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Analysis of Rural-Urban Linkages in Fast Growing Cities for Enhancing Resilience to Natural Disasters (Case study: Đà Nẵng City, Vietnam)

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Abstract: The present study analyzed rural-urban linkages in Da Nang city, Vietnam, where is undergoing high rates of urbanization. The research results showed that the rural-urban linkages provide many opportunities for mobilizing and exchanging migrants, commodities, capital, and innovation between rural areas and urban centers, and improvement disaster management systems of the city. The adequate development of transportation, communication and information services, education and health services in urban areas is an important fundamental for promoting connection between the urban and rural areas. The rural-urban linkages play crucial roles in enhancing the income of rural dwellers through the flow of cash from the migrants and knowledge sharing on natural disasters and climate change between urban to rural areas. According to the climate change scenarios, the surface- and ground-water resource depletion is one of the greatest challenges of the rural communities in the northern districts and flood is a major threat to communities living in the low ground elevation and near the river basin in southern districts of the Da Nang city. The knowledge of the rural-urban linkages will provide more efficient means for enhancing resilience to natural disasters in the fast growing cities.

Keywords: urbanization, rural-urban linkages, climate change, Da Nang city.

1. Introduction

Urbanization is defined as a process of physical growth of urban population and urban areas, and a widespread of urban lifestyle and culture [1,2]. Developing countries have been experiencing a fast urbanizing rate, which quickly transforms the appearances of the city and urban areas, particularly the urban land-use and land-cover change [3,4]. The urbanization provides many opportunities to develop and upgrade the infrastructure, education system, and medical services in the urban areas, and to improve the living quality of a large proportion of urban communities. In other side, urbanization has also caused many challenges, including migration of people from rural and through periurban to urban centers [5]. The high population density in the urban centers triggers a high-pressure on the labor, environment, and transportation systems, health care services,

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education system, and social security [6] and natural resources [7]. Particularly, the urbanization often causes loss of productive lands of rural dwellers surrounding urban areas [4], increasing the trend of unemployment and *per se* fostering the migration flows from rural to urban area [8]. The high density of population in the urban area pressurizes food, vegetable, water, energy resources [9] and attributes many socio-environmental problems [10]. These consequences of urbanization have been (in)directly impacted on adaptation and vulnerability of urban communities to climate change [6], preventing the sustainability in the region [10]. The urbanization has also influenced on the linkages between rural and urban areas [11].

The rural-urban linkages are defined as the relationship between rural and urban areas in exchanging the natural resources, people, food, finance (money), and ideas [12] (Fig. 1). The rural-urban linkages play important roles in sustainable use of natural resources, particularly, water and biological resources, and food security [13,14]. The rural-urban linkages are the causes and consequences of the socioeconomic development of urbanization. The adequate development of the infrastructure such as transportation, communication and information services, and education and health services is an important fundamental for promoting a connection between the urban and rural areas. Therefore, it is needed to study the rural-urban linkages in the processes of urbanization for understanding the roles of the rural and urban communities in adapting to natural disasters and climate change and sustainability of the city. The characteristics of the rural-urban linkages have been presented in numerous studies. For examples, Bah et al.[15] conducted a research in three countries, Mali, Nigeria and Tanzania to gain better

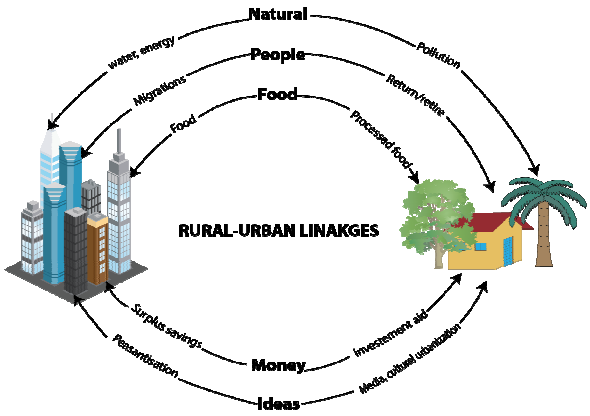

Fig. 1. Rural-urban linkages scheme [12].

understanding of the ways in which the livelihood of rural and urban households rely on both rural-based and urban-based resources and on exchanges between urban and rural areas. Tacoli [16] showed that rural dwellers can gain many social services from urban centers such as schools, posts and telephone, hospitals and government services, and farm equipment. In Vietnam, Van den Berg et al. [17] demonstrated that the rural communities around Hanoi Capital could provide fresh food, including fish, pork, and vegetables for the urban dwellers.

In Vietnam, the importance of the rural-urban linkages has been emphasized in Master Plan Orientation for Viet Nam's Urban System Development to 2025 with a vision to 2050. The Master Plan Orientation shows that "it is needed to recognize the importance of the rural-urban linkages, to ensure the national food security, to improve the urban living standard, to preserve and enhance the traditional culture". Therefore, the rural-urban linkages should be recognized as an important component in the urban development planning in Vietnam. The relationship and interaction between rural and urban areas are an important factor to promote the economic development [18]. As shown in Fig. 1, the investment to infrastructure development is the most crucial factor for

improving productivity, production, and commercial values of rural based producers, promoting the trade market, to implement the environmental protection measures, to increase the equity between rural and urban areas in education and health services [16]. The quality and magnitude of the rural-urban linkages will be main factors to increase the mobility of labor, livelihood strategies, and the diversity of the social structures during the processes of urbanization.

Several studies have been conducted in Da Nang city for understanding the urbanization processes [4,19,20] and the adaptation of the urban communities with the urbanization [21]. These studies have partly shown the characteristics of land-use and land cover change during the urbanization. However, there is still lack of the research on rural-urban linkages in the processes of urbanization in Da Nang city. Therefore, the major goal of the present study is to analyze the characteristics of the rural-urban linkages in Da Nang city by investigating five objectives: (1) to study the roles of rural-urban linkages in the processes of urbanization; (2) to analyze the migration patterns during urbanization; (3) to study the economic characteristics and livelihood of local communities; (4) to study the environmental and hygiene problems during urbanization; and (5) to examine the roles of rural-urban linkages in the context of natural disasters and climate change.

2. Materials and methods

2.1. Study area

Da Nang city is located on the central coast of Vietnam, at the most important economic-political position, connecting the Hanoi Capital and Ho Chi Minh City (Fig. 2). Da Nang city is well known as a crucial city of the Central Key Economic Zone and an international trade corridor connecting Laos, Myanmar, and Thailand with the rest of the world by its air and sea port systems. Da Nang city covers an area of 1283.42 km^2, consists of six continental districts (Cam Le, Hai Chau, Hoa Vang, Lien Chieu, Ngu Hanh Son, and Son Tra) and Hoang Sa Islands district [4]. According to the administrative classification, Da Nang city is one of the centrally-governed municipalities in Vietnam and is ranked at the highest importance in political economy of the central region. The urban population of the city markedly increased in the period of 1995 – 2013 (Fig. 3). The urban areas are radiating to the rural areas at a rapid pace and the urban population reaches to 88%, being significantly higher than the national average of 34% [14].

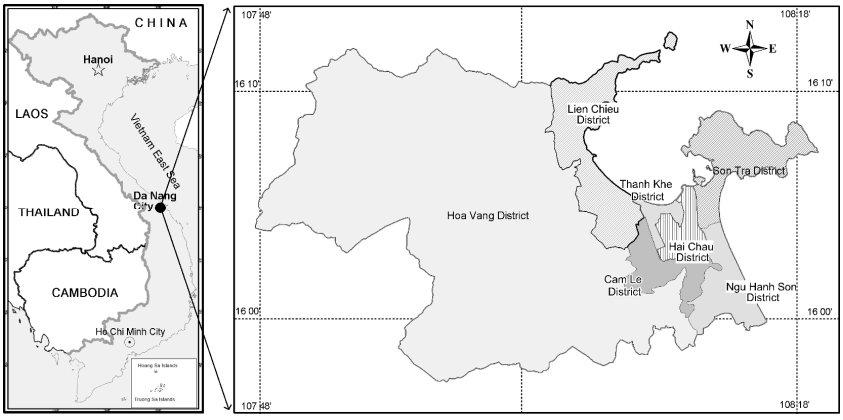

Fig. 2. The location of Da Nang city in Vietnam.

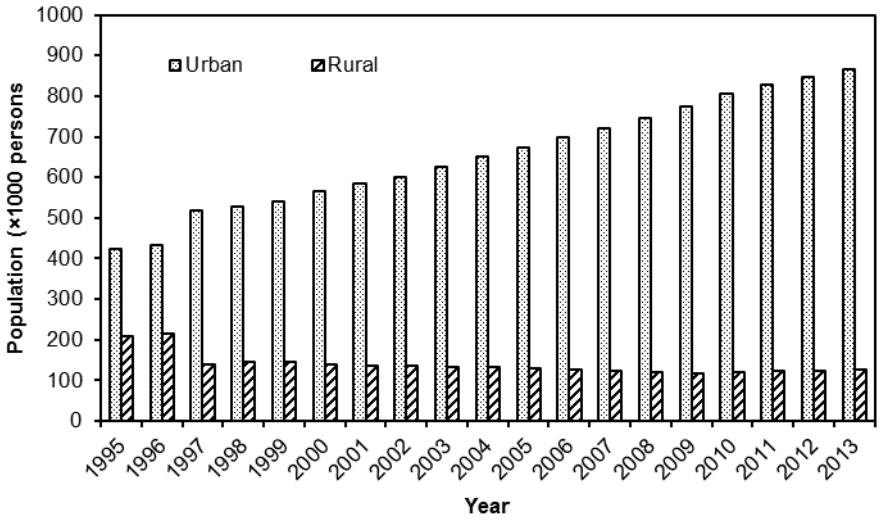

Fig. 3. Variation in urban and rural population in Da Nang city from 1995-2013 [23].

Da Nang city is located within a tropical monsoon climate zone with a rainy season from August to December and a dry season from January to July. The average temperature, rainfall, and humidity are 26 ^{o}C, 2500 mm, and 83%, respectively. According to the climate change projection scenarios, climate change is likely to increase the intensity of moderate to severe rain events in Da Nang city, leading to increase flood hazards in both magnitude and frequency [22].

2.2. Questionnaire and socioeconomic data

In the present study, different types of data have been used to examine the characteristics of the rural-urban linkages. The primary data were collected in the form of questionnaire and interview the local residents and direct observation during the fieldwork in June 2014. A total of 2473 questionnaires were randomly distributed to households in 6 districts of Da Nang city. The questionnaire is constructed to gather information on the characteristics of economy, education, and hygiene of the households in Da Nang city. Moreover, the questionnaire is designed to gather information on how the households in the rural, periurban, and urban areas respond to the urbanization and the impacts of urbanization on soil, water, and air environment. The local residents were interviewed on site in order to examine the characteristics of rural and urban linkages, the impacts of economic development on water, soil, air environment. The secondary data were collected from the statistics office of Da Nang city in 2012 [23] and previous studies [4,24], including socioeconomic characteristics, land-use change and the proportion of households used the lump sums of compensation for different purposes.

3. Results and discussion

3.1. The roles of the rural-urban linkages in the processes of urbanization

The transportation system quickly radiates from the urban center (Thanh Khe and Hai Chau districts) to the rural areas of Hoa Vang district and to neighboring provinces (Quang

Nam and Hue provinces). These patterns increase the transportation capacities of goods and migrants (Fig. 4). The adequate transportation systems provide opportunities for the rural residents approaching the labor markets in urban centers and directly increase their income [18]. The high quality and adequate infrastructure systems are important factors to expand commercial trade services and to increase the commercial values of the agricultural products [2]. These factors directly promote the investment to develop the agricultural products which are high in commercial values.

In addition, the urban development provides the high quality of utilities such as permanent housing, educational system, and health care. For example, according to the DN GSO [23], the numbers of children to kindergartens markedly increased in the period from 2005-2012 (Fig. 5), indicating a high concentration of young couples to live and work in urban areas, industrial zones and other urban economic sectors. Fortunately, the numbers of preschool teachers also increased during this period (Fig. 5). The keep in pace of the preschool teachers with the children meets the basic need and demand of urban households, contributing to the peace of mind of the young families, helping them to focus the work and increase labor productivities. These statistical data are well consistent with the previous results of Huong [21], who has shown that a large proportion of urban residents have positively responded to the process of urbanization and enjoyed with the urban life. However, the urbanization caused land-use change, intensified the migration flows from the rural area to urban, exaggerated social conflicts (e.g., Xom Dau village), put more pressures on livelihood, environment, and natural resources, transportation, health care, education, conservation of the core values of the culture and functions of traditional handicraft villages (*local people interview*).

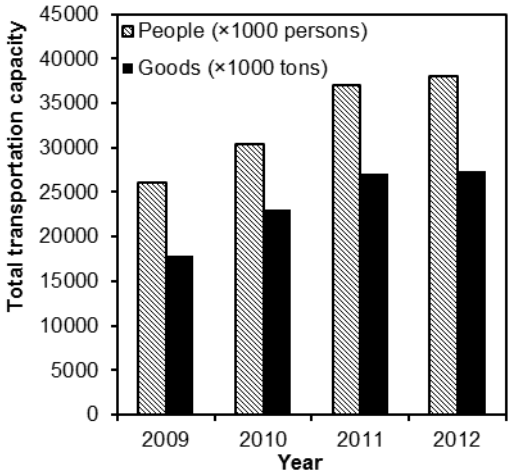

Fig. 4. The transportation capacities of the goods and migrants in Da Nang city from 2009-2012 [23].

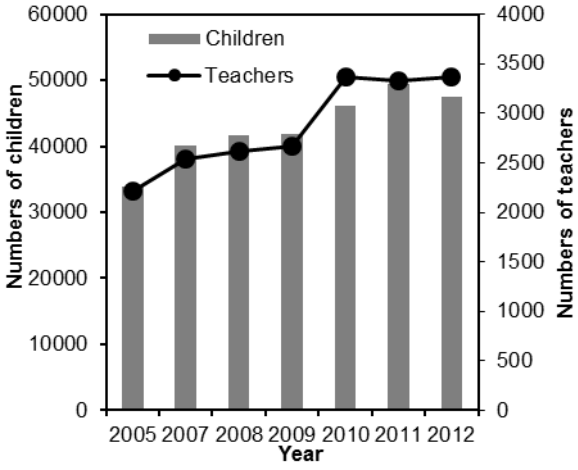

Fig. 5. The variation of numbers of children to kindergartens and kindergarten teachers in Da Nang city from 2005-2012 [23].

3.2. The characteristics of the migration during urbanization

The migration of people in Da Nang city during the processes of urbanization occurs complexly by directions from rural to urban areas, short distances, and within the same administrative boundaries and from other neighboring provinces. The urban population markedly increased during period from 1995-2013, and accounted for greater than 88% of the total population in 2013 (Fig. 3). The urban population quickly increased in the early process of urbanization, and concurrent with the development processes of industry and services. Both the processes of planned and spontaneous urbanization led to growth of population in Hoa Tho Dong, Hoa Tho Tay, Hoa Phat communes (Cam Le district), Hoa Quy, Man Quang, Khue My, Hoa Hai communes (Ngu Hanh Son district), Hoa Khanh Nam, Hoa Khanh Bac, Hoa Hiep Nam, Hoa Minh, Hoa Hiep Bac, Lien Chieu communes (Lien Chieu district) (Fig. 6) and Hoa Lien commune (Hoa Vang district). The process of population growth in urban areas increased demand for housing, food, water, resources, energy and other services [9]. The high density of population in the urban areas also created the high competition for jobs, leading to increase the unemployment rate (*local people interview*). These patterns will become major concerns of the urban residents about their future life [10,21]. Moreover, the urbanization has also differentiated the labor force in the economic systems, which has high demand for labors in the industrial, trade, and service sectors and least number of people working in the agricultural sector (Fig. 7).

The population shifts due to the migration and immigration have created a mixture of local and immigrant culture in the urban areas. The high proportion of immigrants has changed the lifestyle of the local residents, making the socio-environmental problems such as social behavior, food insecurity [9,21] and vulnerability [25]. Thus, local residents are worried about the increase in expenditures of the urban lifestyle and the noisy environment, and especially, the education and training the youth and young people in the new environment [21]. Almost households responded that the teenagers currently spend more for street activities such as shopping, coffee and others in recent years [10]. This problem exists to be a negative issue of the urbanizing process, which requires urban governance to take appropriate attention and measures.

3.3. The economic characteristics and livelihood of urban residents

The present studies on urbanization in Da Nang city shown that both planned and spontaneous urbanizing areas have extremely caused the land use change. The large areas of agricultural and aquaculture land, water, forest, and bare lands have been converted to urban lands, industrial parks and infrastructure development [4]. Higher conversion rates of land-use change are taking place in Lien Chieu, Ngu Hanh Son, and Cam Le districts, leading to paddy rice areas rapidly decreased during the period from 2008-2012 (Fig. 8). Particularly, the paddy areas are declining up to 85% in the Cam Le district. The land use change has strongly impacted on the livelihood of residents in the periurban areas. The poor households and unemployment have been seriously influenced due to the loss of cultivated lands [24] and the impacts of pollution from industrial activities. The pattern of land-use change is similar to Hanoi Capital, where is reported that the loss of arable land is a threat of sustainability of the agriculture system, livelihood of farmers and food provision to the city [26].

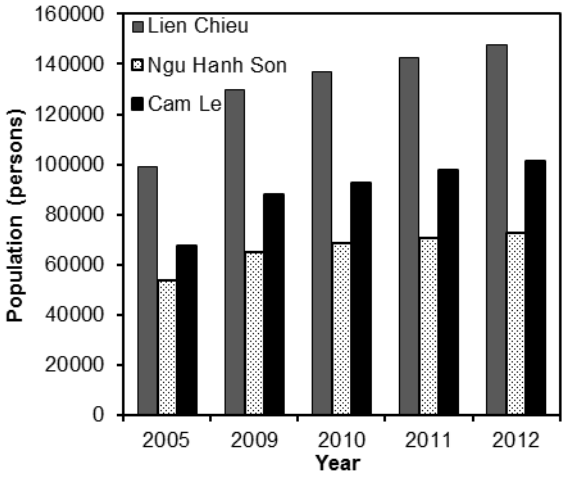

Fig. 6. The variation in population in three rapid urbanization districts in Da Nang city [23]

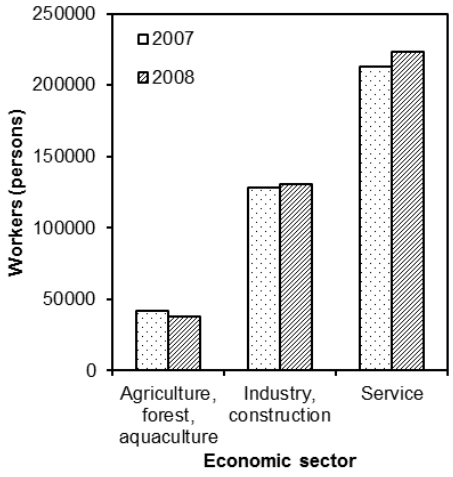

Fig. 7. The variation of numbers of workers in several economic sectors in Da Nang city in the early process of urbanization [23].

The processes of urbanization have extremely impacted the livelihood of rural residents. Due to loss of cultivated lands, a large proportion of rural population has shifted their job from the agricultural sector to the industrial sector, working in local factories and enterprises. The rate of labor shift was sharply occurred in the early process of the urbanization, in which the number of agricultural workers has been significantly reduced and the numbers of industrial and service workers have been significantly increased (Fig.7). It should be noted that there are still approximately 40,000 people worked in the agricultural sector. The agricultural products produced by farmers in the Da Nang city include foods, vegetables, poultry, and livestock that partly meet the consumption needs of the urban residents. However, the proportion of cultivated products in the rural and periurban areas significantly shifted from food crops (rice and corn) to the vegetables in the period from 2008-2012. The economic value per ha of the vegetables was significantly higher than the food crops (Fig.9). This pattern could be explained by two factors: the first was the increase demand of vegetables from urban dwellers and the other was the decrease of the cultivated areas due to the land use change (Fig. 8), and the land degradation by drought and pollution from industrial activities [27]. The higher economic value of the vegetables in comparison with the food crops is similar to the previous study in Hanoi Capital [17].

At the present, some productive lands are planning to convert to urban areas and industrial parks. The rural households are acquired the lands, but the projects have not been implemented. In these areas, local residents have lost the means of production and employment, but they have not arranged the jobs, leading to increase in unemployment, freelance, and other labor, particularly the groups of people are greater 30 years old in Hoa Chau, Hoa Phuoc communes (Hoa Vang district), Hoa Xuan commune (Cam Le district), and Nai Hien Dong commune (Son Tra district). Some areas in Hoa Xuan commune (Cam Le district) are planned to develop the urban infrastructure and industrial parks, but

they are still delayed in the project implementation. These land areas provide temporal spaces for the local dwellers to retain rural links though urban agriculture, such as livestock, maize, and bean farming. As a result, the agricultural products, for instance, livestock markedly increased in number heads from 2005-2012 in the three districts of the Da Nang city (Fig. 10). Therefore, the urbanization was a major factor to take or change the livelihood of the rural dwellers, leading their living condition is very unsustainable. Particularly, many rural households don't know how to use the lump sums of compensation paid by the City People's Committee for their productive agricultural lands. These households could spend the lump sums of compensation to build a new house, to buy the durable assets and others (Fig. 11). Thus, housing finance of many resettling households was eventually worse in term of the loss of livelihood, for them, the loss of cultivated land is the disappearance of livelihood. This pattern is similar to the resettled households in the periurban areas in Hanoi Capital [17].

3.4. Environmental and hygiene problems during the urbanization

The fast growing urban population and industries were major factors that increased the volume of waste, sewage, and dust, putting high pressure on water, air, and soil environment. The present results showed that many periurban and urban areas are lack of the collective waste systems and sewage treatment plants. The waste and sewage from the residential and commercial buildings, factories, and industrial parks have been illegally discharged to the surrounding environments, causing surface- and ground- water, soil and air pollution [27]. Consequently, the productive lands in peripheral urban areas are polluted by the sewage discharge from the factories and industrial parks. The impacts of environmental pollution from domestic and industrial activities

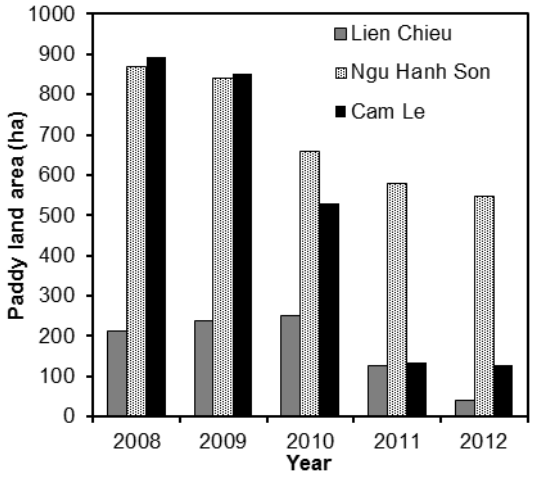

Fig. 8. The decreased trend of paddy land areas in three periurban districts in Da Nang city from 2008-2012 [23].

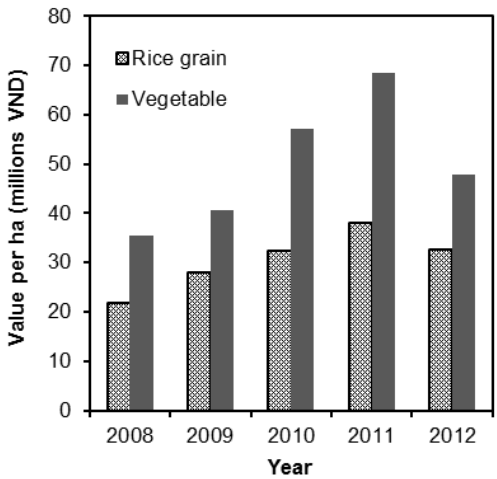

Fig. 9. The variation of economic values per ha of the rice grain and vegetables in the Da Nang city from 2008-2012 [23].

were taken place along the Phan Tu street of My An commune and the spontaneous urban areas of Lien Chieu, Cam Le and Ngu Hanh Son districts. In which, the industrial parks had the greatest impacts on environments, for examples, the Hoa Cam, Hoa Khanh industrial parks have discharged large volumes of sewage, waste, smoke and dust to surrounding environments, causing degradation of agricultural lands [27]. The interviewed results showed that from 30 to 40% of households in Lien Chieu, Son Tra and Hai Chau districts have been faced with the environmental and hygiene problems. Particularly, approximately 50% of the households in Cam Le districts are using the contaminated water (Fig. 12). The well- and surface-water resources are currently contaminated by iron, aluminum, salinity, suspended matter, and unpleasant smell (*local person interview*). Therefore, it is urgently needed to improve the water supply system for urban dwellers, especially surrounding the industrial parks. The greatest proportion of households impacted from air pollution was recorded in Thanh Khe, Hoa Vang, Son Tra and Cam Le districts. The contaminants caused air pollution consisted of the smoke, dust, unpleasant smell and noise from transportation, industrial parks, rock exploitation and processing, and seafood processing factories. The environmental pollution has caused a great impact on the human health (e.g., respiratory diseases) (*local person interview*). Thus, the urban dwellers were worried about the environmental pollution and food contamination [10,21].

3.5. Rural-urban linkages in the context of natural disasters and climate change

Climate change is occurring faster than previously thought, and causes serious impacts on human society by intensifying warming climate and precipitation, sea level rise, natural hazards (e.g., tropical typhoon, flood and drought) [25].

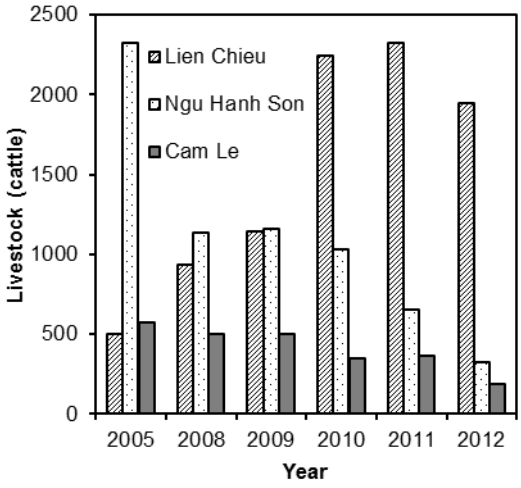

Fig. 10. The number of cattle in three urban districts of Da Nang city from 2005-2012 [23].

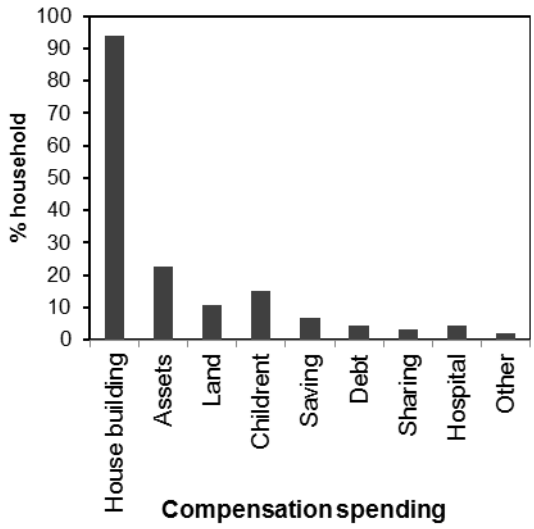

Fig. 11. The proportion of households used the lump sums of compensation for different purposes [24].

Both rural and poor urban communities in the developing countries have suffered the greatest impacts of natural disasters and climate change [2,25]. In addition, cities in the developing countries are highly vulnerable to climate change, sea level rise and natural hazards due to expanding trends towards the sea and the river basin, high population density, concentration of solid and liquid wastes, and the land-use and land cover change [28]. The interdependent relationship between rural and urban areas indicates that climate change impacts on agriculture will affect urban areas and *vice versa* [2,15]. Therefore, it is needed to find answer for the question: How the rural-urban linkages will contribute to reduce the vulnerability of rural and urban communities from climate change impacts in Da Nang City? Particularly, it is necessary to look at how will the flows of migration, commodities, and services between the rural areas and urban centers contribute to adapt to natural disasters and climate change impacts? Da Nang city is increasingly facing severe natural disasters due to climate change such as typhoons, flood, and drought [22]. The typhoons Chanchu and Xangsane (occurred in 2006), Ketsana (occurred in 2009) and Nari (occurred in 2013), and flood (occurred in 2007) have caused particularly severe damages on human lives, livelihoods, and infrastructures of the city. The most vulnerable communities to the disasters induced by climate change are living in the coastal areas, nearby the rivers and the lowland areas in southern areas of city [27].

The urban centers provide financial resources for constructing infrastructure such as road, sea and river dykes, and buildings that protect the vulnerable communities from the typhoon, flood and drought [29]. During flooding, food supplies are disrupted within the urban areas due to the difficulty of transporting conditions, leading to increase in the prices of fresh foods such as vegetable, meat, and fish. The fresh foods are inadequate and almost supplied from the nearby rural region. Thus, rural agriculture can maintain food availability during- and post- disasters and support to increase adaptation for the urban dwellers (*local person interview*). As shown in the above mentions, the remittance from rural to urban migrants significantly enhances rural livelihood diversity in Da Nang city. The flow of cash from the migrants can be used to build, maintain or repair houses for reducing the threat from the disasters in the rural areas. Additionally, the remittances can be used to improve the education, healthcare and agricultural investment that indirectly increases the adaptive capacity of the rural households to disasters (*local person interview*). Besides their direct financial support, the migrants can also help their relatives by sharing information about the disasters and climate change impacts. However, the migrants often leave their parents and children in rural areas, leading to increase vulnerability of rural households to disasters. The poor immigrants in urban areas commonly live in semi-permanent dwellings, which are limited access to public services and infrastructure of the city, causing them to expose to higher impacts of climate change [29].

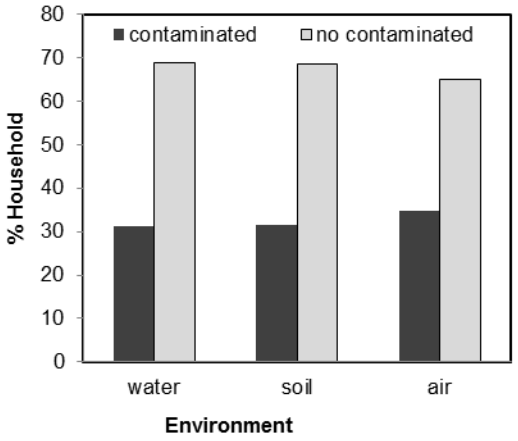

Fig. 12. The proportion of households is facing with environmental pollution.

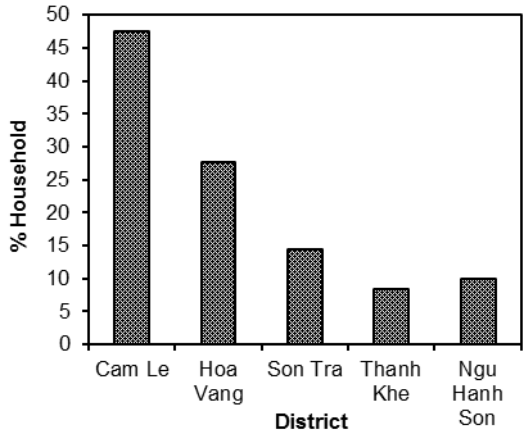

Fig. 13. The proportion of households is using the contaminated water in the six districts of Da Nang city.

According to the climate change scenarios, the northern region of Da Nang city, including Lien Chieu and Hoa Vang districts will be extremely exposed to drought and salinity intrusion due to the increase in air temperature and seawater intrusion into estuaries [27]. The southern region of Da Nang city, including Hai Chau, Cam Le and Ngu Hanh Son district has been highly sensitive by flooding due to relatively low ground elevation. The surface- and ground-water resource depletion is one of greatest fear for the rural and periurban communities. The drought caused to degrade approximately 60 ha paddy and vegetable fields in Lien Chieu district in 2013 [27]. The damage of drought would cause a failure of the agricultural investments to the region, consequently intensifying rural population migration to urban centers [30]. The threat of natural disasters and climate change has therefore heightened the importance of rural-urban linkages in climate change adaptation, and sustainable use of natural resources, particularly, the water resources. The adaptation policies need to implement efficient strategies for the water, land, and bio-resources management. The knowledge of the rural-urban linkages will provide more efficient means for offsetting climate change impacts in the fast growing cities of the developing countries.

4. Conclusions

Lessons learned of the rural-urban linkages from the case study in Da Nang city suggest that:

- Rural and urban communities should be seen as an interdependent relationship, wherein, the rural communities benefit from the infrastructure development, the labor market in the city, remittances sent from relatives in cities, urban market for agricultural products, and other social services. Whilst, the urban communities could rely on the agricultural products (rice, bean, vegetable, seafood, and meat);

- The weak institutions in the processes of urbanization could have negative consequences on both rural and urban communities such as loss of livelihood, unemployment, and environmental pollution;

- The programs and policies should aim to enhance the rural-urban linkages, to reduce the adverse impacts, and to increase the benefits of urbanization in the fast growing cities. Although the general development trend of the fast growing city tends to execute heavily the urban development, but it shall be necessary to strengthen the rural economy development. Because if poverty and backwardness occur in rural areas, the sustainable development in urban areas might not be feasible due to the flow of rural-urban migration that incessantly puts high pressure on already overburdened infrastructure and services in the urban center.

- Enhancement of the rural-urban linkages, including livelihood and income improvement based on the benefits and resource from the land use change is one of efficient means for offsetting climate change impacts in the fast growing cities.

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Nghiên cứu tương tác Đô thị-Nông thôn ở các thành phố có tốc độ đô thị hóa nhanh để nâng cao khả năng thích ứng và chống chịu với tai biến thiên nhiên (lấy ví dụ ở thành phố Đà Nẵng, Việt Nam)

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Tóm tắt: Mục tiêu của nghiên cứu này là phân tích đặc trưng tương tác đô thị-nông thôn tại thành phố Đà Nẵng và xác định vai trò của nó trong nâng cao khả năng thích ứng và chống chịu với tai biến thiên nhiên và biến đổi khí hậu. Kết quả nghiên cứu chỉ ra rằng tương tác đô thị-nông thôn cung cấp

các nguồn lực và cơ hội quan trọng cho quá trình di cư của người lao động, trao đổi thương mại, vốn, và tính sáng tạo giữa các vùng nông thôn và trung tâm đô thị, cũng như nâng cao hệ thống quản lý tai biến của thành phố. Sự phát triển đồng bộ hệ thống cơ sở hạ tầng gồm giao thông vận tải, thông tin liên lạc, giáo dục và y tế ở các khu vực đô thị là yếu tố then chốt thúc đẩy quá trình tương tác giữa đô thị và nông thôn. Tương tác đô thị nông thôn có vai trò làm tăng thu nhập của người dân nông thôn thông qua các dòng vốn từ các người di cư và làm việc ở thành thị gửi về và tăng khả năng hiểu biết về tai biến và biến đổi khí hậu thông qua các kênh chia sẻ thông tin từ khu vực đô thị. Dựa vào các kịch bản biến đổi khí hậu, các cộng đồng dân cư nông thôn tại ở các quận, huyện phía bắc sẽ phải đối mặt với tình trạng khan hiếm tài nguyên nước mặt và nước ngầm. Trong khi các cộng đồng dân cư sống tại các vùng đất có độ cao thấp, gần các lưu vực sông ở phía nam thành phố sẽ bị đe dọa bởi tai biến lũ lụt. Kết quả nghiên cứu này sẽ đóng góp các thông tin quan trọng cho quá trình xây dựng giải pháp nâng cao khả năng thích ứng và chống chịu với tai biến thiên nhiên và biến đổi khí hậu ở các thành phố có tốc độ đô thị hóa nhanh.

Từ khóa: đô thị hóa, tương tác đô thị-nông thôn, biến đổi khí hậu, thành phố Đà Nẵng.