ENHANCING PRODUCTION WHILE SAVING WATER THROUGH THE SYSTEM OF RICE INTENSIFICATION (SRI) IN KENYA'S IRRIGATION SCHEMES

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Abstract
Water available for irrigation has drastically reduced in recent years, especially in agricultural areas of Kenya, due to climate variability as well as unprecedented expansion of irrigation projects. As a result, any intervention that can save water, while also increasing crop yields and quality of produce is a welcome intervention. This is where the System of Rice Intensification (SRI) comes in. SRI is a technology that changes how rice is grown in paddies, and which increases yields. SRI involves among its practices, the alternate wetting and drying of paddies, wider spacing and transplanting only one seedling per hill as well as mechanical weeding. SRI was introduced in Kenya at the Mwea Irrigation Scheme in 2009, through research, awareness creation and training of various cadres of stakeholders, especially farmers. Starting with just two adopter farmers, adoption of SRI steadily rose to cover five irrigation schemes in Kenya, namely, Mwea, Ahero, Budalangi, West Kano and South West Kano. By December 2017, over 10,000 rice farmers had adopted SRI in the five schemes. The high adoption was driven by positive results. In Kenya, SRI increased rice yields by between 20% -100% depending on variety, while water savings of 25%-33% have been recorded under controlled experimentation. Research on SRI has been conducted by PhD and masters students, thus validating the technology scientifically, showing increased yields and water-saving factors. The effects of SRI on mosquito breeding showed that all mosquito larvae died in paddies under SRI, while they remained alive and multiplied in conventional flooded paddies, showing the technology holds promise for reducing malaria prevalence. Furthermore, SRI produces a harder, better grain which has superior qualities on milling and marketing. Indeed, SRI is a green technology which holds promise for food security, water savings, health and environmental benefits and improved productivity of rice in Africa.

Key words: Rice, production, intensification, technology, water saving, Kenya

1.0 Introduction

1.1 Conventional Rice Production Utilises too Much Water

For thousands of years, rice has been grown under flooded paddies utilising too much water. Rice production in conventional flooded paddies utilizes between 3,000 and 5,000 litres of water for each kilogramme of grain produced (Molden *et* *al.*, 2007). For instance, a reduction of 10% in water used in irrigated rice would free 150 billion cubic metres of water, corresponding to about 25% of the total fresh water used globally for non-agricultural purposes (Klemm, 1999). Most irrigation schemes for rice in Africa practice the traditional method of continuous flooding of paddies. This is because it is believed that rice is an aquatic plant or at least a hydrophilic one (Satyanarayana et al., 2006). But sometimes, flooded paddies conform to convention or tradition, handed down over generations, as it helps to control weeds.

1.2 Climate Change is set to Impact on Rice Production

Climate change includes gradually increasing average temperature as well as increased frequency and magnitude of extreme weather events (Mirza, 2003). This has implications for traditional paddy production, which utilizes continuous flooding of approximately 5 cm depth. In some rice growing countries in Africa, the extra demand for water is likely to exert pressure on existing rice producing schemes, brought about by the already present challenges of water scarcity due to adverse effects of climate change and variation. Climatic change could affect rice production differently, as increasing CO_2 concentration in the atmosphere has a positive effect on crop biomass production, but its net effect on rice yield depends on possible yield reductions associated with increasing temperature. For instance, for every 75ppm increase in CO_2 concentration rice yields will increase by 0.5 t ha^{-1}, but yield will decrease by 0.6 t ha-1 for every 1°C increase in temperature (Sheehy et al., 2006).

For many countries within Sub Saharan Africa (SSA), increasing the productivity of rice in the existing schemes rather than further expansion of irrigated areas is likely to be the main source of increased production, due to limited arable land, low usage of efficient production practices and water scarcity (IPCC, 2007). Yet rice could grow and yield well with less water. This is because, whereas the rice plant can withstand water-logging and indeed, it requires a lot of water, it does not have to be grown under water all through. Producing more rice with less water on the same paddy, using the same seed varieties, by the same farmers is possible (Jagannath et al., 2013; Lin et al., 2009). The answer is to be found in the innovation called System of Rice Intensification (SRI). In addition, anaerobic decomposition of organic matter, reducing the incidence of methane emissions, further reduces greenhouse gases emitted from paddies. This means that SRI is also beneficial as a “win-win” climate change adaptation practice.

2.0 The System of Rice Intensification (SRI)

The System of Rice Intensification (SRI) is a package of practices especially developed to improve the productivity of rice grown in paddies. SRI was developed with small-scale farmers in Madagascar to devise better ways to raise paddy yields with the aim of reducing the pervasive poverty and hunger in that country (Laulanié, 1993). Since then, the practice has spread to many countries all over the world. SRI increases the productivity of irrigated rice by changing the management of plants, soil, water and nutrients (Shambu, 2006). This method has been associated with water saving, because of alternate wetting and drying of rice paddies as opposed to the conventional continuous flooding. The system has also been associated with increased yields in a number of countries where it has been tried (Uphoff, 2005). It has the potential of disrupting the life cycle of malaria vectors due to alternate drying and wetting of the paddies. SRI should not be confused with upland rice, which are the rice varieties produced for cultivation in normal rain-fed fields and do not require flooding, albeit SRI is also practiced in rain fed systems. In practice, SRI involves some combination of the following changes in rice agronomic practices (Stoop et al., 2002 and Laulanié, 1993)

(i) Raising seedlings in un-flooded nurseries and well-supplied with organic matter. This produces a studier seedling which establishes easily once transplanted.
(ii) Transplanting young seedlings, i.e. 8-14 days old seedlings, instead of the conventional 21-30-day old ones. This enables the seedling to preserve the plants' growth potential. Early transplanting ensures that the plant maximizes on the tillering potential under the phyllochron concept. This concept applies to the gramineae species under which rice falls (Nemoto*et* et al., 1995). A phyllochron is the period of time between the emergence of one phytomer (a set of tiller, leaf and root which grows from the base of the plant) and the emergence of the next (Berkelaar, 2001).
(iii) Transplanting one seedling per hill (instead of the conventional clumps of 4-12 seedlings). The rice plant belongs to the grass family. Thus, it is the number of tillers a single plant produces that results in good yields, not the quantity of seedlings planted. This is the essence of planting a single seedling, which thrives better and yields more per hill.
(iv) Transplanting seedlings at wider spacing, in lines and in a square pattern, giving roots and leaves and more space to grow. Under SRI, each hill is transplanted, with a wider plant spacing of 25 cm by 25 cm or more. This practice lowered plant density, effectively reducing inter-plant competition for light, air as well as moisture and nutrients, and further contributing to increased number of tillers and leaves per hill. Solar energy is important for photosynthesis. The potential ability of a population of leaves to photosynthesize, and the capacity of grains to accept the photosynthesis, influences dry matter production, which in turn influences grain production (Tanaka, 1972). The increased leaf and tiller numbers due to SRI greatly enhances the entire mechanism of plant food production both above-ground (at the leaves) and below-ground (at the roots).
(v) Alternate wetting and drying of the paddy field to ensure aerating of the root zone**.** Unlike the conventional method of continuous flooding of paddy fields, SRI involves intermittent wetting and drying of paddies matched to the soil

and climatic conditions. This enables air to enter this soil, which is beneficial to the plant roots.

(vi) Weed control is preferably done using a simple mechanical/rotary weeder. This kind of weeding actively aerates the soil as much as possible, while mixing weeds with the soil to form green manure. The method also eliminates weeds, giving better results than either hand weeding or herbicides. It has been documented that the green uprooted weeds decompose rapidly (Hodges, 2010) and in some cases, improve the soil nitrogen levels (Katambara et al., 2013).

(vii) Enhance soil organic matters much as possible by applying compost, mulch, and manure. Chemical fertilizers can be used with SRI, but the best results have come with organic soil amendments.

3.0 Why SRI is a win-win Technology

Compared to conventional flooded paddy systems, SRI is a win-win technology bearing many benefits to the farmer, the economy, the irrigation scheme, the environment and to the country. These are summarised as follows:

a) Increased Yields

One of the main benefits of SRI is the fact that the practice increases the yield of rice, by various factors depending on crop variety, management and climatic conditions. In a study of SRI in Mwea, Ndiiri et al. (2013) found that among farmers in Mwea Irrigation Scheme, average SRI yields were significantly higher than flooded paddies ranging from 5.2 t/ha to 8.0 t/ha under SRI, as compared to 4.1 t/ha to 6.0 t/ha for flooded paddies, equivalent to an increase in average yields that varied from 26.8% to 33.3% attributed to SRI. In yet another study in Mwea, up to 71% increase in rice yields under SRI were obtained for three rice varieties (Nyamai et al., 2012) as shown in Table 1. Farmers getting higher yields with conventional practices have been reported by other researchers, such as Stoop *et al.* (2002), Anthofer (2004), Husain et al. (2004), Kabir and Uphoff (2007) and Thakur (2010).

Table 1: Effects of treatments (production system and variety) on yield components

Treatments	Yield component				
	Panicles per m^2	Grains per panicle	Filled-grain Ratio (%)	1000 grain weight (g)	Grain yield (ton/ha)
Production system (PS)	***	NS	NS	NS	**
CF	247.1	177.8	0.78	26.41	8.66
SRI	460.2	176.8	0.75	26.19	14.85
	(6.87)	(7.29)	(0.03)	(0.17)	(0.68)
Variety (V)	***	**	*	***	**
Basmati370	361.2b	162.5a	0.69a	20.21a	8.10a
BW196	495.9c	145.0a	0.77ab	28.91b	15.89b

NERICA1	203.9a (13.44)	224.5b (12.40)	0.83b (0.03)	29.77c (0.18)	11.26a (1.24)
PS*V	***	NS	NS	NS	NS
CV (%)	10.8	19.8	12.3	1.9	29.8

*, **, ***: Significance at 5%, 1% and 0.1% level respectively; CV: coefficient of variation; CF: Conventional flooded; SRI: System of Rice Intensification; standard error (see) in brackets; Means with the same letter in the columns are not significantly different at LSD (0.05).

Studies conducted in several countries report higher yields with SRI compared to the conventional method. In China, research by the National Hybrid Rice Research and Development Centre using the Super-I hybrid, gave a record yield of 16 t ha^{-1}, 35.6% higher than the 11.8 t ha^{-1} achieved under conventional water-intensive methods (Yuan, 2002). This underscores the far- reaching effects of SRI on crop growth and yield is that of active aeration of the soil. Aerobic conditions are healthy for increased soil microbial activities, which further induce an increased breakdown and subsequent release of nutrients available for plant uptake within the rhizosphere. This has been demonstrated by research (Barison and Uphoff, 2011; Zhao et al., 2009). Re-wetting dry soil facilitates mineralization (Ceesay, 2006), a process which is inhibited by hypoxic conditions in the soil. Scientists have also shown that anaerobic conditions inhibit root growth and rooting depth (Berkelaar, 2001; Stoop et al., 2002).

b) SRI Saves Water

The wetting and drying practiced under SRI results in less water being applied, and thus savings in water. SRI reduces the amount of water used to grow rice by between 25-35% compared with conventional flooded paddies (Mati, 2013). The wetting and drying of rice paddies has the beneficial effect of enhancing root growth. The rewetting facilitates nitrogen mineralization, which is made available to the plant for growth (Ceasey et al., 2006). Studies in Mwea (Omwenga et al., 2014) showed that the drying of rice paddies for between 4 and 12 days under SRI has positive impacts on rice yields, resulting in water savings of between 27% and 42%.

The water saving associated with highest yields was 32.3%, which was for the eight days drying regime. This gave the yield of 7.13 t ha^{-1} under SRI compared to 4.87 t ha^{-1} obtained under conventional flooded paddy. This was an increase of 46.4% above the conventional method of growing rice. As shown in Table 2, Ndiiri et al. (2013) rice grown under SRI was irrigated fewer times than with the conventional farmer's practice in part because its grain matured earlier by an average of 10 days, but also, farms under flooded paddies were irrigated more times than SRI plots, which were left to dry out rather than have standing water on the fields.

Table 2: Water savings comparing SRI with Conventional flooded paddy in Mwea

	Rainfall (m^3/ha)		Irrigation water (m^3/ha)		Water use (m^3/ha)		Water Productivity (kg/m^3)		Savings on irrigation water
Rice variety	**SRI**	**CF**	**SRI**	**CF**	**SRI**	**CF**	**SRI**	**CF**	**(%)**
Basmati 370	613 *	2,821**	8,422	11,610	9,035	14,431	0.7	0.4	27.5
mBW 196	696 *	3,464**	11,573	15,691	12,269	19,155	0.5	0.2	26.2
IR 2793-80-1	613 *	2,644**	10,420	15,096	11,033	17,740	1.0	0.5	31.0

**Rainfall water was drained from SRI plots hence lower than that in the CF plots. **Rainfall amount is different for each variety because of differences in crop duration.*

c) SRI Utilises Less Seed from Wider Spacing

SRI uses less seed, requiring about 7.5–12.5kg ha^{-1}compared to 62.5kg ha^{-1} that is used under conventional flooded paddies. The use of one seedling during transplanting means less seeds are required in the nursery, and this saves on costs of seeds by about 80% (Ndiiri et al., 2013).

d) Weed Control under SRI

Although weeds proliferate under SRI, control can be made easier as SRI utilizes mechanical/ rotary weeding. Mechanical weeding has been proven to stimulate root renewal and hence faster root development and improved tillering of the rice plant. Different viewpoints exist about comparative labor inputs in the SRI method of paddy cultivation. Uphoff (2002) and Anthofer (2004) argue that SRI may require more labor in the beginning but once farmers master the technique it could lead to labor savings. However, farmers in Kenya have indicated that when mechanical weeders are used, the cost of weeding is reduced by 75% compared to manual weeding under conventional flooded paddies (Mati, 2013).

e) Reduced cost of inputs

Less fertilizers and other inputs are used under SRI practice. This is because farmers can apply fertilizers directly to the plant since they are in rows. Thus, SRI can utilize about half the fertilizer used under conventional systems, in which by contrast, fertilizer is broadcasted which is wasteful and not targeted. Ndiiri *et al.* (2013) showed that the costs of inputs compared favorably for SRI as compared to flooded paddies (Figure 2). Moreover, SRI encourages use of organic manures prepared by the farmer, thus saving on the cost of fertilizers. Anthofer (2004) showed that the fertilizer input is significantly lower under SRI. According to Uphoff et al. (2002) primary field evidence from leading rice-growing countries shows a reduction in inputs such as seeds, water, chemical fertilizers and pesticides, while greater use of organic fertilizer is necessary to sustain increased yield. Therefore, SRI is a practice that can increase the farmer's production with less farm inputs if the principles are adhered to.

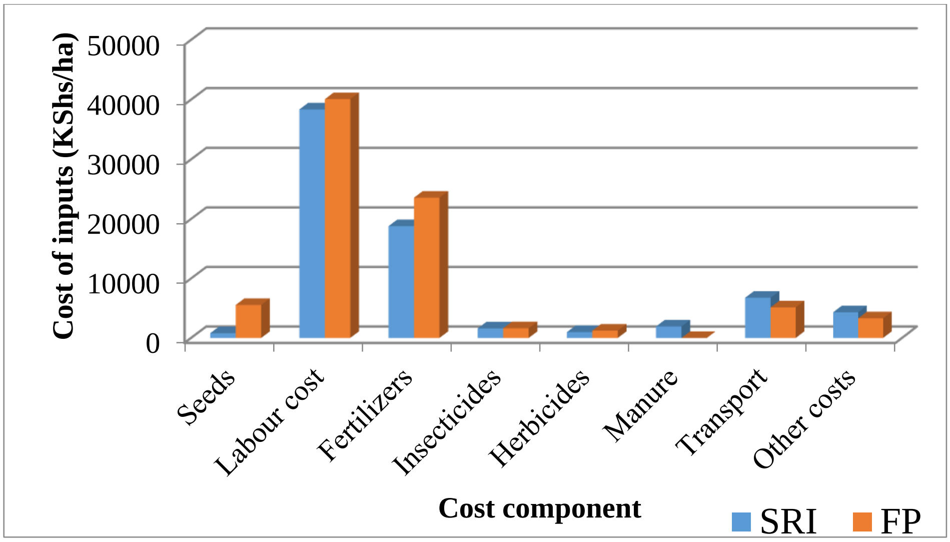

Figure 2: Input costs comparing SRI with flooded paddy (FP) practices
Exchange rate: 1 US $=100.0 KES

f) SRI Plants are more Resilient

In addition, research findings and farmers' reports have verified that SRI crops are more resistant to some pests and diseases, and better able to tolerate adverse climatic influences such as drought, storms, hot spells or cold snaps. The length of the crop cycle (time to maturity) is also reduced. In Mwea, SRI rice matures by two-three weeks earlier than conventional paddies. Resistance to biotic and abiotic stressors will be important in the coming decades as farmers have to cope with the effects of climate change and the growing frequency of extreme events. In general, the use of SRI methods, that increases resistance of SRI plants to lodging caused by wind and/ or rain due to larger root systems and stronger stalks, reduces the agronomic and economic risks that farmers face from crop loss (Uphoff, 2007). SRI practices improve the growth and functioning of rice plants root systems and enhance the numbers and diversity of the soil biota that contribute to plant health and productivity (Stoop et al., 2002; Uphoff, 2003).

g) Better Grain Quality

SRI practice results in a harder grain which does not break on milling resulting in a more whole, good quality grain which has higher market value (PANAP, 2007). The cumulative effect of these methods is to raise not only the yield of paddy (kg of un-milled rice harvested per hectare) without relying on improved varieties or agrochemical inputs, but also to increase the outturn of milled rice. This bonus on top of higher paddy yields is due to having fewer unfilled grains (less chaff) and fewer broken grains (Mati et al., 2014). The harvested SRI paddy is heavier than conventional paddy. Farmers in Kenya have found that the normal bag of paddy weighs about 100-110 kg for SRI, compared to conventional paddy which weighs 80-90 kg per bag of equivalent size (Table 3).

Table 3: Findings of the milling test for SRI and conventional paddy rice

Properties	**SRI**	**Conventional**	**SRI Advantage**
Head rice (%)	90	81	**+9**
White rice (kgs)	631	594	**+37**
Recovery (%)	63	59	**+4**
Broken (kgs)	37	56	**-19**
Chicken feed (kgs)	4.4	5.5	**-1.1**
Bran/dust (kgs)	79	101	**-22**
Colour sorter (kgs)	1.5	1.9	**-0.4**

Note: SRI has superior milling qualities in all the categories

h) SRI increases net farm-gate incomes from Rice

SRI increases the overall economic returns to the farmer from rice production. Research at Mwea in Kenya has found that net farm-gate incomes increase by about 20-50% from SRI compared to conventional paddy production. This is due to not only higher yields, but also the lower inputs costs. Ndiiri et al. (2013) in an economic assessment of SRI and conventional paddy, found a significantly higher benefit–cost ratio of 1.76 and 1.88 compared to 1.31 and 1.35 for flooded paddy in the first and second seasons, respectively. Barah (2009) reported similar ratios and even higher values in some of the districts he studied in India. A wide range of reductions in cost of production with SRI for different countries is elaborated in Uphoff (2005) and Sinavagari (2006).

i) Reduction of Disease Vectors in Paddies

SRI reduces the incidence of disease vectors in comparison with the situation found in conventional rice paddies. Research at Mwea has shown that due to the wetting and drying of paddies under SRI, mosquito larvae are eradicated in paddies when left dry for about two days. Omwenga et al. (2014) showed from plots studies that alternate wetting and drying of rice paddies under SRI practice interfered with the development process of mosquito larvae, eliminating the larvae from SRI plots compared to conventional flooded paddies (Figure 3).

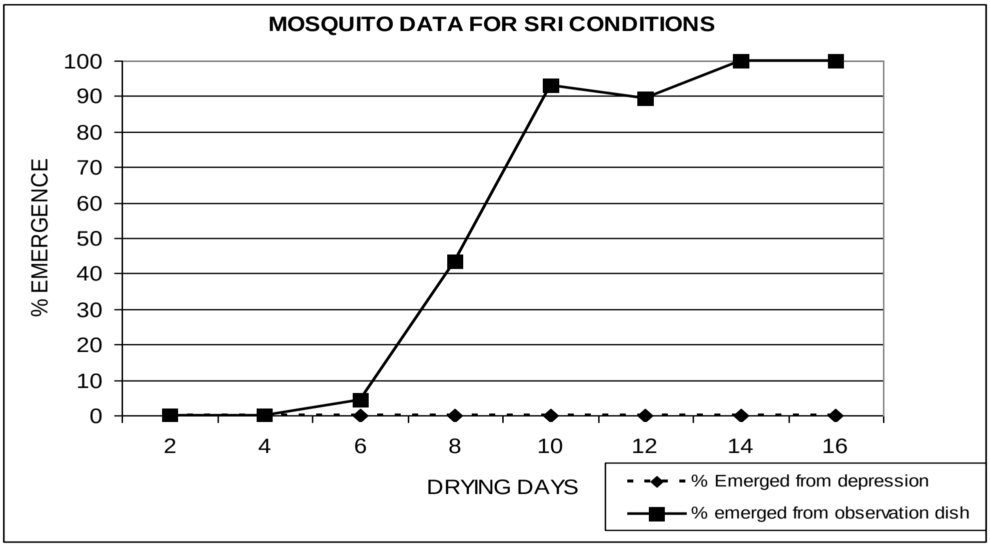

Figure 3: *Mosquito larvae survival comparing SRI Plots with flooded conditions at Mwea*

Other Major Findings under SRI Technology

a) Optimal Row Spacing for SRI varies with Local Conditions

SRI recommends a wider plant spacing of 25 cm by 25 cm or more. This means that the optimal row spacing depends on the prevailing soil and agronomic condition of the area. Table 4 shows the optimal row spacing on SRI in four irrigation schemes in Kenya as simulated by the Ceres Rice model (Nyang'au, 2013).

Table 4: Optimal row spacing under SRI as simulated by the CERES Rice model

Irrigation scheme	**Soil properties**	**Row spacing (cm) that gave highest yield/ Rice Variety**
Mwea	Available Nitrogen (%) = 0.161 Available Phosphorus (ppm) = 14.9 Potassium (Me/100g) = 0.078 Total organic carbon (%) = 5.094	Spacing: 25 by 25 Variety: Basmati Highest yield: 5.9t/ha
West Kano	Available Nitrogen (%) = 0.116 Available Phosphorus (ppm) = 46.97 Potassium (Me/100g) = 0.333 Total organic carbon (%) = 4.16	Spacing: 35 by 35 Variety: IR 2793-80-1: Highest yield: 8.59t/ha
Bunyala	Available Nitrogen (%) = 0.151	Spacing: 25 by 25

	Available Phosphorus (ppm) = 3.33 Potassium (Me/100g) = 0.191 Total organic carbon (%) = 2.97	Variety: IR 2793-80-1 Highest yield: 4.66t/ha
Ahero	Available Nitrogen (%) = 0.132 Available Phosphorus (ppm) = 36.2 Potassium (Me/100g) = 0.0.736 Total organic carbon (%) = 5.3.892	Spacing: 20 by 20 Variety: IR 2793-80-1 Highest yield: 4.63t/ha

b) Planting Calendar impacts on SRI

Adherence to appropriate planting calendar is key under the practice of SRI technology. As temperature varies from month to month, it is crucial to select the right date for crop establishment in such a way that the reproductive and grain filling phases of rice fall into those months with a relatively low temperature. This would minimize the negative effect of temperature increase on rice yield as reported by Peng *et al.*, 2004. Figure 4 shows the effect of planting dates on yield of IR 2793-80-1 rice variety under SRI simulation using the CERES Rice model. The planting dates were shifted 4 days before and 7 days after the actual planting dates and their yields simulated. As per the planting dates considered, the simulated results show that shifting the planting dates from the actual planting dates (21st July) led to increase as well as decrease in rice yield.

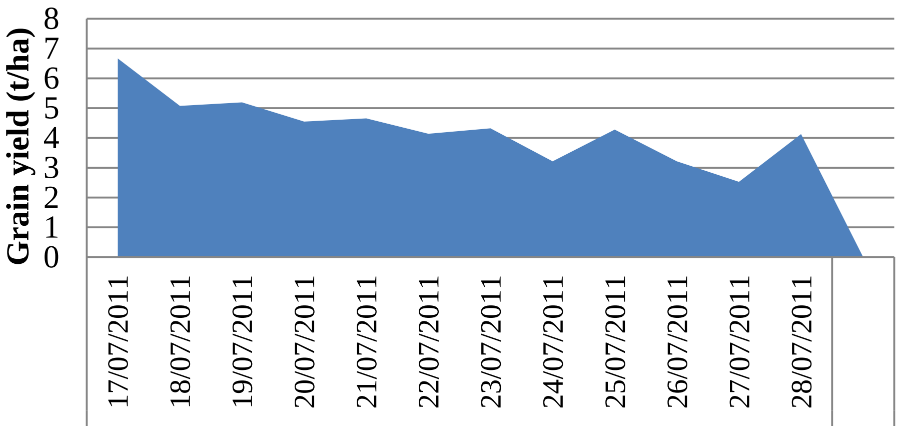

Figure 4: IR 2793-80-1 simulated yield under SRI at various planting dates at Ahero irrigation scheme, Kenya

c) Changes in weather conditions affect rice under SRI

Research on the impacts of changing weather parameters on rice under SRI has been documented. Nyang'au et al, 2014 reports that increase in solar radiation led to decrease in grain yield but increase in days to maturity for IR 2793-80-1 cultivated under system of rice intensification in Ahero irrigation scheme Table 5.

Table 5: Effects of solar radiation on IR 2793-80-1 grain yield and duration to maturity under SRI

Solar radiation (MJ/M^2)	+1	+2	+3	+4	+5
Grain yield (t/ha)	4.356	4.113	3.866	3.337	2.989
Duration to maturity (days)	156	158	160	161	162

Similarly, Yoshida (1983) reported that solar radiation of 300cal/cm^3/day (12.55MJ/m^2/day) during reproductive stage makes possible yields of 5t/ha. Lower solar radiation during grain filling is required to attain same yield. Temperature regimes greatly influence not only the growth duration, but also the growth pattern and the productivity of rice crops, even when grown under SRI practices. Nyang'au *et al,* 2014 further reports that increase in both maximum and minimum temperature led to a decrease in basmati 370 grain yields planted under system of rice intensification in Mwea irrigation scheme. As compared to maximum temperature, increase in minimum temperature had more pronounced negative impacts on Basmati 370 yields. According to Peng et al. (2004), this more pronounced negative impact of minimum temperature on rice yield could be explained by increased respiration losses during the vegetative phase and reduced grain-filling duration and endosperm cell size during the ripening phase (Morita *et al.*,2004).

4.0 Limitations of SRI

SRI practice has also certain challenges. These are described here along with respective remedies. They include (PANAP, 2007; Katambara et al., 2013; Ndiiri *et al.*, 2013; Omwenga et al., 2014):

(i) Increased incidence of weeds – Due to the wetting and drying of an SRI paddy, the aerobic conditions created attract more weeds than under conventional flooded paddies.
The remedy is to start rotary weeding on the tenth day after transplanting. If the SRI seedlings were planted well and the paddy allowed drying spells, the young seedlings hold the ground so well that they cannot be uprooted by the tenth day. Thus, it is safe to weed the field at this early stage. Thereafter, two more rotary weedings are done before the crop starts flowering. This eliminates weeds very effectively.

(ii) High initial labour requirement - which increases the cost of production, particularly for weeding. This can be a major constraint for initial practitioners of SRI, especially if they lack of rotary weeders. This is a common problem in the rice growing areas of SSA where SRI has been introduced for the first time, as mechanical weeders are not easily found in the local hardware/agrovet shops.

The remedy is to support local foundries to fabricate weeders. This requires capacity building not only through training, but also to equip the foundries with the necessary tools and equipment for the manufacture of high quality mechanical/rotary weeders. For instance, in Mwea, once local artisans learnt how to make weeders, their manufacture became a market-driven part of the SRI value chain. Another option is to provide subsidized weeders to farmers, obtained from elsewhere, even imported.

(iii) Survival of very young seedling – Depending on local conditions, in some areas, the young transplanted seedlings get trampled upon by large water birds (these birds are looking for frogs and insects) thereby submerging the seedlings.
The remedy is to have a bird-scarer for at least two weeks after transplanting. This problem is solved by the farmer.

(iv) Water management challenges **-** especially on fields which are poorly drained and those poorly levelled. Also, in large irrigation schemes, the canal layout may be such that water delivery may inhibit SRI farmers from practicing wetting and drying when they border others who are non-adopters.
This problem is solved by ensuring that the paddy field is properly levelled. Also, scheme-level water control and allocation is necessary.

(v) The pests and diseases which affect conventional flooded paddies also affect SRI paddies.
SRI paddies should also be accorded proper pest and disease control.

5.0 Conclusions

With the onset of climate change, the intensity and frequency of droughts are predicted to increase further exacerbating the competition for water. Due to population growth, the consequent increase demand for food production will put the greatest strain on water availability. This will also affect rice-growing areas as droughts could extend further into irrigated areas. This will have implications on the water made available for rice cultivation. In Kenya, recurring droughts affect nearly 80% of the potential 20 million hectares of rain fed lowland rice. Therefore, any technology which can save water and result in increased yields should be upheld. Overall, SRI is a better practice scientifically, because it promotes the growth and health of rice plant roots, which grow larger and deeper. Due to alternate wetting and drying of the paddy, SRI roots do not degenerate for lack of oxygen in the soil, instead, they thrive. In addition, SRI promotes agro-diversity of soil organisms that improve soil fertility and contribute to plant growth and health. The rice plant is a “water loving plant”. But SRI practice has proved that a rice plant requires just adequate water. There is no need to waste water flooding the paddy unnecessarily. SRI can be practiced on nearly all sizes of farms and is especially beneficial to smallholder rice farmers. SRI is a win-win technology with multiple benefits to the farmer, and for climate change adaptation.

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