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Peri-Urban Agriculture and its Impacts on Smallholder livelihoods in Arusha, Tanzania

Mr. Terevael Aremu Nassari[a]*, Dr. Anoma Ariyawardana[b]

[a]*University of Queensland 14, South Ridge Road, Brisbane, Gatton 4343, Australia*

[b]*University of Queensland, Brisbane, Gatton 4343, Australia*

[a]*Email: terevaeliaremue@yahoo.com,* [b]*Email: a.ariyawardana@uq.edu.au*

Abstract

Urban population in Tanzania is increasing alarmingly, creating an increased demand for food by both peri-urban and urban dwellers. Meeting this demand has been challenging, and thus, this research examined the existing farming systems in peri-urban areas and how these farming systems contribute to smallholder livelihoods. Data were collected using mixed research methods, namely, an in-depth interview with an extension officer, a focus group of 8 farmers, and a household survey of 150 farmers. Initially, the data were analysed using descriptive statistics and then the association between variables were explored using chi-square and Spearman's rank-order correlation analysis. The peri-urban farming area per household is small with a quarter to one acre but their farming systems had both livestock and crops. Although there are no specific policies on peri-urban agriculture, households have changed their farming practices due to government and private sector interventions. It was revealed that peri-urban agriculture provides food and is the main source of income for the smallholders that helps cover health and education costs. The livelihood forms of capital varied across the study area with some having more forms of capital than others. Given the significance of peri-urban agriculture among smallholders in the study area, it is recommended that coordinated support mechanisms are developed to enhance the production and marketing.

Keywords: Africa; Tanzania; Farming systems; Livelihood; Peri-urban agriculture; Smallholder farmers.

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* Corresponding author.

1. Introduction

In Africa, the malnutrition rate is high because providing an adequate and nutritious food to all people is challenging. One in four people in Africa are lacking adequate food for a healthy life [24]. Further, because the total population in Africa is projected to be 2.4 billion by 2050 [24;10], this adds difficulty to ensuring food security. Likewise, by the year 2050, about 60 per cent of the total population of Africa will be living in cities [2]. This necessitates the importance of peri-urban agriculture as an opportunity for food security and poverty alleviation in the community [32]. Generally, with this growing population, conventional agriculture is not enough to meet the food demand, thereby increasing the importance of finding alternatives, specifically using peri-urban agriculture [42]. Peri-urban agriculture is contributing considerably to food security and household income with 15-20 per cent of global food produced in peri-urban areas, thus improving the nutrition and wellbeing of smallholders [14;45;57;13].

There is no universally agreed definition of peri-urban agriculture as it depends on the geographical position of farms. For example, for some, peri-urban defines the transition zone between cities and towns and the less populated rural areas [5]. Generally, peri-urban agriculture involves producing crops, aquaculture, forestry, and livestock around cities and towns and may also involve processing or distributing food products and services to urban areas [39;59;34]. Further, peri-urban agriculture contributes to the resilience of surrounding cities and towns by ensuring food security, giving dietary options, and providing a source of income [44;35;38].

The social roles of peri-urban agriculture, its economic contribution, and its ability to sustain the livelihoods of both urban and peri-urban inhabitants in African countries is important to combat malnutrition and alleviate poverty [51]. The growth of cities in the late 1990s resulted in the increased importance of peri-urban agriculture in Africa whereby farmers from cities like Harare, Zimbabwe and Nairobi, Kenya farmed commercially and not just for household food security [17]. Consequently, peri-urban agriculture contributes to the smallholders' livelihood because the demand for agricultural produce is created in nearby cities and towns.

While the primary goal of peri-urban agriculture is to provide household food, the income it derives commercially are also used to support the social values and services in the community [15].

Additionally, peri-urban agriculture provides employment, alleviates poverty, and ensures people's livelihoods [33]. Peri-urban agriculture is also practised in Sub-Saharan Africa [40] where its socio-economic importance has been increasing [18]. Each season, relatively high yield and productivity are expected from the peri-urban agriculture per farm. This is because knowledge and skills obtained from trainings and experience gained from interaction with buyers and consumers have gradually increased more from town and city centres than rural areas [42]. Much research has focused on peri-urban agriculture and its impact on household income and food security [28;12;7;43;21;22]. However, little focuses on how peri-urban agriculture relates to the social-economic status of smallholder farmers or how it contributes to the livelihoods and food security of urban and peri-urban dwellers in Tanzania. Therefore, this study examines how Tanzanian peri-urban agriculture contributes to the smallholders' livelihoods and socio-economic status. This study answers the following three research questions;

1. What are the existing farming systems in peri-urban settings of Arusha, Tanzania, and how are they being supported?
2. What is the contribution of peri-urban agriculture to the smallholders' social-economic status and livelihoods?
3. How can smallholder livelihoods be improved through peri-urban agriculture?

This report is organised into five sections. Section 1 introduces the study by highlighting peri-urban faming and its impact on smallholder farmers. It also lists the objectives of this study and their expected outcome. Section 2 reviews the literature review to enable it to define livelihood, capital assets, farming systems and supporting mechanisms. It also deals with land tenure status, farming trainings and information sharing among farmers. Section 3 covers the research methods and describes the study area and sampling procedures. Section 4 analysises and give study's findings, while Section 5 concludes the study and makes recommendations.

2. Farming system, supports and policies

How smallholders select their farming system is influenced by soil type and weather patterns and hence will vary from one agroecological zone to another. The type of farming system also depends on the relationship of cultural, economic, social and sometimes political factors in the society [62]. In other words, how farming systems are defined depends on the how individuals in the same agroecological zone vary according to their different resource bases, farming practices, constraints and household livelihoods [62]. For example, in Western Africa, the farming systems are classified as livestock, field crops, and gardens. Others are combination of field crop and gardens and finally livestock, field crops and gardens all together [17]. The farming systems, as used in this study, refer to the way peri-urban farmers specialise to carry out their farming activities, whether it be by producing crops only, livestock only, or combining the two. The expertise of the involved farmers also contributes to what type of farming systems to use, each of which has relative benefits and challenges [37;30;46]. Ethiopian farmers combine livestock with crop production and most of the field crops is produced for home consumption while the gardening is commercial [6]. These authors also show that the number of farmers who keep livestock only differ slightly from those who both keep livestock and produce crops. The ability to do both types of farming is associated with families of approximately 7 members per household who provide enough labor to do both forms of farming. Peri-urban farmers face many challenges: inadequate agricultural inputs, no market information, insufficient water for irrigation, low access to financial services, insignificant land resources, and poor post-harvest management of farm produce [11]. Sound policies would ensure that both the public and private sector collaborate to address these challenges [11]. Finally, this collaboration would ensure that helpful information about having adequate food and profitable value chains would be communicated to research institutions, farmers' organisations, buyers and extension agents.

2.1 Land size and ownership

Land in peri-urban areas in developing countries has been highly demanded mainly for public infrastructure and for commercial centres, factories, housing and other urban facilities, thus reducing farming land and income, changing farming systems [54], and varying farm sizes from place to place. For example, in Bangkok the

average land size under peri-urban agriculture is more than 3.5 hectares [59].

Because of increased land markets for residential house constructions, encouraged by housing subsidies to civil servants, the land available for peri-urban farming has also been diminishing in Tanzania [44]. A high rate of city growth causing residents to relocate to peri-urban areas has led to policies that produce conflict between those who regulate the urban development and those who encourage peri-urban farming [44]. That urban and peri-urban land has not been clearly demarcated and has exacerbated this conflict because, in most cases, city officials have convicted farmers despite some attempt at initiating polices to safeguard peri-urban farming in Tanzania.

2.2 Livelihoods capitals and outcomes in peri-urban farming

Livelihood has been defined varyingly: (a) the ability of people to earn and sustain a living [20]; and (b) the set of activities, or assets and capabilities that provide the means of living [19]. It is also the ability to recover from shocks and to maintain assets that benefit current and future generations to sustain livelihood [53;41;48]. These authors added that there are five forms of capital needed for a suitable standard of living and hence improved people's livelihood: human, financial, social, physical and natural.

Human capital refers to the education of household members, family size, gender, and age [63]. Peri-urban agriculture, especially in developing countries, depends more on this form of capital than technology. The age of a group of farmers determines how well they produce as they differ in ability and experience in farming. The [47] shows that the more years in farming, the higher the experience and consequently the higher the yield, assuming all other factors are constant. Social capital applies to establishing micro-credit, cooperatives and producer groups to participate in meetings and decision-making forums for poor people; this underlies the strategy to increase agricultural production and reduce poverty [11]. More effort is needed to build social capital, and thus involve civil societies in facilitating social meetings.

Physical capital refers to infrastructures, such as buildings and the quality roads to enable timely access to both farm input and output, it refers to accessing information, and the production technology involved in facilities like chemical sprayers and four-wheel tractors [36]. Adequate physical capital increases productivity and lowers post-harvest losses to increase income and food availability [55]. Financial capital refers to wages, credit, debt and savings. Having sufficient agricultural credit improves production and profit [8].

Natural capital involves wildlife, forest and aquatic products, and refers to the gross revenue earned from selling crops, livestock and land. Further, land size determines the possibility to diversify by practicing different farming systems to avoid the risk of practicing only one type of farming in case of any failure it fails [36;29].

People use the five forms of livelihood capital to implement pertinent strategies to meet their goals. Livelihood strategy, influenced by these forms of capital and their related policies, refers to people's implementing activities to achieve their livelihood [20]. Both policies and organisations shape the livelihood and they work from household levels and in both public and private sector. Policies determine the access to capital, strategies and decision-making and they also determine the returns to livelihood strategies [23].

Livelihood strategies have been classified differently: farming, farming and non-farming, non-labor and only non-farming activities. Others classify it as livestock keeping only, crop production only and both livestock keeping and crop production [54]. The livelihood outcome depends on how efficiently people combine the livelihood capital but also the livelihood strategies chosen and the interaction between the two [63].

As a result of this literature review, a modified sustainable livelihood framework developed by the Department for International Development was used to understand these livelihood capitals, strategies and outcomes (Figure 1). This is a conceptual framework for sustainable livelihood that is useful because it allows many forms of livelihoods to be balanced [27;52;11;23;50].

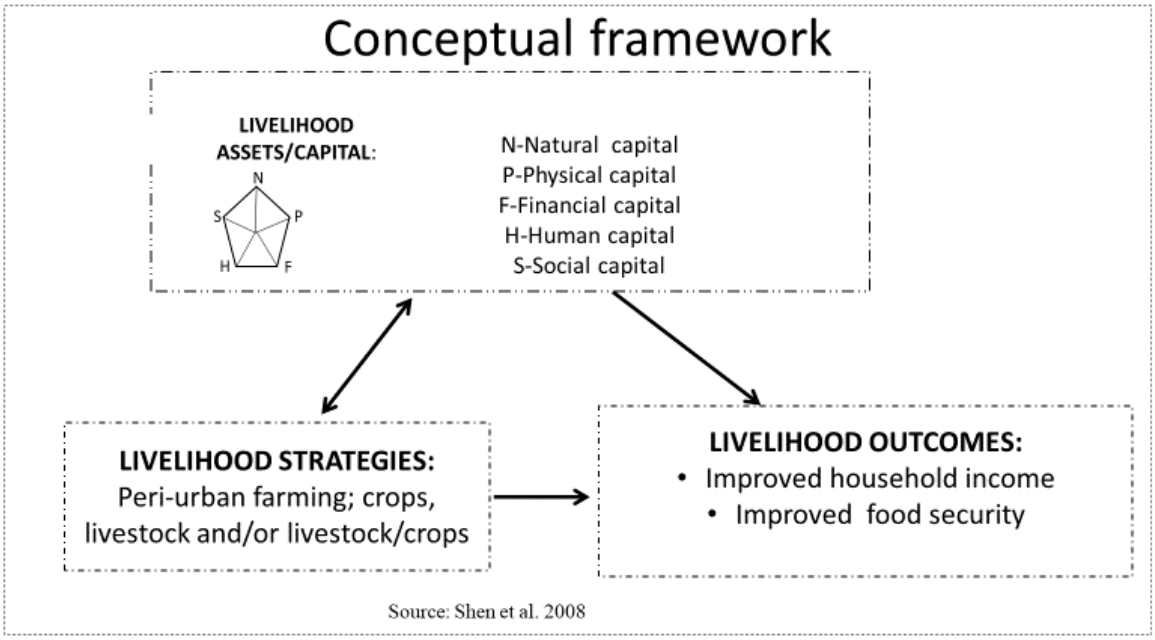

Figure 1: Conceptual framework.

Source: Developed based on the literature review [27;52;23;16].

3. Methodology

3.1 Study area

Tanzania is the largest member country in East Africa. It borders Uganda and Kenya to the north; the Indian Ocean to the east; Rwanda, Burundi, and the Democratic Republic of Congo to the west; and Zambia, Mozambique, and Malawi to the south (Figure 2). Tanzania boasts the highest mountain in Africa, Kilimanjaro, and has a tropical climate. More than 80 per cent of Tanzania's population is engaged in agriculture. Tanzania has six cities (in order of size): Dar es Salaam, Mwanza, Arusha, Dodoma, Mbeya and Tanga.

Figure 2: Tanzania map.

Source: Adopted from Encyclopedia Britannica, 2019

Arusha City, where this study targeted the peri-urban areas, is in northern Tanzania and is the capital of the Arusha region. Arusha City was chosen as a research site because its increasing population produces high food demand and thus any initiative to promote both the economic, social and ecological aspects of peri-urban agriculture in this area should be studied. Arusha City is formed by two district councils: Arusha Urban Council and Arusha Rural District Council. Arusha Rural District surrounds Arusha City. The population of Arusha City is 739,640 with annual growth of 5.6 per cent [4], creating more demand for food and hence an opportunity for peri-urban farmers. Additionally, Arusha City is the hub for both international diplomats and tourists and hence the demand for agricultural produce and products has increased. Finally, Arusha Rural District has a population of 323,198 and is where the sample of respondents for this research were collected [4]. Four wards were selected: Manyire, Bangata, Kivululu and Kisongo. The selection was purposive, picking only those involved in peri-urban agriculture.

3.2 Research methods

Because using mixed research methods allows specific variable relationships to be established to gain answers to how and why questions [25], this type of approach was used to collect data. Qualitative data were gathered using a focus group and an in-depth interview, while a household survey was used to gather quantitative data.

3.2.1 Focus Group Discussion (FDG)

With the help of ward extension officers, a total of 8 farmers (two from each ward) were identified and invited to participate in the focus group. Topic guides were prepared for it to provide understanding of the various

farming systems and why they engage in them, technology currently used in their farming, decision-making criteria for those who make them, and any cultural beliefs concerning some farming systems. Further, broader discussion topics were introduced to explore any changes in farming systems in the past five years and the reasons behind these, challenges in farming, and marketing and possible solutions. Further, this method was used to explore why and how peri-urban farming contributes to farmers lives regarding food security and household income.

Figure 14: Focus group discussion photos from field in year 2020.

3.2.2 In-depth interview

There was one in-depth interview with an extension officer from the Department of Agriculture in Arusha Rural Council. This is the government department that coordinates and implements extension services to farmers. Extension officers seek to deliver agricultural trainings on good agricultural practices, liaise with farmers on behalf of District Department and communicate information between both sides. The particular extension officer chosen for interview provided technical and strategic information about peri-urban agriculture. The interview aimed at understanding the various farming systems in the study and the supporting policies and strategies. Other information captured by this method concerned marketing infrastructure, projects currently available, the role of extension officers in peri-urban farming and challenges in peri-urban farming.

3.2.3 Farmer Survey

A farmer household survey was designed to collect quantitative data on farming systems, socio-economic factors, and the livelihood forms of capital. Its first section captured the farming systems and the available supporting services while the second focused on livelihood forms of capital as apply to agriculture and the last section was covered socio-economic factors in agriculture. In planning the survey, a two-stage method was used. First, an inventory of the study area from Arusha Rural District Council, which surrounds Arusha City,

was devised to identify all four wards involved in peri-urban agriculture. This approach used the purposive to get the wards and to get respondents probability sampling was used and therefore all respondents were randomly selected from the list of farmers registered within each of the four wards.

To ensure the sample was proportionate to the population of the wards, the study's calculation gave 150 respondents from the study area consisting of 36 from Bangata, 21 from Kisongo, 26 from Kivululu and 67 from Manyire. This sample fits closely with the sample size used in similar studies [3;61;32;47;58]. A pre-test of the questionnaire was conducted with separate five farmers from Bangata Ward to remove unclear wording and to estimate time, and to ensure data quality. After identifying all respondents, they were then invited to a ward office to administer questionnaire. Four trained enumerators administered a questionnaire to respondents and clarify it to respondents whenever needed. To obtain a targeted number of respondents, data collection occurred from December 2019 to January 2020. The questionnaire avoided times that clashed with special events such as funerals, weddings, Christmas Eve, and festive events.

Figure 15: Survey participation captured during the data collection in 2020.

3.2.4 Ethics

Prior to data collection the required ethics approval was sought from the Human Research Ethics Committee (HREC), University of Queensland. The data collection tools: a project information sheet, consent forms for FGD, in-depth interview and survey participants with details of the research purposes, expected duration and procedures, participants' rights, confidentiality and anonymity, benefits and risks in participating in the research were outlined in the ethics application. The ethics compliance approval was obtained from the University of Queensland with the approval number 201900265. Prior to collecting data, both confidentiality and privacy of the respondents was ensured by coding the questionnaires and safely storing data using a password.

3.3 Data analysis

The data from FGD and in-depth interview were organised in a word document based on the sections of the report and the research questions.The narrative part of it helped to clarify more about the quantitative data collected and have a wide understanding of questions like "Why" and "How" from the research.The data from the questionnaires were transcribed into an Excel spreadsheet and then transferred into statistical package for social science (IBM SPSS 25). This report used descriptive statistics to analyse the farming systems, livelihood forms of capitals and peri-urban farming constraints in the study area. Cross-tabulation was used to describe the relationship between livelihood variables and outcomes. In particular, the chi-square method was used to determine the strength of association and statistical significance of cross-tabulated variables such as land size and the type of farming systems, and household income and access to credit.The pivot tables of Excel were used to create a two-way table and establish the relationship between annual household income and land size in all wards, and annual income and access to agricultural credit in all wards. Finally, in livelihood capitals a Likert scale of 1 to 5, where 1 = strongly disagree to 5 = strongly agree was used for data collection and with the help of literature review, key constructs and items were identified (see sub-section 4.5). Correlation matrix was used to identify the association between the identified constructs and livelihood outcomes.

4. Findings and discussion

4.1. Farming systems

Based on the agro-ecological zone of this area, which is arid with low annual rainfall and high temperature, farmers are growing short maturity crops [26].

This study found that 96 per cent of households are practicing both crop production and livestock rearing in their peri-urban farms. No cultural belief relates to a certain type of farming practice in the study area. None of the respondents has changed the farming system during the last five years although some changes in practices have occurred within the faming system itself. About 23.3 per cent of households had shifted their cropping practices from producing coffee, maize and banana to vegetables, especially tomato, cabbage, and nightshade indicating that Tanzanian farmers have been changing their farming practices. My discussion with farmers revealed that changing farming practices results from training and awareness campaigns by government and Non-Government Organizations to help farmers do so commercially.

In other words, farmers change their practices because of government or project interventions [9]. High productivity, resistance to disease, increasing costs of production, increasing shortage of land, decreasing output prices, and tolerance of drought are why farmers were advised to change their practices within the farming system. Figure 3 displays the crops produced in the researched area: maize, beans, banana, cowpea, lablab and sunflower.

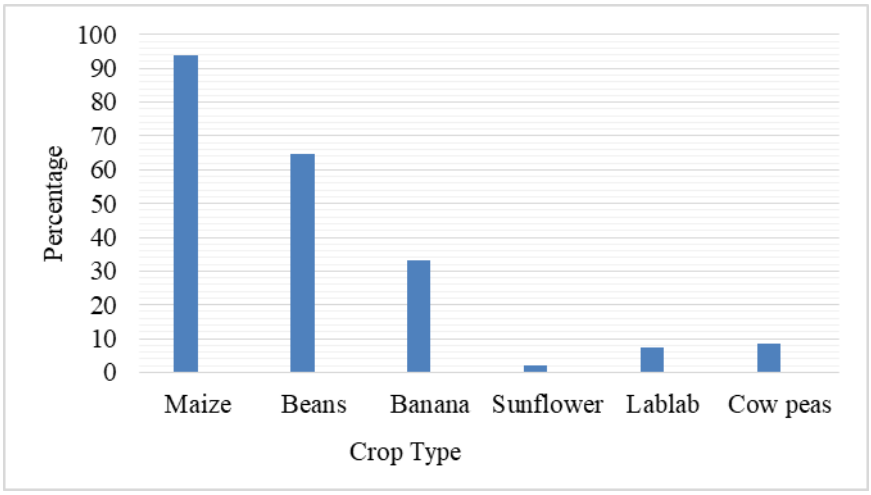

Figure 3: Crops produced in the study area.

Figure 4 displays the vegetables and fruits produced: Irish potato, African eggplant, cabbage, tomato, onions, okra and the leafy vegetables, kale, night shade, amaranths, watermelon and cucumber.

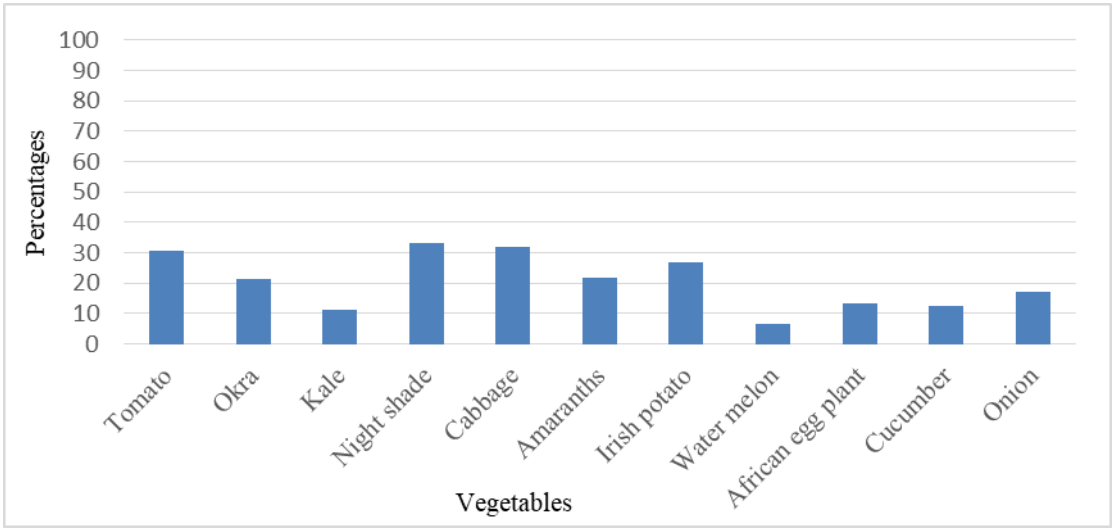

Figure 4: Vegetables and fruits produced in the research area.

Figure 5 presents the main livestock kept by farmers as identified by this study: cattle, goat, sheep, and chicken, while a few households having pigs and duck. In the focus group, farmers reported that pigs and ducks have low demand and hence are kept only by a few households.

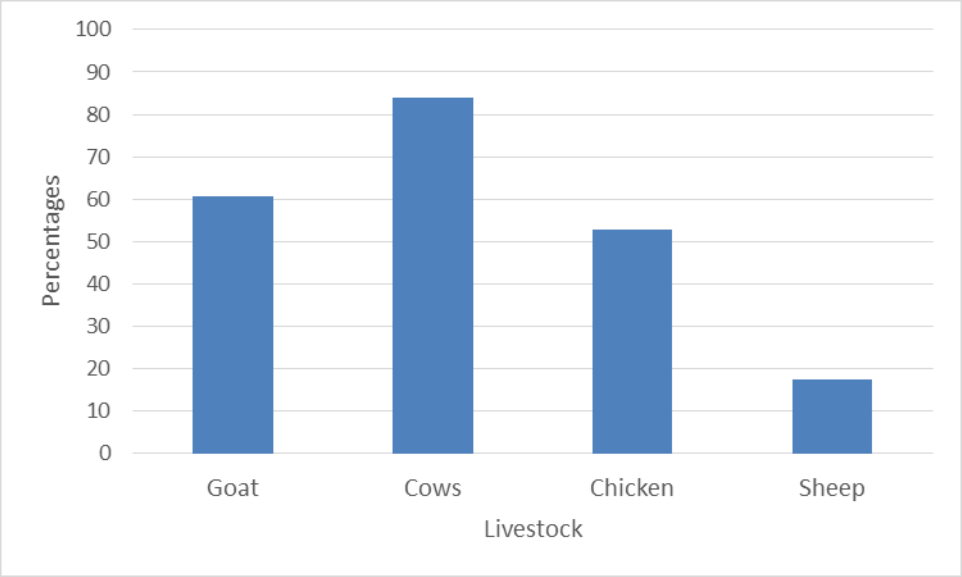

Figure 5: Main livestock production in the research area.

During the focus group, respondents indicated that crop production and livestock keeping support each other and hence they adopt both systems. The decision to choose a certain type of farming relies mainly on farmers' land ownership status and advice from extension officers. However, analysing survey data showed no association between land ownership status and the type of farming system (χ^2-value=0.519; p-value=0.05). Farmers consider this type of system as the means to diversify risk so that they can use income from crops or livestock to sustain their lives if one option fails. The farmers use farmyard manure to fertilise their farms and crop remains to feed their livestock. Further, I found no significant association between experience and household annual income (χ^2-value = 0.709; p-value=0.05), and gender and household annual income (χ^2-value = 0.659; p-value = 0.05). Finally, a significant relationship exists between household annual income with the following variables: water availability for farming (χ^2-value = 0.032; p-value = 0.05), family size (χ^2-value = 0.039; p-value = 0.05), and farming trainings (χ^2-value = 0.027; p-value = 0.05).

4.2. Land size and ownership, gender and household income

The land ownership shows that 82.7 per cent of respondents' own land, 16.7 per cent rent, while only 0.6 per cent of respondents own some and rent others. Also, most respondents (45.3 per cent) have land size less than or equal to 1 acre while 26 per cent had land size ranging from 1.25 to 2 acres allocated for farming. Figure 6 shows the proportion of land allocated to farming from each ward. The comparison shows that Bangata and Kivululu Wards have relatively small land under peri-urban farming. In Manyire, households farm a land size ranging from 3.25 to 4 acres as well as from 4.25 to 5 acres. This occurs because Manyire Ward has lower population density than other wards. While Bangata, Manyire and Kivululu Wards do not combine grazing with crop production, Kisongo Ward is land of the Maasai people who are pastoralists in nature. They therefore farm less land per household than those of Kisongo Ward where 42.9 per cent of households each farm more than 5 acres.

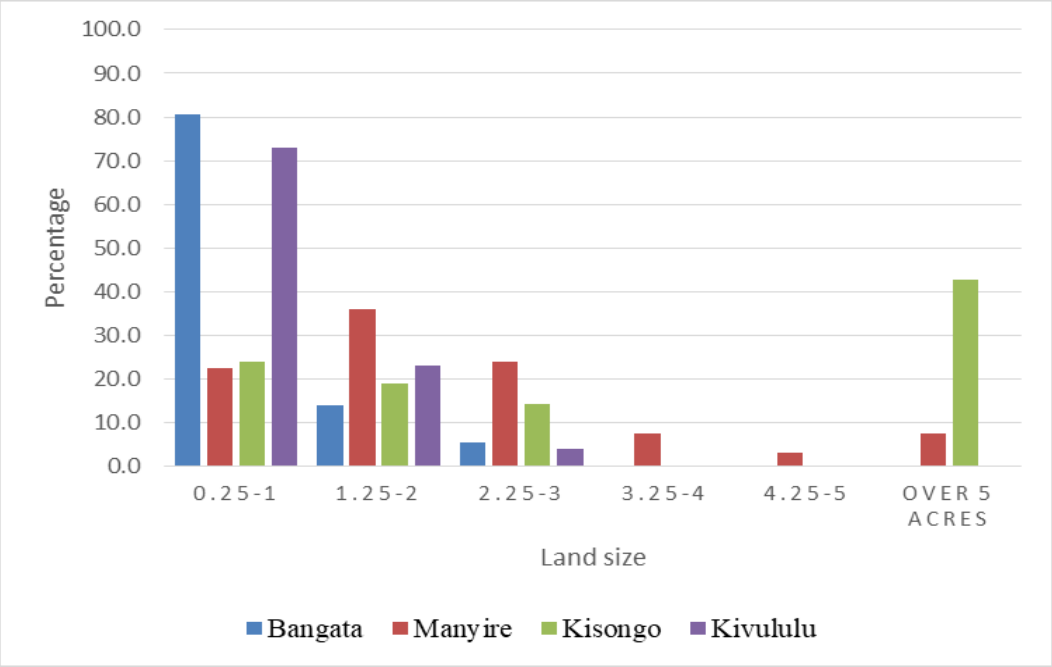

Figure 6: Land size under farming from each ward.

While 11.3 per cent of respondents said only men participate in peri-urban agriculture, 83.5 per cent reported that women and children join men for different stages of farming. All households are farming both for family consumption and selling. Although statistics from this research show that the average experience in farming is 18 years, less than 50 per cent of respondents have enough expertise in peri-urban farming particularly in good agronomic practices. My analysis of crop production from each ward showed that the crops produced are mainly maize and beans, followed by tomato, and amaranths (see Figure 7).

All wards produce Maize and beans because they are the region's staple food. Further, Manyire leads in producing many crops because it has a larger population and land size than other wards. Since maize and beans are generally produced for home consumption in wards, Manyire and Kivululu grow the greatest amount of tomato and sunflower and thus produce the main source of income. Growing sunflower is successful because of the favourable warm climate in the region. Kivululu produces more onions and cabbages than the other wards as this ward have enough water to irrigate. Kisongo ward does not produce okra and watermelon as they concentrate more on lablab and cowpea farming, and livestock keeping as their main source of livelihood. The livelihood of farmers from the study area also depends on livestock keeping. While all four wards were keeping cows, goats, sheep and chicken (Figure 7), two wards, Kisongo and Manyire, were found to have relatively more sheep and pigs respectively mainly to raise income for social services. Manyire is the only ward which was found to have ducks that they use them for food and selling.

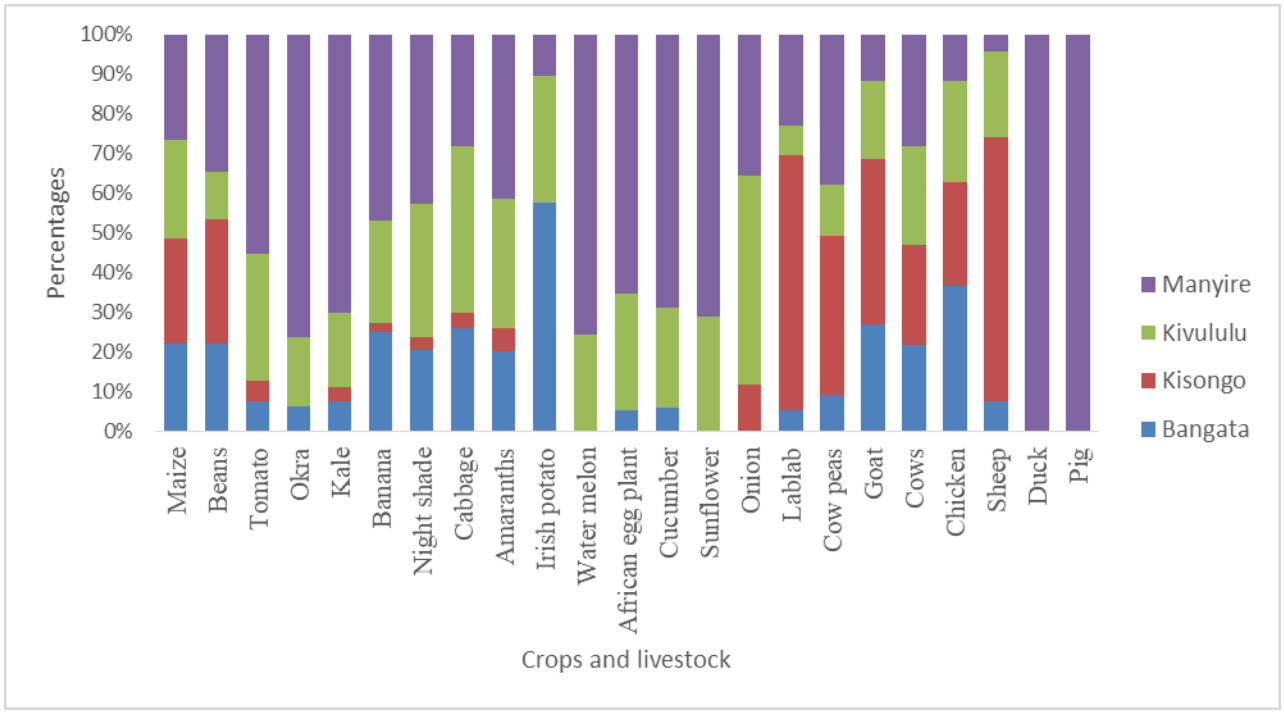

Figure 7: Crops and livestock production level in each ward.

Comparing annual household income among the four wards shows that most households from all wards have an annual income level ranging from TZS 500,000 (217.5 USD) to TZS 2,000,000 (870 USD) followed by households with less than TZS 500,000. Very few households from all wards earned income above TZS 5,000,000 (Figure 8). This could be attributed to the inadequate agronomic knowledge and skills, post-harvest losses and poor marketing organization.

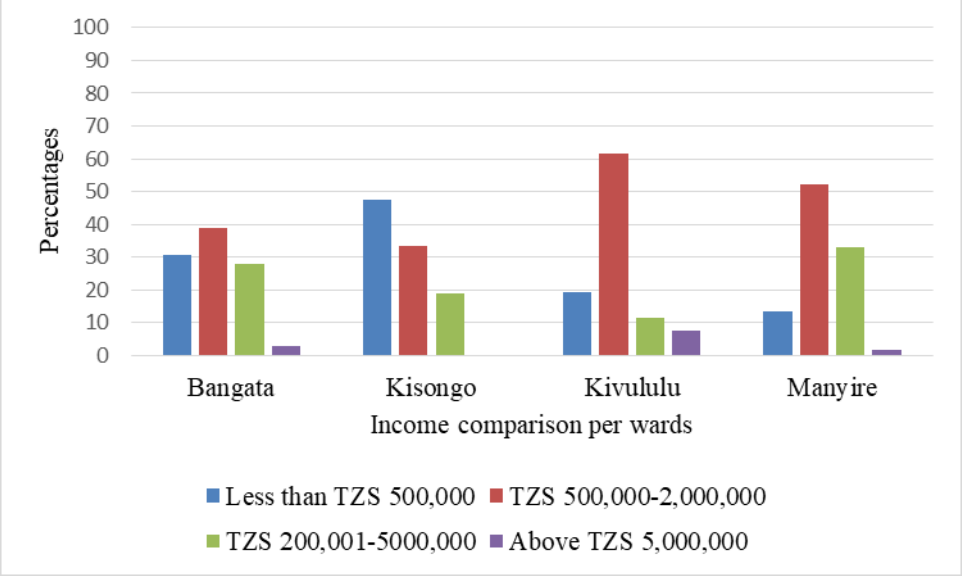

Figure 8: Household annual income comparison across wards.

The relationship between household income and land size shows that, in Bangata Ward, the increased annual income correlated positively with land size up to when it reached TZS 5,000,000 (2174 USD) until it then starts decreasing. In Kisongo, the relationship between income level and land size worked in reverse. This might be because the pastoralist community owns larger areas, but lower numbers of livestock and that livestock signifies wealth and respect in the community even though they sell less. Small areas are for crop production, the main source of income. Kivululu earns high income from its small land size and this can be attributed to it producing more horticultural crops which have relatively high unit price and can be harvested more than twice a year. In Manyire, those with the highest land size earn an income ranging from TZS 500,000 (217.4USD) to TZS 2,000,000 (870USD) (Figure 9). Manyire Ward leads in producing a surplus of crops thus benefitting its farmers commercially.

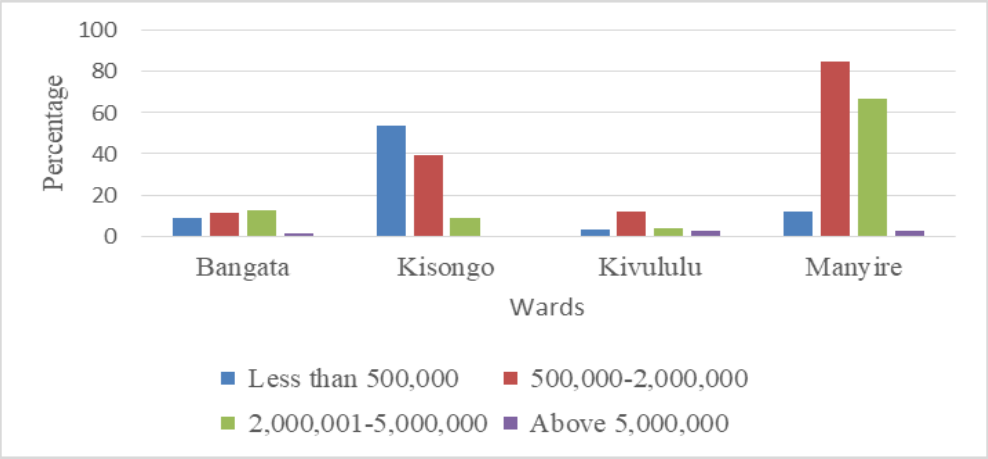

Figure 9: Interaction between land size (acres) and household income across wards.

4.3. Support and policies

Farmers receive technical support and advice from extension officers though, because they are few and without working facilities, each farmer cannot be reached on time. Four private institutions exist in the area under study: The One Acre Fund, the Foundation for International Community Assistance (FINCA), the Tanzania Horticulture Association (TAHA), and World Vision Tanzania, who support some farmer groups financially and train them in agronomic skills. While no specific policies support peri-urban farming in Tanzania, its government is industrialising its economy. This has emphasised general agriculture support as this sector is the main source of raw materials for industries and to feed the people. Three established support policies, programs and strategies are Kilimo kwanza (agriculture first), the Agricultural Sector Development Program (ASDP), and the Feed the Future program supported by the United States Agency for International Development (USAID). Two other programs are the bread-basket initiative supported by the Alliance for a Green Revolution in Africa and the Marketing Infrastructure Value Addition and Rural Finance (MIVARF) program supported by the International Fund for Agricultural Development (IFAD). These programs and policies aim at strengthening the institutional framework, strengthening the public-private sector relationship. and transforming from subsistence to commercial farming. Others are strengthening marketing links and integrating agriculture with other sectors of the economy [56].

4.4. Training, agricultural services and information sharing

It was revealed that 52 per cent of the respondents had no farm training at all. Of those who had trained, a low proportion (23.3 per cent) had received it frequently. More training in agronomic skills, and post-harvest management would equip farmers with the expertise to enable them to benefit from peri-urban farming. This research also found that 60.7 per cent of respondents do not keep farming records, thus threatening their rational decision-making in farming. Agricultural inputs are available in the study area, represented by 67.1 per cent of respondents but most cannot afford these as the prices are high. Subsidies from the government may help them afford such inputs and improve productivity.

Financing agriculture has been challenging for small-scale farmers for more than a century. This study revealed that only 19.3 per cent of households can access credit and about 64 per cent receive credit from informal saving. The survey showed that only 18.7 per cent had taken credit and 78.6 per cent was allocated to agriculture, with the rest covering other costs such as education and health services. Additionally, 60.7 per cent of the total credit taken was a maximum of TZS 450,000 (USD 196) (Figure 10). As identified by my research, the primary barrier to credit for small-scale farmers could be that they lacked two things: qualified collateral, and crops and livestock insurance. This makes production uncertain with low yield and low quality to the extent that these farmers received low prices for their farm produce.

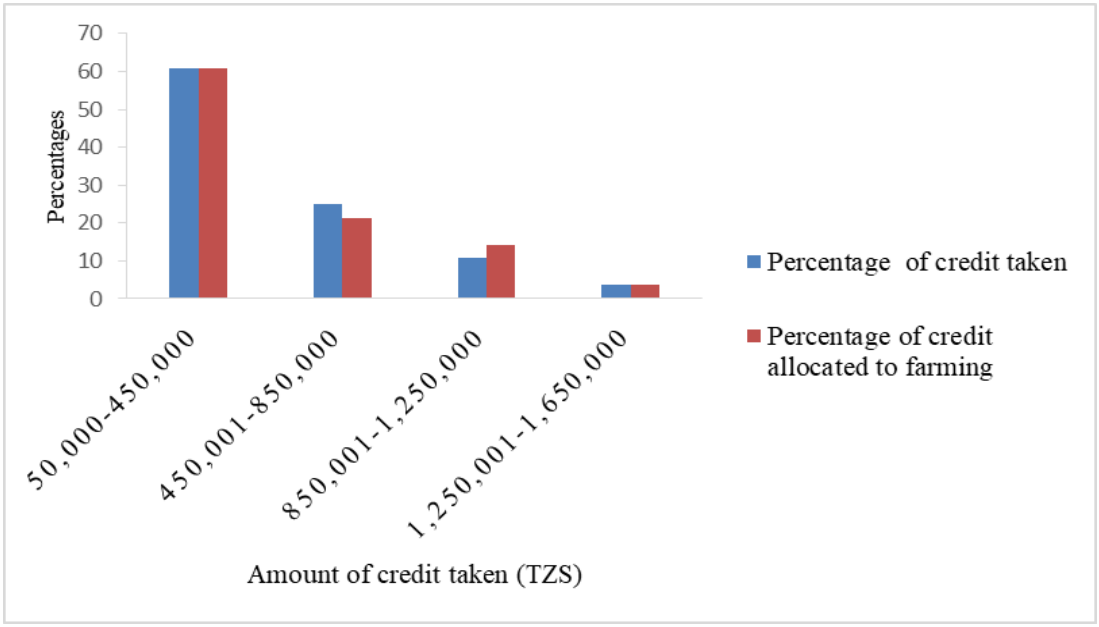

Figure 10: Proportion of credits allocated in farming.

The analysis found that access to credit led to high annual incomes from farming in all wards, except for Kisongo (Figure 11). The interview with the extension officer revealed that some farmers in Kisongo redirect the loans they get for farming to other activities such as personal or social reasons. Training on agricultural credit management might help those involved to use credits for its intended purpose.

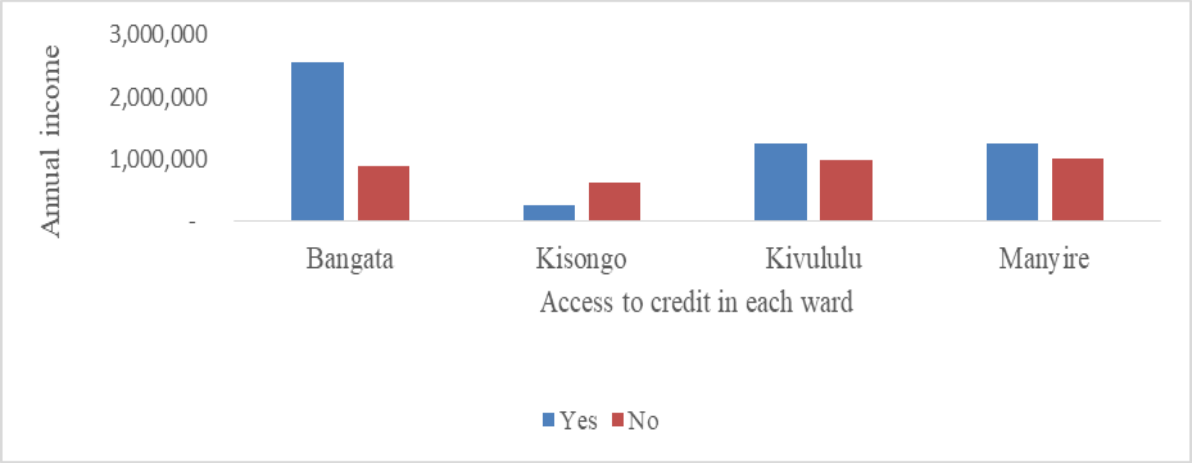

Figure 11: Access to credit vs annual income level from each ward.

Regarding services to improve infrastructure, about 35.6 per cent said, for example, that roads are poor and high transport costs per unit were high. In addition, because no storage facilities for post-harvest management was identified by this research, farmers suffer a high rate of post-harvest losses. If they are supported to increase production, farmers will be more able to afford social services because household income will increase. Food security is one of the highest livelihood outcomes in farming and 43.3 per cent of respondents acknowledge that peri-urban agriculture provides them with food throughout a year and 88 per cent show that it improves their nutrition. Indeed, 82 per cent of respondents said that they balance their diet using the income from peri-urban agriculture.

Some respondents do not have enough food to last until the next harvest. For example, 46.7 per cent of households had more than two months of food shortage. This can be attributed to farmers' experiencing low yield because they lack capital or enough credit to finance production. Improving peri-urban farming will reverse this situation as it will increase productivity. This is possible because 68 per cent of respondents have enough water for farming. One of the focus group participants said,

'*If peri-urban agriculture is supported by making inputs affordable as well as strengthening marketing linkages, then its contribution to food security will increase to nearly 100 per cent*'.

4.5. Livelihood capital, strategies and outcome

Farmers have different livelihood capital needs depending on what type of capital they already receive, and their type of farming systems and expected livelihood outcome.

Using a Spearman's rank-order correlation test, correlation coefficients (r) were calculated to measure how livelihood capital, strategies and livelihood outcome associate with each other. Based on the literature review, livelihood outcomes were food security and household income. Specific items were selected from each component of livelihood capital for analysis purposes as appears in table 1.

Table 1: Construct and livelihood capital items.

Livelihood capital (Constructs)	Items used to measure it
Human Capital	• Experience • Education level • Access to peri-urban agriculture training
Physical capital	• Infrastructure (in the form of roads, warehouses) • Access to market information • Technology (in form of farm equipment and processing facilities)
Financial capital	• Access to financial services • Amount of credit taken
Social capital	• Availability of farmer groups • Availability of farmer cooperatives
Natural capital	• Access to land ownership • Availability of adequate water • Ability of farmers to speak about natural resource management

4.5.1.Association between livelihood capitals

The results of the correlation analysis revealed that there is positive association between human capital and financial capital as well as human capital, natural resources and social capital (Figure 12). Specifically, these positive associations were evident across the variables; training on peri-urban agriculture and access to finance (r=0.205*); training on peri-urban agriculture and marketing infrastructure (r=0.369**); training on peri-urban agriculture and access to marketing information (r=0.261**); training on peri-urban agriculture and farmer groups (r=0.227*); training on peri-urban agriculture and farmers' cooperatives (r=0.214**) and ability to speak about natural resources and training on peri-urban agriculture (r=0.177*). Discussion with farmers acknowledged the importance and advantages of such training. They highlighted that these trainings give them knowledge and skills on how to access finance for farming, protect natural resources, increase productivity and storage facilities' usage.

Further, there is positive association between farmers' cooperatives and access to finance (r=0.336*); marketing infrastructure and marketing information (r=0.364*); and marketing infrastructure and farmers' cooperatives (r=0.243*). The availability of farmers' cooperatives improves access to finance and also improves marketing infrastructure. This is to say, social capital supports access to both financial and physical capital. Similar studies found that farmers use groups and cooperatives as a collateral to qualify for credits to increase agricultural productivity [1]. In addition, there is a positive association between access to marketing information and access to finance (r=0. 174*); and access to marketing information and production technology (r=0.354**); and production technology and training on peri-urban agriculture (r=0.393**). The in-depth discussions reveled that trained farmers have more ability to search for marketing information and they have more access to financial services. For example, this is evident by one of the comments made by a farmer from Bangata wards which indicate*; "I received training from FINCA on finance management for the farming couples and from there I easily accessed the credit from the same institution for my tomato and Irish potato production".* A study by [55] also have similar findings that availability of improved infrastructure increases productivity, reduces postharvest losses and increase household income.

Positive associations were also evident across farmers' groups and farmers' cooperatives (r=0.401*); farmers group and access land ownership (r=0.269**); farmers' cooperative and infrastructure (r=0.243**); farmers' cooperatives and land ownership (r=0.259*) and farmers' cooperatives and ability to speak about natural resource management (r=0.295*). Cooperatives bring farmers together and make it easy to provide trainings on good agricultural practices. A similar study done in Lesotho found that farmers' cooperatives are used as a vehicle and platform for delivering various training and gives a concerted effort in negotiating for financial services and improving marketing infrastructure [60]. Also, there is positive correlation between access to land and ability to speak about natural resource managements (r=0.566*) and access to land and adequate water availability (r=0.321*). Land and water form part of natural resources and sustainable land use allows its value to be relatively more appreciated and more production. Other studies show that farmers who care and value their land in most cases take care of natural resources as they support their agricultural production [31].

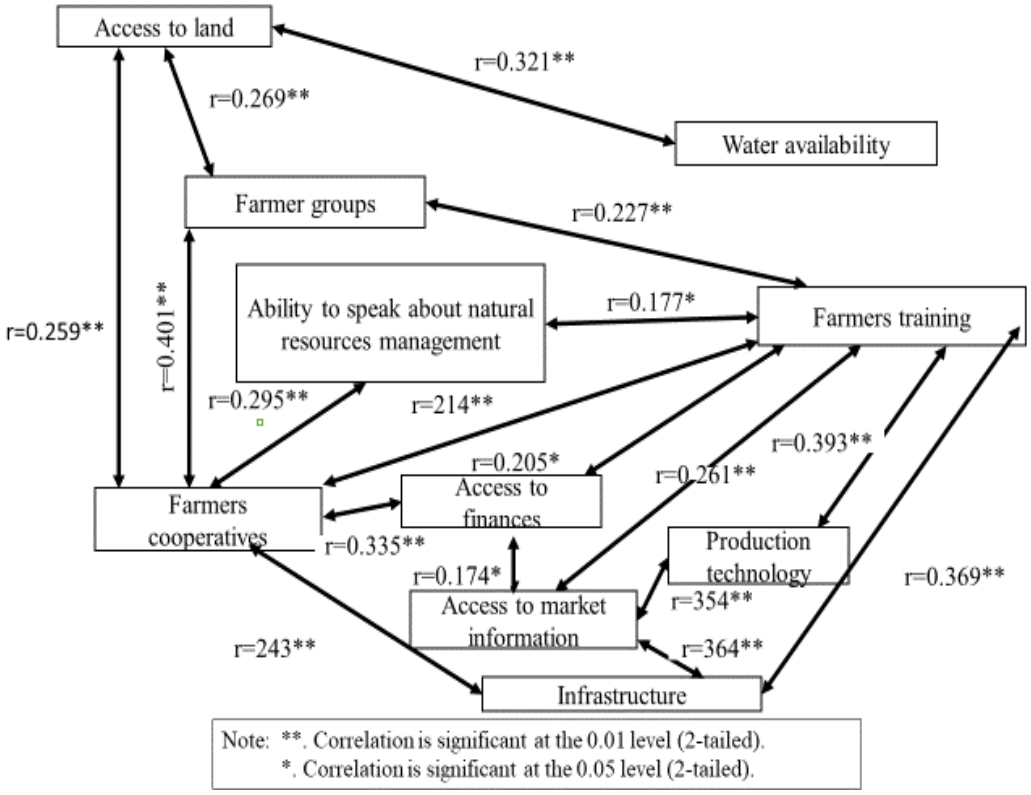

Figure 12: The relationship between livelihood capitals.

4.5.2. Association between livelihood capitals and food security

In human capital, training on peri-urban agriculture (r=0.262*) and education (r=0.271*) have positive association with food security. From this test, education and training on peri-urban agriculture influenced food security and any improvements in these items will lead to improvements in food security. From descriptive analysis, this study found that inadequate expertise leads to low yield and hence food insecurity. [63] also had similar results that human capital in peri-urban and rural agriculture requires more labor to produce enough food and be food secure. In physical capital, the analysis found a positive association between marketing information

(r=0.207*) and food security, marketing infrastructure (r=0.157**) and food security as well as farming technologies (r=0.151**) and food security. Regardless of this weak correlation, farmers participating in the focus group recommended on-time and adequate market information both for the product's inputs and outputs would improve their agriculture and hence food security. Farmers put less emphasis on infrastructure and technology, most likely because of inability to associate the effect of poor infrastructure and technology with low production. The focus group analysis identified that poor roads and a lack of storage facilities constrained peri-urban farming from being able to ensure food security. This is contrary to findings from other studies which found a strong association between household income and infrastructure as the later increases productivity and lowers postharvest loses [55].

The analysis found a positive association between food security with access to finance (r=0.171**) as well as amount of credit taken (r=0.292*). Descriptive analysis showed that more than 78 per cent of the credit accessed goes to peri-urban agriculture and that, the higher the credit, the higher the productivity in peri-urban agriculture. The analysis of social capital found association between farmer groups (r=0.207*) and food security. Regardless of this weak correlation, farmer producer groups were identified in FGD as a key to have a concerted effort in peri-urban agriculture. Farmers acknowledged that being associated with these groups helps in accessing credit and in bargaining for their farm output. Farmers in groups were found to be relatively more food secure than those that were not in these groups. A study by [11] had the same findings that farmer groups and cooperatives helps to increase production and become food secure. Finally, for natural capital, having access to land ownership (r=0.043**), being able to speak about natural resource management (r=0.029**), and having adequate water for farming (r=0.139*) items, were found in the analysis to weakly correlate with food security. This might be attributed to each ward having different livelihood capital priorities and challenges. Access to land and adequate water availability improves peri-urban agriculture and hence food security similar to the findings by [29] that access to land ownership is key to food security.

When correlation analysis was carried out in segregated data by wards, the forms of livelihood capital required in different wards varied in that some correlated moderately and some strongly. For example, farmers from Bangata ward put more importance on human capital (education, r=0.453*) which correlates moderately. They also need more financial capital (amount of credit taken, r=0.885*) which correlates strongly. This means that the higher the credit amount that each farmer has accessed, and the higher the education level that each respondent has reached, the greater the food security will be in Bangata ward. Both natural and physical capital were less important to farmers from Bangata ward. In Kisongo ward, farmers need more financial capital (access to finance (r=0.435*), and physical capital (marketing infrastructure (r=0.520**). When interviewed, the extension officer recommended improving these forms of livelihood capitals which include feeder roads, storage facilities, and access to finance for Kisongo ward farmers. Other studied show that some farmers put more importance in financial capital to improve agricultural production [8].

In Kivululu ward, farmers placed more value on human capital (education (r=0.271*) and peri-urban farming training (r=0.262**), financial capital (amount of credit accessed (r=0.292*), and social capital (farmers group (r=0.207*) which are all positive. All items are weakly correlated with food security. This ward grows horticultural crops that require large financial capital and human capital to produce. Also, because this

horticulture requires a collective effort to transport and market their produce, these farmers understandably priorities human, finance and the social forms of capital. Physical capital was less important probably because most farmers from Kivululu ward sell their horticultural produce at a farm gate price, which does not require them to have storage facilities. This might also be interpreted that they are unaware that storage facilities importantly increase shelf life, reduce post-harvest losses, and produce better output prices.

The analysis in Manyire ward showed that farmers regard human and natural capital to be more important including education level (r=0.215*), marketing infrastructure (r=0.184*) and land ownership (r=0.221**). Manyire ward has the highest population among the four wards that participated in this study and therefore, the natural, human and physical components of livelihood capital were shown to be of most important to farmers in their peri-urban farming. Discussion with farmers found that, the greater the land ownership, the larger the yield and the more food secure farmers will feel. Farmers also need peri-urban farming training to have adequate expertise in peri-urban agriculture and improved roads for transporting their crops to markets. A similar result from a study is South Sudan were reported by [49] that farmers differ in the livelihood capitals requirements.

Note: **. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.5.3. Association between livelihood capitals and household income

The same livelihood capital items as in food security were used to measure the extent that livelihood capital correlates livelihood outcome (i.e., household income). For human capital, training on peri-urban agriculture (r=0.247**) and education level (r=0.250**) were found to have a positive association with household income. As with food security, the higher the education level then the better peri-urban farming training was, the increase in the household income, keeping other factors constant. For financial livelihood capital, the amount of credit accessed (r=0.427*) correlated moderately with household income. Farmers who borrow a lot of credit acknowledged having more household income and that the reverse is true.

Further, natural livelihood capital: access to land ownership (r=0.251**), adequate water availability (r=0.323**) and ability to speak about natural resource management (r=0.360**) were found to correlate positively with household income. Farmers with relatively big land ownership have the chance to earn more income than those with small areas of land. Also, availability of adequate water for farming and a continual water supply were identified by farmers as the key to determining the extent of crop production. My research found that farmers with adequate water for farming are able to produce more and hence more to sell than farmers with inadequate water. Finally, farmers able to protect natural resources including water shades had more for farming than those with no such protection.

Farmers' cooperatives were found to be correlated (r=0.236**) with household income. The main role of these cooperatives is to unite farmers and have the institutional authority to oversee commercial farming. Cooperatives help to organise training for farmers to ensure quality produce and organise markets and marketing links. Though I was able to identify no single cooperative in the study area, farmers acknowledged that their

presence would benefit their peri-urban farming. Both infrastructure (r=0.233*) and farm technology (r=0.357**) were found to associate with household income. Farmers linked the presence of improved infrastructure and farming technology to high productivity, low post- harvest losses, and high household income. Findings from this research revealed that the components of livelihood capital vary among wards to the extent that some did not correlate and were not significant in some wards. This may thus be interpreted that different wards require different forms of livelihood capital. For example, education level associated moderately with household income in Kivululu (r=0.540*), although not significantly in the other wards (Figure 13). Further, marketing infrastructure associated moderately with household income in Bangata ward (r=0.445**) as well as improved technology associated moderately with household income (r=0.380*). This accords with the findings from the focus group where Bangata farmers recommended that seeds, roads, access to affordable credit, and on-time market information need improving so that they can increase their household income and food security. Also, access to finance was found to moderately associate with household income in Manyire ward (r=0.540*), while the amount of credit accessed was found to strongly associate with household income in Bangata ward (r=0.953**) and in Manyire ward (r=0.540**). Bangata ward has access to financial services from Foundation for International Community Assistance and Vision Fund institutions and use it in improving their production. Finally, enough available water for farming associated strongly with household income in Kisongo ward (r=0.637*) and moderately in Kivululu ward (r=0.429**). The strength of association shows that water availability in both would increase productivity and hence farmers' income.

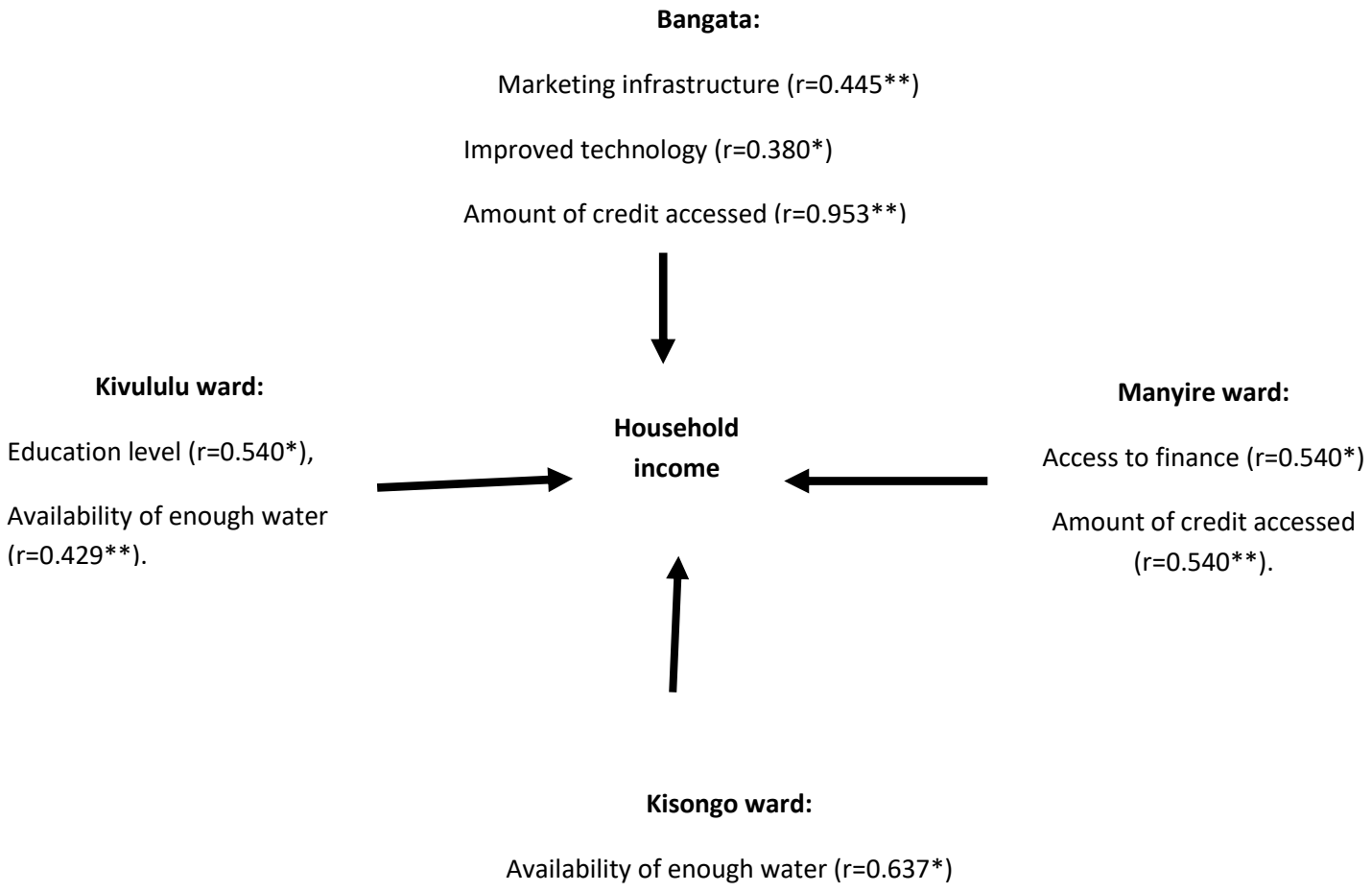

Figure 13: Capita needs in different wards.

Note: **. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5. Recommendations and conclusion

In the study area, peri-urban agriculture contributes to both improved food security and is the main source of farmers' income. Although farmers commonly said that farming experience ensures that expertise is attained, my research shows that, regardless of farmers averaging 18 years of experience, this applies to only 48.7 per cent of them. Having such expertise in peri-urban agriculture helps farmers afford their children's school fees and health services and ensures that they have food security until the next harvest. However, peri-urban farmers are challenged when beset with inadequate capital and post-harvest training and facilities, crop and livestock disease, poor marketing infrastructure, and poorly linked and uncoordinated value chains.

More training is needed to increase the number of farmers with adequate expertise for peri-urban agriculture and practical and clerical know-how for farm and credit management. The Tanzanian government should develop agricultural policies that are specific to peri-urban agriculture to guide and maximise their impact on both food security and household income. Further, both government and others involved should collaborate to improve agriculture infrastructure to avoid high transport costs and post-harvest losses. To have adequate water, this report recommends that farmers be given access to rainwater harvesting technology, dams, and underground water tanks. Finally, the government should collaborate with private sectors to develop farming cooperatives that support farmers' access to crop insurance and to services that financially support production and subsidise farm management so that the majority of farmers can flourish.

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