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A Cropping System for Resource-Constrained Urban Agriculture: Lessons from Cape Town

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Received: 6 November 2018; Accepted: 11 December 2018; Published: 17 December 2018

Abstract: In Africa, many urban farmers apply cropping systems from rural backgrounds into their urban setting. This paper explores the possibility that "upgrading" cropping systems in African cities could boost economic empowerment for impoverished urban farmers. To these ends, the author conducted a case study of cropping systems in Cape Town, identifying the strengths and weaknesses of the predominant cropping system. Data collection consisted of in-depth interviews and focus-group discussions with a selection of 59 urban farmers as well as interviews with key informants from non-governmental organizations, and local government. The findings are interpreted using an asset-based community development lens, which suggests that local networks and locally sourced inputs, utensils, and infrastructure are fundamental to resilient urban agriculture in this context. A limitation of the case study method is in the generalisability of the findings to other contexts. This study may, however, be used as a guideline for conducting similar case studies in other contexts.

Keywords: urban agriculture; cropping systems; Cape Town; sustainable livelihoods

1. Introduction

Scholarship on urban agriculture originally attempted to identify good-practice case studies in indigenous cropping systems, and to adapt such systems to the urban context [1]. The key attributes of cropping systems in these case studies were a high density of diverse crop types year-round and a low reliance on external inputs [1]. Emerging at a time when the concept of food security was a key focus of development studies, urban agriculture's benefits in this regard were somewhat inflated in publications of the time [2]. Central to disagreements over urban agriculture's potential for supporting sustainable livelihoods are the breadth of practices that may be included within the term "urban agriculture".

Urban agriculture is an extremely broad term. The variety of scales of operation, agricultural principles and cropping systems are so diverse that to apply a blanket statement about "urban agriculture"—for example that it may or may not provide food security—is ill advised. It is, however, useful to adapt urban agriculture to the local context. In so doing, it may be possible to optimize the benefits of this practice to local people and local ecologies [3].

A great shortcoming in research on African smallholder farming in general is found in the opposite extreme to the overly-optimistic publications that first emerged on urban agriculture. A large cadre of scholarship portrays African smallholder farming as stagnant, inefficient, and vulnerable to shocks and stresses [2,4]. This line of reasoning is typically the basis for arguments to industrialize smallholder farming in Africa [4,5]. What such arguments gloss over, however, is that there are many models for smallholder farming in Africa; some of them are unsustainable, certainly, but many are socially empowering, ecologically benign, and economically sound [6]. Thus, in a context such as Cape Town, where a small minority practices urban agriculture, current research identifies the need for case studies to establish the conditions under which urban agriculture can benefit economically marginalized people [7].

Farming in an urban environment is challenging in any city, as space is expensive, relative to rural areas, and lower-priced areas are generally on poor quality soil [3]. When urban agriculture is promoted for community development, one of the key challenges is to provide the necessary resources without creating dependency [7,8]. Numerous case studies, spanning Africa, India, and America, show that the benefits of urban agriculture tend to accrue with those who are already well-off; marginalized urban farmers face more frequent, more intense, and more diverse challenges than their better-off counterparts [9–15]. In Africa, urban farmers are typically limited by a lack of access to land, inputs, and markets [10,11,13–15].

In attempting to overcome resource limitations, aid organizations and governments roll out large-scale agricultural development schemes. These schemes are characterized by free or subsidized fertilizer, pesticide, and seeds as well as guaranteed markets [16]. The benefits of such schemes rarely accrue to the most marginalized, however, and those who do benefit may be rendered wholly dependent on program-supplied external inputs [17].

Sustainable development theory provides the appropriate interpretive lens for urban agriculture case studies, as urban agriculture programs in post-industrial and developing countries tend to strive for ecological, economic and social wellbeing [9,18–20]. Any agricultural sector requires external inputs [7], but under a sustainable development approach, the purpose of such support is to remove the barriers to entry that exclude the marginalized from becoming urban farmers. With the minimal of external inputs utilized in this way, it is possible to initiate a virtuous cycle of empowerment in a community; that is when previously marginalized people become increasingly able to generate their own wealth, thereby becoming less dependent on external inputs [21]. External inputs are a catalyst to, not the backbone of, such programs.

A practical approach to implement sustainable development, particularly in resource-constrained environments, is asset-based community development [22]. Key to this process is a focus on identifying local assets that may be underutilized, suppressed, or overlooked [23]. Such assets include individuals with skills or passions; land; infrastructure; resources; and local groups, upon which to base community development [24]. The principles of asset-based community development tend to be prevalent in urban agriculture programs, even if not purposefully implemented. For example, a New York case study identifies the opportunity in urban agriculture programs to teach residents about social justice, the food system, and agro-ecological food production [9]. Moreover, in Berlin, social acceptance was greatest for urban agriculture programs that balanced economic, ecological, and social goals. Such findings are echoed in Africa more broadly [14], and in South Africa in particular [15]. Notwithstanding the seemingly "natural" integration of asset-based community development with good-practice urban agriculture, the actual application of this conceptual lens to urban agriculture case studies is extremely limited. The few scholarly studies in which it is applied, such as in Cagayan de Oro, Southern Philippines, record greater community cohesion, ecological stewardship, and livelihood sustainability [25].

The present study aims to demonstrate that urban agriculture in Cape Town presents a good practice model for a cropping system that is suited to socioeconomically marginalized urban farmers. The paper begins by describing the qualitative empirical research that was conducted in the low-income, high-density residential areas of Cape Town's Cape Flats. The personal perspectives of the urban farmers are presented thereafter in the Findings. These contribute to the discussion that follows, in which the experiences of Cape Town's urban farmers are compared to the contextual and conceptual literature on urban agriculture cropping systems. Finally, the paper concludes with some lessons from Cape Town's case that may be applicable more broadly, in resource-constrained urban contexts.

2. Materials and Methods

Empirical research took place from March to August 2014 on the Cape Flats, an area within the City of Cape Town municipality, South Africa, consisting primarily of low-income residential areas, government-subsidized housing estates, and informal dwellings [26,27]. Unemployment on the

Cape Flats is high (29%) and standards of living are low, with 44% of households living in informal dwellings [28]. Further challenges include poor-quality infrastructure, suboptimal service delivery, and social ills such as domestic violence, theft, gangsterism, alcoholism, and drug abuse [29].

The climate and geography on the Cape Flats have historically been conducive to horticulture: the presence of ground and surface water [26], and soil quality has supported agriculture in the area for centuries [30]. However, the residential areas were deliberately located in the areas with the poorest soils, while construction activities and decades of informal waste disposal have created the poorest soil conditions in the residential areas [31]. In spite of these challenges, about 5% of residents on the Cape Flats practice urban agriculture [32].

At the time of research, four NGOs, Abalimi, Soil for Life, The Sozo Foundation, and Inity, provided training and extension services to urban farmers on the Cape Flats, supporting 6563 urban farmers. All four NGOs were selected for the present study. Following the selection of NGOs, urban farmers within the NGOs were sampled. The informal nature of housing in the fieldwork site rendered any form of simple random sampling impossible. Thus, opportunistic sampling was used, drawing on information from the NGOs, as well as referrals from local people and the urban farmers themselves, to identify where urban farmers were located. Data collection continued until data saturation was achieved; that is, no new data categories emerged and no new information emerged within existing categories [33]. Data saturation, not a statistically representative sample, is indicative of sampling sufficiency in qualitative research [33]. By the point of data saturation, 59 urban farmers had been interviewed. The majority (74%) of the urban farmers were over the age of 40, 85% were of the Xhosa ethnic group, and 60% were women.

In-depth individual interviews were conducted with 34 of the urban farmers. The remainder were divided into four focus groups: two mixed gender groups, one all-female group and one all-male group. The interviews and focus group discussions were guided by a semi-structured interview schedule and were recorded using a recording device and field notes. The audio recording was transcribed. The "code and retrieve" method of analysis was adopted [34], according to which transcriptions were coded according to themes on the cropping systems, as laid out in the subsections of the Results section below. Extracts from the transcription are quoted verbatim in the Results where the urban farmer's manner of speaking or succinctness of description lends a qualitative depth of insight into the subject under discussion [35]. To supplement the urban farmers' perspectives, the study also included interviews with a key informant from each of the four NGOs, and an interview with a local government official responsible for managing urban agriculture in the municipality.

In order to maintain the anonymity of the research participants, each is assigned a unique identifier that includes: the method of data collection (Individual or Focus group); the gender of the individual (F or M) (when citing an individual interview); the individual interview schedule number (1 to 59); and the individual's age range ("≥18" for those between 18 and 39; "≥40" for those between 40 and 64; and "≥65" for those 65 and older). Thus, a citation from an individual interview with a young adult woman might be assigned the identifier "(Individual F1 ≥ 18)". Citations from, for example, the first focus group discussion are simply indicated by the identifier "(Focus group 1)". As is consistent with other case studies on urban agriculture in Cape Town, the NGOs featuring in this research are named. However, in order to protect the identities of the key informants, no socio-demographic characteristics of these individuals are described.

3. Results

The following section presents the key aspects of the cropping systems that the farmers themselves identified as important to their success. The layout of the section is structured in order to provide the reader an overview of the basic support structures at the beginning. Thereafter, the subsections follow a sequence that echoes the process the urban farmers themselves follow, namely, land acquisition, soil preparation and obtaining inputs, deciding which crops to plant, managing pests, and finally, the impact the process has on one's worldview.

3.1. Training in Agriculture

The operational centre of each NGO's program is located within their target communities; this is the "Garden Center". The local Garden Centers include demonstration plots, where a seasonal array of vegetables are grown year-round on a tract of land comparable to most residents' plots. The demonstration crops are grown using the methods that the NGOs teach. At Garden Centers, local residents may purchase agricultural inputs at subsidized rates, or may receive free advice. The atmosphere at such Garden Centers is informal and welcoming. These Garden Centers therefore provide a support base within the urban farmers' neighborhoods.

The primary focus of the NGOs, according to all of the key informants, is on training "home gardeners", but Abalimi supports several dozen commercially-oriented farming groups as well. Individuals are trained in courses that run for a few weeks. A group of several people participate in one course, and the course participants are grouped according to the neighborhood or street that they come from. Usually, a group taking the course consists of friends, neighbors, and relatives. This is deliberate, as the NGO encourages such groups to support each other.

The course consists of hands-on training designed for people with low levels of formal education. As part of the training course, urban farmers are provided with all of the basic inputs they need to begin farming, and during the course they establish their own cultivated plot. During their first season following the training course, they receive intensive extension services from extension officers employed by the NGO that provided the training. While the intensity of extension services reduces after the first season, advice is always freely available from the local Garden Centers. The course teaches urban farmers to depend on minimal external inputs, so the intention is that urban farmers will become increasingly self-sufficient over time.

Many of the urban farmers in Cape Town have agricultural experience already. The majority in the study area migrated to Cape Town to seek work and originate from South Africa's rural Eastern Cape. Subsistence farming was a way of life in such urban farmers' households. Many were also taught basic agriculture as part of their school curriculum. Nevertheless, past experience in agriculture proves insufficient for Cape Town's context, according to urban farmers, as the farming conditions on the Cape Flats are remarkably different from the conditions that they were used to in the Eastern Cape or other areas. This is particularly true in terms of the area of land urban farmers have access to, as well as the quality of the soil.

3.2. Accessing Land

The area available for farming within residential areas on the Cape Flats is extremely limited. The vast majority of urban farmers only have the few square meters of "garden" around their home in which to farm. For this reason, all of the NGOs in this study teach urban farmers to use intercropping and container planting to maximize the diversity and density of crops being cultivated. Part of the training the NGOs provide includes "micro farming"; growing vegetables in small containers (the back cover of televisions, plastic crates, and tires are abundant and most commonly used) or on two square meters of soil (Abalimi key informant). The use of vertical space is also encouraged, so that every available surface of the small residential plot may be utilized for cultivation. A Soil for Life key informant explained that "Everyone thinks they have to have land, and I try to tell them 'no'. [. . .] In Overcome Heights they have no land and they make it work."

Many of the urban farmers who began with the small garden they established during the training course aspired to use any available space on their property for growing food when they realized how successful they could be at urban farming. For example, a middle-aged female urban farmer states that her family "don't want now these unused spaces" in their yard (Individual 07 F $\geq$ 40). For some, this means prioritizing horticulture over ornamental landscaping:

> "I took out all the unnecessary stuff so that I could plant vegetables. And my neighbors were asking, 'What are you doing that for? Why do you want to plant vegetables?' But after a few

> months, when the vegetables started coming out then it was a different story altogether. My neighbors said, 'Look here, don't you want to sell us that lettuce?'" (Individual F18 $\geq$ 40).

When the urban farmers realized what was achievable on even a small tract of land, many aspired to scale up. According to many of the urban farmers, obtaining access to land remains one of the main limitations to the expansion of urban agriculture in Cape Town:

> "The issue of the land, ah, it's one major thing that is affecting this agriculture [. . .]. We have small chunks of land, but we are passionate about planting [. . .]. We are not employed, so if I were having a huge [chunk of land], maybe it would be easy for us to feed, you can imagine, five, six kids" (M19 $\geq$ 18).

The commercial cultivation groups were particularly desirous of larger tracts of land, as their profits related directly to the volume of their outputs. Some of the formal groups explained that they had attempted to acquire larger tracts of land that appeared unused by inquiring at their local municipal offices. These endeavors were unfruitful however, as the applicant tended to be sent from one government office to another and would finally give up in frustration.

The department tasked with supporting urban agriculture in Cape Town is the City of Cape Town Directorate for Economic and Human Development (the Directorate). A key informant from the Directorate explained that their department lacked the capacity to carry out its mandate. Key limitations included: lacking the resources to meet the level of demand for urban agriculture in Cape Town; considerable bureaucratic processes involved in working with other government departments to carry out support services; and negative perceptions towards urban agriculture held by government officials. These limitations frustrated attempts by the Directorate to release land for urban agriculture:

> My biggest limitation at the moment is [...] to get the consent of the landowner—meaning the City [of Cape Town]; the process is too long. And then also, the other thing is that there are still officials within the City that does see urban agriculture more as a nuisance or an unsuccessful activity than a real, progressive kind of activity.

The key informant from government explained that officials from government departments "do not go in to Khayelitsha", and therefore do not see urban agriculture in practice. By contrast, the individuals working for the institutions located in Khayelitsha (and in similar contexts on the Cape Flats) are far more supportive of urban agriculture, allowing urban farmers to use the land surrounding their NGO, school, community center or place of worship. Typically, some negligible lease fee is agreed upon, or a portion of the output is shared with the lessor. It appears therefore that informal arrangements are a more efficient way to access larger plots on the Cape Flats than by applying to the local municipality.

3.3. Soil Preparation

The cropping system developed by the NGOs in this study is based on permaculture principles adapted to suit Cape Town's conditions. The two largest and most longstanding of the selected NGOs introduced these principles when they launched urban agriculture training in Cape Town decades ago. One of Abalimi's founders trained in biodynamic farming in Sussex, United Kingdom, and brought that knowledge to Cape Town in the 1980s (Abalimi Key informant). Soil for Life implements permaculture principles but has simplified these to better suit the context they train within (Soil for Life key informant). The more recently established NGOs, Sozo and Inity, learned their methods from Soil for Life and Abalimi, respectively, and operate in very much the same way. In practice, all four NGOs therefore have come to implement comparable cropping systems.

Soil preparation in the residential areas of the Cape Flats often requires quantities of refuse to be removed from the soil to prepare it for agriculture. One of the urban farmers described her plot as "a rubbish dump" before she prepared it for farming (Individual F3 $\geq$ 40). Many of the urban farmers, and the NGO key informants explained that the low fertility of the soil also requires large amounts of

fertilizer which, due to the soil's sandy nature, needs to be organic matter, to improve the soil's ability to retain water.

Trench-bedding is one of the main methods urban farmers used for preparing the soil. This involved digging a trench of variable length, which was re-filled with alternate layers of organic matter and soil. The final covering of soil was mixed with compost. The resulting mound was typically bordered with scrap material such as wooden planks to hold its rectangular shape and was covered over with a layer of mulch. Seedlings may be planted in such a bed immediately.

For large tracts of land, where trench-bedding is too labor-intensive, sheet mulching was used. Sheet mulching involved spreading a layer of organic matter in long tracts and covering this with compost-enriched topsoil and mulch.

3.4. Sourcing Inputs

Considerable volumes of organic matter are required for preparing the soil on the Cape Flats. One of the cheapest raw materials to do this with is organic waste from greengrocers, landscaping companies, and stables, according to many of the respondents.

The NGOs train urban farmers to use kitchen scraps and any organic waste that they can forage for in their area. On the Cape Flats however, and particularly in the high-density residential areas, vegetation is sparse and very small quantities of organic matter result from food preparation, according to a key informant from Sozo. Urban farmers overcome these challenges by, for example, collecting the bags of grass clippings left by the municipality after trimming the grass verges. One urban farmer from Seawinds, near to the False Bay coastline, catches the train to a nearby beach to collect kelp (F18 $\geq$ 40). Other urban farmers ask for waste from fruit and vegetable vendors in their areas (Soil for Life key informant; Sozo key informant). Thus, for the urban farmers, finding sufficient organic matter for free is possible, but doing so requires considerable effort. Many urban farmers, therefore, prefer to buy ready-made compost at a subsidized rate from the NGOs' garden centers.

The NGOs require large volumes of organic inputs to supply the training courses, as the inputs are donated to the trainee urban farmers to help them set up their operations. To source such volumes, the NGOs draw on a broad network of contacts from around the city. NGOs' networks for organic wastes included feeding schemes, grocery stores, landscaping companies, and stables (Soil for Life key informant). While these inputs were donated, the time it took to collect them and the space necessary to store and process them were constraining. As a key informant from Soil for Life explains,

> One of our biggest running costs is petrol because of the logistics of shifting. So we're driving to Fruit and Veg [City], we're driving back. We're driving to get dry brown, we're driving back. We're loading manure, dry brown, green wet; driving it out to communities [. . .]. It's tons and tons of stuff. So, it's like *bakkies*- (Pickup truckloads) and trailers-full [. . .]. Sourcing that stuff, bringing it back here, packing it, taking it out to the relevant places, coming back here. It's like, never enough time in the day" (Soil for Life).

The time and resources required to source organic waste present considerable limitations to scaling up the NGOs' operations. The larger cultivation groups, who require greater volumes of compost, buy it by the truckload from Abalimi (who alone supported cultivation groups at the time of fieldwork) or are eligible for donations from the City of Cape Town Municipality. Urban farmers explained, however, that they prefer to avoid sourcing compost from the City of Cape Town, as the waiting time for delivery was too long, and they did not trust the quality of the compost. One group, for example, referring to a load of compost nearby that had been delivered by the City of Cape Town, complaining:

> On this compost, we harvest waste. We took [our harvest] and threw it away. [. . .] We don't know what is wrong with the compost, but all the cabbages we grew in it grew wrong [. . .]. They turned brown on the leaves [. . .]. We as farmers are not sure of what ingredients went into the compost [. . .]. Perhaps there is other material that is not supposed to be in there (Focus group 5).

Many of the groups, therefore, purchased compost from Abalimi, who was the only NGO of the four to be selling compost at such volumes. According to Abalimi's key informant, Abalimi supports farming groups by selling compost at heavily subsidized rates: "Compost costs us five thousand rand for fifteen cubic meters. Farmers can't afford that, but they pay one-thousand rand per fifteen cubic meters, and the rest is under our subsidy scheme". Even at one-fifth of the price, some groups nevertheless complained that the prices had inflated by 50% in that year:

> We buy compost with the money we make, but this year prices have gone up and it is too expensive. It used to be one-thousand-six-hundred rand, but now it is two-thousand-four-hundred rand for a truck load, so it is too expensive (Focus group 1)

Sourcing sufficient organic matter is therefore a key cost (whether of time or money) to cultivating on the Cape Flats. Depending on the scale of operation, there are ways to reduce the financial cost, but the time required to cut costs renders larger-scale operations less feasible.

3.5. Factors Determining the Choice of Crops

A number of factors influenced which crops were grown in the study area. As with any agricultural operation, climate and soil type are major considerations that influence the viability of farming certain organisms, as well as the quality of the output. Nevertheless, such considerations were not the only criteria for the selection of crop types among the urban farmers. Other criteria included the availability of seeds or seedlings, market demand, cultural significance, the growing time, competition with local supermarkets, and even attractiveness to thieves.

One of the most popular crops informally sold throughout the urban farmers' neighborhoods is "spinach" (oftentimes actually Swiss chard). The popularity of this crop is due to its versatility, resilience, cultural relevance, short time to harvest, and long harvest period. It is one of the few crops that meet almost every criterion for crop choice. Spinach is therefore the first crop to be planted:

Spinach, while sold for "not more than five rands per bunch" (Focus group 1), has a reliable demand from local informal markets. According to Sozo's key informant, their Garden Center had standing orders for spinach from local crèches. For urban farmers establishing a plot, or replanting after a harvest, spinach is planted to generate cash flow while waiting for other crops to mature:

> [In] winter, we are putting spinach first [. . .]. Any other crop [. . .] would follow after spinach, because [. . .] crops that are taking too long to grow [. . .] will be costing [. . .] time to generate income [. . .]. Crops that would be growing faster [. . .] gain faster the income [. . .]: crops like spinach (M19 $\geq$ 18).

Additionally, urban farmers can prolong the spinach harvest by harvesting only a few leaves from the same plant: "You just pick the leaves off every now-and-then" (F51 $\geq$ 40). Such crops therefore create a constant cash flow over a long duration, "so you can sell some of it and then use the money to buy your breads and potatoes and stuff like that" (F03 $\geq$ 40). In addition to having a long harvest duration, spinach is also able to grow year-round in Cape Town's climate, so it is an ever-present fresh ingredient to add flavor to an otherwise bland meal. For example, a single mother of seven brags about her daughter-in-law's spinach relish (*smoor*), which they make when they feel like *pap* (a meal comparable to polenta or grits): "Sometimes my daughter-in-law will make *smoor* if they *smaak* for *pap*; then they pick it from the garden" (F1 $\geq$ 40).

Other cash crops are not popularly consumed in the urban farmers' neighborhoods but are sought after by upper-income consumers. Abalimi's Harvest of Hope caters to these through their community-supported agriculture scheme. Thus, there are a number of crops grown by the commercial cultivation groups that the farmers themselves have little interest in eating, such as egg-plant, sweet peppers and lettuce. As one commercial group explains about lettuce, "It's fast growing, and less work: no pests. Um, and it gives good, good, good figures, you see, in the market [. . .]. It's good for market, [but] it's not most people that eat lettuce [in this area]" (Focus group 6).

In terms of subsistence crops, spinach was once again the most popular. Other subsistence crops included onions, carrots, potatoes, and cabbage. While urban farmers growing for subsistence tended to grow foods that they were familiar with, urban agriculture provided them with an opportunity to sample new types of food, according to some urban farmers. Urban farmers were pleasantly surprised by trying unfamiliar crops or eating familiar crops in a new way. One urban farmer described the experience of trying new foods he had grown: "The turnips are my favorite, with the leaves. And the parsley. I grate them into soup. I had Chinese cabbage, almost like salad, I put it on a cheese sandwich. The first time, I was amazed, it was so crispy; it was so nice" (Individual M08 $\geq$ 40).

Certain plants provide two different crops. For example, turnip leaves are gleaned for meals while the root itself is still growing (Focus group1). Similarly, some urban farmers have come to realize that certain "weeds" are in fact edible. Commonly eaten weeds are pigweed (*Amaranthus*), stinging nettle (*Urtica dioica*), and purslane (*Portulaca oleracea*). As one urban farmer explains, "I didn't know that there are a lot of weeds that are edible, even in my town where I am coming from. We shouldn't actually be hungry. We shouldn't be suffering from diseases that are the cause of bad eating" (Individual F16 $\leq$ 18).

Theft, or the threat thereof, played an important role in influencing the choice of output. The farmers chose not to farm higher-value products such as those derived from livestock and fruit because they were certain that such products would be stolen.

3.6. Pest Management

Pest management practices were based on the principles of permaculture. The NGOs taught that optimal growing conditions and intercropping reduces the need for pest management. Petrochemical pesticides were anathema to the urban farmers, as they believed that these would harm non-target organisms, including humans. Pest management therefore took a combination of approaches depending on the pest being targeted. The most commonly named pests were snails, caterpillars and aphids.

Key to pest management included encouraging beneficial fauna to inhabit the plot. Hedgerows were planted and rockeries were built, which the urban farmers believed would host animals that prey on pests. The larger pests, such as snails and caterpillars, the urban farmers removed by hand. Some of the urban farmers used the pests that they removed as an ingredient in a concoction that they believed would repel such pests. The concoction was made by allowing the organisms to rot in water, and then sprinkling the result on the ground around the plants. The urban farmers believed that the putrid smell would repel pests of the same species. The farmers also infuse soapy water with garlic and chili, and sprayed or splashed this onto the plant.

3.7. Basic Infrastructure and Tools

The NGOs also encouraged urban farmers to repurpose whatever waste materials they could find as infrastructure for their garden. For example, tires were frequently used as containers for growing vegetables or sprouting seedlings (Sozo key informant). One individual paid the neighborhood children to source plastic soft-drink bottles, which he used for bordering his beds (Individual M38 $\geq$ 40).

In addition to scrap materials, a few basic tools were prerequisite to practicing urban agriculture. Thus, the NGOs' practical training courses concluded with a donation of basic hand-tools that the course participants were instructed to share. The larger cultivation groups received donations of irrigation infrastructure, fencing, tools, wheelbarrows and storage facilities from local government, but they received training from Abalimi.

Many types of infrastructure were used for sourcing water. There were no natural rivers of adequate cleanness for urban farmers to draw from, but throughout much of the Cape Flats is an aquifer that provides "decent water", according to Abalimi's key informant. Thus, larger plots inevitably have a borehole or well-point pump installed to utilize this resource. Few urban farmers harvest rainfall, both because the plots are rarely near to any building with a large enough roof, and

because summer rainfall is so negligible that stored water does not last until the onset of the winter rains (Individual F18 $\geq$ 40; Individual M38 $\geq$ 40). Nevertheless, some of the plots that were located on school grounds used waters storage tanks that collected water from the gutter downpipes. Smaller plots that were near enough to a public standpipe drew water from this source, while the urban farmers who had a municipal water supply in their house benefitted from the 6000 L per month provided at no charge to all of the households in the province at the time of fieldwork.

3.8. Urban Agriculture Shapes Urban Farmers' Worldviews

Included in the formal training on the cropping methods described above was a basic description of sustainability and an explanation as to why the cropping system is based on agro-ecological principles. This knowledge gives urban farmers a deep sense of responsibility towards the soil—a "relationship", some even said:

> You know, when you work with the soil you get in touch with the soil, you know; you connect with the soil. I never knew someone could have a conversation with the soil [. . .]. There is a relationship: you, my dear, and the soil [. . .]. If you don't have that relationship, nothing will come out of the soil (Individual 34 F $\geq$ 18).

A young male urban farmer captured this sense by explaining that the cropping system he adopts is:

> . . . a natural way and form of, like, keeping in nature. And I believe—I strongly believe—that it is a God-approved way of planting; because there is nothing that we are doing in killing or in affecting the soil (Individual M19 $\geq$ 18).

There was a pervasive sense among the urban farmers that urban agriculture is a holistic livelihood strategy—a calling, even—not merely a source of food or income. Their preference for farming using agro-ecological methods stemmed from a deep sense of responsibility towards the ecology; they saw themselves as stewards of the ecology.

4. Discussion

Traditional smallholder cropping systems in Africa are often portrayed as outdated and inefficient, while industrialized agriculture is promoted as a solution to African poverty [4]. Neither of these claims is necessarily true. Cape Town provides an interesting case, as the predominant cropping system applied by its urban farmers is based on agro-ecological methods imported from the "developed world" but adapted to suit local socio-economic and geographical conditions.

The findings support the assertion that traditional farming methods are not necessarily transferrable in a changing context [3], but this does not imply that the findings support the broad scale industrialization of smallholder farming either [16]. One of the key shortcomings of the latter is the erosion of the sustainability of local livelihoods through creating dependency on external inputs [7,8]. Such models tend to create a few commercial farmers but do nothing to eradicate poverty [4,17].

Urban agriculture certainly requires some external inputs and structured training, regardless of whether it is being practiced in post-industrial [9] or developing countries [7], but good practice models in this regard limit such inputs to tenure security, start-up inputs and basic training, and local market access [10–15], as confirmed by the present study. The key principles that appeared to contribute to the success and sustainability of urban agriculture in the case in point were: supplemental material support for start-up; long-term extension services; horizontal support networks among farmers; and cropping systems based on maximizing the use of locally-available resources and minimizing dependency on external inputs.

One of the limiting factors to the smaller scales of operation typical of urban agriculture is the lack of interest from local government. Such is found in case studies from post-industrial cities, such as New York [9], and is confirmed in the present study in the difficulty urban farmers experience in gaining

access to vacant land. Nevertheless, this study has shown that small scales of operation warrant the use of relatively simple technologies. Using inputs and technologies that are locally available or as simple as possible, in addition to drawing on peer-to-peer support networks, enables urban farmers to resolve many of the challenges intrinsic to urban agriculture without waiting for external support. External material support in the present study was limited primarily to basic inputs for start-up, while free advice was available over the long-term. The necessity for startup inputs and agro-ecological training is not limited to the present case, but are seen in cases from post-industrial cities as well [9]. Thus, the programs applied by NGOs in the present study exhibited asset-based community development principles, even if this concept was not consciously implemented by the NGOs.

Cropping systems of the scale practiced by the urban farmers in this study are unlikely to create great wealth, but profit maximization rarely appears to be the priority among urban farmers: urban farmers from around the world are driven by holistic goals centered on community cohesion, healthy lifestyles and ecological stewardship [3,9,14,17]. Nevertheless, a minority of urban farmers in this study who were part of the formal market-garden network were able to generate their sole income from urban agriculture. Interestingly, however, even these commercial urban farmers placed little emphasis on profitability as their main motivation for farming, and all generously donated surplus to those they perceived to be in need in their area. The consensus among urban farmers in this study was that they farmed because they wanted to live healthily and contribute to the impoverished neighborhood within which they lived. Based on the findings, as well as broader case studies, it would appear that good practice urban agriculture programs are built on community networks and agro-ecological cropping systems that draw on locally available inputs.

5. Conclusions

Cape Town's case demonstrates that some external inputs may be necessary to overcome the challenges intrinsic to farming in economically marginalized urban areas, but that external inputs should not form the core of such programs. Urban agriculture good practice in Cape Town "works" because it is based upon networks of passionate and capable local individuals, and cropping systems that are tailored to the local environment. The findings of this study may be relevant to Cape Town, but do not necessarily provide a model that can be applied, unaltered, in a different context. Rather, this research provides principles that may be used to adapt urban agriculture to best suit the local context in other cases.

This article contributes towards an extremely limited body of scholarship recording what the application of asset-based community development may look like in an urban agriculture context. In so doing, this article demonstrates that urban agriculture programs (even unconsciously) based on asset-based community development principles may require some external resources, but that the core of such programs must remain endogenous assets: existing relationships; the passions and skills of individuals; repurposed "waste" resources; and freely available natural goods and services. The findings indicate that cropping systems based on these principles can create highly resilient urban agriculture practices.

Funding: National Research Foundation: 78647.

Acknowledgments: This research was based upon funding from the National Research Foundation [grant number 78647] through Stellenbosch University's Food Security Initiative, as well as funding from the Open Society Foundation through the African Climate Adaptation Initiative at the Global Change Institute, University of the Witwatersrand.

Conflicts of Interest: The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

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