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STOCHASTIC DOMINANCE LEVELS AND THEIR EFFECTS ON CASH CROPS DIVERSIFICATION

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ABSTRACT

Farmers' crop production preferences are often overlooked when recommendations are made on crops to plant in different regions due to paucity of knowledge on the underlying farmer preferences. This limitation can negatively impact their productivity and poverty levels. The study aimed at revealing the stochastic dominance of crops which are grown by smallholder farmers, and was conducted in Rwanda's Rulindo District from a sample of 400 farm households using various statistical methods, including stochastic dominance tests and kernel density to determine crop preferences, and a subsample of 50 smallholder farmers for a quasi-experiment to obtain certainty equivalence data which was used in both nonparametric first-order and normalized second-order stochastic dominance tests. A Kruskal-Wallis rank test was conducted to contrast results of stochastic dominance analysis. The study revealed that traditional cash crops like tea and coffee demonstrated a first-order stochastic dominance over macadamia. In contrast, traditional cash crop options did not dominate nonmandatory cash crops such as chili, flowers, and sericulture. Notably, no cash crop showed second-order stochastic dominance over others among the five tested cash crops, and farmers generally did not display risk-averse attitudes. Simularly, the Kruskal-Wallis test results showed no significant difference in the ranks of certainty equivalence among cash crops, nevertheless, with coffee and tea having rank sums of 4362.50 and 3978.50 in the first and third positions, respectively. The focus group discussion results revealed that farmer preferred food crops over cash crops, particularly beans with its aura of awe among Rwandan consumers taking the lead. Based on these findings, the research recommends promoting macadamia in suitable agro-ecological zones for poverty alleviation while supporting ecologically appropriate coffee and tea production, especially given their demonstrated market resilience during the COVID-19 pandemic. This research underscores the importance of considering farmer preferences and local conditions when making crop recommendations for agricultural development.

Key words: Cash crop, Kruskal-Wallis, Risk aversion, Stochastic dominance, Rwanda

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INTRODUCTION

The risk attitude of smallholder farmers influences the adoption of cashcrops that contribute to poverty alleviation. However, thus far, few studies in Rwanda have analyzed the perception of smallholder farmers in ranking cash crops using stochastic dominance level analysis. A national policy that aims at increasing the net foreign investment is among the factors that push farmers to grow traditional and mandatory cash crops without considering their risk-attitude-driven preferences [1].

Pierpaoli *et al*. [2] established that awareness through education, training of farmers on new technologies and benefits of diversifying their production and good agricultural institutions boost the adoption of new cash crops, even though, as Nkomoki *et al.* [3] demonstrated, high level of education is not always a means to increased probability of adopting new technologies. For instance, Abebe and Kjørholt [4] discovered that adoption of new cash crops may be a good opportunity for smallholder farmers to increase their revenues, pushing them to dominate other traditional cash crops like coffee. Similarly, Bekele [5] showed that adopting new technologies stochastically dominated their non-adoption, both in terms of returns and yield level. This demonstrates that new technologies concerning adopting new crops may constitute dominant strategies in poverty alleviation among farmers. Unfortunately, land tenure ownership may act as a limiting factor for the adoption of perceived dominant strategies or technologies as farmers who are land insecure may not invest in some perennial crops, consequently, if not well assessed, biased in ranking crops that they do not both grow and know [6]. Additionally, following Fosu-Mensah *et al.* [7], crop diversification is also affected by land right security, and according to Field [8], enables squatters' devotion to work on-farm to stochastically dominate that of non-squatters. Moreover, crop dominance is also driven by population density, with the dominance of staples like cassava and banana and cash traditional crops that are tea and coffee [9-10]. However, Kibet *et al.* [11] reported that farmers are mostly risk and loss-averse; consequently, governments could encourage the establishment of insurance companies to mitigate marketing and environmental risks involved in agricultural investments. Warning and Soo Hoo [12] found out that small growers are less likely to adopt non-traditional crops that are riskier than traditional crops because of the high variability in their prices and poorly local, well-structured markets. Similarly, it was highlighted that ebbs and flows in the production and prices of a crop leave it dominated by those with a high and stable production level, at least in the class of risk-averse farmers [13]. The COVID-19 pandemic outbreak and subsequent travel restrictions are good examples of marketing risks encountered by farmers.

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Bidogeza [14] reported that to cope with risks and uncertainties involved in agricultural production, farmers' crops portfolio, and off-farm activities are used as champion strategies that mitigate the effects of any unfavourable state of nature. Contrary to this finding, Diiro [15] demonstrated that off-farm income may act as a decreasing factor of returns from some cash crops, even though the specific income acts as a motivating factor to adopt the new technology (crop) because farmers can afford to purchase the new technology.

Expansion of cultivated land to produce both cash and food crops to hedge the risk of food insecurity is nevertheless conditional, as German [16] reported the use of income from cash crops in food crop production. Similarly, Sardos *et al.* [17] found practical implications of the willingness to conserve some crops as hedging to famine. This shows that some food and indigenous crops may dominate new crops due to the risk aversion characteristics of farmers [18]. Other idiosyncratic findings are from Verdone and Seidl [19], whose results showed that in Rwanda, utility-maximizing smallholder farmers might prefer poorly managed over well-managed enterprise production, which is consistent with Habiyaremye [20], who stripped away the veil of smallholder farmers behaviour who are reluctant to adopt non-mandatory cash crops like sericulture that potentially might increase their income and reduce poverty. This is despite the Rwandan agriculture policy aimed at reducing the production of brewing bananas and some varieties of cooking bananas,; they are primarily grown by smallholder farmer and are the second most staple food, after beans. Coffee cropping trend remained stagnant whilst tea production increased [21]. Subsequently, according to Wekesa *et al*. [22] agricultural policy that considers farmers' perception of new technologies adoption is a paramount priority.

This paper established the stochastic dominance among various crops, considered as different technologies in the environment specific to Rwanda, to reveal the crop preference among smallholder farmers in Rulindo District.

MATERIALS AND METHODS

The study area

Rwanda is located in Africa, just in the South of the equator between latitudes 1°04' and 2°51' South and between longitudes 28°45' and 31°15' East. Rwanda has a surface area of 26.338 km^2 with 500 inhabitants per km^2 for the physical density [23-24]. The study area was Rulindo District, which has 17 administrative sectors[1] and a surface area of 566.7 km^2. Rulindo is strategically located as the

[1] Rwanda's decentralized administrative layers consist of Provinces, Districts, Sectors, Cells and Villages. Cells are the lowest administrative unit that is responsible for community mobilization, data reporting and the provision of

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link to Rwanda's most touristic destinations of the Volcanoes National Park in Musanze, Ruhondo Beach in Burera, and Lake Kivu in Rubavu district, as well as close to the country's capital city, Kigali. Additionally, the District is located in the north-western corridor that is highly populated and referred to as Virunga-belt [25].

The 2021 Population and Housing Census Provisional Results depicted that Rulindo District had a population of 360,144 [26] with a population density of 522 per sq.km and an average household size of 4.7 [27]. The study area map is presented in Figure 1.

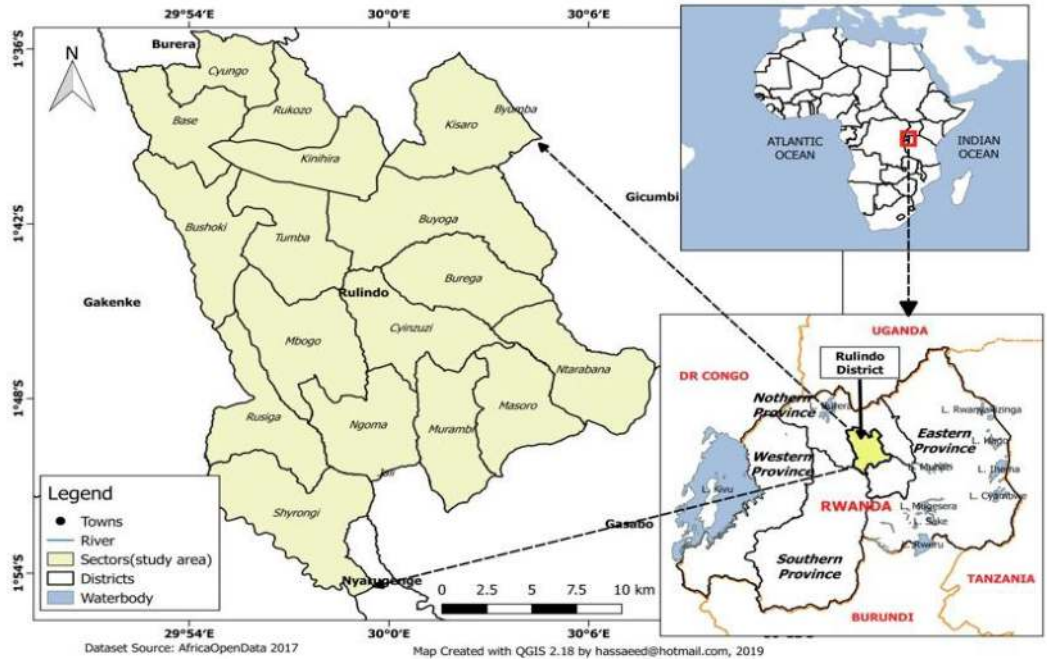

Figure 1: Map of Africa and Rwanda showing the study area
Source : Africa Open Data, 2017

Research design

The study applied a quasi-experimental research design as the research administered a questionnaire with two different options: A series of payoffs for a cash crop and a column for any hypothetical food crop with a certain return. The returns from the cash crop could be changed to reveal the certainty equivalence to food crop returns. The explanations of the causal relationship between dominance level among crops and some socioeconomic factors in Rulindo District. Most importantly, an answer to the research question was provided. The study is also grounded on the utility maximization theory testing approach, with farmers assumed to be willing to optimize the returns obtained from produced crops.

administrative documents to the citizens. Districts are the most important layer of the decentralization systems that are characterized by financial and legal independence

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Sampling and sample size

The study was anchored on multi-stage sampling. The target population was household farmers in Rulindo District with high agricultural potential in both traditional cash crops and a range of varieties of non-mandatory cash crops. The following stage was the establishment of two strata composed of non-mandatory cash crops and traditional crops, smallholder farmers. At the sector level, farmers were selected using a proportionate and then stratified sampling for the two groups concerned. At the household level, random sampling was used to obtain respondents. A sample size of 400 households was established, according to Yamane [28][2]. The agricultural households in the Rulindo districts were estimated to be 62,000 by 2018 [29-31].

The sample size was computed in such a way that all Sectors were proportionately sampled, and as the proportion of households involved in non-mandatory and traditional crops was unknown, a proportion of 0.5 for each stratum was assumed to compute the subsample size using Kothari formula [32][3].

A subsample of 50 small-scale farmers growing either traditional crops or non-mandatory cash crops were randomly selected among 400 farmers that composed the two primary strata to be administered a quasi-experiment to elicit the certainty equivalence (CEs) of various cash crops.

Data

A quasi-experiment was conducted to enable data collection on certainty equivalence for six cash crops that are coffee, tea, macadamia, sericulture, chilli pepper, and flowers as a series on the one hand and on the other hand a series representing any hypothetical food crop with a sure sum of 860 Rwandan francs equivalent to 0.67 USD during the time of the experiment was established as a certain return from growing food crops.

Four questionnaires from the quasi-experiment were excluded from the research as interviewed farmers failed to give relevant information relating to the certainty equivalence of at least one of the cash crops. Qualitative data were collected using Focus Group Discussions (FGD) from eight sites, each with five participants, and

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[2] $n = \frac{N}{1+N(e)^2}$, where; n = required sample size, N = target population size, e = precision error or the degree of accuracy, and the computed sample size was $\frac{62000}{1+62000(0.05)^2} = 397 \approx 400$

[3] $n_i = \frac{z^2.\ p.q.N}{e^2(N-1)+(z)^2.\ p.q}$ where; n_i = size of stratum i, z = value of a standard variate at a provided confidence level, and p = stratum proportion and $q = 1 - p$
A proportion of 0.5 and a confidence level of 95% are assumed in the mentioned formula

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40 transcripts were gathered, as a large number of them may become unwieldy were avoided [33].

Model specification

A model specific to elicit the stochastic dominance levels among different certainty equivalence alternatives was used. In this study,those different alternatives were different for both traditional and non-mandatory cash crops.

Stochastic efficiency with respect to a function (SERF)

To test the first hypothesis, both First Order Stochastic Dominance (FOSD) and Second Order Stochastic Dominance (SOSD) were used to rank different alternatives. Stochastic dominance was used to establish the dominance level among cash crops, and the utility preference of smallholder farmers for one cash crop over another was depicted per FOSD and SOSD. A Probability Density Function (PDF) and Cumulative Density Function (CDF) showed the dominance among cash crops. The comparison was pairwise among cash crops.

First Order Stochastic Dominance

A distribution is said to dominate another if for a given non-decreasing utility function $u: \Re \rightarrow \Re$ such that:

$$\int u(x)dF(x) \geqslant \int u(x)dG(x). \quad (1)$$

If it is established that a PDF is greater than another, then its CDF is less than the other such that,

$$F(x) \leqslant G(x) \text{ for all } x \quad (2)$$

This means that a smallholder farmer with a utility function $u(x)$ with $u(x) > 0$ will prefer a FOSD distribution to the one being dominated. However, if the two CDFs cross, none dominates the other in the sense of FOSD [19, 34].

Second Order Stochastic Dominance

Risk-averse farmers receive diminishing marginal utility from the cash crops, which increase income. Every risk-averse farmer will prefer a distribution demonstrating a SOSD over another. It implies that;

$$\int_{-\infty}^{x} [G(.) - F(.)]dt \geqslant 0 \text{ for all } x. \quad (3)$$

Zheng [35] highlighted ways of assessing the SOSD for the distributions having different means. Their approach, known as Normalized Stochastic Dominance (NSD), compares CDFs of normalized distributions. For a PDF of income that has a mean of μ_f its normalized PDF $f(x^n)$ is derived from a normalized distribution

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of income, x/μ_f. Its corresponding normalized CDF is $F(x^n)$. Therefore, the distribution of $F(x^n)$ dominates the one for $G(x^n)$ if and only if;

$$F\left(x^n\right) \preccurlyeq G\left(x^n\right) \text{ for all } x^n \quad (4)$$

This implies that $F(x)$ SOSD $G(x)$ if and only if

$$\int_{-\infty}^{x} U\left(x^n\right) dF\left(x^n\right) \geqslant \int_{-\infty}^{x} U\left(x^n\right) dG\left(x^n\right) \text{ for all } x^n \quad (5)$$

Empirically, a non-parametric density function, the Kernel Density Function (KDF),was estimated to approximate the probability density function of certainty equivalence values. The technique does not require fixed assumptions about both functional form and distribution. The Kernel density estimator is the key feature of the technique. For the number of independent observations, like $y_1, y_2, \ldots, y_n$ that are drawn from a random variable Y that is assumed to have an unknown distribution, a kernel density function $K(z)$ satisfying the condition can be estimated:

$$\int_{-\infty}^{+\infty} K(t)dt \text{ and } K(t) \geq 0 \quad (6)$$

The kernel density estimator $f(y)$ can then be given by

$$f(y) = \frac{1}{nh} \sum_{n=1}^{n} K\left(\frac{y_i - y}{\theta}\right) \qquad with\ i = 1, 2, \ldots, n \quad (7)$$

Where θ represents the bandwidth, n is the number of observations, y stands for the observed CE value, y_i denotes the observation corresponding to the appropriate probability, and finally $K(.)$ denotes kernel [36]. Moreover, to have a smoothened density function, using a normal kernel estimator is critical in the analysis. It is thus given by:

$$K(t) = \frac{1}{\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{y_i - y}{\theta}\right)^2\right] \quad (8)$$

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The choice of the kernel is not of great importance; instead, the bandwidth selection affects the smoothness of the estimator. However, a large bandwidth induces smoothness of the density function, with a significant bias of the estimator and small variance. The suggestion is that for the proportion of observations that are in a histogram to converge to the area under the corresponding density, the width must shrink more gradually than $1/n$. Common applications use a bandwidth equivalent to some multiple of $n^{-1/5}$ and is sufficiently low to reduce the biases in the estimator [36].

An intuitive interpretation that follows the expected utility theory of Von Neumann-Morgenstern is given to the FOSD criterion: if one crop returns an alternative dominates another, every non-satiated farmer chooses the dominant alternative [5]. Ceteri peribus, if farmers shifted from the cash crop to the food crop series with a sure sum at the earlier stage compared to the other cash crop, the latter would be dominant to the former. Equally likely certainty equivalent (ELCE) method and a sure sum were used to establish CEs that were used to compute PDFs and CDFs for each cash crop.

RESULTS AND DISCUSSION

Stochastic efficiency with respect to a function (SERF)

A stochastic dominance analysis was conducted to determine the level of importance farmers assign to traditional and non-mandatory cash crops, and the results are presented in Figure 2. Farms were assumed to have mutually exclusive land uses.

The results show that two traditional cash crops, tea and coffee, unambiguously first-order stochastically dominated macadamia. A FOSD is a necessary condition and a further step of SOSD was not necessitated. However, they did not FOSD dominating any other cash crop, as all their empirical distribution functions intersected. The graph of cumulative density functions (CDFs) of certainty equivalences of different cash crops in the study shows that tea and coffee were constantly below the CDF of macadamia certainty equivalence. The expected certainty equivalences are 1625, 1852.558, and 1955.789 Frws for macadamia, coffee, and tea, respectively. The KDF of certainty equivalences also indicates that tea and coffee had higher certainty equivalence means than other cash crops' certainty equivalences as their KDFs are placed to the right of other KDFs. This is again confirmed from the results in Table 1 with certainty equivalence of tea having both the highest kurtosis and positive skewness of 17.94 and 3.478, respectively. Macadamia had a relatively smaller mean value than sericulture, chilli, and flowers. Moreover, tea and coffee did not dominate other cash crops as their mean values position is almost the same. Consequently, their KDFs are assumed not different

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even though the two traditional cash crops would dominate all other cash crops as far as higher returns per hectare from those crops are concerned. This is shown in the figure 2 with KDFs of tea and coffee positioned to the right of other curves for high values of certainty equivalence. The kernel density estimate of flowers is positioned to the left of all other KDFs, showing an antipathetic perception of adoption of flowers among smallholder farmers compared to their counterpart cash crops.

Figure 2 shows the FOSD among cash crops using the Kernel density estimates. The horizontal axis is the certainty equivalence values obtained during a quasi-experiment.

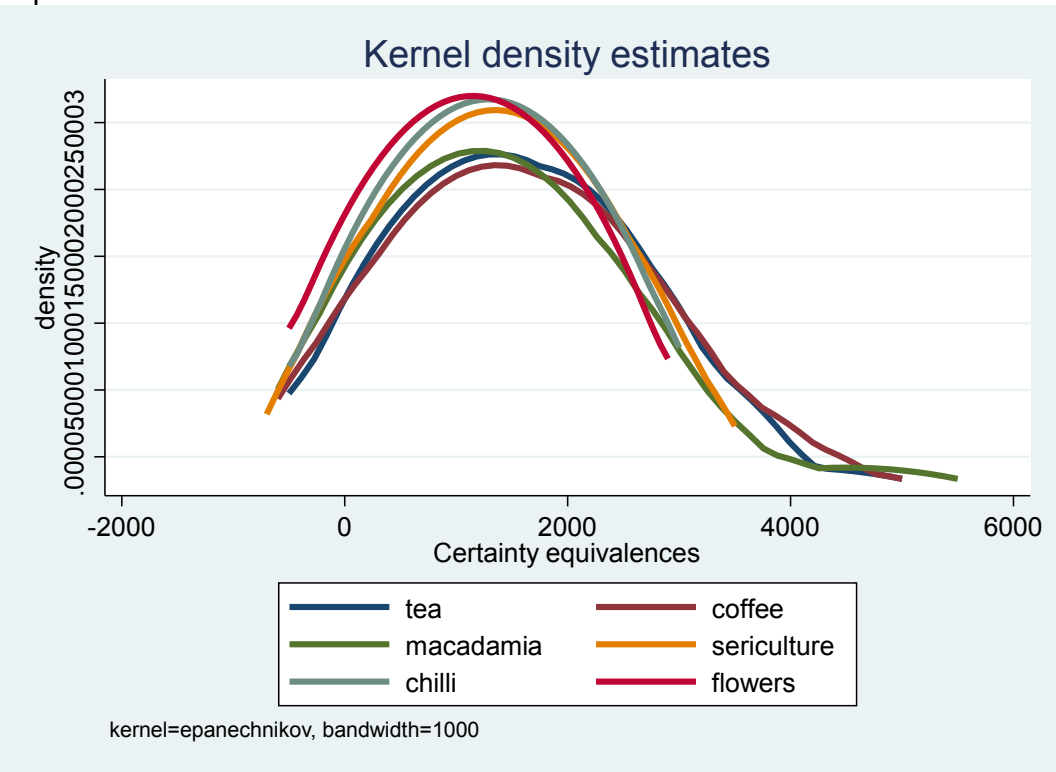

Figure 1: First Order Stochastic Dominance for cash crops grown in Rulindo District

Although farmers were asked to give information recorded from the beginning of 2019, data collection was conducted during the COVID-19 pandemic period and farmers might have been influenced by the shock they had on some cashcrops that rely on export and were not exported due to travel restrictions like macadamia and flowers. The commercialization decreased and, macadamia as perennial crop, the flexibility on land use for other crops is limited. This had a negative effect on food security because of the failure to invest in food crops [37], consequently, negative perception on non-mandatory cash crops and a bandwagon effect as a consequence of agricultural policy and a spillover effect in tea production.

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Sericulture also lagged traditional cash crops in terms of certainty equivalence, stripping away the veil of crop dominance as perceived by smallholder farmers. This diverges from Habiyaremye [20], who found a dominance of sericulture on traditional cash crops in terms of returns from their production, with, however, a minimal rate of adoption among smallholders.

Description of parameters for some cash crops grown in Rulindo District

The results in Table 2 show that tea has a greater standard deviation of 0.819, followed by macadamia with a standard deviation of 0.778. The third cash crop with a high standard deviation is coffee, with a standard deviation of 0.624. The above highlights that those cash crops have a high coefficient of variation, implying a high risk compared to the ones with lower standard deviations.

The kurtosis and skewness tests had coefficients much higher than three and zero, respectively, implying a significant violation of normality, hence, the use of non-parametric tests is required.

Even though coffee and tea are traditional cash crops that are riskier than other non-mandatory cash crops, except macadamia, which is riskier than coffee, farmers increasingly invest in tea. This may be due to government policy. The bandwagon effect in tea production is motivated by the government policy for mandatory cash crops. These findings are different from those of Kassie *et al.* [38], who factually showed that farmers adopt low-risk technologies and involve smaller cash outlay. However, and presumably close to Diao *et al.* [9] and Warning & Soo Hoo [12] whose findings relate the dominance of tea and coffee as traditional cash crops and perennial staples to nontraditional crops, especially in densely populated areas like Rwanda.

The study findings are by far close to what Kuma *et al.*[39] reported that diversification, as one of the risk management strategies put forward by the government of Rwanda was hindered by the world price high volatility of nontraditional cash crops and government agricultural policy that set subsidies of traditional cash crops, thereafter, bringing in comparative advantage and influencing crop preference of smallholder farmers.

Graphical illustration of SOSD for cash crops grown in Rulindo District

The lack of unambiguous results in significant differences among variability in certainty equivalences of five cash crops, as shown in Figure 3 obtained from the normalized second order stochastic dominance analysis (NSOSD). This is observed by the absence of any Normalized Cumulative Distribution Function (NCDF) positioning to the right of the check. This indicates the absence of a dominant cash crop among tea, coffee, sericulture, flowers, and chilli pepper for

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smallholder farmers who are risk averse. Risk attitude among smallholder farmers does not influence the adoption of those five cash crops.

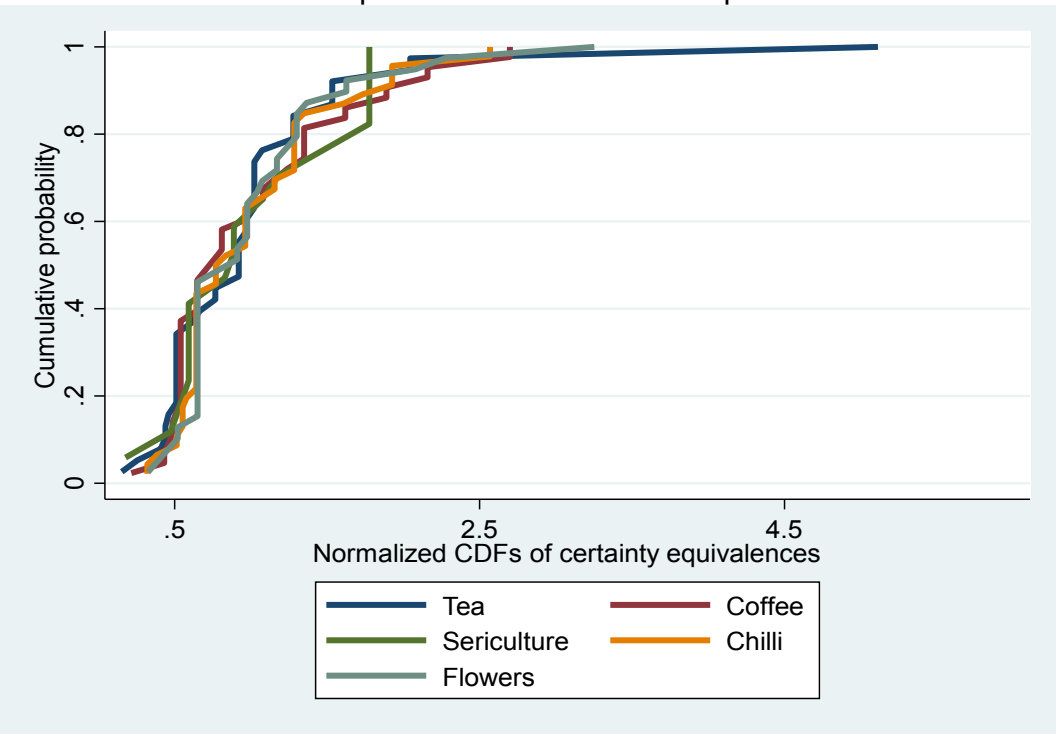

Figure 2: Normalized Cumulative Density Functions of some cash crops grown in Rulindo District

A non-parametric test, Kruskal-Wallis rank test, was performed to contrast its results with those of first order and second stochastic dominance analysis. The test results are presented in Table 3 and the test revealed insignificant differences among six cash crops in the study (Chi-square= 2.791| p= 0.732). Thus far, results from the Kruskal-Wallis test are almost the same as the one of first order stochastic dominance because coffee and tea are ranked among the three first cash crops in terms of data points of certainty equivalence. Chilli was ranked second (4147.5) followed by tea (3987.5), maybe due to the fact that tea had some outliers that will not significantly reflect in the Kruskal-Wallis test.

Coffee and tea are among the first three dominating cash crops and is in contrast to Porto [1] who pointed out that farmers grow traditional cash crops as a consequence of national policy the main objective of which is to increase the net foreign investment. Therefore, farmers' preferences driven by their risk attitude are not considered. This is true with the crop intensification program which specializes crops in different areas. Findings also contrast that of Abebe and Kjørholt [4], who qualified the adoption of new cash crops as a good opportunity for smallholder farmers to increase their income, preferred it. However, as chilli ranked second, they partly corroborate his findings.

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Results in Table 3 correspond with those of Warning and Soo Hoo[12] who established that small growers are less likely to adopt non-traditional crops because of their risky characteristics, which are brought about by high price variability and poorly local well-structured markets.

Focus Group Discussion on crop preference among smallholder farmers

A FGD served as a tool to obtain qualitative data that helped to understand farmers' crop production preferences. Figure 4 shows the importance they place on various crops. As staple food, beans dominate other crops weighing 34, as farmers consider beans a food crop that mitigates hunger. Beans is a staple food in Rwanda, followed by maize with 28. Coffee occupied the third position as a cash crop scoring 18; farmers were incentivized by market availability. Banana and Irish potatoes came on the fourth position with a score of 16 each; smallholder farmers who prefer them consider their time valuation and short-run period of their in-situ lifespan for Irish potatoes, respectively. Leaf vegetables had a score of 14, whereas tea, sweet potatoes and cassava had a same score of 12. Flowers positioned on the tenth with a score of five.

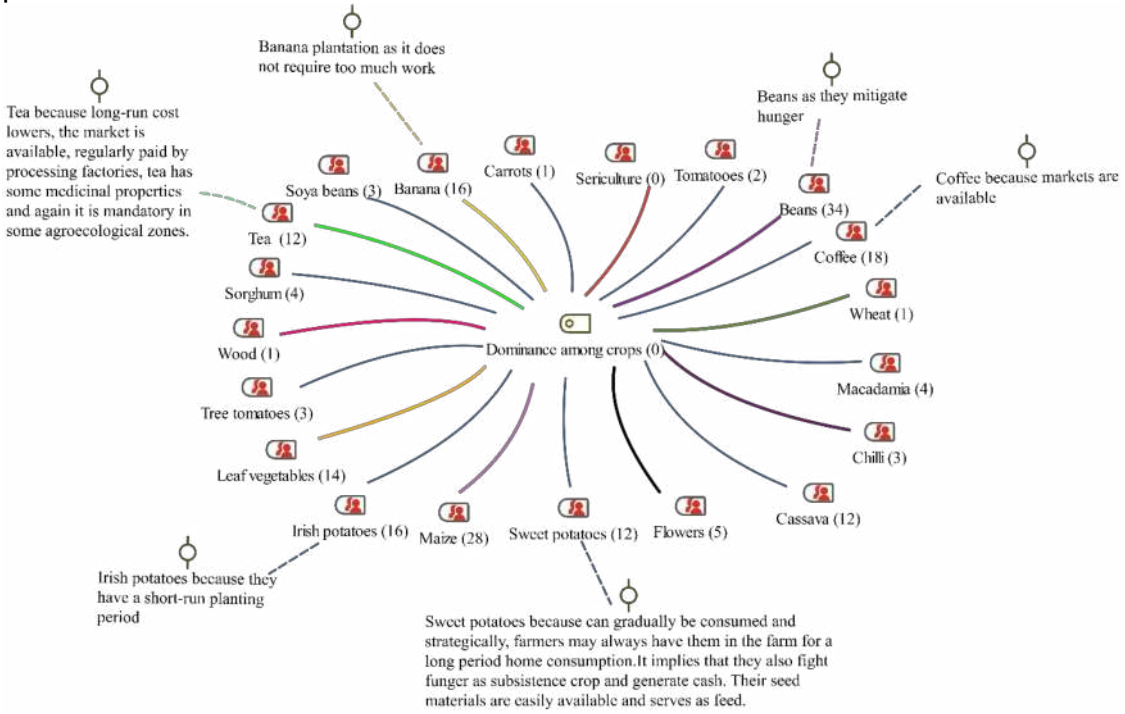

Figure 3: Crops preference among small-scale farmers

Focus group discussions and individual open-ended questions in an informal interview revealed that farmers prioritize food crops. Remarkably, the findings above are different from previous studies by Abebe [4], who noticed that new cash crops and traditional cash crops [39] adoption was a mean to probable increased revenues, nevertheless similar to Bekele [5], Sardos *et al.* [17], and Keya and

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Rubaihayo [21] who established that willingness to conserve some crops (beans in this study) as hedging to famine. Farmers also consider the opportunity cost, and as Diiro [15] has demonstrated, off-farm income may incentivize the adoption of crops and Figure 4 above shows that farmers adopt crops that are non-time consuming to get an opportunity of generating farm income. This results in idiosyncratic behaviour from farmers who, according to Verdone and Seidl [19] in Rwanda, utility maximizing smallholder farmers might prefer poorly managed over well-managed enterprise production. Findings also corroborate the one of Warning and Soo Hoo [12] who showed that perennial staples and traditional cash crops dominate in areas with high population density; Rwanda is no exception. Different noncontrolled factors induced the dominance of food over cash crops, especially non-mandatory cash crops; however, they were not included in qualitative data analysis [3,6,8].

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

Tea and coffee, which are traditional cash crops in Rwanda, were found to be first order stochastically dominating macadamia. Although chilli, cut flowers, and sericulture were not first order stochastically dominated by tea and coffee. A normalised second-order stochastic dominance analysis proved that the risk attitude of farmers who are risk averters did not place any dominant preference for one cash crop over another to avoid risks related to high variability in the returns because tea and coffee with high variability in certainty equivalent returns, their kernel density estimates positioned to the right of others cash crops for higher certainty equivalent returns, although not first-order stochastically dominating them. The FGD results served as a robust check and depicted the drawbacks of COVID-19 on income from flowers among smallholder farmers. This led to the dominance of some staple foods like beans, maize, and banana over other cash crops. The adoption of new non-mandatory cash crops requires setting policies and strategies that lower the opportunity cost of investing in them and increase food security among adopters.

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Conflicts of Interest

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Table 1: Statistics of certainty equivalence of cash crops grown in Rulindo District

	Mean	Standard dev	skewness	kurtosis	No. of occurrences
Tea	1955.789	1601.392	3.478	17.940	38
Coffee	1852.558	1156.553	1.237	3.728	43
Macadamia	1625	1263.499	1.597	4.564	8
Sericulture	1688.235	902.692	0.384	1.792	17
Chilli	1557.174	843.813	1.262	4.169	46
Flowers	1537.179	878.974	1.988	7.799	39

Table 2: Presentation of some descriptive parameters of cash crops grown in Rulindo District

Variables	sum	mean	sd	kurtosis	skewness
Normalized tea	38.00	1.000	0.819	17.94	17.94
Normalized coffee	43.00	1.000	0.624	3.728	3.728
Normalized macadamia	8.000	1.000	0.778	4.564	4.564
Normalized sericulture	17.00	1.000	0.535	1.792	1.792
Normalized chilli	46.00	1.000	0.542	4.169	4.169
Normalized flowers	39.00	1.000	0.572	7.799	7.799

Note: sd means standard deviation

Table 3: Ranking of six cash crops using a Kruskal-Wallis test

Cash crop	Observations	Rank sum	mean	median
Tea	38	3978.50	1955.789	1800
Coffee	43	4362.50	1852.558	1400
Macadamia	8	698.00	1625	1350
sericulture	17	1664.50	1688.235	1500
Chilli	46	4147.50	1557.179	1250
flowers	39	3476.00	1713.403	1400

Note: $\chi^2 = 2.747\ p = 0.7389$; $\chi^2$with ties= 2.791 p= 0.7322

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