transpiration that only a small percentage of precipitation from the Zambezi's headwaters actually reaches Victoria Falls (see Figure 7). Rain and floodwater percolates easily through the Kalahari sand that covers much of the region both above and within the plain and rapidly descends to the water table. High evaporation potential is the largest reason for the low runoff coefficients found throughout the Upper Zambezi. The Zambezi basin overall, like the Nile Basin, has low 'run-off efficiency' and a high dryness index, increasing its vulnerability to climate change (Riebsame

et al. 1995). The plain, together with the Caprivi-Chobe swamps further downstream in north-eastern Namibia, acts as a filter to water flowing from Angola and north-western Zambia so that the flow over the Victoria Falls actually carries very little sediment load (Du Toit 1983). This has been left as a fertile layer in the aforementioned floodplains overlying the Kalahari sands typical of the region, supporting the flora and fauna as well as the human security of the local population. In short, the river is central to the life support system of the region.

While these conditions are ideal for cultivation where silt is deposited and where clay outcrops occur, the soil quality of these floodplain zones varies considerable and is divided into several different types. Those that are cultivable all year round, known as Sishanjo or Litongo gardens, and that are close to centres of population do suffer from over-usage leading to removal of topsoil, revealing the Kalahari sand layer below. Meanwhile the Bulozi floodplain is one of the most important areas for the production of fish and cattle in southern Africa (FAO). The depth of flooding of the Zambezi and its tributaries varies considerably from year to year. The satellite images in Figure 8 show that water fills the Bulozi and Caprivi plains and Okavango delta, another hydrologically connected river-floodplain system (via the Magwekana Spillway) during different temporal seasons despite being supplied with run-off from the same watershed regions. The height of the inundation varies from year to year and the diagram in Figure 9 illustrates the median extent of inundated plain.

Due to difficulties in forecasting from such a vast and varied watershed region, this means that livelihoods that are mediated by annual inundation become largely dependent on chance, generating high sensitivity and vulnerability. In years of high rainfall the floods recede slowly and the cattle suffer. Local people have given evidence that is backed up by available climate data that variability and lack of predictability of both rains and flood have increased over the last two decades in particular (see section on climate).

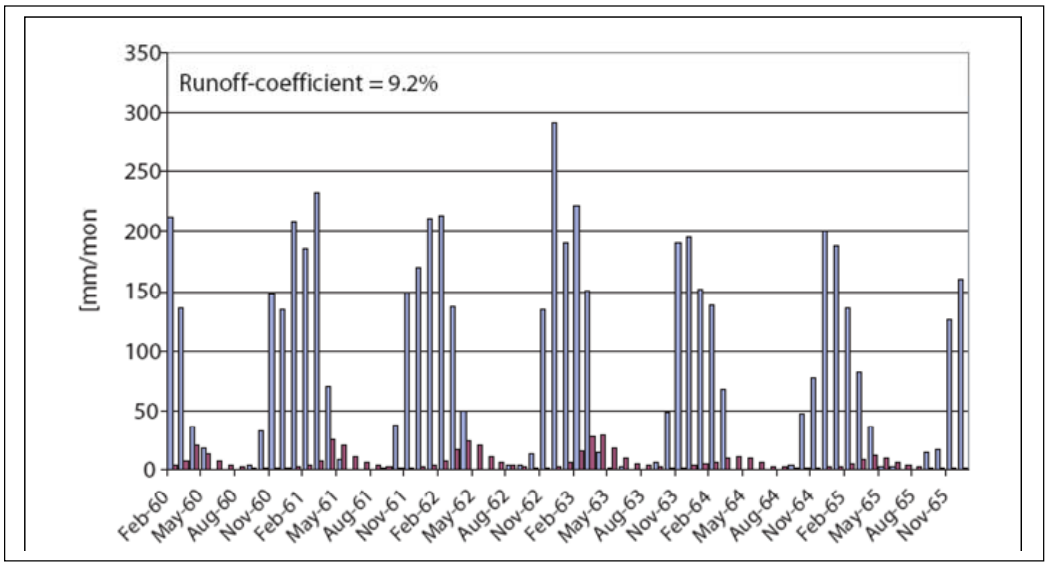

Figure 7. Precipitation (average for Upper Zambezi Basin) and run-off at Victoria Falls 1960 -1965 showing run-off coefficient of just 9.2% (taken from Winsemius et al. 2006) Light coloured bars = precipitation, dark coloured bars = run-off.

Meanwhile, the Upper Zambezi Valley and the Bulozi floodplain, in particular, comprise the productive and socio-cultural lifeblood for maybe a million people living in western Zambia, south-eastern Angola, northeastern Namibia and Northern Botswana. This lifeblood should

be understood in terms of water for human life support and the establishment of settlements, agricultural production and livestock and the reproduction of culture and heritage, arguably equally important in the protection of human security. It also provides annual fertilization of existing good soils and a deposition of nutrient rich silt upon which extensive grasslands grow. The early Luyi learned to use this ecological system process to their advantage and produce food surpluses that aided and abetted the creation of the most powerful politico-economic entity in the region in the pre-colonial era.

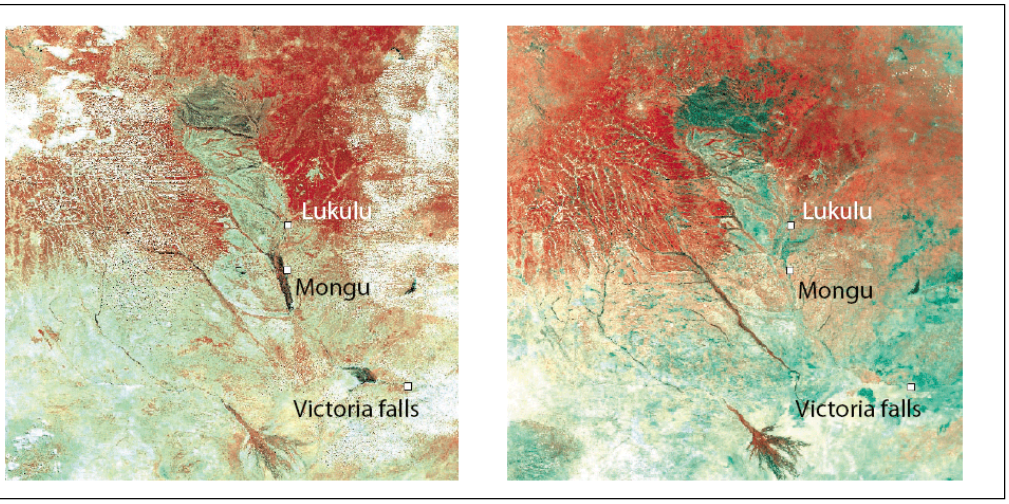

Figure 8. MODIS 250m channel 2 images of Upper Zambezi Basin: left – start of the dry season, right – end of the dry season. Dark grey areas denote surface water. Bulozi floodplain is located immediately west of Mongu

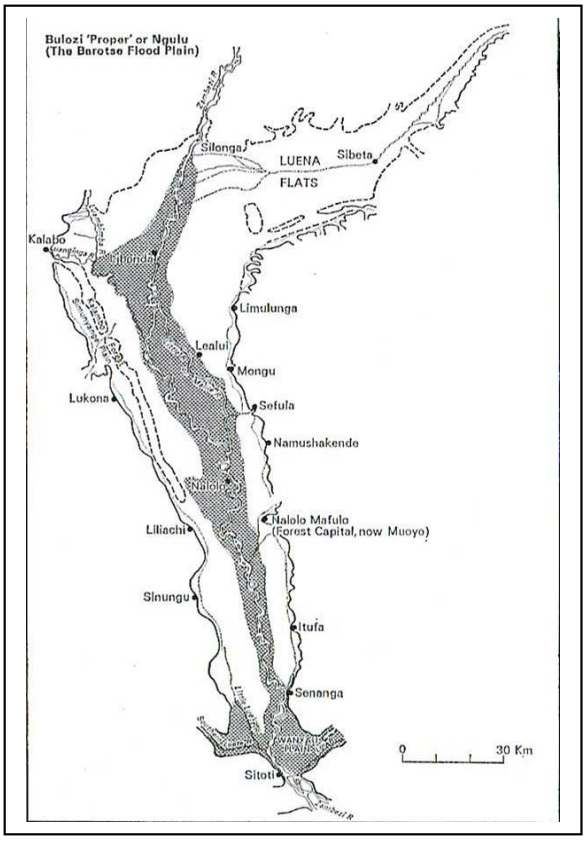

Figure 9 Close-up image of the Bulozi floodplain showing the median extent of land inundated at the height of the flood (hatched area) during an average year (taken from Mainga 1973).

3.2.3 *Flora and Fauna*

Floodplains demonstrate large and distinctive floras. The Bulozi or Barotse floodplain with its unique blend of ecological services supports the highest number of species in the entire Zambezi basin including approximately 91 species of fish, large numbers of avifauna (including 133 wetland bird species), and herpetofauna (including >100 reptiles and >50 amphibians). Large mammals have largely disappeared except for remaining pockets of hippopotamus in the river system but there are numerous small mammals and a wide distribution of grasses, especially *Loudetia simplex* for which Western Province is renowned.

Vegetation on the sand-covered surrounding uplands on both sides of the plain comprise low canopy woodland vegetation such as Brachystegia or Mopane sprinkled with rapidly disappearing hardwoods such as Rhodesian teak and rosewood. To the west, woodland gives way in some areas to extensive savannah grassland plains such as those that exist in the Liuwa National Park. These arid upland areas are interspersed with dambos and pans on and around which cultivation takes place on clay outcrops.

As already indicated, the main focus of productive activity in the plain has traditionally been premised on the ebb and flow of the annual inundation of the plain with nutrient-rich, silt-laden water brought downstream by the Zambezi and its affluents from around January to May each year, peaking in late March/early April. This inundation heralds the spawning of fish and the deposition of most of the silt as the water loses velocity, sparking the growth of lush grass and rendering large areas of the plain, particularly close to the margins, fertile for agriculture.

4.0 Social history

The Bulozi floodplain became the socio-ecological nucleus around which a powerful kingdom grew, a primitive state with its capital and centralised polity located in the heart of the productive core of the kingdom, the floodplain. The peoples who became dominant in this region from the seventeenth century to the present day, built up the most powerful political economy of the sub-region by producing food surpluses and using these in trade with other less settled groups in the surrounding region and in specialist production and for financing military conscription whenever it was needed.

On visiting the plain in the 1850s, David Livingstone noted that:

> *Here the Banyeti* (a name he gave to local people at the time) *have fine gardens, and raise great quantities of maize, millet, and native corn of large grain and beautifully white. They grow also yams, sugar cane, the Egyptian arum, sweet potato, two kinds of manioc or cassava… besides pumpkin, melons, beans and ground nuts. These, with plenty of fish in the river, its branches and lagoons, wild fruits and water fowl, always make the people refer to the Barotse Valley as the land of plenty.*
>
> *The great valley is not put to tithe of the use it might be. It is covered with coarse succulent grasses which afford ample pasturage to large herds of cattle, these thrive wonderfully and give milk copiously to their owners. At present the pasturage is never eaten off, though the Makololo possess immense herds of cattle.*[4]

[4] Makololo is the name given to an army made up of various peoples conquered during a stepped migration by a Sotho clan which became known locally as Makololo. These people brought with them large herds of cattle, derived principally from confiscations and capture during numerous raids and wars.

> *The Barotse are strongly attached to this fertile valley, they say 'Here hunger is not known'* (Livingstone 1857).

Livingstone was renowned as an astute field scientist, meticulous in the accuracy of his observations and recordings (Siddle 1974); thus we can be fairly certain that he described what he saw and heard at the time. Certainly his account corresponds with oral history and, although the Lozi were under temporary subjugation at the time of Livingstone's visits, clearly the Bulozi floodplain had been turned into an ecological powerhouse of goods and services which had allowed the Lozi to become powerful, and the subject of competition with other powerful forces.

The Bulozi floodplain is an example of a natural floodplain even given that humans have been living and subsisting within the floodplain ecosystem for hundreds of years, in effect becoming part of that ecosystem, hence the expression socio-ecological system (SES). In the sixteenth or seventeenth century the Luyi or Luyana people who were later, after considerable absorption and merging with other peoples, to become the present day Lozi peoples, migrated into the Zambezi floodplain, probably from the northeast via the Kabompo River Valley.

On arrival, the Luyi found a land capable of providing life support but subject to climatic extremes and an annual inundation generated by a strong and sustained pulse that differed in timing and extent but which was the essential life support of the wetland ecosystem. Rainfall and run-off to provide the inundation however, does not occur locally but rather in the Angolan highlands and on the Zambezi-Congo watershed area in southern Katanga/north-western Zambia.

Over the generations, the Luyi learned to harness the natural advantages of the annual layer of silt deposited in the plain, the verdant grass that covers the plain for most of the year except for the hot season when it dies back and is burnt away either through lightening strikes or by the hand of man for fertilization purposes. The Luyi took advantage of the plentiful fishing from when the flood started to recede and grew cereal and vegetable crops in abundance. Cattle rearing and grazing also became an important feature of food supply and socio-cultural wealth.

This particular aspect of the Luyi social economy was to attract an invasion by a mixed horde led by a Sotho clan called the Makololo in around 1830 which disrupted the local political economy. Most of the army of invaders was made up of peoples conquered by the Sotho and absorbed into their ranks as the horde moved northwards in a stepped migration as part of the Difaqane. These people brought with them a military style political organisation that partly infused itself into the Lozi system and in which cattle rearing and settled agriculture were not staple components, hence these aspects of the Luyi economy diminished somewhat while the Sotho elite stayed in power (until 1864 when they were overthrown by Lozi elites).

Meanwhile, around the plain margins, the most fertile and productive lands were to be found, with some lands cultivable all the year round (Litongo, Sishanjo gardens - see Figure 10) on account of seepage filtering into these margin lands from the plateau uplands. In these fertile margin lands, the Luyi learnt to drain the humic swampy peat lands found there by use of furrows or shallow canals which were dug in curving form to retain as much of the life-giving nutrients as possible. After the arrival of European missionaries towards the end of the nineteenth century, however, a more extensive system of canals was dug with deep straight arterial channels that could act both as transport arteries and provide water for

secondary or minor channels (Prins 1980). However, the benefits of improved transport were probably made at the cost of lower fish yields (Zambezi Society 2001)

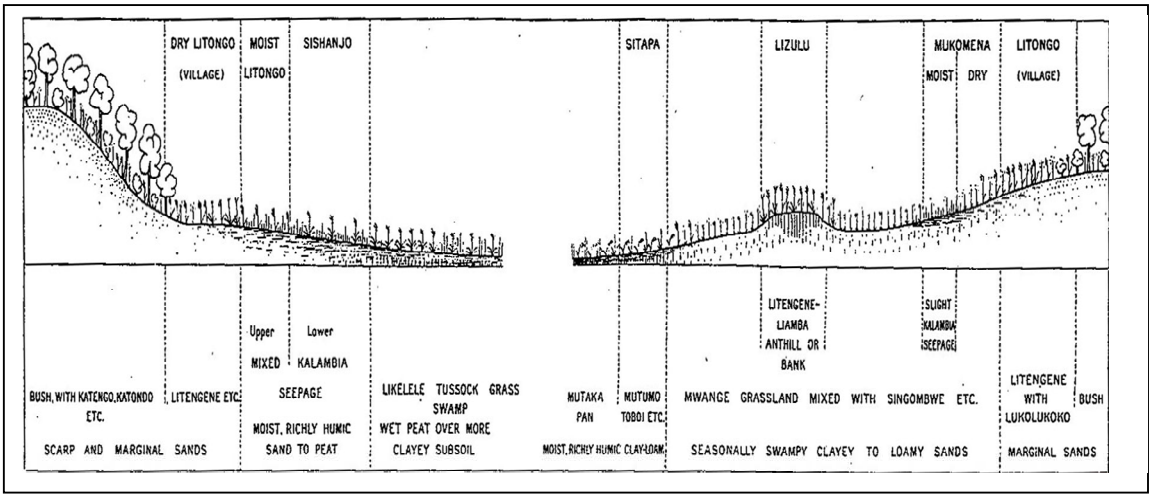

Figure 10: Diagram of floodplain garden system employed by Lozi (Luyi) peoples (taken from Trapnell and Clothier 1937, 35)

The Sishanjo and Litongo gardens were part of a network of soil-livelihoods relationships developed as part of the Lozi political economy in the pre-colonial period (see Figure 11)

The political economy that grew up in the Bulozi plain functioned, by the early nineteenth century, as a primitive state centralized around capital villages in the middle plain and focused on a king known as Litunga (keeper of the earth). The term Lozi 'peoples' refers to the product of absorption, merger and conquest of over 25 groups, some of whom are still remembered individually today, now united by common language and history. The Lozi 'state' supported its influence through the production of large surpluses of food which were used for the creation of an army, and to trade with less settled groups in the surrounding Kalahari sand woodlands and to create specialization of activities. Labour to work the lands of the Lozi was provided both by tribute from the subject peoples and by slave labour from people captured during raids.

The Lozi nation was a homogenous political entity that drew its subjects together in a kind of universal servitude to the dynamics of river and floodplain, with management and administration of key ecological goods and services dominated by an elite representing the Luyi/Lozi Kingship and culture. By the 1870s most people in the valley were in fact, the slaves of this minority elite (Holub 1879 and 1881). In fact, due to a long period of infighting that preceded and succeeded the Makololo invasion, even the Litunga was in fear of other elite factions and advisors who maintained their positions with support to and from Lozi royals who dealt out important political and economic (ecological) assets. Members of the elite were duty bound to provide for their subjects or these subjects would leave, thereby depriving the title holder of labour for livestock rearing and cultivation without which, his (always male) holdings were valueless.

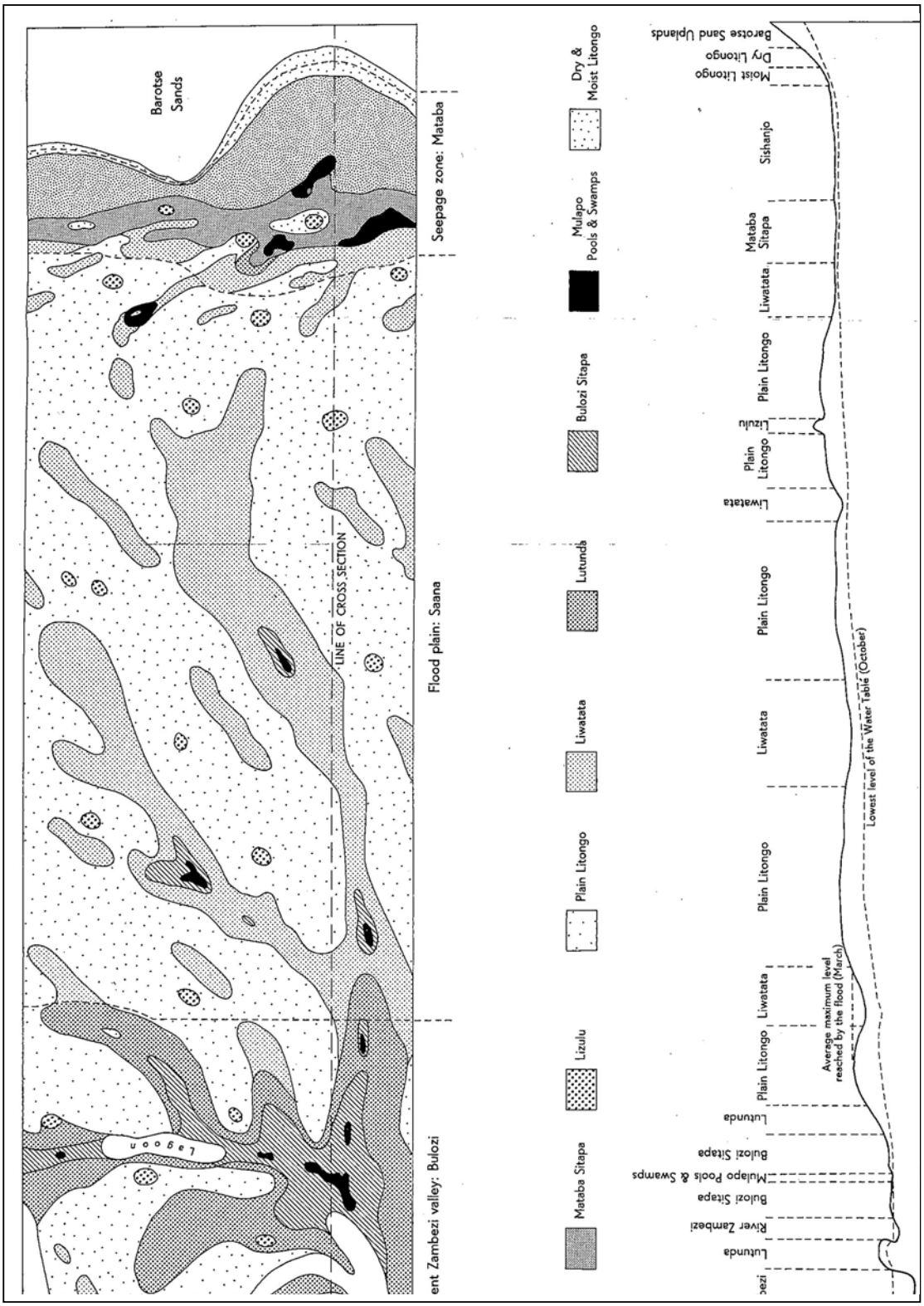

Figure 11: The land facets of the Bulozi floodplain and their Lozi names (after Peters 1960 in Verboom et al. 1970)

Membership of and status within the Lozi nation was usually conditional on the exercise of influence, for productive activity or for displays of valour. This principle extended to land usage and tenure. No land could be owned by an individual but was rather parcelled out by the Litunga under guidance from the extensive chiefly system to worthy 'citizens' whose job it was to make productive use of allocated land. If land was left untended or unused, or if a holder offended the Litunga or implements of Lozi nationhood, it could be confiscated and handed back to the Litunga for distribution to more productive individuals.

The whole system was held together by the socio-ecological functioning of the Bulozi plain which provided a sense of identity existing to the present day among Lozis whose mental landscapes feature the plain, the river, the kingship, and the unique culture and comportment that has grown among the Lozi peoples over the generations.

With the arrival of colonialism, the productive system of Bulozi was broken down by the prohibition of tribute and slave labour and the introduction of taxation to be paid in money which could only be obtained from the mines of South Africa or plantations of what was then Southern Rhodesia. So was set in train a system of labour migration through which the subsistence and wealth provided by the old plains system was replaced with remittances from far away places that also imbued a vague sense of modernity among migrants who also started to turn their back on traditional cultural mores and norms.

Two years after independence in 1966, however, the President of the First Republic of Zambia, Kenneth Kaunda, stopped the flow of migrants by closing the recruiting stations and banning labour migration to South Africa. Unfortunately, the government provided nothing to substitute the earnings of the migrant workers. This situation was later compounded during the freedom struggles of Angola and, particularly, Namibia when thousands of strangers from protagonist groups invaded Lozi lands and disrupted the rural productive system even further.

During this time and later, the Bulozi plain started to suffer depopulation as people migrated out of the plain to the towns of the margin, such as Mongu and Senanga, with the chance that they would migrate further if the funds and opportunity occurred. Thus, by the 1980s, whilst still utilizing the lands that farmers were able and willing to cultivate, Barotseland had become heavily dependent on imported food for survival, leaving the population extremely vulnerable during years of drought and high flood.

5.0 Climate variability and change – nature and impacts

The Upper Zambezi River basin, like that of the Senegal, Niger and other rivers flowing through the semi-arid tropical belts, is swept by a unimodal rainy season controlled by the latitudinal movement of the Inter-Tropical Convergence Zone (ITCZ). In the case of Bulozi, this results in one rainy season per year from November to April, which is responsible for the seasonal character of the discharge in the Zambezi (Winsemius et al. 2006).

The catchment area for the Upper Zambezi is mostly influenced by the tropical Atlantic system (Jury 2003). In terms of the annual inundation of the Bulozi plain, it is important to mention that most of the run-off precipitating the flood does not originate in the region surrounding the plain but rather in the central Angolan highlands and Zambezi/Congo watershed area. This run-off cascades down important tributaries such as the Lungwe-bungu, Kabompo, Luena and Luanginga into the main channel that then overspills its banks into the plain south of Lukulu.

Rainfall in the Upper Zambezi basin has been recognized to be of a somewhat unpredictable nature (Trapnell and Clothier 1957; Verboom et al. 1970). This uncertainty is articulated both in terms of seasonality and in volume that have a direct bearing on sensitivity and vulnerability for socio-ecological processes.

5.1 *Seasonality*

Lozi seasons are related, as in other cultures, directly to climate and correspond to starkly different climate regimes. The seasons of Bulozi are (from Gluckman 1941, Howe 1953 and Verboom et al. 1970):

Litabula – the rainy season (warm to very warm days, mild nights) – *October-April* (this season is showing a shifting temporal trend as will be shown later).The wettest months are December and January with up to 400mm in each month. At this time humidity may rise to 80% with maximum temperatures of around 27^{o} with an overcast sky most days.

Munda – the flood season (warm days, little diurnal range) – *February to May*. Humidity drops to around 60% after March, skies begin to clear as rainfall decreases.

Maliha – winter season – warm days (max: 26-27^{o}C), cold nights (10-14^{o} C - large diurnal range) *May-August*. Frost is possible in August and humidity drops to as low as 30%.

Mbumbi – the hot, pre-rainy season, very hot days (up to 38^{o}C) and warm nights – *September-October/ November*. Occasional thunderstorms can occur from September to the start of the rainy season proper. Humidity starts to climb again during this period.

Details given are for the central plain and vary from north to south. More precise meteorological details are provided in Figures 12 and 13.

Climatological Information for Mongu, Zambia

Location of weather station : 15.2 S, 23.1 E, altitude : 1053 m

	Data Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Maximum Temperature (deg. C)	1961-1991	28.9	28.6	29.1	29.6	28.4	26.5	27.0	29.8	33.4	33.8	31.3	29.3
Mean Temperature (deg. C)	1961-1988	22.8	22.8	22.8	22.3	19.9	17.3	17.8	20.7	24.6	25.4	23.7	22.9
Mean Minimum Temperature (deg. C)	1961-1991	18.6	18.7	18.4	16.5	12.7	9.5	9.7	12.4	16.4	18.1	18.2	18.6
Rainfall Amount (mm)	1961-1991	209.1	184.6	139.9	43.4	4.9	0.7	0.0	1.5	2.2	32.7	106.4	192.8
Days with Rain*	1961-1991	19	16	14	4	0	0	0	0	0	5	13	19
Mean Daily Sunshine Duration (hours)	1961-1991	6.4	6.4	7.3	8.9	9.9	9.9	10.1	10.1	9.6	8.6	7.2	6.3

* denotes number of days with at least 1.0 mm of rainfall

Figure 12: Basic temperature and rainfall data for Mongu, Zambia 1961-1991, supplied by Zambia Meteorological Services

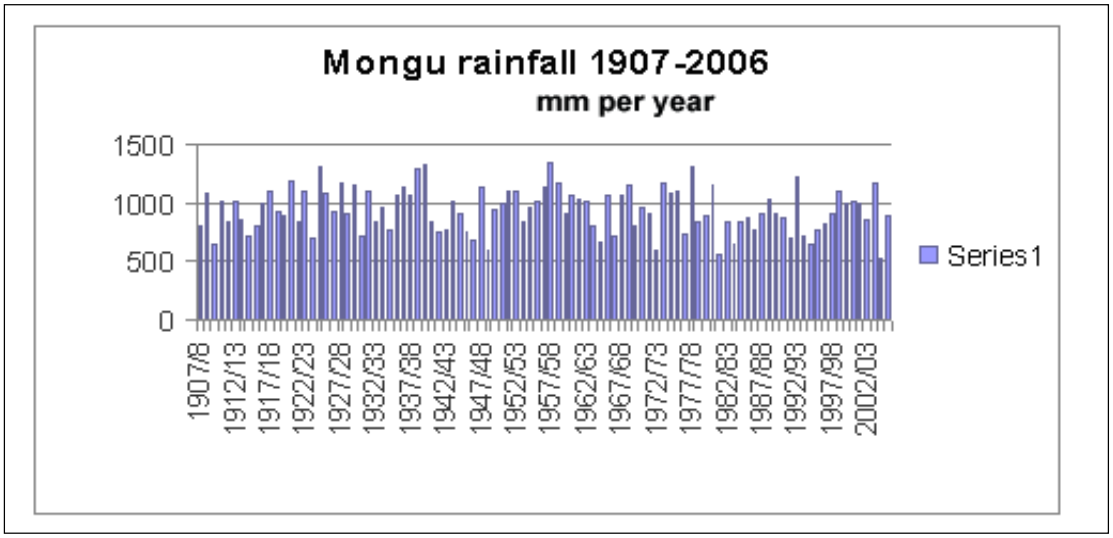

Figure 13: Histogram plotting actual rainfall at Mongu station 1907-2006 showing roughly intradecadal variation (info supplied by Zambia Meteorological Dept., Provincial HQ., Mongu)

The seasons can and do overlap and vary in timing and duration from north to south across the floodplain according to a sliding scale (rainfall - approximately 1100mm per annum n the north to 800mm per annum in the south). With increasing climate variability and change (el Niño/la Niña events and increasing variation in the migration of the Inter-tropical Convergence Zone (ITCZ)), seasonal variation has increased. This is leading to a certain amount of confusion and uncertainty among a community that is closely linked to its physical environment for life and livelihoods as well as identity and maintenance of culture.

The Bulozi floodplain is a verdant grassland during the rainy season and up to the point when all moisture has subsided from the surface strata. During the remainder of the year, the plain becomes a sun-scorched thirstland, scoured by desiccating winds.

During this time the grass turns yellow and dies back, to be burnt in October in extensive man-made fires ahead of the next rainy season. Traditionally, this was done in order to deposit fertilising ash to aid new growth. In contemporary times, however, this burning has become so extensive that substantial pollution of the local atmosphere is caused by heavy concentrations of particulates which cause health problems, obscure visibility and contribute to greenhouse gas emissions.

The seasons of the Lozi year are also associated in the mental consciousness with vivid colours that relate directly to ecosystem activity (see Figure 14). Here blue represents the water of the flood, green the new growth in response to rains and flood, brown as the plain dries out and grass dies back and purple as the plain grasses get burnt.

Figure 14: Photographs denoting the four colours of the Lozi mental landscape representing seasonality blue for flood season, green for rainy season, brown for cool dry winter and reddish-purple for hot dry season before rains.

Experiential evidence of seasonal variation

In surveys carried out among peoples living in Bulozi between 2001 and 2008 (Flint 2005 and 2007), evidence was presented that variability in seasonality has been on the increase. This is normally expressed in terms of impacts on livelihoods practices and has led to heightened uncertainty and confusion. Transhumance has traditionally been practised in Bulozi largely in response to the annual inundation of the plain and this has also been affected by increasing climate variability leading to increased pressure on poor flood season grazing and increased prevalence of livestock disease which may be climate related. Climate data suggests that local experiential evidence of increasing climate variability may be justified as will be seen below.

Interpretation of data is limited by insufficient recording stations and length of recording with only one station supplying data to international climate agencies (Mongu see Figure 15). Meanwhile, in the Bulozi floodplain area, the Zambia Meteorological Department does maintain stations at Lukulu, Kalabo and Senanga as well as at Mongu, although, as previously stated, data availability is differential between stations. However, from the information and analysis available provide some idea of rainfall and temperature dynamics and trends can be ascertained.

Rainfall decreases from north to south through the Valley with the central plain receiving around 950 mm per year. Rainfall over the period 1906-2005 at Mongu shows cyclical consistency on a roughly intradecadal basis with generally higher levels of rainfall in the later middle parts of the century (see Figure 13). This information is useful in terms of rainfall in and around the Bulozi plain but is not necessarily consistent with other regions supplying rainfall run-off to Bulozi.

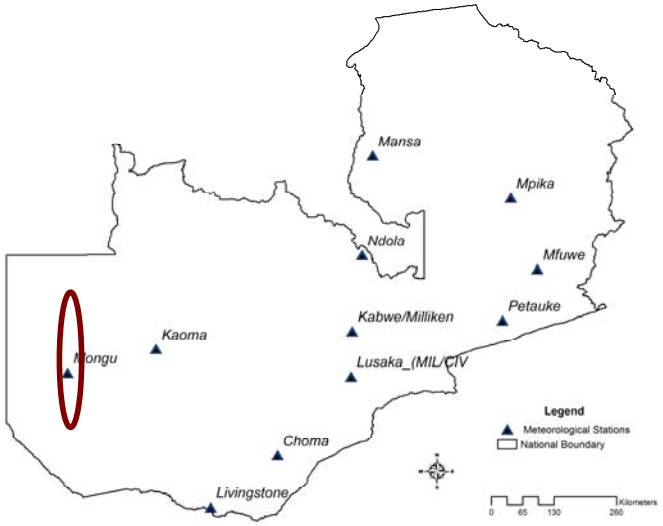

Figure 15: showing weather stations connected to the World Meteorological Organisation network of monitoring stations. Only one of these (Mongu) lies in or close to the Bulozi floodplain (marked with maroon oval)

From evidence taken during the LYVA project fieldwork, respondents asserted that in their living memory, rainfall and flood had become less predictable in recent decades than previously. This variability took the form of late starts to the rainy season and more heavy damaging storms, with torrential downpours. People also spoke of increasing occurrence of extreme hot temperatures in the pre-rainy season and cold temperatures in the post-flood winter season.

5.2 *Climate variability and its impacts*

The following observations and analysis demonstrate how information supplied by local people may have some correlation with climate data. It is important to be careful when considering observed changes. In particular, it is not clear that these changes are representative of the wider region as they are derived from one rain gauge (located at Mongu) and results for Kasempa to the northeast are dissimilar (earlier start to the rains and increased seasonal duration). In light of this, these results are really a possible guide to rainfall dynamics at Mongu station that may inform discussions around variation and uncertainty experienced affecting particular sectors e.g. rain-fed agriculture.

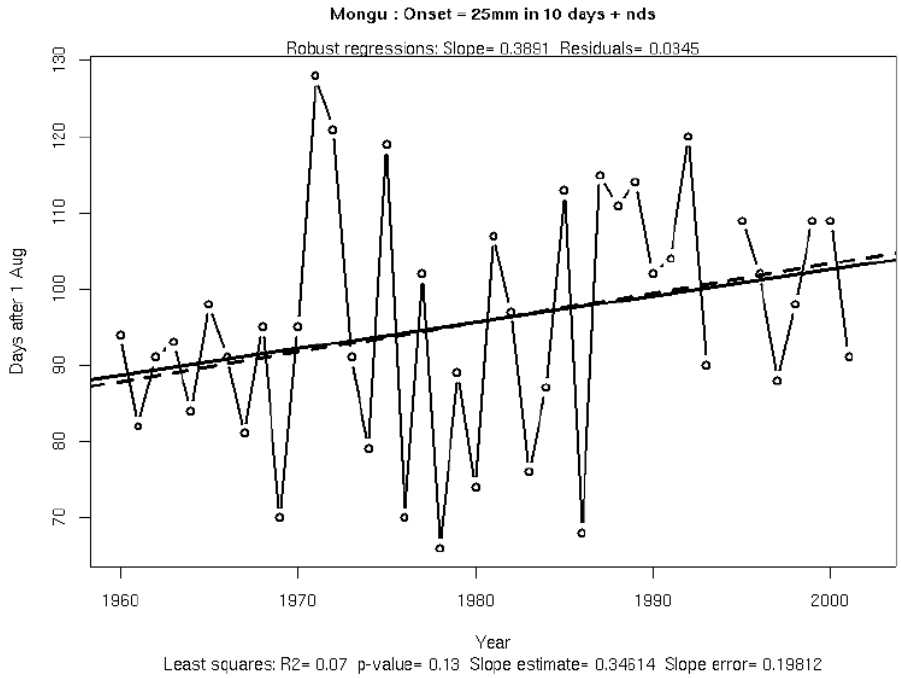

Figure 16: Planting days (days after 1st August) for each year: assumed to be when 25mm of rainfall falls in a 10 day period and is not followed by a dry spell of 10 days or longer in the following 20 days (data supplied by Climate Systems Analysis Group, University of Cape Town)

Figure 16 above shows the planting day (no. of days after 1st August) for each year which is taken as being the first day when 25mm of rain falls in 10 days and is not followed by dry spell of 10 days or longer in the following 20 days. On average, planting dates are later during the later period (approx 10-15 days) but the trend is not statistically significant. There may be a step change in the data around 1980 but the high variability during this period makes definitive statements difficult.

Figure 17 indicates the day (after 1st august) of the end of the rainfall season (cessation) taken when 3 consecutive 10-day periods each have less than 20mm of rainfall. This figure indicates no very little long-term change in rainfall cessation during the period.

Figure 18 indicates the duration of each season (days) as the number of days between planting and cessation days. This indicates a clearer trend for reduced seasonal duration over time. The trend is significant at the 93% confidence interval and suggests a reduction of 20-30 days in the duration of the rainfall season as defined here. Again there is a lot of variability between years. All three tables display a high degree of variation and this adds to the difficulty of discerning a trend

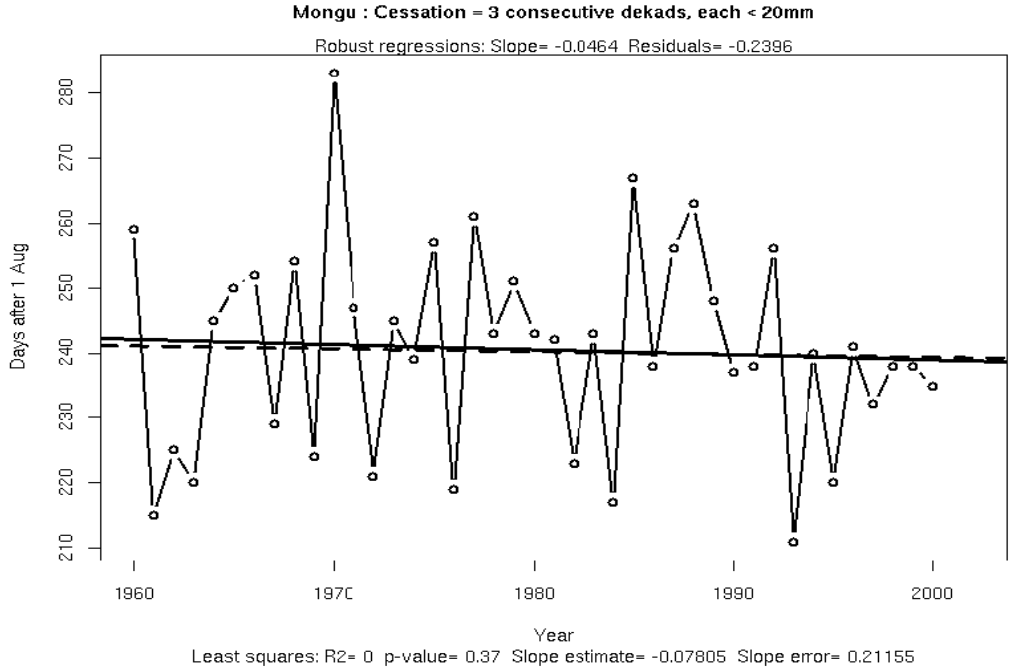

Figure 17: Day of rainfall cessation (days after 1st August) taken when 3 consecutive 10-day periods have less than 20mm of rain in each 10-day period (data supplied by Climate Systems Analysis Group, University of Cape Town)

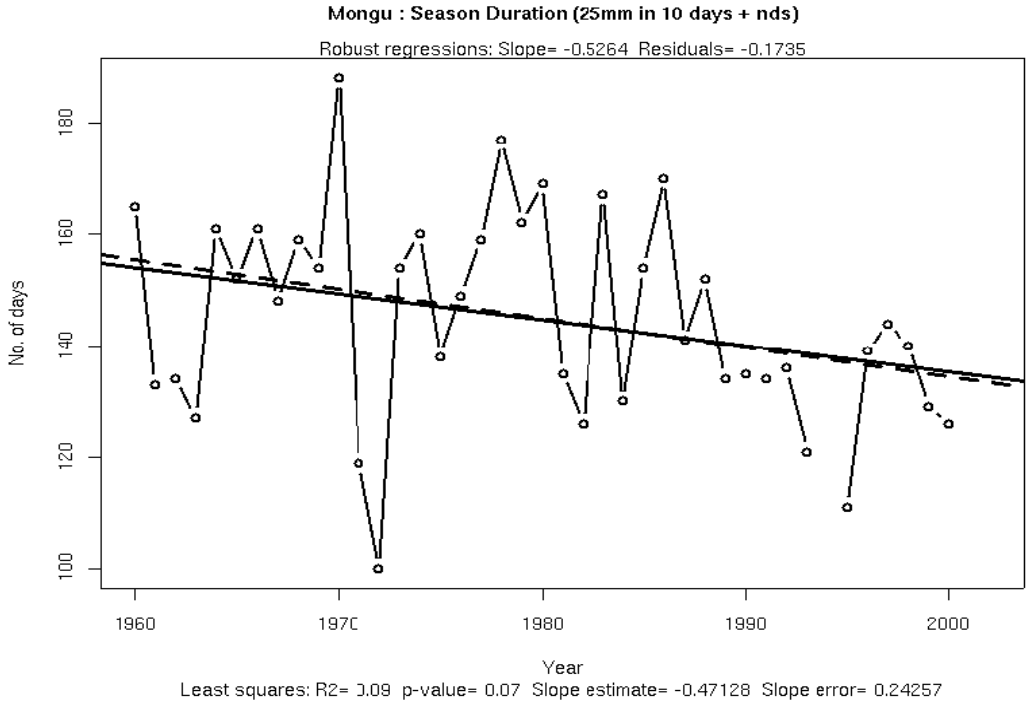

Figure 18: Seasonal duration (days) taken as the number of days between the planting and cessation days defined earlier (data supplied by Climate Systems Analysis Group, University of Cape Town)

Figure 19 shows the statistically downscaled projected change in monthly rainfall for 6 GCMs (boxplots). The main aspect of the figure is that the boxplot ranges straddle the zero change line i.e. there is little consensus of +/- change between each downscaled model. Except during the late summer (March – May) period, when the indication is that rainfall will increase (this is more consistent in the change projected for rain days where all downscaled models show an increase during this period – not shown). This is therefore the consistent message for rainfall changes that might be expected under this scenario of climate change.

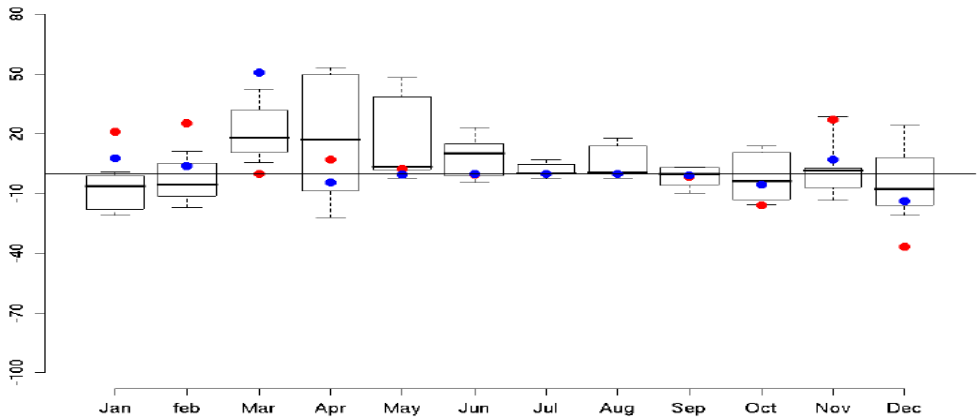

Figure 19: Change in monthly total rainfall (mm) statistically downscaled from 6 GCMs (boxplots). Change is for A2 SRES scenario for the period 2070-2100 (data supplied by Climate Systems Analysis Group, University of Cape Town)

Whilst it is beyond the scope of this work to speculate on links between historical and projected future change it is clear that the extension of the summer rainfall season suggested in the downscaled future climate projections is not yet observable in the historical record. This is not surprising as rainfall changes related to climate change may not become apparent for several decades. It is also worth noting that different aspects of rainfall (frequency and intensity) may change at different periods in the future, resulting in non-linear changes that will not be captured when looking at single periods in the future (such as the 2070-2100 period in Figure 19).

5.3 *Temperature*

Temperature data also appear to bear out the experiential evidence provided by local people, although yet again, the data used for analysis is only from one monitoring station, Mongu.

It would appear from the evidence in Figures 20 and 21 that the occurrence of extreme heat and days of above average temperatures are increasing in frequency and persisting longer. This would correlate with experiential evidence provided during participative action field research suggesting a later start to the rainy season. As with precipitation, such variations do not show up significantly when looking at overall averages. If we compare the above evidence with that from the charts in Figures 22 and 23 it is hard to detect the same trends although it is clear from these latter two that maximum temperatures seem to be increasing in the hot season and, as local people have suggested, there is some evidence that minimum temperatures are declining. Thus it is only when weather variability is analysed that it is possible to see the real climate change taking place that is impacting on local lives and livelihoods.

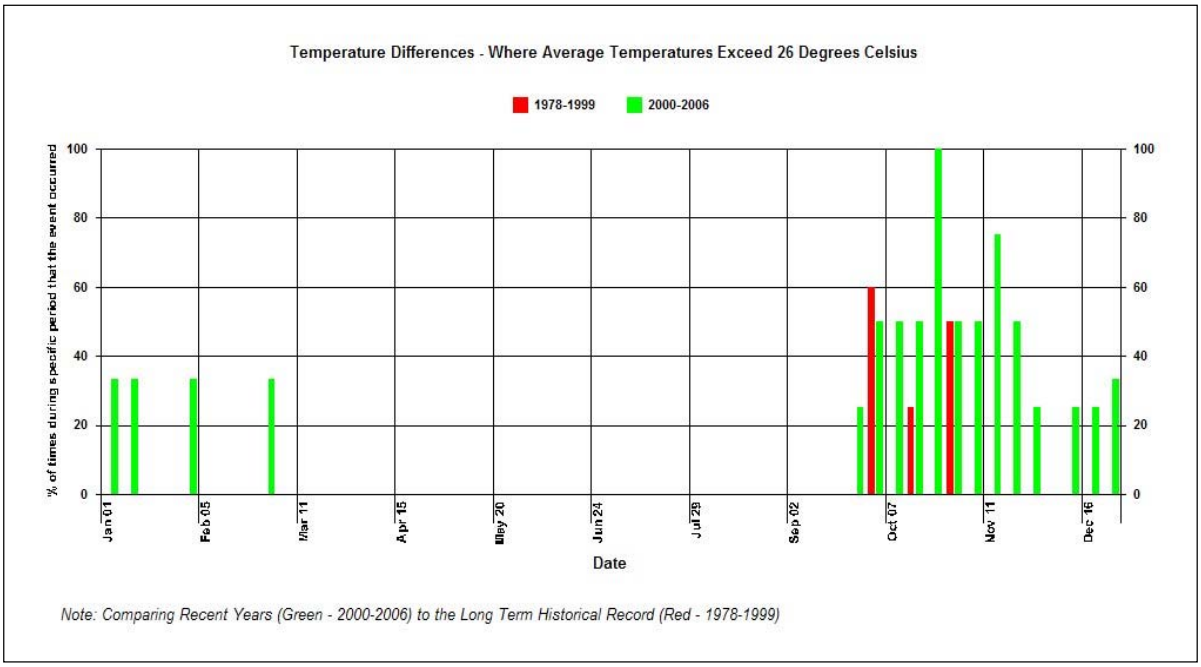

Figure 20: Chart showing occurrence of average temperatures in excess of 26°C for the period 2000-2006 (green bars) and 1978-1999 (red bars) [compiled by Fernanda Zermoglio with the use of MetWhere (TM), available form AWhere, Inc.] [5]

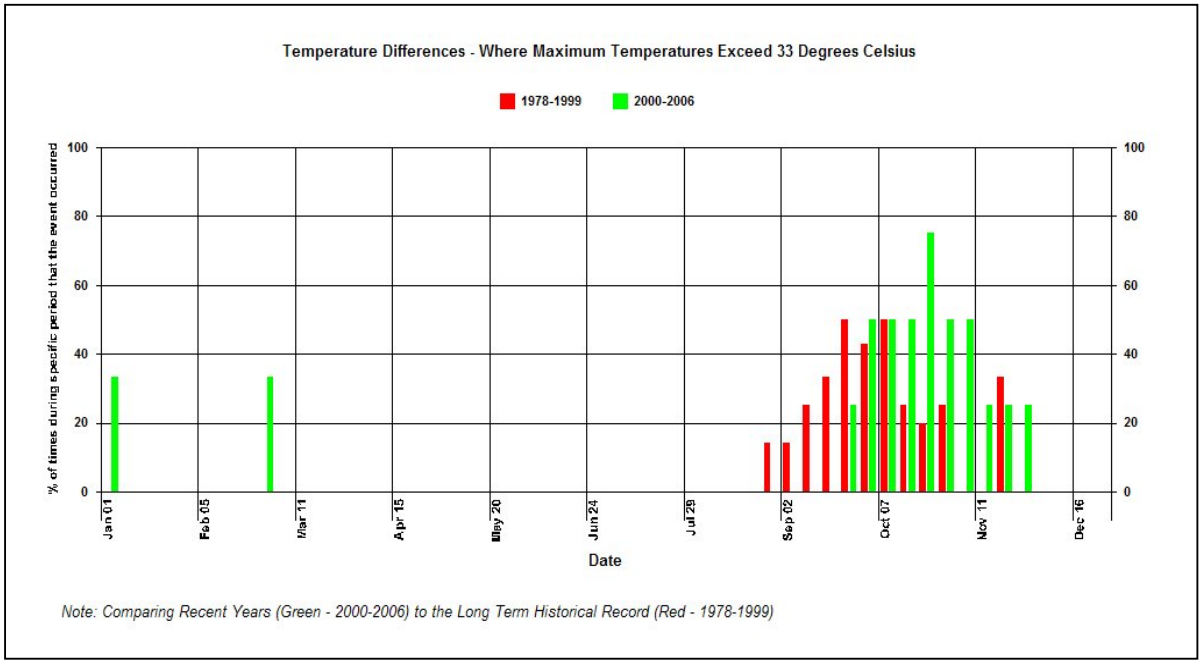

Figure 21: Chart showing occurrence of maximum temperatures exceeding 33°C for the period 2000-2006 (green bars) and 1978-1999 (red bars) [compiled by Fernanda Zermoglio with the use of MetWhere (TM), available form AWhere, Inc.][5]

[5] AWhere Inc. (mapping software experts) 720 14th St., Golden, CO 80401 Tel: 303.279.9293 Fax: 303.279.9327.

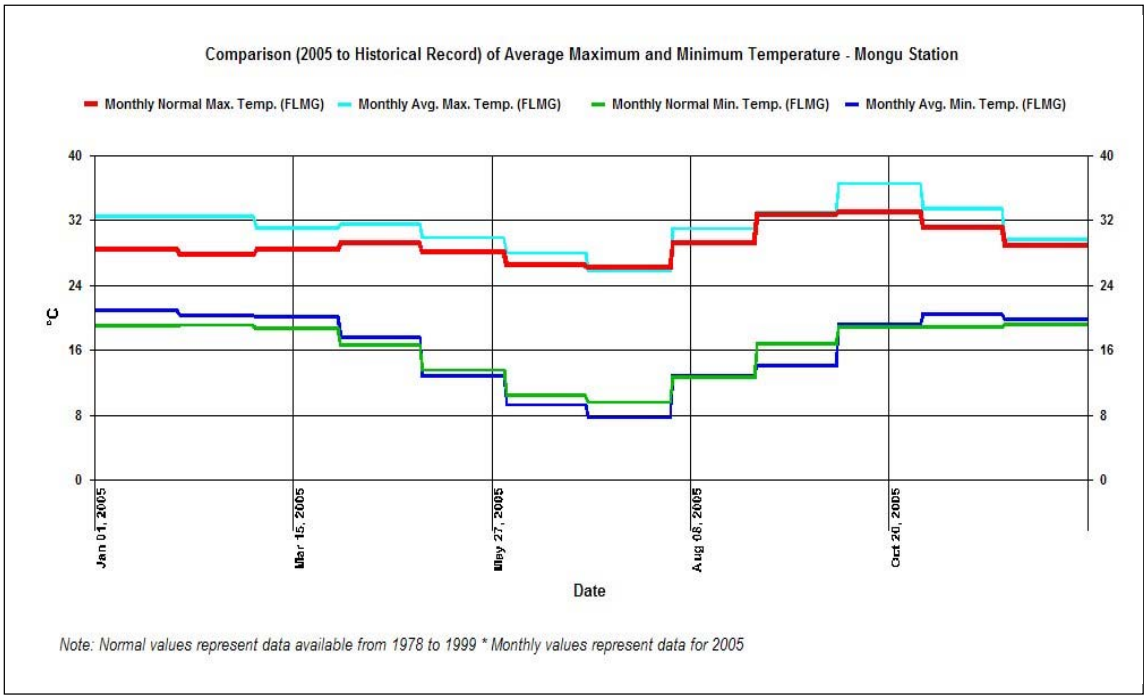

Figure 22: Chart showing average maximum and minimum temperatures for 2005 compared with the period 1975-1999 ('normal') [compiled by Fernanda Zermoglio with the use of MetWhere (TM), available form AWhere, Inc.][5]

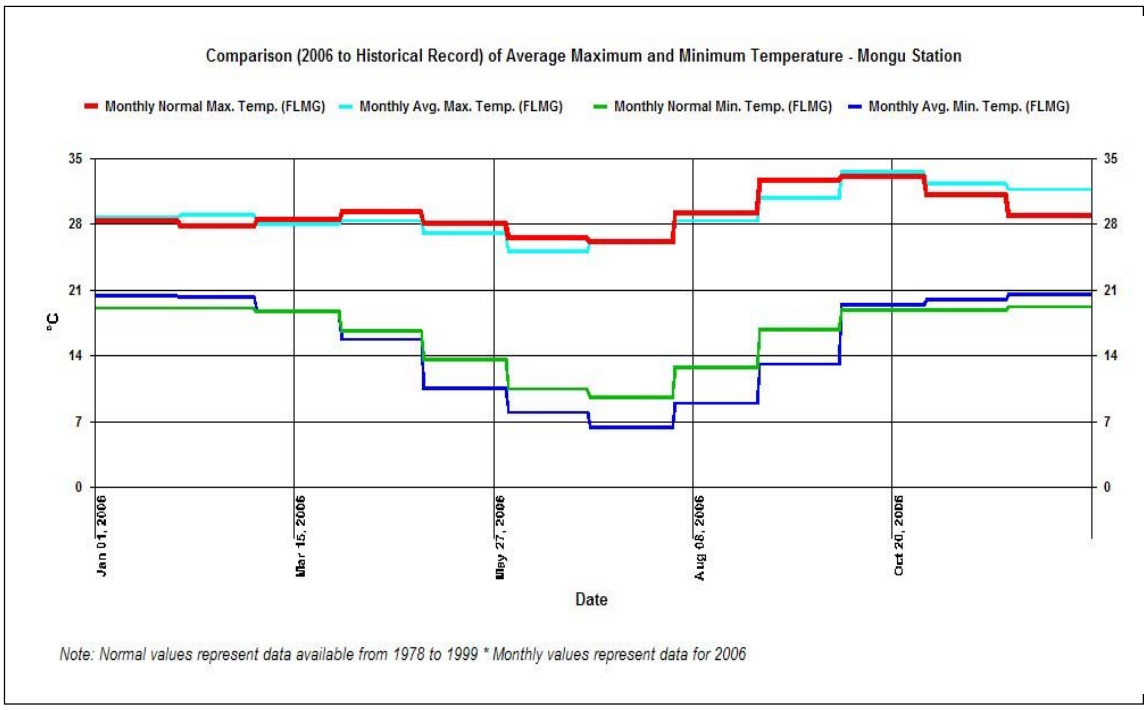

Figure 23: Chart showing average maximum and minimum temperatures for 2006 compared with the period 1975-1999 ('normal') [compiled by Fernanda Zermoglio with the use of MetWhere (TM), available form AWhere, Inc.][5]

Thus climate change is by no means new to the Lozi whose productive system has been mediated by climate since earliest times in the valley. What has changed though, and is articulated by those whose livelihoods still focus on the plains ecosystem, is the level of uncertainty and increasing unpredictability of climate and the extremes that have started to be experienced in recent memory. These include temperatures (hotter in the hot, dry season and colder in mid-winter) and more frequent damaging storms with high winds and torrential lashing rain. Floods have also become even more unpredictable than before, with unusually high floods causing damage to crops and infrastructure interspersed with drought years such as 2004-5 when agricultural production was decimated and famine rapidly ensued. These high and low flood years are crosscut by shifts in timing resulting from increasingly irregular rainfall patterns. The fact that this region now exists on the edge of subsistence makes it sensitive and vulnerable to increasing climate variability.

6.0 Adaptation and the idea of "community" adaptation

Sen (1999) defines development as the creation of choice and lack of development as having no choice or no say in what happens.[6] According to Sen's analysis, underdevelopment is a condition in which a mode of economic production has ceased, due to changed local or external conditions that render the process valueless, and where no alternative strategy is in place and available to pursue. Vulnerability, meanwhile, is produced as conditions change. Africa has been 'underdeveloped' by processes engineered by external and internal agencies whose agendas have conflicted with local human and ecological security. One might include here the Atlantic Slave Trade, formal colonialism and postcolonial neo-liberal paradigms that encouraged Africa to reduce food self-sufficiency and rely on export earnings from a single crop or raw mineral. In this way, for centuries past, Africa was sucked into a vortex of increasing vulnerability by reducing its choices and making it dependent on economic processes articulated and controlled from outside.

Thus, any exogenous, or for that matter, endogenous shock may do serious damage to the resilience of the African social economy. This could take the form, for example, of an earthquake, an extreme climate event, a sudden drop or rise in commodity prices on international trading markets or a substantial change in nature or content of inputs to a socio-ecological system. However, no single event that appears to be causing so much damage, such as climate change, is in fact the main cause of sensitivity and vulnerability. It may, however, be an exacerbating factor, impacting a cumulative series of debilitating social processes that have already engendered serious vulnerability that the current event or process is now able to impact upon in such a virulent way. Adaptation must, therefore, engage with the historical production of vulnerability that increasing climate dynamics are impacting upon.

Adaptation, should therefore, be a response partly to current exigency, such as increasing climate change and variability and partly to the historical social production of vulnerability. Adaptation attacks vulnerability or low resilience and any false postcolonialist notion of dependency, so rampant in contemporary Africa. This is because it encourages inspirational, self motivational thinking 'from the inside', along the lines of 'what can we do and what do we want to do for ourselves to increase our options and make us both less dependent and less vulnerable?' In this sense adaptation looks at current capacity and what can be achieved, and what might be useful from outside to build or extend existing capacity, not to replace it.

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[6] Sen, A. Development as Freedom (Oxford University Press, Oxford, 1999), also "The Possibility of Social Choice," American Economic Review (American Economic Association, 89 (3) 1999, 349-378).

Adaptation must take place in an arena of increased awareness, ownership and a sense of shared responsibility. Knowledge and information are the two key 'goods' that are required for adaptation to be enacted sustainably for both maintenance of the SES and socio-economic development of the human component. Yet even possession of these key goods is insufficient without an understanding first of the essential difference between information and knowledge and how to manage the two to increase capabilities and choice, thereby increasing resilience, a key objective of adaptation.

Adaptation is a social response to human and environmental vulnerability. As suggested, most vulnerability has not been caused by current dynamics such as increasing climate change, but climate variability and uncertainty have become added factors exacerbating vulnerability. Smit et al. (2000) assert that there are two distinct modes of adaptation to be considered in relation to climate change impacts, those aimed primarily at the physical environment and those aimed at human processes, primarily socio-economic. However, in most cases the two are interdependent; they cannot operate independently. This is to say that both sets of processes have causal relationships with one another.

Adaptation actions are rarely innovative; being mostly based on ideas that were already thought about. What is innovative is the thinking and methodology that lies behind community adaptation planning e.g. thinking and learning about climate in a locally interpreted and valorised manner, assessing vulnerability and resilience from and within an affected community's purview and planning actions to alleviate or prevent vulnerability across time. This does not suggest rejection of information, knowledge, skills and technology from the outside; on the contrary, community adaptation welcomes such inputs; simply, they must be interpreted, acculturated and valorised within the community.

The way in which we communicate information on climate (such as early warning systems), communicating climate risk, assessing adaptation capacity and delivering alternative strategies for consideration and possible implementation by stakeholder groups. In fact, the communicative strategy attached to climate adaptation is a vital adaptation action in itself as will be explained.

Adaptation must be seen as a positive response to a set of changes that, on the one hand, produces threats while, on the other, concomitantly produces sets of opportunities. It is this aspect that injects positivity into the adaptation process. Adaptation to vulnerability, whether impacted by climate change or other processes, can lead to innovation in a multiplicity of ways not necessarily connected to the prime cause of vulnerability. This translates what would otherwise be a discreet process responding to a single dynamic (e.g. climate) into one which can and must be integrated into sustainable development strategies.

Adaptation, then, is a positive social process. It is partly about creating a set of insurance policies against loss of lives and livelihoods in the form of increased choices and alternatives. Its methodology focuses on communicative dynamics such as social learning, participative workshops, consultation etc. and actions that respond to community perceptions, aspirations and objectives. In fact, the communicative strategy attached to climate adaptation is a vital and core adaptation action in itself. Adaptation requires stakeholder communities to undertake cognitive discourse (in participative workshop environments) concerning past practices, indigenous knowledge and skills. It may also result in realising that even after remembering and adding up all the cumulative knowledge, skills and coping strategies employed to date, that this is not enough to deal with current exigencies or to achieve community aspirations in the context of survival or sustainable socio-ecological development.

And on that basis, community adaptation capacity can more easily be assessed and objectives designed to be negotiated with relevant potential enabling agencies i.e. donors and institutions possessing some or any of the desired resources to achieve stated objectives, including policy and decision makers, all of whom can assist or erect substantial barriers to achievement.

A vital strategic component of the communications strategy is management. A central argument of this work is that part of the explanation for the conspicuous failure of prior paradigmatic development ideologies and strategies to date, including climate adaptation is that firstly, they have not been grounded in the lived experience of people and their ecosystems and that they have omitted to consider the vital ability to manage the conversion of information into knowledge, knowledge into planning and planning into implementation.

Effective strategic management of resources and knowledge is a key lubricant of all these processes. No business could survive without it yet it does not receive sufficient attention from most stakeholders in the development "community", mainly because they have little experience in the field. Effective management of community adaptation must adhere to the ethical (moral and cultural) standards of the community and requires a set of targets supplied and endorsed by a wide cross-section of the community and its representative leadership. Planned outcomes must fit into a community's envisioning of a desirable future within present and forecast constraints. They must also be perceived as achievable i.e. viable in an operational sense, adhering to a sense of community "futurability".

6.1 *Community-based adaptation*

When we talk about community it is necessary to know what we mean. A community can be a social or a material term but what it embodies in all cases is a sense of cohesion, some aspect of sharing or commonality. In social terms it may refer to people who share a common homeland or urban/rural living space (such as a village) or it may refer to common race, profession, technical aspect or other mode of identity.

Thus, community based adaptation (CBA), for example, to climate change, is action by or for a community to alleviate or respond to the negative impacts of increasing climate dynamics in order to maintain human security and enhance levels of social and economic development. These actions should not augment inputs to global warming and should at all times conserve the ecological sustainability of the community and its ability to reproduce the biocapacity it consumes.

All of these stages involve boundary partners to a greater or lesser degree and Figure 24 below puts the variety of possible boundary partner into perspective. The list is not exhaustive and may vary between project according to the theme, location and community involved.

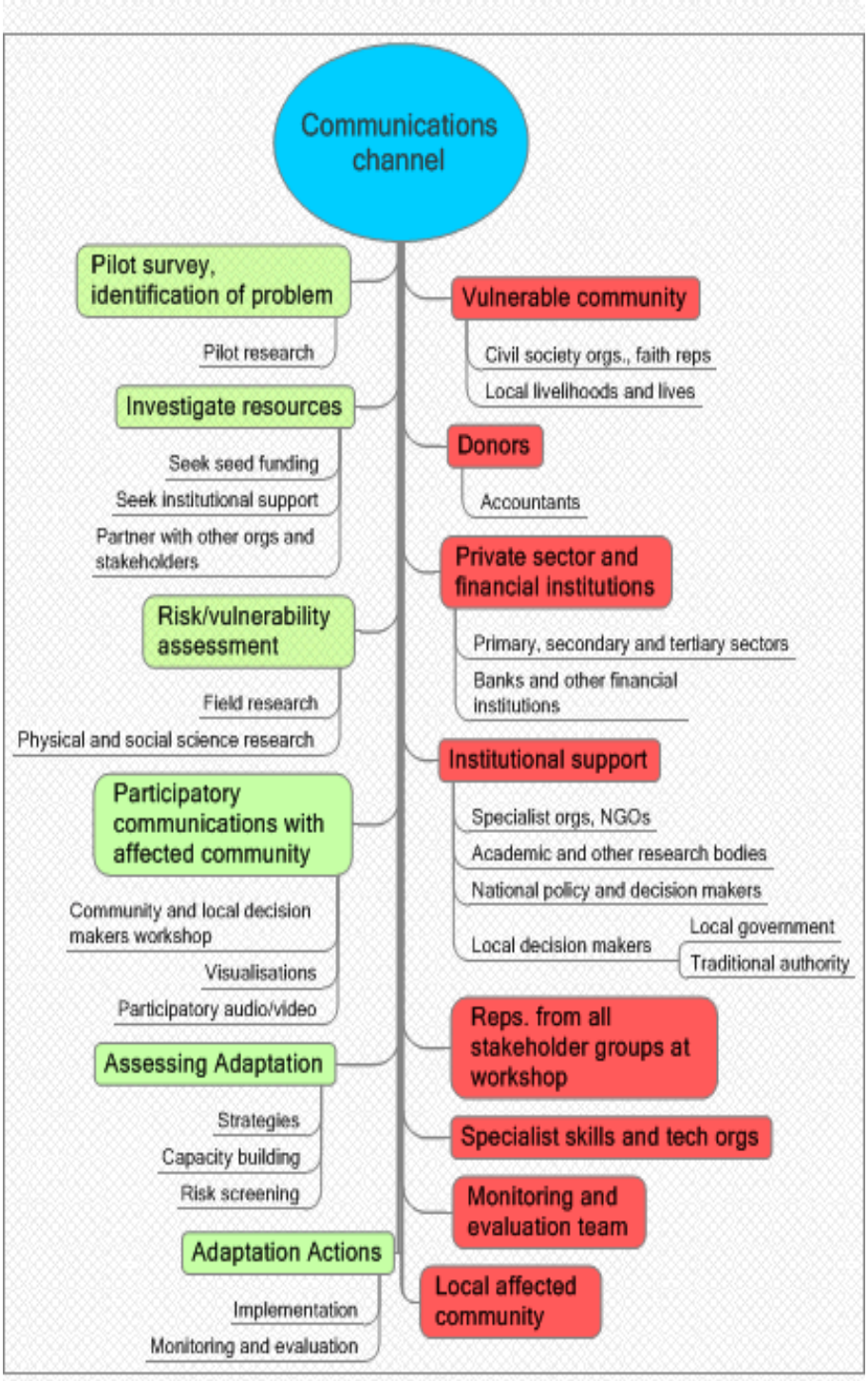

Figure 24: The communicative stages and nodal points that a CBA project might engage with on its journey towards adaptation action

Community adaptation is about local people taking control of their potential and their destinies with external assistance provided at the behest and according to the agenda of the population group, termed 'community'. This external assistance can be sought in two forms, technical and managerial. The first deals with skills, training and the introduction of new or better technologies to supplement, not to replace existing coping and management

strategies that have traditionally taken cognizance of the environment and conservation of the assets upon which the local population have depended for survival and growth.

The second deals with communicative strategies and management of human resources with social learning, respect for local culture and tradition at the core of its methodology. This methodology is loosely termed participative action research and is based on a two way learning system whereby local experts and external development researchers and practitioners inform each other to the long-term benefit of the vulnerable population who may rediscover and, more importantly, re-valorise their own indigenous knowledge and systems and benefit from information and knowledge from outside that they select for its usefulness and relevance to their lives and livelihoods.

In this scenario, it does not serve for science to be presented in a form that and in a language that is not familiar to the recipient. Thus researchers and scientists who endeavour to assist vulnerable communities to adapt, must codify and translate the language of their assistance into meaningful and useful terminology that can be understood and employed locally. It is also important to transfer the knowledge and information that is desired and not to overload or send signals that may blur or alarm local people. Thus the business of effective risk communication and management o information and knowledge becomes a responsibility on all stakeholders in the identification and assessment of vulnerability and strategizing for adaptation.

Throughout this process there is a demand for understanding local and external epistemologies and for cognitive recognition of processes that are too often articulated in mediums incomprehensible to 'local' communities. Local ways of interpreting information processed and exported by a world increasingly dominated by globalising scientific practices and market-based dynamics of the global capitalist economy are rarely understood or appreciated. The medium and language used in export is often unsuitable or inappropriate in the arena of vulnerable communities in the developing world, who are denied access to 'modern' or associative processes for deciphering globalised or scientific information and epistemologies and attach completely different meanings and interpretations based on their own modes of politico-economic and socio-cultural regulation.

6.2 *Notions of community and "ownership"*

The central pivot around which the management of a socio-ecological system and adaptation effectiveness must revolve is ownership by the society that dwells within the system whose vulnerability is being addressed by the adaptation action. It is around ownership that the concept of community comes into play as it is not possible for ownership to exist without owners. When we talk about community it is necessary to define what is meant. Thus, 'community' is a fluid idea, socially constructed and largely imaginary (reflecting Anderson's 1983 concept of perceived affinities); it can be a social or a material term but what it embodies in all cases is a sense of cohesion, some aspect of sharing or commonality. In social terms it may refer to people who share a common homeland or urban/rural living space (such as a village) or it may refer to common race, profession, technical aspect or other mode of identity. Thus, community, as a social concept, does not have rigid discrete boundaries.

Ownership, particularly 'local ownership', is a much embraced term in contemporary development discourse yet few projects and programmes address the issue subjectively which, it is argued here, is where the true achievement of ownership lies. Ownership is an essentially internal and subjective feeling that comes about as a result of intertwining

strands of emotional response to physical and metaphysical goods or processes that may or may not have physical shape, dimensions and tangibility.

The argument being deployed here is that a real sense of ownership of the adaptation process is commensurate with assuming responsibility for its operationalisation, management and achievement of outcomes. In the case of the SES, the population dwelling within the system rely on ecological goods and services provided by the system and have an obvious interest in actions that maintain and support both these goods and services and extend socio-economic development through better practices of diversification. An extension of this argument is that if a sense of ownership is imbibed by the community, that engenders responsibility for the adaptation process, a stronger sense of motivation, innovation and positivity will ensue. These are essential in order to overcome the postcoloniality that has coloured most previous development work (amongst both the development "industry" and those communities and populations whose vulnerability, impoverishment or inequalities have been the subject of the "industry").

However, ownership is not something that can be imbued by a person, community or organisation in a purely material, objective manner; rather, ownership lies essentially in the metaphysical, subjective realm. Thus, one may own a building in the legal, material and objective sense with title deeds. However, because of a high mortgage, or because the building was inherited or due to the nature of social relationships with those who live in or occupy the building or conduct a range of socio-economic or cultural activities from it, one may actually experience little true sense of subjective ownership or control.

Thus if an adaptation project is serious about community or stakeholder ownership then it must adopt a deliberate strategy aimed at making this a felt reality both in an objective and subjective sense. For any community adaptation project the entry point is talking, listening to and valuing the evidence in what might be termed 'real life stories of lives and livelihoods' presented by a community, constructed within the community world-view and cosmos. One example might be participatory 'social learning' (learning from each other) workshops, held in the heart of the home region of the community (and not in a remote place). Here, the agenda and direction of issues discussed must be set by community members.

Outsiders may participate, mostly by learning from the evidence (physical and metaphysical) of the community and imparting information (as opposed to knowledge, unless this is requested) that can be useful for the community to digest, interpret, acculturate and validate or reject. The process and output of such events is easily broadcast to the wider community that may want to make statements via local communications networks – religious gatherings, traditional authorities and local governance, media and civil society representative groups, including gender, youth associative organisations or politically formations. This communicative outpouring, together perhaps with in-depth field surveys by *local* researchers AND locally valorised scientific and other information supplied from outside, are the essential first steps towards creating a sense of *local* ownership and the belief that 'this is *about* us, authored *by* us, and *for* us.'

The process of expressing and disseminating experiential evidence in a participative manner is an adaptive process in itself because the participants take ownership of the collective sum of their experiences and knowledge from which the willingness to adapt and to seek adaptive capacity in order to be able to adapt becomes a logical extension of the process of social learning.

Adaptation, then, can be seen as a process which must be integrated into the struggle for socio-economic development within the framework of sustainable human and environmental security. It is a process and not an event, it is not discreet and neither are the impacts of climate change which have contributed to the vulnerability upon which adaptation will act. Meanwhile, the goal of 'mainstreaming adaptation' is meaningless unless it is understood that policy and/or policy makers cannot create adaptation. They can, however, encourage and influence the adoption of adaptation as a conceptual process by affected communities and their representative leaderships.

Similarly, there are no individuals or organisations who can claim to be practitioners of adaptation, *per se*. This would be to diminish and undervalue the agency of the real practitioners of adaptation, the communities who, through their active representative bodies, decide for themselves if and when to indulge in adaptation. Instead, those who get involved with adaptive processes should see themselves as catalysts, enablers, helpers, drivers even from below. They may be providers of requested information, knowledge and skills; to claim more would be pejorative to the communities and their appointed representatives/leaders who have decided to do the adapting. Most particularly, interaction with or participation in the adaptation process from the outside can only be meaningful when the outside agency can be perceived as valuing the social information held by the community and the socio-ecological environment with which it attempts to intercede.

6.3 *The vital role of policy and decision makers in the adaptation process*

By pivoting adaptation around the idea of integrating responses to climate into strategies devised primarily by vulnerable communities themselves to maintain and enhance self-sufficiency, resilience and sustainable development, policy and decision makers can feel a sense that adaptation responds to their own agendas. This makes the idea of mainstreaming adaptation less of an intrusive and alien concept, imported from outside by agencies from the advanced economies whose responsibility for the dynamic they are trying to address is highly suspect.

Politicians and policy/decision makers across the world in both the developed and developing world are taking climate change more seriously. This is because the process is on the cusp of every major discussion of the world economy and because governments have to engage with processes such as production of national communications on climate change to show just what they are doing in their respective countries and how they are mainstreaming climate into their national development plans. National Adaptation Plans of Action (NAPAs) and Poverty Reduction Strategy Papers (PRSPs) are just two examples of this.

However, there are two further intervening barriers between policy makers knowing that adaptation requires to be mainstreamed and obtaining their support for enabling policies and help in eliminating bad practices. The first is to do with the fact that most decision makers have little knowledge of climate and even less time to spend on gaining such knowledge. The second has more to do with decision makers' sets of priorities that have more to do with economic development or poverty reduction and self-preservation than with the efficacy of adaptation. Yet the two goals have to be seen to be harmonious and mutually desirable.

It is important to engage both national and local decision and policy makers at the outset of an adaptation project in order to gain legitimacy and to cement into place a node of communication that will need to be returned to during and certainly at the end of the process. However, for this engagement to be successful requires research into the agenda and pressures facing the relevant policy maker, and renewed focus on positive, sustainable community development.

Meanwhile, as in the arena of CBA itself, failure or perceived failure to achieve the stated objectives of adaptation can be fatal to the credibility of a project and practitioner. Policy makers like to be associated with measures that are popular. So, at the outset it is important to agree on objectives and realistic projected outcomes. The emphasis is on gaining legitimacy while stressing the vitality of the report-back function, possibly with a policy makers workshop, saying what has worked well and what has not and to show how it will be possible for local people, through their own enhanced capacity, to adjust, replicate and upscale those actions that have worked. This is to show that, for adaptation practitioners, the intention is only to inspire, drive and build capacity and not to create territory.

Thus, the emphasis at the policy maker level is to inform, be positive, obtain approval and legitimacy, and promise to come back with results that can be presented in a policy maker's workshop. This way, policy makers benefit in a useful and constructive way from the work that has taken place, get a better idea of local realities and are able to utilise the information better in their policy reviews. Climate, in effect has been integrated into policy and decision-making.

6.4 *Vulnerability and community adaptation in Bulozi*

CBA projects began in the Bulozi floodplain in early 2007 under the aegis of a local NGO, based in the main town of the floodplain region, Mongu, and comprising a small team of dedicated Lozi personnel. The project has been entitled the Lyambai Vulnerability and Adaptation (LYVA) project .The team has received capacity building in the way of training, software, funding and equipment from outside organisations to start an adaptation project in four village clusters in and close to the eastern margin of the floodplain.

The strategy consisted of a strong early research component carried out by local field researchers in the villages concerned, followed by a community workshop in Mongu involving representatives of the four village clusters concerned, including livelihood operators, climate specialists (Lozi), local government and specialist departments, faith representatives, local media and organisation workers. The research methodology employed throughout this process was Participatory Action research in association with social learning whereby researchers and local scientists imparted information on climate and learnt from villagers about their interpretation of climate and its impacts on lives and livelihoods.

During field research and at the LYVA Community Workshop held in Mongu in October 2007, local livelihood workers and leaders from the four village clusters spoke of a growing sense of uncertainty and confusion that had crept into their lives as a result of unexpected weather events and their impacts. This uncertainty was reflected in the way that people related to the natural environment, the plains system of which they and their ancestors had been a part for so many generations. It was also reflected in adaptation decisions such as temporary or permanent migration that served no useful purpose for self-sufficiency in the region leaving the population deprived of working age males in particular, and with a growing dependent population of very young and old (including retired Lozis returning to their beloved homeland from various locations of financial and material accumulation).

Most local people are very well aware of the way their floodplain ecosystem works. Some expressed confusion about increasing climate dynamics and all were anxious to move beyond the talking stage. This confusion was expressed through discussion of lives and livelihoods. It centred on immediate concerns regarding planting, loss of crops, damage to infrastructure, people injured or dying due to extremes of weather or other indirect impacts. In terms of contributing to vulnerability, of particular significance was the realisation of

certain bad practices for example in fishing and burning and how these practices have been invaded and distorted by outsiders who are not aware of traditional Lozi practices.

People spoke also of the way they felt that sometimes they felt forced to do things that, in their hearts, they knew were damaging to the ecosystem such as fishing with mosquito nets and allowing pigs to roam uncontrolled. Pig-keeping has become popular in recent years as traditional cattle-rearing has become too expensive for local people. Unfortunately, when pigs not kept enclosed, they have tended to rummage for root vegetables and plants that form emergency rations for people in times of food shortage and crisis.

Many were critical of the fact that the traditional authority, the Barotse Royal Establishment (BRE) no longer polices ecosystem goods and services as in the past, while representatives from the BRE itself defended their institution robustly to local people stating that all their powers and resources to police the environment had been taken away over the years and that they now felt powerless to prevent bad practices from taking place.

Another significant theme at the workshop was that of belief with animated interaction developing between certain faith leaders and the climate scientists with the former almost accusing the latter of interference in the ways of "God". This debate attracted more comment on the issue of 'muloi' or witchcraft, something that most Lozis believe exists but never openly discuss. What these discussions may have pointed to was the idea that, in the past, the Lozi nation and natural environment had existed largely in harmony except when humans did something to upset the God or spirits, as a result of which, retribution would be exacted with penalties that were ecological in nature.

A further issue for discussion was that of broadcasting information. In the past, information, news or instructions were carried very quickly to different parts of the sphere of Lozi influence and beyond. This was a factor in the kingdom's eventual demise as a politico-economic entity as, like other redistributive world empires, to use Wallerstein's (2004) terminology, the ability to communicate became degraded by distance and time. Thus there exists in the contemporary era, a communications deficit because, to date, globalising modes of communication have not permeated much of the Bulozi floodplain. People receive information in the villages more by accident than design. There are two local radio stations both of whom came to the workshop. But both have limited coverage. Newspapers reach the main town of Mongu from Lusaka but are distributed no further. Thus, this became a key demand of local villagers, the need to receive information, whether it be news of a likely change in weather pattern (early warning) or information about issues concerning social welfare.

The second phase of the project in 2009 proposes to take the prioritised adaptation actions recommended by the village clusters and try to turn these into a reality by attracting funding and interest from outside. Key to this process is the enthusiasm and positive emphasis attached by local people to the LYVA project which is seen as Lozi people's own project helped from outside but designed and implemented by local people in the land and ecosystem of local people. Hence the sense of ownership responsibility for outcomes is high.

These consultative processes have resulted in the appreciation of local people for knowledge on issues such as climate change. A familiar refrain throughout the workshop was, 'we did not know about this' or 'nobody has ever discussed these things with us before' and 'we want to know more'. In the era when politico-centrality was centred in the floodplain, information was distributed, probably, it would be fair to say, on a need-to-know basis, but

it would appear that information provision and distribution was more effective than it is today due to higher levels of information and knowledge management.

Finally, during these essentially awareness-raising exercises, people made clear their dear affection and affinity with their floodplain environment and the socio-economic life associated with the annual shifts in ecological goods and services; by implication, this meant the ecosystem. There was consternation at the potential loss or damage to ecological goods and services as a result of processes which, for the one part are not controllable, but for the other, probably are (e.g. control over bad fishing methods, livestock and burning, cutting of timber for firewood or sale)).

7.0 Synthesis

Drawing together the strands from the different interdisciplinary lens reveals a vibrant socio-ecological system that has been exploited in the past to serve the purposes of dense human populations without damaging the ecological balance of the system. In the contemporary era, the strength of the relationship between ecosystem and social change has become disparate and dysfunctional on account of the emigration of power and influence and, with it, management of ecological goods and services to remote and indeterminate places leaving the SES vulnerable to damage, degradation and abuse from social processes and the negative impacts of biophysical processes such as climate variability and change.

When the Lozi nation was at its most influential, arguably at the start of the nineteenth century under the famed Litunga Mulambwa, the primitive Lozi state was centralised in the heart of the Bulozi floodplain from where power radiated to all corners of influence. People, goods and information, were imported into the heart of politico-economic centrality, where they were intercepted, questioned, and interpreted using local indigenous cognitive systems before being deployed and re-exported in locally acculturated form. Key to the effective management of the system was administration over water and core ecological goods such as fisheries, forestry, grazing and fertile land for cultivation. Because politico-economic power depended on the exploitation of ecological goods and services, these were valued, conserved and policed.

In the past, the Lozi leadership protected its future interests and that of the nation by carefully managing core ecological goods and services. Thus, although human activity in Bulozi was much greater than during the present era, the SES was actually less vulnerable because socio-economic resilience was high. By the early nineteenth century, however, like many primitive states with rudimentary communications infrastructure that blurred over distance, the Lozi kingdom had over-reached the limits of its capacity and became vulnerable to its own institutional incapacity. This left the entire socio-ecological system vulnerable to attack from within and without and the country was invaded from the east in the late 1820s by the Makololo who descended into the central Bulozi plain and took advantage of competition over power and wealth between warring factions of the Lozi elite.

In the two hundred years that have passed since the peak of indigenous ecosystem management, a succession of socio-economic processes have sucked the politico-economic power out of the floodplain and redistributed it, first in the hands of African invaders who partially usurped the existing system, then into the capitals of colonial powers, in this case British, and finally to the capitals of new African republics granted independence at the end of the colonial era. During this phase, the capacity to manage core ecological goods and services gradually became eroded and ecological systems over-exploited and abused due to lack of effective administration.

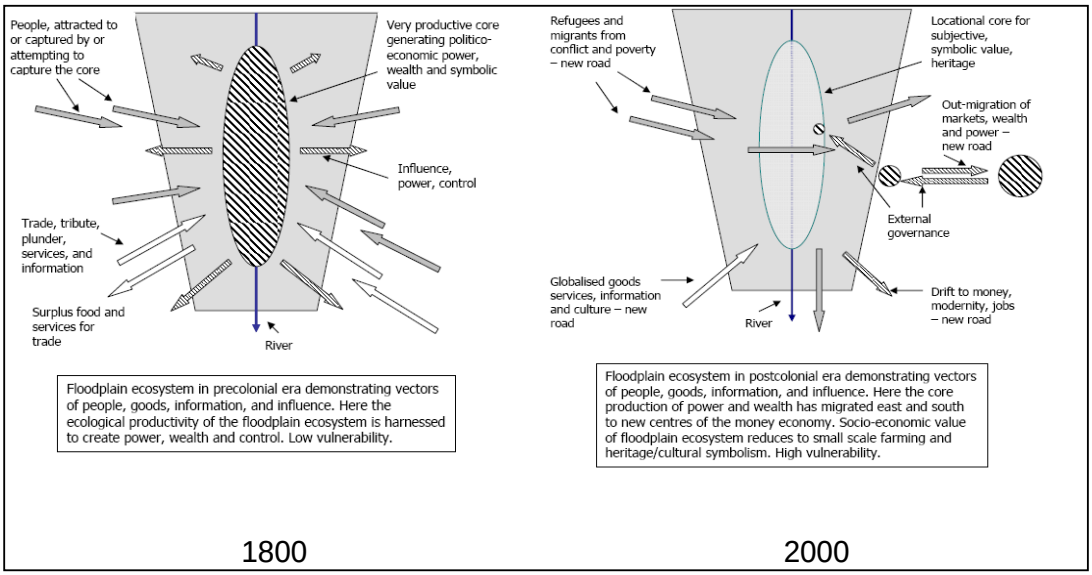

Figure 25: Migration of power and influence, including management and administration of key ecological goods and services.

In the current phase, flows of people goods and information take place in an unfettered and poorly controlled manner. Institutional capacity in the form of traditional authority and local government is low and does not have the capacity to police the impacts that these vectors of change have upon either the social or ecological components of the SES. Figure 25 displays this new vulnerability with much less social activity in 2001 than in 1801 with centrality of power fragmented and transferred to remote and indeterminate places in the minds of local society.

Peoples have remained and are subject to much more mobile and migratory flows across the floodplain but these do not bring value to the SES hence decreasing overall resilience of the system. Food production and self sufficiency was exported at the same time as power was lost thus both social and ecological vulnerability has been impacted. It is upon this set of dynamics that external processes such as increasing climate variability and change acts with such apparent intensity and impunity threatening the services that the SES still provides including the annual flood, ambient conditions for productive activity and for the exercise of culture and heritage.

8.0 Summary and conclusions

Floodplain ecosystems display potential for high degrees of biodiversity, particularly in riverine systems that have not been substantially modified by human hand. This potential has been made use of by countless human populations for life support livelihoods and establishment of settlement, sedentary agriculture and politico-economic centrality. The expression 'hydraulic empires' and 'hydraulic civilisations' arose to describe some of these systems. However, there is growing evidence of tensions between floodplain and other ecosystems, and human needs for food, water and energy security.

The human and ecological inputs, processes and outputs of the prevailing socio-ecological system (SES) active in the Bulozi floodplain in western Zambia are intertwined. Due to a variety of historical social processes of change, a high proportion of people in Bulozi

floodplain rely mostly on the biophysical environment for their lives and livelihoods but do not enjoy a high degree of resilience. To date, the relationship and impact on the natural functioning of the SES has been relatively benign compared to human interaction with other floodplain ecosystems. However, this position is likely to come under increasing threat during the next century due both to greater demand from migratory human populations (moving mostly west to east through the floodplain from Angola) and changing biophysical processes, particularly climate variability and change.

It is clear that the climate is already behaving more erratically in the Bulozi floodplain and the region surrounding the plain including the Central Angolan highlands from where the water creating the annual inundation of the plain mostly originates. This erratic behaviour has become increasingly apparent during the latter part of the twentieth century and start of twenty-first and is likely to increase in intensity in the decades to come. As discussed earlier, one manifestation of this might be a shortening growing season that may already have been set in train.

It has been suggested elsewhere that levels of human development and, implicitly, of vulnerability and resilience are affected by rainfall type and quantity, by latitude and by climate generally. In the case of Bulozi, there is no shortage of rainfall although it is unevenly distributed and arrives more erratically than before. Climate is characterised by extremes and these extremes appear to be on the increase causing uncertainty and confusion. However, peoples who have lived in the Bulozi floodplain ecosystem have endured and coped with extremes of climate in the past. Meanwhile, levels of social and economic development are low and have decreased, according to the local perception, compared to what they were a hundred or two hundred years ago. In addition, people's sense of impoverishment and disempowerment through the colonial and independence eras, has become acute.

In the past, the socio-ecological system (SES) of the floodplain and its ecological goods and services inspired the Lozi peoples who became dominant in the plain to produce food surplus to subsistence requirements which, in turn, permitted specialisation of activity, trading and the ability to impose influence and a differing degree of domination in the surrounding region. That these same peoples, several generations later, are some of the poorest in the sub-region with regular food shortages and generally low levels of life compared to other groups, generates two questions. The first concerns ecological conditions. Have the ecological goods and services that generated past wealth diminished or been degraded? Secondly, are there other problems that have created the socio-ecological vulnerability and low resilience demonstrated in recent decades?

The answer to the first is differential. Certainly, there is experiential evidence from local people, not yet supported by scientific measurement, of reduced biodiversity, particularly of birds, animals and trees and of changing behavioural dynamics. Meanwhile, as argued in the main body of this paper, floodplain inputs have not changed immeasurably. However, the ecological balance is starting to become more fragile due in some small part, to natural biophysical change and certainly climate is a factor here. But by far the largest explanation lies in socio-economic behaviour. There are several quantitative and qualitative social factors that have combined to break down social resilience:

- Lack of available labour – manual and skilled, when it is required
- Lack of mechanisation or use of draft power, most agriculture is carried out on smallholdings using manual labour

- Lack of technical capacity for investment in better seed strains, new crop varieties, irrigation for dry season agriculture, veterinary facilities to cope with new disease strains and prevalence among livestock
- Outdated land ownership/tenure system, does not incentivise production
- Poor or inadequate markets due to lack of consumer base and inadequacy of money economy
- Lack of locally situated experts and specialist vocational training, especially in management of human resources, information, knowledge and capital
- Lack of up to date reliable information, particularly regarding weather and climate, agricultural practices and possibilities, but also of social factors regarding people and training
- Lack of accessible water storage
- Lack of infrastructure in transport and communications
- Institutional weakness and barriers, high levels of bureaucracy, rent-seeking and corruption
- Poor engagement between the state and the rural areas, particularly those far form the capital and main industrial belt leading to:
- Low levels of education and training – particularly among women and girls
- Poor health services leading to increasing prevalence and deadliness of age-old diseases such as malaria and TB that are increasingly exacerbated by newer diseases that lower immunity, particularly HIV-AIDS

These boil down to a shortfall in capabilities, leading to reduced choices and this has engendered several bad practices that are impinging on the integrity of the ecological balance. The exigency of the situation is compounded by other dynamics concerned with human agency:

- Loss of administration and management skills for ecosystem goods and services and socio-economic processes and pre-existing knowledge networks and coping strategies.
- Increasingly mobile demographic dynamics with people leaving the region and others crossing the region, usually in a series of steps, from west to east in search of economic opportunities.
- Increasing confusion and uncertainty
- Low morale – a perception of helplessness and isolation made worse by increasing levels of crime and a gradual breakdown in societal structures under pressure from impoverishment and the arrival of outside influences that appear predatory and exploitative.
- The problem of postcoloniality, manifesting itself in the idea that improvement in conditions can only come with outside assistance. Loss of confidence in self and community when societal structures start to break down under the pressure of exigency. A feeling of exhaustion and exploitation by colonial and postcolonial forces that have squeezed the lifeblood out of the region over the last century

Thus vulnerability or low resilience is engendered by these predominantly social dynamics and the likelihood for the future is for both social and ecological vulnerability in the region to be exacerbated still further by mostly socio-economic developments including:

- Increasing climate change and variability, mostly contributed to by anthropogenic factors. It is almost certain that rainfall in the region will become increasingly variable and may decline in total. There will be an increase in extreme climate events that will cause damage to agriculture and infrastructure. Temperatures are also likely to

increase leading to increasing evaporation. Water scarcity as a result of these factors is likely to increase and the issue of inadequate water storage must be addressed urgently to avoid crisis and the need to take more extreme adaptation measures.

- New road currently under construction between Mongu and Kalabo, the east and west sides of the plain intended to become a link in new communications network between Zambia and Angola threatening vast numbers of new people heading east in search of opportunities from an impoverished and war-soaked region.
- New road arriving from southern Africa via Katima Mulilo in Namibia and Senanga to Mongu. This road will transport people, goods and information from the regional global hub of South Africa which may lead to an influx of people intent on exploiting the fragile ecosystem of the floodplain and its surroundings and soak away even more of the best people from the local SES.

The capacity of people to absorb these pressures and to be able to maintain the integrity of the SES in which they live and depend upon is a key question. It is likely to hinge on the ability to access new capabilities and diversify productive activities so that society can regain a sense of momentum, control and motivation to enhance living standards without damaging the ecological components of the SES.

Key here, as demonstrated in the adaptation case study above, is the ability to feel a sense of ownership and control over developments concerning climate, life and livelihoods. Government - national, local and traditional, must understand the importance of decentralising control and learn to act as enabling agencies for local communities in order for them to be able to take more responsibility for what befalls them. People have not been passive recipients of underdevelopment but they do need to participate more in both the assessment of their vulnerability and the strategies and actions aimed at increasing resilience.

Finally, this paper argues that socio-ecological systems were best managed in the past by systems of autochthonous administration of ecological goods and services. Migration of centrality of authority conversant with politico-economic authority has seriously diminished and degraded SES management in the Bulozi plain leaving both social and ecological components of the system open to abuse and exploitation.
Bulozi will need careful, environmentally conscious management and sensitive, participatory input from outside agencies to take advantage of the potential to both lessen vulnerability and exploit the economic potential that clearly exists.

Abbreviations

BWI: Bretton Woods Institutions
IRIN: Integrated Regional Information Networks (media organ of UN Office for the Coordination of Humanitarian Affairs)
SES: Socio-ecological System

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Research Institute for Humanity and Nature (RIHN)
Inter-University Research Institute Corporation, National Institutes for the Humanities
457-4 Kamigamo Motoyama, Kita-ku, Kyoto, 603-8047, Japan
www.chikyu.ac.jp

大学共同利用機関法人 人間文化研究機構
総合地球環境学研究所
〒603-8047 京都市北区上賀茂本山 457-4
www.chikyu.ac.jp