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Diversity of Sources of Income for Smallholder Farming Communities in Malawi: Importance for Improved Livelihood

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Abstract: Agriculture is vital to global food production. Around 550 million smallholding households produce most of the world's food, and many rely on livestock rearing for a living. Smallholder farms must survive and thrive to maintain and increase food production. Baseline information is vital for further extension service interventions. The goal of this Malawian study was to collect quantitative baseline data on crop and livestock production, agriproduct sales, and other indicators through a household survey, and to compare the efficacy (in terms of income) of using the concept of "Lead and Follow" farmer training programs. The baseline study survey was carried out in 44 sections of 11 extension planning areas from Malawi's five districts (Dowa, Kasungu, Mchinji, Mzimba, and Rumphi). In total, 1131 smallholder households were interviewed. Crop production, livestock farming, and providing casual labor for others were all identified as significant sources of income for smallholders, implying that all agriproducts (the whole-farm approach) is equally important for improving smallholder livelihoods. On the one hand, the whole-farm approach should improve smallholders' resilience regarding climate change and poverty. Lower agriproduct sales, on the other hand, indicated that links to the market were frequently poor but an increased market focus should help smallholders sell their produce at a fair margin. In terms of best practices adoption, both Lead and Follow farmers adopted similar farm practices (crops and livestock) to increase income. In general, no significant difference in income was calculated from many farm enterprises for both Lead and Follow farmers. However, the income from pigs and firewood was significantly higher for Follow farmers than for Lead farmers. Lead farmers reported significantly higher off-farm income sources. Significant changes are proposed to the "Lead farmer extension approach".

Keywords: follow farmers; lead farmers; livelihood; market linkages; smallholder; sustainable production

1. Introduction

Agriculture provides the foundational basis for food supply [1,2], and this is particularly true in developing regions. Sub-Saharan Africa must significantly improve productivity in the agricultural sector to combat issues of rapid population growth and climate change. According to the United Nations, small-scale family farms account for more than half of the world's food production [3]. About 1.5 billion people live on smallholder farms,

of which half a billion are completely or partially dependent on livestock. Approximately two-thirds of the African population relies on smallholder agriculture. It is estimated that 73% of the food consumed in Asia and sub-Saharan Africa is produced by these farming communities [4,5]. Many farmers who grow smaller quantities of produce often do not rely much on the market but retain their produce for their own use [6]. Cattle herders in Africa, relying heavily on grazing areas for fodder, use small-scale farming as a means of providing feed for their livestock. Livestock often struggle to maintain body condition during the dry season, especially in places where rainfall is erratic, and decreases in milk availability result in malnourishment in the family and in particular in infants [7]. Local food resources are also scarce in the marketplace.

Malawi is a landlocked country with a large freshwater reservoir; Lake Malawi, the third-largest freshwater lake in Africa, is the eleventh largest in the world. It constitutes 20% of Malawi's total area [8,9]. More than 19 million people in Malawi live on a per capita gross national income (GNI) of USD 380 per annum basis, making the country the sixth poorest in the world [10–12]. An overwhelming majority rely on farming for their livelihood [13], with 70% of the population living on less than USD 1.08 per day. Half of Malawi's population earns less than the estimated costs of a diet providing minimum calorie intake, and about half of the children are malnourished [13,14]. Whether in rural or urban areas, households use 48–53% of the average monthly budget to buy maize; meat comes the second, with milk and eggs the next [15]. Livestock are mostly used as a form of financial insurance against drought, erratic rainfall, and flooding in farm fields [16]. They are essential for the population's ability to recover from unfavorable climate conditions, and to maintain food security.

Food production is dependent on rainfall and is, thus, susceptible to droughts and inconsistent rainfall [17]. In recent years, more frequent severe weather-related shocks and stresses, including erratic rainfall, flooding and prolonged dry spells, attest to the impact of climate change [18]. Malawi has experienced high rates of climate vulnerability, with significant disparities between urban and rural areas, and between regions, with the south of the country being the worst affected. In 2015, 2016 and 2019, Malawi experienced serious and unprecedented consecutive floods and droughts, with consequent adverse effects on key socio-economic sectors and on the economy overall.

It is important to develop a detailed understanding of any farming system before exploring opportunities to improve it. The smallholder farming systems of Sub-Saharan Africa (SSA) and the disparate extension services supporting them have received very little attention. A better understanding of the type and scale of extension protocols required for smallholder farming communities in this challenging environment is of prime concern. The extension was originally intended as a "service" to farmers to improve their livelihoods by disseminating research-based knowledge [19]. Davis [19] briefly described the possible causes of extension service failure, including a lack of relevant technology, a failure to consider the clientele in defining and solving problems, and weak linkages between extension, research, and farming practitioners. Critical analysis is required before future interventions can be prioritized. The most appropriate extension methodologies for any farming community should improve the productivity of smallholders. Once their productivity is improved, a sustainable linkage with a market free of political interference is vital to selling the agriproducts at prices that yield a profit for the farmer. It is believed that smallholder producers have failed to attain reasonable market prices due to their naivety with marketing and also from inept government controls on pricing. Linkages with the private sector (private enterprises) are essential to support sustainable production and profit margins to maintain smallholders' livelihoods.

This study aimed to establish a baseline related to the TRANSFORM program (designed to focus on sustainable food systems for rural resilience and transformation in Malawi). The objective of the TRANSFORM program is to strengthen local food systems in selected extension planning areas (EPAs) in five of Malawi's rural districts and to demonstrate a sustainable improvement in food and nutrition security, resilience to climate

change and improvements in income among agriculture-dependent rural households. The TRANSFORM program is being implemented under the Malawian context, based on low incomes and high poverty levels. Over 80% of Malawi's rapidly growing population relies on subsistence rain-fed agriculture, and limited economic diversification is needed. While some development programs have had a tangible and measurable impact on household resilience, to date, none have reached a scale at which they make a significant impact on poverty levels. If the cycle of hunger and crisis is to be permanently disrupted, a truly transformational program is required.

The objective of this study was to collect quantitative baseline data on crop and livestock production, market access, and other indicators through a household survey. In addition, the effectiveness of the strategy of training Lead Farmers and Follow Farmers was checked. A *Lead Farmer* (LF) is defined as someone who motivates other farmers to try new technologies [20]; a *Follow Farmer* (FF) is one who observes the farming practices used by others and then selectively adopts those practices that, in their own opinion, will improve the productivity of their farm (further defined in the next section). The TRANSFORM program Consortium will use this baseline information to compare the project status before and after the implementation of TRANSFORM program activities. Identifying the areas of intervention in crops, livestock production and marketing that can improve the livelihoods of smallholder farmers was our main goal. An important aim of this study was to investigate the income gains based on the LF-led extension approach and compare the earnings of LF and FF groups. This will help to provide further directions for the TRANSFORM program.

2. Material and Methods

The baseline study survey was conducted in the 44 sections of 11 EPAs from 5 districts (of a total of 28 districts) of Malawi (Table 1). The districts were selected to cover the TRANSFORM project. The five districts were: Dowa, Kasungu and Mchinji from the central region; and Mzimba and Rumphi from the northern region (Figure 1).

Table 1. List of Extension Planning Areas (EPAs) [1].

District *	EPA	List of Sections in EPAs
Mchinji	Mkanda	Mkanda East, Mkanda North, Mkanda South, Mkanda Central
	Kalulu	Kalulu, Chitunda, Mchakanga, Mchakanga, Kapiri South
Dowa	Mndolera	Dzoole, Katchitsa, Lipili, Msese
	Madisi	Katalima, Kalonga A, Madisi A, Madisi B
Kasungu	Lisasadzi	Mponda West, Kasera, Kawamba North, Kawamba Central
	Kaluluma	Chamakala East, Chamakala West, Kamwalembo, Kaluluma Central
Mzimba South	Luwerezi	Luwerezi, Ngoli, Chirawegu, Mphazi
	Champhira	Champhira Central, Chamanji, Luviri, Kaulusi
Mzimba North	Engucwini	Engucwini, Emayaleni, Madise
Rumphi	Bolero	Bolero, Lundu, Jallira, Chirambo
	Mhuju	Chimyanga, Phwamphwa, Mwakhunikira, Ng'onga

[1] Sampled from the study districts, including section names from the respective EPAs. * Malawi has a four-tier administrative structure: agricultural development divisions (ADDs, 8), districts (28) and extension planning areas (EPAs, 187).

Methodology: Quantitative data were collected by administering a semi-structured questionnaire to the households in the five study districts of Malawi. After pre-testing, the final questionnaire was structured to acquire information on basic demographics, household assets and income sources, food production and availability, livestock production, marketing, agro-processing and value addition, the adoption of climate-smart agriculture technologies, and access to credit/loans. In this study, data related to the demographics, crop and livestock production, sources of livelihoods, and income comparison for LFs and FFs were analyzed and presented. The TRANSFORM program's partners, and consortium members, had previously worked in Malawi on LF extension programs (such as the Sustainable Agriculture Lead Farmer Program). In a Malawian study, Fisher, Holden [21] used

the term "Lead farmers" to refer to farmer trainers. In a report, Regine Andersen [22] has described the detailed procedure for the selection of LFs in Malawi. The income disparity between existing LFs and FFs was used to verify the efficiency of the strategy. The survey questionnaire asked if the respondent was an LF or not.

Figure 1. Map of Malawi: The study area districts (Mchinji, Dowa, Kasungu, Mzimba and Rumphi) for the survey are shown by red-colored stars.

Sampling techniques: The sampling process for the baseline survey was designed based on the selected EPAs in the program target districts. The study used a multi-stage sampling process to determine the sample of farming families that participated in the household survey. This included purposive, stratified, and simple random samplings. The rationale for adopting multi-stage sampling was to target the potential project beneficiaries across a wide geographic area over the five study districts (Table 1).

Firstly, purposive sampling was adapted for all the project districts where the project has been implemented. Secondly, a stratified sampling technique was used, with extension planning areas (EPAs) as strata. Villages within the targeted EPAs were selected based on a probability proportional to size (PPS), using the size and number of villages in each EPA. Two EPAs were selected in each district except Mzimba, where 3 EPAs were selected, based on the subdivision of the district, into southern and northern zones. Thirdly, a simple random sampling technique was used to select farming households from each participating village to participate in the baseline survey. The survey participants were from a list of farm-family households obtained from the Agricultural Extension Development Coordinator (AEDC) of the respective EPA.

Sample size (*SS*): To capture the current demographic, socio-economic, agronomic and nutritional status of the participants in the project, the study unit for the survey was the individual farming family household. The number of households included in the study was determined using the following statistical formula (from Creative Research Systems, Sebastopol, CA 95472 [23]):

$$SS = \frac{Z^2 \times p \times (1-p)}{C^2}$$

where Z is the z-score used for creating a 95% confidence interval, p is the proportion picking a choice, expressed as a decimal (0.5 was used for the sample size needed), and C is the confidence interval expressed as a decimal.

Electronic household data collection and capturing: The KoBo Software (KoBo Toolbox at the Harvard Humanitarian Initiative, Cambridge, MA 01138, USA) was used to upload, collect and manage the household data collection. The pre-programmed questionnaire was loaded onto tablets for data collection, and the enumerators were instructed to upload the data onto a server. Most of the 15 research assistants collecting the household data were graduates who were able to speak the local dialects, Chichewa and Tumbuka, so that they were able to communicate well with the interviewees. They underwent a 3-day training course to understand the survey questionnaire and other operational tasks, such as data collection using KOBO and the ethics required during data collection. Before starting the actual data collection, the questionnaire was pre-tested in Waliranji Village (district Mchinji), which was not part of the selected EPAs used for this baseline study. In all, 1131 questionnaires were completed and considered for further analysis.

Data analysis: Welch's two-sample *t*-tests were used to compare numerical variables between two groups. For the comparison of numerical variables from more than two groups, an analysis of variance followed by Tukey's honest significant difference (HSD) tests were used. The level of significance and the family-wise error rate was set to 5%.

Income sources were grouped based on the number of people who relied on each source, and the average income generated by the corresponding income source was calculated. This means that the income sources shown in the tables below involved the majority of people and generated the most income.

Participation in the study was voluntary. Before each interview, either at the household or community level, a brief introduction about the purpose of the study was given. Verbal consent for participation was sought before starting the survey. Similarly, participants were assured of confidentiality and that the information collected would only be used for the purposes of the survey. Interviewers were also instructed to be neutral and were trained to respect the respondents' dignity and culture.

3. Results and Discussion

The results of this baseline study were limited to the following: basic demographic characteristics, smallholder agriculture produce, livestock ownership and animal products, ranking of important income sources for smallholder farmers, mean income from all kinds of sources for smallholders across all five districts, and mean income comparison between LFs and FFs (all kinds of income) were presented.

In this survey, 663 women (58.6%) and 468 men (41.4%) were interviewed (Table 2), including 56 LFs, implying that one LF is available for every twenty FFs in the study districts. All respondents were smallholder farmers, so the average land size across all districts was 2.7 hectares. In all districts, only 18.7% (n = 211) of farmers hired labor for farm activities. Rumphi district had the highest percentage (26.5%, n = 56) of farmers involved in hiring labor among the five study districts. The baseline data (Table 1) revealed the variety of different sources of income for smallholder farmers.

Table 2. Demographics of interviewed smallholder farmers, land, grown crops and vegetables, livestock owned, and products sold (from livestock and forestry).

Description	All Districts	Mchinji	Dowa	Kasungu	Mzimba South	Mzimba North	Rumphi
Number	1131	205	218	204	206	101	197
Male	468	81	95	91	70	37	94
Female	663	124	123	113	136	64	103
Lead farms	56	12	8	9	8	8	11
Average land size (ha)	2.7	2.5	2.8	2.9	3	2.3	2.7
Hire labor	211	23	36	35	41	20	56
Grow crops and vegetables							
Grow any crop	1108	199	205	201	206	101	196
Tobacco	224	11	56	22	12	33	90
Sugar cane	15	1	3	4	3	2	2
Groundnut	488	116	120	78	28	52	94
Soya	578	89	105	139	143	47	55
Beans	102	6	5	5	56	6	24
Maize	1098	196	211	198	203	99	191
Cassava	32	3	1	1	13	3	11
Irish potato	53	3	2	0	45	1	2
Sweet potato	279	14	19	31	43	12	160
Banana	11	2	0	2	3	1	3
Vegetables	119	24	16	17	25	19	18
Spice	6	0	0	0	0	0	6
Own livestock							
Cattle	73	8	7	11	23	2	22
Goats	330	44	69	53	53	38	73
Sheep	4	1	0	2	0	1	0
Chicken	590	59	115	104	117	64	131
Pigs	192	5	29	34	58	13	53
Rabbits	18	4	2	5	1	4	2
Sell products (livestock and forest)							
Milk	6	0	2	1	2	0	1
Meat	7	1	0	0	1	2	3
Eggs	16	2	5	3	1	1	4
Timber	17	5	2	1	4	1	4
Poles	16	4	4	2	1	0	5
Firewood	56	5	18	12	11	6	4
Honey	2	0	0	0	1	0	1
Mushroom	3	1	0	1	1	0	0

3.1. Crops and Vegetables Growing

The surveyed smallholder farmers were growing crops of many kinds.

Maize: Most (99%) of all surveyed smallholder households who were growing any crop or vegetable reported growing maize. Maize flour is used as a staple food in Malawi.

Soya: With 52% of the surveyed households reporting growing soya, this was the second most popular crop. Households from Mzimba South had most (25%) of the soya

growers in the survey, while smallholder farmers from the Kasungu (24%) and Dowa (18%) districts ranked second and third, respectively.

Groundnuts: Groundnuts were the third most popular crop, with around 44% of smallholder farmers growing them. Dowa district had the most (25%), while smallholder farmers from Mchinji (24%) and Rumphi (19%) were the second and third most important groundnut growers in the survey, respectively.

Sweet potatoes: Around one-quarter (25%) of the households grew sweet potatoes. Of these, smallholder farmers from Rumphi comprised 57%, followed by growers from the Mzimba South (15%) and Kasungu (11%) districts.

Tobacco: About 20% of all surveyed farmers reported growing tobacco. The Rumphi district contributed 40% of these, while Dowa and Mzimba North provided 25% and 15% of these, respectively.

Vegetables: About 11% of all surveyed smallholder farmers reported the cultivation of vegetables. These were most prevalent in Mzimba South (21%), followed by Mchinji (20%) and Mzimba North (16%).

3.2. Livestock Ownership, Sales of Livestock and Livestock Products

Livestock provides an important component of the livelihoods of smallholder households (Figure 2). Different classes of livestock were found, including dairy cattle, crossbred goats (local goats and Boer goats), guinea fowls, rabbits, and crossbred chickens (local chicken with Black Australorp). The prevalence of each of these classes in each district was assessed.

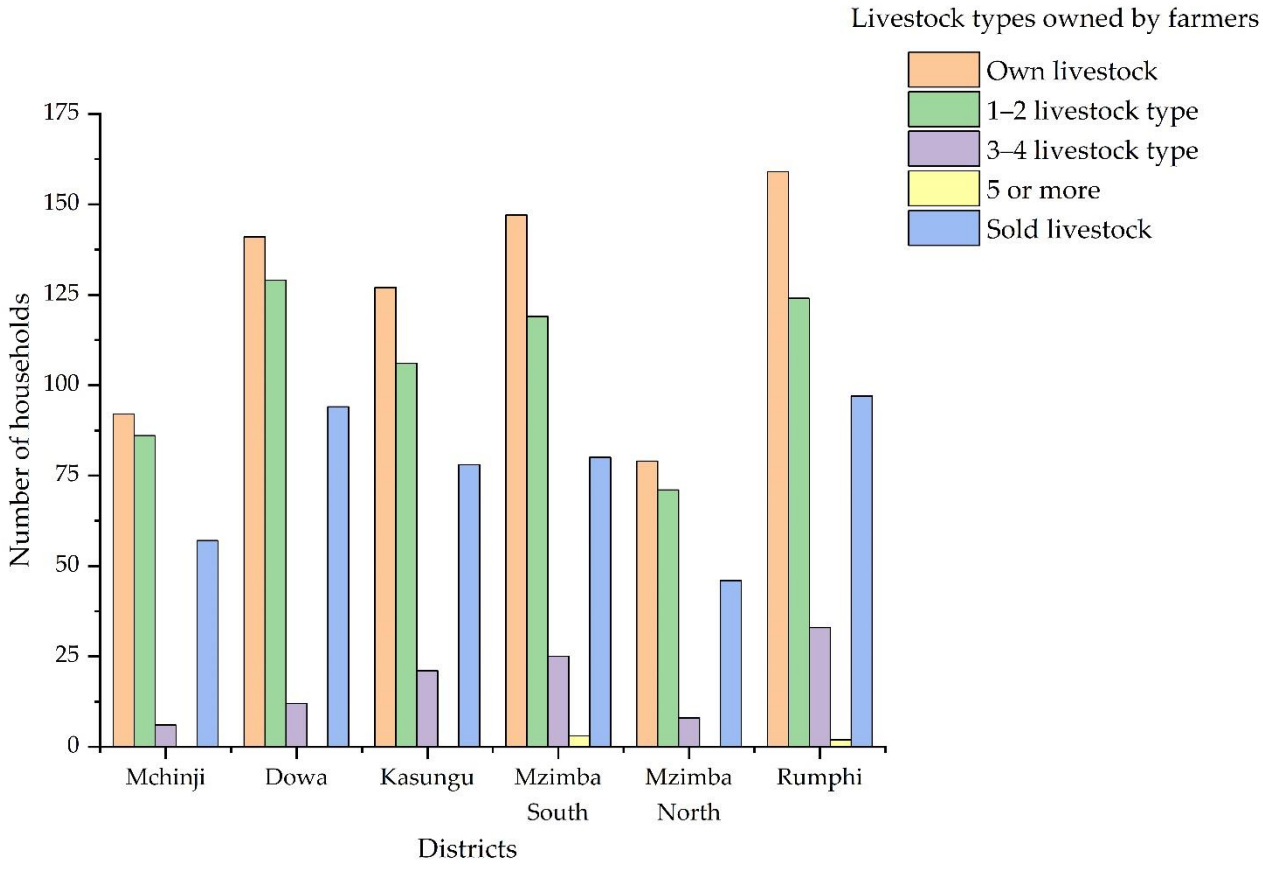


Figure 2. An overview of livestock ownership in study districts, as reported by the surveyed smallholders.

Overall, 67% of the households owned some type of livestock (Table 3). In Rumphi, this figure was 81%, in Mzimba North, 78%, and in Mzimba South, 71%. In contrast, only 92 (45%) of the 205 respondents in Mchinji owned livestock. The communities reported that

the variation in livestock numbers is largely due to drought and the incidence of diseases, such as Newcastle disease in chickens. For example, households sold a high proportion of their livestock in the second half of 2019 because of major feed shortages and a lack of market infrastructure, poor veterinary services, and access to improved breeds. An overview of livestock ownership is shown in Figure 2.

Table 3. The number of farmers who reported owning and selling livestock of various types (on an annual basis) in the study districts listed. (MWK is the Malawian Kwacha, which is equivalent to 0.0012 USD).

Number of Farmers	Mchinji	Dowa	Kasungu	Mzimba South	Mzimba North	Rumphi	TOTAL
Farmers owning livestock	92	141	127	147	79	159	745
1–2 livestock types	86	129	106	119	71	124	635
3–4 livestock types	6	12	21	25	8	33	105
5 or more	0	0	0	3	0	2	5
Farmers selling livestock	57	94	78	80	46	97	452
Types of livestock							
Farmers owning cattle	8	7	11	23	2	22	73
Number owned (average)	1.9	2.9	2.6	3.8	5.0	5.5	3.6
Sale of cattle	2	5	6	15	2	17	47
Number of cattle sold (average)	1.0	1.0	3.0	1.6	2.0	1.7	1.7
Total Value (MWK)	190,000	111,750	240,000	262,000	520,000	249,571	262,220
Farmers owning goats	44	67	53	53	38	73	328
Number owned	3.9	3.6	4.0	4.7	5.1	6.2	4.6
Sale of goats	34	52	39	37	28	54	244
Number of goats sold (average)	1.7	2.1	2.3	2.1	2.4	2.7	2.2
Total Value (MWK)	31,344	31,500	38,437	36,703	46,684	53,500	39,695
Farmers owning chickens (broiler)	59	109	104	117	64	131	584
Number owned (average)	8.3	7.7	7.4	9.5	8.0	11.6	8.7
Sale of chickens	37	77	62	63	38	79	356
Number of chickens sold (average)	4.5	5.3	4.7	5.4	4.9	5.3	5.0
Total Value (MWK)	9616	8619	9854	22,894	11,017	14,583	12,764
Farmers owning pigs	5	27	34	58	13	53	190
Number owned (average)	1.6	2.3	4.6	5.0	2.9	5.3	3.6
Sale of pigs	5	20	28	33	6	31	123
Number of pigs sold (average)	4.3	1.8	1.6	2.7	1.3	2.1	2.3
Total Value (MWK)	74,666	36,555	47,461	93,695	24,666	65,181	57,037

The majority of livestock holders (85.2%) owned only one or two kinds of livestock, while 14.1% of farmers were able to generate income from 3–4 different classes of livestock. A very small proportion (0.7%) owned five or more livestock types (Figure 2). Among all districts, farmers from Rumphi, Mzimba South and Dowa districts owned the highest livestock numbers.

3.2.1. Livestock Sale

Livestock sale was widespread across the sampled districts, with slightly over 60% of the respondents owned livestock and/ or had livestock sold in the past 12 months. Among smallholder farmers that owned livestock in the respective districts, livestock sales were the most common in Dowa (67%), Mchinji (62%), Rumphi (61%) and Kasungu (61%), and the least common in Mzimba (54%).

A reason for livestock sales being somewhat more common in Dowa and Rumphi (close to the central and northern capitals, respectively) could be that a number of fast-growing trading centers (such as Mponela) are located there, offering an active and competitive livestock market for farmers. Dowa is also closer to the capital city of Lilongwe, while

Rumphi is closer to the northern capital of Mzuzu, where restaurants and hotels have a high demand for local chicken and cattle meat. Farmers in other districts sold chickens and other livestock during the lean dry season (February–March) to be able to buy staple foods to feed their families.

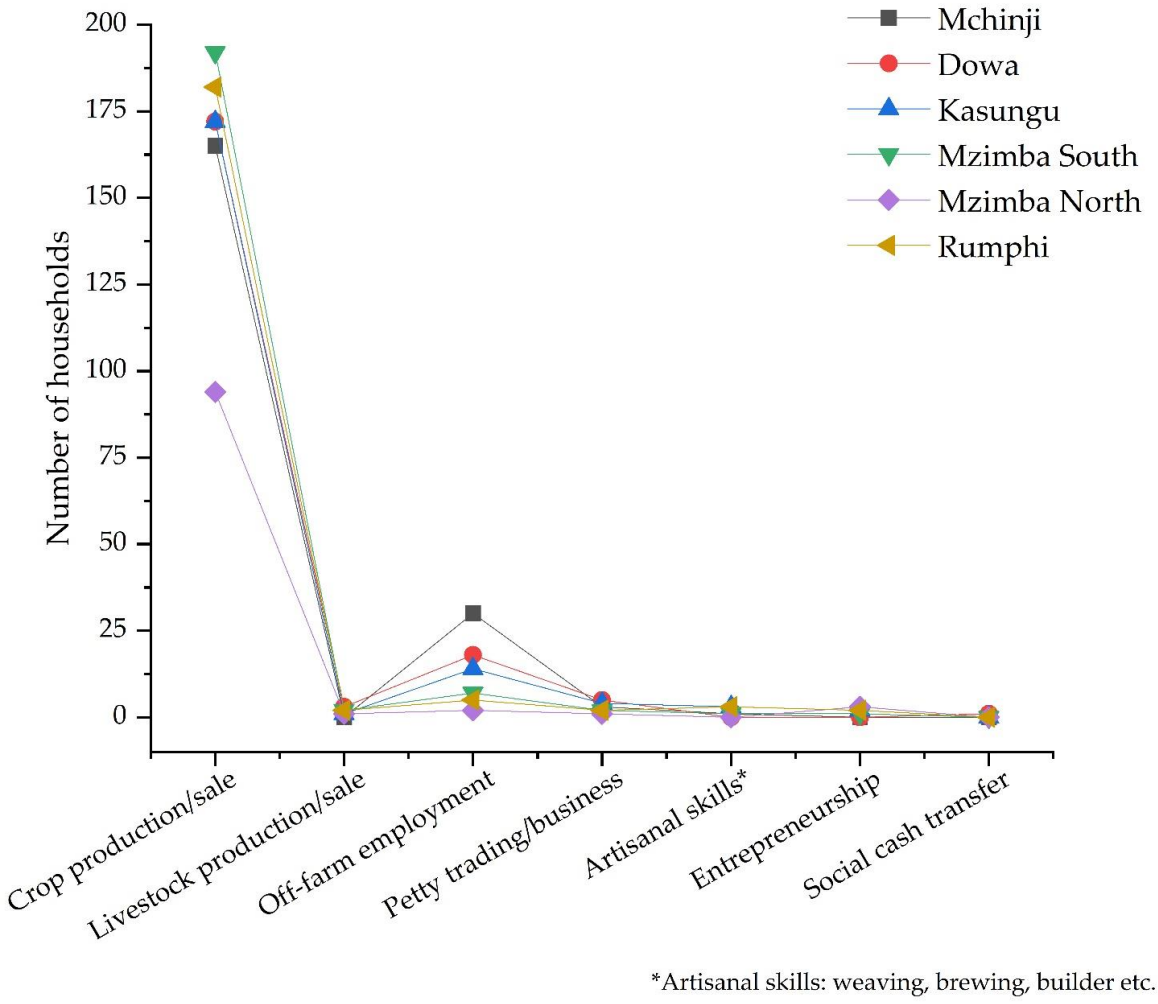
3.2.2. Livestock Product Sale

Livestock products were milk, meat and eggs, with Rumphi district being a leading source of these to service the growing market in Mzuzu (the northern capital city) (Table 2). However, very few households (29 of 1131) reported selling livestock products.

The livestock ownership and sale of livestock in each district are presented in Table 3.

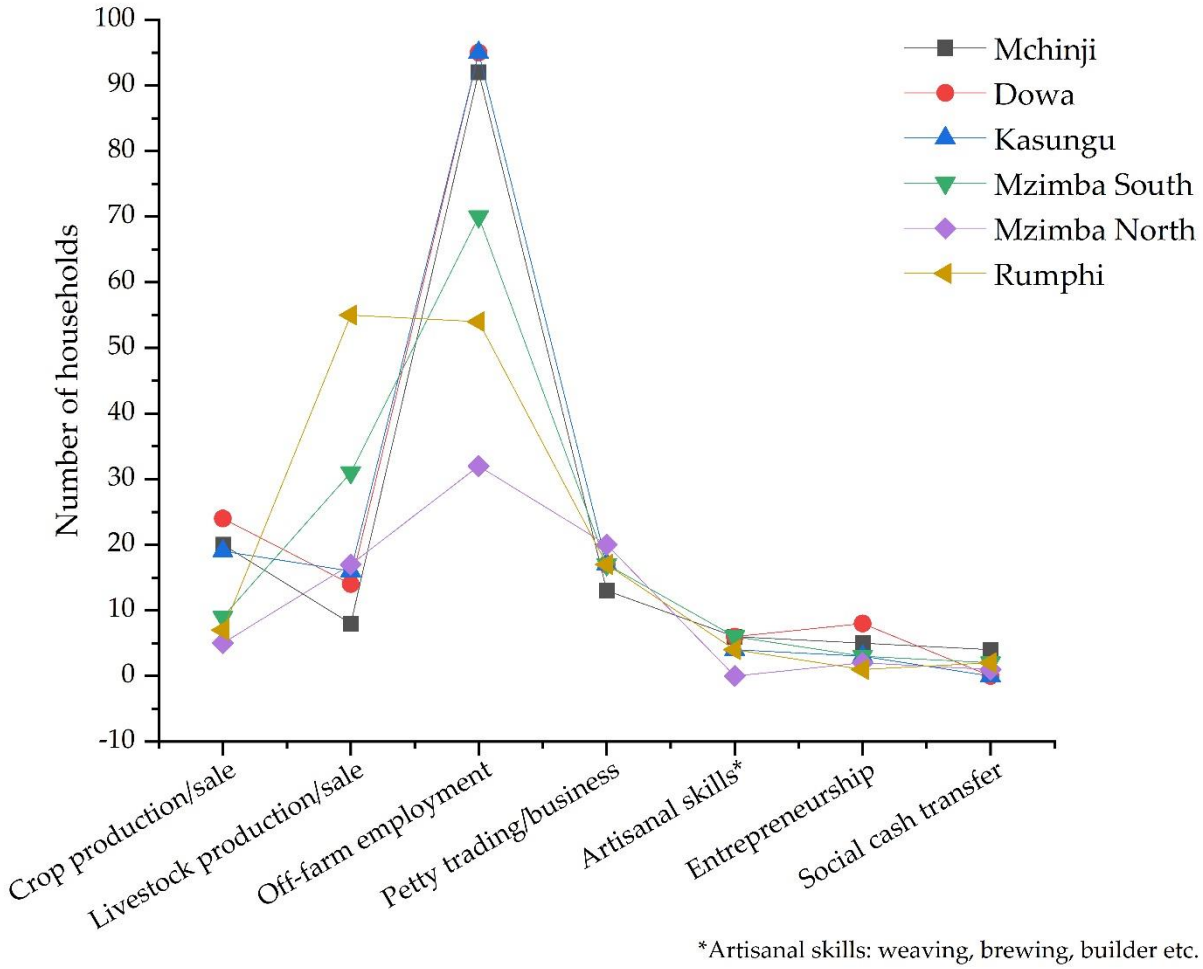
3.3. Important Sources of Income for Malawian Smallholder Farmers

The smallholder farmers were asked to prioritize their sources of income to support their livelihoods, such as crop production and sale, livestock rearing and sale, off-farm employment, petty trading/business, artisanal skills, entrepreneurship, and social cash transfer. The majority of the respondents ranked "crop production/sale" as the most important source of livelihood, followed by "off-farm employment" and "livestock production/sale" (Figure 3). Within the agri-production system, livestock was ranked as their second most important source of income.



(**a**)

Figure 3. *Cont.*



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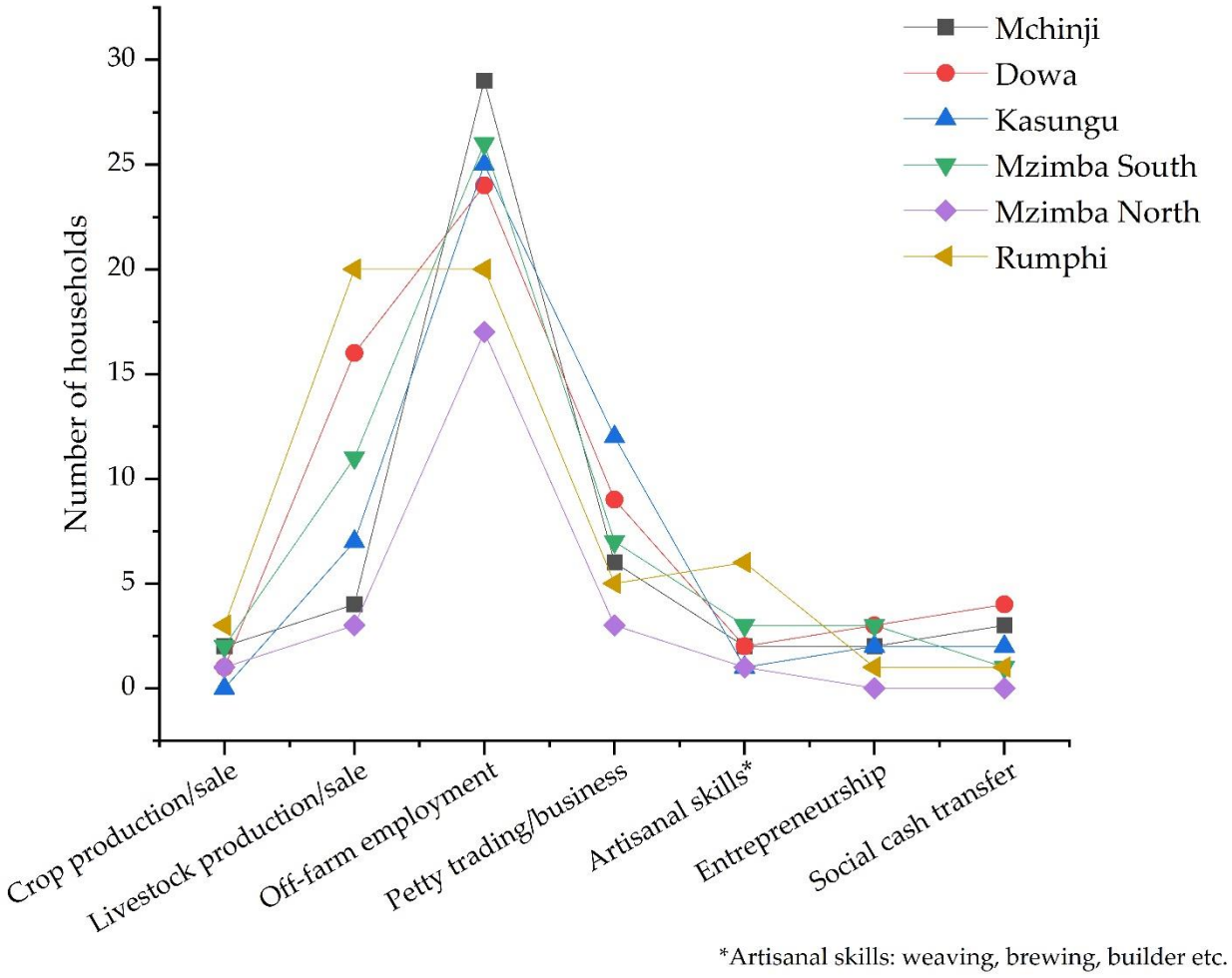

(**c**)

Figure 3. (**a**) Ranking of smallholder livelihood sources: The first most important source of livelihood for surveyed smallholding households (n = 1096) from all study districts in Malawi. (**b**) Ranking of smallholder livelihood sources: the third most important source of income for surveyed smallholder households (n = 290) across all study districts in Malawi. (**c**) Ranking of smallholder livelihood sources: the third most important source of income for surveyed smallholder households (n = 290) across all study districts in Malawi.

Means of incomes per household from livestock (animals and products), forestry products, fishery and small business operations were not significantly different across districts (Table 4 and Figure 4). The farmers of Rumphi had the highest average income (MWK 257,138) from crops, which comprised 66% of their total income (MWK 387,934). People from Mzimba North and Rumphi districts derived more revenue from crops than farmers from Mchinji and Kasungu. In general, crops, fishery, and small businesses of any kind at the local level provided a higher income than other sources in all districts.

Table 4. Mean income from various sources for households (n = 1118) reporting such income across different districts. For each income source, mean values with different letters (a, b, c) are significantly different based on Tukey's HSD test.

Income Source		Mchinji	Dowa	Kasungu	Mzimba South	Mzimba North	Rumphi	All Districts
Crops	Mean	80,923 ^{a}	131,476 ^{ab}	91,658 ^{a}	149,767 ^{ab}	250,881 ^{bc}	257,138 ^{c}	151,688
	SD	215,411	326,323	140,433	293,269	776,823	456,820	378,396
	(n)	199	205	201	206	101	196	1108
Livestock	Mean	19,409 ^{a}	19,934 ^{a}	25,460 ^{a}	39,777 ^{a}	25,848 ^{a}	46,159 ^{a}	30,956
	SD	50,549	30,112	63,419	106,467	65,875	113,594	81,850
	(n)	93	141	127	147	79	160	747
Forestry	Mean	35,152 ^{a}	9050 ^{a}	11,412 ^{a}	42,215 ^{a}	26,971 ^{a}	15,941 ^{a}	24,028
	SD	118,112	16,332	17,432	70,876	16,866	22346	66,070
	(n)	25	24	16	22	7	17	111
Fishery	Mean	171,000 ^{a}	362,000 ^{a}	227,983 ^{a}	394,933 ^{a}	172,400 ^{a}	219,600 ^{a}	260,233
	SD	131,256	285,926	306,643	494,390	92,955	169,119	289,992
	(n)	13	10	12	9	5	6	55
Enterprise (small business)	Mean	120,660 ^{a}	124,266 ^{a}	113,518 ^{a}	152,400 ^{a}	161,422 ^{a}	158,986 ^{a}	136,586
	SD	196,437	179,733	145,886	233,967	213,949	194,028	193,008
	(n)	46	67	56	53	35	51	308
Casual labor	Mean	25,871 ^{a}	31,632 ^{ab}	38,418 ^{a}	42,619 ^{b}	38,516 ^{ab}	39,254 ^{ab}	35,058
	SD	26,988	31376	45,579	62246	46,009	68,212	46,888
	(n)	156	156	143	116	61	95	727
Total	Mean	149,488 ^{a}	228,590 ^{ab}	178,559 ^{a}	263,124 ^{abc}	360,704 ^{bc}	387,934 ^{c}	351,333
	SD	266,924	380,601	224,569	415,698	802,816	579,443	452,026
	(n)	205	205	204	206	101	197	1118

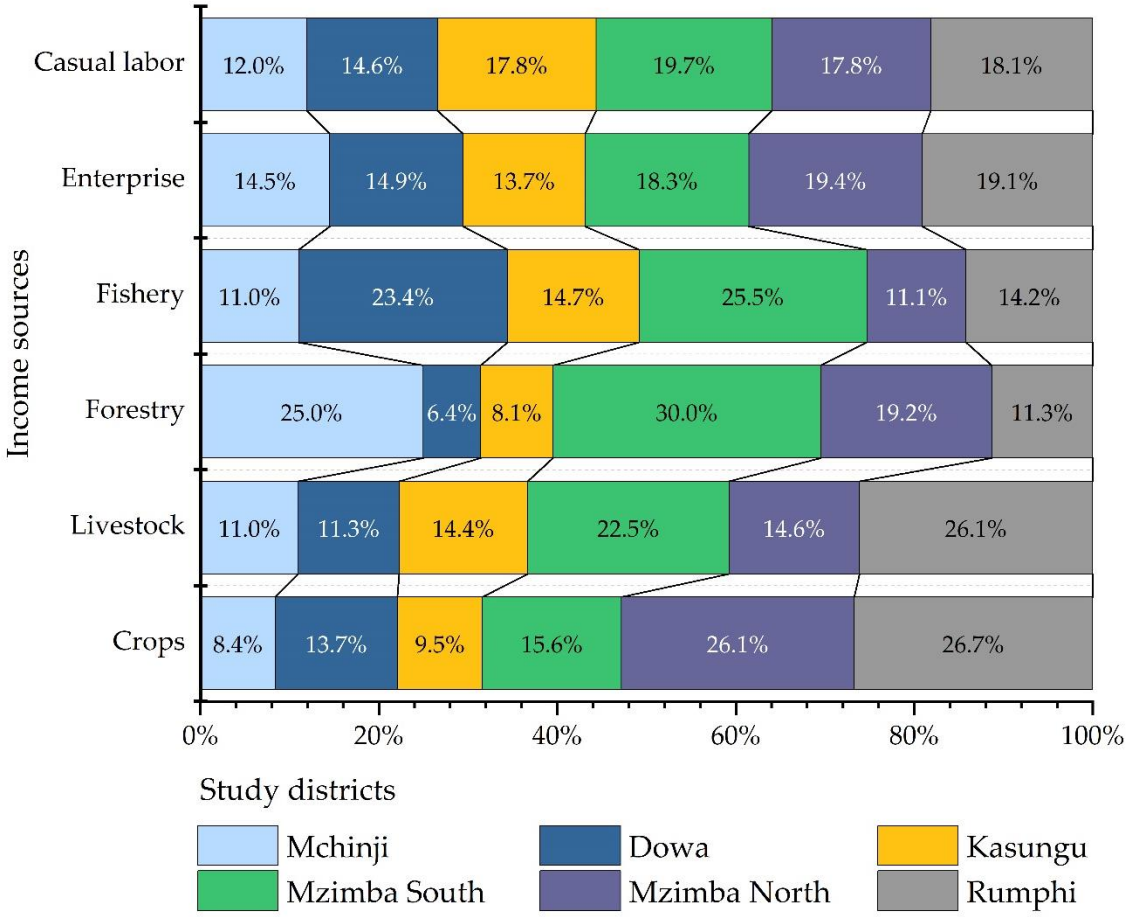

Figure 4. The average percentage of income from various sources, as reported by smallholder farmers in Malawi's five surveyed districts.

3.4. Mean Income Comparison between LFs and FFs Producing Crops and Vegetables

The incomes of Lead and Follow farmers were compared on the basis of average quantity produced (kg), average quantity sold (kg), unit sale price (MWK) and an average value of all the commodities (Figure 5). LFs were on average producing more of all crops and vegetables except sugarcane and banana. FFs were selling a larger quantity of cassava, banana, Irish potato, and sugarcane compared to LFs. There was a difference in the quantities of crops and vegetables produced and sold, which could be based on the fact that some agriproduct was consumed at home. FFs gained higher sale prices for vegetables, bananas, Irish potato, cassava, soya, groundnuts and sugarcane. The cumulative income from bananas, cassava, and sugarcane was higher for FFs, while for vegetables, sweet potatoes, Irish potato, maize, beans, groundnut, soya, and tobacco income was higher for LFs (Figure 5).

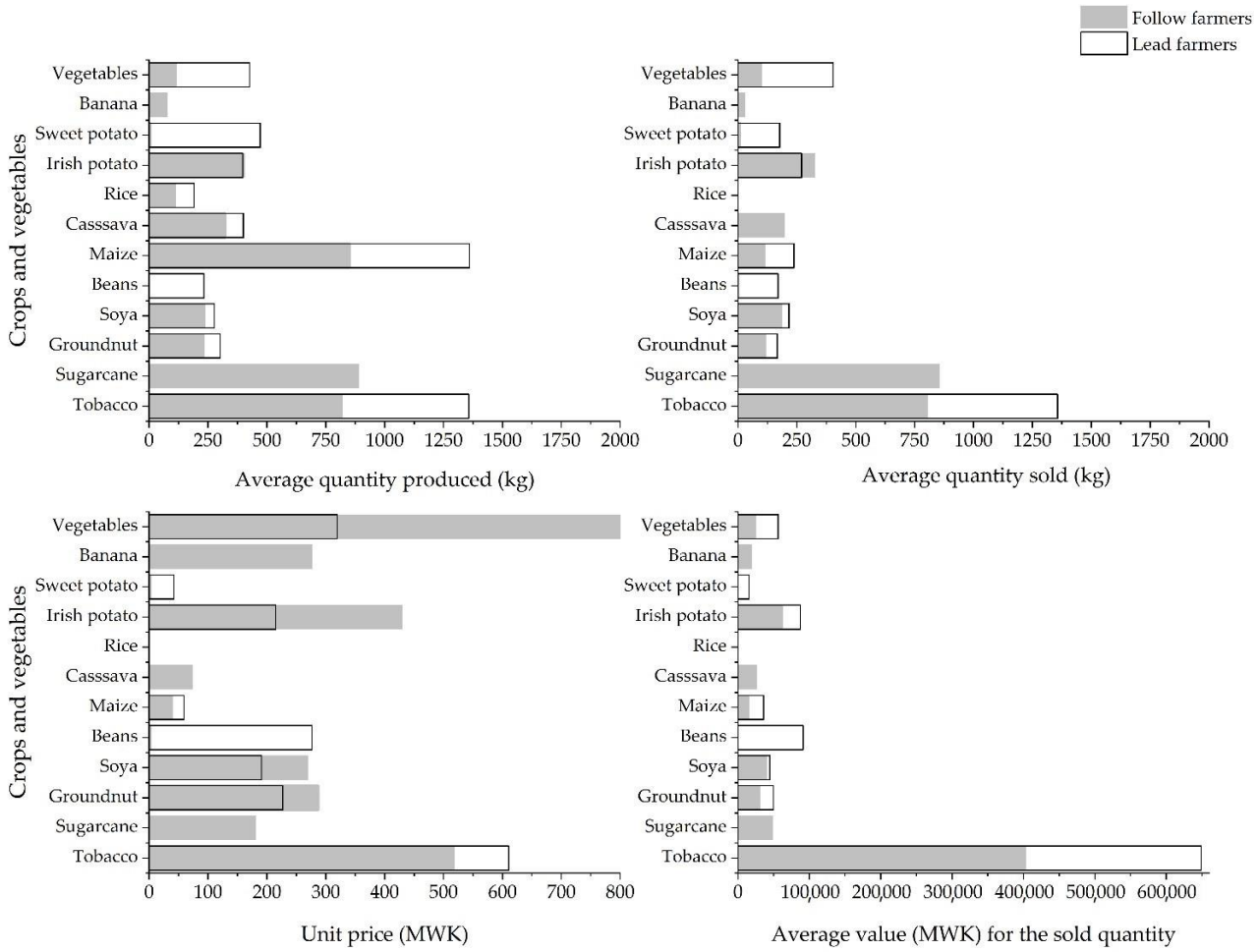

Figure 5. A comparison of income sources for Follow farmers and Lead farmers measured as average quantity produced (kg), average quantity sold (kg), average unit price in Malawian Kwacha (MWK) (USD 1 = MWK 790), and average cumulative value (in MWK) from various crops and vegetables cultivated by smallholder farmers in all study districts in Malawi. Sugarcane values for Lead farmers were not reported.

3.5. Mean Income Comparison between LFs and FFs Producing Livestock

For livestock numbers and income, among all the surveyed households, the proportion of FFs keeping livestock was higher than for LFs. LFs, in contrast, on average maintained larger herds, with the exception of rabbits. Both classes of farmers were selling more chickens. FFs were selling more rabbits, pigs and cattle, while LFs sold more goats. The cumulative income gained from animal sales was higher for FFs in the cases of rabbits,

pigs and chickens, while LFs made more from goats (Figure 6). In particular, the average income gained from selling pigs for FFs was significantly higher than that of LFs ($p = 0.0009$; Table 5). An overview of the average income (in percent) comparison (between LF and FF) from various sources is presented in Figure 7.

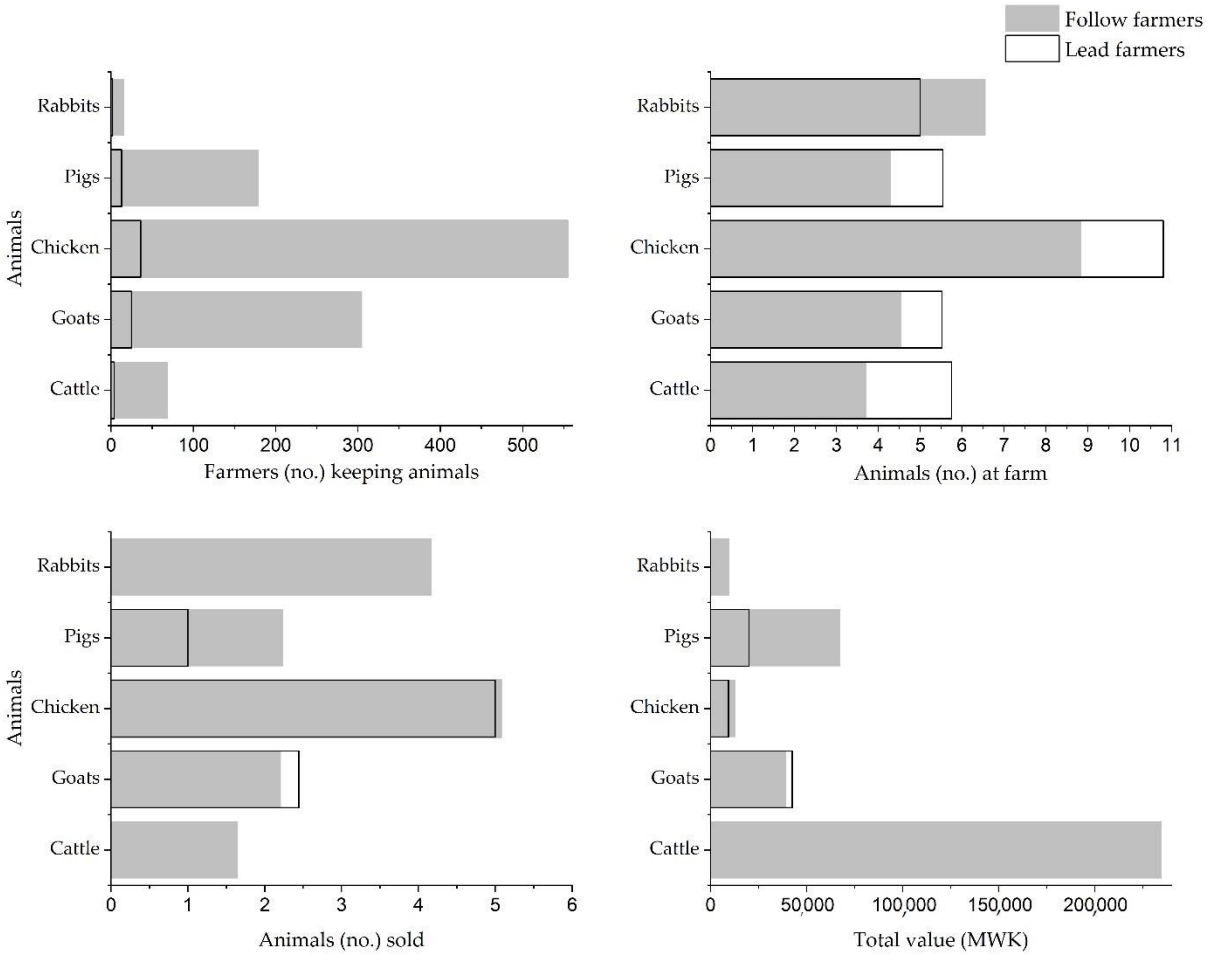

Figure 6. A comparison of the number of livestock and poultry kept by Follow and Lead farmers (average for all farms), as well as the total sale value of animals in Malawian Kwacha (MWK) (USD 1 = MWK 790) across all study districts. Lead farmers' cattle sales and total cattle value were not reported.

3.6. Mean Income Comparison between LFs and FFs Having Income from Other Sources

Table 5 shows that income from most other sources and businesses was not significantly different between LFs and FFs. Significant differences were found for firewood ($p = 0.0276$) and beer-brewing ($p = 0.0038$).

Overall, LFs often had a wider range of income sources (6 vs. 4, $p < 0.0001$) and the cumulative income from all sources was significantly higher (469343 vs. 239837 MWK, $p = 0.0006$) than that of FFs (Table 5).

Table 5. Mean income (±SD) in Malawian Kwacha (MWK) from Lead farmers and Follow farmers from June 2019 to June 2020. The sample sizes (households) are represented by the numbers in parentheses. The *p*-values are based on Welch's two-sample *t*-test.

Product	Lead Farmer ± SD (*n*)	Follow Farmer ± SD (*n*)	*p*-Value
Crops			
Groundnuts	49,575 ± 109,287 (26)	31,009 ± 45,919 (457)	0.3968
Irish potato	87,375 ± 121,445 (2)	62,344 ± 94,587 (51)	0.8197
Maize	35,687 ± 83,814 (56)	15,669 ± 62,669 (1033)	0.0835
Soya beans	44,501 ± 46,962 (41)	40,630 ± 57,737 (533)	0.6195
Spice	NA	82,700 ± 117,608 (6)	NA
Sugarcane	50,000 ± NA (1)	48,485 ± 63,575 (14)	NA
Sweet potato	15,294 ± 28,964 (17)	1,283,652 ± 26,249 (141)	0.7422
Tobacco	649,007 ± 730,522 (13)	395,033 ± 682,512 (207)	0.2434
Other crops *	49,206 ± 128,413 (30)	41,477 ± 110,432 (304)	0.7523
Livestock			
Eggs	500 ± NA (1)	12,880 ± 28,893 (15)	NA
Meat	120,000 ± NA (1)	115,166 ± 93,317 (6)	NA
Milk	NA	260,950 ± 241,782 (5)	NA
Cattle	NA	234,700 ± 140,262 (20)	NA
Chickens	9433 ± 13,806 (21)	13,026 ± 26,441 (248)	0.3049
Goats	42,611 ± 35,298 (18)	39,455 ± 38,165 (178)	0.7233
Pigs	20,000 ± 7071 (2)	67,614 ± 99,888 (70)	0.0009
Other livestock **	7000 ± 5656 (2)	7666 ± 6146 (15)	0.8970
Forestry products			
Firewood	7650 ± 3457 (4)	14,688 ± 17,320 (51)	0.0276
Mushroom	NA	56,300 ± 65,010 (4)	NA
Poles	15,250 ± 10,253 (2)	7592 ± 8874 (13)	0.4725
Seedlings	10,000 ± NA (1)	28,187 ± 41,629 (4)	NA
Timber	1600 ± 282 (2)	72,266 ± 164,966 (15)	0.1193
Other forestry ***	1500 ± NA (1)	8508 ± 5176 (12)	NA
Fishery			
Fish sales	340,000 ± 197,989 (2)	203,200 ± 123,904 (3)	0.4986
Fish vending	298,850 ± 347,695 (8)	247,265 ± 292,878 (12)	0.7025
Commercial enterprises			
Artwork	62,500 ± 24,748 (2)	115,469 ± 16,2000 (3)	0.1860
Barbershop	NA	151,000 ± 105,090 (4)	NA
Beer brewing	269,000 ± 26,870 (2)	75,247 ± 102,006 (36)	0.0038
Grocery business	215,000 ± 177,974 (3)	256,030 ± 296,670 (26)	0.7483
Petty trading	115,633 ± 46,671 (3)	98,959 ± 81,400 (44)	0.6138
Value-added products	172,412 ± 203,048 (10)	86,262 ± 119,171 (89)	0.2182
Others ****	307,500 ± 466,413 (4)	152,410 ± 218,057 (84)	0.5546
Casual laboring work			
Laboring Work	35,716 ± 48,514 (30)	35,079 ± 46,867 (696)	0.9443
Number of sources	6 ± 2 (56)	4 ± 1 (1062)	<0.0001
Total income	469,342 ± 594,435 (56)	239,837 ± 440,628 (1062)	0.0006

* Includes beans, cassava, rice, sorghum, banana, vegetables, and fruits. ** Includes sheep, rabbit, pigeon, ducks. *** Includes honey, wild fruits. **** Includes selling of charcoal and bicycle taxi.

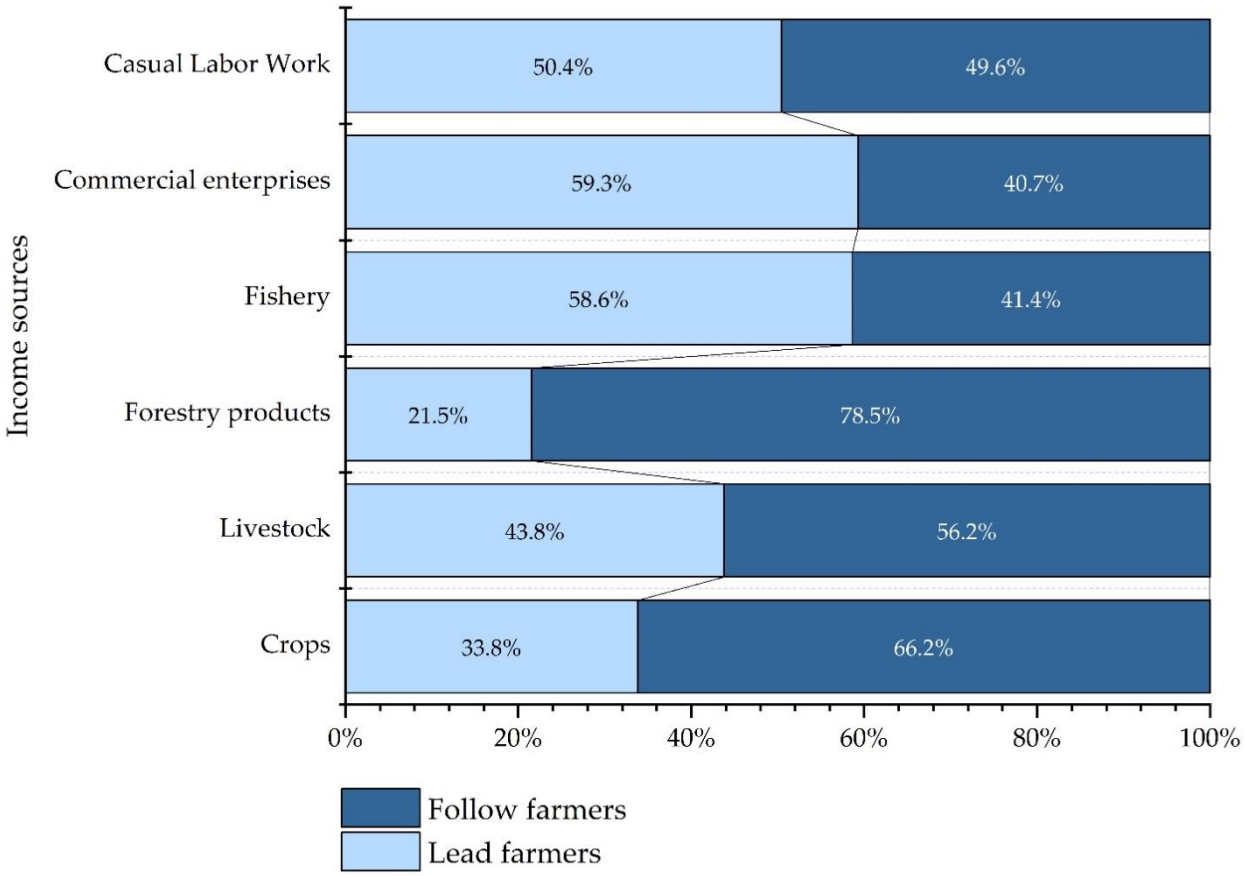

Figure 7. A comparison of Lead and Follow farmers in Malawi in terms of average income (in percent) from various sources, reported by smallholder farmers in all five surveyed districts.

The utility of LFs as a mechanism for agricultural extension should facilitate knowledge transfer to a higher number of FFs and, thus, increase the adoption of best practices in any specific area. However, this study mostly showed that existing LFs were similar to the FFs and had not improved significantly in regard to adopting best practices. Ragasa [24] reported that the majority of smallholder farmers gave a good rating to all questions about production performance, including questions about the performance of LFs in terms of conveying messages, but a major discrepancy was found when LFs were double-checked for their adoption rate.

Due to their low adoption rate for best agricultural practices, there was not much difference between Lead and Follow farmers' income from farm activities. However, the current study found statistically significant, higher total income (average) for LFs due to off-farm activities such as beer brewing ($p = 0.003$). This is consistent with the findings of Ragasa [24], and Holden, Fisher [25]. Ragasa [26] checked the effectiveness of the LF approach for technology awareness and adoption by modeling the data of 531 randomly selected LFs. To gain a higher adoption rate, LFs should adapt and implement the best practices on their farms (hence, receiving better economic gains) before conveying their messages to the FFs [26]. In the current study, higher income from off-farm activities revealed that LFs were not implementing best agricultural practices, resulting in lower profitability and less interest in farm activities. Rather than simply delivering "extension messages" to FFs via LFs or extension workers, the focus of the "Lead farmer extension approach" should be on boosting the adoption of best agriculture practices to have a long-term impact on smallholder livelihoods. As a result, when FFs will witness best practices being implemented in the field, they are more inclined to adopt them. Following that

process, documenting the adoption of those best practices in the form of "success stories" will have a ripple effect, resulting in increased adoption by the FFs.

Additionally, it is understood that since (in the case of Malawi) the majority of the LFs and FFs are illiterate, concise and innovative, visualized messages, such as diagrams and storytelling, should be used consistently and as often as possible. The purpose of all research-based extension messages and other interventions is to improve production, profitability, and livelihoods. Research institutes are vital to the development of extension materials and protocols, keeping in mind the priority areas of smallholders for extension. Therefore, based on the results (Figures 5 and 6), a strong focus should be placed on linking smallholders with the private sector to increase the profitability of agriproducts. This is the first study of its kind from Malawi that highlights the importance of farmer activities in maintaining the sustainability of their farming enterprises, particularly for small-scale farmers and especially in terms of coping with climate change and increasing production and profitability. The model could be replicated in developing countries where the majority of the population lives in rural areas and where agriculture contributes a significant portion of the country's GDP.

This baseline study serves as a foundation for potential future interventions across Malawi's five districts as part of the TRANSFORM program initiative (2020–2024). A follow-up study should be conducted with a greater emphasis on the linkages established between smallholders and operators in the private sector to improve their livelihoods.

4. Conclusions

The surveyed smallholder households were subsistence farmers with limited direct market orientation and access. Crops, vegetables, and livestock production are all important for smallholders' livelihoods, and some agriproducts are consumed in the smallholders' household. Adopting best practices to increase agriproduct production will increase sales and, thus, profitability. A significant portion of respondents did not report any sales whatsoever. The sales of both raw and value-added products are often lacking. Among the farm activities, crops were the most important, followed by livestock and off-farm work. Groundnuts, soya beans and maize were essential cash crops when considering both the quantities produced and the market price value. For livestock, cattle production gave the highest return, followed by pigs, goats, and poultry. Farmers mostly sold live animals, but not their produce (meat, milk, processed commodities). Thus, there is an absence of product value-addition and contemporary production skills. The focus should be on commodities that bring the highest income for smallholders, coupled with a needs assessment, systems approaches and farmer-participatory decision making. Farmers rely on a diverse range of products for their livelihood; rather than promoting specific interventiaons, the emphasis should be on the whole-farm approach. The focus of the "Lead farmer extension approach" should be on the adoption of best practices and increasing the long-term impact on smallholders' livelihoods. Furthermore, there is a need to tailor research-extension messages to accommodate the limited education of the farmers.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. TRANSFORM program has all the rights and ownership of all data collected in this study.

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