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Flowers in the dark: The contribution of rooftop urban agriculture to human well-being in the Ein El-Hilweh Refugee Camp, Lebanon

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ABSTRACT

Securing the livelihoods of disadvantaged social groups such as refugees is a decisive part of sustainable development globally. In Lebanon, Palestinian and Syrian-Palestinian refugees are marginalized groups facing aggravating hardships in the light of the country's rising economic and political crises. Urban agriculture has become an increasingly popular tool for city residents to counteract economic instability and secure their livelihoods. This study explores the intersection between refugees in protracted displacement, urban agriculture, and sustainable livelihoods by analyzing the livelihood effects of rooftop urban agriculture for Palestinian women in Ein El-Hilweh, Lebanon's largest refugee camp. To this end, we applied a mixed-method approach combining a document analysis and a survey of ten female participants of an urban agricultural project in Ein El-Hilweh Camp, Lebanon. We analyzed data by an adapted Sustainable Livelihoods Framework. Our findings suggest that rooftop urban agriculture as an informal bottom-up strategy that contributes considerably to more sustainable livelihoods of Palestinian women and their families in the refugee camp by enabling them to develop natural and human capital as the basis for increasing their food security while protecting natural resources. Rooftop urban agriculture thus is a low-threshold tool for refugees in protracted displacement that enhances their well-being over the medium term. By providing novel data on the livelihoods of Palestinian urban gardeners in Lebanon, this study closes an empirical gap and offers entry points for further research. If scaled up, the initiative could catalyze social improvement in other protracted refugee situations in the Middle East and elsewhere.

1. Introduction

In 2007, the worldwide number of people living in cities exceeded the number of people living in rural areas [1]. Since the driving force of global urbanization is urban growth in developing countries, these countries are critical in catalyzing sustainability problems [2]. Cities, with their oftentimes non-sustainable production and consumption patterns, outsource their resource demands to external territories, thereby establishing globalized processes that overstrain biogeochemical cycles and drive global environmental change [3]. Cities thus reinforce climate change, air and water pollution, intensified land use, and the accumulation of solid wastes [4]. Adverse effects of environmental pollution on human well-being are carried disproportionately by poorer members of society, leading to environmental and social equity concerns [5]. Since poverty is closely linked to food insecurity, poor urban dwellers face challenges accessing high-quality, diverse, and safe food and are at risk of suffering diet-related health problems [6]. Urban poverty is in turn linked to displacement due to host governments' policies to deny refugees equal access to rights, resources, and services [7]. When exile prolongs, the risk is that the refugees' marginalization becomes a persistent condition [8].

One of the world's most protracted refugee crises, with no solution after over 70 years, is the Palestinian diaspora. It dates to the expulsion of Palestine's Arab population by Jewish militia throughout the 20th century in order to establish and expand the state of Israel [9]. Back in 1948, the United Nations General Assembly adopted resolution 194 that recognized the Palestinian refugees' right to return to their homes, which was supposed to be enforced by the United Nations Conciliation Commission for Palestine (UNCCP). Three developments then led to the so-called "protection gap" in the legal enforcement of Palestinian human and refugee rights ([10], p. 43). Firstly, the vanishing of the UNCCP as it could not protect Palestinian refugees' right of return against Israeli occupation [11]. Secondly, the ineligibility of the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) to take on UNCCP's protection function due to its restricted assistance mandate of solely providing temporary relief. Thirdly, an exclusion clause in the 1951 Refugee Convention and Protocol prohibited the United Nations High Commissioner for Refugees (UNHCR), which

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was normally responsible for refugees' rights protection, from doing the same for Palestinian refugees in UNRWA areas [10].

Fostering the well-being of disadvantaged and marginalized groups like refugees is vital to encourage the sustainable development of cities [12]. One component of sustainable urban development is urban agriculture (UA) which can be defined as the cultivation, processing, and distribution of food and non-food products in urban or peri-urban areas (Mougeot, [13]). Thereby, the local area is both the source of the used material resources and the destination of supply. It includes components beyond mere food production, like waste recycling and reuse [14]. By shortening food supply chains, reducing greenhouse gas emissions and making land and water use more efficient, UA as part of a locally oriented food system can help mitigate global warming and reduce environmental pollution [15]. Next to environmental benefits, UA has proven to enhance the social inclusion of disadvantaged groups and to increase food security [16]. Food security can be defined as the condition "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" ([17], p.50). There are four dimensions inherent to achieving food security: Firstly, economic and physical access to food, secondly, the availability of food, thirdly, the utilization of food referring to nutritional and practical knowledge about food preparation and cultivation, and fourthly, the dimensions' stability over time [17]. When income and livelihoods are as directly linked to food security as in the case of poor urban populations, UA serves as a crucial survival strategy to improve their livelihoods [18]. Chambers & Conway (1992) define livelihood as "the means of gaining a living, including livelihood capabilities, tangible assets, and intangible assets" (p. 9). A livelihood is considered sustainable "when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base" ([19], p. 5). Having a secure and controllable dietary diversity and calorie availability becomes even more important for the urban poor, especially children and women of reproductive age, when economic crises lead to an additional increase of food insecurity [20]. An evolving trend for rooftop urban agriculture (RUA) can be observed particularly in Palestinian refugee camps in the Middle East: In the West Bank, there are RUA initiatives by Karama in Dheisheh Camp, by Refutrees/Lajee in Aida Camp and by GIZ/FCYC in Fawwar Camp. In Gaza, there are projects by Global Communities in Gaza City and by Anera in Deir El-Balah as well as Beit Lahia. In Lebanon, a small RUA project by Anera can be found in Nahr El-Bared Camp as well as a project in Bourj Hammoud, and the here researched project by Nashet in Ein El-Hilweh Camp. In Iraq and Jordan, there are two UA projects for Syrian refugees located in Domiz Camp and Azraq Camp [21]. This study aims to answer the research question of how RUA can contribute to the formation of sustainable livelihoods in the Palestinian refugee community of Ein El-Hilweh Camp in Lebanon.

2. Palestinian livelihoods in Lebanon

2.1. Livelihood context and landscape

In Lebanon, the mentioned protection gap is apparent since the state has institutionalized legal discrimination against Palestinians and has denied them civil rights to prevent their naturalization in the country [22]. Even though the vast majority of Palestinians in Lebanon were already born in the country, they are still legally referred to as stateless foreigners [23]. The exact number of Palestinian and Syrian-Palestinian refugees in the country is unclear, but it is estimated to amount to 270000 [24]. The marginalization of Palestinians in Lebanon is apparent in spatial, institutional, and economic dimensions: they are confined to camps, face massive employment restrictions, and are excluded from public institutions of social life, legal rights, and protection [25]. Hanafi et al. [26] point out that particularly the spatial separation into urban slum-like areas and being discriminated against in the labor market cause the endemic poverty of the Palestinian refugee communities in Lebanon. The survey on the socioeconomic status of Palestinian refugees in Lebanon by Chaaban et al. [24] found that around 65% of the Palestinian and 89% of the Syrian-Palestinian refugees live in poverty with rates even higher in the camps, and that 62% of the Palestinian and around 95% of the Syrian-Palestinian refugees are moderately to severely food insecure. Unemployment rates are high, particularly for women and camp inhabitants, and the vast majority of working Palestinians work in low-skilled and low-paid work without contracts, work permits and social security. UNRWA is still the main provider of education and health services for Palestinians in Lebanon [27]. However, in 2020, UNRWA ran out of money [28]. There are 12 official refugee camps in Lebanon with Ein El-Hilweh Camp in the city of Saida as its largest where around 80000 people are living in a highly crowded area of 1.5 square kilometers. The camps are lacking adequate sanitary infrastructure and functioning public services (UN [29]). These quasi-sovereign "spaces of exception" arose from state absence and abandonment and are characterized by insecurity, militant mobilization, and armed struggle ([30], p. 33). Inside the camps, popular committees operate as semi-official organizations to manage municipal and security functions, but their effectiveness is constrained by a lack of resources, absence of elections, and inter-factional conflicts [31]. The recurring periods of armed conflicts threaten the camp inhabitants' security and come along with their constant exposure to violence, the closure of necessary facilities and services, and government restrictions on their freedom of movement (UN [29]). Being both confined to those spaces and dependent on humanitarian aid leads to an abandonment of social responsibilities and creates asymmetric, disempowering power dynamics [32]. Next to domestic violence, women and young girls may experience sexual assault or harassment in the camps' public sphere, leading to their reluctance to leave the house [33]. It can be summarized that the situation of Palestinians in Lebanon is characterized by an imposed lack of self-reliance meaning the social and economic ability to meet their essential needs is low while their vulnerability and reliance on humanitarian assistance is high [34].

Lebanon's current crises exacerbate this situation: the formation and collapse of two governments within 2019, high state indebtedness and economic crises resulting in a rapid currency devaluation and increasing prices, and anti-austerity protests. The COVID-19 pandemic in 2019 caused the quick spreading of the Coronavirus in the overcrowded Palestinian camps lacking medical and sanitary services paired with income and job losses. Apart from that, the 2020 explosion of ammonium nitrate in Beirut's port led to the death, injury and homelessness of thousands of people [35]. Those multiple shocks with the financial crisis at the forefront have led to increased prices of agricultural products and a reduced overall food availability in Lebanon. Due to limited crop land and water resources, the country's food supply is highly based on food imports which in the beginning of 2020 dropped by around 14%. In addition, the Beirut port explosion destroyed parts of the infrastructure for food quality control, e.g., laboratories analyzing the quality of imported wheat, and impacted small-scale fishery through fish mortality triggered by the blast. Most Lebanese households recorded inflation-caused income drops and dept occurrence with food purchase being the main cause for dept. Price inflation of the eight items of the Survival Minimum Expenditure Basket amounted to 183%. The number of food insecure households in Lebanon doubled compared to the time period from 2014 – 2018, reaching around 60%. Half of the questioned households ate less than two meals per day and most left out meals to spare foods [36]. Vulnerable households like refugees who are strongly affected by financial instability have now such low food consumption that they cannot meet their basic needs and experience the impacts of malnutrition. When looking at the already alarming food insecurity rates of 62% to 95% amongst Palestinian and Syrian-Palestinians that were reached even before the wave of the country's recent crises hit, it is clear that their livelihoods are de facto threatened.

2.2. Rooftop urban agriculture in Ein El-Hilweh camp

The RUA project in Ein El-Hilweh was established in 2018 as a pilot project by the non-governmental organization (NGO) Nashet. Today, 53 greenhouses are installed on the flat rooftops of the participants' multi-story houses. The target group are women from low-income families from Ein El-Hilweh interested in gardening and willing to be long-term committed to the program. Each greenhouse is made of a nylon-metal construction that accommodates seven tubes with eight to ten seedling spots connected to a water tank and drip irrigation system. The used seeds are native, non-genetically modified species, and no pesticides and chemical fertilizers are used for cultivation. The approximate amount of vegetables produced per garden per year is around 450 kg within three harvest periods. In the first project stage, the women participate in weekly training sessions that focus on basic information on the greenhouse, plant cultivation, and pest treatment. The project is supervised by an environmental engineer and project coordinators who carry out regular home visits. The RUA project is connected to the women's initiative and food production facility Zewedetna, founded in 2016 by Nashet. It employs Palestinian and Syrian refugee women from Ein El-Hilweh Camp and has seven full-time and 50 part-time employees. The initiative located outside the camp buys off the raw vegetables and fruits from the gardeners and processes them into value-added products, e.g., fruit preserves and spreads. These products are then sold at farmers' markets like the Souk El-Tayeb market in Beirut and to organizations like Fairtrade Lebanon. Next to the production of preserves, the initiative serves as a bakery and a canteen. With the breakout of the COVID-19 crisis, an emergency food supply was organized for Ein El-Hilweh Camp residents. The Bethlehem-based NGO Karama assisted Nashet during the implementation since it conducts a similar project in a Palestinian refugee camp in Bethlehem. The main funding partner of the RUA project is the German aid and human rights organization Medico International which has cooperated with Nashet since 2007 and funded 48 of the greenhouses. 70 more rooftop gardens are planned to be built in Ein El-Hilweh in the coming years. A composting plant was installed in 2021 as well. As far as known, there has been one other empirically researched UA project addressing refugees in Lebanon in the past. The project was located in Bourj Hammoud, a Lebanese community close to Beirut. It distributed planting kits for rooftop and balcony cultivation to low-income Lebanese and Syrian refugee families. Dehnavi & Süß [37] found that the project effects were limited since the participants lacked water access and financial means to provide gardening inputs. Outputs specifically from balcony cultivation were low, so was the participants' commitment [37].

3. Methods

3.1. Mixed-method approach

A mixed-method approach with a convergent parallel design was chosen. Therefore, empirical research was combined with qualitative document analysis. The qualitative document analysis included two project reports from the executing NGO and two Youtube videos from the project's partner organization, displaying the practices of two participants (videos A and B). Empirical research was conducted in the form of written questionnaires that were distributed amongst RUA project participants in Ein El-Hilweh via one of the project coordinators. The questionnaire incorporated qualitative and quantitative questions. Question formulation was informed by the Sustainable Livelihoods Framework (SLF) which served as the deductive research basis. The questionnaire was designed in accordance with Leuphana University´s official guidelines for good scientific practice, verified formally and content-wise by the project lead and pre-tested with two peers. It was then translated into Arabic and later retranslated by a native speaker and corrected by another native speaker who received both the original questionnaire and the first translation. This non-probability convenience sampling produced a sample of 10 from a total of 53 RUA project participants from Ein El-Hilweh Camp which equals around 19% of the target population of gardeners. Nine of them are Palestinian refugees from Lebanon, and one is a Syrian-Palestinian refugee. Surveys were conducted after we acquired an interviewee's consent and explained the purpose of the study. Results from both qualitative and quantitative research were first described and then triangulated. Quantitative questionnaire elements were evaluated statistically, mainly in terms of relative and absolute frequency comparisons. Qualitative parts of the questionnaire, the project reports, and the video transcripts were assessed through a deductive content analysis after Mayring [38], again using the SLF as the theoretical base.

3.2. Sustainable livelihoods framework

We adapted the Sustainable Livelihoods Framework in this research to categorize the qualitative and quantitative data. The SLF is a people-centered, responsive, and multi-level approach to analyzing people's livelihoods, emphasizing poverty elimination [39]. The approach helps to explore linkages between different dimensions that influence livelihoods on a micro-, meso- and macro-level [40]. It combines the internal perspective of people as active agents who can initiate and sustain positive transformation with the external structures that shape and limit such opportunities [41]. The asset base comprises human, social, natural, financial, and physical capital. It is incorporated into people's strategies in the form of choices and activities they pursue to achieve positive livelihood outcomes, which again influence the capital assets [42]. Human capital is deemed the foundation of the framework since it often is the basis for developing other capital assets [43]. People's access to assets is affected by the surrounding livelihood context.It includes the government, private sector, organizational and societal structures as well as laws, policies and culture [39]. It further comprises shocks and critical trends like conflicts, illnesses, environmental crises, and economic developments that can affect a specific group and lead to their vulnerability due to lacking means to cope with these [44]. Altogether the structural context has the potential to either limit or encourage the formation of communities' livelihoods. Natarajan et al. [45] identified some shortcomings of the original SLF including the lack of theoretical grounding, the higher weighting of people's actions instead of structural causes, the neglect of historic aspects in livelihood development and the rather unpolitical approach. The challenges are addressed by using the adapted framework as presented and by emphasizing how Palestinian livelihoods in Lebanon have formed over time within broader political, economic and cultural circumstances. After having looked closely at the macro-level in *Section 2.1 Livelihood context and landscape*, the livelihood strategies and outcomes on the individual level were empirically investigated.

4. Results

4.1. Livelihood strategies

RUA serves as a livelihood strategy for the participating camp residents to improve different areas of their life (Fig. 1). Firstly, the organizational goals of Nashet, as stated in the project reports, are described. Secondly, the individual motives of the participants are looked at to understand their strategies. One main project objective of Nashet is to reach food security of underprivileged, low-income refugee women and their families by establishing self-sufficient access to organic food, decreasing dependency on external assistance. Providing the physical infrastructure and cultivation of knowledge through workshops are means to reach that goal. It further aims to foster women's mental health and personal development within a safe outdoor learning environment. Another goal stated by the organization is to improve the communication and interaction in the household between the participants' family members. In a broader sense, it aims to create jobs for the unemployed and

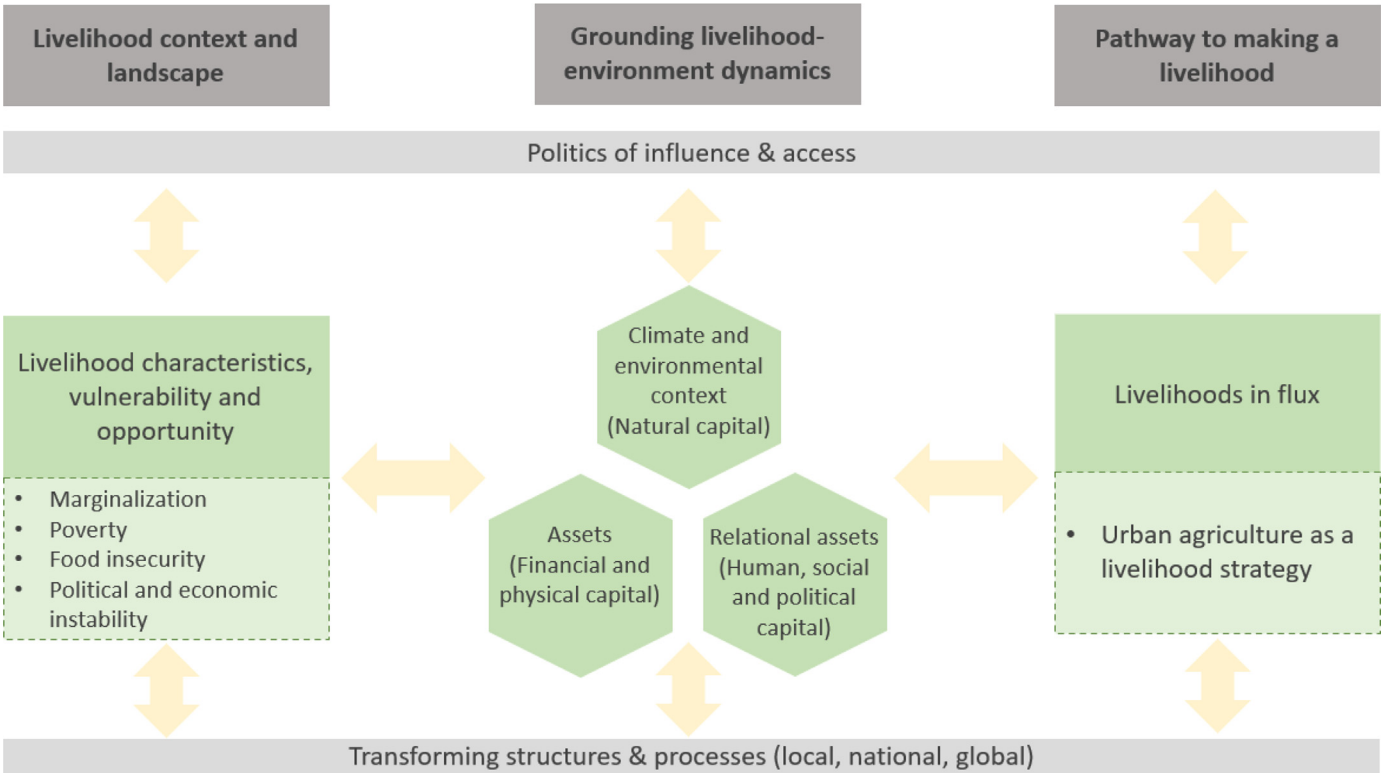

Fig. 1. Sustainable Livelihoods Framework. Adapted from Natarajan et al. [45].

a women-led production business that supplies local markets with high-quality food. When asked individually about the motives for applying for a greenhouse, the questioned women stated various reasons. Most noted that it was a means to pursue their gardening interests as a hobby. Another goal for most women was to reach food self-sufficiency, particularly to become independent from the current economic crisis and increased vegetable market prices. Half of the women intended to improve their health and nutrition by establishing access to organic vegetables. To smaller shares, reaching psychological relief and financial improvement were named as goals.

4.2. Capital assets

4.2.1. Natural capital

All questioned women stated that there are no natural spaces like forests or parks in their area accessible to them. Asked about the advantages of the RUA project, 90% of the participants found their access to healthy and nutritious food improved. Again 90% of the questioned women reported that their relationship with nature strengthened since having a garden. In addition, 80% named the joy in gardening as one major benefit. Program participant from video B points out that she enjoys watching the plants grow and spending time in the green space. Descriptions from project reports and video B specify the organic farming practices, including not using synthetic fertilizers, pesticides, or herbicides. The program participant also emphasized the value of now being able to eat untreated organic vegetables she has cultivated herself. She grew paprika, cucumber, eggplant, tomatoes and supplied her own direct family and the families living in her house.

4.2.2. Human capital

The diet of 80% of the interviewed women became significantly healthier and more nutritious since they started gardening. Increased physical activity was pointed out as a health advantage by most, while one woman stated that the gardening work posed a physical burden. 90% of the surveyed women described their project participation as a major change in their lives. All described changes were located in the field of human capital. Of those who specified on that change, three women found their mental health improved. Two referred to new learning experiences and realizing their gardening passion, and two others pointed out their ability to grow vegetables all year round. All questioned women could build up new skills since starting with the RUA activity and the vast majority of women rated this skill-building as an important project benefit. Asked about problems that occurred, a challenge for many women initially was a lack of plant cultivation experience and knowledge, especially when it came to pest management. When asked about the type of skills they acquired, all stated having now developed cultivation skills, e.g., irrigation, fertilization, and cutting. Both women from videos A and B mentioned that they were able to put their gardening interests into practice, which is also the case for most of the questioned women who named their gardening interests as a participation intention. These results suggest positive effects on the women's personal development since they could both realize a hobby and learn new skills. 80% reported that their mental health benefitted from the gardening activity. All women associate positive emotions with gardening, with the highest values for happiness and hope, followed by satisfaction and attachment. The gardening activity significantly helped 60% and slightly helped 40% of the women cope with external crises. It is noteworthy that the women who gained distance from external stresses through gardening were the same women who cited joy in gardening and the connection to nature as the program's benefits. Also, the program participant from video A stated that she experienced happiness, psychological balance, and distance from camp pressure when spending time in the greenhouse. The participant from video B also derived pleasure and psychological relief from both the activity and just sitting in the green space.

4.2.3. Social capital

All women have established new contacts within the Palestinian community in Ein El-Hilweh through being part of the RUA project. Two women had connections to Palestinians from outside the camp,

Lebanese, and international people as well. 90% of the women used their new contact network for exchanging and receiving gardening assistance and advice. The participant of video B reported that the gardeners share information on plant cultivation, pest control, and improvement options. Seven women reported having joint activities with the group, while three women also have established personal relationships and friendships within the group. Five women meet the others monthly, while the other five have different meeting frequencies. If a harvest surplus is reached, consumer contacts take place mainly with women from the Zewedetna initiative. Family involvement in agricultural work strongly varies from regular support through husband and children to little or no support. Those family members involved help with irrigation, fertilization, and heavy work like repotting and carrying materials.

4.2.4. Financial capital

Eight of the ten questioned women are unemployed and thus have no income. The vast majority are married, with four having to provide for children. Project participant from video A stated that most of the women's husbands are unemployed as well, and the project coordinator pointed out the same issue. 60% said that participating in the RUA project has significantly contributed to their economic situation. Both videos A and B participants emphasized that the RUA project and the connected women's initiative Zewedetna create job opportunities. Only 40% named improved financial security through the RUA project as a project benefit. 60% of the women who produced more than their subsistence needs sold their vegetables and fruits to the women's cooperative. Half of the questioned women could save money through their gardening activity. The participant of video B explained that financial savings through agricultural activity mainly stem from replacing purchased food with their own harvest and a smaller share from selling the harvest surplus as an income.

4.2.5. Physical capital

The participant from video A points out her greenhouse as an important physical infrastructure that makes cultivation possible and enables her to plant three seasons instead of two. When asked about tools needed for gardening, 90% of the women said they do not have sufficient equipment to continue independently with the gardening activity. One participant stated that getting soil and gardening tools like barrels was a challenge for her. Two of the five women who could afford new things through the RUA project reinvested the new financial resources into buying agricultural equipment like barrels, soil, plants, and other materials. The other three purchased household items and food with the saved money.

4.3. Livelihood outcomes

The results suggest improvements in the nutritional health and the food security of gardeners and their families through natural resource use. After the FAO [17] definition, food security is achieved when availability, access, and food utilization are ensured and stable over time. Firstly, the availability of organic vegetables for the women and their relatives is enabled through feasible vegetable cultivation during three seasons. Secondly, the household's access to food is steadied through the heightened food self-sufficiency and control over the food supply. That decouples them to a certain degree from economic obstacles to food access like financial constraints and economic crises, including increased food prices. Thirdly, the women obtained cultivation skills through which they were able to utilize food. The stability of food availability and access is largely reached as cultivation is made possible during most of the year. Stability of food utilization is achieved since the women have acquired cultivation knowledge persistently. In addition, food utilization is continuously further developed through the gardener network that serves as a platform for exchanging advice and expertise, and skill-building workshops by Nashet. Therefore, one essential livelihood outcome of the RUA project is improved food security for the gardeners and their families in Ein El-Hilweh Camp. Another main livelihood outcome is the improvement of the gardener's resilience on two levels. Firstly, the gardening activity contributes to their mental resilience by fostering positive emotional states and serving as a means to deal with outside crises. Secondly, through enhanced food self-sufficiency, they are less dependent on changes in the food market. Both are expressions of greater independence and could be indicators for reductions in the refugees' vulnerability to external events.

5. Discussion

5.1. Integration of results

Through the interconnectedness of vegetable cultivation and food production facility, the project in its design and implementation covers almost all crucial components of UA, including the production, processing, and distribution of food to the urban area of Ein El-Hilweh Camp and surroundings. By favouring female Palestinian and Syrian-Palestinian refugees from the camp through the project design (selection criteria, opportunity to work from home), the initiative empowers one of the most vulnerable groups in Lebanese society. For the participating camp residents, involvement in RUA served as a strategy to put their gardening interests into practice, improve their health and nutrition through access to organic vegetables, and reach food self-sufficiency in the face of current economic hardships. Therefore, it was a means to, largely informally, improve their livelihoods within an extremely restraining environment that formally hinders them from social and economic improvement. Through RUA, the women built up various capital assets. The development of natural capital, particularly the productive use of land and recreational aspects of nature, was the basis for extending other assets. The advancement of human capital was the most distinctive, encompassing personal development and improvements in mental health and nutrition. Social capital was built in terms of establishing new contacts and an informal gardener assistance network. RUA enabled savings in the food purchase and partly contributed to direct financial resources like income. One crucial gain in physical capital was the greenhouse infrastructure. In addition, financial savings or income were invested into physical capital like household necessities and equipment. The development of these capital assets was closely linked to the observed livelihood outcomes, namely food security and resilience. Those livelihood outcomes, to some extent, expand to the women's direct families, e.g., when they are in the same household and benefit from the improvements in food security. This is a decisive outcome since most of the Palestinian population in Lebanon suffers from food insecurity, with refugee camp residents in particular [24].

For UA to support sustainable livelihoods, it must address three conditions: the ability to cope and recover from stresses and shocks, the development of assets, and the preservation of the natural resource base [19]. This research found that the RUA project in Ein El-Hilweh Camp addresses, to varying degrees, all these aspects. Distinct findings are in the development of assets with a particular enhancement of natural and human capital. The use of organic agricultural practices in existing urban spaces points to sustainable food production regarding its use of natural resources. Production and consumption in geographical terms move closer together, reducing transport distances. The land use for food production shifted from natural lands to spare urban spaces. Both reduced distances and reduced burdens on ecosystems are linked to the protection of natural resources. One observed factor that could indicate better coping abilities in the context of external shocks is the developed mental and food-access-related resilience. But since vulnerability is complex and was not the research focus, general statements on that cannot be made. Thus, it can be concluded that RUA largely contributes to forming more sustainable livelihoods for gardeners and their families in Ein El-Hilweh Refugee Camp. Supporting sustainable livelihoods of Palestinian refugees is indispensable since they are trapped in protracted displacement facing rights violations and discrimination in Lebanon for

an indefinite period. When host states impede refugee livelihoods' securement in a legal and economic sense, then alternative possibilities to improve their self-reliance become crucial. Local refugee-led organizations like Nashet constitute important entry points for them to become economically more self-reliant through entrepreneurial activities [34]. RUA certainly is a survival strategy that allows them to better their living conditions despite the restrictive environment they live in. These positive contributions and potentials should be recognized. However, the effects of informal strategies are somewhat limited and cannot be seen as a sole measure to improve the livelihoods of Palestinians in Lebanon. Structural and legal changes are needed to dissolve their refugee status permanently by means of the UN General Assembly's resolution 194.

5.2. Methodological reflections

The major methodological limitation was not being present at the research location due to the COVID-19 pandemic. The convenience sampling method via the project coordinator implied potential risks of influence by the coordinator, verbal exchange between participants, and social desirability of the answers. Social desirability can also be an issue for the document analysis since both the videos and the project reports are coming from the NGO or the partner organization itself. The sample of ten women, which equals around 19% of the gardener population, allows drawing some conclusions in quantitative terms, especially because the participants have similar attributes due to the selection procedure. Due to its high variance, though, it is not suitable for sophisticated statistical analysis. The lack of control through the researcher reduced the reliability of the results. Finally, it can be useful to conduct a more extensive quantitative study in the future, e.g., on food consumption amounts of gardeners and their household, harvest potentials, and the relations to food security. Follow-up studies in mixed-method or qualitative research could be useful as well, like conducting interviews with the women to find out more about their needs and limitations, e.g., if the activity is also associated with an extra work burden. Another important field would be explicitly studying the resilience and vulnerability reduction potentials of RUA for refugees in Lebanon.

5.3. Recommendations for practice

With its focus on female Palestinian refugees, the RUA initiative is unique in Lebanon and has multiple positive effects on women´s livelihoods. It is highly recommended to expand the project to more camp inhabitants and other camps by sharing knowledge and best practices with other NGOs. That way, RUA benefits may be multiplied to reach more Palestinian and Syrian-Palestinian refugees in Lebanon and beyond. Moreover, it may be applied to other protracted refugee situations as well. To foster environmental sustainability and protect the natural resource base, efforts to close biogeochemical cycles, e.g., through waste recycling, could be further emphasized. The installation of the composting plant was a crucial measure for that. A practice-related recommendation for ensuring the stability of food security over time is giving instructions on how to reconcile the fourth non-harvest season. One possible option would be increasing the added value of the harvest by home-based processing, preserving, or drying the vegetables and fruits for time-independent consumption or sale. To further reduce dependencies on the NGO and thus donations, all necessary physical resources like tools and infrastructure should be made available, and supply sources should be communicated to the women. That way, they could continue the gardening activity independently without external support in the long term, if they wanted to do so.

5.3.1. Guidelines for refugee-centered urban agricultural projects in the Middle East

The results suggest some indications for similar UA interventions in refugee camps in the Middle East that could help successful implementation.

1. *Establish a project design based on organic farming and closed material cycles.* Organic farming practices should be at the core of the intervention to enable a sustainable resource use and participants' long-term access to natural capital which is the cornerstone for developing other resources. Include circularity aspects by planning a shared or individual composting plant, by using and reusing locally available materials for the greenhouse construction and by enabling rainwater collection since drought and water scarcity will exacerbate with climate change.

2. *Prioritize women in protracted displacement as project participants.* People in protracted displacement often face an exceptionally long duration of stay paired with harsh living conditions that manifest through yearlong marginalization. In contrast to short-term refugees, they will have a constant accommodation available for farming practices. For women in particular, there may be few other options to actively improve their living situation and become economically self-reliant.

3. *Include participants' needs in the project design.* The needs of the participants must be analyzed and included in the program design, e.g., when directed to women, the intervention should consider their safety and vulnerability concerns like restrictions or hesitations to leave the house or the refugee camp. It should therefore be in a safe-to-reach place like the home or surrounding. Moreover, safe sales possibilities should be offered for selling the harvest, e.g., as done in this project via the women's cooperative.

4. *Use rooftops as a space.* Space is a scarce resource in refugee camps so that rooftops - which are common for Middle Eastern housing - are oftentimes the only available free spaces. By utilizing unused space, financial costs are saved and the further occupation of land is avoided. Consider sharing options for people who have no access to their own roof.

5. *Make nutritional and farming knowledge constantly available.* Food utilization is an easily forgotten but highly important dimension of food security that should be addressed. That includes knowledge on harvesting, ecology, waste recycling, composting, fertilization, nutrition etc. Different forms of knowledge transfer should be established like creating opportunities for gardeners to meet and exchange advice and by offering workshops with agricultural experts.

6. *Share best practices by linking the intervention to similar projects in the region.* With RUA being an increasingly observed trend in Palestinian refugee camps in the Middle East, mapping existing projects and creating a network between them can be a means to share knowledge and best practices, to save resources, overcome similar challenges collectively and centralize funding efforts.

6. Conclusion

Decades of marginalization have put the livelihoods of Palestinian refugees in Lebanon at risk. The restrictive, disempowering institutional context makes them extremely vulnerable and leaves few opportunities to improve their living conditions formally. For female inhabitants from Ein El-Hilweh Refugee Camp, who are one of the most vulnerable groups of Lebanese society, practicing rooftop urban agriculture is a means to impact their livelihoods informally. The access to natural capital in terms of productive and non-productive use of natural resources was the cornerstone for the gardeners to develop other assets. The greatest effects appeared in the field of human capital: Through being involved in rooftop urban agriculture, the women experienced improvements in their nutritional health, mental health, and personal development. In terms of social capital, they established a knowledge exchange network with other gardeners from the camp. Essential livelihood outcomes linked to the enhancement of assets were improved food security and resilience towards external crises. The local food supply created through rooftop urban agriculture addresses aspects of natural resource protection by supporting organic farming practices, efficient land use, and reduced food supply distances. Thus, it can be concluded that rooftop urban agriculture as a bottom-up strategy contributes considerably to the formation of more sustainable livelihoods for Palestinian

women and their families in Ein El-Hilweh Camp in Lebanon. Consequently, rooftop urban agriculture offers a particular opportunity for refugees in protracted displacement to mobilize agency and to actively transform their livelihoods and well-being during the indefinite period of their stay - for Palestinians usually a lifetime.

Declaration of Competing Interests

Dear editors and reviewers, We hereby declare that the submission of our article “Flowers in the dark: The contribution of rooftop urban agriculture to human well-being in the Ein El-Hilweh Refugee Camp, Lebanon” is free from any financial and personal conflicts of interest. We confirm the disclosure of relationships with people or organizations that could inappropriately influence (bias) our work.Sincerely yours, Anisja Tarchahani, Jacqueline Loos

CRediT authorship contribution statement

Anisja Tarchahani: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft. **Jacqueline Loos:** Supervision, Validation, Writing – review & editing.

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