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**Farming styles, livelihoods and social
differentiation of smallholder
farmers: Insights from New Forest
Irrigation Scheme in Mpumalanga
Province of South Africa**

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Bulisani Lloyd Ncube ¹

¹ MPhil graduate (2015), Institute for Poverty, Land and Agrarian Studies, University of the Western Cape, Bellville, Cape Town, South Africa

PLAAS Working Paper 53: Farming styles, livelihoods and social differentiation of smallholder farmers: Insights from New Forest Irrigation Scheme in Mpumalanga Province of South Africa

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Author: Bulisani Lloyd Ncube BulisaniIncube@gmail.com

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Institute for Poverty, Land And Agrarian Studies

Faculty of Economic and Management Sciences
University of the Western Cape
Private Bag X17
Bellville 7535

Tel: +27-(0)21-9593733
Website: www.plaas.org.za
Twitter: @PLAASuwc

Fax: +27(0)21-9593732
Email: info@plaas.org.za
Facebook: www.facebook.com/PLAASuwc



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ABSTRACT

This article focuses on the socio-economic differentiation of smallholder farmers in New Forest Irrigation Scheme. Smallholder irrigation schemes are seen as a way of alleviating poverty and contributing to economic growth. Although smallholders are lumped together as a homogenous group, the study of New Forest Irrigation Scheme shows diversity amongst farmers' endowments, farming styles and livelihood trajectories. Understanding the social differentiation of smallholder farmers is essential in ensuring that they are assisted in pursuing farming styles that are congruent to their respective livelihood trajectories. The article argues that farming objectives and livelihood aspirations are not only varied according to individual circumstances but also evolve over time.

Keywords: Smallholder irrigation, livelihoods, farming styles, gross margins, socio-economic differentiation.

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Faculty of Economic and Management Sciences
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Tel: +27-(0)21-9593733
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Fax: +27(0)21-9593732
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Facebook: www.facebook.com/PLAASuwc

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Fax: +27(0)21-9593732
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Facebook: www.facebook.com/PLAASuwc



1. INTRODUCTION

The majority of smallholder farmers in South Africa are engaged in dryland farming that has risks of low and unreliable rainfall. Irrigation schemes mitigate the risks of dryland farming and open up the possibility of farming throughout the year. The National Development Plan (NPC 2011:197) of South Africa states that without major policy interventions, the agricultural sector could continue to shed employment, mostly due to farm consolidation and technical change. It therefore proposes that agriculture could establish over a million direct and indirect jobs if land is allocated to labour-absorbing crops. One of the key proposals tabled in the National Development Plan is substantial investment in irrigation infrastructure, leading to an increase of 33% of land under irrigation over a period of 10 years. In this context, smallholder irrigation schemes are seen as a key avenue to achieve goals of poverty alleviation and economic growth.

Smallholder irrigation schemes are historically located in the former homelands, cultivated by black households, and supplied with water for crop production. In general each plot holder has a plot of less than 5 ha in extent (Fanadzo 2012: 1957). Smallholder irrigation schemes range from about 30 ha to about 400 ha in overall area. The objectives of farmers on these smallholder schemes are diverse, ranging from providing a source of cash income to enhancing household food security.

Smallholder farmers have been seen as a homogenous group requiring the same support in terms of extension, and access to finance. Farmers engaged in small-scale irrigation schemes in reality are quite diverse and follow different livelihood strategies that are often complex in character. Cousins (2011: 3) observes that smallholders are heterogeneous, and that differences are often class-based. This diversity and complexity needs to be understood by policy makers, as well as by implementing agencies, as blanket approaches that assume homogeneity will tend to be ineffective. A key issue in my own research was to determine how irrigation schemes impact on the livelihoods of socially differentiated smallholder farmers. This is the main focus of this article.

Many studies exist on irrigation schemes in KwaZulu-Natal, the Eastern Cape and Limpopo Provinces (Cousins 2013; Denison and Manona 2007; Fanadzo *et al* 2010a; Machethe *et al* 2004; van Averbeke *et al* 2011). Although there are a number of smallholder irrigation schemes in Mpumalanga, little research has been undertaken on them as compared to other provinces. This was one motivation for my detailed study of the farming styles, livelihoods and social differentiation of smallholder farmers in New Forest Irrigation Scheme in Mpumalanga Province.

2. FARMING STYLES AND LIVELIHOOD TRAJECTORIES

The major theories and concepts in this study derive from ideas about ‘farming styles’ and ‘livelihoods strategies and trajectories’. These are relevant for exploring the realities of smallholder farmers engaged in irrigation scheme production, given the diversity of the aspirations, strategies and activities that they tend to pursue in obtaining their livelihoods.

Van Averbeké and Mohamed (2006: 138) describe farming styles as a portrayal of a particular way of practicing agriculture, and thus combining and ordering the various activities and elements involved in agricultural production. They used a farming styles approach to classify farmers into *employers* who were employing full time labour on their plots, *food farmers* devoted mostly to household food production, and *profit makers* who farm primarily for selling their produce and generating a significant income (*ibid*:147). This typology was used in this study to classify New Forest irrigation farmers, based on the ways that they practice agriculture, the risks that they take, and the variable outcomes of their farming activities.

The livelihoods theory is relevant for smallholder farmers engaged in irrigation schemes, as they tend to combine their assets (both household and agricultural) in activities to produce crops and income for consumption, sale and future investment. Dorward *et al* (2009: 4) propose three types of livelihood strategies that agricultural households pursue, i.e. ‘hanging-in’, ‘stepping-up’ and ‘stepping-down’. ‘Hanging-in’ households are those where assets are held and activities are engaged in order to maintain livelihood levels in adverse socio-economic circumstances. ‘Stepping-up’ households engage in activities and investment in assets in order to expand their activities, so that production and income increase and thus improve their livelihoods. ‘Stepping-out’ households engage in existing activities to accumulate assets, which in time provide them opportunities for diversifying their activities into other livelihood strategies that become relevant.

The farming styles approach can be combined with the livelihood strategies approach to determine the relationship between farmers’ approach to farming and their livelihood development trajectory. Thus van Averbeké and Mohamed (2006: 152) argue that particular styles are strategically and structurally congruent with particular types of livelihoods. The literature on farming styles argues for the importance of recognising that farmers are not homogenous, be it through their resources endowments, approaches to farming, management of risks or adoption of technologies (van de Ploeg 2010:1; Vanclay *et al* 1998:85; Schwarz *et al* 2004:33). This helps to avoid a mismatch between farmers’ expectations and how development actors (e.g. policy makers, extension services, or civil society organisations) attempt to support and promote farmers’ development.

3. LITERATURE REVIEW

In South Africa there are currently about 302 smallholder irrigation schemes across eight provinces that utilise a variety of different irrigation systems, such as gravity-fed surface, pumped surface, overhead/sprinkler, and micro-irrigation (van Averbeke *et al* 2011: 799). The majority of these schemes are concentrated in Limpopo, Eastern Cape and KwaZulu-Natal provinces. Not all these irrigation schemes are functional, with the pumped surface and micro-irrigation having the largest numbers that are non-functional. As a proportion, 69.6% of the 296 schemes are functional, 30.4% non-functional and the status of 2% of the irrigation schemes is not known. Even the functional schemes may not be fully operational.

In 2010 smallholder irrigation schemes covered an area of 47 667 ha, which is much smaller than the 1 675 822 ha of registered (commercial) irrigation land in South Africa recorded in 2008 (van Averbeke *et al* 2011: 797). Around 58% of the area commanded by smallholder irrigation schemes in South Africa uses pumped overhead irrigation systems (van Averbeke 2012: 418). Gravity-fed irrigation schemes have been found to be more durable and last longer than pumped schemes (*ibid*: 432), but only 25% of the command area of smallholder irrigation schemes is under gravity-fed systems, while the area commanded by pumped surface irrigation accounts for 9% of the total (*ibid*: 417). Gravity-fed irrigation schemes have also been found to have lower running costs than pumped schemes (Bembridge 2000:150).

Smallholder irrigation schemes in South Africa have transitioned from state-led during the 'homeland' era, to irrigation management transfer and rehabilitation and revitalisation era (van Averbeke 2008:15). All in all, the management of smallholder irrigation schemes in South Africa has generally been authoritarian in nature, despite responsibilities shifting from government to the private sector in recent years (Cousins 2013: 126).

The benefit of irrigation schemes compared to rain-fed agriculture is that the former should provide higher crop yields, as moisture stress is curbed, and create an additional planting season. It is disappointing to observe from studies that yields achieved by smallholder farmers in irrigation schemes are unsatisfactory (Fanadzo *et al* 2010b: 27; van Averbeke *et al* 2011:804). Fanadzo *et al* (2010b: 34) discovered that at Zanyokwe Irrigation Scheme in the Eastern Cape large yield gaps exist. Cropping intensity is also shown to be very low at smallholder irrigation schemes (Manona *et al* 2010: 4; Fanadzo *et al* 2010b: 29), which at times means that farmers utilise only half of the potential arable land in a scheme (van Averbeke *et al* 1998: 124). The only instances of observed high cropping intensities (closer to 200%) were at irrigation schemes in which farmers were farming through joint ventures with commercial partners, who provided most of the inputs required (van Averbeke 2012: 430). This implies that low cropping

intensities are due to inadequate resources for farming, such as inputs, labour, and water.

In terms of income, van Averbeké (2008: 77) showed that farmers at Dzindi irrigation scheme in Limpopo were able to produce positive gross margins for maize when the crop was sold as green cobs rather than dry grain. He also noted that farmers were able to obtain higher yields for green vegetables (such as Chinese cabbage) when the crop was planted during months with the lowest daily temperatures (van Averbeké 2008:251). Studies by Cousins (2013: 131) at Tugela Ferry irrigation scheme showed that 71% of the farmers were able to obtain positive gross margins, with the highest proportions being for maize and sweet potatoes compared to tomatoes and cabbages. Though tomatoes and cabbages were potentially more profitable, they were also highly perishable and thus required a ready market to prevent losses.

Smallholder farmers engaged in irrigated crop production face a multitude of challenges that account for their poor performance, as noted by many authors. The constraints identified in a study of two irrigation schemes in Eastern Cape and KwaZulu-Natal were grouped into four categories: (1) weak institutional and organisational arrangements; (2) socio-economic constraints; (3) infrastructural and water management constraints, and (4) agronomic constraints (Mnkeni *et al* 2010: iii). Similar issues are discussed at length in other studies of constraints on the performance of smallholder irrigation schemes in South Africa (van Averbeké *et al* 2011: 799; Tapela 2008: 183; Bembridge 2000: xvii; Perret *et al* 2003: 22; Botha and de Lange 2005: 3).

4. NEW FOREST IRRIGATION SCHEME BACKGROUND

New Forest Irrigation Scheme is located in the Bushbuckridge Local Municipality of Mpumalanga Province in South Africa. The irrigation scheme comprises approximately 622 ha and 531 farmers (plot-holders) according to Agterkamp (2009:69), but extension officers in the Department of Agriculture estimate that the scheme is about 1000 ha in area. Estimates are that approximately 160 ha are being utilised and not all irrigators are actively farming. The irrigation scheme draws water by gravity from the Orinocco dam, supplied by the perennial Mutlumuvhi river, and has nine storage dams, of which eight are currently operational. Due to lack of maintenance and funding from government, canals are broken down, reservoirs are highly silted, and do not hold much water.

The scheme dates back to the 1960s, when the land was taken from a private company and transferred by the government of the day to local people. The state resettled black household families in the four wards of New Forest village (New Forest, Tsuvulani, Edinburgh, and Demulani) and allocated one hectare plots to each household for irrigation farming. This closely followed the Tomlinson Commission's recommendation

in the 1950s that irrigation holdings of between 1.3 ha to 1.7 ha were adequate for an African household's livelihood needs (Perret 2001:3).

The purpose of this scheme was to ensure that the households resettled in the villages could support their livelihoods (combining food production and selling crops for cash) through farming at the irrigation scheme. However, the supply of water for irrigation is usually inadequate for this purpose as infrastructure is broken down, and this becomes worse during the dry season.

New Forest Irrigation Scheme is organised as a cooperative led by the cooperative committee. The role of the cooperative is to provide services and technical assistance to the farmers, such as tractor services, advice and extension. The scheme has two dedicated extension officers from the Department of Agriculture.

5. STUDY METHODOLOGY

An in-depth case study of the smallholder irrigation scheme was undertaken, that combined extensive and intensive research approaches (Swanborn 2010:1,2). Different types of interviews conducted during the study included a randomly stratified household survey of 94 irrigators (that included individual crop data sheets), in-depth life history interviews of 11 irrigation farmers, interviews with extension staff, and interviews with the New Forest irrigation committee representatives.

The survey was administered at the irrigation scheme to all the plot-holders (both owners and tenants) that were available. Crop record sheets were administered to the same 94 households in order to obtain data on each crop they grew, in relation to variables such as the area planted, planting and harvesting dates, tillage costs, inputs used (seed, fertiliser, and pesticides), labour use, yields obtained and marketing. The in-depth life history interviews were purposively sampled to be representative of the villages at the scheme, and explored livelihood dynamics amongst the diversity in the types of farmers (i.e. male-headed farmers, female-headed farmers, plot-holders, and tenants). These research approaches together provided a wide range of data that could be triangulated across the different methods.

6. FINDINGS AND DISCUSSION

6.1 Household assets

The majority of households in New Forest Irrigation Scheme own a range of domestic, agricultural and electronic assets. The agricultural assets include tractors, ploughs, wheelbarrows, knapsack sprayers, donkey carts, garden spades, garden forks and hoes, used in agricultural production processes. All households own agricultural assets, but in different proportions. The mean number of agricultural assets owned is six out of eight

agricultural asset types. This high rate of ownership reveals that New Forest households are indeed farming households.

Few New Forest irrigation farmers own livestock. This is related to the history of displacement and resettlement in the irrigation scheme, as grazing areas are limited compared to their previous residence. Though cattle have various uses, they are the only draught animals, owned by only 14% of the households. Even fewer households own goats and pigs reared for meat. The majority of households (72%) own chickens, mostly for household consumption. The asset ownership profile of New Forest irrigators shows diversity in terms of wealth status implying that the households are not the same economically.

6.2 Income sources

The income sources of New Forest irrigation farmers are varied and include irrigation income, social grants (pensions, and child grants), formal jobs and piece jobs. Almost all households (95.7%) derive some of their income from irrigation farming. This demonstrates the importance of irrigation farming in contributing to households' livelihoods. Though all households derive part of their income from irrigation farming, its proportional contribution to household income differs across them.

Just over half of the households have members receiving government pensions on a monthly basis. Child grants are also important to New Forest irrigation households, being received by 40% of households. The proportional contribution of social grants to household income also differs across them. Very few households in the irrigation scheme earn income from formal jobs and piece jobs, and formal employment does not play a significant role in the lives of the majority of households in New Forest.

6.3 Types of crops grown

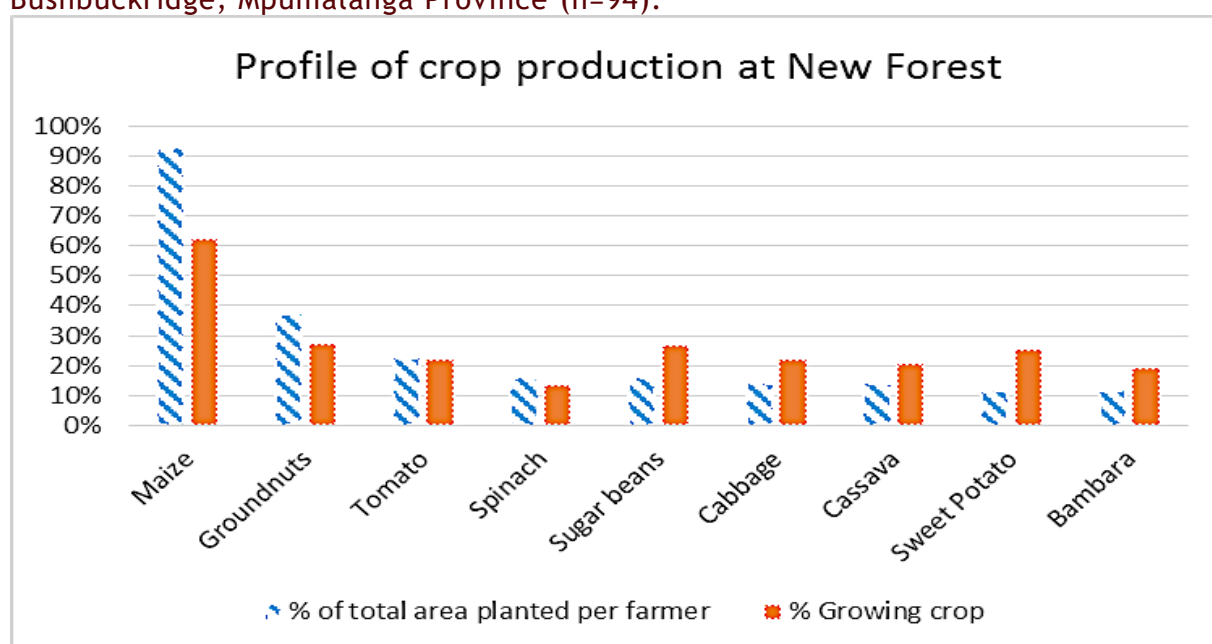
New Forest irrigation farmers grow a diverse range of crops that include cash crops and subsistence crops. For the purposes of this study, 'cash crops' are crops that the New Forest farmers grow primarily for sale, while 'subsistence crops' are grown essentially for household consumption. The cash crops include green maize, tomatoes, spinach (Swiss chard), cabbage, and sugar beans. The subsistence crops include groundnuts, cassava, sweet potato and Bambara groundnuts. The cash crops are mostly perishable (other than sugar beans) while subsistence crops are non-perishable. Farmers do sell small amounts of the subsistence crops, while some households also consume some of the cash crops.

Figure 1 shows the major crops grown by the New Forest irrigation farmers as well as the proportion of the total area used by each farmer that is planted to the crops. Maize is the dominant crop grown by the majority of farmers (93%). The majority of maize

growers sell the crop as 'green mealies' to 'bakkie' traders and hawkers. Maize also commands the largest allocation of land (62% of the area planted by farmers) compared to other crops. These figures show the importance of the maize cash crop to the New Forest irrigators.

In addition to maize, groundnuts are the other main crop, grown by 37% of the households and allocated about 27% of the land area of individual farmers on average. Interestingly, groundnuts are grown mostly for subsistence purposes, with very small quantities for sale to neighbours. The other crops are allocated to at least 20% of the land area planted (except for spinach which is allocated to a lower percentage, around 13% of the total).

Figure 1: Profile of crop production at the New Forest Irrigation Scheme, Bushbuckridge, Mpumalanga Province (n=94).



Clear differences in crop management practices emerged when cash crops were compared to subsistence crops. A large number of households (if not all crop growers) applied fertilisers and pesticides to the cash crops, while for subsistence crops, fertilisers were applied only to sweet potatoes. For groundnuts, Bambara nuts and cassava it was clear that no fertilisers and pesticides were used at all. Smallholder farmers in South Africa generally do not apply inorganic fertilisers to these crops, although DAFF notes that this may be necessary after prolonged depletion of soil fertility and/or when planting improved varieties (DAFF 2010a: 6; DAFF 2010b: 6).

6.4 Land tenure arrangements

Three types of land tenure arrangements exist at New Forest Irrigation Scheme. The first group of rights holders are *PTO-holders* (constituting 65% of the total), who acquired land either from the government or the traditional leader (i.e. the chief) or

through inheritance from their parents or other relatives. These farmers possess permission-to-occupy (PTO) certificates. The second category is *self-allocated plot holders* (comprising 5% of the total). They cleared land adjacent to the existing plots and converted it into an irrigation plot. This group includes some existing PTO-holders that extended their plots in order to gain access to more irrigable land, those that did not have access to any land at all to begin with, and tenants who identified adjacent and un-demarcated land and converted this into an irrigation plot. The third category are *tenants* (comprising 30% of the total), farmers who do not 'own' land on the scheme but either borrow land without paying for it or rent the land for an annual fee paid to a PTO-holder.

Secure access to land is critically important for an irrigation farmer, as this greatly influences investment and thus production, holding other variables constant. The PTO-holders are the most secure farmers, as they hold documentation as evidence of their rights or have inherited the land from a relative. The self-allocated category experiences a lower level of tenure security, including those whose land has been *certified* by the local traditional authority and who therefore pay tribal levies.

The tenants experience the most insecure form of land tenure. As long as farmers are insecure on the land, they are less likely to invest significantly in agricultural production and maintenance of land quality (Adams *et al* 1999: 7). One tenant-farmer, Allan¹, contends that when he applies kraal manure he is never sure that he is applying it to benefit only his own crops, given the risk that the owner could remove him before the next planting cycle.

6.5 Gross margin analysis

Individual crop record sheets allowed for the collection of detailed data on production, and the estimation of gross margins for individual crops in 2012-13. Gross margins per farmer per crop were aggregated to determine the overall gross margin per farmer. The gross margins applied to a single planting cycle and on a single bed planted. That allowed the identification of farmers that made a positive gross margin overall and those that made a negative gross margin overall. At New Forest Irrigation Scheme, there were more farmers that made an overall 'profit' (61.3%) compared to those that made an overall 'loss' (38.7%)².

A one-sample binomial test of these proportions shows a statistical significance of $p=0.05$, showing that the proportion of profit makers were significantly more than loss makers. The profit margins are R5283.56 on average while the loss is -R2932.46 on average. The range of profits made shows that for some the margins are low (R12), while for others it is quite high (R24 915). These results are shown in Table 1.

¹ The farmer's name has been changed to preserve his anonymity.

² Net Farm Income could not be calculated due to lack of accurate data on fixed costs.

Table 1: A comparison of total gross margins between profit makers and loss makers (n=93)

Farmer type	Proportion	Mean gross margin (ZAR)	Median gross margin (ZAR)	Range (ZAR)
Profit makers	61.3%	5283.56	3333	12 to 24915
Loss makers	38.7%	-2932.46	-2655	-110 to -8265
All farmers	100%	2080	1025	-8265 to 24915

Table 2 shows the positive gross margins for individual crops grown by the New Forest irrigators. The crops show that the majority of farmers make a profit from maize (green mealies), groundnuts, sweet potato, Swiss chard, Bambara nuts and cassava. All these crops³ except maize and Swiss chard are so-called 'subsistence crops'. The main cost drivers for 'cash crops' are the costs of fertilisers and seeds, while for 'subsistence crops' they are tillage and labour-hire. Although there are more farmers making a profit through production of subsistence crops than through the growing of cash crops, the positive gross margins of cash crops are generally higher than for subsistence crops. These results show that smallholder farmers can also make profits from subsistence crop production, while growing cash crops can also expose them to financial risks due to the high cost of inputs.

Table 2: Positive gross margins for main crops planted at New Forest Irrigation Scheme

Crop	Profit makers ⁴ as proportion of all growers		Positive gross margin ZAR		
	%	N	Mean	Median	Range
Maize	56.3%	87	2993.68	2265	53 - 15680
Tomato	46.6%	21	3087.70	1299.50	119 - 10975
Cabbage	30.8%	13	8190.25	6440	1410 - 18471
Groundnuts	97.1%	35	899.32	890	50 - 2100
Sugar beans	33.4%	15	434.4	217	40 - 1260
Sweet potato	72.7%	11	1686.38	464.5	110 - 7520
Swiss chard	60.0%	15	1648.22	496	80 - 7620
Bambara nuts	90.9%	11	532.9	190	64 - 2275
Cassava	84.6%	13	708	480	105 - 2270
All nine crops	62.8%	-	4381	2450	12 - 19050

Table 3 shows negative gross margins (i.e. 'losses') amongst crop types at the irrigation scheme. The majority of those making losses were the farmers that grew cash crops of tomatoes, cabbages and sugar beans. The ranges of losses (i.e. negative gross margins) were highest for tomatoes, cabbages, maize and sugar beans (shown by the bold

³ The local market rates were used to determine a value for the output of crops produced for domestic consumption.

⁴ The bold percentages show the crops with more than 50% farmers that made positive gross margins.

figures), showing the riskiness of these crops. Most of these crops (other than sugar beans) are highly perishable thus requiring a ready market to prevent losses.

Table 3: Negative gross margins for the main crops planted at New Forest Irrigation Scheme

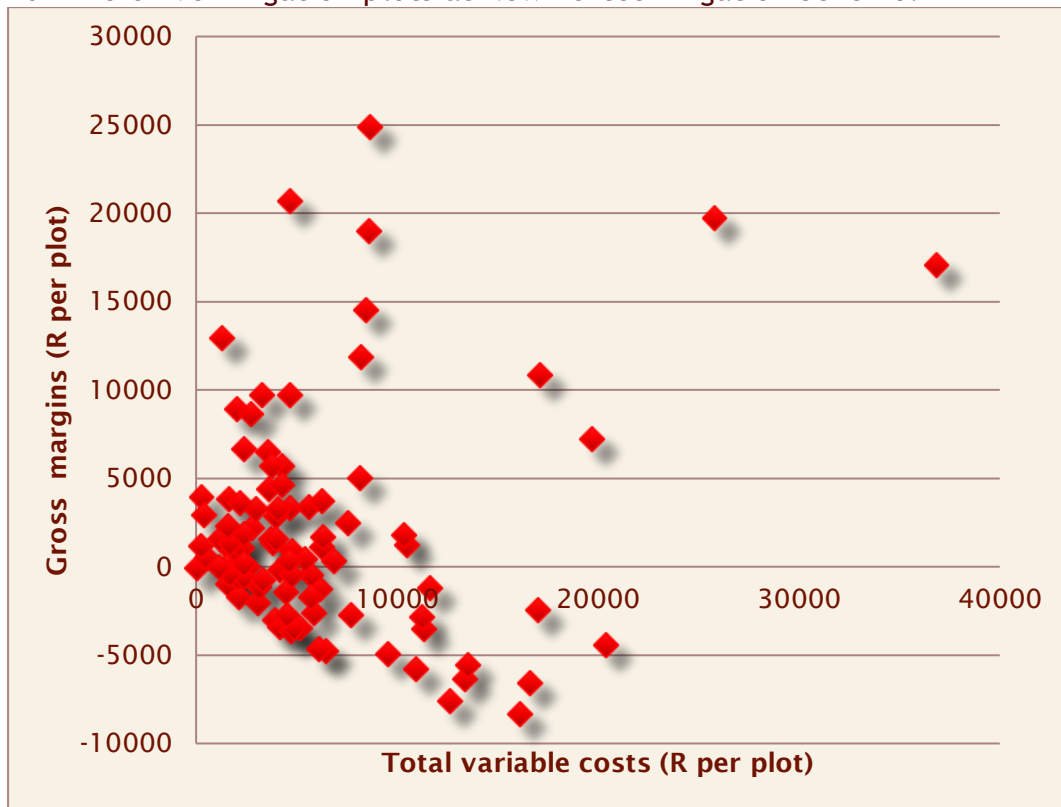
Crop	Loss makers ⁵ as proportion of all growers		Negative gross margin (ZAR)		
	%	n	Mean	Median	Range
Maize	42.5%	87	1902	1240	7850 – 110
Tomato	52.4%	21	2011	1445	8395 – 238
Cabbage	69.2%	13	2296	1939	7192 – 54
Groundnuts	2.9%	35	515	515	515
Sugar beans	66.7%	15	924	473	3320 – 65
Sweet potato	18.2%	11	770	770	770
Swiss chard	40%	15	662	390	1950 – 120
Bambara nut	9.1%	11	60	60	60
Cassava	15.4%	13	610	610	780 – 440
All nine crops	35.1%	-	2906	2660	6965 – 110

6.6 Identification of farming styles and livelihood trajectories

A scatter diagram was used to explore diversity amongst New Forest irrigation farmers. Gross margins per plot were compared to the total variable costs per plot. This analysis was applied to all the 93 farmers in the sample survey.

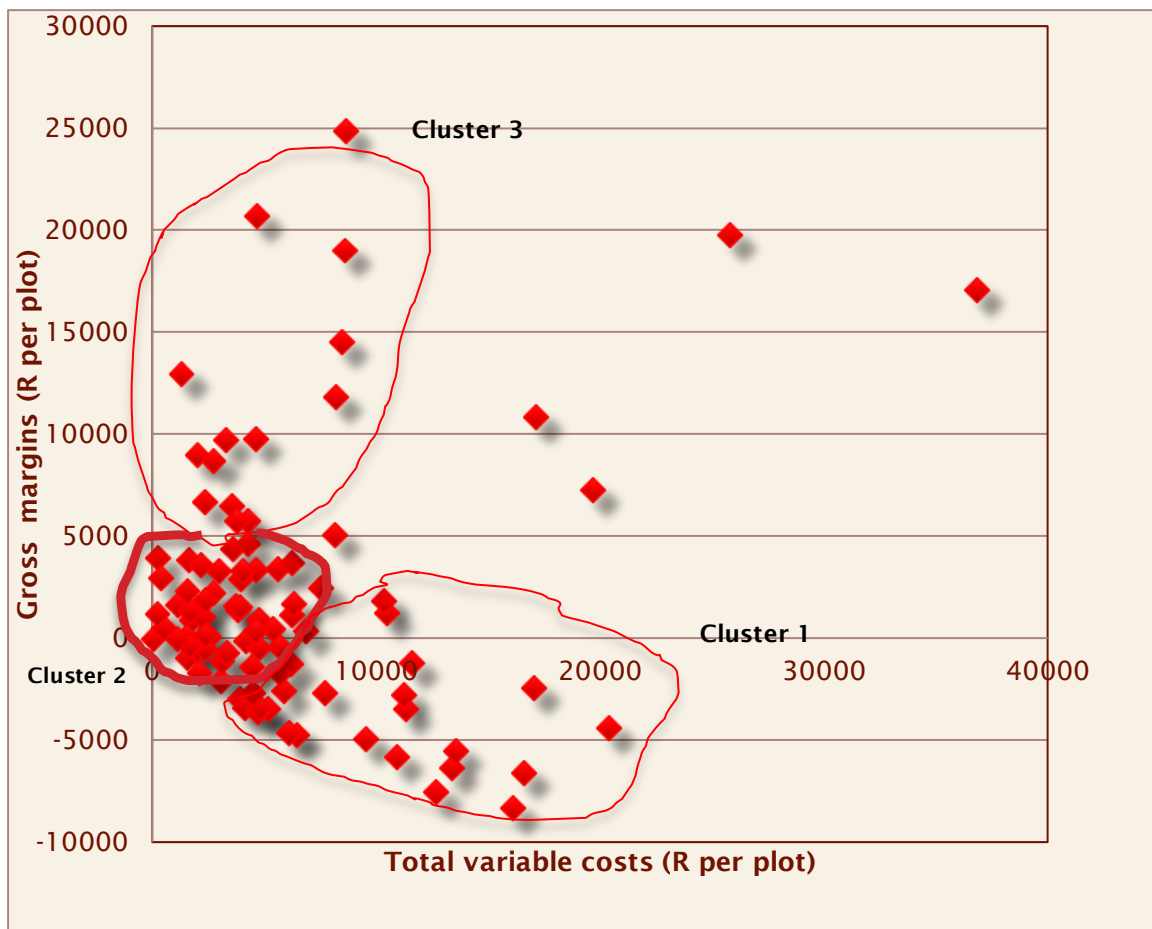
⁵ The bold percentages show the crops with more than 50% of the farmers that made negative gross margins.

Figure 2: Relationship between total variable costs and gross margins obtained in 2012-13 on 93 irrigation plots at New Forest Irrigation Scheme.



The data points were subdivided into clusters based on the relationship between gross margins and the total variable costs. These clusters are shown in Figure 3.

Figure 3: Farmer clusters at New Forest Irrigation Scheme (n=93)



The first cluster stretches from left-of-centre to bottom-right of the graph and a few data points stretching to the lower right section of the graph. This cluster consists of plots that have a negative response in gross margin to increase in total variable costs. The second cluster has the majority of its data points bundled together at the centre on the lower left section of the graph. This consists of plots that have both variable costs and gross margins that are low, generally R2990 and less. The third cluster stretches from left of centre to upper-left and comprises of plots where the gross margin response to increase in total variable costs tends to be highly positive and R3330 and more. Six data points were left out of the clusters since they represented outlier values, and did not fit into any of the three clusters.

Table 4 used selected variables to characterise and differentiate farmers in the three identified clusters, based on their performance in the 2012-13 farming season. These include total variable costs, gross farm income, and the proportion hiring labour, type of labour and type of crops grown. The sample size that was analysed comprised 87 plot-holders, after removing the outlier values and one household that did not have crop cost data.

Table 4: Characteristics of farmers in three clusters at New Forest Irrigation Scheme (n=87)

Characteristic	Cluster 1 (n=36)	Cluster 2 (n=28)	Cluster 3 (n=23)
Total variable costs	High	Low	Medium to high
Gross farm income	Negative to low	Low to medium	Medium to high
Proportion hiring labour (casual and full-time)*	63.6%	37%	34.8%
Proportion with full-time labour**	53.3%	20%	26.7%
Type of crops grown	Mostly cash crops, few subsistence crops	Mostly subsistence crops, few cash crops	Similar number of cash and subsistence crops

*Pearson chi square = 6.12, df=2, significant at p=0.04.

** Pearson not statistically significant.

Farmers in Cluster 1 have high total variable costs and negative to low gross farm incomes. The majority of these farmers also hired additional labour for their farming needs compared to the other clusters (significantly more so, at p=0.04). Most of the crops grown are cash crops, with the addition of a few subsistence crops. The production of mostly cash crops results in high expenditure on fertilisers and pesticides, in addition to the cost of hiring labour. This cluster of farmers also has more farmers hiring full-time labour compared to the other clusters. Based on these characteristics these farmers may be classified as *employers*, using categories similar to the classification of farming styles employed by van Averbek and Mohamed (2006: 143).

The farmers in Cluster 2 have low total variable costs and low to medium gross farm incomes. A few have negative gross margins. Compared to the other farmer types they have the lowest number of farmers hiring additional labour. These farmers grow mostly subsistence crops, with a few growing cash crops. By virtue of their labour hiring practices and the crop types they grow, their total variable costs remain low. The food produced is used primarily to supplement household food requirements, while occasional excess production is sold. The characteristics of these farmers are similar to those referred to by van Averbek and Mohamed (2006: 143) as *food farmers*, whose agriculture is primarily aimed at producing food for own consumption.

Cluster 3 comprises farmers growing both cash crops and subsistence crops. Their total variable costs and gross farm income range from medium to high. The returns to their total production costs are relatively high compared to the other two clusters. Their average gross farm income relative to total variable costs was high at a ratio of 3.98 (see Table 6) and was higher than the other clusters and significantly different (P<0.05). The farming style of these farmers means that they can be labelled as *profit-makers* (van Averbek and Mohamed 2006: 144).

Table 5: ANOVA analyses of socio-economic characteristics of farming styles at New Forest Irrigation Scheme (n=87)

Characteristics *	Employers (n=36)	Food farmers (n=28)	Profit makers (n=23)	Total (n=87)
Age of household head	62 _a	59 _a	56 _a	60
Household size	5.6 _a	6.3 _a	6.5 _a	6.1
Proportional contribution of main sources of income to mean total household income of plot holders (%)				
Pensions (%)	39.5 _a	30 _a	15.3 _b	30
Childcare grants (%)	7.6 _a	12.2 _a	9.6 _a	9.6
Irrigation plot income (%)	52.9 _a	57.7 _a	75 _b	60
Total household income (R)	26826 _a	27899 _a	52048 _b	34043

*ANOVA analyses were undertaken using farming styles as factors. Means followed by different sub-scripted letters differed significantly ($p \leq 0.05$).

Table 5 provides an analysis of the social and income characteristics of farmers using different farming styles at New Forest Irrigation Scheme. The main income sources were pensions, childcare grants and irrigation plot income. The other income sources (formal employment, part-time jobs and remittances) were not included in this analysis as very few farmers (<5% of the total) accessed these, and the actual values of these incomes were difficult to verify. The households across the different farming styles were comparable in terms of age of household head, household size, and childcare grants. These results are similar to the findings at Dzindi Irrigation scheme reported by van Averbek and Mohamed (2006: 146).

In terms of pensions, their proportional contribution to total income was similar for employers and food farmers. However, for profit makers, the contribution of pension grants to total household income was significantly less ($p < 0.05$) than that for the food farmers and employers. On the other hand, for irrigation income, its proportional contribution to the total income of profit makers was significantly higher than for employers and food farmers. This clearly shows that profit makers receive more income from irrigation farming. The annual total household income (R52 048) of the profit makers was also significantly higher ($p < 0.05$) than the incomes of the food farmers (R27 899) and employers (R26 826).

Table 6: ANOVA analyses of crop production-related variables amongst farming styles at New Forest Irrigation Scheme (n=87)

Characteristics (based on per cost ratios)*	Employers (n=36)	Food farmers (n=28)	Profit makers (n=23)	Total (n=87)
Mean total gross margins per plot (Rands)	-2932 _a	1314 _a	8724 _b	1598
Annual crop income (Rands)	13 046 _a	14 368 _a	39 853 _b	20 778
Total area planted (ha)	0.91 _a	0.77 _a	0.86 _a	0.85
Mean cost of seed per ha used (R/ha)	3207 _a	1677 _a	2564 _a	2544
Mean cost of tillage services /ha used (R/ha)	2702 _a	1956 _a	1977 _a	2270
Mean cost of fertilisers /ha used (R/ha)	13 599 _a	5717 _b	8060 _{ab}	9598
Mean cost of pesticides /ha used (R/ha)	843 _a	524 _a	555 _a	664

Mean cost of labour /ha used (R/ha)	3909 _a	1473 _b	1619 _{ab}	2520
Mean total variable costs (Rands)	7400 _a	3607 _b	4925 _{ab}	5518
Ratio of mean total gross farm income to mean total variable costs	0.57 _a	1.99 _b	3.98 _c	1.95

**ANOVA analyses were undertaken using farming styles as factors. Means followed by different sub-scripted letters differed significantly ($p \leq 0.05$).*

Table 6 shows the mean values of crop production-related variables across New Forest irrigation farming styles. The variables include total area planted to crops, and mean cost of seed, tillage services and costs of pesticides. These data show that the values for these variables are similar for farmers regardless of their farming style. Tillage costs are related to the area planted, since tillage services are charged per unit of land. The total area planted on average is similar across farming styles, though the profit makers obtained higher total gross margins per plot and higher annual crop incomes. This shows that profit makers are more efficient than employers and food farmers. The annual crop income, gross margins per plot and the ratio of mean total gross farm income to total variable costs for profit makers are significantly higher than for both the employers and food farmers. These characteristics emphasize the high returns on investment in irrigation production enjoyed by profit makers. Employers experience negative gross margins per plot, and the lowest ratio of mean total gross farm income to total variable costs (0.57) due to high variable costs (especially for fertilisers and labour). The food farmers' production costs are in-between the profit makers and the employers, as they are cautious in terms of the amount that they invest in irrigation production for home consumption.

The mean gross margins per farmer were negative for farmers in the employer category, at -R2932.46 (see Table 7). This translates into negative annual gross margins of -R308 260.20 for all employers sampled, and negative annual scheme gross margins of -R525 443.51 when applied to all active employers in the scheme (41% of the total). These figures show clearly that employers incurred significant losses and made negative returns on investment in crop production, due mainly to high production costs, especially the cost of hiring labour. As irrigation production is not profitable for them, over time they are likely to scale down their efforts in irrigation production and/or diversify into other less risky activities.

Table 7 shows that food farmers produced a low but positive mean gross margin per farmer of R1314 per crop. This translated to low, but positive annual gross margins (R107 443.27) for all food farmers sampled, and annual scheme gross margins (R183 141.94) when applied to the proportion of all active food farmers in the scheme (32%). These figures confirm the findings from the farming styles analysis that food farmers make reasonable amounts of farming income, that enables them to supplement their household consumption through their participation in the irrigation scheme. These farmers are likely to continue farming to meet their household consumption needs.

The profit makers obtained a positive and high mean gross margin per farmer (R8723.65). This translated to high and positive annual gross margins (R611 353.39) for all profit makers sampled; and positive and high annual scheme gross margins (R1 042 079.65) when applied to the proportion of all active profit makers in the scheme (27%). The profit makers produced a mean annual gross margin per household of R25 473.06, more than double the annual state old-age pension amount of R14 400 per person (R1200 x 12). These income figures tend to align with the findings from farming styles analysis, which suggests that profit makers are able to earn high profits from irrigation production, which, through continued investment, is likely to result in expansion of their operations and thus higher profits over time. These farmers are eventually likely to develop into small-scale capitalist farmers (Cousins and Chikazunga 2013).

Table 7: Total gross margins at New Forest Irrigation Scheme for employers, food farmers, and profit makers

Gross Margins	n	Employers (41%)	Food farmers (32%)	Profit makers (27%)
		Total GM for all farmers growing crops	Total GM for all farmers growing crops	Total GM for all farmers growing crops
Mean Gross Margin per farmer (R)		(2932.46)	1314.13	8723.65
Total Crop Gross Margins (R)		(105568.56)	36795.64	209367.60
Mean number of plots per farmer	1.46			
Total Crop Gross Margins for all plots (R)		(154130.10)	53721.63	305676.70
Number of times planted in a year	2			
Annual Gross Margins per year (R)		(308260.20)	107443.27	611353.39
Annual Gross Margin per household (R)	1	(8562.78)	3837.26	25473.06
Annual Gross Margins for active farmers (R)	150	(525'443.51)	183'141.94	1'042'079.65

6.7 Comparison of farming styles and livelihood trajectories

The farming styles of the New Forest irrigation farmers can be categorised using the livelihood trajectories typologies developed by Dorward *et al* (2009:4 and Scoones *et al* (2012: 516). Food farmers can be seen as falling within the *hanging in* livelihood trajectory. The hanging in trajectory is that experienced by farmers who successfully maintain their livelihood levels. They do not expose themselves to large financial risks, beyond ensuring that they are able to meet household consumption through the irrigation scheme and the welfare incomes that are received by the majority of them. By hanging in, they have managed to continue farming at the irrigation scheme in spite of the challenges they face of high production costs and inadequate access to water.

Profit makers achieve a *stepping up* livelihood trajectory, engaging in activities and investment in assets that enable them to expand their activities and improve their livelihoods. Investment at the irrigation scheme results in positive financial returns. These farmers are thus expanding their production and continue to invest in the irrigation scheme. Although this group does receive welfare grants, their contribution to total household income is less important (15% of the total for pensions and 10% for child care grants) than irrigation plot income (75% of the total).

Employer farmers can be classified as following a *stepping down/out* trajectory that consists of maintaining their production but being compelled to reduce their scale of operations due to high production costs (Dubb 2013: 188). The employer farmers at New Forest Irrigation Scheme have not as yet begun to diversify into other enterprises compared to the cases described by Dorward *et al* (2009: 4), Scoones *et al* (2012: 516) and Dubb (2013: 188). Their high production costs (R7400 on average) result in these farmers obtaining the lowest crop incomes, and often negative gross margins per plot (-R2932 on average).

7. WIDER IMPLICATIONS OF FINDINGS

Several studies argue that investing in smallholder irrigation schemes is one of the most effective ways of developing smallholder agriculture and thus contributing to poverty alleviation (Machethe *et al* 2004:17). Irrigation development has been shown to benefit the rural poor by: (1) increasing food production, (2) increasing on-farm and off-farm employment, and (3) increasing income generation (Machethe *et al* 2004:17; Mwendera and Chilonda 2013:68; Bembridge 2000:5). For smallholder irrigators to benefit from irrigation development, it has to be provided in line with farmers' diverse farming aspirations.

Access to land within irrigation schemes in South Africa is mostly through PTO-holding, inheritance, informal leasing and share-cropping (Tapela and Alcock 2011: 134; Perret *et al* 2003: 14; Cousins 2013: 129). Most PTO-holders at New Forest Irrigation Scheme generally do not use their land at present, and are not willing to lease it out to others for

longer periods. This observation is similar to other findings on Thabina and Msinga irrigation schemes (Veldwisch 2006: 11; Tapela and Alcock 2011: 140). Secure access to irrigation land should be assured for the different plot-holder types to ensure that they continue to invest in agricultural production and maintenance of the land quality.

Active farmers at New Forest Irrigation Scheme illustrate that there is much potential at the scheme for increased levels of production. Smallholder farmers can make 'profits' from subsistence crops, while cash crops can sometimes expose them to higher financial risks due to high input costs. It is thus essential to understand the circumstances of different types of smallholders before recommending to them which crops to grow.

The diversity of farming styles and livelihood trajectories adopted by New Forest irrigation farmers has implications for national policies for assisting smallholder farmers, and irrigation farmers in particular. Smallholder farmers are not only a diverse and heterogeneous population, but also change their farming styles over time depending on their circumstances.

'Food farmers' whose main objective is to supplement their household consumption needs tend to be conservative and may not be willing to incur the risks associated with commercial production. The fact that this farming style exists underscores the key point that not all farmers engaged in crop production at irrigation schemes have the sole objective of earning cash income. These findings agree with those of Tapela's study of Limpopo irrigation schemes, in which she proposes subsidising the livelihoods of 'food producers' and providing them with social safety nets in order to achieve broader policy objectives regarding poverty and social integration (Tapela 2014:27).

The 'employers' farming style lies between the extremes of risk aversion and risk taking. These farmers are cautious in pursuing activities that will result in them incurring higher costs. Diversification by 'employers' into other, less risky livelihood activities, both on-farm and off-farm in character, is an option for them. The gross margins for 'employers' show that not all smallholder irrigation farmers are able to make a profit, and that other, less risky alternative livelihood options need to be considered.

Those farmers who are 'profit makers', on the other hand, are more willing to embrace risky activities with the potential to increase their profits. Increased access to inputs, water, and alternative markets could well result in them increasing their profits, investing additional resources in irrigation production, and increasing their wealth. These findings show that some smallholder farmers are productive and earn high profits from farming. They need assistance to continue to improve their productivity, and to enhance their linkages with alternative markets (both informal and formal).

All these farming styles and livelihood trajectories are dynamic in character, and farmers migrate from one farming style to another depending on their individual circumstances and access to resources. Constant interaction and consultations with farmers is thus critical to ensure that support provided to them is congruent to farming objectives and livelihood aspirations.

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