THE 56TH ANNUAL CONFERENCE OF THE AGRICULTURE ECONOMICS ASSOCIATION OF SOUTH AFRICA

25 - 27 September 2018 | Lord Charles Hotel | Somerset West

Factors Affecting the Adoption and Intensity Cultivation of High Value Crops: A case study of Agricultural Research Council's HVC Programme in the OR Tambo District.

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Abstract:

This study investigates factors influencing adoption and intensity cultivation of high value crops (HVC) in the OR Tambo district municipality. HVC programme is a collaborative effort between Agricultural Research Council and Is'Baya Development Trust. A multistage sampling procedure was employed and 151 respondents were interviewed using a semi-structured questionnaire in 3 local municipalities. A double hurdle model was used to separately assess the factors influencing adoption as well as intensity. The results of the probit regression (first hurdle) revealed that household characteristics such as gender, household size, off-farm income, employment status and access to water for irrigation are key influencers to adoption of HVC cultivation. The truncated regression (second hurdle) indicated that gender is also significant at intensity cultivation of HVC's along with land size and market participation. The study recommends that an increased effort to help households fully participate in the formal markets will be beneficial and will significantly improve food security and household incomes. Also, installing taps in and around the villages will allow households to irrigate regularly to meet the quantity and quality of produce needed to penetrate formal markets.

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1. INTRODUCTION

The Eastern Cape Province has implemented many intervention programmes over the decades; namely, The Betterment Planning, Farmer Support Programme (FSP), Integrated Nutrition Programme, Massive Food Production Programme (MFPP), Siyazondla Homestead Programme, Siyakhula Step-up Food Production and the current Cropping program implemented in 2012. These programmes have achieved varying results with many suggested to have failed due to different reasons. Nilsson and Karlsson (2008) attributed MFPP's failure to lack of information about the project by the beneficiaries and their roles in the project, which in turn led to low participation levels by the smallholder farmers, whereas de Wet (1989) reported in his evaluation of the Betterment Planning programme, that the scheme was not implemented as originally planned; causing the programme to fail dismally.

The failures in the aforementioned programmes, which mostly focused on staple crops, are not something prevalent in South Africa only. This has caused many governments, private sector, and non-governmental organisations (NGOs) globally to invest in cultivation of High Value Crops (HVC) as a way to improve household incomes and alleviate poverty in rural households and peri-urban areas. These views are shared by the Asian Development Bank (2016), when it stated that investing in HVC is a particularly effective way to increase the value addition and climate resilience in the agricultural sector.

For instance, according to an publication by Fintrac (2014), the USAID's Zimbabwe Agricultural Income and Employment Development is working with smallholders around the country to commercialize more than 35 irrigation schemes through the introduction of horticultural crops, which often produce the opportunity for cash income as they are high in value, and has a local, national and export demand. One scheme in Mutema has 240 farmers and had planted 60 hectares of tissue-cultured bananas with high-quality inputs and good agricultural practices. The results were 80 tons of bananas in 2011 per hectare compared to the average national yield of 10 tons per hectare (Fintrac, 2014). The household net income from all crops improved to more than $4 000 per year. On the side of the world, far across in North America in Chiapas State, Mexico, there was a project established in 2004 to promote fruit production. The name of the project is not clear in the literature, but what is, is the impact it made. According to Hewett (2012), the objective was to promote fruit production in poor rural regions of Mexico and Guatemala, to reverse poverty and environmental degradation. The programme's number participating communities increased from 54 in 2005

to 90 in 2007. The report asserted that by 2011, it was estimated that more than 11 000 new jobs had been generated and about 3500 farmers organized into 75 cooperatives with fruit now being exported to international markets, mainly the United States of America. These programmes are evident that HVC production for increased household incomes and alleviation in poverty is possible, with right support from relevant stakeholders in the form of funding, infrastructure, marketing channels and production inputs.

Success in high value crops is not only achieved internationally but here in South Africa too. In the Eastern Cape, Peddie, there is what is called Peddie Pineapple Cooperation (PineCo) which began in 1998 as a joint venture between the Pineapple Growers Association (PGA) and the Peddie community (Hollands, 2012). The project, according to its managing director has employed 48 community workers who are working the 400 hectares under production (Hollands, 2012). This project is said to be successful because one of its core objectives was to create employment in Peddie as the village was rife with criminal activities prior the project. Hollins (2016) reported that in 2016, the coop secured an off-take agreement for all fruit produced and that the coop was expected to earn in excess of R1.5 million in that year. This is made possible through the partnership with Summerpride Food which is a processing plant based in East London and enables export to other markets such Europe and the United States of America.

The High Value Crop (HVC) programme was initiated by the Is'Baya Development Trust, a non-profit organisation in collaboration with the Agricultural Research Council (ARC) after a feasibility study in 1999-2000 by the ARC's Institutes for Tropical and Sub-Tropical Crops (ITSC) and Soil Climate and Water (ISCW) (Agricultural Research Council, 2012). The HVC programme is an agricultural development intervention based on conservation agriculture (CA), with a sustainable low-input approach suitable to the isolated project area's rugged and hilly terrain.

High value crops are generally referred to as crops that have higher market value compared to staple crops and other widely planted crops (Temu and Temu, 2006). These high value crops include a wide range of horticultural crops (avocadoes, mangoes, guavas, pineapple, litchi, pawpaw, macadamia, and oranges), vegetables, flowers, aromatic plants and herbs (Hewett, 2012). According to (AVRDC, 2007; Hewett, 2012), increasing the production, processing, and marketing of HVC has the potential to enhance dramatically the incomes of rural households and smallholder farmers while reducing poverty through increased employment

and improving nutritional levels of households. This was confirmed by ARC (2012), in an impact assessment that the project has generated substantial economic impact with participating farmers generating an average of R3 900 in new household income, a total of R19 million against a budget of R600 000 per year over a period of 15 years. The same impact assessment by ARC concluded that the HVC programme developed technical skills and created village-based management capacity and contributed to food security and household nutrition

The participants of the programme are given an opportunity to select one or two high value crops from a wide range of crops that they think is best suited for them. However, the headman from each village must buy-in the idea of an integrated farming system (a low input system which seeks to optimize the management of use of on-farm production inputs such as manure, compost, cover crops and management practices) and to minimize the use of off-farm resources such as fertilizers, herbicides and pesticides whenever it is feasible.

The project has enjoyed an excellent adoption rate throughout its existence, but the studies before have not investigated what factors influences these farmers to buy-in and adopt these high value crops through the conservation agriculture (CA) principles. Also, the intensity of adoption had not been investigated before. It is against this backdrop that there is need to investigate both adoption and intensity cultivation of HVC's in order to help the programme implementers know where to channel investment to, in order to get optimum participation of the right beneficiaries, adoption and cultivation intensity of HVC's.

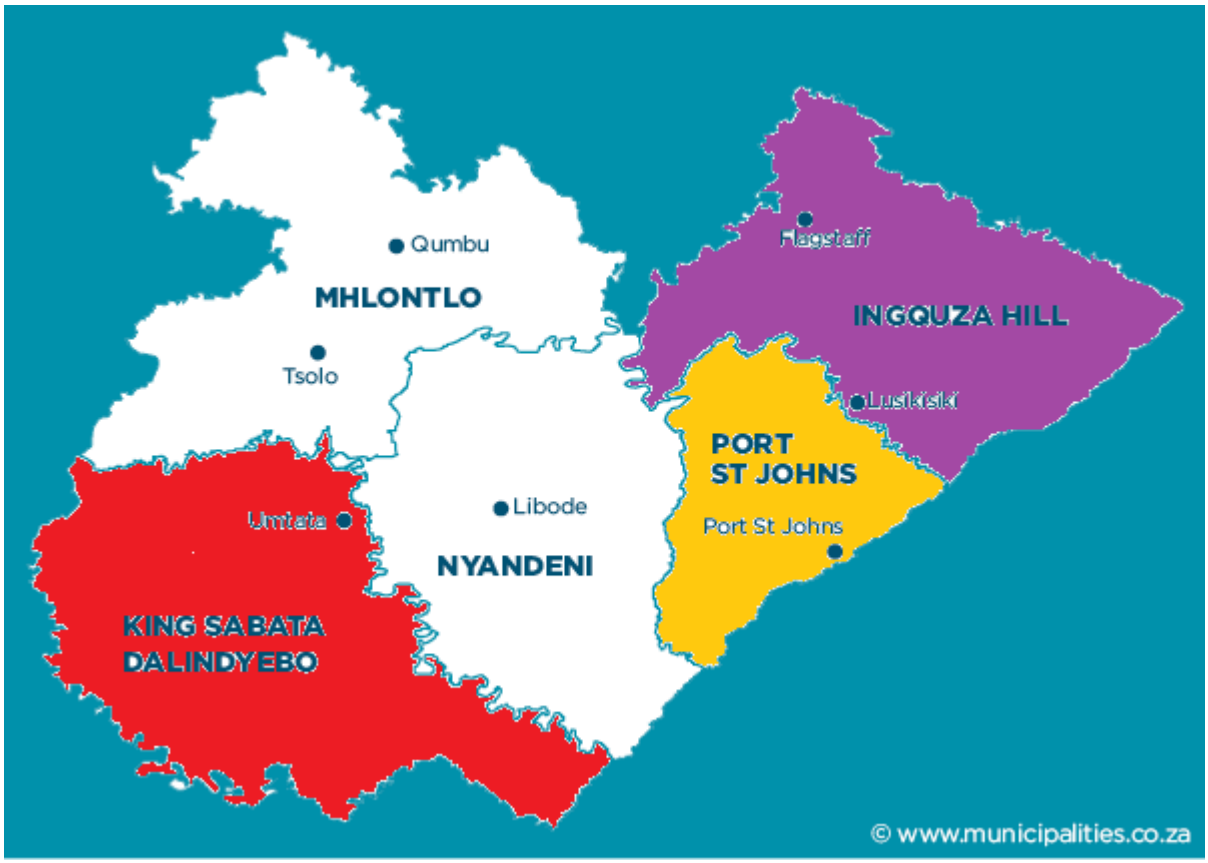
High Value Crops, therein referred to as HVC or fruit trees will be restricted to only horticultural crops; namely; orange, banana, avocado, guava, mango, naartjie, litchi, peach, apple, pawpaw, lemon, and nectarine which were provided by ARC and Is'Baya Development Trust.

2. METHODOLOGY

Description of the study area

The study was conducted in 3 of 5 O.R Tambo District Municipality in the Eastern Cape; namely; Port St Johns, Ingquza Hill, and King Sabata Dalindyebo (KSD) Local Municipality.

Figure 1: Map of OR Tambo District Municipality



Source: Municipalities of South Africa (2016)

Sampling procedure and Sampling size

A multi-stage sampling procedure was adopted to select the respondents. In the first stage of the sampling procedure3 were purposely selected in the OR Tambo District Municipality based on easy availability of the participants and accessibility of village monitors who were accompanying and introducing the researcher to the village headmen and members. Also villages that have been in the programme longer (preferably those that have had at least 1 harvest) were purposely selected for the study. The second stage involved the inclusion of villages with most households participating in the programme. The information was supplied by the field workers as to which are those villages. Participants were mainly interviewed in Chief's homestead, community halls, and church's whereas non-participants were

conveniently selected and interviewed in their households. A total of 151 respondents were selected and interviewed for the study.

Table 1: Sample size

Local Municipality	Villages	Adopters	Non-adopters
Port St John's	Mgxabakazi	14	19
	KuQhaka	8	12
	Caguba	13	10
Ingquza Hill	New Rest	9	14
	Ngobozana	13	13
King Sabata Dalindyebo (KSD)	Qokolweni	5	6
	Ncise	5	7
Sub-total		67	84
TOTAL	**7**	**151**	

Source: Field survey data (2017)

Source of data and collection methods

The study used primary data. The data collected was sub-divided into 2; namely semi-structured questionnaires which were administered by well trained and experienced enumerators who conducted interviews in IsiXhosa for ease of communication with the respondents. The data included socio-economic demographics, farm characteristics, and types and number of fruit trees produced. The questionnaire also allowed for the participants to share their perceptions regarding the impact made and constraints they are currently facing. Secondly, key informants such as field workers and the programme coordinator from ARC were also interviewed to discuss the implementation, monitoring and challenges the programme is encountering. The survey was conducted from September to November 2017.

Method of data analysis

STATA 15.0 was used to analyse the socio-economic factors, farm characteristics and institutional factors which were hypothesized to influence the adoption of HVC and to analyse factors that influence the extent to which HVC are planted.

3. THEORETICAL FRAMEWORK

Double-hurdle model

A feature of many models of adoption (binary or censored data models) is that the process, which results to adoption, is assumed to be the same as that which determines the intensity of adoption (Teklewold *et al*., 2006). Greene (1993) cited by Teklewold *et al*., (2006) asserts that the Tobit model analyse under the assumption that the two decisions are affected by the same set of factors. This might hold true in principle, but in reality the decision to adopt and the decision to intensify adoption are 2 separate steps that household farmers are normally faced with, with both decisions influenced by explanatory variables that may appear in both equations or in either of one (Teklewold *et al*., 2006). This is made possible by the use of double-hurdle model, which treats the two decisions separately. Another advantage of double-hurdle model is that, it accounts for variables that can appear in both the adoption and intensity to adopt, but may have opposite effects in the two equations.

In the context of this study, a household head is faced with decision to whether participate in the programme and therefore adopt HVC's (first hurdle), and the decision to choose how many HVC he/she will accumulate over the duration of his/her participation. This decision-making phenomenon is what led to the selection of the double-hurdle model. The model assumes that the decision and the intensity cultivation are independently determined by different set of explanatory variables. Obuobisa-Darko (2015) cited Teklewold et al., (2006) as they specified the model from equation 1 as follows:

$$\left.\begin{aligned} &D_i = 1 \text{ if } D_i^* > 0 \text{ and } 0 \text{ if } D_i^* \leq 0 \\ &D_i^* = \alpha' Z_i + \mu_i \end{aligned}\right\} \qquad (1)$$

Where D is adoption, D* is a latent variable that takes the value 1 if the farmer adopts the High Value Crops (HVC) and zero, otherwise. Z is a vector of household and farm characteristics as well as institutional factors.

Teklewold *et al*., (2006) specified the level (or intensity) of adoption (Y) as follows:

$$\left.\begin{aligned} &Y_i = Y_i^* \text{ if } Y_i^* > 0 \text{ and } D_i^* > 0 \\ &Y_i = 0 \text{ otherwise} \\ &Y_i^* = \beta' X_i + v_i \end{aligned}\right\} \qquad (2)$$

Where Y_i is the observed answer to the intensity of adoption which is the number of current fruit trees planted, and X is a vector of individual's characteristics and β is a vector of parameters and v_i an error term. The error term μ_i and v_i are distributed as follows:

$$\left\{\begin{array}{l}\mu_i \sim N(0, 1) \\ v_i \sim N(0, \sigma^2\end{array}\right\}$$

The log-likelihood function for the double hurdle model was specified by Teklewold *et al*., (2006):

$$LogL = \sum_0 In\ [1 - \Phi(\alpha Z'_i)]\left(\frac{\beta X'_i}{\sigma}\right) \sum_+ In[\Phi(\alpha Z'_i)\frac{1}{\sigma}\phi]\left[\frac{Y_i - \beta X_i}{\sigma}\right] \quad \ldots\ldots (3)$$

Where Φ and ϕ are the standard normal cumulative distribution function and density function, respectively. The first portion is the log-likelihood for a Probit, while the second portion is the log-likelihood for a Truncated regression with truncation at zero.

First hurdle: Probit regression

Adoption refers to the decision to use a new technology, methods, practice by a firm, a farmer or a consumer (Beshir, 2014). Martey *et al*., (2014) further states that the individual's adoption decision of is dichotomous, involving two mutually exclusive alternatives. The individual either adopts or choose not. According to Weyessa (2014), most adoption studies have used the Tobit model to estimate adoption relationships with limited dependable variables. The author further explains that the Tobit model is very restrictive statistically because it assumes that the same set of variables determines both the probability of non-zero adoption and intensity use level. Also, the Probit regression is preferred because of its ability to constrain the utility value of the decision to adopt variable to lie within zero and one, and its ability to resolve the problem of heteroscedasticity (Asante *et al*., 2011).

Second hurdle: Truncated regression

Beshir (2014) defines the intensity of adoption as the aggregate level of use of a given technology, practice, or method by a farmer. The second level of the analysis involved the determination of the factors that influences intensity use of high value crops provided by ARC.

EMPIRICAL FRAMEWORK

To examine the factors that influence adoption and intensity cultivation, a number of explanatory variables were fitted in a regression model. The explanatory variables included socio-economic household characteristics, farm characteristics and institutional factors, and were fitted as follows:

$Y_i^* = \beta' + \beta_1$ GEND1 + β_2 AGE1 + β_3 EDU1 + β_4 HHSI1 + β_5 EMPLST1 + β_6 HA3 + β_7 MOFFI1/MONFI1 + β_8 AW2 + β_9 DMP4 + β_{10} WDYJ2 + β_{11} RES2 + β_{12} TF2 + μ_i

Where, $\beta'$is the constant term, β_1 , β_2 , β_3 … β_{12} are the parameters of the respective explanatory variables in the model, and μ_i is the error term

Table 2: Variable definitions and expected sign of the variables

Definition of variables	Nature and units of measurement of variables	Expected sign	
Dependent variables HVC adoption . Current trees planted	Dummy variable (1=yes/0=no) Continuous (no. of trees planted)		
Explanatory variables			
Gender (GEND1)	Continuous	+	+
Age (AGE1)	Dummy (0=Male; 1=Female)	+/-	+
Education (EDU1)	Continuous	+	+
Household size (HHSI1)	Continuous	+/-	+/-
Employment status (EMPLST1)	Dummy (0=Yes; 1=No)	+	+
Farm size (HA3)	Continuous	+	+
Off-farm income (MOFFI1)/ On-farm income (MONFI1)	Continuous	+/-	+/-
Access to water (AW2)	Dummy (0=Yes; 1=No)	+	+
Access to markets (DMP4)	Dummy (0=Yes; 1=No)		+
Years in the programme (WDYJ2)	Continuous		+
Access to ext. services (RES2)	Dummy (0=Yes; 1=No)		+
Type of farmer (TF2)	Individual, co-op member or lead farmer		+

4. RESULTS AND DISCUSSION

4.1 Socio-economic status of adopters and non-adopters

Table 3 shows that more females (77.61%) have adopted the HVC's than males (22.39%). This is affirmed by Thangata *et al*., (2002), cited by Nhundu (2010) when they concluded that studies in Zambia have shown that female headed households are more likely to adopt resources conservation technology than male headed households, holding everything else constant. This also holds true in the study group because participants are required to cultivate these HVC's using agriculture conservation techniques such as intercropping, mulching and

composting, use of grey water for irrigation, and minimum to no tilling. Another reason could be that, women are widely known to be more inclined in working their backyard gardens, leaving livestock and field crops to man. It is against this background that gender is one of the most important factors that need to be investigated in adoption and intensity use.

Nhundu (2010) asserts that literature puts contrasting arguments on how age impacts on participation in programmes. In the table below, it can be seen that adopters are younger compared to non-adopters. It could be the case of younger farmers are more willing to engage in new innovative and resource conserving farming than non-adopters who probably still use traditional methods.

Household size is the number of people currently living in a particular household. Non-adopters have lesser residents compared to adopters. This is agreed by (Bonabana, 1998; De Souza Filho *et al*, 1999) when they asserted that larger households adopt new technologies more often than smaller households, holding other factors constant. Conservation Agriculture (CA) is labour intensive and the more people are found in a household the more likely they will adopt the CA techniques

Also, HVC adopter has child grants as their main source of income whereas non-adopters has pension. This is in line with household size and age above. Since HVC adopters have a bigger household size, most the residents are made up of children who are young enough to earn child grants (47). Same applies to non-adopters and age, since they have a larger average age, this is mainly the reason they have pension (36%) as their main source of income

Table 3: Household characteristics (n=151)

	HVC Adopters (n=67)	Non adopters (n=84)
Variables	Mean	
Gender • Male • Female	 15 (22.39%) 52 (77.61%)	 28 (16.42%) 56 (83.58%)
Age (years)	58.27	61.07
Household size (numbers)	7.16	5.61
Main source of income (%) • Farming • Child grants • Pension • Remittances • Old age grants • Salary/wage	 2 47 27 12 3 9	 0 27 36 21 12 4
Highest qualification (%)	 9	 6

• No formal education • Primary school • Secondary school • Tertiary	 24 64 3	38 54 2
Monthly off farm income (%) • <R500 • R501-R1000 • R1001-R2000 • R2001-R5000 • R5001-R10 000 • >R10 001	 16 16 60 6 0 1	 6 15 58 17 0 0
Monthly on-farm income (%) • <R500 • R501-R1000 • R1001-R2000 • R2001-R5000 • R5001-R10 000 • >R10 001 • No income	 43 9 15 6 1 1 6 0	 73 19 5 2 1 0 0
Employment status (%) • Unemployed • Formally employed • Self-employed • Part-time farmer • Full time farmer • Retired	 36 4 8 7 10 2	 35 7 5 0 52 1

Source: Field survey data (2017)

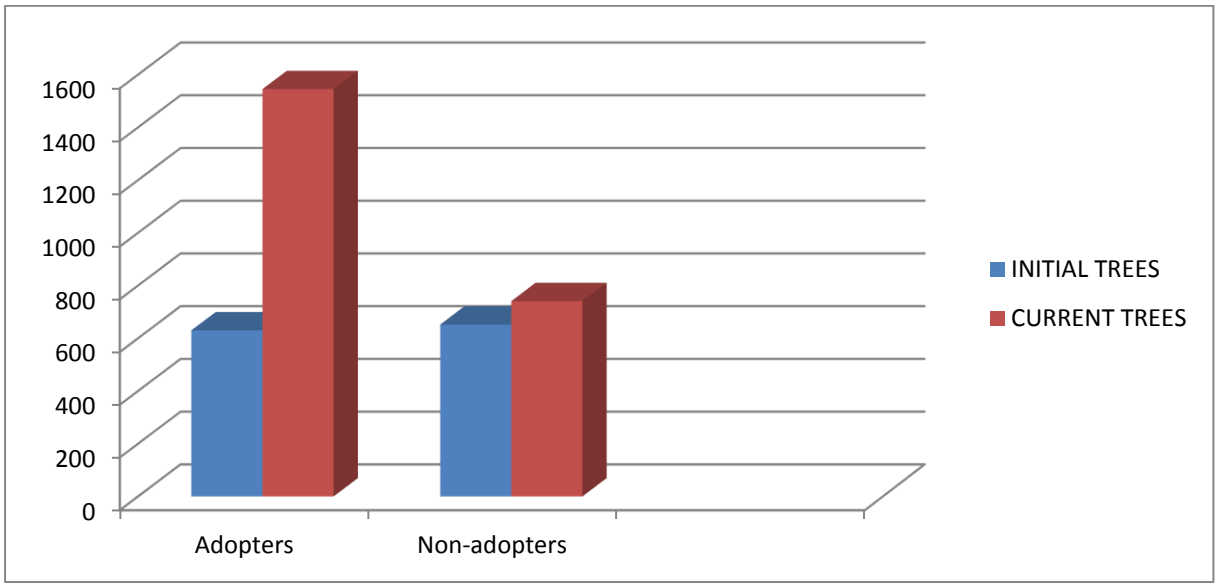
4.2 HVC adoption levels (a comparison between adopters and non-adopters)

It can be deduced from figure 2 that HVC adopters have increased cultivation compared to non-adopters in the period under study. Year 2002 was used as the baseline to compare adoption levels between adopters and non-adopters. The year (2002) was used since it is the year that the first household joined the programme in the sample. However, accumulation of trees after 2002 were included for non-adopters and trees planted before 2002 were excluded. In the case of adopters, initial trees are taken as those trees that were bought from the programme upon participating and only trees from the programme are included in the number of current trees. The years in which the households participated vary from 2002 to as late as 2016. This alone show how much participating households have intensified cultivation of HVC's.

Using 2002 as baseline, adopters and non-adopter had almost the same number of trees initially with 630 and 652 trees, respectively. However, by 2017, the adopters had more than doubled cultivation of HVC's to up to 1545 trees compared to only 741 trees by non-

adopters. This shows that the programme has enjoyed a massive buy-in from the participating communities in the O.R Tambo District Municipality.

Figure 2: HVC adoption levels



Source: Field survey data (2017)

In this study, a household is said to have intensified adoption if the difference in number of trees planted (number of current trees less initial number of trees upon participating) is above the average of current trees planted by all the participants in the study. The levels of intensity are categorised as follows:

If; $\beta > TB/N$, high intensity of adoption

$10 < \beta < TB/N$, moderate intensity of adoption

$B < \beta < 10$; low intensity of adoption

$\beta < B$, there has been loss in number of trees planted (no intensity)

Where; β = current number of trees planted in household

B = initial number of trees planted upon joining the programme in household

$B - \beta$ = level of adoption of trees per household

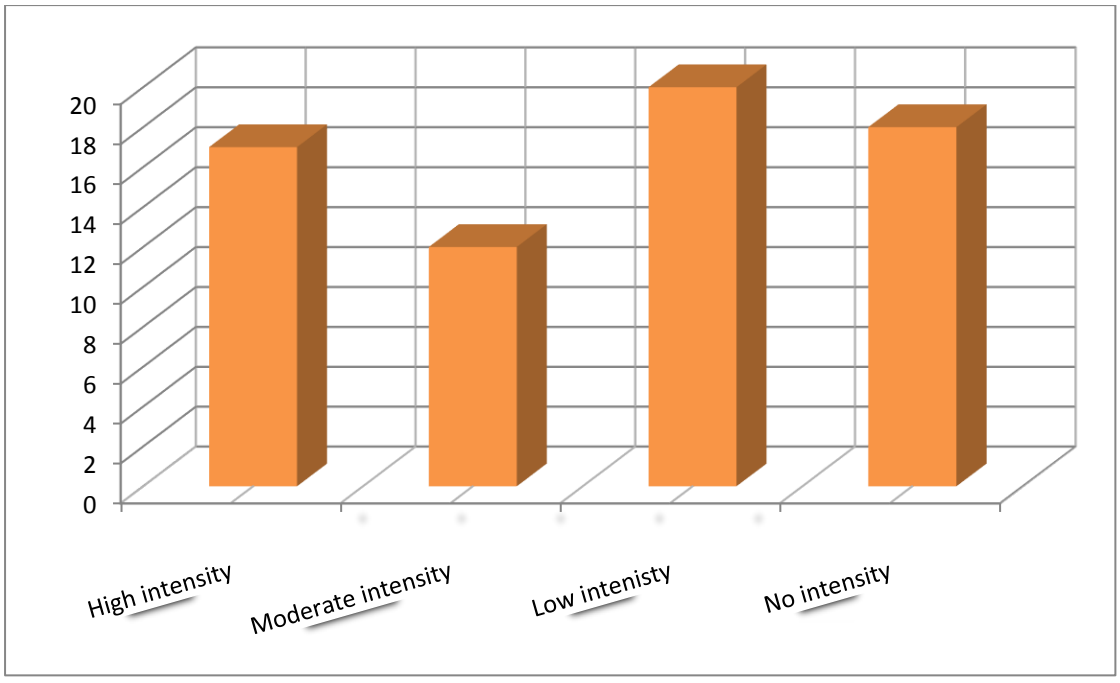
TB = Total number of trees by all households participating in the programme in the study

N = sample size of participants in the study

TB/N = average number of trees per participating household in the study

Figure 3 is displaying the level of intensity among the households who are participating in the programme. Households who have adopted and highly intensified HVC are 17 out of 67 (25.4%). These are the households who have cultivated more than the average (23 trees) number from all respondents who are participating in the programme in the study. This category mostly consists of households who have partaken in the programme since 2004. Most of these households have not only increased the number of trees but have also diversified the trees. This allows for households to consume more nutrients from different kinds of fruits they harvest. However, most households (20) (29.9%) fall under low intensity category, whereby they have managed to increase production by between 1 and 10 trees. This category is mainly made up of households that have started participating in the programme about 5 years ago. 18 households have not increased (no intensity) or have lost some tree(s) since participating in the programme. Some of the farmers have confirmed during the interviews that they have indeed suffered mortality due to poor or lack of fencing which allows goats to destroy their fruit trees. They are mostly prone to destruction when they are still seedlings. Also, worms have, to some extent, contributed to tree mortalities in the study area.

Figure 3: Categorisation of intensity level



Source: Field survey (2017)

There has, undoubtedly, been some level of adoption and intensity cultivation of HVC's by participating households. However, an empirical model was used to determine the main factors influencing both adoption and intensity. The next part shows empirical evidence.

4.3 Factors affecting adoption and intensity use of high value crops in OR Tambo District

The results of a double hurdle model are presented in Table 4 and 5. The first stage is the Probit model and it takes into account whether the farmer adopted the high value crops or not. The second stage (Truncated regression) measured the intensity cultivation of these HVC's. Overall, the model was highly significant as indicated by Wald Chi-Square (p<00.01). The results showed that out of 12 variables included in the model, five were statistically significant in the probit model and three in the truncated regression.

Factors affecting adoption of high value crop by ARC

The first stage of a double hurdle model showed that demographic factors such as gender, household size, off-farm income, and employment status and access to water for irrigation were significant in determining the factors affecting adoption.

Table 4: A Probit regression (1st hurdle).

Probit regression Log likelihood = -79.180484		Number of obs = 151 LR chi2(9) = 49.05 Prob > chi2 = 0.0000 Pseudo R2 = 0.2365				
IYDYP2	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
GEND1	-.4941556	.2614619	-1.89	0.059*	-1.006611	.0183002
AGE1	.0024837	.0111454	0.22	0.824	-.0193609	.0243283
HHSI1	-.1020785	.0364546	-2.80	0.005**	-.1735282	-.0306287
MSI1	-.1698945	.1222143	-1.39	0.164	-.40943	.0696411
EDL1	-.17146	.1889839	-0.91	0.364	-.5418616	.1989416
MOFFI1	.4251755	.1562275	2.72	0.006***	.1189751	.7313759
EMPLST1	.1213274	.066875	1.81	0.070*	-.0097452	.2524
AW2	.2962248	.0824889	3.59	0.000***	.1345495	.4579002
HA3	-.9078578	.6054165	-1.50	0.134	-2.094452	.2787367
_cons	.550709	.8648606	0.64	0.524	-1.144387	2.245805

Source: Field survey data (2017). ***, **, and*, implies Significant at 1%, 5%, and 10% respectively.

Gender (Gend1) was regarded as one of the most important socio-economic variables in influencing both adoption and intensity of HVC's. Table 4 shows that gender is significant at 10% and has a negative association. These results coincides with (Hlomendlini, 2015 and Mathebula, 2015) when they determined key factors influencing smallholder market

participation and household participation in agricultural production, respectively. The significance was expected since females tend to be hands-on on high value crops and males to livestock production. In table 2, it can be seen that 77.61% were females and only 22.39% were males. This shows how woman play an important role when it comes to backyard gardens and HVC's in ensuring household food security. However, the negative association shows that the likelihood of adopting HVC's decreases when there's a unit increase in female adoption.

Household Size (HHSI1) was determined to be significant in the probability to adopt high value crops. A priori expectation from table 3 suggested that this variable might have a positive or negative effect on adoption. The results above show that the variable has a negative association with adoption of the high value crops. The negative association implies that as family size increases, the chances to adopt HVC's are reduced. The reason for this relationship is that, family members, there better the chances of the family members to go seek work elsewhere, preferably in the cities where there are immediate returns and less risks compared to farming. The results are in line with (Martey, 2014; Akpan *et al*., 2012; and Mpangwa, 2011) that fertilizer adoption (the former 2 authors) and improved sorghum varieties have a negative but significant association with adoption. On the contrary, table 2 reveals that household size of adopters is higher than that of non-adopters. An explanation to this is that, even though adopters are larger in terms of size, they constitute mostly of young members of the family who cannot assist with labour services.

Monthly off-farm income (MOFFI1) is income derived in a household outside farming activities. An *a priori* expectation was that, monthly off-farm income might influence adoption of HVC negatively or positively. From table 4, it can be deduced that there is a significant and positive relationship in terms of HVC adoption. This is attributed to the fact that members need to purchase the trees upon joining the programme. The prices to which they buy these trees vary according to which fruit one is purchasing and how many they will purchase. However, they purchase these fruit trees at subsidized amounts. Inversely, Verkaart *et al*., (2017) found off-farm income to be negatively related to chickpea adoption, asserting that an additional source of income tend to reduce a household's ability or interest to adopt.

Employment status (EMPLST1) of household head plays a crucial role and forms part of socio-economic characteristics. This variable was found to be positive and significant at 10% level. These findings agree with *a priori* expectations and it shows that if household head is

employed, they are willing to invest money from their off-farm activities to the programme. This was expected since one needs to pay for trees (even though at very subsidized prices) upon joining the programme. However, there were few cases whereby villagers would contribute money on behalf of a particular struggling family to pay for their trees.

Water access (AW2) plays a vital role in agricultural production. Unlike staple crops like maize which is mostly grown under dryland conditions in rural areas, HVC's require frequent irrigation for a farmer to harvest good produce. It is for that reason that there is a very strong significance at 1% and a positive association. This means that the more a farmer has access to water, the more like they will adopt HVC's. On the contrary, Mathebula (2015) found a negative relationship and attributed it, even though uncertain, to the climatic characteristics of the study area, whereby most households farm on wetlands. It is worth noting that, participants of the HVC programme are urged to use conservation agriculture techniques as is it required in the programme and one of the techniques is the use of grey water.

Factors affecting intensity cultivation of high value crop

The truncated regression indicates that out of 12 explanatory variables fitted in the model, only 3 were found to be statistically significant and are gender, land size and market participation.

Table 5: Truncated regression (2nd hurdle)

Truncated regression

Limit: lower = IYDYP2
upper = +inf
Log likelihood = -249.62782

Number of obs = 65
Wald chi2(12) =22.43
Prob > chi2 =0.0330

HMFTREE2	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
GEND1	-13.234	7.910361	-1.67	0.094*	-28.73803	2.270021
AGE1	-.1060409	.358375	-0.30	0.767	-.808443	.5963612
HHSI1	1.368406	1.162335	1.18	0.239	-.9097295	3.646541
MSI1	1.296552	3.222516	0.40	0.687	-5.019464	7.612568
EDL1	-4.323155	5.099026	-0.85	0.397	-14.31706	5.670751
MOFFI1/ MONFI1	2.008997	5.241379	0.38	0.702	-8.263916	12.28191
EMPLST1	1.434544	1.93657	0.74	0.459	-2.361063	5.23015
WDYJ2	-1.294131	1.348751	-0.96	0.337	-3.937634	1.349372
TF2	-1.176947	7.48901	-0.16	0.875	-15.85514	13.50124
HA3	54.11415	19.21167	2.82	0.005***	16.45998	91.76833
DMP4	34.29155	10.58184	3.24	0.001 ***	13.55152	55.03158
_cons	-6.506054	28.3342	-0.23	0.818	-62.04007	49.02796
/sigma 18.02155		2.626978	6.86	0.000	12.87277	23.17033

Source: Field Survey data (2017) ***, **, and*, implies Significant at 1%, 5%, and 10% respectively.

Gender (Gend1) was found again to have a negative association in influencing intensity use of HVC's and significant 10% level. This negative association implies that the likelihood of adopting HVC's decreases whenever there is a unit increase in female adoption. This therefore calls for more male household heads to participate in the programme. Even though male counterparts tend to be inclined in looking after livestock, adoption of HVC's will eventually lead to increased food security and improved household incomes, helping

diversify risks due to food supply shocks, drought, loss of off-farm income and other unforeseen circumstances.

Land size (HA3) is important when it comes to agricultural production. Table 5 reveals that land size is significant at 1% with positive association. This bodes well with the intensification of fruit trees since trees like mango and orange tend to take up space. HVC's adopters have an average of 0.42ha and on top of that, are required to intercrop with cash crops. This means that with every additional unit increase of land size, they have the opportunity increase number of trees. These finding were in line with Mathebula (2015) when she found that land size was positive and significant at 5%, allowing for households to intensify participation in agricultural production when there is more land available. Also, Hlomendlini (2015) and Makhura *et al.,* (2001) agree with these finding when they revealed that an increase in land size also led to an increase quantity of maize sold

Market Participation (DMP4) consists of both formal and informal market in this study. Market participation was found to be highly significant at 1% level and has positive association. This implies that the households saw an incentive of intensifying cultivation of HVC's by participating in the market to improve household income. This is one of the main objectives of the programme; to improve both household food security and income. Because of inconsistent quantity and quality, households have not made a breakthrough of supplying formal markets like supermarkets and retailers. They are, however, selling to surrounding schools and in town as vendors. But most households sell in their homesteads, and by doing so, reducing transaction costs associated with looking for markets. On the other hand, non-adopters tend to sell less and consume more since they do not produce as much surplus as adopters.

5. CONCLUSION AND POLICY IMPLICATIONS

The objective of the study was to assess the factors that influence adoption and intensity cultivation of high value crops in the OR Tambo District Municipality. As such, the study used cross-sectional data from 3 local municipalities and 7 villages through interviews. The data collected consisted of household and farm characteristics, and the data pertaining the HVC programme. The study used a double-hurdle model to determine factors influencing adoption and intensity cultivation of HVC's. Multistage sampling was used to obtain a sample size 151, with 67 having adopted HVC's and the further 84 having not adopted.

Adoption and intensity levels revealed that there is a huge uptake and intensity cultivation of HVC's in the study area. This uptick in cultivation can be attributed to associated benefits such as different nutrient consumption, improved household income since most of the participants are selling to local, informal markets and increased food security. Also, increased gardening skills and awareness of conservation agriculture has played a pivotal role in ensuring both adoption and intensity cultivation of HVC's.

The results of the double-hurdle revealed that off the 12 explanatory variables fitted in the model, gender, household size, off-farm income, employment status and access to water for irrigation were crucial in the adoption of HVC's cultivation. Also, the regression analysis revealed that gender, land size and market participation were key factors influencing intensity cultivation of HVC's.

Policy implications

On the basis of the results of this study, the following policy implications are suggested to further enhance the programme's impact to other communities, districts and provinces in the country.

- Gender was found to be significant and negative in association both in terms of adoption and intensity cultivation of HVC's. This implies that since the majority of participants are females, male counterparts should be encouraged by the implementers to participate more in the programme, in a bid to improve household food security and income. More male participants will ensure that the programme reaches a wider audience and as such bigger impact will be achieved.
- Market participation is also one of the crucial factors influencing intensity cultivation. It was found to be positive and significant. Most households do not sell to formal markets because of low output which lead to inconsistent supply. Households need to join forces, market in bulk so that they can be able to supply formal markets consistently. In terms of quality, more extension services are needed so that farmers can be advised as to how to keep their produce in good condition before and post-harvest. Lastly, most farmers cited problems of produce influx, which result to low prices. Transportation to Kei Fresh Produce Market in Mthatha would be helpful since farmers would be able to get better prices than selling locally.
- Access to water was also revealed to play a vital role in ensuring adoption of HVC's. Households that were able intensify cultivation where those that had taps nearby. Most households do not have taps nearby and those that have tanks mainly use them for the purpose of drinking and cooking. Most households rely on rainfall for irrigation. The local municipality should consider installing more taps in the district so that the crops can be irrigated regularly for households to achieve the desired quantity and quality.

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