Land Tenure Insecurity Constrains Cropping System Investment in the Jordan Valley of the West Bank

Mark E. Caulfield [1,2,*], James Hammond [2], Steven J. Fonte [1] and Mark van Wijk [2]

1   Department of Soil and Crop Sciences, Colorado State University, Fort Collins, CO 80523-1170, USA;
    steven.fonte@colostate.edu
2   International Livestock Research Institute (ILRI), Livestock Systems and the Environment,
    Nairobi 00100, Kenya; J.Hammond@cgiar.org (J.H.); M.VanWijk@cgiar.org (M.v.W.)
*   Correspondence: markcaulfield11@gmail.com; Tel.: +212-(0)-6-39-59-89-18

Abstract: The annual income of small-scale farmers in the Jordan Valley, West Bank, Palestine remains persistently low compared to other sectors. The objective of this study was therefore to explore some of the main barriers to reducing poverty and increasing farm income in the region. A "Rural Household Multi-Indicator Survey" (RHoMIS) was conducted with 248 farmers in the three governorates of the Jordan Valley. The results of the survey were verified in a series of stakeholder interviews and participatory workshops where farmers and stakeholders provided detailed insight with regard to the relationships between land tenure status, farm management, and poverty. The analyses of the data revealed that differences in cropping system were significantly associated with land tenure status, such that rented land displayed a greater proportion of open field cropping, while owned land and sharecropping tenure status displayed greater proportions of production systems that require greater initial investment (i.e., perennial and greenhouse). Moreover, as confirmed by a structural equation model and the interviews and workshops these associations led to significant differences in farm income and progress out of poverty index scores. However, while sharecropping farms enjoyed the benefits of being able to invest in longer-term, more profitable farming strategies, questions were raised regarding the sustainability of these farms as well as the vulnerability of the farming households that manage the land. We concluded that small-scale agricultural development in the Jordan Valley relies on farming households achieving more secure land tenure and that rural development agencies should prioritise farming households that rent land and practice open field cropping systems within their projects and programmes.

Keywords: Jordan Valley; West Bank; land tenure; regime shifts; inputs; progress out of poverty

1. Introduction

Smallholder family farming accounts for 98% of farms globally and 53% of agricultural land and agricultural production [1]. In many countries, poverty among these smallholder farms is widespread and usually much higher than the national poverty rate [2]. This reflects the reality in the Jordan Valley of the West Bank, Palestine, where poverty rates are nearly twice as much as other areas in the West Bank, and many families struggle to make a living from farming without adequate access to land [3]. Indeed, small-scale farming constitutes the majority of agriculture, with average farm size varying between 1.2–2.5 ha depending on the governorate (PCBS Agricultural Census 2011). However, despite the fact that agriculture is the main source of income for the majority of households in the Jordan Valley, farm income remains consistently low, with one study reporting that average income for Palestinian farming families was less than USD 700 a month, just USD 40 above the national poverty line [4,5] while another found that 55% of the rural population is poor in the West Bank and Gaza

compared to only 21% in urban areas [6]. These rural poverty figures mirror other countries in the region such as Egypt, Algeria, Morocco and Tunisia where the proportion of poverty is greater in rural areas compared to urban ones [6].

While these figures are alarming, there is growing recognition that small-scale farming presents important opportunities for rural development to improve food and nutritional security and to reduce global poverty, rather than contributing to the poverty problem [1,7,8]. According to a number of studies, agricultural growth has particularly positive impacts on rural development in countries where agriculture is dominated by small-scale farming [9]. Rural development, however, is not a question of how farmers can improve their circumstances by simply changing a specific behaviour. As observed by a number of authors, no panacea solutions exist for achieving rural development [10,11]. Instead, potential development pathways are often context-dependent and constrained by multiple variables at different scales. Understanding the inter-relations and feedbacks between small-scale farming households, farm management and broader contextual factors is therefore critical to rural development organisations in order to advance more effective intervention strategies. In accordance with this framework [1], a clear and detailed knowledge of the local context is critical to design and assess policies affecting small-scale farms [1]. Moreover, the theoretical framework of Complex Adaptive Systems [12–14] suggests that rural development changes may not always be simple linear trajectories along a gradient, but often involve regime shifts [15].

Farming, Agricultural Development, and Land Tenure Status

In this vein, while some rural development policies are likely to have more direct associations with farm productivity and agricultural growth, these mechanisms may be constrained by broader structural challenges limiting opportunities for more fundamental improvements to farm income. For example, a meta-analysis of 15 studies in low and lower-middle-income countries found that subsidy programmes were significantly associated with an increase in the use of the agricultural inputs, as well as higher agricultural yields and increased income among farm households [16]. However, while such programmes may stimulate agricultural production on average, some farming households are far more able to engage and benefit than others [17–20].

One of the broader structural constraints to agricultural development that has received particular attention over the last few decades has been differences in land tenure status among households. Indeed, land tenure is considered a major factor in land use and agricultural management decision making [9,21–23]. Much of this research has focused on the effect of land tenure status on the use of agricultural inputs and "modern" agricultural technologies. One study, undertaken in East India, found that farming households that owned their land were more likely to use modern rice seed varieties than tenant cultivators, and that the more secure land tenants (those with longer-term land tenure contracts) were also more likely to adopt modern rice seed varieties than other tenant cultivators [24]. Another study investigated the effect of land tenure status on the participation in a government-sponsored crop intensification program focusing on the use of agricultural inputs, and the improvement of postharvest handling and storage technologies in Rwanda. This study found that those farming households that owned their land were significantly more likely to participate in the programme than those that did not [17].

Another rich vein of research with regard to the effect of land tenure status on land and farm management has been related to the adoption of more sustainable agricultural practices [25–28]. Generally, the results from these studies appear to suggest that farming households who own their land or have more secure tenure rights tend to employ more sustainable agricultural practices (that also potentially require greater investment) such as crop diversification, agroforestry, improved fallow, and soil and water conservation techniques [29,30]. However, it is important to point out that this is not always the case. Indeed results from a farmer survey in the USA, indicated that contrary to what was expected, farming households that rented the land they farm were more likely to practice conservation tillage than households that were full-owners of their land [31].

An area of research that has received less attention is how land tenure status is related to cropping system differences between households. One study addressing this topic assessed these relationships in farming households in Nicaragua. The results indicated that households that owned their land tended to practice mixed cropping systems consisting of tree crops (coffee, citrus, bananas, and mangoes) and annual crops (maize, beans, and cassava) and incorporate more fertilizers, while those that rented land focused mainly on annual crops and incorporated less fertilizer [32].

Despite this growing body of research assessing the relationship between land tenure status and opportunities for greater agricultural development, studies addressing this topic in southern and eastern Mediterranean countries remain sparse. This is a particularly important gap in the research literature as these countries are often characterised by complex land tenure systems with their origins found in the Ottoman Empire and measures taken after decolonization. Indeed, these complex land tenure systems have been found to be the cause of substantial inequality in land distribution [33]. Furthermore, as found by a study on the sustainability of agro-food systems in Mediterranean countries, countries from the south and east Mediterranean tended to score lower than their neighbours in the north suggesting that opportunities for more sustainable agricultural development exist in these areas [34].

Given this gap in the research literature, the objective of this research was to further explore the relationships between land tenure status and cropping systems in order to better understand some of the drivers and constraints for agricultural development of small-scale farms in the Jordan Valley of the West Bank, Palestine. In doing so, we hoped to inform more concrete recommendations for more contextualised development strategies in the region. We undertook a two-step methodological approach. The first step was to administer a rural household survey to 248 small scale farms in the Jordan Valley. The second step was to verify the results of this survey and explore the relationships between land tenure status, farm management and poverty in a series of stakeholder interviews and three workshops in the Palestinian governorates of the Jordan Valley. This second step in the methodology is an extension of methodologies previously adopted in the research literature assessing the relationship between land tenure and farming systems that tend to rely mainly on household surveys [24,29,31]. By complementing such household surveys with more nuanced and interpretative evidence from both farmers and local stakeholders in the form of workshops and interviews, we hoped to address some of the challenges raised by the question of endogeneity often cited in the literature [18,35,36].

In line with previous research outlined above, it was hypothesised that: (1) the primary cropping system would vary depending on land tenure status of the farming household, with farming households who owned the majority of their land practicing cropping systems that required greater long-term investment; (2) agricultural inputs, market linkages and area of land cultivated would also be significantly associated with different land tenure status; and (3) these associations between land tenure status and investment in farm management practices would result in significant differences in farm income and poverty status among farming households.

2. Materials and Methods

2.1. Study Site

The Jordan Valley of the West Bank is a highly to extremely arid area of around 1500 km^2, receiving less than 100 mm of precipitation per year [37]. The three governorates that comprise the West Bank area of the Jordan Valley include Tubas in the north, Nablus on the western edge and Jericho to the south. The great majority of farms in these governorates are small to medium scale (up to 8 ha). The average farm size in Jericho and Tubas is around 2.5 ha, while in Nablus farms tend to be even smaller with an average size of 1.2 ha (PCBS Agricultural Census 2011). Plant production systems account for the majority of farms in the area and generally rely on access to irrigation water (PCBS Agricultural Census 2011). Many different types of land tenure arrangements exist in the Jordan Valley, from private land ownership to rented land, collectively owned land, governmental owned land and share-cropping systems, where landowners lend out their land to farm "managers" who run

the farm and return a proportion of the profits (usually around 50%) back to the landowner. The three main land tenure status types assessed in this study are owned-land; rented land and sharecropped land. Rented land was considered to have a less secure status of land tenure, while owned-land and sharecropped land were considered to hold more secure land tenure status.

Three main cropping systems exist in the Jordan Valley: open field, greenhouse and perennial, or orchard production. The data from this study suggested that the main crops grown under open field production included squash (*Cucurbita pepo*), eggplant (*Solanum melongena*), faba beans (*Vicia faba*) and maize (*Zea mays*). Greenhouse production consisted mainly of tomato (*Solanum lycopersicum*), cucumber (*Cucumis sativus*), squash, eggplant and paprika (*Capsicum annuum*). Perennial or orchard production consisted of guavas (*Psidium guajava*), citrus fruits (*Citrus*)) or date palms (*Phoenix dactylifera*). Farms in the Jordan Valley often integrate two of the cropping system types, but one cropping system usually dominates by land area and commercial focus. While the agricultural sector is considered as the main source of income for the majority of rural households in the Jordan Valley, farm incomes are low, averaging less than USD 700 a month [5].

2.2. Rural Household Multi-Indicator Survey

The Rural Household Multi-Indicator Survey (RHoMIS) [38,39] was applied to 248 farming households in six villages of the three governorates of the Jordan Valley by local agricultural extension agents from the Palestinian Ministry of Agriculture and the Palestinian Union of Agricultural Workers (UWAC) under the auspices of a research project led by the UN Food and Agriculture Organisation (FAO) in the West Bank and Gaza Strip. The villages for the survey were selected in consultation with local agricultural extension agents from the FAO and the Ministry of Agriculture who have been working a long time in the region and therefore were well acquainted with all the rural villages in the Jordan Valley. The selection of the villages was undertaken in order to capture the greatest heterogeneity for small scale farming in the Jordan Valley of the West Bank particularly taking into account cropping systems, land tenure systems, access to water, and levels of rural development. The surveys took place over a series of months from May 2018–December 2018.

Key variables extracted from the RHoMIS data to test the hypotheses outlined in the Introduction are presented in Table 1. The main predictor variables were governorate, land tenure status (owned-land, rented land and sharecropping), and primary cropping system of the farm (open field, greenhouse, or perennial—orchards). Household characteristics variables were age of household head, household size, food self-sufficiency (defined as the amount of food energy generated by the consumption of farm produce), progress out of poverty score (Schreiner, 2014; an asset-based poverty indicator), and gendered control of production (defined as the proportion of total household income and farm production under female control). Farm economic variables were farm income, production value (the marketing value of the crops sold by the farm on an area basis), market orientation (ratio of agricultural production sold relative to the total agricultural production), and membership of a cooperative. Farm management variables were area of land cultivated, N fertilizer inputs (on a per ha basis), manure inputs, and irrigation water use (on a per ha basis). Farm income was calculated for each farm and converted to dollars to facilitate international comparison. Land tenure systems of the farm were also reported on a per farm basis or according to the primary land tenure system of the farm.

Table 1. Description of variables assessed.

Variable Type	Variable	Description
Main predictor variables	Governorate	Jericho, Nablus or Tubas
	Land tenure status	Owned-land, rented land or sharecropping
	Cropping system	Greenhouse, open field or perennial production systems
Household characteristics	Average age of HHH (years)	The (average) age of the household head(s)
	Size of household (members)	Number of family members living in the household
	Progress out of poverty index (PPI)	A country-specific indicator of poverty, based on ten closed questions on directly observable household characteristics [40]
	Food self-sufficiency (Kcal MAE^{-1} day^{-1})	Amount of food energy generated by consumption of farm produce
	Female participation in decision-making	Relative control of adult female over the potential total food energy available
Farm economics	Farm income (USD year^{-1})	Total amount of cash generated by farm sales
	Production value (USD ha^{-1} year^{-1})	Total amount of cash generated by farm sales divided by area of land cultivated
	Market orientation (scale 0–1)	Relative importance of crop sales in generating potential total food energy available
	Membership of a cooperative (%)	Membership of a cooperative
Farm management characteristics	Land cultivated (ha)	Area of land cultivated
	N fertilizer inputs (kg ha^{-1} year^{-1})	Amount of nitrogen applied on farm through chemical fertilizer
	Manure inputs (kg ha^{-1} year^{-1})	Amount of manure applied on farm
	Irrigation inputs (m^3 ha^{-1} year^{-1})	Amount of irrigation water applied on farm
	Crop diversity (number of crops)	Number of different crops grown

2.3. Pathways to Development Stakeholder Interviews and Workshops

Key stakeholder interviews facilitated by the local coordination office of the FAO were conducted over the months of May and June 2018 to gather local insight into the relationships between land tenure status, farm management, rural development and poverty. In total, five groups of farmers and 25 key stakeholders from governmental (different departments from the Palestinian Ministry of Agriculture, the Palestinian Water Authority, the Swiss Development Cooperation, and the Spanish Development Cooperation), and civil society (Palestinian Hydrology Group, Applied Research Institute Jerusalem, Land Research Centre, Hebron University, Union of Agricultural Workers Committee, EcoPeace, and local cooperatives and water users committees) institutions were interviewed. The interviews lasted about one hour each. All conversations were recorded in written format then summarised and synthesised. Three further workshops were held in March 2019 in the different governorates of the Jordan Valley (Tubas, Nablus and Jericho). Ten to twelve farmers participated in each workshop representing the main cropping systems present in each governorate, along with key stakeholders from the Ministry of Agriculture and producer organisations. Each workshop began with a brief introduction to the research and the methodology of the workshop. Participants were then split into three groups, which were subsequently tasked with characterising three different types of farms in the Jordan Valley, one that is "hanging-in", one that is "stepping up" and one that is "successful". These prototype farms were then presented to the plenary group in order to stimulate discussion regarding the most important differences between the farms; the underlying reasons for these differences and thereby the most important entry points for more sustainable development. Notes from the group presentations and discussions were taken during the workshop and then translated and recorded electronically.

2.4. Statistical Analysis

Descriptive statistics were run on the data by the governorate. Where appropriate a Fisher's least significant difference test was applied to test for differences among governorates at the 5%

level of probability. To assess whether the cropping system was associated with land tenure status, a Pearson's Chi-squared test was applied to the proportion of farming households practicing the different cropping systems by land tenure status. To assess annual farm income by cropping system, a mixed linear regression model was used with land tenure status and governorate as random effects and cropping system used as the predictor variable. Mixed linear regression models were also used to evaluate the relationship between land tenure status (as the predictor variable) and different household, farm economic, and farm management characteristics (as the response variables), with the governorate included as a random effect in order to control for location-specific effects. Fisher's least significant difference tests were again applied to test for differences among land tenure status types at the 5% level of probability. To explicitly test the hypothesis that more secure land tenure status (owned land compared to rented land) would positively affect farm income and PPI indirectly through investments in farm management (cropping systems) we built a structural equation model. As such households that rented land were assigned the ordinal value of 0, while those that owned their land were assigned the ordinal value 1. Governorates were assigned ordinal values for the model according to feedback from local rural development stakeholders with regard to the vulnerability of farming households in each governorate. Accordingly, Tubas was assigned the lowest value (1) as it was deemed to have the most vulnerable farming households, Jericho was assigned 2, while Nablus was assigned 3, as the governorate with the number of least vulnerable farming households. Assumptions of homoscedasticity and normality were tested and data transformed as needed using the log function. All analyses were undertaken within the RStudio environment version 1.2.1335 for R (version 3.6.1), using ade4, agricolae, lme4, emmeans, multcomp, semPlot and ggplot2 packages.

3. Results

3.1. Farming Household and Farm Management Characteristics by Governorate

The descriptive statistical analyses of the dataset revealed that, in Jericho, the most common land tenure status for farming households was owned land (34 households—52%) and sharecropping (29 households—45%). Nablus was dominated by farming households that owned their land (62 households or 91% compared to 6 sharecropping (9%) and 0 renting land). In Tubas the majority of farming households also owned their land (61 households or 64%) compared to 34 renting (35%) and 1 sharecropping (1%). Across governorates, greenhouse cropping systems dominated. While open fields were more popular than perennial systems in Nablus and Tubas, the opposite was true for Jericho. The average age of heads of households did not significantly vary among governorates with the average age ranging between 42.7 in Nablus and 45.4 in Jericho. The size of households did differ among governorates with Tubas displaying the largest households on average (6.19) and Nablus displaying the smallest (5.21). Annual farm income was greatest in Nablus (USD 7641 year^{-1}) and smallest in Tubas (USD 3917 year^{-1}). The production value and market orientation mirrored these differences in annual farm income among governorate, while the highest proportion of farming households in Tubas were members of a cooperative (90%, compared to 62% and 34% in Jericho and Nablus, respectively; Table 2).

Table 2. Descriptive statistics by the governorate of the farming households surveyed in the Jordan Valley of the West Bank.

Variable		Governorate		
		Jericho	Nablus	Tubas
Farming households surveyed		65	68	96
Land tenure	Own land	34	62	61
	Rent in land	2	0	34
	Sharecropping	29	6	1
Cropping system	Greenhouse	37	45	48
	Open field	6	20	41
	Perennial	21	3	8
Average age of HHH (years) [†]		45.4 (1.19)a	42.7 (1.16)a	44.5 (0.97)a
Size of household (members) [†]		5.83 (0.34)ab	5.21 (0.33)b	6.19 (0.27)a
Farm income (USD year^{-1}) [†]		5278 (918)ab	7641 (1299)a	3917 (557)b
Production value (USD ha^{-1} year^{-1}) [†]		11443 (2130)a	14606 (2658)a	2586 (394)b
Market orientation (scale 0–1) [†]		0.899 (0.228)ab	0.957 (0.0237)a	0.882 (0.0183)b
Membership of a cooperative (%)		62	34	90

[†] means are indicated followed by standard errors (in parentheses). Letters to the right of standard errors indicate results from Fisher's least significant difference tests with different letters signifying differences at the 5% level of probability

3.2. Primary Cropping System by Land Tenure Status

A Pearson's Chi-squared test indicated significant differences in proportions of primary cropping system among land tenure status ($p \leq 0.001$). Households who owned their land tended to employ greenhouse cropping systems (over 60%) to a much greater extent than either perennial (just over 10%) or open field (about 25%). This pattern of proportion of cropping systems was very similar for sharecropping. However, on rented land over 60% of farming households employed open field cropping systems, but only around 36% employed greenhouse cropping systems, and less than 5% used perennial cropping systems (Figure 1). Annual farm income was significantly higher for perennial cropping systems (above USD 13,000 year^{-1}), while it was lowest for open field cropping systems (around USD 2500 year^{-1}). The average annual income for greenhouse cropping systems was around USD 7500 year^{-1} (Figure 2).
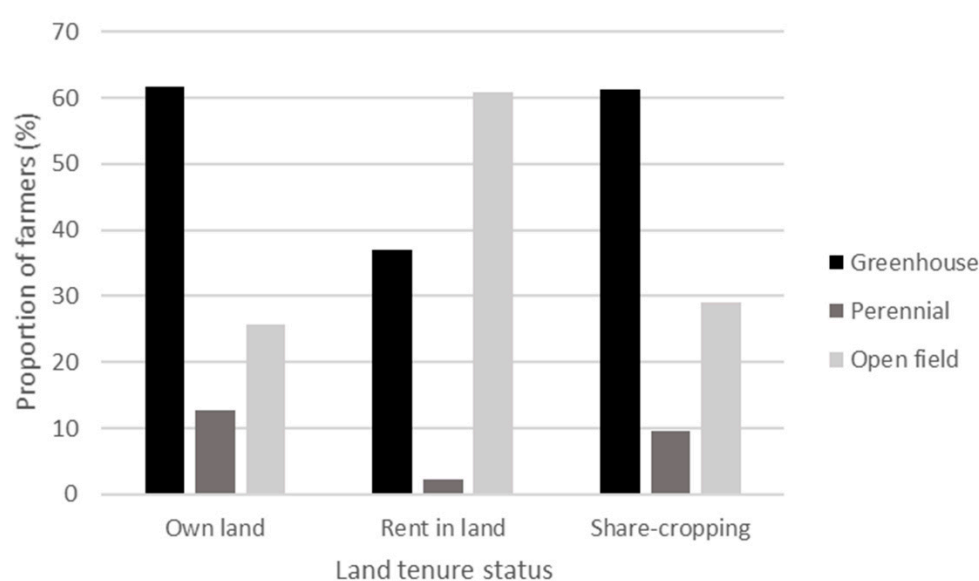
Figure 1. Bar chart displaying proportion of cropping system by land tenure status.
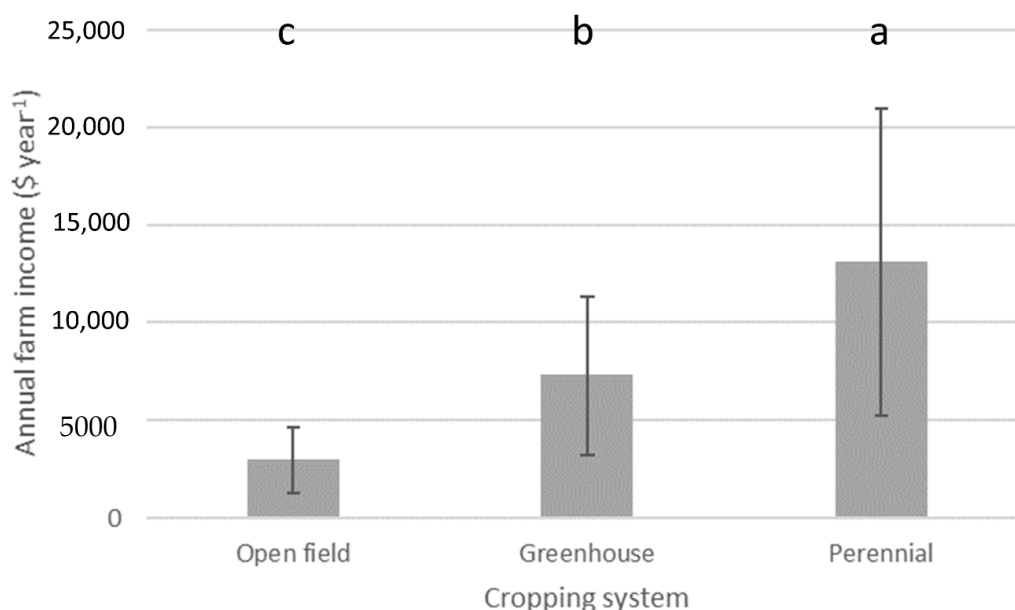
Figure 2. Annual farm income according to production system (Standard errors are indicated by the whiskers on each bar. The letters at the top of the chat indicate the results of the Fisher's least significant difference test with different letters signifying differences at the 5% level of probability).

3.3. Farming Household and Farm Management Characteristics by Land Tenure Status

Neither age of head of household nor size of household differed significantly among land tenure status types. Annual farm income was significantly highest for sharecropping farming households (USD 16,945 $year^{-1}$). Farmers who own their land also displayed greater annual farm income (USD 4667 $year^{-1}$) than those who rent land (USD 2444 $year^{-1}$). The production value was also greatest for sharecropping (USD 12,786 ha^{-1} $year^{-1}$), but not significantly different to owned-land (USD 8322 ha^{-1} $year^{-1}$). Both were significantly higher than rented land (USD 2053 ha $year^{-1}$). Market orientation displayed no significant differences among land tenure status. Nearly all households with rented land were members of a cooperative, but only 61% and 50% were for households that owned their land and participated in sharecropping, respectively (Table 3).

Sharecropping farms cultivated the largest area of land (2.55 ha) compared to those with rented land (1.31 ha), which in turn cultivated a larger area of land that owned-land farms (0.85 ha). Nitrogen fertilizer inputs were also greatest for sharecroppers (123.2 kg ha^{-1} $year^{-1}$) compared to owned-land (13.3 kg ha^{-1} $year^{-1}$) and rented land (11.0 kg ha^{-1} $year^{-1}$). No significant differences were found among land tenure status types for manure inputs with means ranging from nearly 90 kg ha^{-1} $year^{-1}$ for sharecroppers to just above 140 kg ha^{-1} $year^{-1}$ for households who owned land. Irrigation inputs were significantly higher for owned-land (3102 m^3 ha^{-1} $year^{-1}$) and sharecroppers (3677 m^3 ha^{-1} $year^{-1}$) compared to rented land (1041 m^3 ha^{-1} $year^{-1}$). Crop diversity was also higher for sharecroppers (2.7) compared to owned-land and rented land (both 1.8) (Table 3).

The Progress out of Poverty Score (PPI) was significantly better in owned-land households (50.1) compared to those with rented land or sharecroppers (43.2 and 35.8 respectively). Sharecropping households displayed the greatest food self-sufficiency (5164 Kcal per MAE^{-1} day^{-1}) compared to both owned-land and rented land. Rented land, on the other hand, displayed the lowest levels of food self-sufficiency (190 Kcal per MAE^{-1} day^{-1}), also significantly less than owned-land (720 Kcal per MAE^{-1} day^{-1}). Female participation in decision-making was highest among households that rented land (0.08) compared to both households that owned land (0.02) and households that participated in sharecropping (0.02) (Table 3).

Table 3. Results of the mixed model linear regressions assessing the effect of land tenure status on different farming household and farm management variables in the Jordan Valley of the West Bank.

Variable	Land Tenure Status		
	Own Land	**Rented Land**	**Sharecropping**
Average age of HHH (years) [†]	43.9 (1.09)a	47.6 (2.08)a	42.6 (1.99)a
Size of household [†]	5.60 (0.279)a	6.31 (0.587)a	6.02 (0.551)a
Annual farm income (USD year^{-1}) [†]	4667 (1144)b	2442 (831)c	16945 (5632)a
Production value (USD ha^{-1} year^{-1}) [†]	8322 (3077)a	2053 (920)b	12786 (5650)a
Market orientation [†]	0.912 (0.0264)a	0.929 (0.0439)a	0.897 (0.0409)a
Membership of a cooperative (%)	61	97	50
Land cultivated (ha) [†]	0.854 (0.308)c	1.307 (0.515)b	2.551 (0.999)a
N fertilizer inputs (kg ha^{-1} year^{-1}) [†]	13.3 (7.53)b	11.0 (8.99)b	123.2 (101.54)a
Manure inputs (kg ha^{-1} year^{-1}) [†]	147.7 (54.4)a	112.8 (51.5)a	89.2 (40.0)a
Irrigation inputs (m^3 ha^{-1} year^{-1}) [†]	3102 (2407)a	1041 (836)b	3677 (2964)a
Crop diversity (number of crops) [†]	1.86 (0.405)b	1.80 (0.418)b	2.65 (0.613)a
Progress out of poverty index (PPI)	50.1 (1.42)a	43.2 (2.86)b	35.8 (2.70)b
Food self-sufficiency (Kcal per MAE^{-1} day^{-1}) [†]	720 (181.4)b	190 (80.1)c	5164 (2096.8)a
Female participation in decision-making (scale 0–1) [†]	0.0234 (0.0206)b	0.0772 (0.0230)a	0.0199 (0.0228)b

[†] means are indicated followed by standard errors (in parentheses). Letters to the right of standard errors indicate results from Fisher's least significant difference tests with different letters signifying differences at the 5% level of probability.

3.4. Structural Equation Model Results

Land tenure status was positively associated with governorate such that Tubas had more households that rented land, while Nablus had more households that owned-land. Governorate was not directly associated with cropping system but was indirectly associated via the mediating pathway of land tenure status, such that households that owned their land tended to practice more greenhouse and perennial systems, while households renting land tended to practice more open field cultivation. This indicates that the differences observed in the distribution of the cropping system among governorates may be a result of differences in land tenure status distribution among governorates. Land tenure status was not directly associated with farm income but was indirectly associated via the mediating pathway of cropping system, such that households who practiced greenhouse and perennial systems generated greater annual farm income than households that practiced open field cropping. Finally, reflecting the associations with farm income, the cropping system was also associated with PPI such that households that practiced greenhouse and perennial systems had a higher PPI than households that practiced open field cropping (Figure 3).
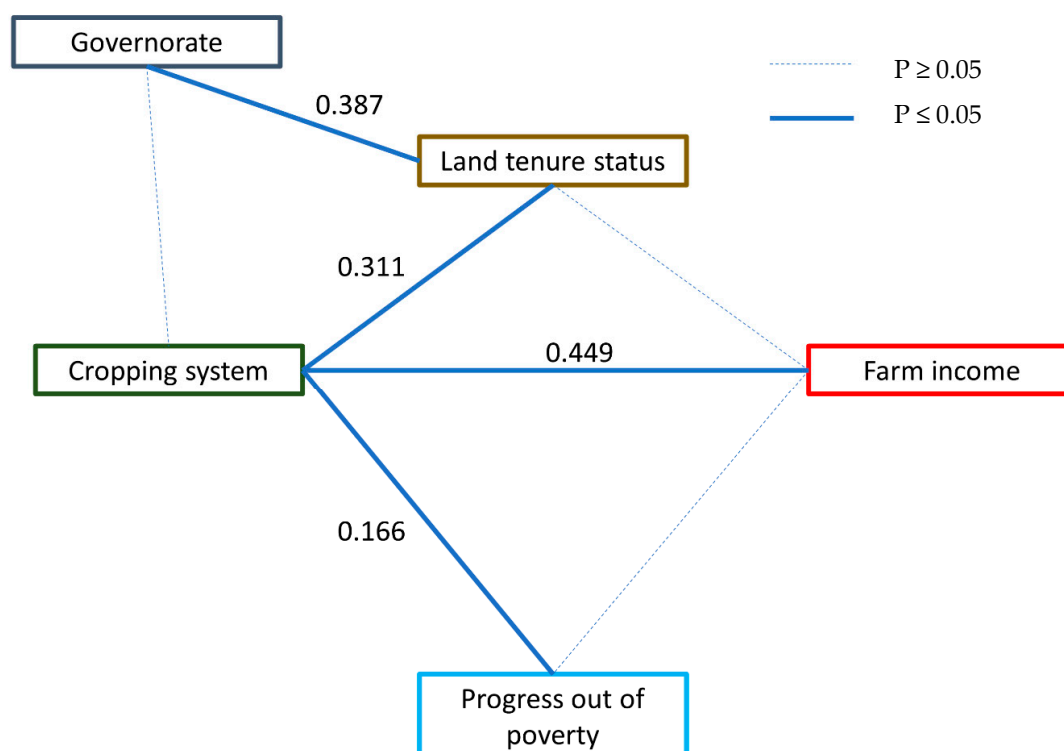
Figure 3. Structural equation model displaying the direct and indirect relationships between land tenure status, cropping system, farm income, and progress out of poverty (The standardised coefficient estimate is presented next to each "path" with a significance level of $p \le 0.05$. The standardised coefficient estimate refers to the regression coefficient that has been standardized so that the variances of dependent and independent variables are equal to 1 enabling comparability between SEM variables in terms of strength of effect. Root Mean Square Error of Approximation (RMSEA) ≤ 0.075; 90 Percent Confidence Interval: 0.000–0.155; p-value RMSEA: 0.236; Standardized Root Mean Square Residual (SRMR): 0.043).

3.5. Pathways to Development Stakeholder Interviews and Workshops

During both the workshops and stakeholder interviews (Figure 4) land tenure status was raised as a critical factor that can affect farm management decisions and therefore pathways to development. In particular, it was argued that farming households were less likely to invest in "less securely held land", either through investment in infrastructure or long-term management planning than land that was held with a more secure land tenure status. Specifically, with regard to rented land, it was argued that farming households would restrict their planning and decision-making to the time period of the rental contract. This, for example, would mean that farming households that rented land were less likely to cultivate perennial crops or orchards or even invest much in on-farm infrastructure such as greenhouses.

Furthermore, interviewees and workshop participants suggested that farming households that managed land under share-cropping agreements were constrained by the decisions taken by landowners with regards to cropping patterns and investments. Sharecroppers who received allocated resources (irrigation water and agricultural inputs) as part of the sharecropping agreement had little interest in either improving water use efficiency or adopting more sustainable integrated soil fertility or pest management. During interviews with key stakeholders and farmers, it was often stated that farmers who do not own their land tended to under-value the land.

Figure 4. Photos from the pathways to development workshop with farmers from Tubas governorate, West Bank, Palestine. Left: group of farmers and key stakeholders in discussion about the potential barriers and opportunities to agricultural development in the Jordan Valley. Right: Presentation of group discussions to the workshop.

It was argued by a number of stakeholders and farmers that large areas of agricultural land have been concentrated in a relatively small number of families as a consequence of historical land tenure systems in the Jordan Valley. Either for commercial reasons or out of fear of land confiscation, this land is often rented out to farmers for cash or placed under a sharecropping agreement. It was argued that this can create land fragmentation. An additional factor compounding the problem of land fragmentation according to many stakeholders and farmers is cultural traditions associated with land inheritance. According to traditional Islamic laws, land is passed down from generation to generation, being partitioned equally by area and location between (usually male) siblings. According to interviewees and workshop participants, this diminishes the original sizes of farms and fragments the land across locations.

It was argued that the growing trend towards land parcelization and fragmentation was a fundamental reason why small and medium scale farmers account form the majority of farms in the Jordan Valley. According to a number of key informants interviewed the relatively small size of land managed significantly affects the financial sustainability of these farms. Moreover, it creates barriers to the consolidation of agricultural land as it makes farm expansion dependent on the negotiation of land rights between more landowners.

4. Discussion

4.1. Land Tenure Status Influences Farm Income Via Cropping Systems Investments

In line with our hypotheses, the farming households with more secure land tenure status, those owning land and those sharecropping, generated significantly greater overall farm income and value production per hectare than the farming households with less secure, rented land tenure status (Table 3). These findings were verified in the pathways to development stakeholder interviews and workshops and are also supported by other studies reporting more secure land tenure status to be associated with greater farm income [24,41,42].

According to our results, both the data analysis and the pathway to development interviews and workshops, one of the reasons for these differences in annual farm income is likely to be linked to the differences in cropping systems practiced by the household land tenure status types. Significant

differences were observed in annual farm income among cropping systems, such that greenhouse cropping systems generated significantly greater amounts of annual farm income compared to open field, while perennial cropping systems generated significantly greater amounts of annual farm income than greenhouse cropping systems (Figure 2). Furthermore, those households with less secure land tenure status (rented-in land) tended to practice a much greater proportion of open field cropping systems (just over 60%) compared to owned-land (25%) and sharecropping (just under 30%). On the other hand, greenhouse cropping systems were employed by just over 60% of households that owned their land and those that were sharecropping, while they were employed in only around 35% of those households that rented-in their land. Perennial systems were only really practiced by households that owned their land (12%) or participated in sharecropping (10%) (Figure 1).

These relationships are further borne out in the structural equation model which confirmed that land tenure status was indirectly associated with farm income via the mediating variable of cropping system practiced on the farm. Specifically, the model indicates that the more secure the land tenure status (i.e., owned land compared to rented land), the more likely a farming household was to practice either greenhouse or perennial cropping systems, and the more likely a farm was to employ either greenhouse or perennial cropping systems the more annual farm income the household was likely to generate (Figure 3). It is likely that the relationship between cropping system and annual farm income is partly a result of differences in crops cultivated under each cropping system. As noted earlier, while open field cultivation tended to be dominated by squash, eggplant, faba bean and maize production, greenhouse and perennial cropping systems enabled farmers to produce more profitable crops such as tomato, cucumber, paprika and date palm.

These are important findings as they support previous research that suggests that there is an important link between land tenure status, farm investment decisions, and therefore annual farm income [24,43]. For example in a recent study from China, farming households that had more secure land tenure status tended to invest in crop–tree intercropping practices compared to those with less secure land tenure status [36]. In another study from Nicaragua that closely resembles our findings, farming households with greater land tenure security tended to practice cropping systems that required longer-term investments such as perennial fruit orchards compared to households with less secure land tenure status, which tended to practice annual cropping systems [32]. These results provide further evidence for Besley's hypothesis of "security effect" that argues that should a farming household perceive their land to not provide land tenure security, then the farming household is disincentivized to invest in the land [44]. In the current case, both greenhouse and perennial cropping systems require significantly more long-term investment than open-field cropping, and therefore it stands to reason that households that rented land in this study are much less likely to invest in these types of cropping systems.

Placing this finding within our conceptual framework, it appears that the land tenure status of farms in the Jordan Valley presents structural barriers to linear development transformations. Instead, as a result of the land tenure constraints associated with particular cropping systems, it is unlikely that farming households that rent their land can enjoy the same potential improvements to farm income as the other farming households that have greater land security. As outlined in the pathways to development stakeholder interviews and workshops these problems may be aggravated by the trend toward greater land fragmentation in the Jordan Valley, meaning that farm expansion is not necessarily a straight forward option. This is not to say that alternative development paths do not exist. However, within the farms studied in this investigation, cropping system and therefore land tenure status appear to be particularly important variables in influencing annual farm income and agricultural development.

This analysis provides for further evidence for the theoretical framework of complex adaptive systems [45] and aligns closely with Tittonell, (2014) who argued that rural development changes are not based on simple linear trajectories, but involve regime shifts that are constrained by broader structural factors. Seen from this perspective, many now argue that land tenure security is a critical requirement

for the attainment of a number of sustainable development goals [46]. As concluded by a review of policy recommendations for the sustainable management of natural resources and food production in Mediterranean countries, new innovative approaches to governance and land tenure will be necessary to unlock opportunities for future generations. Such approaches may include governmental schemes to enable farmers, especially younger farming households, to purchase farm land and new legislation or land tenure system reforms that enhance land tenure security [33]. In addition to such approaches, it will also be critical to support programmes to stimulate entrepreneurship skills related to agriculture and food systems and explore opportunities for income and livelihood diversification in rural areas [6]. Indeed, livelihood diversification through tapping into economic opportunities presented by greater rural mobility has been shown to be an important mechanism to increase resilience and may be associated with different cropping systems [47–49]. Rural tourism, food processing industries, business start-ups along with construction, rehabilitation and maintenance of essential community infrastructure among other sectors are often cited as sectors that enable rural livelihood diversification in the West Bank and Jordan Valley [50].

4.2. Sharecropping as a Special Case of More Secure Land Tenure Status

Another notable finding was that the more secure land tenure households (owned-land and sharecroppers) generally applied the most chemical fertilizers and used the most irrigation water (Table 3). These results reflect previous studies reporting more secure land tenure status to be associated with higher agricultural inputs [41,51]. For example, in a study from Rwanda, farmers were found to be more likely to participate in a crop intensification programme using subsidised fertilizers when the farming families felt they had more land tenure security [17]. In another study from Côte d'Ivoire, greater land tenure security was associated with investment in irrigation water supply canals [52].

While the statistical analyses did not reveal significant differences, sharecroppers displayed the lowest levels of manure inputs, and farming households who owned their land displayed the greatest (Table 3). This may raise an important question with regard to the approach to sustainability among the household land tenure status types. Generally speaking, the research literature has found that farming households with more secure land tenure status tend to adopt more soil and water conservation land management techniques [25,29,53,54]. In our case study, however, despite the large role played by organic matter inputs in regulating soil organic carbon (SOC) and the critical role SOC plays in water capture and storage [55,56] and soil biological activity and diversity [57,58], sharecroppers appear to invest proportionately much more in chemical fertilizer inputs than manure inputs. Given the extremely arid ecological context and the much larger irrigation water inputs compared to farming households that rent land, this may indicate important sustainability concerns for sharecropping farms and provides an additional example, where enhanced land tenure status may not always lead to the adoption of more sustainable agricultural practices (such as Varble et al., 2016). Indeed, these sustainability concerns were specifically raised with regard to sharecropping farms during the pathways to development stakeholder interviews and workshops, where many argued that sharecropping agreements often provided few incentives for either improving water use efficiency or adopting more sustainable integrated soil fertility or pest management. Could it be that sharecropping farming households generally have less incentive to consider soil health issues than the other household land tenure status types despite seemingly greater land tenure security compared to farming households renting-in land? Contrary to this idea, a case study in Ghana found that sharecropping farming households displayed no significant differences in the adoption of soil conservation techniques than farming households that rented their land [51].

Clearly, sharecropping systems represent a more complicated relationship between landowner, land manager and land. Moreover, shareholder arrangements come in many different forms that may influence the prominence sustainability considerations are addressed in sharecropped farms [59]. Indeed [60], different forms of sharecropping will lead to different outcomes with regard to land sustainability. A contributing factor in our case study is likely to be due to the fact that the most

common form of sharecropping contract in the Jordan Valley involved the landowner covering all of the costs for irrigation water and other agricultural inputs. In this instance therefore it seems that the sharecropping land manager may have fewer incentives to adopt more efficient agricultural input management, although more research in this regard is required to understand this potential relationship more.

The results of this study also revealed significant differences among land tenure household types for PPI, such that households that owned their land displayed the highest PPI score compared to both sharecropping households and those that rented land (Table 3). While the difference between households that owned their land and those that rented their land may be expected due to the associations discussed above between land tenure status and farm income, the fact that farming households that participated in sharecropping did not display higher PPI than those that rented their land is an important finding. It indicates that in spite of the fact that sharecropping farming households generated significantly more farm income than those that rented land, the farming families that managed the sharecropping land may still represent the most economically vulnerable farming households surveyed. Part of the explanation for this may be because sharecropping households may not have been sharecropping for as long as families that owned their land have been farming, and therefore may not have had the time to accrue the same wealth and assets (the indicators upon which PPI is based). More research to assess the potential cause of the disparity between farm income and PPI scores for sharecropping households is necessary. Nevertheless, it is striking that one of the only previous studies that have assessed the welfare of sharecropping families found similar results to ours. In the study from eastern Thailand sharecropping households were also the most economically vulnerable types of households surveyed, often being landless migrants or local farmers with marginal lands [42]. While some have argued for the promotion of sharecropping systems due to their association with higher agricultural investment and productivity [61], we would, therefore, urge caution from a broader rural development perspective until more is understood with regards to the challenges and opportunities related to the farming families that manage the sharecropped land as well as the sustainability concerns raised above.

4.3. Land Tenure, Food Self-Sufficiency and Gender

Farming households with greater land tenure security, both those who owned their land and participated in sharecropping, displayed higher levels of food self-sufficiency than households who rented land (Table 3). Moreover, those participating in sharecropping tended to display significantly greater food self-sufficiency than farming households that owned their land. While important gaps remain in the literature with regard to the links between land tenure status and food security, the results from the current study appear to corroborate previous studies suggesting that there is a positive association between the two variables [62]. For example, in a study from India, farming households that were more land tenure secure displayed increased levels of milk consumption as a result of their greater ability to grow fodder in between cropping cycles [63]. In another from Zambia, the food security status of landowners increased as a result of their investment in more sustainable agricultural techniques such as agroforestry practices and crop diversification [29]. With regard to this last study, it is noteworthy that in the current study households participating in sharecropping also displayed the greatest crop diversification, reflecting their higher levels of food self-sufficiency (Table 3).

Female participation in decision-making was observed to be significantly less in farming households with more secure land tenure status (owned-land and sharecroppers) compared to households that rented in their land. It is not immediately clear why this may be the case. However, a small but growing number of studies have started to address the relationship between land tenure, gender issues and agricultural production systems. For example, two recent studies from Uganda, and Tanzania and Ethiopia, found that while female operated plots and farms displayed lower yield levels, possibly as a result of lower input levels, the granting of land ownership rights to women for the land could have the potential to significantly increase productivity. This suggests that productivity

differences based on gender may be a result of land tenure status inequalities [64,65]. Given that land tenure rights in the Jordan Valley are highly skewed toward male ownership, as outlined by participants in the pathways to development interviews and workshops, it is likely that similar challenges will be present there too [66]. Overall, however, there is a lack of consolidated and synthesized data on women's land rights, especially in rural areas [67]. Therefore, more research is necessary to help identify effective ways of addressing land tenure security for rural women.

5. Conclusions

A number of prerequisites for addressing rural poverty among small scale farmers in the Jordan Valley have become apparent as a result of this research. Our data suggest that land tenure systems are associated with investments in different cropping systems, such that rented land is associated with a greater proportion of open field production, while owned-land and sharecropping land tenure systems tended to have greater proportions of perennial or greenhouse production (cropping systems that require more initial and longer-term investment). We also found that annual farm income was associated with cropping system, such that farms whose primary cropping system was open-fields tended to generate less annual farm income than those whose primary cropping systems were either greenhouse or perennial. This finding suggests that agricultural development of small-scale farms in the Jordan Valley may not be just a linear process but may also involve regime shifts in farm management (cropping systems). It may be the case therefore that land tenure constraints a farming family's ability to "shift" from an open-field producer to a greenhouse or perennial cropping system. These findings were confirmed by both the structural equation model and the "pathways to development" interviews and workshops indicating that farm income and progress out of poverty are mediated by investments in farm management, in particular cropping system techniques practiced, which itself is dependent on land tenure status.

Our research also indicates that sharecropping may be a special case of "more secure" land tenure. While these farms enjoyed the benefits of having a more secure long-term investment for the owners, and therefore also tended to display a greater proportion of farms employing cropping systems that generated greater value production and farm income, the farming families managing these farms displayed lower levels of PPI compared to the other farming family households. Furthermore, the greater proportional investment in chemical fertilizers rather than manure inputs and the greater use of irrigation inputs in this extremely arid ecological context raises important sustainability questions for these farms. Both of these findings raise concerns for calls to promote sharecropping contracts.

The practical implications of this research are very concrete. Small scale agricultural development in the Jordan Valley relies on farmers achieving greater access to more secure land tenure. Moreover, the research reveals that farming households that rent land and practice open field cropping systems are likely to be the most vulnerable group of farming families, and, as such, rural development agencies should incorporate these considerations within their projects and programmes.

Author Contributions: Conceptualization, M.E.C., J.H. and M.v.W.; Formal analysis, M.E.C.; Investigation, M.E.C., J.H. and M.v.W.; Methodology, M.E.C., J.H. and M.v.W.; Project administration, M.E.C.; Supervision, J.H. and M.v.W.; Writing—original draft, M.E.C.; Writing—review & editing, M.E.C., J.H., S.J.F. and M.v.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: The research was conducted as part of a voluntary research assignment with the Food and Agriculture Organisation Coordination Office for the West Bank and Gaza Strip. The authors wish to thank the generous administrative and logistical support provided by the FAO during the data collection, especially Ciro Fiorillo, Rana Hannoun, Azzam Saleh and Intissar Eshtayah. We would also like to thank the farming families and local stakeholders who participated in the research.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Graeub, B.E.; Chappell, M.J.; Wittman, H.; Ledermann, S.; Kerr, R.B.; Gemmill-Herren, B. The State of Family Farms in the World. *World Dev.* **2016**, *87*, 1–15. [CrossRef]

2. Rapsomanikis, G. *The Economic Lives of Smallholder Farmers*; FAO: Rome, Italy, 2015.

3. Oxfam. *On the Brink: Israeli Settlements and Their Impact on Palestinians in the Jordan Valley*; Oxfam: Nairobi, Kenya, 2012; Volume 10.

4. Palestine Economic Policy Research Institute. *Economic Monitor*; Palestine Economic Policy Research Institute: Ramallah, Palestine, 2016.

5. Isaac, J.; Ghattas, R.; Hrimat, N. *Palestinian Agricultural Production and Marketing between Reality and Challenges: Executive Summary for a Research Study*; ARIJ: Jerusalem, Israel, 2015.

6. Nori, M.; Triandafyllidou, A. *Mediterranean Interfaces: Agriculture, Rural Development and Migration. Forward-Looking Policies and Programmes for an Integrated Approach*; Cadmus: Florence, Italy, 2019.

7. Birner, R.; Resnick, D. The Political Economy of Policies for Smallholder Agriculture. *World Dev.* **2010**, *38*, 1442–1452. [CrossRef]

8. Hazell, P.; Poulton, C.; Wiggins, S.; Dorward, A. The Future of Small Farms: Trajectories and Policy Priorities. *World Dev.* **2010**, *38*, 1349–1361. [CrossRef]

9. Panichvejsunti, T.; Kuwornu, J.K.M.; Shivakoti, G.P.; Grünbühel, C.; Soni, P. Smallholder farmers' crop combinations under different land tenure systems in Thailand: The role of flood and government policy. *Land Use Policy* **2018**, *72*, 129–137. [CrossRef]

10. Scopel, E.; Triomphe, B.; Affholder, F.; Da Silva, F.A.M.; Corbeels, M.; Xavier, J.H.V.; Lahmar, R.; Recous, S.; Bernoux, M.; Blanchart, E.; et al. Conservation agriculture cropping systems in temperate and tropical conditions, performances and impacts. A review. *Agron. Sustain. Dev.* **2013**, *33*, 113–130. [CrossRef]

11. Ostrom, E.; Cox, M. Moving beyond panaceas: A multi-tiered diagnostic approach for social-ecological analysis. *Environ. Conserv.* **2010**, *37*, 451–463. [CrossRef]

12. Liu, J.; Dietz, T.; Carpenter, S.R.; Alberti, M.; Folke, C.; Moran, E.; Pell, A.N.; Deadman, P.; Kratz, T.; Lubchenco, J.; et al. Complexity of Coupled Human and Natural Systems. *Science* **2007**, *317*, 1513–1516. [CrossRef] [PubMed]

13. Ostrom, E. A general framework for analyzing sustainability of social-ecological systems. *Science* **2009**, *325*, 419–422. [CrossRef]

14. Cumming, G.S.; Barnes, G.; Southworth, J. Environmental Asymmetries. In *Complexity Theory for a Sustainable Future*; Columbia University Press: New York, NY, USA, 2008; pp. 17–45. ISBN 9780231134613.

15. Tittonell, P. Livelihood strategies, resilience and transformability in African agroecosystems. *Agric. Syst.* **2014**, *126*, 3–14. [CrossRef]

16. Hemming, D.J.; Chirwa, E.W.; Dorward, A.; Ruffhead, H.J.; Hill, R.; Osborn, J.; Langer, L.; Harman, L.; Asaoka, H.; Coffey, C.; et al. Agricultural input subsidies for improving productivity, farm income, consumer welfare and wider growth in low- and lower-middle-income countries: A systematic review. *Campbell Syst. Rev.* **2018**, *14*, 1–153. [CrossRef]

17. Nahayo, A.; Omondi, M.O.; Zhang, X.H.; Li, L.Q.; Pan, G.X.; Joseph, S. Factors influencing farmers' participation in crop intensification program in Rwanda. *J. Integr. Agric.* **2017**, *16*, 1406–1416. [CrossRef]

18. Zeng, D.; Alwang, J.; Norton, G.; Jaleta, M.; Shiferaw, B.; Yirga, C. Land ownership and technology adoption revisited: Improved maize varieties in Ethiopia. *Land Use Policy* **2018**, *72*, 270–279. [CrossRef] [PubMed]

19. Delgado, J.A.; Barrera Mosquera, V.H.; Escudero López, L.O.; Cartagena Ayala, Y.E.; Alwang, J.R.; Stehouwer, R.C.; Arévalo Tenelema, J.C.; D'Adamo, R.; Domínguez Andrade, J.M.; Valverde, F.; et al. Conservation Agriculture Increases Profits in an Andean Region of South America. *Agrosystems Geosci. Environ.* **2019**, *2*, 1–8. [CrossRef]

20. Mattia, C.M.; Lovell, S.T.; Davis, A. Identifying barriers and motivators for adoption of multifunctional perennial cropping systems by landowners in the Upper Sangamon River Watershed, Illinois. *Agrofor. Syst.* **2018**, *92*, 1155–1169. [CrossRef]

21. Mensah-Bonsu, A.; Sarpong, D.B.; Al-Hassan, R.; Egyir, I.S.; Asuming-Brempong, S.; Egyir, I.S.; Kuwornu, J.K.M.; Osei-Asare, Y.B. Intensity of and factors affecting land and water management practices among smallholder maize farmers in Ghana. *Afr. J. Agric. Resour. Econ.* **2017**, *12*, 142–157.

22. Muzari, W.; Gatsi, W.; Muvhunzi, S. The Impacts of Technology Adoption on Smallholder Agricultural Productivity in Sub-Saharan Africa: A Review. *J. Sustain. Dev.* **2012**, *5*, 69–77. [CrossRef]

23. Place, F. Land Tenure and Agricultural Productivity in Africa: A Comparative Analysis of the Economics Literature and Recent Policy Strategies and Reforms. *World Dev.* **2009**, *37*, 1326–1336. [CrossRef]

24. Paltasingh, K.R. Land tenure security and adoption of modern rice technology in Odisha, Eastern India: Revisiting Besley's hypothesis. *Land Use Policy* **2018**, *78*, 236–244. [CrossRef]

25. Saudubray, F.; Scherer, C. Land Tenure Management: A Key Determinant of Sustainable Farming in Martinique. *J. Sustain. Agric.* **2007**, *29*, 13–28. [CrossRef]

26. Soule, M.J.; Tegene, A.; Wiebe, K.D. Land Tenure and the Adoption of Conservation Practices. *Am. J. Agric. Econ.* **2000**, *82*, 993–1005. [CrossRef]

27. Tefera, B.; Sterk, G. Land management, erosion problems and soil and water conservation in Fincha'a watershed, western Ethiopia. *Land Use Policy* **2010**, *27*, 1027–1037. [CrossRef]

28. Walmsley, A.; Sklenička, P. Various effects of land tenure on soil biochemical parameters under organic and conventional farming—Implications for soil quality restoration. *Ecol. Eng.* **2017**, *107*, 137–143. [CrossRef]

29. Nkomoki, W.; Bavorová, M.; Banout, J. Adoption of sustainable agricultural practices and food security threats: Effects of land tenure in Zambia. *Land Use Policy* **2018**, *78*, 532–538. [CrossRef]

30. Lawin, K.G.; Tamini, L.D. Land Tenure Differences and Adoption of Agri-Environmental Practices: Evidence from Benin. *J. Dev. Stud.* **2019**, *55*, 177–190. [CrossRef]

31. Varble, S.; Secchi, S.; Druschke, C.G. An Examination of Growing Trends in Land Tenure and Conservation Practice Adoption: Results from a Farmer Survey in Iowa. *Environ. Manag.* **2016**, *57*, 318–330. [CrossRef]

32. Bandiera, O. Land tenure, investment incentives, and the choice of techniques: Evidence from Nicaragua. *World Bank Econ. Rev.* **2007**, *21*, 487–508. [CrossRef]

33. CIHEAM (International Centre for Advanced Mediterranean Agronomic Studies); FAO (Food and Agriculture Organization of the United Nations). *MediTerra: Zero Waste in the Mediterranean. Natural Resources, Food, and Knowledge*; Presses de Sciences Po: Paris, France, 2016; ISBN 9782724619218.

34. Casini, M.; Bastianoni, S.; Gagliardi, F.; Gigliotti, M.; Riccaboni, A.; Betti, G. Sustainable development goals indicators: A methodological proposal for a multidimensional fuzzy index in the mediterranean area. *Sustainability* **2019**, *11*, 1198. [CrossRef]

35. Gray, C.L. Rural out-migration and smallholder agriculture in the southern Ecuadorian Andes. *Popul. Environ.* **2009**, *30*, 193–217. [CrossRef]

36. Rao, F.; Spoor, M.; Ma, X.; Shi, X. Land tenure (in)security and crop-tree intercropping in rural Xinjiang, China. *Land Use Policy* **2016**, *50*, 102–114. [CrossRef]

37. Kool, J. *Sustainable Development in the Jordan Valley Final Report of the Regional NGO Master Plan*; Springer: Cham, Switzerland, 2016; Volume 13, ISBN 9783319300351.

38. Hammond, J.; Fraval, S.; van Etten, J.; Suchini, J.G.; Mercado, L.; Pagella, T.; Frelat, R.; Lannerstad, M.; Douxchamps, S.; Teufel, N.; et al. The Rural Household Multi-Indicator Survey (RHoMIS) for rapid characterisation of households to inform climate smart agriculture interventions: Description and applications in East Africa and Central America. *Agric. Syst.* **2017**, *151*, 225–233. [CrossRef]

39. Van Wijk, M.; Hammond, J.; Gorman, L.; Adams, S.; Ayantunde, A.; Baines, D.; Bolliger, A.; Bosire, C.; Carpena, P.; Chesterman, S.; et al. The Rural Household Multiple Indicator Survey, data from 13,310 farm households in 21 countries. *Sci. Data* **2020**, *7*, 1–9. [CrossRef] [PubMed]

40. Desiere, S.; Vellema, W.; D'Haese, M. A validity assessment of the Progress out of Poverty Index (PPI)^TM. *Eval. Program Plan.* **2015**, *49*, 10–18. [CrossRef] [PubMed]

41. Wannasai, N.; Shrestha, R.P. Role of land tenure security and farm household characteristics on land use change in the Prasae Watershed, Thailand. *Land Use Policy* **2008**, *25*, 214–224. [CrossRef]

42. Smith, R.E. Land tenure, fixed investment, and farm productivity: Evidence from Zambia's southern province. *World Dev.* **2004**, *32*, 1641–1661. [CrossRef]

43. Aha, B.; Ayitey, J.Z. Biofuels and the hazards of land grabbing: Tenure (in)security and indigenous farmers' investment decisions in Ghana. *Land Use Policy* **2017**, *60*, 48–59. [CrossRef]

44. Besley, T. Property rights and investment incentives: Theory and evidence from Ghana. *J. Political Econ.* **1995**, *103*, 903–937. [CrossRef]

45. Norberg, J.; Cumming, G.S. *Complexity Theory for a Sustainable Future*; Columbia University Press: New York, NY, USA, 2008; ISBN 0231508867.

46. Keovilignavong, O.; Suhardiman, D. Linking land tenure security with food security: Unpacking farm households' perceptions and strategies in the rural uplands of Laos. *Land Use Policy* **2020**, *90*. [CrossRef]

47. Caulfield, M.; Bouniol, J.; Fonte, S.J.; Kessler, A. How rural out-migrations drive changes to farm and land management: A case study from the rural Andes. *Land Use Policy* **2019**, *81*, 594–603. [CrossRef]

48. Brandt, R.; Kaenzig, R.; Lachmuth, S. Migration as a Risk Management Strategy in the Context of Climate Change: Evidence from the Bolivian Andes. In *Migration, Risk Management and Climate Change: Evidence and Policy Responses*; Springer: Cham, Switzerland, 2016; pp. 43–61.

49. Serrat, O. The Sustainable Livelihoods Approach. In *Knowledge Solutions: Tools, Methods, and Approaches to Drive Organizational Performance*; Springer: Singapore, 2017; pp. 21–26, ISBN 9789811009839.

50. European Training Foundation. *Labour Market and Employment Policies in Palestine*; European Training Foundation: Torino, Italy, 2014.

51. Abdulai, A.; Owusu, V.; Goetz, R. Land tenure differences and investment in land improvement measures: Theoretical and empirical analyses. *J. Dev. Econ.* **2011**, *96*, 66–78. [CrossRef]

52. Sakurai, T. Intensification of rainfed lowland rice production in West Africa: Present status and potential green revolution. *Dev. Econ.* **2006**, *44*, 232–251. [CrossRef]

53. Nguyen, T.T.; Bauer, S.; Grote, U. Does land tenure security promote manure use by farm households in Vietnam? *Sustainability* **2016**, *8*, 178. [CrossRef]

54. Mariara, J.K.; Linderhof, V.; Kruseman, G. Does Land Tenure Security Matter for Investment in Soil and Water Conservation? Evidence From Kenya. *Afr. J. Agric. Resour. Econ.* **2010**, *4*, 123–139.

55. Álvarez, A.M.; Carral, P.; Hernández, Z.; Almendros, G. Assessment of Soil Organic Matter Molecular Characteristics Related to Hydrophysical Properties in Semiarid Soils (Central Spain). *Arid Land Res. Manag.* **2013**, *27*, 303–326. [CrossRef]

56. Buchmann, C.; Schaumann, G.E. The contribution of various organic matter fractions to soil–water interactions and structural stability of an agriculturally cultivated soil. *J. Plant Nutr. Soil Sci.* **2018**, *181*, 586–599. [CrossRef]

57. Wood, S.A.; Bradford, M.A. Leveraging a New Understanding of how Belowground Food Webs Stabilize Soil Organic Matter to Promote Ecological Intensification of Agriculture. In *Soil Carbon Storage*; Elsevier: Amsterdam, The Netherlands, 2018; pp. 117–136.

58. Moore, J.C.; Berlow, E.L.; Coleman, D.C.; De Suiter, P.C.; Dong, Q.; Hastings, A.; Johnson, N.C.; McCann, K.S.; Melville, K.; Morin, P.J.; et al. Detritus, trophic dynamics and biodiversity. *Ecol. Lett.* **2004**, *7*, 584–600. [CrossRef]

59. Sen, D. Sharecropping in Theory and Practice: A Selective Review. In *Understanding Development: An Indian Perspective on Legal and Economic Policy*; Banerjee, S., Mukherjee, V., Haldar, S.K., Eds.; Springer: Cham, Switzerland, 2015; pp. 1–272. ISBN 9788132224556.

60. Ray, T. Sharecropping, Land Exploitation and Land Improving Investments. *Agric. Econ.* **2004**, *56*, 127–143. [CrossRef]

61. Ofuoku, A.U. Sharecropping Contract Experience in Delta State, Nigeria. *J. Notheast Agric. Univ.* **2015**, *22*, 62–68. [CrossRef]

62. Holden, S.T.; Ghebru, H. Land tenure reforms, tenure security and food security in poor agrarian economies: Causal linkages and research gaps. *Glob. Food Secur.* **2016**, *10*, 21–28. [CrossRef]

63. Pritchard, B.; Rammohan, A.; Sekher, M. Land ownership, agriculture, and household nutrition: A case study of north Indian villages. *Geogr. Res.* **2017**, *55*, 180–191. [CrossRef]

64. Mwesigye, F.; Guloba, M.; Barungi, M. Women's Land Rights and Agricultural Productivity in Uganda. In *Women and Sustainable Human Development*; Springer International Publishing: Cham, Switzerland, 2020; pp. 71–88.

65. Melesse, T.M.; Awel, Y.M. Land Tenure, Gender, and Productivity in Ethiopia and Tanzania. In *Women and Sustainable Human Development*; Springer International Publishing: Cham, Switzerland, 2020; pp. 89–108.

66. Mizyed, N.; Sahar, J.; Saleh Ayasa, A. *The Status of Land Tenure, Planning and Management in the West Bank and Gaza Strip*; FAO: Jerusalem, Israel, 2015.

67. Namubiru-Mwaura, E. *Gender Equality & Development, Land Tenure and Gender: Approaches and Challenges for Strenghtening Rural Women's Land Rights*; World Bank: Washington, DC, USA, 2014; Volume 6, pp. 1–30.