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The mutual benefits of promoting rural-urban interdependence through linked ecosystem services

Tewelde Gebre [a, *], Dr. Berhanu Gebremedhin [b]

[a] Mekelle University, Institute of Environment, Gender and Development Studies, Ethiopia
[b] International Livestock Research Institute, Ethiopia

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ABSTRACT

Rural and urban areas are economically, socially, and environmentally interlinked spaces. Ecosystem services are among the major areas of rural-urban linkages in which their interdependence is highly manifested. This paper is based on the systematic review of diversified theoretical and empirical literature. The different mutual benefits that rural and urban areas gain from their linkage are analyzed from the ecosystem services perspective. The main aim was to explain how rural area ecosystem services can be used to strengthen rural-urban linkages. Urban development is generally unthinkable in the absence of rural development, particularly for areas where agriculture is the mainstay of the economy. Rural areas are absolutely necessary for urban areas to function. Almost all ecosystem services of urban areas are imported from rural areas. Urban areas rely on rural areas to meet their demands for food, water, wood, raw materials, etc., which are basically products of rural ecosystem services. Nevertheless, the benefit that rural areas gain from urban development, such as market, farm inputs, employment opportunities, etc. should not be overlooked. Thus, well managed rural-urban linkage is imperative based on a principle that urban development should not affect the supply of rural ecosystem services and rural life at all. Furthermore, the rural population should be given policy attention to the ecosystem services the rural areas are providing and the rural area's ecosystem should be protected for its sustainable service delivery.

1. Introduction

This world is getting more urbanized than ever. By 2050, nearly 7 of 10 people in the world will live in cities (World Bank, 2019). For developing countries like Ethiopia, the urbanization rate is much higher than the global average. This does not mean that a mere focus should be given to urban development. Unless due emphasis is given to rural development, the question of ensuring food security will still remain unanswered. In line with this, realizing urban development through rural development should be a policy agenda because of the ongoing rapid rate of urban population growth and physical expansions.

Thinking rural and urban areas as separate domains is unjustified. Both spaces are inseparable and the development of each area depends on one another's development. Urbanization entails broader transformations that benefit the wider

* Corresponding author.
E-mail addresses: tewelde.gebre@mu.edu.et (T. Gebre), b.gebremedhin@cgiar.org (B. Gebremedhin).

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population, including the rural population. Rural development, on the other hand, benefits not only the rural area but also urban areas. This is fundamental because of the production and expenditure linkages they have each other (Davis et al., 2002). Thus, national development can be achieved based on rural-urban linkages. (see Fig. 1)

In the context of urban development, the rural-urban linkage is very crucial, especially the linkage is critical for urban development. Because of the rapid rate of urbanization, urban poverty, limited space, higher food prices, limited water supply services are among the problems that the urban areas are facing today. A strong rural-urban linkage in this context has a higher potential for reducing these urban area problems.

It is commonly perceived that a rural-urban linkage is more important for rural development, poverty reduction and transformation (Akkoyunlu, 2015; Mayer et al., 2016; Tacoli and Vorley, 2015). The essential role that rural-urban linkage has on urban development is often overlooked and the roles that rural ecosystems play in urban development are not well represented.

The theoretical foundation of this paper is that rural-urban linkage is important not only for rural areas, the benefits also go to urban areas. Ecosystem services are one of the areas in which rural and urban areas can be linked. Ecosystem services are the diverse material and non-material benefits that we gain from the environment freely because of natural processes, such as forests, water, raw materials, landscapes, etc. To make the linkage more strong, the ecosystem services found in rural areas should be sustainably enhanced and services need to be supplied to the rural areas to get the benefits in return for their services. The basic premise is that rural and urban areas are endowed with unequal ecosystem services (Howard, 2013).

Ecosystem services have wider spatial dimensions and serve as a critical link between rural and urban areas. Promotion of these ecosystem services is one of the major ways in which rural-urban linkage is manifested. Therefore, describing these ecosystem services and how they function to connect the two spaces has paramount importance in further enhancing and sustaining the linkage.

The main objective of this term paper is to analyze the role of ecosystem services in enhancing the rural-urban inter-dependence for their mutual benefits. Hence, what are the rural area's ecosystem services that urban areas are dependent on? How these ecosystem services contribute to the development of both rural and urban areas? Can urban areas survive in the absence of rural area's ecosystem services? And how can the rural-urban linkage be enhanced through these ecosystem services? were the rationales for conducting this systematic review.

It is almost known that rural and urban areas cannot stand alone without the mutual interdependence with one another. In order for the enhanced rural-urban linkages, governments and relevant bodies have to work for the maintenance and protection of rural ecosystem services and building infrastructures to bring rural products to urban markets.

2. The concepts of rural-urban linkages

The concepts of both rural and urban areas are subjective to different economic, social, environmental and political aspects. Nevertheless, the concept of the rural area has been perceived as farming areas and urban areas as crowded population

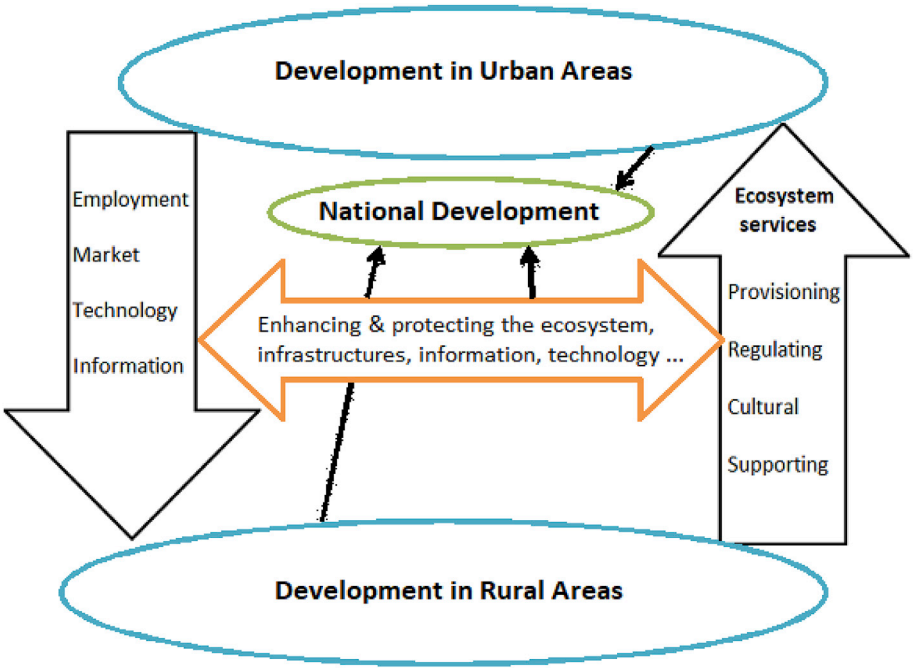

Fig. 1. Conceptual framework of ecosystem based rural-urban linkages.

settlements by many policy makers and researchers (Braun, 2007). This view could be a cause for treating both settlements differently. Further, it could underestimate the contribution that each space has to provide for the poverty reduction in both fields.

In fact, there is a common variation between rural and urban areas in population density and availability of social services. Urban areas are places where lots of people live on a small amount of space with better and improved access to social services, whereas rural areas are places where people live in dispersed space with limited access to social services. This variation decreases as rural areas are nearer to urban areas.

Apart from this, it would be debatable to put a clear point of difference, especially numerical variations to rural and urban areas. This point of view would be clear when the number of the poor living in rural areas of developed and developing countries is analyzed. According to the findings of a research conducted across 105 countries by Alkire et al. (2014), while 86% of the poor in Sub-Saharan Africa and South Asia live in rural areas, the figure is 28.6% for developed countries. This clearly indicates the global average of the poor living in rural areas does not specifically represent the developed countries.

The variation between rural and urban areas is wide in developing countries. These variations between urban and rural areas basically exist not only in terms of poverty but also in infrastructural provisions. In many developing countries, rural people do not have access to social infrastructure in relation to their urban counterparts (Braun, 2007).

3. The three magnets theory

Rural and urban areas are endowed with different amenities. What is cheap for rural areas is expensive in urban areas, and what is abundant in urban areas is less in rural areas. This is the main cause of the different lifestyle existing in urban and rural areas (Howard, 2013). The people face difficulty in choosing between urban and rural lifestyle because of the different advantage and disadvantages each area has.

According to Howard's three magnets theory, rural areas have an advantage over urban areas in beauty nature, fresh air, abundance of water, and low rent. But, rural areas are disadvantaged in lack of public spirits, lack of amusement, long walking hours and low wages. Urban areas, on the other hand, have an advantage over rural areas in social opportunities, chances of employment and higher wages, and more places of amusement. At the same time, they have a disadvantage in higher rent and prices, polluted air, more slum areas, and isolation of nature (Howard, 2013).

Thus, a rearrangement is important that would provide the basis for a more prosperous, cooperative and liberated human experience and give a solution to the lack of opportunities in the rural settings. The theory of the three magnets calls for the establishment of an area which can never be called ‘rural’ nor ‘urban’ area, but having the beauty of nature, social opportunities, low rents and high wages, fields of easy access, bright homes and gardens, and free of slums and polluted air.

4. Areas of the rural-urban linkages

The interaction between rural and urban areas is important for the social and economic development of both rural and urban communities. Their interaction would be of importance if they are treated as linked rather than looking separately at urban and rural areas.

Rural-urban linkages can be viewed from two perspectives: spatial linkages that link people, goods, money, information, and sectoral linkages that link agriculture, manufacturing industries and services (IIED, 2018). Rural-urban interactions can also include rural activities taking place in urban centers and urban activities taking place in rural areas.

Rural-urban linkage can also be viewed from the context of urban area food systems; ecological linkages, comprising ecosystem services; socioeconomic linkages, including more direct supply chains; and governance linkages, which bring together urban and rural governance structures in a democratic and participatory way (Jennings et al., 2015).

Ecosystem services are generally services that result from a complex interaction of natural cycles such as solar energy, contribute to the functionality of the biosphere, which contains all living organisms (Daily, 2003). These different types of ecosystem services are broadly classified into four major categories: provisioning services, regulating services, supporting services, and cultural services (Gómez-Baggethun and Barton, 2013).

4.1. Provisioning services

Provisioning services are the services that directly provide basic goods like food, water, timber and fiber like wool and cotton from the ecosystem. Virtually, all urban and rural areas are dependent on these services. Rural areas provide food, water, energy, raw materials, and other ecosystem services to urban areas (Jennings et al., 2015).

4.1.1. Food supply

The urban population of the world has rapidly increased from 746 million people in 1950 to 3.9 billion population in 2014 (UN, 2014). Nowadays, urban population shares more than half of the world's total population. By 2050, projections show that 2.5 billion people will be added to the total number of population living in urban areas, making the share of the urban areas population increase to 66% (UN, 2014). The population growth combined with the rapid rate of urban growth and income growth, the demand for food in urban areas will increase sharply.

Nearly 70% of all food consumed worldwide is produced by rural areas on the 60% of the earth's arable land (Locke, 2017). The majority of these foods are traded to urban markets for the sake of generating income. Although the extent varies, many cities are entirely dependent upon rural areas for their food supply (FAO, 2017).

Considering the rapid urbanization occurring in urban areas of the world, cities will need more and more food to fulfill the needs of their dwellers. Because of the rapid urbanization, the value of food in urban areas of Sub-Saharan Africa is projected to increase from US$313 billion to US$1 trillion between 2010 and 2030 (FAO, 2017). This would influence food production around rural areas.

Thus, how we feed the growing, richer urban population is the question. Rural areas have a higher potential of producing food and related activities. Although rural and urban areas are linked in terms of social, ecological and economic spheres, there is a very clear disconnection between rural and urban areas in food production (Jennings et al., 2015).

The supplies of food from rural areas to urban areas require improved infrastructure, facilities, and smooth administrative systems. In many developing countries, the lack of infrastructural service like lack of road is a major bottleneck for farmers seeking to meet the urban demand for food (FAO, 2017). Building up the necessary infrastructure to connect rural areas and urban markets is highly important in the supply of food. Further, a range of policies should be in place to ensure that small-scale producers are able to participate fully in meeting urban food demands.

More addition to this, the basic requirements needed to enhance the quality and quantity of food to meet the needs of urban dwellers are (Argenti, 2000):

- Improved land use management for efficient and sustainable food production;
- Protect the environment from contamination;
- Supplying enough amount of water for food production;
- Improving the transportation infrastructure for better access;
- Increasing wholesale and retail markets;
- Arranging itinerant traders in low-income districts;
- Allowing free dissemination of market information for better production and marketing decisions;
- Improved transportation methods to reduce food losses; and
- Clear, well-articulated and well-understood regulation of production, transporting and marketing of food.

In order to realize the sufficiency and quality provision of food to urban areas, the quality of the connections between rural and urban areas should be improved and strengthened. To enhance the rural-urban linkage in the food supply, a major emphasis should be given to reducing the impact of urban areas physical growth in agricultural production and productivity. Urban areas of most developing countries often expand to agricultural areas because of the absence of a strategic land use plan (Satterthwaite et al., 2010).

Promoting better market access for the rural area food producers is the other point of rural-urban linkage. Urban markets in towns, and small and medium cities are the entry point into the food market for the large majority of the world's rural area food producers (Proctor and Berdegué, 2016). These changes have implications on the livelihoods, local economic development and food security in both the rural and urban areas.

Livestock products are the other potential market areas for rural farmers. Because of increment in income and concerns given to energy giving food, there is a rapid increase in consumption of livestock products (meat, milk, and eggs), vegetable oils and sugar. The meat, milk, and eggs together account for 29% of total food consumption in the developing countries and 48% in the developed countries (Proctor and Berdegué, 2016). This share is more likely to increase considering the rapid rate of urbanization in urban areas.

Rural farmers can be more benefited from rural-urban linkages through the food supply in the following conditions:

- The pattern of spatial expansion of modern markets and fast food outlets will occur in urban areas. This can increase market opportunities for food producers from rural areas.
- The primary, secondary and tertiary stage of food processing sectors will enter into the modern market in which food prices can be higher and food producers from rural areas will benefit more.
- Changes in the procurement systems of market chains will occur in which specialized and committed buyers will go to the rural areas where food is produced. This reduces transaction cost for food producers in rural areas.
- Modern food systems require an integrated packing, grading, processing and transport, and logistics infrastructure. These changes, in turn positively affect rural areas by providing them employment opportunities. Across the world, urbanization is characterized by stronger rural-urban linkages, with more intense flows of people, money, and goods across the rural-urban interface. For instance, the outlook for remittance flows indicated that there has been a massive growth of remittance flows globally and between urban and rural areas in developing countries (Mohapatra et al., 2011).
- The modern food processing system can enable food processing organization to see for external markets where the food can be sold for higher prices. Thus, large numbers of food producers will have a higher demand for their product at higher prices. For instance, more than 21,000 farmers and more than 340 traders are beneficiaries from selling 13,000 tons of cowpeas produced annually in the rural areas of Burkina Faso, destined for the capital city and for the export purpose (Proctor and Berdegué, 2016).

- A change will also occur at the traditional (informal) market level where farmers can increase their human and social capital with the urban dwellers.

Thus, farmers have to improve the quality and quantity of their food production to take market advantages in urban areas. Further, the policies have to be adjusted to better serve the needs of the rural and urban people basically through promoting the rural-urban linkage benefits to the rural and urban areas.

In line with this, the Sustainable Development Solutions Network has identified three strategies to boost food production in rural areas. These are:

- Enhancing sustainable food production systems through high yield varieties and high efficiency of water, soil nutrients, and energy, supporting nutritious diets with low food losses and waste.
- Protecting the forest and conversion of wetland to agricultural areas, protecting soil resources, and ensure that farming systems are resilient to climate change and disasters.
- Ensuring smooth access in rural areas to basic resources and infrastructure services (land, water, modern energy, transport, mobile and internet communication, agricultural inputs, and advisory services).

Focusing on the infrastructure services that can enhance the rural-urban linkage is the other important issue to be considered to benefit the rural and urban interface. There is substantial evidence that investment in roads that can connect rural with urban areas positively affect agricultural productivity and production. According to Fan and Hazell (2001), public investment in roads to connect rural with urban areas has increased the agricultural production in China and India. In sub-Saharan Africa, agricultural production is found highly correlated with road proximity to urban market areas (Dorosh et al., 2010).

4.1.2. Water supply

Water is the most important substance of health. Water is important to regulate body temperature and maintain bodily functions. Although, there are many factors that determine the amount of water needed daily, including the temperature, daily exercise, health conditions, anyone has to consume adequate water daily. Adequate water consumption is important for proper digestion and to prevent dehydration.

Water is also one of the key resources important for sustainable rural and urban development. It is important for household use, agriculture purpose, industry, leisure; and has an important ecosystem function. Nevertheless, the provisions of sufficient water and preventing pollution have been challenging tasks.

This day, half of the world's population lives in urban areas. The developing countries will have the fastest urban growth rate in the next decades. This rapid growth of urban centers will place tremendous stress on the environment and pose challenging problems of social and institutional change, infrastructure development, and pollution control.

According to the WHO (2017a), more than 2.1 billion people lack access to an improved water source, of which, 844 million do not have even a basic drinking water service. By 2025, two-thirds of the world's population is projected to face water scarcity (WHO, 2017a).

Because of the rapid rate of urban population growth, the demand for water in urban areas is increasing from time to time. A report by the UNDESA (2015), shows that more than 789 million people of urban residents have no access to improved water supply. According to the same source, this number is increasing by six million each year.

The prevalence of slums in urban areas is the other challenge in providing water. Many people living in these urban sprawls are prone to diseases because they have no access to safe water and sanitation. In addition, they have to overcome the high levels of pollution as manufacturing, and other urban activities release their chemical waste into the waterways in the nearby peri-urban areas (Braun, 2007).

Given the increasing number of urban population and the limited fresh water resources, it is paramount to think of the sustainable provision of water and prudent water resource management. This calls for promoting the interdependence of rural and urban areas in enhancing the ecosystem services for better water supplies.

The enhancement in the interdependence of rural-urban linkages with respect to ecosystem services will be very crucial as a result of increased urban demands for rural resources like water (Braun, 2007). As the urban expansion is characterized by the expansion of urban space into rural areas to accommodate growing populations and growing levels of economic activity, the importance of the rural-urban linkage will be most visible.

Urban areas use water for a range of different types of activities, commonly including commercial and industrial as well as residential purposes. As urban areas grow rapidly, the pressure on water resources will also increase. For this reason, many studies are emerging in the cases of water transfers and reallocations from rural to urban areas (Newborne, 2016). There are commonly used rules and regulations in national laws and policies that guide the use of water (Newborne, 2016). Accordingly, urban areas are given priority in the water allocation. In urban areas where water is scarce, this issue is an important aspect.

Where water is to be transferred from potential rural areas to urban areas, there should be a new or altered infrastructure to be built for the water supply. Here, the distances to urban areas, the engineering works, the energy requirement, and the urban planning issue have to be taken into consideration. Further, the intended use of the water to be supplied has to be properly identified, like for drinking, sanitation, industry, irrigation, and other purposes.

Many urban areas across the world are located near waterways. This is because water is a resource with strong spatial dimensions that provide critical links between urban areas and rural areas. This can have important ecological implications in terms of ecosystem services and water systems. Further, the water systems created to provide water for the urban areas can affect both upstream and downstream users and increase the interdependence between urban and rural areas for water (Braun, 2007).

In urban areas where water is very scarce, decisions on water resource management have to look for long-term strategies for the allocation of water resources between urban and rural areas. In some cases, there is a tendency to argue for a systematic reallocation of water from rural to urban uses, on the basis that 'water is too often devoted to economically inefficient, low return (agricultural) uses and that transfers to more efficient, "high-return" (urban) uses would increase total economic welfare (Molle and Berkoff, 2009). Although this view is a little bit a source for debating, there should be an emphasis given to the appropriate urban and rural water balance for the better national economy and society's well-being.

The Ouagadougou case in Burkina Faso is an example of a water transfer from rural to urban areas. The capital city of Burkina Faso, Ouagadougou draws 70% of its water from the rural areas (Newborne, 2016). In Ethiopia, a significant amount of water for the capital city, Addis Ababa is supplied from the nearby rural areas, in which *Gefersa* and *Legedadi* are the two basic sources of water for Addis Ababa.

Generally, ecosystem services highly determine the provision of water and benefit the urban and rural population in a rural-urban linkage. In Mexico city, the ecosystem service is found to be a significant determinant of the water supply by providing 18.4 hm^3 of drinking water per year; and benefits 78,476 inhabitants and could supply 153,203 potential beneficiaries (Jujnovsky et al., 2012).

The rapid increment in urban population will increase the demand for water resources and will likely require the transfer of water from rural to urban areas. Water policy reform and demand management are therefore required to minimize adverse impacts when water is transferred from rural areas to urban areas. Comprehensive reforms are required to reduce the potentially adverse impacts of water transfers on rural communities. These key policy reforms should include the establishment of secure water rights to users; the decentralization of water management functions to appropriate levels; the use of incentives, including pricing reform, especially in urban contexts, and markets in tradable property rights; and the introduction of appropriate water-saving technologies (Rosegrant and Ringler, 2000).

4.1.3. Raw materials supply

Raw materials are unprocessed natural materials that are used to produce goods and services. These raw materials can be used to produce either finished or semi-finished materials. Agricultural products that are used to produce food and beverage and other products like cotton are considered as one of the basic raw materials supplied from rural areas.

Rural resources are increasingly becoming important because of the wider range of economic advantages it serves. These resources, if used prudently, can bring a fundamental change in the sustainable development of rural communities. Yet, recognition should be given that these resources are rural endowments in which everyone could use them in the prime benefit of the rural communities. Conceptualizing rural area resources as countryside capital can provide significant importance in improving sustainable development (Garrod et al., 2006).

Urban areas are centers of industries and related institutions in which they depend on agricultural raw materials. The commercialization of these agricultural raw materials will revitalize rural economies by increasing farm income and by creating jobs related to the resource use, the processing of the raw commodities, and the production of new products. Increased income, in turn, can benefit the rural economy by allowing farmers to spend more money on the farm improvement and rural economies.

Natural rubber is one of the agricultural products used in many different forms of end-products and other general rubber goods including, hoses, belting, footwear, surgical goods, and rubberized cloth. Most natural rubber production is traded for international markets. World consumption of natural rubber has significantly increased in the last three decades (FAO, 2010). Also, there is a difference in the utilization of natural rubber between the developed and developing regions. Consumption of natural rubber in the developing countries is larger than the developed countries (FAO, 2010). This is partly because of the relatively higher rate of urbanization occurring in developing countries.

Vegetable oil is the other agricultural product which links rural and urban areas. Soy oil, palm oil, rapeseed oil, and sun oil are the major vegetable oils in the international markets. These oils are substitutable to each other with the most common applications. These products are mostly used by industries to make foods and other products. The Statistics Portal (2018) report on the global consumption of vegetable oils from 2013/14 to 2017/18 shows that sunflower seed oil consumption accounted for 17.63 million metric tons worldwide and global vegetable oil production accounted to around 198 million metric tons in 2016/2017.

Sugarcane is another important agricultural product used to produce sugar. Sugar is a common substance in our daily food consumption. It is also highly used by industries to make other products. Sugarcane agriculture is primarily derived by the demand for sugar. The rapid expansion of demand for ethanol is the other main determinant of sugarcane production. Although Ethanol is produced through the fermentation of agricultural products such as sugarcane, corn, wheat, sugar beet and cassava, the great majority of ethanol is produced from sugarcane (Goldemberg et al., 2008). This has positive impacts like the elimination of lead compounds and noxious emissions from gasoline. It also contributes to the fight against global warming by reducing carbon dioxide emissions from motor vehicles, being thus a renewable fuel.

The other important agricultural input for industries in urban areas is the animal and plant foods. Agriculture is the practice of crop and livestock production. Agriculture in rural areas produces raw food, feeding products, fiber, and other desired products by the cultivation of certain plants and the raising of domesticated animals. These products mainly serve to industries engaged in food processing.

Food processing is the expanding industry all over the world. Food processing industries entails a series of industrial activities engaged in the processing, conversion, preparation, preservation, and packaging of foodstuffs for market purpose. Food processing includes the methods and techniques used to transform raw agricultural items into food for human consumption. There are diversified food processing industries with manufacturing ranging from highly labor-intensive small, traditional, family-run activities to large, capital-intensive and highly mechanized industrial processes.

Many food industries bring raw food items almost entirely from local agriculture or fishing (Parmeggiani, 1984). Food processing takes clean, harvested or slaughtered components and uses them to produce food products basically for urban markets. As the number of industrial food consumers grows, the role of food processing has become the dominant market category with infinite possibilities in job creation (Kunkel et al., 2010).

The role of rural economies to the intensification of agriculture-related industries in urban areas is magnificent. While agricultural production is spread across the whole rural area, there are certain urban areas which become the center of agriculture-related transactions with other rural areas. A study made by Roberts et al. (2013) confirmed that the contribution of agricultural businesses to their immediate surrounding urban areas is highly important.

Farm households, on the other hand, will be benefited from spatially concentrated agricultural transactions due to the consolidation of agribusinesses in the region. There is evidence that the farmers' economy significantly increases with the selling of their products to agricultural related industries (Roberts et al., 2013). Further, Harrison (1993), claimed that agricultural related industries have an important economic impact on the rural economy. This in turn, increases the purchasing power of farmers for agricultural inputs which can enhance their agricultural production. Thus, policies should aim at enhancing rural agricultural productivity and production, which would add the benefit of increasing opportunities for urban industrial activities.

4.1.4. Wood supply

Globally, wood is the fastest growing product in urban markets (FAO, 2009). This is the most promising opportunities for small-scale farmers to sell their high-value wood and wood products for industries directly or through intermediaries. Market opportunities for forest products from rural areas mainly include preprocessing, milling to supply semi-finished products, niches that cannot be efficiently served by industrial scale producers, and through giving contracts for selected functions in forest-based industries (Scherr, 2004).

At present, there are an estimated 1.2 billion smallholder farmers who grow farm trees for generating income (Baker et al., 2017). Nevertheless, many institutions, including the policy directions are giving emphasis only to the large scale natural forest (Scherr, 2004). The major challenge for the efficient utilization of forest products in rural areas is therefore to reshape policies that could serve small-farm producers (Scherr, 2004).

Urban areas consume forest products for the purposes of construction, fuelwood, and industrial purposes like office and house furniture. For developing countries, the supply of wood and wood products is highly vital. This is partly because of the rapid rate of growth in construction and increased demand for energy. In rural areas, the purchase of fuelwood is very insignificant. The purchase of fuelwood is made by a small proportion of rural consumers those who are not farmers (Morgan, 1983).

Wherever there is urban expansion, there will be a consumption of fuelwood or charcoal. For this reason, there is always the probability of too extensive supply of fuelwood and charcoal associated with urban population growth (Morgan, 1983). In most developing African cities, wood fuel is the major source of energy (Brouwer and Falcão, 2004).

Forest wood is one of the basic inputs for the construction of residential and nonresidential houses. Because of the increment in urban population and income, the demand for construction is increasing, particularly in developing nations (Liu et al., 2010).

The renewability nature of forest wood products makes it preferable over the other nonrenewable construction materials such as steel, aluminum, concrete, brick, and plastics. This is because if the nonrenewable construction materials are used, there will be significant increases in global energy consumption and in carbon dioxide additions to the atmosphere. According to Koch (1992), the use of nonrenewable construction materials will increase the amount of oil to about 717 million gallons annually, and about 7.5 million tons of carbon dioxide will be added to the atmosphere annually. Thus, the annual harvest of forest wood products has to be increased to replace the nonrenewable construction materials.

To enhance the production of wood in rural areas, forest market institutions should provide business services to small-scale farm producers, and they should be enabled to invest in regional forest enterprise development to better benefit from the value chain for wood and related products. It is also necessary to make the policy suitable for small-scale farmers to participate in markets, by removing excessive regulations, creating just and open perfect market environment, and involving farmers' organizations in the forest policy formulation and discussions. Further, wood suppliers should improve their market strategy, strengthen their institutions, and follow strategic business partnerships to develop a practical forest wood market.

4.2. Regulating services

Regulating services are the benefits obtained from the services that ecosystems provide from the regulation of ecosystem processes like maintaining the quality of air and soil, regulating climate and extreme weather events, providing flood and disease control, or pollinating crops. They are often invisible and therefore mostly taken for granted. When they are damaged, the resulting losses can be significant and challenging to restore.

The regulating services provided by the ecosystems are amongst the most important aspects for the sustainable utilization of economic resources. The Millennium Ecosystem Assessment identified the regulating services as amongst the potentially most valuable services offered by ecosystems (Simonit and Perrings, 2011).

Regulating ecosystem services support the reliability of provisioning services by maintaining the capacity of the system and enabling ecosystems to continue to function over a range of conditions like stresses or shocks, often of anthropogenic cause. It should thus be guaranteed that regulating ecosystem services have a general interest at the international, national, regional and local level.

The regulating ecosystem services are highly important for urban areas. In urban areas, there is an accelerating demand for ecosystem services; and with the projected doubling of urban populations, the demand will alarmingly grow (Elmqvist et al., 2015). The rapid expansion of urban areas is amongst the fundamental challenges of providing ecosystem services.

In most cases, urban areas are characterized by a sustained decline in their ecosystem services (Nuissl et al., 2009). This is partly because of the loss of urban green areas following physical expansions. Urban areas are key in determining the relationship between people and nature, yet they generate enormously large environmental impacts (Elmqvist et al., 2015).

Thus, the urban areas ability to provide ecosystem services is altered and consequently lead to dependence on rural areas ecosystem services. A study conducted by Larondelle et al. (2014) on regulating ecosystem services in across 300 European cities shows that cities rely on ecosystem services provided by their rural areas to meet the needs and wants of their residents.

The regulating services provided by the ecosystems tremendously vary with conditions. The status and trends, drivers and results of change, management, and knowledge gaps vary greatly from place to place (Smith et al., 2011). The services are, therefore, explained independently.

4.2.1. Regulating climate and air quality

The massive economic and industrial growth in the last century has made an immense increase in greenhouse gas emissions. This has made air quality an important environmental problem in the world. The most abundant components of air pollution in urban areas are carbon dioxide, nitrogen dioxide, ozone, sulfur dioxide and particulate matter (D'Amato et al., 2010). For this reason, urban activities are blamed to be major causes of climate change (Dodman, 2009).

Climate regulation, as ecosystem regulating services, provides goods and services that regulate climate so that adverse climate impacts on human well-being and other living organisms are reduced. Ecosystems regulate urban climate through the forest and open spaces found within the urban areas or those which are found in rural areas. But, the rural forests do have a substantial role in regulating urban climate.

4.2.2. Ecosystem services regulate the climate by

(i) Providing sources or sinks of greenhouse gases and sources of temperature rise and cloud formation (Smith et al., 2013);
(ii) Enhancing evapotranspiration and thereby cloud formation and rainfall (Kleidon et al., 2000); and
(iii) Affecting surface insolation absorption capacity and thereby radiative forcing and temperature (Betts, 2000).

Ecosystems can also regulate the local climate through the provision of shade and shelter and the regulation of humidity and temperature (Smith et al., 2013). This regulation of micro-climate can have a noticeable impact on human well-being, particularly for those living in urban areas.

Ecosystem regulating services also regulate air quality of urban areas. Forests have a vital role in regulating air quality by removing pollutants from the atmosphere (De Groot et al., 2002). During 1991, forests in the Chicago area removed an estimated 6145 tons of air pollutants, providing air cleansing valued at $9.2 million dollars (McPherson et al., 1994).

Ecosystems provide important services that can help people adapt to climate variability and change. For this reason, several international and nongovernmental organizations have focused on promoting ecosystem services-based approach to better adaptation (Pramova et al., 2012). Depending on ecosystem services is the best way to adapt to climate change considering its effectiveness in reducing vulnerability, its cost efficiency, and its benefits for biodiversity conservation, and climate change mitigation.

Regulating urban heat island is the other important service of ecosystems in urban areas. An urban heat island is a phenomenon that occurs when urban areas are warmer than their neighborhood rural areas. The causes of urban heat island are a large amount of heat generated from urban activities like transportation, industrialization, and the building structure which consume and re-radiate solar radiations (Rizwan et al., 2008).

Forest covers and green spaces in rural areas provide a cooling ecosystem service to urban heat island (Jenerette et al., 2011). Thus, increasing and maintaining ecosystem services through the forests and green spaces is one strategy for

regulating regional climate changes in urban areas. This has a simultaneous advantage of providing multiple ecosystem services and reducing climate extremes.

4.2.3. Carbon sequestration and storage

Carbon sequestration is a phenomenon for the storage of carbon dioxide or other forms of carbon to mitigate global warming. Carbon is sequestered in the process of plant growth as carbon is captured in plant cell formation and oxygen is released during photosynthesis (Warran and Patwardhan, 2008). Branches, leaves and other materials that fall to the forest floor may store carbon until they decompose or get burnt. Additionally, soils play a major role in storing a significant amount of carbon. Soils contain about 75% of the carbon on land, which is three times more than the amount stored in living organisms (Lal, 2004).

Intensified urban activities are increasing the atmospheric levels of carbon dioxide and other greenhouse gases like methane, chlorofluorocarbons, nitrous oxide, and ozone. These are the main factors contributing to the global warming by trapping of certain wavelengths of radiation in the atmosphere (Nowak and Crane, 2002).

Urban areas emit more carbon dioxide, with a very limited capacity of carbon sink (Akbari et al., 2009). Although there are some urban areas with good progress in the carbon sink, many more urban areas sink carbon very far in amount than they emit. For example, carbon sequestration in Pune City (India) is 1% of the total standing biomass. Accordingly, the trees in the city are currently sequestrating 15,000 tons of carbon each year; indicating that 2% of the city's emissions are absorbed and 98% remains atmospheric overload (Warran and Patwardhan, 2008). Thus, maintaining ecosystem services in rural areas is the option to bring the balance among the absorption and the emission.

Ecosystem services regulate the local, regional and global climate by storing and sequestering these excess greenhouse gases from the atmosphere. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively fix it in their bodies. Forests and other green areas in rural areas play a very important role as carbon sinks.

In Canberra, about four million trees planted are estimated to have a combined energy reduction, pollution mitigation and carbon sequestration value of USD 20–67 million during the period 2008–2012 (Ugle et al., 2010).

According to (Rathore and Jasrai, 2013), all trees do not have the same performance in a carbon sink. Accordingly, the trees which have a higher potential of carbon sequestration are those which have high wood specific density. Further, the trees should be fast-growing, increasing biomass at a fast rate and should have a huge canopy (Rathore and Jasrai, 2013). In most cases, one ton of carbon storage in the tree represents the removal of 3.67 tons of carbon from the atmosphere, and 2.67 tons of oxygen are released in return back into the atmosphere (Nowak and Crane, 2002).

Recognizing the importance of forests for this purpose enhances the interest in preserving and maintaining the ecosystem services. A well maintained rural area's forest can play a significant role in helping to balance atmospheric carbon dioxide concentrations in urban areas. Further, this will play a significant role in the environmental quality and human health of the urban areas.

4.2.4. Moderation of extreme events

Extreme weather events or natural hazards include floods, storms, tsunamis, landslides, and extreme heat events. The effects of these hazardous events are worse when they occur in relatively densely settled population like big urban areas. In relation to rural areas, urban areas are more exposed to extreme weather events (Aronica et al., 2012; Jenerette et al., 2011).

Flooding is amongst the detrimental natural hazards affecting many urban areas of the world. The structure of flood water flow, coverage of large parts of the ground with houses, roads, and pavement, obstructing channels and building drains are the main factors exacerbating flooding impacts in urban areas (Fernández and Lutz, 2010).

Landslide hazard is the other extreme event that can be caused by natural and human development related activities. Ecosystem services like forest cover and its wise utilization play a vital role in reducing the risk of land sliding (Dolidon et al., 2009). Furthermore, well-managed forests reduce the processes that lead to landslide hazard, such as gully erosion (Dolidon et al., 2009). Thus, forest management and development are of better adaptation ways to the risks of the landslide.

Ecosystems reduce damages from these extreme weather and climate events by providing cooling services, stabilizing slopes, soaking up flood water, breaking speedy floods and storms. Due to the intensification of climate change induced hazards like heavy rains and sea level rises, the importance of this ecosystem service is growing worldwide. Incorporating ecosystem services into the reduction of natural hazards can protect communities by enhancing their adaptation capacities (Renaud et al., 2013).

Forests are being valued for the hazard protection services they provide. Services provided by forests have been associated with reduced hazards from floods, landslides, snow, and rock falls (Dolidon et al., 2009; Sakals et al., 2006). In order to maintain a high level of community protection, forests should be actively managed. The degree of protection provided by forest is determined by forest condition and the nature of the hazard. The expected protective services can be well predicted if the nature of the hazard is understood and forests are protected and managed in the well manner (Sakals et al., 2006).

4.2.5. Waste water treatment

Urban activities, mainly industrial activities are the major threat to both surface and underground water quality. These activities discharge some toxic elements to the water bodies. In return, these toxic elements kill important organisms in the water and cause the water to be unsuitable for human and animal consumption. After an investigation made over time about

how pollutants from water can be removed by the natural and cost-efficient method, wetland application has become an ultimate solution (Kivaisi, 2001; Stottmeister et al., 2003).

Ecosystems such as wetlands filter and decompose waste water polluted by human activities and act as a natural neutralizer to the surrounding environment. Most polluted water is treated and harmful elements are eliminated through the natural process of microorganisms in the soil. The practical role of natural wetlands in treating high levels of waste water has become the main reason for wetland preservation and protection (Kivaisi, 2001).

For developing countries, natural and constructed wetlands are the best option of treating urban waste water. Besides, there is good potential for the use of natural and constructed wetlands in developing urban areas. For developed nations, because of the appropriate and most expensive technologies of waste water treatment techniques (Denny, 1997); the application of wetlands is relatively low.

In most cases, urban waste water is discharged to rivers and open areas in rural areas which thereby flow into agricultural fields. The role of wetlands, in this case, is very crucial in reducing the possible impacts of these contaminants. However, the provision convenient and cost-efficient wastewater treatment in rural areas is a challenge in many parts of the world, mainly in developing countries (Massoud et al., 2009). Thus, the rural-urban linkage is very important and urban areas have to provide assistance to the construction, protection, and preservation of wetlands in rural areas.

4.2.6. Erosion prevention and maintenance of soil fertility

Soil is the basic element in the food system. Healthy and fertile soil produce healthy food with good yield. Sustainable food provision to urban areas is highly dependent on the soil nutrients and fertility capacities. The soil requires nutrients to support plant growth. Soil obtains nutrients from organic matter by decomposition of living organisms and from minerals (Bot and Benites, 2005).

Soil fertility is essential for plant growth and agricultural productivity, and well-functioning of ecosystem services. It is through fertile and well-managed soil that agriculture can produce food for the rapidly growing urban population. Enhancing soil fertility and restoring depleted soil is among the three requirements identified for increasing per capita agricultural production (Sanchez et al., 1997).

Soil erosion is the main cause in the process of loss of soil fertility, land degradation and desertification, which will lead to a shortage of crop production and food supply. Soil erosion is still undermining the resource base of agriculture in many parts of the world. Soil fertility depletion in agricultural lands is the fundamental bio-physical root cause of declining per capita food production in small holding farmers. Irrespective of other remedial measurements, if soil erosion is not effectively addressed, per capita food production in Africa will continue to decrease (Sanchez et al., 1997).

Ecosystem services like forest cover provide a vital regulating service by preventing soil erosion. Forest prevents soil erosion and ensures soil fertility through natural processes such as breaking floods and holding soil from being eroded. A study by Razafindrabe et al. (2010) showed that a proper forest management function, which can be insured by stand density control, is highly important in preventing and reducing soil erosion.

Without forests, soil erosion can occur and degrade the land into rivers. In addition, as the land loses its fertile soil, agricultural producers will continue to clear other more forests and the cycle of soil erosion continues. Understanding these effects is crucial. The clearance of forest cover can lead to the subsequent loss of millions of hectares of productive land (FAO, 2015). Moreover, as forests continue to be cleared, the land will be exposed to direct attack from wind and rain. For this reason, forest preservation in dryland areas is vital for protecting soil erosion.

To control soil erosion and maintain soil fertility, sustainable management of forests is imperative. Forest stabilizes slopes and provides the soil with the necessary support to prevent erosion. Further, comprehensive forest management practices, such as measures to maintaining forest cover on soil erosion-prone areas will help control and minimize the risk of soil erosion (FAO, 2015). By investing in forest protection and management, forests can act as a crucial protector of soil resources.

Therefore, food security and a healthy environment can be maintained if trees and forests are well managed and protected from irresponsible cutting. Thereby soil erosion will be reduced and the maximum possible agricultural production can be gained. Thus, urban areas have to give emphasis to the ecosystem services of rural areas in order to meet their basic necessities of life and secure healthier living.

4.3. Cultural services

Cultural services are the other important ecosystem services that are mostly available in rural areas. Cultural ecosystem services are the intangible benefits we get from nature and include benefits such as spiritual sustenance, ecotourism, recreation, and aesthetic values. Cultural services are intensely interconnected with other ecosystem services. For instance, forest areas are not only about provisioning or regulating services, but also about tourism and recreation.

Recreation for mental health is one of the cultural services of rural areas. According to the WHO (2017b), depression is the foremost cause of disability in the world and plays a vital role in intensifying the overall universal burden of disease. Walking and relaxing in the countryside is a good treat for mental illness. Despite it is difficult to measure, the role that rural areas play in maintaining the mental and physical health of human beings is noticeable.

Urban areas have relatively less natural recreational services than their rural counterparts (Pretty et al., 2005). This implies that there are reduced mental well-being and less opportunity to recover from depression in urban areas. For this reason, many tourists around the world prefer to visit rural sites, which offer them enjoyable involvements related to the natural

environment, historical heritage, and cultural patterns (Butler and Hall, 1998; Vanslembrouck et al., 2005). Hence, many urban residents have to depend on rural areas for recreational services. Thus, the link with rural areas is imperative.

Ecotourism is the other important and growing ecosystem services of rural areas. It is mostly a tour to undiscovered and undisturbed rural areas, mainly for educational and research purposes. Ecosystems, particularly the biodiversity play an important role in the development of the ecotourism sector. This can in turn provide substantial economic benefits for many countries.

Ecotourism has a substantial role in enhancing knowledge for both academicians and it is a source of rural employment for local inhabitants. Further, it is important for the restoration of degraded lands, protecting ecologically sensitive areas and biodiversities (Blangy and Mehta, 2006). These services are particularly important for universities and research institutes that are found mainly in urban areas. This is mainly due to the fact that rural areas are with many unique ecosystems and cultural attractions (Che, 2006). Thus, due care should be given to the protection of these ecotourism sites through a strong link of these researches and academic institutes with the ecotourism sites.

Aesthetic appreciation and inspiration for culture and art and spiritual experiences are also the other important parts of cultural ecosystem services. The natural environment at all and the biodiversity and natural landscapes, in particular, has been the source of inspiration and are intimately related to human beings. Moreover, some natural landscapes such as monasteries are considered as holy areas or have religious meaning in many parts of the world.

Urbanization is one of the major threats to the sustainable exploitation of the services from the natural environment. It is the main reason for biodiversity reduction in urbanizing landscapes (Urban et al., 2006). Because of the rapid urbanization occurring throughout the world, it is expected to cause extensive loss of biodiversity, endemic species extinction, ecosystem degradation, land use changes, and hampering species dispersion over several areas (Urban et al., 2006).

Therefore, maintaining and restoring the natural environment would be the optimal prevention mechanism to the detrimental impacts that urban expansion has on the cultural ecosystem services. Further, avoiding urban expansion to the ecologically sensitive areas through land use zoning will contribute to the sustainable ecosystem service delivery to the rural areas and to the urban population at large.

4.4. Supporting services

Supporting ecosystem services are those services that support the service delivery of the other services and that are necessary for the production or maintenance of the provisioning, cultural and regulating ecosystem services, such as nutrient cycling that maintain the conditions of the living organisms on earth (FAO, 2016). Supporting ecosystem services are different from provisioning, regulating, and cultural services in that their benefit to human beings is not direct or the benefit comes after a long time.

The economic and environmental benefits of supporting ecosystem services are substantial to farmers and rural residents at all in terms of the economic values of these services. In addition, the role of these supporting ecosystem services will have an indirect benefit to the urban population. Thus, these ecosystem services should be maintained for better rural-urban linkages.

Nutrient cycling, maintenance of biological species and primary production are among the major services of supporting ecosystem services. These services are highly important in maintaining the rural-urban linkage by helping the provision and conservation of all the other ecosystem services found mainly in rural areas.

Nutrient cycling is one of the most significant processes that occur in the ecosystem. The nutrient cycle describes the recycling of nutrients like carbon, oxygen, phosphors, calcium, nitrogen, etc. in the ecosystem. These important elements are essential to the existence of life and must be recycled in order to maintain life organisms on earth. Nutrient cycle incorporates both living and non-living components that consist of biological, geological, and chemical processes (Bailey, 2018). Because of this, nutrient cycles are also known as biogeochemical cycles.

Maintenance of biological/genetic diversity is the other important supporting ecosystem service. Biological/genetic diversity is the variety of genes within species populations. All species have different breeds and thus are having different adaptation capacity. For this reason, local genetic species are locally well adapted and a base for further developing other species. Genetic diversity is crucial for the long-term existence of species and sustainability of the ecosystem at large. In Africa, the genetic biodiversity are under increasing pressure mainly because of rapid urbanization and unregulated land use changes (IPBES, 2018).

Habitat formation and primary production are the other important supporting ecosystem service which basically supports the other ecosystem services. This service is the base for the creation of habitats which provide everything that a living organism needs to survive and function, such as energy. Each ecosystem provides different habitats that can be essential for a species' life cycle.

In an ecosystem, primary production is the production of new plant tissue through the process of photosynthesis (Field et al., 1998). After a time, the primary production results in the addition of a new plant to the ecosystem. Consumers including human beings derive their energy from primary producers either directly or indirectly. Almost all living organisms depend directly or indirectly on primary production.

There is an accelerating loss of species in the human-dominated ecosystems like urban areas. Besides, the rate of natural resource depletion has increased and the recovery potential is decreasing exponentially with declining diversity (Worm et al., 2006). Nevertheless, these trends have a high potential to be reversed and restoration of the damaged ecosystem is very

important in increasing production. For instance, the restoration of biodiversity in the marine ecosystem has increased productivity with more than double (Worm et al., 2006).

Generally, all the provisioning services like food and water supply, raw materials supply, forest supply, etc. and regulating services like climate regulation, erosion prevention, waste water treatment, etc. heavily depend on the supporting ecosystem services. Unless the supply of these services is protected, there will not be any life on earth, mainly in urban areas. Because most of these services are found in rural areas, urban areas should be cautious in protecting these services and should preserve the rural-urban linkage by giving support to the protection of these services.

One of the main challenges in maintaining the supporting ecosystem services could be the ways that are being used to modernize agriculture. Understanding the biological processes and environmental consequences of agricultural intensification, in this case, is very important so that agricultural development practices can be managed and enhanced to protect supporting ecosystem services to ensure food production for the growing human population. The current intensive, mechanized and high input agricultural practices are found affecting the ability to support ecosystem services to provide some ecosystem services (Sandhu et al., 2010), which in the longer term can challenge their capacity to produce the provisioning and regulating ecosystem services to the growing urban population.

5. Conclusions

Rural-urban linkages play a crucial role in accelerating national development through the flows of goods and services, information, people and technology from and to rural and urban areas. The interdependence of rural and urban areas is very important to their respective development in social, economic and political spheres. Nevertheless, the development of urban areas is highly dependent on the development of the nearby rural areas. Urban development is generally unthinkable if the rural areas are physically, socially and environmentally isolated places.

Urban development hardly exists in the absence of linkage with rural areas. Although the connectivity of rural and urban areas is crucial for both spaces, it is absolutely necessary for urban areas. Almost all the food, water, fuelwood, raw materials, clean air and the like basic necessities of urban life are imported from rural areas. For this reason, rural development should be the prime agenda in planning for national development in general and urban development in particular. Nevertheless, the benefit that rural areas gain from urban development should not be overlooked.

The important point to be considered is that the role of urban economies on rural areas will not be very significant if the rural ecosystem services are in good condition. Urban areas will be very important for rural areas when the agriculture or rural economy is developing. In this case, the mutual benefits happen as rural areas will supply foods, wood, raw materials, etc. to the urban areas, and urban areas will provide market, farm inputs, consumer goods, etc. to the rural areas. Thus, rural development is the precondition for urban development.

In this paper, the emphasis is given to the four basic ecosystem services: provisioning, regulating, supporting and cultural ecosystem services. The basic foundation of these ecosystem services is in rural areas. The rural area supplies are generally free gifts of the environment with little human efforts. Yet, they require a due care to sustain their current and future use. The ecosystem is the source of life on earth. In the absence of these ecosystem services, there will not be the biosphere at all.

More importantly, the development of urban areas at the expense of rural resources could make the urban areas suffer much from the shortage of the basic requirements of life later on, unless otherwise equity is ensured and the forthcoming national development is socially equitable. Therefore, policies have to focus on enhancing the service delivery of the rural ecosystems in the way that the benefits will be shared to both rural and urban areas. Further, urban areas have to invest in the protection and restoration of the rural ecosystem services.

The current trend in urban expansion is one of the threats to the rural ecosystem services. Because of the fact that much amount of the ecosystem services are found in rural areas, the outward expansion of the urban areas towards rural areas is causing limitation of the services delivered by ecosystems. If these trends keep on invading rural areas, the rapidly growing urban population will certainly fall under critical shortages of these ecosystem services. These problems will also affect the lives of the rural population.

This calls for well managed rural-urban linkages based on a principle of urban development should not affect the supply of rural ecosystem services and rural life at all. Furthermore, the rural population should be given policy attention to the natural services that the rural areas are providing. Thus, extending hard and soft infrastructures to link rural areas with urban areas; coordinating markets for agricultural products; creating employment opportunities in urban areas; arranging training services to improve agricultural production; and protecting the ecosystem services are among the requirements that decision makers have to consider for the strong rural-urban linkages.

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