

Towards alleviation of the digital divide and poverty through land information

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ABSTRACT

Accesses to lands, houses, the Internet and other utilities are regarded as basic human needs to escape poverty and are required to recognize the relationships between the digital divide and socio-economical inequality. The digital divide might not be a single technical disparity, but stems from a complicated mixture of economic and socio-technical symptoms of inequality. There is growing awareness of scrutinizing causal mechanisms between the digital divide and poverty since combating poverty could be a primary step to mitigate the digital divide. In this paper, the Hexad model is proposed to explicate poverty interpretation by using 6 parameters as a major tool for partly assisting in poverty monitoring system in connection with land information. A solution model of the Internet is suggested to break the digital divide. It expounds a conceptual framework and new idea for poverty management to notify spatio-temporal locations of poor actors and geography of the digital divide when efforts of poverty eradication hinge on understandings of geographic location of digital disadvantaged groups through parcel-based land information.

Keywords : Digital Divide, Internet Model, Poverty, Land Information

1. Introduction

A great deal of efforts for poverty alleviation have increasingly been spotlighted at national and international societies while sustainable livelihoods are playing a major role in contribution to poverty management focused on the poor who live in marginalized areas. Accesses to the basic rights of food, clothes and shelter, education, proper health care, clean water, and the Internet are primary human desires and strong solutions for the digital divide that marginalized poor

actors are faced with technical gulf. However, there might be several question marks and stalemates when interpreting a poverty profile as to who and where poor actors are, what poverty looks like and why they are poor. The information for developing a poverty profile comes from census data, household survey, statistical analysis of income/consumption, and others. Additional factors associated with lifetime poverty and anti-measures as to when they are poor and how they can escape from vicious cycle of poverty must be necessary to be added to a

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poverty profile when carrying out socio-economical and information (or Internet) poverty mapping in the context of actor-based interpretation.

The digital divide is regarded as disparities of access to and use of information and communication technology between countries and groups or individuals within a certain organization. The digital divide is closely related with conventional notions of technical gap that electronic or electrical uses and technical knowledge could be a part of landmarks of information society. There still exists socio-economic inequality and technical exclusion between the information haves and the information have-nots. Although many different analyses and models have put an emphasis on the digital divide with regard to socio-economical and educational aspects, there might be problematic obstacles to indicate a tangible framework because the digital divide is related with multidimensionality of poor variances. It appears that information poverty coming from a variety of factors of socio-economics exacerbates other form of poverty and feed into the cycle of poverty. The digital divide tends to extend to the socio-economical divide showing geographical focus and disparity of local or household wealth. Solution of the Internet access and use is one convincing way, but might not be a panacea for root problems of the digital divide. To scrutinize the reasons of the digital divide in this research, causal mechanisms between the divides and poverty are illustrated around a central role of land information and are focused on the information poor and marginalized groups

who experiences economic poverty, social exclusion and technical divide by interpreting the Hexad model. The Generic Internet model for communications between land information and the Internet towards digital equity is proposed to find a way of poverty alleviation and to shed light on six factors for the causations and results of poverty management. The Web-based parcel-level GIS methodology or model will not only give us more dynamic ways of self-descriptions about our living conditions, but also illustrate geographic distribution of the digital divide towards buildings of digital opportunity.

2. Related works and problems

In a digital revolution and information-intensive economy society (Compaine, 2001), access to information may be regarded as a basic human need for bridging the digital divide (NTIA, 2000; OECD, 2001) and contributing to closing technical gap (Beneton, 1998), and enhancing income generation and poverty alleviation. In fact, a wide variety of articles and reports deal with the digital divide with respect to economy and market (Prieger, 2001), policy (Leigh and Atkinson, 2001), organizational divide, education and learning (OECD, 2000), urban polarization and Internet (Graham, 2000). In terms of poverty and the divide, poverty measures of human needs and future desires in developing countries might be based upon conditions of their holdings or access to foods and monetary credits, and affordable lands and shelters, etc. Many research works have examined symptoms of poverty with

Towards alleviation of the digital divide and poverty through land information

regard to lacks of income and assets (UNDP, 2001; World Bank, 2001), food insecurity and poverty (Swaminathan, 2000), soil and land degradation (Ballayan, 2001), real estate of human well-being (Lee, 1997), ICT & Internet inequality and poverty (Panos, 1998), information and poverty (Spink and Cole, 2001), knowledge networks and geographic dispersion (Willard, 2001), poverty and sustainable development (Markandya, 2001), and urban poverty management (Akinyemi, 2001) and poverty mapping (Henninger, 1998) in geographic information system. Traditionally, poverty is a major cause of food insecurity (Narian, 2001) and lacks of agro-ecological technologies (Altieri, 1999) in developing nations. Many theories and models have long discussed the real truth of socio-economical and cultural problems of poverty. This paper, however, does not deal with conventional approaches to multi-dimensionality of poverty, but concentrates on causal mechanisms between the digital

divide and poverty around a central pivot of land information because accesses to lands and houses are regarded as very fundamental human needs to escape poverty.

Fig. 1 offers some ideas of a conceptual framework of causal poverty ranging from economic dimension to technical dimension that a dominant poverty indicator or several factors of poor conditions bring about economic poverty, social exclusion, and technical gulf that reiterates cycles of the divide. Each dimension can be composed of three or four analyses to alleviate current bottlenecks of poverty. Economic poverty begins with understandings of asset-based or income-based measure of poverty considering income's affordability for production and consumption as a basic needs indicator in spatial dimensions of poverty (Hentschel et al., 1998).

It often causes the economic divide or income divide. This economic poverty seriously impacts on individual educations

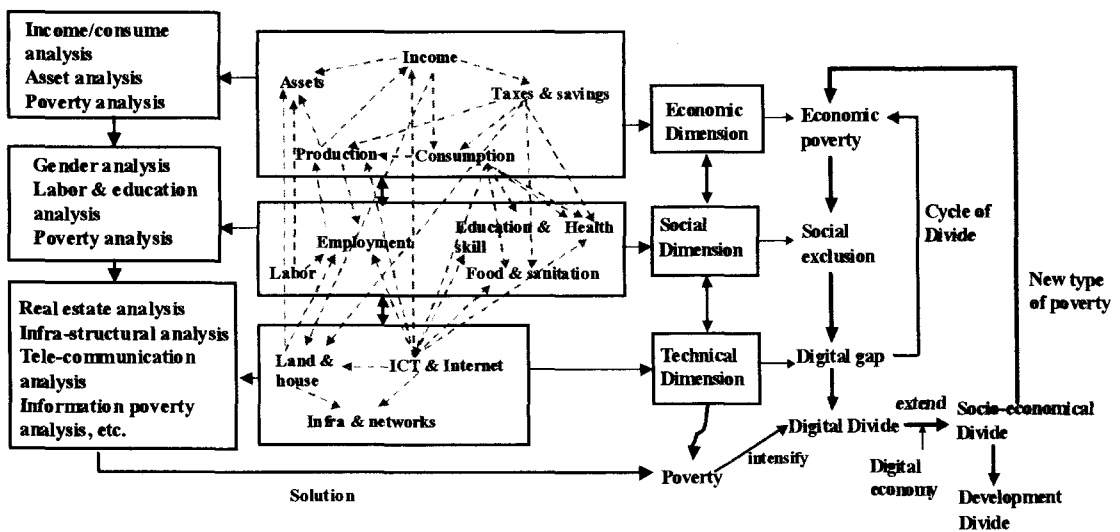


Fig.1. Causal mechanisms between the divide and poverty

and employments. Those who appear to be social exclusion or isolation in digital society could rarely enjoy economic gains and socio-cultural benefits. Social exclusion prevents disadvantaged groups from contributing to or benefiting from the economy and society. These two negative influences could give rise to technical gap or the digital divide with regard to lacks of access to computers, Internet and other electronic utilities and shelters as evident differences based on race, gender, demography and geography, economic status, and physical ability. Technical exclusion is a principal phenomenon in accessible to ICT access, usage and application. The digital divide might not be only technology-oriented facts, but result from causal outcomes of socio-economic and technical burdens such as low-income, unemployment, food insecurity, disability, and low education & skills, and others. There are growing recognitions of the importance of land reform to make a direct impact on poverty (Drimie and Mbaya, 2001) through targeted resource transfers as a vital instrument for readdressing the inequalities in access to economic opportunities. Most governments allow people to access to properties not only to make more productive use of their interests, but also to provide appropriate guideline of asset's transactions as well as to equalize the opportunity of land information shares. However, poor people who do not have access to physical assets might be partly caught in poverty trap arising from traditional economic games and theories. They often fail to get out of poverty because they are uneducated and lack capital-skills

being unable to purchase lands. Few works and studies frameworks might have been done with regard to causal relationships and consequent results between the digital divide and poverty based on the concept of parcel-based land information to be focused on six parameters of a poverty profile.

3. Land information approach to poverty management

3.1. The role of land information for the poor

Many attentions are focused on serious disharmonies and inequalities of individual or group incomes and unbalances of social benefits, and undesirable focus of land ownerships, etc. It is hard to estimate exactly what it is a good guideline of social equilibrium and sustainable land management (Grant et al., 1999) for anti-poverty measurement as to who they are the poor, and where they do live now, and how we can investigate poor conditions over time. Because poverty measurements tend to be subjective and are often pertinent to living quality of housing status and land ownerships associated with social and cultural circumstances, and economic policies and developments. Improvement in land titling and registration system within the framework of land information can benefit tenure security of the poor in Asian and Africa countries, who have difficulty in establishing legal ownership of the land and are located in marginal land increasing natural resource degradation. In other words, measures of land concentration

Towards alleviation of the digital divide and poverty through land information

are measures of inequality in surface area, but are not measure of inequality in the values of land as a productive asset. Deininger and Squire (1996) mention that possession of land can be a major determinant of an individual's productive capacity and their ability to invest in agrarian societies and highly dense population areas where land is a major asset.

Given the fact that the degree of inequality for land redistribution leads to wealth gaps in some African societies (Sibanda, 2001; Selebalo, 2001), we may reconsider traditional aspects of land conflicts and dilemma how land information correlated with the improvement of sustainability for the poor. We do not delve into economic and social perspective of the poor, but make a point of the causes and impacts of poor conditions by interpreting geographical analysis of locations of the poor who have not benefits of local and governmental supports of land information and its Web-based services. Surely, it takes enormous efforts and times to identify the level of poor conditions and classify the poor when government intends to eradicate absolute poverty in slum and rural areas, and makes efforts on reducing relative poverty among working classes.

3.2. Hexad surveying and mapping for the poor

The relationships between real estate management and human welfare concerned with understandings of the reasons and results of cycle of poverty through dynamic poverty mapping (Henninger, 1998; Sehlin

and Bodin, 1996) might have rooms to be desired for analytical interpretation and debate of spatial distribution of poverty pattern, and individual symptoms of poor status quo since many geo-referenced survey data are designed to be used to understand living standards (Grosh and Munoz, 1996) and the effects of government policy-making as a national level of census and population survey or others. Most current poverty maps often make use of census data and sampling clusters techniques because it allows quick glances at rough ranges of socio-economical inequality and demographical issues of human welfare. However, this approach would lead to ineffective analysis of the urban and rural poor that often concentrate in a relatively small number of villages. There might be little efforts for clear indication of spatial causes and reasons of poverty as to why and when they move in and out of poor conditions. Although De Janvry and Sadoulet (1996) investigate causal relationships of poverty and inequality through spells of growth and recession over time, this economical analysis at macro level might have limitations to examine feasible model of human well-being's status quo at a specific community and household given in periods (or time).

In addition, a poverty profile (Lok Dessallien, 1996) for poverty-related information might not be sufficient for expounding many cases of poor causalities of the household. The poor tend to live with poor people in a specific and concentrated area even in urban district and frequently look for affordable shelters over time. This spatial concentration could often give rise to

land degradation and hard infra-structural setting for public communications and the Internet due to the high cost of networks. Here, we propose the Hexad model (Liou, 2001) to make it possible to explain poverty circumstance dealing with actor (who) and then apply to individual timeline of poverty when and why he (or she) enters and how they can move out of poverty. The idea of Hexad model based on actor-based (or agent) framework is to interpret the reasons and results of behaviors and actions of actors in geographic environment and institutions.

These six parameters are used to assist the framework for information system architecture (Sowa and Zachman, 1992) and are shed on the light at the domain of spatio-temporal data modeling (Liou, 1999). This Hexad model is only used to depict geo-location of the poor groups and to trace their movements, but is limited to describe poor circumstances and conditions without interviews and field surveys. This model should be linked to more details of household surveys and data collection methods such as

the LSMS (Grosh and Munoz, 1996) and DHS (Westoff, 2000), and others if there are demands for full descriptions of status quo of poverty and practical ways of escape. Hexad surveying and mapping for spatial conditions of poverty starts to address the geo-locations of poor households (Fig. 2) as to where the poor live, why and when they move in poor situations and what kinds of poverty they are faced with and how local and national authority can establish anti-poverty programs and measurements. Obviously, these six parameters often connect with external environments such as socio-economic, political and enabling factors.

A similar idea of this concept is recently focused on the PASIR (Duraiappah et al., 2000) framework pertaining to poverty-environmental degradation in relation to spatial and temporal dynamics of the changes. Hexad surveying and mapping provides household survey with more details of built environment, natural biophysics, education, health, and nutrition maximizing its potential

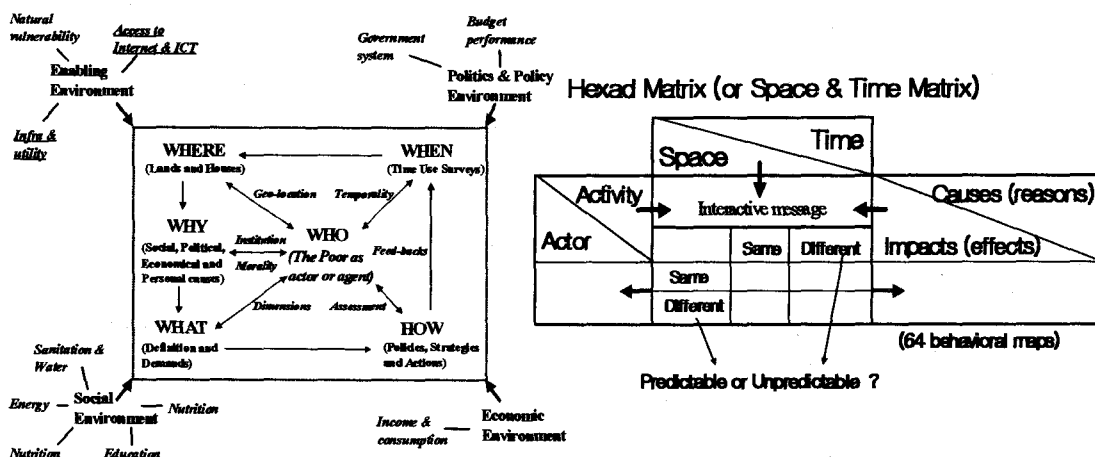


Fig. 2. Hexad model for poverty interpretation

when connecting within the framework of space-time matrix to explain more details of actor's behaviors. It might require significant amount of data collections and timing between data sources and access to household unit level, but can illustrate dynamic simulation of human behaviors in spatio-temporal domains when time use surveys are involved with individual men and women who make their decisions on how to divide or spend their time between remunerated and unremunerated work in the context of actual environments of economy.

4. Closing the digital divide with the Internet-based land information

The digital inequality between the rich and the poor is increasingly widening and leads to political debates and the social divide. In particular, those who excel in the Internet tend to acquire stock options and can monopolize social capitals and information markets that already shows serious income unbalances between IT workers and all others. An inequality access to the Internet gap between the technology haves and the technology have-nots can be considered as a poverty indicator resulting in the potentials of technological poverty trap. Many central or local governments, however, try to boost digital economy and e-commerce in support of the infrastructure of information highway. There are common senses that those who do not keep up with the Internet evolutions and digital economy might be regarded as social renegades. Meanwhile, it might not be easy to measure the impact of the Internet since it

has been already penetrated into all spheres of industries, educations, and businesses, etc and the use of Internet causes serious income gap and the social divide between the information haves and have-nots.

Thus, it requires investigations of negative aspects of the Internet that the digital divide can directly give rise to poverty seriousness. Naturally, the Internet is a part of tools for ICT that several models scrutinize the impacts of information technology such as Mosaic Model (Wolcott et al., 1996), Meta-level framework (Lanfranco, 1997), Information Environment Model (Spink and Cole, 2001), and Internet Engagement Model (Norris, 2001). Before taking the bird's eye of view of the impact, we may need to consider the use patterns and impacts of the Internet, such as question about: Who are the major users?, What do they use the Internet?, How can user practices be measured and monitored over Time?, Why do they (individual/ institution) get interested in the Internet? and Where are serious areas of the digital divide in our region? These six factors give us a basic interpretation of the use of Internet and enable to conjecture possible model of Internet impacts in association with relationship between the Internet and social inequality, and poverty. The Internet has more technical characteristics of communication, computing and conversation than commercial and social functions. Here, we may need to illustrate holistic approach to the Internet impact by creating the Generic Model in conjunction with land information (Fig. 3).

This Generic Model depicts all possible high classes of behaviors from policy, economy,

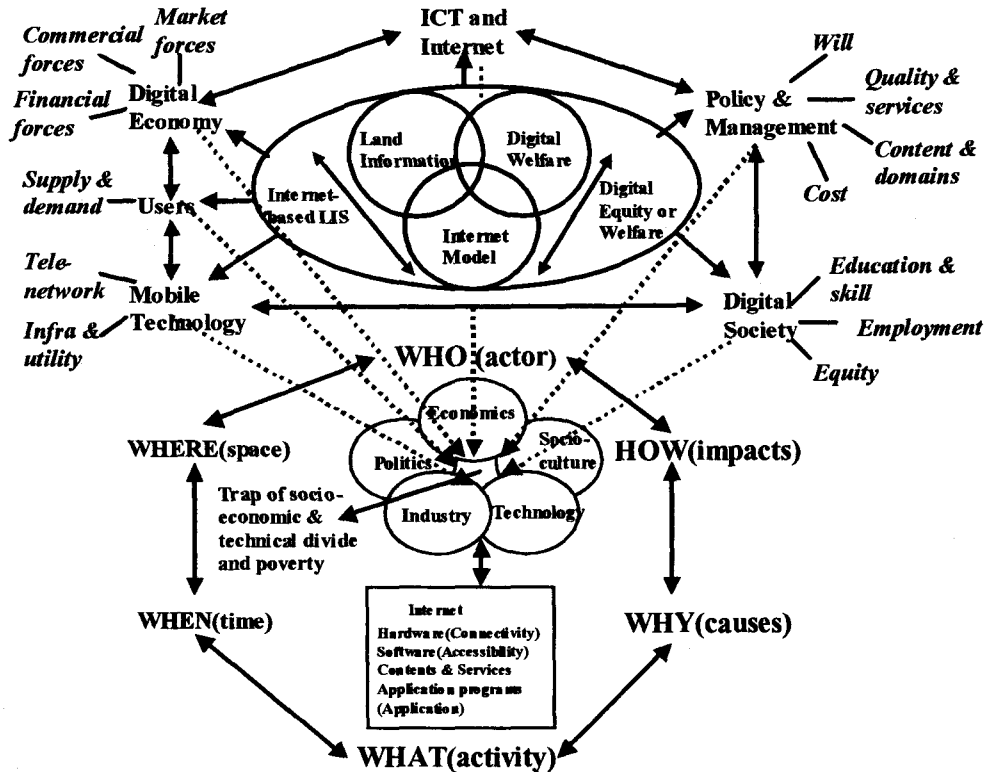


Fig.3. The Generic Internet model for solution of the divide

technology, management, users and Internet service providers (ISP), and digital advocates and groups. Considering current Internet's function and property, it has, to a certain extent, four types of section in relation to hardware, software, content, and application programs. Spatial distribution of the Internet tends to concentrate on capital investments and densely clustered population areas where the users can be affordable payments for PCs and Modems with public networks. Although there are also efforts for explanation of the Internet's effects on possible eradication of poverty in developing countries, there might be few works for causal mechanisms between the Internet model and poverty profiles as to how the Internet becomes a major engine of

economic poverty or social inequality.

In addition, little efforts have been done in terms of the relationship between the Internet and land information towards digital society or welfare as to how land-related assets could have a powerful role in alleviation of shadows of poverty and increasing access to computer and the Internet. This is a real question mark to further investigate dark islands of cyberspace. It needs to push further and ask: access to what, for what, why, where, for whom, how, and when. Perhaps, these six questions might be useful to interpret information poverty. The diffusion of Internet technology prompts the necessity to fundamentally reconsider the relevance of contemporary business models and the

Towards alleviation of the digital divide and poverty through land information

Web-based systems. The impacts of the Internet access and use depend on different public and private consumer service sectors that continuously search for maximizing economic gains and information's benefits. It could lead to socio-economic inclusion and exclusion, or technical disparity in the course of participation and aspiration of digital developments. On the contrary, expansions of the Internet contents might be parallel to socio-cultural, political, industrial, technological growth at the regional level, and commercial and real estate transactions at the community or household level that enable to further accelerate the diffusion of the Internet.

Considering the advent of the Web-based land information, we can presume potentials of cyberspace enabling low-income classes to access to civic information on real estate's ownerships and values, land uses, housing rents, local economic situations and job news, and concerned issues of land related activities with free and low charges of service through the Internet. It might be significant to support the poor who are willing to consider land and house as the future assets to move out of poor environments. Thus, the Web-based land information might be one of attractive strategies for the poor to use the Internet and let them think of other application programs. However, it is required to examine the constraints and feasibilities of the Internet model at the three different interactions towards increases of the Internet's access and application for low-income classes, and assuagement of information poverty as well as increases of digital benefits. Here, much deeper

examinations on anti-poverty programs and actions in socio-economical and environmental aspects are beyond the objectives of this paper.

Meanwhile, poverty researchers using an individualistic model try to identify causes of poverty at the individual level (Henninger, 1998) and the poor are highly mobile and migrate or to remain in poor area because of specific wage and their income power for rents.

In terms of geographical model, poverty is due to the geographical causality pertaining to local & community factors such as climate, soil type, infrastructure, environmental risk and natural disasters, and access to social services, etc. This is why actor-based geographical modeling might be essential for clarifying trace of actor's (or agent) location, and spatial distribution of computer and land ownership, and mapping of the Internet access with an appropriate survey method and Internet-based technologies.

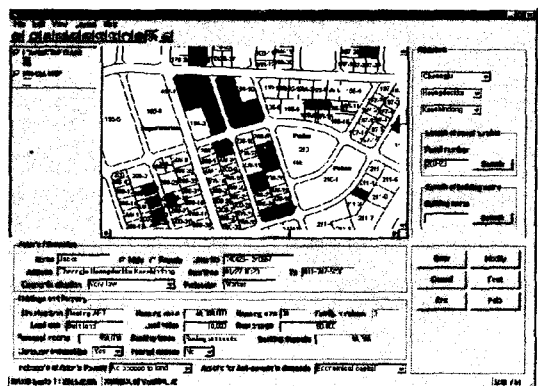
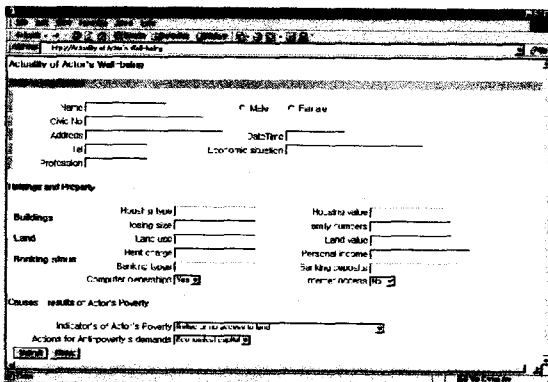
5. Conceptual design for Hexad model

In this section, we illustrate conceptual idea of Hexad model as the proof-of-concept. Principally, it is discussed as confirmation of the feasibility of six parameter's application in parcel-level GIS environment. A full-scale expansion of six parameters to an integrated spatial poverty information system could be a large-scale project if it could include the great deal of welfare's services and the ranges of different software environment between land information and poverty

information system. Here, we describe geo-locations of poor actors and their poor circumstances to assist partly poverty monitoring and control through the conceptual model of Hexad. Considering traditional census and household survey, and interviews with poor actor's status quo, it is still required for huge expenses and time-consuming tasks to continuously maintain their individual information and data. To prove effectiveness and efficiency of conceptual model of Hexad in poverty management, the Internet-based menu system (Fig. 4A) is proposed to support poor actors who often need to secretly express their living conditions and qualities no matter where they are. One of clear things is that poor actors are unwilling to confess their current difficulties and scarcities due to the matters of social separation or segregation. Basic ways for poverty eradication may depend on characteristics of the individual, the household, the community, and the consumption as well as affordability for payment of their lands and housing rents. These are not only associated with definition

of human well-being, guideline of poverty indicators, economic recognition of the poor, and financial performance of government budget, but also surveying techniques and the data collection methods. This is why our menu system is made for client-oriented forms that enables poor actors to submit their opinions through the Internet, and then this information is only controlled by a local and commune administrator. On the basis of narrow targeting at the individual or household level, data collection is very information-intensive, and the necessary information is costly compared with other geographical survey techniques. Thus, our Hexad model might be considered to be a feasible idea to reduce costs and times when this Web-based input system is further developed towards an integrated poverty information system.

As shown in Fig. 2 and 3, six parameters are interpreted as actor (name), space and time (address and datetime), activity (profession), cause and effect (indicator and action) in Fig 4A. If six parameters are used for a full framework of poverty monitoring



A) User interface of Hexad Model

B) Parcel-based mapping for poverty management

Fig. 4. User interface and parcel-based mapping for poverty management

Towards alleviation of the digital divide and poverty through land information

system in GIS, this input system should be linked to one of socio-economic welfare systems. The focus of this input system is not the full scale of the dynamics and persistence of poverty that can notify the flows into and out of poverty, and the time spent in poverty. Because tracks of individual poverty based on agent GIS system require huge times and costs, and are related to individual privacy's matters. There is, of course, the way of indirect data collection and surveys of individuals and households with the supports of national real estate taxation system, social welfare system, other related banking networks and census data. This input system can be regarded as one of user interface of an integrated system that enables us to get a part of informations on the poor when local authorities protect their privacy. If we need consistent information on the length of poverty spells and the relationship between poverty transition and individual or household characteristics, spatio-temporal poverty monitoring information system is required. Furthermore, local authorities should distribute all profitable information about financial projects, medical service and job training program through the Internet. Civic center and local educational program not only allow the poor and marginalized people to access to the Internet and train them how to use the Internet, but also explicate easiness and convenience of the Internet to express as to who and why they are poor, and what poor people are faced with, etc.

Based on conceptual idea of Hexad model, an appropriate way for poverty identification through parcel-based GIS methodology is explored (Fig. 4B) which enables local or

commune administrators to inspect complicated information on spatial distribution of poverty and certain circumstances of poor actors. Parcel-level inventory and asset-mapping (or property-mapping) in GIS environment allows the collection and representation of social and economic data at the finest possible level of local and household or individual resolution that can assist in low-level census geography and digital landscape for nature of quality of life. The Internet can connect low-income households to information on loans or poverty alleviation schemes. In terms of benefits between land information and the Internet, where agricultural or urban lands are the main resources of their communities, information and knowledge about legal ownership of land, commercial values of land use, and urban land development plan through the Internet are principal resources enabling local or commune organizations to assist in individual poverty alleviations.

In response to the digital divide and concerned poverties, asset-based mappings or community asset mappings approach to community development might be a crucial pathway to maximize their strengths and capacities of the individuals and neighborhoods. These mappings provide some judgments as to what kinds of assets are available to help improve not only individual quality of life, and local employments and educations, but also collaborative networks of land and housing supply through the Internet. However, they require enormous developments of survey instruments and methods for collecting and gathering asset's information. This

parcel-based map information can benefit further understandings of more accurate examination on poor actor's assets in connection with their holdings and properties. Naturally, it depends upon actor's description whether they are poor or not. This is why actor's holdings and property are essential for indirectly measuring poor circumstances. Dark color of households shows low-income households in a cadastral map. Administrators should input actor's information through map's window when poor actors submit their poor conditions. Through the strengths of parcel-based mapping, administrators can visualize poor household's location and can approximately measure their living qualities. Although this visualization is surely not enough to determine poverty seriousness, it provides easy ways and freedoms for geographical targeting of anti-poverty programs and actions at the individual and household level.

6. Conclusions

This study examines causal mechanisms between the digital divide and poverty based on application of parcel-based GIS environment, proposing the Hexad model and a prototype of solution model for the divide and poverty management. Since there are ongoing efforts for closing the digital divide analyzing and interpreting socio-economic, environmental, financial, and technological divides within umbrella of poverty management, our conceptual model might have drawbacks to cope with multifold symptoms of the digital divide. As a clear

evidence of economic divide, the economical gains would lead to serious land ownerships by elites and greater impoverishment when land administration and registration system could not guarantee economic problem of the poor, women, and other marginalized groups who are inaccessible to land and high burdens of urban utilities. There might be lacks of serious attention to the causes of poverty, and analysis of structural factors such as differential access to the means of production and to political influence. Many researches have focused on the question of access to land and consider land access as a major welfare role of the poverty reduction. However, they rarely discuss the risks of socio-technical exclusion presented by a lack of ICT and the Internet enabling the poor to look after better place of shelter and good information on job opportunity.

In this study, it shows an experimental usage of the Internet-based menu and visualization of a cadastral map that depicts spatial location of poor household and their circumstance through interpretations of Hexad matrix (or space and time matrix). However, this interpretation should link to household survey and periodically interview with individual poor if efforts for alleviation of the divide and poverty can be effective. Since the dynamics of individuals and household of poverty are volatile, the snapshot survey of poverty is only used for special case of economic crisis and long-term plans of poverty monitoring and its accurate survey should be considered. Although our model of Hexad suggests the concept of temporal trace of poverty, individual poverty transition could not be measured without full

Towards alleviation of the digital divide and poverty through land information

functions of social safety net and legal safeguards. Thus, actor-based temporal land information research might be useful to support consistent measuring and monitoring of poverty transition. Obviously, institutional and legal basis of alleviation of the divide and poverty should be further consolidated in connection with program and project of asset building.

On the other hand, there might be rooms to be desired in dealing with three perspectives without different environments of poor actors who continuously move here to there so as to find appropriate environmental safety and quality of life, and escape information poverty. Urban and rural poverty management is more larger than land information management when considering not only living standard survey for poverty in developing countries, but also growing issues of the digital divide and economical potentials of digital economy in advanced nations. The wage gap between IT workers and other workers continues to widen. This relative poverty is, today, significant signs of social divide and intimidating the birth of digital economy stemming from labor market imbalance. The analysis of the Internet usage and impacts on the poor and the rich resulting in serious relative poverty gap in space over time should be further reconsidered within the framework of buildings for an integrated poverty information system and establishments of digital opportunity.

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Towards alleviation of the digital divide and poverty through land information

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