Land Use Planning for reducing natural disaster risks and damages

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SUMMARY

The international community has been highly concerned in the last few years with natural disasters management and risks reduction. Organisations like UN, FAO, World Bank and FIG have worked on different aspects of the problem. It is now widely recognised that land tenure must integrate disaster risks reduction (DRR) into its processes and activities. Land tenure can contribute to DRR by adopting sustainable land policies and controlling the types of rights and interests that are granted in disaster-prone and vulnerable areas.

Land use planning is a basic component of sustainable land governance and is closely linked with land tenure. Land use planning is defined as an approach to envision future land development and to translate these visions into programs and actions. As indicated in the FAO's *Voluntary Guidelines on the Responsible Governance of Tenure*, land use planning "affects tenure rights by legally constraining their use". Specifically, land use planning is enforced by the technique of zoning, which could be defined as the art and practice of best location. Spatially defined areas (or zones) are then reserved for specific uses: residential, commercial, industrial and recreational. Zoning can also lead to define zones with a risks reduction approach. Different types of risks can restrict land uses: flood, coastal erosion, tsunami, landslide, earthquake, volcano.

In a context of natural disaster management, responsible land governance authorities are expected to foresee, prevent and mitigate potential risks by implementing sustainable and socially acceptable land use planning instruments (master plans, local development plans, legal zoning and regulated standards). This relies on a wide knowledge of land, natural resources, economic activities, social and demographic profiles, and spatially defined risks. Public authorities must also include in the planning process public participation, in order to democratize land policies and its legal restrictions to land use. To those vulnerable areas, preparedness to natural disasters is linked with risk mapping, and a public acceptance of emergency scenarios and evacuation plans. DRR is a shared responsibility between public authorities and civil society.

Land use planning is also fundamental to reconstruction, for identifying secure land tenure, risk-safe areas, adapted construction standards, infrastructure provision, … Resettlement operations must also be planned and spatially organized, and accepted by concerned people through public participation. Successful resettlement plans are those appropriated by relocated people, not those enforced legally by authorities.

Potential contributions of land use planning to DRR will be illustrated with some examples from Asia-Pacific, Africa and the Caribbean.

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1. INTRODUCTION

This paper presents an overview (written from extracts) of a report prepared on behalf of FAO, focusing on land use planning potential for natural disaster risks reduction. The project was intended to underline the importance of responsible governance of land and provide information to help implement the *Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security*. It was mainly dedicated to the potential role and requirements for land use planning in the context of the Disaster Risk Management Framework, particularly with regard to the way in which land use planning can help address the land issues identified in the UN FAO Land Tenure Manual n° 3 *"Assessing and Responding to Land Tenure Issues in Disaster Risk Management"*.

The objective of the report was to provide conceptual basis and material for new on-line training material that will expand upon the content of FAO (2012) *Voluntary Guidelines on the Responsible Governance of Tenure*[1] section 20 about "regulated spatial planning". The particular interest for land use planning and land valuation for disaster risk management leans on spatial information management, so the focus remains here on good land governance and land tenure policies, meanwhile in interrelationship with land administration for achieving good land use planning. The key issue is that the poor often have informal tenure, if any, at least for residence, and are the most vulnerable to natural disasters, if dwellings are fragile and installed on risky sites in unplanned areas. Because it relies strongly on public participation (and not only on expert knowledge), land use planning must be considered as a community disaster-preparedness process and a spatially located risk management approach. After being through a land use planning process, a community is supposed to be more aware of the nature and the location of natural disaster risk affecting the land it occupies. Land use planning is then characterized by its rational components (acute knowledge of every aspect concerning land features and spatial location) and its political approach (public decision-making process for adopting land policies and land-use regulations). This work is part of a joint project between the United Nations Food and Agriculture Organisation (FAO) and the International Federation of Surveyors (FIG).

[1] FAO (2012), V*oluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security*, Rome: FAO, vi + 40 p.

2. DISASTER RISK MANAGEMENT AND LAND USE PLANNING

According to recent publications on natural disasters and land tenure[2], the main objective of the report was to improve awareness about land use administration and planning with respect to land tenure and spatially located natural disaster risks. The *Background Paper on Land Use Planning for Disaster Risk Management* provides information that may assist authorities in preparing orientation, documentation, and operation during the disaster risk reduction processes and as well in foreseeing major types of emergency situation that follows the outbreak of a natural disaster. In particular, it aims to discuss why land census, surveying, and mapping are crucial accordingly to land tenures and to identify both risky and relocation zones to prepare adequate alternatives for reducing or resolving such disaster issues that may arise. It advocates that land tenures, possession, and residential rights should be considered in all stages of disaster risk management (DRM) and associated projects. The processes of land use planning (LUP) for establishing and empowering legal and socially accepted restrictions of land right exercise (i.e., the use of any rights among a bundle of rights on real estate) could contribute in all phases of disaster risk management and reduction (preparedness and mitigation, emergency, recovery, reconstruction, rehabilitation). Improving land tenure security, even for the simplest title holder on a dwelling, and protecting access to housing and land shall reduce the risk of future disasters to all holders of housing, land, and property rights, including owners, renters, and even squatters, in particular the most vulnerable groups among the community[3].

In the context of DRM, LUP might not be confused only with the general mechanism of urbanism, neither to the urban planning maps nor some zoning regulations; it is based on effective methods and concepts of land use administration, what implies a strong connection to a range of adapted land tenure possibilities allowed by law. The objective of reducing potential land use conflicts and natural disaster risks existing in some areas is to plan and foresee the best allocation of land in order to prevent human and material consequences of disasters. That requires official decision-making processes associated with strategies for emergency response and recovery from disasters, and then rehabilitation of the affected sites or relocation of affected people. These issues should also be considered as opportunities in reconstruction and development projects to improve and diversify, not just to reproduce, tenure security for the more vulnerable as part of a disaster mitigation process.

The efficiency of preparedness, emergency, and resettlement strategies and actions depends highly on wide public participation processes before a predicable disaster occurs for the development of planning proposals and the review of spatial plans to ensure that priorities and

[2] UN-Habitat and FAO (2010), *Land and Natural Disasters: Guidance for practitioners*, Nairobi, Kenya: United Nations Settlements Programme; FAO, UN-HABITAT, IASC Early Recovery Cluster, Global Tools Network (2010), *On Solid Ground*, Rome: FAO (Re-printing, January 2011) ; FAO, UN-HABITAT, IASC Early Recovery Cluster, Global Tools Network (2011), *Land Tenure and Natural Disasters. Assessing Land Tenure in Countries Prone to Natural Disasters*, Rome: FAO, Rome.

[3] FAO, UN-HABITAT, IASC Early Recovery Cluster, Global Tools Network (2011), *Land Tenure and Natural Disasters. Assessing Land Tenure in Countries Prone to Natural Disasters*, Rome: FAO, Rome, p. xii

interests of communities are taken into account[4]. Authorities must lead adequate public consultation of populations exposed to hazards. It contrasts with emergency decisions made under pressure to demolish affected buildings and forbid contaminated grounds and then to relocate residents on unprepared lands like parks or brown fields. It is the best-proven method for public acceptance of enforced policies on preparedness, preventive actions, area planning, titling renewal, and alternatives to resettlement. Public consultations contribute also to increase personal capacities and autonomy in a natural disaster context. For sure, it must encompass necessarily gender-sensitive issues at multiple degrees of complexity[5].

Land use planning, as a collective approach and an authoritative process of establishing and empowering legal restrictions over land right exercise (or the use of land right), could contribute in all phases of disaster risk management and reduction (preparedness and mitigation, emergency, recovery and reconstruction/rehabilitation). It suggests a decision-making process that is sensitive and includes concerns to natural disasters emergency response and recovery. Rehabilitation programs and reconstruction projects should improve land tenure security by enforcing strict development and buildings standards for the areas vulnerable to natural disasters.

From a land use planning perspective, recovery means that decisions and actions must planned and prepared in advance and take into account both human and material aspects: the affected population (displacement and relocation or resettlement on site), the demolition and reconstruction of immoveable (shelters then houses, commercial, welfare and community centers, public equipment and infrastructures), the sites for disposal of rubbishes and potentially recycling some of this material, the energy, water and service lines for supply and transportation (firstly streets, sewers, waterworks, and electric lines), agriculture fields and plantations for both local and external markets. To maximize opportunities for efficient recovery after a disaster, one must initiate the conditions of resilience within the populations and institutions by advance, what means that the preparedness and foreseen solutions are congruent and consistent with local culture and physical resources on site. That may obligate public authorities to consider new laws and regulations introduced in the normal way of social practices, particularly with respect to housing, land tenure, land use, and even agriculture. Resilience of food production systems should be integrated within land use policy, to minimize the dramatic consequences of natural disasters on local population[6].

[4] This item support article 20.4 of the FAO *Voluntary Guidelines*: « *States should ensure that there is wide public participation in the development of planning proposals and the review of draft spatial plans to ensure that priorities and interests of communities, including indigenous peoples and food-producing communities, are reflected. Where necessary, communities should be provided with support during the planning process. Implementing agencies should disclose how public input from participation was reflected in the final spatial plans. States should endeavour to prevent corruption by establishing safeguards against improper use of spatial planning powers, particularly regarding changes to regulated use. Implementing agencies should report on results of compliance monitoring.* »

[5] FAO (2012), V*oluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security*, Rome: FAO, articles 20.2 and 20.3.

[6] FAO (2011), *Resilient Livelihoods: Disaster Risk Reduction for Food and Nutrition Security Framework Programme*, Rome: FAO, p. 9.

Example of Hurricane Sandy **–** The case of Hurricane Sandy (in 2012) hitting the United States East Coast shows that no region of the World is safe from natural disasters. This example demonstrates clearly that emergency plan (when well supported by appropriate infrastructure and institutional incentives) can be efficient: a large part of people living in the affected regions were evacuated (or evacuated by themselves) before the storm hit the US coast and heavy material with competent workforce was immediately available for essential reparation within few hours to one week. Recovery is then much faster in the USA than it will be in Haiti, where Sandy hit too. Even if there were unfortunate loss of human lives, the damages were mainly material in the USA. The aftermath of Sandy is by far more dramatic in Haiti with the destruction of 70% of agricultural crops (bananas, beans, rice, avocado, corn) in the southern part of the country, heavy livestock losses and a resurgence of cholera[7]. Haiti suffers more from human impacts (shortage of food, illness, and refugees) than the USA (even though the storm-affected areas and populations were by far much larger and costs in losses and reparation are higher with a stronger economy capabilities and available manpower and resources). Then Haiti is much more vulnerable to storm and natural disasters than the USA and recovery is there haphazardly slow. Also, more than necessary buildings and equipment are accessible in the USA for temporary shelter for displaced persons, who will probably all return on the same home place after the event. In Haiti, the most urgent task is to erect (within a chaotic situation) refugee camps on secure and dry sites; for many people, this will result in a permanent relocation, even resettlement elsewhere in new communities. These options must be planned carefully because people tend to come back and reinstall themselves in their previous location (even if destroyed).

3. LAND USE PLANNING TO SUPPORT GOOD LAND GOVERNANCE

Good Land Governance is now considered as a basis for human development and the creation of sustainable living environment[8]. It can be defined as a political process, concerned with public decision making related to land allocation and development. According to the FAO *Voluntary Guidelines*, Good Land Governance is comprehensive in nature, aiming at coordinating and harmonizing public, community and private interests in land[9]. Its practice relies highly on a coordinated approach of land tenure, land use planning, land valuation, and land information. Good Land Governance must be concerned in particular with land use, infrastructure provision, public facilities and networks, economic development, social acceptability, environmental impact assessment, risk consideration, public participation,

[7] Two recent articles from *La Presse* newspaper (Montréal, Canada) report the catastrophic situation in Haiti after the passage of Hurricane Sandy in October 2012:
http://www.lapresse.ca/international/dossiers/la-tempete-sandy/201210/31/01-4588826-lapres-sandy-haiti-decrete-letat-durgence-pour-un-mois.php ;
http://www.lapresse.ca/international/dossiers/la-tempete-sandy/201211/03/01-4590047-apres-sandy-la-grogne-samplifie-en-haiti.php .

[8] This was recognized and underlined by the *Economic Commission for Europe*, in 1998, in a document entitled « Social and Economic Benefits of Good Land Administration »; United Nations, Economic and Social Council, Economic Commission for Europe (1998), *Social and Economic Benefits of Good Land Administration*, HBP/1998/8.

[9] FAO (2012) *Voluntary Guidelines …*, section 20 – "Regulated spatial planning", subsection 20.3, p. 32.

monitoring and readjustment process. Then, Good Land Governance has a lot to do with land use planning: every use, construction, and facility must be located carefully on the ground, trying to minimize future nuisances between conflicting uses, or to reduce risks associated with certain areas (coastal zone, steep terrain, riparian lot).

Good Land Governance is placed under the jurisdiction of public authorities, because it refers to a political decision-making process for allocating and managing land resources. It encompasses issues related to land development (urban and agricultural), forests, watercourses, minerals, infrastructures, heritage. Good Land Governance applies equally on private, public, and customary land. Issues on public land are as much important as they are on private land, considering among others the presence of important exploitable natural resources as wood and timbers, minerals, hydraulic power, arable land, and so on. Land use planning is then highly desirable to manage public land, especially to make sure that resources allocation and exploitation will be beneficial to neighboring population and will not create unforeseen negative impacts on their habitat. Public land use planning can be guided by national policies on forests, agriculture, fisheries, mining, and environment.

Since land use planning is a voluntary approach and process, we consider that it would be appropriate, if necessary, on customary land. Land use planning would then be incumbent to the customary authorities. It certainly would be practiced and applied differently but aiming the same objectives, of good land governance and effective land organization. Probably, land use rights would be managed differently: attribution to a family or a clan, overlapping of non-conflicting uses, timely restricted right over the year, …

Example from Honduras – The voluntary watershed planning of lake Yojoa in Honduras (Amuprolago) is an example of land use planning applied to prevent environmental degradation by a too intensive fish-farm production[10]. Eight municipalities, preoccupied with lake environment degradation and weak legal land use planning framework, launched this local initiative in 1994. By taking voluntary actions for Yojoa Lake watershed preservation, local authorities aimed at creating the sustainable conditions to support their future land development. It is accepted that social and economical development of the region depends strongly on the lake environment quality.

4. LAND USE PLANNING ACCORDING TO THE FAO *VOLUNTARY GUIDELINES*

Section 20 of FAO's *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* (VG) presents land use planning as a regulated activity that legally affects (and guides) tenure rights by constraining their exercise and the incumbent use of land. Sub-section 20.1 states that:

> *Regulated spatial planning affects tenure rights by legally constraining their use. States should conduct regulated spatial planning, and monitor and enforce*

[10] AMUPROLAGO – Municipalities Association for protecting Yojoa Lake: http://amuprolago.yojoa.org/eindex.htm

> *compliance with those plans, including balanced and sustainable territorial development, in a way that promotes the objectives of these guidelines. In this regard, spatial planning should reconcile and harmonize different objectives of the use of land, fisheries and forests.*[11]

The ultimate purpose of land use planning is to adopt regulations and technical standards that implement effectively, on the ground, land policies. This is generally done by legally constraining tenure land rights to certain types of use only. But those regulations and technical standards must be first consistent with local land use policies. Then land use planning is political (land use policies), legal (land use regulations), and technical (land use standards).

According to the World Bank, Land-Use Planning is:

> *[A] public policy exercise that designates and regulates the use of land in order to improve a community's physical, economic, and social efficiency and well-being. By considering socioeconomic trends as well as physical and geographical features (such as topography and ecology), planning helps identify the preferred land uses that will support local development goals. The final outcome is allocation and zoning of land for specific uses, regulation of the intensity of use, and formulation of legal and administrative instruments that support the plan.*[12]

Another definition of interest was formulated jointly by UN-Habitat and FAO:

> *The systematic assessment of land and water potential, alternatives for land use and economic and social conditions in order to select and adopt the best land-use options. Its purpose is to select and put into practice those land uses that will best meet the needs of the people while safeguarding resources for the future. The driving force in planning is the need for change, the need for improved management or the need for a quite different pattern of land use dictated by changing circumstances.*[13]

This definition underlines that land use planning aims at improving economic and social conditions of a community by making better collective decision about land use allocation. Land use planning is also guided by continual changing conditions (like climate change, population growth, and desertification) that affect land use pattern necessitating continuous adjustments. The FAO *Voluntary Guidelines* refers clearly to this complexity of land use planning (continual changing conditions), underlying the intrinsic relationships between every component of a territory (land, forest, water, agricultural soil) and general or specific jurisdictions shared by multiple authorities:

[11] FAO (2012) *Voluntary Guidelines…*, section 20 – "Regulated spatial planning", subsection 20.1, p. 32.
[12] Abhas K. JHA *et al.* (2010), *Safer Homes, Stronger Communities: A Handbook for Reconstructing after Natural Disasters*, Washington: The World Bank, p. 109.
[13] UN-Habitat and FAO (2010), *Land and Natural Disasters: Guidance for practitioners*, Nairobi, Kenya: UN-Habitat, p. 135 (Glossary of key land concepts and terms).

States should ensure that regulated spatial planning is conducted in a manner that recognizes the interconnected relationships between land, fisheries and forests and their uses. States should strive towards reconciling and prioritizing public, community and private interests and accommodate the requirements for various uses, such as rural, agricultural, nomadic, urban and environmental. Spatial planning should consider all tenure rights, including overlapping and periodic rights. Appropriate risk assessments for spatial planning should be required. National, regional and local spatial plans should be coordinated.[14]

4.1 Coordination

Because it is comprehensive in nature, land use planning raises important issues of coordination between the different authorities sharing inclusive or exclusive jurisdictions over a delimited territory. In a context of natural disaster emergency, poor coordination between authorities could increase its magnitude and severeness. For example, the organization of emergency operations after the 2007 earthquake affecting Pisco, Peru, was delayed because it was not clear which authorities had the jurisdiction (and the relevant field information) to control those operations. Certainly one of the most important challenges of land use planning is to coordinate those institutions and DRM actors, representing specific interests and agendas, and controlling resources of different nature.

As stated by FAO *Voluntary Guidelines*, land use planning is about coordination. It is highly desirable that ways of inter-institutional collaboration and logical responsibility sharing processes be managed between different government entities, and different levels of authority (national, regional, local). But in most developing countries, land use planning department operates in a different ministry than those responsible for DRM and there is little active coordination [among them due to mandates, orientations, and budgets. Even in normal business, there is often competition, or mutual ignorance, with respect to] different land allocations: transport, environment, agriculture, [residential, commercial, military, parks…]) and little concordance in time for land development priorities and infrastructures.

4.2 State Responsibility

Land use planning is a State [public] responsibility, because its fundamental nature is to promote an equitable, acceptable and sustainable land allocation and development. It aims to describe a desirable future (for example, the city in which the population wants to live in 20 years), and to identify the actions and resources needed to realize it. Land use planning is to be foreseen as a strategic planning approach, where zoning regulations, technical and human resources, budgets, schedules, are programmed to build that desirable future over a long period of time. Many kinds of interest are then at stake, at different political level (national, regional, local). Political decision is then concerned by identifying if a specific land use is desirable or not in a specific area. The decision can either justified by the fact that this land

[14] FAO (2012), *Voluntary Guidelines …*, section 20 – "Regulated spatial planning", subsection 20.3, p. 32.

use is not desirable (because generating too many negative impacts on the neighborhood – an industry in a residential zone) or the area is characterized by potential hazards limiting its use.

4.3 Risk Assessment

It must be pointed out that land use planning is not just a process for expressing some personal preferences about land use spatial location and land development pattern; it is also about assessing risk, constraint, and contingency of certain zones or locations, and restricting uses and intensities for risk reduction. Subsection 20.3 of the FAO *Voluntary Guidelines* expresses clearly this concern[15]. For example, in an unstable soil area (risk of landslide), building could be limited to a maximum of one story, and industrial uses could be forbidden. Inexistent or poor land-use planning could lead to dramatic situation where human settlements and buildings are authorized in areas not suited for that type of use or characterized by important location hazards, putting their inhabitants at risk.

Inexistent or poor building standards can lead to situation where human settlements vulnerability are increased. For example, the erections of tall buildings in a seismic unstable area, rather than one-story residential units, can higher potential hazard and casualties (in the eventuality of buildings collapse). Enforcement of coercive building standards, adapted to risk-prone, will reduce vulnerability and accelerate recovery. But one must remember that risk cannot be reduced to nothing nor eliminated; there always be a risk of natural disaster, even tough everything « reasonable » has been done by the authority. It is impossible to totally eliminate a natural risk (Oudot, 2005). Then a disaster-prone area will always be exposed to a certain degree of risk. Even with the most detailed master plan, implemented with an exhaustive land use regulations, damages (and lost of human life) resulting from earthquake, tornado, hurricane, flood cannot be reduced to nothing. Population living disaster-prone area is generally aware of this basic fact. To foster their resilience, they should be involved in the preparation of different types of emergency scenario, by participating to land use planning public consultation.

5. LAND USE PLANNING AS A COMPONENT OF LAND TENURE

According to Dale and McLaughlin (1999), land use planning is one of the three main components of land tenure administration, together with land tenure (real property or possession rights) and land valuation (mainly for taxation and conveyancing). Land use planning is related to the exercise of land rights, mainly the *usus* (usages of and activities on a possessed parcel-lot), more rarely the *fructus* (benefits/gains/revenues) or the *abusus* (to dispose, mortgage, subdivide, or sell the estate), as these terms referred to in civil law[16]. From a planned perspective, LUP establishes legally what could be politically and rationally preferred for a piece of land and what is forbidden or restricted (in a vulnerable area for example). LUP aims either at harmonizing if possible, or segregating between different competing land uses, in accordance with national, regional, and local land policies.

[15] FAO (2012), *Voluntary Guidelines …*, section 20 – "Regulated spatial planning", subsection 20.3, p. 32.
[16] This is in accordance with subsection 20.1 of the FAO *Voluntary Guidelines*.

The links between LUP and land tenures may be described in many manners. As legal forms of tenure are deeply embedded in culture and socio-economic structure of a nation, developed and defined by practice since centuries, they are stable and considered in the long term. In the present post-colonial epoch, many emergent societies experience new forms of tenure and property introduced by some imperial power, along with the former customary ones[17]. In any case, forms of land tenure cannot be too many within the same country, from sovereign public domain and individual private full-property to commons, condominium, cooperative, tribal homeland, and a bunch of dismembered rights (tenancy, metayage, lease, emphyteosis, etc.).

5.1 Land Use and Land Value

Regulated spatial planning affects tenure rights by legally constraining (or guiding) their future use, then influences the value (by preservation, depreciation, expropriation) of similar land properties located in the same vicinity, and consequently the potential incomes obtained from exploitation and capital gains while selling the property. Land value being greatly affected by possible future uses and development potential of a property, changing land use regulations can exert a great influence on land asset: whether a piece of land value goes up because of its legally created development potential or it looses value due to important use restrictions. Nevertheless, an unplanned increase in property value can lead to the exclusion of the poorest segment of the population (by a too drastic rent increase for example)[18]. Without appropriate pro-poor land policy, a pro-development land use planning could generate perverse effects and dramatic social impacts.

5.2 Land Use and Land Right

LUP and land right must be coordinated within a land tenure policy, in order not to create unnecessary (and otherwise avoidable) conflicts or, worse, to increase land risk vulnerability. For example, the land tenure authority should take into account the LUP legal restrictions over an identified flood-prone area and not grant any right of use or full property over land located therein. Legal access to land (by land tenure grant of right) should be banned within risky areas.

6. ZONING THE RISK OF NATURAL DISASTER

Zoning is a technique that was developed in the 20th century in order to apply with effectiveness on the ground the land use policy adopted within master plans. Zoning refers to

[17] On this topic, refer to subsection 25.3 of the FAO *Voluntary Guidelines*: « *In order that tenure problems do not lead to conflicts, all parties should take steps to resolve such problems through peaceful means. States should revise relevant policies and laws to eliminate discrimination and other factors that can be a cause of conflicts. Where appropriate, States may consider using customary and other local mechanisms that provide fair, reliable, gender-sensitive, accessible and non-discriminatory ways of promptly resolving disputes over tenure rights to land, fisheries and forests.* »

[18] UN-Habitat and FAO (2010), Land and Natural Disasters: Guidance for Practitioners, Nairobi, Kenya: United Nations Settlements Programme, p. 100.

dividing a delimited territory (for example a city or a community) into zones, and to affect or indicate the uses and constructions that would be permitted (or prohibited) in each one. It aims at reducing potential conflicts between different types of uses (e.g. residential and industrial uses). Zoning holds two components: a zoning map showing the division of functional areas (zones) and a set of regulations and standards enforcing legal constraints to each zones shown on the zoning map. Zoning is an instrument of spatial discrimination. By using zoning, a community should aim to provide sufficient space to different types of general uses (residential, commercial, industrial, recreational, conservational), and to prohibit other types of specific uses in certain sensible locations (mines, airport, nuclear plant, dumps). Then zoning can be easily used for disaster risk reduction, by prohibiting certain uses and constructions within zones identified as risky (flooding, landslides, erosion, tsunami).

Zoning must be considered as a method to translate the concept of vulnerability in terms of spatial location (which could correspond to zoning vulnerability and hazards. Also, by making a judicious use of zoning, a community can reduce its vulnerability, on important issues as deforestation, ground waterproofing, anarchic urbanization, watercourse deviation, and over-weighted construction on potential landslide area. Legally, zoning enforces restrictions to land property right use. Zoning is not to be associated with expropriation: it does not result in a state takeover of a private land property. The later remains into the hand of the private owner. But this owner, like its neighbors, is legally obliged to respect restrictions and regulations related to land use. It might be a prohibition to do something (like to construct a residence in a flooding zone) or an obligation to act in a certain way (like to relocate in a new site after a certain period of time).

6.1 Using the Cadastre as a Geospatial Basis for Zoning Map

By integrating the cadastre, the zoning map and flood zones in the same geographical information system (GIS), it becomes easy for local officials to identify every parcel affected by the flood zone, and the corresponding landowner. With a comprehensive land tenure information system (that include land use planning and land valuation), local authority have the right instrument to implement the legal prescriptions related to land use restrictions in disaster-prone areas, and to monitor the due respect of those restrictions (mainly prohibitions and restrictions affecting land use). Zoning restrictions related to vulnerable and risky areas (as flood zones) might be enforced at least in three different ways: by restricting the use of land rights with coercive public regulations; by expressing in land titles provisions creating a private obligation to respect land use restrictions; by keeping into the public domain of the State those piece of land identified as vulnerable and risky.

Zoning efficiency relies strongly on land information provision. Knowledge about land physical features: geography and topography, soil, natural resources, infrastructures and networks, roads, … It also needs a good provision of cadastral information that describes for each piece of land its proper characteristics (area, boundaries, type of right associated with the land parcel) and identifies the owner (name, legal title, address). Practical land use planning is closely related to and depends on thorough land tenure information systems. Cadastre shows

graphically all land division of an area, and provides specific information for every parcel (or cadastral lot). It links land use planning regulations to land tenure into a good land governance system. On a zoning map, risk assessment is illustrated with its spatial extension. Risky zone are then associated with restrictive set of regulations, standards, and norms (concerning land use, land division, and building).

Zoning leads to enforcement of Building Codes of Standards. Every type of building must be erected compliantly with specific standards, adopted to assure the solidity of building, their resistance to natural disasters, and consequently the security of people. Unfortunately, many houses in vulnerable developing countries are not cyclone, earthquake nor flood resistant. This situation creates complex issues because, when destroyed, a low quality house can be easily and quickly be rebuilt at a low cost by using local materials. However, most areas would benefit from stronger building codes.

In many developed countries, land use planning relies on strong public institutions, ranging from national, regional and local levels. Risk management is integrated within the planning process and results in defining and zoning on the ground the nature and level of risks. In some jurisdictions, conformity between national, regional and local is compulsory, meaning that a national land use planning issues must be firstly clarified at the regional level (by locating and delimiting more precisely on the ground a risky zone) and secondly translated into local legal standards which exert a coercive control on land use.

Many case studies show that poorly planned land development increases the risk of disaster, especially in certain disaster-prone areas as coastal zones. Urbanization, chaotic population growth and soil waterproofing contribute to increase disaster risks and human and physical damage magnitude.

7. LAND USE PLANNING AND PUBLIC PARTICIPATION

FAO *Voluntary Guidelines* makes public participation an important element of LUP. According to subsection 20.2, "*States should develop through consultation and participation, and publicize, gender-sensitive policies and laws on regulated spatial planning*." Public consultation and participation is identified as one out of ten principles of implementation of responsible governance of tenure of land, fisheries and forests. It is defined as:

> *Engaging with and seeking the support of those who, having legitimate tenure rights, could be affected by decisions, prior to decisions being taken, and responding to their contributions; taking into consideration existing power imbalances between different parties and ensuring active, free, effective, meaningful and informed participation of individuals and groups in associated decision-making processes*.[19]

[19] FAO (2012), *Voluntary Guidelines…*, section 3 – "Principles of implementation", p. 5.

Legitimacy, social acceptance of DRR programming, like relocation and resettlement plans. Public consultation (and we should use public participation where the population is an active part of the decision-making process and implementation scenarios) should be done before a natural disaster hit a community. Public participation gives way to preparedness toward natural disasters. Again, the example of Superstorm Sandy hitting the United-States East Coast in October 2012 could be presented as an example of this point of view: many people living in affected areas knew what to do, where to evacuate, how to behave, who to contact, and so on. Their preparedness was achieved by pre-disaster information dissemination (and possibly assisting local public assembly, and interacting on social network).

The efficiency of preparedness, emergency, and resettlement strategies and actions depend highly on public participation, democratisation of preventive actions, information dissemination, and social acceptability. This provides a great opportunity for disaster risk management. DRM is often conducted quickly under pressure and adequate public consultation is difficult. By contrast if decisions on resettlement based on hazard-risk are made before a disaster using comprehensive LUP consultation processes, this is much more transparent and more likely to protect the most vulnerable people. Further, it increases social acceptability of complex decision-making relying on rational and expert knowledge related to risk assessment, vulnerability reduction, and community resilience; it also strengthen individual capacities to react safely and positively in a situation of emergency.

Then DRM is not only into the hands of experts and elected officials; it becomes a community issues, concerning every individual. The public input should be reflected in final land use planning decisions, in master plans and in zoning maps. This principle is expressed namely by the FAO *Voluntary Guidelines*, subsection 20.4:

> *States should ensure that there is wide public participation in the development of planning proposals and the review of draft spatial plans to ensure that priorities and interests of communities, including indigenous peoples and food-producing communities, are reflected. Where necessary, communities should be provided with support during the planning process. Implementing agencies should disclose how public input from participation was reflected in the final spatial plans. States should endeavor to prevent corruption by establishing safeguards against improper use of spatial planning powers, particularly regarding changes to regulated use. Implementing agencies should report on results of compliance monitoring.*

Because solutions applied in an emergency situation have been discussed, debated, and accepted by a majority of persons before a natural disaster happens, public consultation and participation is expected to increase the social acceptability and compliance with recovery, relocation, and resettlement initiated by public authorities.

8. CONCLUSION

Successful land use planning highly relies on strong institutions and good land governance. The implementation of participative planning decisions and legal land use restrictions is the key factor of success. Collaborative and responsive planning is by far preferable than authoritative planning. The main objective is not to draft nice technocratic plans, but to influence the behavior of people when settling themselves on the ground and reacting to a natural disaster situation. It is essential to strengthen local capacities in land use planning, and its related practices: mapping, local knowledge production, public participation, decision making, monitoring, dispute resolution of competing uses over land … Going through the process of participative planning, local population gains a more global knowledge of their community, its development potentials and limitations, its land issues, and its vulnerability to natural disasters. By using an open decision-making process, LUP has a direct positive influence on local population, to adopt a sustainable behavior towards their land, their neighbors and their community.

As a political process, LUP currently faces disputes over land and spatial location. Mediation, negotiation, and collaboration should be paramount and preferred to any legal conflict resolution process. For example, public participation aims at resolving disputes, conflicts and oppositions, by balancing, segregating and rationalizing between conflicting types of arguments. LUP proposes a quite simple process of dispute resolution over conflicting land use (whether these uses are competing for the same area, or neighboring parcels affect negatively each other with nuisances). Ideally, the individuals themselves resolve these conflicts; if not, States may enforce an authoritative process held by an administrative body of a court of law (or a judicial tribunal).

At last, it appears clearly that natural disaster management has more to do with people than with land. Land use planning should be applied in order to make people more responsive to natural disaster issues, and more compliant to react orderly according to emergency plans for evacuation, relocation, and resettlement if appropriate. The final message is than that land use planning might be very procedural and technocratic, depending on expert knowledge for risk assessment and mapping. But land use planning is, by its local political nature, fundamentally a social empowerment approach and process based on: public participation, community-based disaster risk management, emergency and resettlement plans design.

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BIOGRAPHICAL NOTES

Francis Roy is professor at the Department of Geomatics Sciences at Université Laval (Quebec, Canada) since September 2003; he is also the program's director of the bachelor degree in geomatics sciences since 2007. He teaches and leads research in the fields of cadastral systems, land administration, law of land property, and land use planning. His research projects focus on land and cadastral reforms, with a particular interest for Latin American countries, as well as for problems of conflicting integration of the private right of land property with public laws of land use planning. After receiving a bachelor's degree of Geomatics (Université Laval, 1990), he succeeded in realising graduate studies in land use planning and regional development for a master's degree (Université Laval, 1992) and a Ph.D. (University of Montreal, 1999). He was hired as a research professional in forestry in

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