Designing a Meta-Synthesis Model of Affecting Drivers of Land Use Changes by Systematic Review of Previous Studies

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The main goal of this study is to identify the most important factors affecting land use change based on previous literature. The method used is qualitative and a type of meta-study known as meta-synthesis. We review the purpose of each study, data collection methods and research design/questions for this task. We perform a systematic search based on keywords used in articles on land use change and transformation of land in the following databases: Scopus, Springer, and Science Direct for articles from 1976 to 2015. After reviewing 63 articles out of 286 articles, we identified 5 dimensions and 28 factors as the most important indicators of land use change in various domestic and foreign studies. The results of this study show that the most important dimensions of land use change are economic, demographic and climate. The most important drivers are urban population, average rainfall, and changes in the price of agricultural land.

INTRODUCTION

Labor, capital and land are identified as three essential factors in classical economics for food production and housing (Wu, 2008). Land, in terms of its value and social role, has a special status in the provision of comfort, security, prosperity and quality for human life. The subject of land and how to use (or exploit it) in the social sphere has always been a source of conflict between public and private resource use (Ziari, 2002; Mehrabi et al, 2013). In general, land is the place source and essential factor for human activities. The human use of this resource is called "land use" and such use can take different forms depending on the purposes such as the production of food, shelter, recreation, mining, and processing of materials. Therefore, economic development and social benefits would not be possible without land use in agricultural economics (Wu, 2008).

The biophysical properties of land play an important role in determining this use. Hence, land use is affected by two formidable factors: basic needs of human life and the physical features of the land. Both of these factors are subject to economic, social, and political forces over time. Changes in land use patterns in different spatial (local) levels and different times indicate the interaction and conflict between human needs and the environment. These changes sometimes are beneficial and in other cases are deleterious. Deleterious changes have undesirable effects on the amount of welfare and tranquility of human societies (Briassoulis, 2001).

There are also costs associated with land use change (Table 1). Changing farmland and forests to urban development reduces the amount of lands available for food and timber production. This change, along with soil degradation such as erosion, salinization and desertification associated with intensive agriculture and deforestation, reduces the quality of land resources and future agricultural productivity (Lubowski et al, 2006).

Agricultural land use change is a process of agricultural land conversion (ALC) to other applications. Nowadays, population growth, on the one hand, and the limitation of resources, on the other hand, have accelerated change in agricultural land use. These land use changes are mainly affected by large-scale factors such as the global economy, climate change, demographic change, and local politics (Azadi et al, 2010; Gorecka-Poznanska, 1978; Zare Mehrjerdi et al, 2014; Herer and Sadowski, 1977).

Fast urban development causes vast changes in the pattern of land use around cities. In many developing countries, the rate of urbanization growth has been quite fast and has led to large land use changes (Hall and Pfeiffer, 2000). This rapid growth is due to the housing and building industry, which thrives from profitable opportunities (Shokoie, 2001). The lack of government support and regulation for rural areas and the agricultural sector, as well as a lack of economic opportunities in villages and rural areas, causes migration of productive labor to the big cities. Experts believe that this increased migration trend is one of the major causes for speculation in land markets and consequently land use change that earns increased returns for landowners (Nasimi and Ohadi, 2004). Increases in the conversion of agricultural land to non-agricultural land leads to negative side effects such as loss of natural resources, social concerns, and environmental loss. Supportive policies and programs need to compensate for market inefficiencies that distort the value of agricultural land in its various uses, but also minimize the negative side effects of these transitions (Marawila et al, 2011).

Many environmental problems, including air pollution, water pollution, and loss of wildlife habitat, are associated with urban development (Wu, 2008). Urban runoff often contains nutrients, sediment and toxic contaminants; it is highly polluted and can cause large variation in stream flow and temperature. Habitat destruction, fragmentation, and alteration associated with urban development are major causes of biodiversity decline and species extinctions (Czech, Krausman and Devers, 2000; Soulé 1991). The other threat of urban development and intensive agriculture, which is obvious in coastal areas and further inland, is to the health, productivity, and biodiversity of the marine environment throughout the world (Wu, 2008).

TABLE 1
IMPACTS OF LAND USE CHANGE

Dimensions	Impacts
Socioeconomic	Conversion of farmland and forests to urban development reduces the amount of land available for food and timber production
	Soil erosion, salinization, desertification, and other degradations associated with agricultural production and deforestation reduce land quality and agricultural productivity
	Conversion of farmland and forests to urban development reduces the amount of open space and environmental amenities for local residents
	Urban development reduces the "critical mass" of farmland necessary for the economic survival of local agricultural economies
	Urban development patterns not only affect the lives of individuals, but also the ways in which society is organized
	Urban development has encroached upon some rural communities to such an extent that the community's identify has been lost
	Suburbanization intensifies income segregation and economic disparities among communities
	Excessive land use control, may hinder the function of market forces
	Land use regulations that aim at curbing land development will raise housing prices, making housing less affordable to middle– and low–income households
	Land use regulation must strike a balance between private property rights and the public interest
Environmental	Land use and land management practices have a major impact on natural resources including water, soil, air, nutrients, plants, and animals
	Runoff from agriculture is a leading source of water pollution for both inland and coastal waters
	Draining wetlands for crop production and irrigation water diversion has had a negative impact on many wildlife species
	Irrigated agriculture has changed the water cycle and caused groundwater levels to decline in many parts of the world
	Intensive farming and deforestation may cause soil erosion, salinization, desertification, and other soil degradations
	Deforestation adds to the greenhouse effect, destroys habitats that support biodiversity, affects the hydrological cycle and increases soil erosion, runoff, flooding and landslides
	Urban development causes air pollution, water pollution, and urban runoff and flooding
	Habitat destruction, fragmentation, and alteration associated with urban development are a leading cause of biodiversity decline and species extinctions
	Urban development and intensive agriculture in coastal areas and further inland is a major threat to the health, productivity, and biodiversity of the marine environment throughout the world

*Reference: Wu, (2008)

Numerous studies have examined the effectiveness of public policies concerning conversion of agricultural lands and other open space uses. They have investigated the effectiveness of policies such as zoning restrictions (Lewis et al, 2008), property tax policies/use value programs (Polyakov and Zhang, 2008), conservation easement programs (Plantinga and Miller, 2001), and afforestation subsidies (Lewis and Plantinga, 2007; Carrion_Flores and Irwin, 2005; Hite et al, 2003; Lewis, 2007).

The phenomenon of ALC in different countries varies in terms of intensity, trend, and drivers (Firman, 1997). The main drivers that contribute to ALC are classified as internal or external. Internal factors are related to the location and land potential (including land productivity), ownership pattern (including parcel size) and household size and income (Levia and Page, 2000; Nelson, 1990). External factors include urbanization, socio-economic conditions and government policies (Lichtenberg and Ding, 2008; Ho and Lin, 2004; Firman, 1997; Van den Berg et al, 2003; Azadi et al, 2010).

One of the major challenges is to distinguish between ALC linked to climate conditions versus ALC changes induced by anthropogenic processes (Nicholson, 2001; Vanacker et al, 2005). This distinction has been addressed, for example, with respect to the impact of agricultural land use, fires and conservation on ecosystem functioning in North and South America (Paruelo et al, 2001); the impact of fire activity on land-cover changes in different ecosystems in Africa and South America (Eva and Lambin, 2000; Wessels et al, 2004; Snyman, 2004); and land use changes in protected areas in Tanzania (Pelkey et al, 2000).

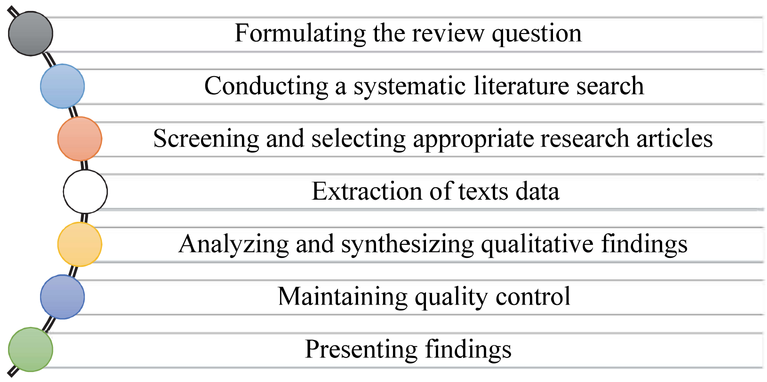
Many papers have investigated the effects of various drivers on ALC. Mertens and Lambin (2000) looked at human forces driving land use change. Yazdani and Hashemi Bonab (2014) investigated economic-environmental damage of agricultural land use changes in Mazandaran. Caldas et al (2010) researched population changes. Khakpoor et al. (2007) studied the lack of proportionality between value-added agriculture activities and sale of land in Babol. Amirnejad (2013) looked at human driving force and physical stimuli. Jokish (2002) investigated population changes in natural areas. Lopez et al. (2006) studied migration of Mexicans to the US and population changes. Long et al (2007) looked at industrialization, urbanization, population growth and economic development in China. Carlson (2000) studied urbanization in northeast US. Gomarasca et al. (1993) investigated rapid growth of the housing sector in Milan Italy. Yazdani and Hashemi Bonab (2014) studied urban growth. Bahador and Murayama (2006) studied growth in rural areas. Brueckner and Fansler (1983) and McGrath (2005) used a Muth-Mills version of the urban model to research agricultural land markets. Deng et al. (2008 and 2010) studied industrialization and expansion of urban land. Seto and Kaufmann (2003) looked at urbanization and its effects on agricultural land. These studies show that many, many factors can be included in an analysis of ALC. From these studies, it is clear that many factors affect the land use changes that are important to include in ALC analyses.

Therefore, while land use change provides economic and social benefits, there is a substantial economic cost on society. Therefore, land conservation is one of the critical elements of long–term economic growth and sustainable development. However, there must be a balance between private property rights and the public interest through land use policy (Wu, 2008). Hence, the aim of this study is to identify the factors explaining land use change.

METHODOLOGY

The methods used in this paper are qualitative in nature: a Meta-Synthesis, which identifies ALC problems. Since there are many articles in the field of land use change using both qualitative and quantitative methods, the Meta-Synthesis method seems a good way for obtaining comprehensive findings (Arab et al, 2014). In general, this method integrates an interpretation of the main structure of selected studies in order to create comprehensive and interpretive findings (Zimmer, 2006) and a deep understanding of the researcher (Beck, 2002). This means that instead of presenting a comprehensive summary, this method creates an interpretive combination of the findings. Meta-Synthesis provides a broad description of the research phenomenon through various combinations of qualitative research, to explore topics and new metaphors (Arab et al, 2014). Meta-Synthesis requires that the analysis is a profound and detailed presentation on the scholarship and quality of the research findings. Through a review of the main articles on a research topic, words are identified to create a more comprehensive view of the phenomenon under consideration (Zimmer, 2006). Sandelowski and Barroso introduce a seven-step method for meta-analysis (Arab et al, 2014). In this study, past studies in the field of land use change are synthesized using this seven-step method. Figure 1 summaries the Sandelowski and Barroso seven-step model.

FIGURE 1
STEPS IN IMPLEMENTATION OF THE META-SYNTHESIS METHOD



(Sandelowski and Barroso, 2007)

Step 1: Formulating the Review Question

As with any research inquiry, developing a specific and articulate research purpose and research question is the first task of the Meta-Synthesis. This method uses research questions such as study area, researcher, variables, and time to establish inclusion and exclusion criteria. This study explores the following topics:

1. *Identify critical components of land use change in the world*
2. *Grouping analyses of land use changes by approach*

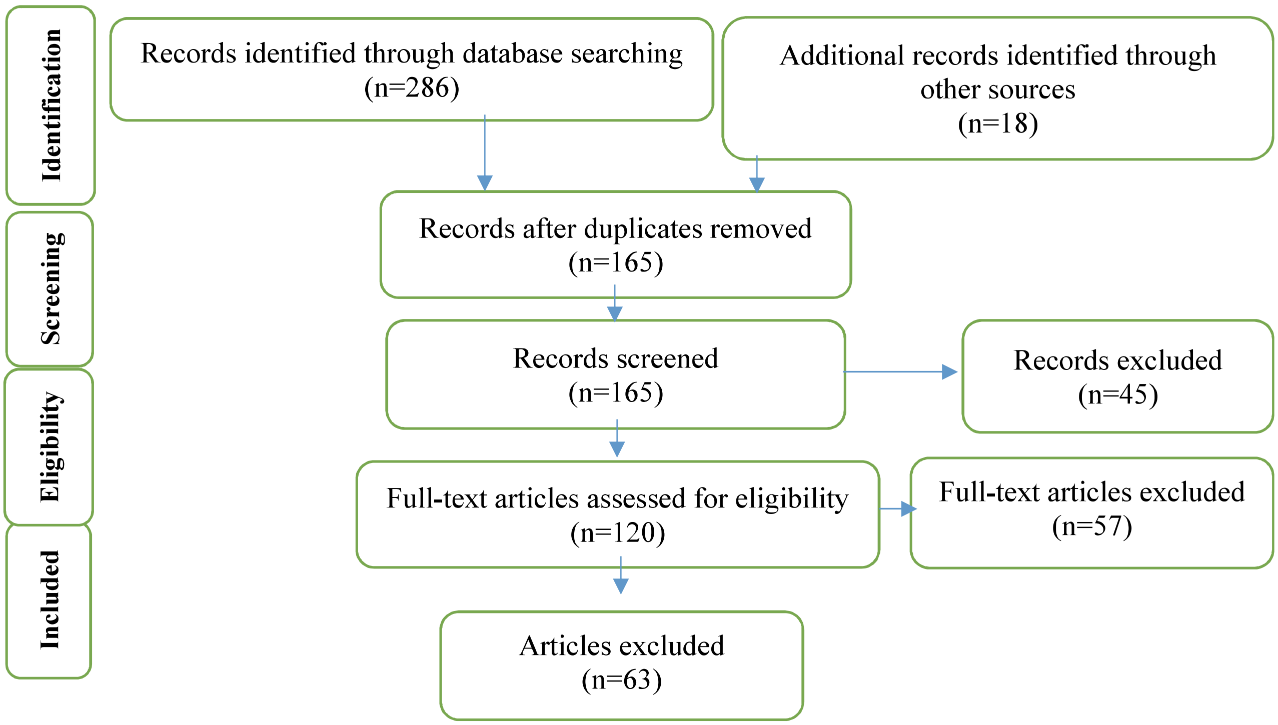
Step 2: Conducting a Systematic Literature Search

It takes considerable effort to develop an exhaustive list of studies that might be included in the qualitative meta-analysis. Keywords are identified and used with all available databases within the study period. This involves learning how different databases translate terms according to subject headings and collecting identified research, including unpublished literature such as dissertations, theses, and research reports. Criteria for inclusion and exclusion of articles is fluid and flexible because the procedures for screening may change as more is learned about populations, models, and various defining characteristics of the studies (Tong et al, 2008). In this step, the researcher focuses on a systematic search of published articles using different keywords. In order to respond to the questions raised in the first stage of the implementation, the keywords used are "land use change" and "transformation of land" in the following databases: Scopus, SID, Civilica, Emerald, IEEE, Springer, Science Direct and Google Scholar for articles from 1976 to 2015.

Step 3: Screening and Selecting Appropriate Research Articles

A key task at this step is to determine what studies are to be included and what features to include in the appraisal. Researchers strive to clarify and use specific inclusion and exclusion criteria. Appraising qualitative research can be difficult because qualitative research is not a unified field due to a plurality of methodological approaches and methods (Dixon-Woods, Shaw, Agarwal, and Smith, 2004). This step involves developing a means for determining the similarities among studies by using comparison parameters such as stated research purposes, research questions asked, data collection techniques, data analysis, and findings reported. The researcher might also consider using an appraisal or rating guide for comparisons in identifying and locating the information appropriate for synthesis. Figure 2 summarizes the reviewing process for the present study.

FIGURE 2
THE PROCESS FOR REVIEW OF RESEARCH CONDUCTED



Sandelowski and Barroso (2003) developed a typology of findings to classify qualitative data by type and content of findings with an emphasis on the degree of data transformation. At the end of this step, researchers select the final sample of studies to use in the qualitative meta-synthesis.

The purpose of this step is to remove articles that are methodologically suspect, so some articles are rejected on this basis. The Critical Appraisal Skills Program (CASP) is used to evaluate the initial quality of the qualitative research. CASP involves 10 questions to understand better the qualitative research. This tool helps assess the accuracy, validity and importance of each qualitative research study identified. The questions focus on: 1) research design 2) sampling strategy 3) reflexivity (the relationship between the researcher and the participants) 4) data collection 5) sampling methods 6) reflectivity (comparisons with other results) 7) ethical considerations 8) rigor of the data analysis 9) clarity of the findings and 10) value of the research. Each question has a score from zero to five, so the CASP has 50 points total (Arab and Associates, 2014). Excellent is from 41 – 50; very good is from 31 - 40; good is from 21 - 30-21; medium is from 11 - 20; and weak is from 0 - 10 (Finfgeld, 2003). The range for the CASP point totals for this study was from 25 to 50. We remove any article with a score below 30 from the analysis. This resulted in the removal of 146 articles, so the number of included articles is 63. Five papers with scores of 50 are included in the meta-synthesis. An important caveat is that using this checklist in a rigid or unreflective way may overlook important research to include, so flexibility is essential.

Step 4: Extracting Information from the Articles

Information within the papers are categorized by their references to other articles (paper title and author, year of publication, and other important factors mentioned in the article) and their research methods (purpose of research and methodology).

Step 5: Analyzing and Synthesizing Qualitative Findings

The researcher presents what has emerged through the process of qualitative meta-synthesis. Effective presentation of findings takes into consideration the different audiences who might use the meta-synthesis to benefit the move from research to practice. Many meta-syntheses use a visual display (charts, figures, or tables) to present the findings for readers graphically.

Step 6: Maintaining Quality Control

In the Meta-Synthesis method, researchers must maintain quality in their study by (Arab and Associates, 2014):

1. Using both electronic and manual search procedures to find related articles.
2. Emphasizing quality control methods used in the qualitative research studies.
3. Using the CASP assessment tool for Meta-Synthesis analysis.

Step 7: Presenting the Findings

The findings from these steps are presented. In this study, 63 papers are selected and their information are identified based on the objective of this paper. The findings are categorized into 5 dimensions and 29 indexes, which are shown in Table 2.

DISCUSSION AND CONCLUSION

In the first phase of this study, we rated the collected studies and classified them according to the CASP index; 63 studies were accepted. Table 2 presents the dimensions that result from the meta-synthesis and the drivers of land use change within those dimensions.

TABLE 2
FACTORS (DIMENSIONS AND DRIVERS) AFFECTING LAND USE CHANGE

Dimensions	Drivers	Reference and Setting*	Source Paper*
Demographic	Number of household members	(27), (39), (44), (28), (41),	(106)
	Urban Population	(27), (39), (44), (28), (41), (7), (35), (43), (55), (86), (91), (89), (13), (37), (85), (56), (87), (82), (86), (111), (110) (74), (47), (64), (48), (29)	(32) (68) (106) (73)
	Changes in population	(7), (35), (43), (55), (86), (91), (89), (47), (64), (29)	(32) (73)
	Number of farmers	(2), (5), (71), (34), (46), (67), (113), (20), (21), (51), (50), (69), (75), (81), (90), (107), (114)	(100) (116)
	Employment density	(2), (5), (71), (34), (46), (67), (113), (7), (35), (43), (55), (86), (91), (89)	(32) (100)
	Number of people employed in agriculture	(7), (35), (43), (55), (86), (91), (89), (2), (5), (71), (34), (46), (67), (113),	(100) (32)

Geographical	From village to town	(27), (39), (44), (28), (41), (13), (37), (85), (56), (87), (82), (86), (111), (110)	(106) (68)
	Distance to the city center	(16), (17), (18), (60), (61), (62), (27), (94), (101), (102), (115)	(45)
	Area of agricultural production	(2), (5), (71), (34), (46), (67), (113), (20), (21), (51), (50), (69), (75), (81), (90), (107), (114)	(100)
Political	Employment in industry and mining	(7), (35), (43), (55), (86), (91), (89)	(32)
	Poll tax	(7), (35), (43), (55), (86), (91), (89)	(32)
	Government policies	(7), (35), (43), (55), (86), (91), (89), (47), (64), (29)	(32) (73)
Climate	Soil quality	(27), (39), (44), (28), (41), (2), (5), (71), (34), (46), (67), (113),	(106) (100), (57)
	Average rainfall	(20), (21), (51), (50), (69), (75), (81), (90), (107), (114), (16), (17), (18), (60), (61), (62), (27), (94), (101), (102), (115)	(118) (45)
	Water Resources	(20), (21), (51), (50), (69), (75), (81), (90), (107), (114)	(118)
	Mean air temperature	(16), (17), (18), (60), (61), (62), (27), (94), (101), (102), (115)	(45)
Economic	Value of agricultural land	(7), (35), (43), (55), (86), (91), (89)	(32)
	Average value of houses	(7), (35), (43), (55), (86), (91), (89)	(32)
	Unemployment rate	(7), (35), (43), (55), (86), (91), (89), (47), (64), (29)	(32) (73)
	Changes in per capita income	(7), (35), (43), (55), (86), (91), (89), (47), (64), (29)	(32) (73)
	Changes in price of agricultural land	(7), (35), (43), (55), (86), (91), (89), (16), (17), (18), (60), (61), (62), (27), (94), (101), (102), (115)	(32) (45)
	Income of agriculture	(7), (35), (43), (55), (86), (91), (89)	(32)
	Total per capita income	(7), (35), (43), (55), (86), (91), (89), (47), (64), (29)	(32) (73)
	Urban wage rate	(16), (17), (18), (60), (61), (62), (27), (94), (101), (102), (115)	(45)
	Investment in the agriculture sector	(16), (17), (18), (60), (61), (62), (27), (94), (101), (102), (115)	(45)
	GDP (state)	(16), (17), (18), (60), (61), (62), (27), (94), (101), (102), (115)	(45)
	Productivity	(7), (35), (43), (55), (86), (91), (89), (16), (17), (18), (60), (61), (62), (27), (94), (101), (102), (115)	(32) (45)
	Average urban household income	(7), (35), (43), (55), (86), (91), (89)	(32)

*All numbers in parentheses are papers from the reference list.

As shown in table 2, the most important factors affecting land use are grouped into the following five dimensions: geographical, demographic, economic, political and climatic. These dimensions are further broken into 28 related drivers. Table 3 shows the frequency and percentage of each factor:

TABLE 3
DRIVERS IN PAST STUDIES OF LAND USE CHANGE

Drivers	Frequency*	Frequency %**
Number of household members	6	1.5
Urban Population	25	6.5
Changes in population	12	3.1
Number of farmers	19	5.0
Employment density	16	4.1
Number of people employed in agriculture	16	4.1
From village to town	16	4.1
Distance to the city center	12	3.1
Area of agricultural production	19	4.9
Employment in industry and mining	8	2.1
Poll tax	8	2.1
Government policies	14	3.6
Soil quality	15	3.9
Average rainfall	23	6.0
Water Resource	11	2.8
Mean air temperature	12	3.1
Value of agricultural land	8	2.1
Average value of houses	8	2.1
Unemployment rate	14	3.6
Changes in per capita income	14	3.6
Changes in price of agricultural land	20	5.2
Income from agriculture	8	2.1
Total per capita income	14	3.6
Urban wage rate	12	3.1
Investment in the agriculture sector	12	3.1
GDP (state)	12	3.1
Productivity	20	5.2
Average urban household income	8	2.1
Total	**382**	**100**

* Number of studies; ** the percentage of studies

The results of the table 3 show that the most important driver of land use change in different countries is population. Other important influencing factors are average rainfall, changes in the land price and land productivity.

FIGURE 3
FREQUENCY OF LAND USE CHANGE DRIVERS IN LITERATURE

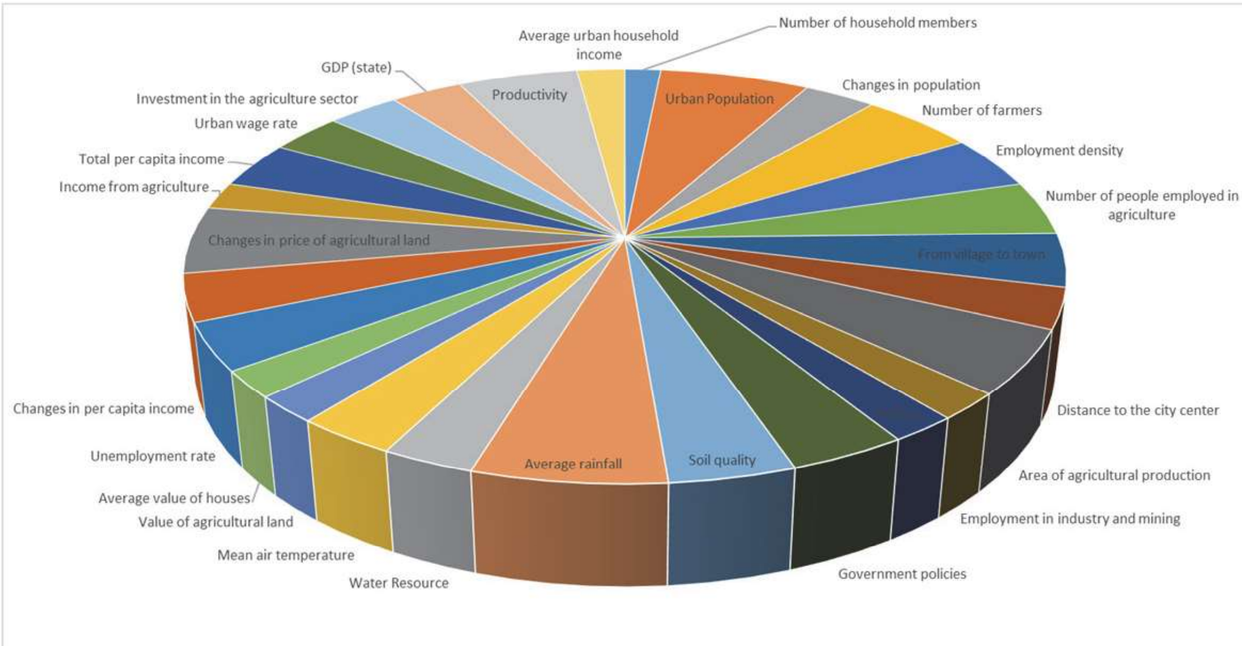


TABLE 4
DIMENSION FACTORS IN ANALYSES OF LAND USE

Dimensions	Frequency*	Frequency %**
Demographic	94	24.6
Geographical	47	12.3
Political	30	7.8
Climate	61	15.9
Economic	150	39.2
Total	**382**	**100**

* Number of studies; ** the percentage of studies

FIGURE 4
SHARE OF LAND USE DIMENSIONAL FACTORS

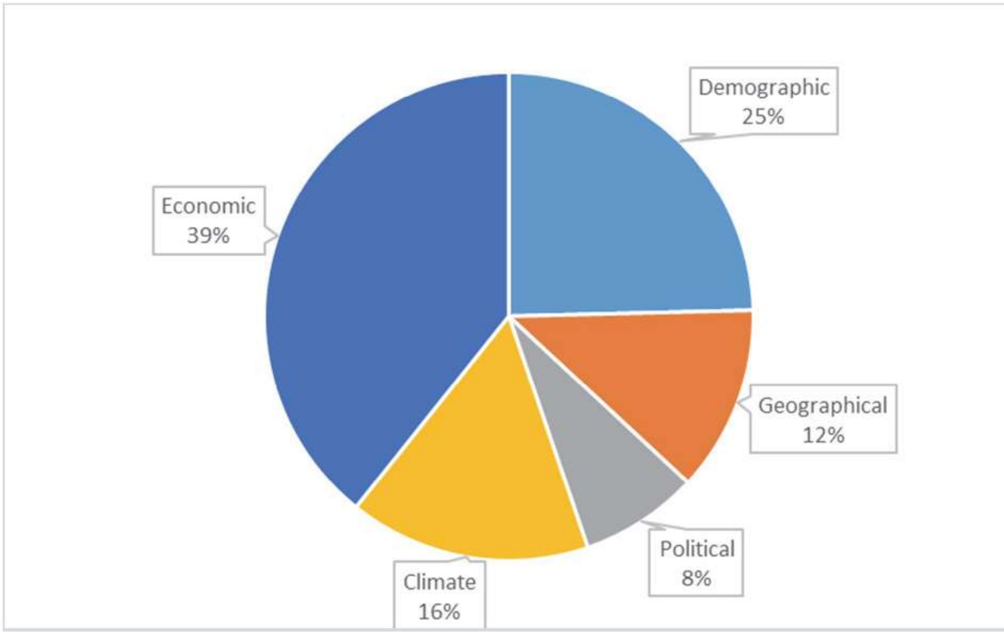


Table 4 shows the importance of each dimension. The most influential dimension for agricultural land use change is the economic dimension, which includes more drivers than the other dimensions. The second most important dimension is demographic and population. Political, geographical and climatic aspects are the other dimensions found in the analysis.

TABLE 5
TIME FRAME FOR STUDIES ON LAND USE CHANGE BASED ON DATE PUBLICATION

Time	Frequency*	Frequency %**
Before 2000	8	**12.6**
2000 – 2010	41	**65.1**
After 2010	14	**22.2**
Total	**63**	**100**

* Number of studies; ** the percentage of studies

Table 5 shows the time intervals for the reviewed studies. Most studies in this field were performed between 2000 and 2010, which shows the importance of the issue at that time.

Methods and models used in the studies are very important in investigating land use analysis. Table 6 shows the frequency and the percentage of use for different land use models.

TABLE 6
MODELS OF LAND USE CHANGE

Models	Frequency*	Frequency %**
Multilevel Modeling	9	14.2
Spatial Models	16	25.3
Programming and geographical models (surveying, photographic, ...)	38	60.3
Spatial Multilevel Models	0	0
Total	**56**	**100**

* Number of studies; ** the percentage of studies

Three basic analytical methods are used for these studies. The most common method used is programming or geographical models. The second most common category is the spatial model.

CONCLUSIONS

Meta-analysis is a new method to combine statistical results in order to reach a conclusion. Meta-analysis is a survey method that helps studies to go further than a single case study. It gives a comprehensive overview of the subject and improves theory building. On the other hand, land use change studies require meta-analysis in order to provide a comprehensive framework to address the impacts of land use change. Conceptualization of the land use change process and its factors gives an essential finding to compare studies. As a result, meta-analysis provides an integrated framework to improve our knowledge of land use change and affective factors.

As mentioned earlier is there substantial cost to the environment associated with the land use change along with its economic and social benefits. Unlike most economic costs, environmental externalities are not figured into private land use decisions, so inefficient land allocation is one of the outcomes of environmental externalities, which lead to a divergence between private and social costs for some land use (Wu, 2008).

There are different ways that land conversion and use are regulated. The traditional command and control approach directly controls use through zoning and density regulations. While these policies are effective, they are associated with a substantial social welfare loss in the form of higher housing prices, smaller houses, and inefficient land use patterns (Cheshire and Sheppard 2002; Walsh 2007). Incentive–based policies include development impact fees, purchases of development rights (PDRs), preferential property taxation, and direct conservation payments. These kind of policies are increasingly used to influence private land use decisions.

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