Transplanted sorghum and pearl millet does well in semi-arid regions

RIU

Validated RNRRS Output.
Transplanting is a simple way to overcome the problems of erratic rainfall in semi-arid regions. Farmers in Zimbabwe and northern Ghana now raise sorghum and pearl millet seedlings in nursery plots before the rainy season and transplant them into the fields when the rains arrive. This considerably reduces the risks of poor or failed crops. Previously, when young crops were patchy, farmers used thinnings to fill in the gaps. But the transplants matured later than the rest of the crop and often didn't do as well because they were susceptible to pests, diseases and end-of-season drought. Transplanting is already used for many other crops and could double harvests of sorghum and millet in semi-arid areas.
Project Ref: **PSP31:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **CAZS-NR, UK**
Source: **Plant Sciences Programme**

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Geographical regions included:

Ghana, Zimbabwe,

Target Audiences for this content:

Crop farmers,

Document Contents:

Description

PSP31

A. Description of the research output(s)

1. Working title of output or cluster of outputs.
In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

Transplanting sorghum and pearl millet in semi-arid regions

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

DFID Flexibility Fund, DFID Rural Livelihoods programme

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RiUP activities.

R7341

UK

- CAZS-NR, Dr Einir M. Young

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- Savannah Agricultural Research Institute (SARI), PO Box 52, Tamale, Ghana
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- Action Aid, Ghana

Zimbabwe

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- Rural Unity for Development (RUDO), PO Box 1329, MASVINGO, Zimbabwe
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*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? **(max. 400 words)**. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

Problem addressed: Food security is difficult to attain in harsh, erratic environments of semi-arid areas. The relatively low long-term average, and large annual and seasonal fluctuations in rainfall, characterise the areas and are major determinants of community livelihood- and agricultural strategies. Sorghum and millet production is of great importance to the settled and agro-pastoral household food economies where alternative non-agricultural sources of livelihood improvement are limited.

In an attempt to offset poor germination and stand establishment caused by early drought, farmers thin and transplant sorghum and millet seedlings to fill in the gaps. However, these transplants mature later than the directly sown crops and can therefore be affected by various pests and diseases and terminal drought. This local intervention fails to solve the problem faced by the farmers.

Outputs proposed: The project adopted a **participatory research** approach to test whether raising **sorghum** and **pearl millet** seedlings in small **nurseries** before the rainy season, then **transplanting** them into the field at 3–5 weeks old when the rains are established is a valid way of enabling **resource –poor farmers** to cope with problems associated with **erratic rainfall** and providing a **safety net** against **drought**. In both Zimbabwe and Ghana, it was found that raising sorghum and pearl millet seedlings in small nurseries before the rainy season, then transplanting them into the field at 3–5 weeks old when the rains are established helped to overcome the problems associated with erratic rainfall. Crop vulnerability to a premature ending of the rains was reduced and, In many participatory trials on farmers' fields, yield increases were also observed.

The research was conducted in three phases (1) The physical and socio-economic constraints on the adoption of transplanting for improving crop establishment as a means of increasing food security in selected areas were characterised (2) The suitability of locally available varieties and landraces for transplanting were tested (3) Areas suitable for transplanting were identified and the best methods for transplanting in those areas determined.

When produced: The transplanting project was initiated in September 1998 through a one year pilot project funded by CAZS Natural Resources. Following the success of the pilot phase funding was secured from the DFID Flexibility Fund administered by the Rural Livelihoods Department for work initially in Zimbabwe, but following political unrest the work was moved to Ghana. The project ended in March 2003.

The wider adoption of transplanting could offer resource-poor farmers' flexibility to significantly improve their food security and their livelihoods.

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
	x		*x*		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

The output focuses on transplanting sorghum and pearl millet in particular with the explicit purpose of minimising the risks associated with erratic and unreliable rainfall in semi-arid areas.

Transplanting crops is widely practiced, e.g. for crops such as rice, vegetables, tobacco etc. where water supply is better controlled. Even maize is transplanted in areas of adequate moisture such as the Mekong delta of Vietnam, to capture three instead of two crops per year.

As the effects of climate change become more pronounced it is possible that transplanting could be used more widely. For example the tobacco float system for producing seedlings for transplanting sweet sorghum with a tobacco transplanter enables farmers in the USA to plant earlier in cold wet soils and to harvest three weeks

earlier. Consideration of labour saving devices such as this could make transplanting sorghum and millet more attractive beyond the low production semi-arid subsistence production systems.

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	***High potential***	***Hillsides***	***Forest-Agriculture***	***Peri-urban***	***Land water***	***Tropical moist forest***	***Cross-cutting***
x							

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	***Irrigated***	***Wetland rice based***	***Smallholder rainfed highland***	***Smallholder rainfed dry/cold***	***Dualistic***	***Coastal artisanal fishing***
				ü		

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**). Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.*

Transplanting sorghum and pearl millet involves the testing of a modified intervention – transplanting from nurseries rather than gap filling – with farmers in the farmers' fields. The technique has synergy with other interventions which impact on crop establishment such as seed priming (PSP, On farm seed priming to improve plant nutrition in low fertility soils, R7438, R8221, R8269), and pest and disease management – in particular the work on Striga prevention (CPP, Promotion and dissemination of integrated pest and soil fertility management strategies to combat Striga, stemborers, and declining oil fertility in the Lake Victoria basin R8449/R8212; CPP, Green Manure to control Striga, R8449, and R8436, R8194, R7564, and NRSP, Land management and market access constraints, R7962).

Although transplanting is a familiar technique the timing of sowing nurseries and the timing of transplanting is location/season specific and requires technical input for at least 2 seasons and extension back-up for a third. A possible cluster around methodologies for scaling-up (NRSP, East Africa 1, Rainwater harvesting and management R8381, and NRSP, India 1 Policy process for pro-poor rural services, R8363) would be useful.

Techniques such as solarisation of seed beds, which can reduce soil borne diseases and increase soil fertility could be adapted for transplanting. Treatment of diseases at the nursery stage is easier and there are suggestions that micro-nutrient loading at the nursery stage using seed priming (see above) may be beneficial for the subsequent growth and development of the crop in the field.

Validation

B. Validation of the research output(s)

***10. How** were the output(s) validated and **who** validated them?*
*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

How validated: On station trials and on-farm trials were conducted in Zimbabwe and Ghana between 1998-2002. More than 200 farmers participated. The trials were sufficiently replicated in each country to provide a test of statistical significance.

Who validated: Validation was primarily done by farmers (male and female) and the research teams in the participating countries, which included extension services and NGOs.

*A **checklist*** of elements critical to the success of transplanting was compiled based on discussions with participating farmers and local institutions:

1. Reliable, perennial, conveniently situated source of water essential for establishing nurseries.
2. Farmers should normally grow either sorghum or millet, or both. This is not a package for introducing sorghum and millet into new areas.
3. Rainfall should be low and the distribution erratic. Not much can be gained by this type of low-input transplanting in high-potential areas unless double cropping is the main aim.
4. Labour must be available for transplanting
5. A series of nurseries providing a supply of seedlings at the 'right' age for transplanting when the rains stabilise, should be established.

Farmers in Ghana and Zimbabwe concluded that:

- Transplanting produces an earlier harvest at a time when food from the previous season is in short supply and when market prices are high. Harvest may be sold or kept for household consumption.
- If the rains are late, seedlings can continue to grow in the nurseries to be transplanted when the rains arrive.
- If the rains stop prematurely the crop can still mature as it was already 20-40 days old when transplanted into the field.
- Labour requirements following transplanting are reduced at certain times of the season, *e.g.* frequency of weeding is reduced.
- Growing seeds in nurseries conserves seed compared to broadcasting - which may need to be repeated

several times.

- Germination rates are better in nurseries compared to the field as farmers can supervise them more easily.
- Surplus seedlings from nurseries may be sold to generate income.
- Tending a nursery at the end of the dry season when the environment is brown and parched introduces a "feel-good" factor into farmers' lives.

*11. **Where and when** have the output(s) been validated? Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

On station trials and on-farm trials were conducted in Zimbabwe and Ghana between 1998-2002. More than 200 farmers participated.

The work was aimed at the semi-arid, low production agricultural zones 4 & 5 in Zimbabwe and conducted with male and female groups. There was a perception that sorghum is a poor man's crop, exacerbated by the extension service geared, since colonial days, for the cash crops of the high production zones 1, 2 & 3 and irrigated areas. Women were more interested in subsistence production of landrace sorghum and were generally allocated the most unproductive lands. Men on the other hand tended to focus on cash crops. Seeds were scarce and were therefore provided, on the understanding that a part of the harvest would be returned for the following year's trial. The seed available was a higher yielding improved variety supplied by ICRISAT and this increased the interest and participation of men to the extent that they considered the transplanted crop a cash crop.

Estimates suggest that approximately half the 200 million hungry and malnourished people in sub-saharan Africa live in farm households situated in higher risk production arid and semi-arid environments, remote from markets and public services, in places where rainfall is low and highly unreliable and soils are inherently unfertile and degraded.

The main challenges for farmers in these areas are poor food security, yield instability and risk of crop failure associated with erratic and unreliable rainfall - the biggest physical constraint to crop production in these areas. Shortages of water have serious effects on rainfed crop production as the first rains are often not sufficient for seed germination and emergence, resulting in patchy stands or complete crop failure. In these cases re-sowing is often necessary, but this is risky as the season may not then be long enough for the crop to reach maturity, and the harvests may be small or even fail completely. Farmers may also not able to re-sow due to lack of funds to purchase more seed, and even where funds are available seeds may be in short supply.

Sorghum and millet production is of great importance to the settled and agro-pastoral household food economies of this region where alternative non-agricultural sources of livelihood improvement are limited. In Ghana no inputs were provided and farmers used their own seeds and resources. Men and women participated, but women in particular were inspired by the results as they are the ones who have to feed the family.

Current Situation

C. Current situation

*12. **How and by whom** are the outputs currently being used? Please give a brief description **(max. 250 words**).*

The original project ran from 1998-2000 (three seasons) in Zimbabwe and from 2000-2003 (two seasons) in Northern Ghana. This was sufficient time to ascertain that the technique worked and offered significant potential for managing risk, earlier harvest, escaping the effects of Striga. However one of the constraints identified was the need for considerable extension input in the early years to work with farmers and groups of farmers to fine-tune the technique to their own circumstances based on onset of rain.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

Transplanting was incorporated as part of the CGIAR Challenge Programme on Water and Food project in the Volta River Basin 'Empowering farming communities in Northern Ghana with strategic innovations and productive resources in dryland farming'. The transplanting component of that project is progressing well particularly in the Bawku East district. About 10 farmers out of the 80 participating farmers are transplanting more than an acre each and the yields in 2005 were described as 'fantastic' (The yields of transplanted sorghum and millets ranged between 3.5 – 4.6 ton/ha and 2.6 –3.5 ton/ha respectively. The corresponding direct-sown yields were 1.8 – 2.8 ton/ha for sorghum and 0.9 –1.6 ton/ha for millet). Non-participating farmers are slowly adopting the technique from observing their colleagues the previous year.

The Volta River Basin Project also reports that in some villages (e.g. Walewale and the surrounding villages) farmers showed interested in the concept of transplanting. However, in those villages water is not readily available for watering during the dry season and therefore they could not construct nurseries at the right time. This confirms the requirement that availability of a reliable source of water in the dry season is critical to the success of the technique.

The political situation in Zimbabwe has diverted the attention of the participating NGO 'Rural Unity for Development' away from agriculture to focus instead on orphan care. It has not been possible to visit, but some farmers may still be transplanting; Mrs Rumbidzai Dhodho one of the participating farmers in Zimbabwe, who continued with the transplanting project despite official withdrawal of funding wrote: *"I wish to inform you about the progress I have made in the sorghum planting project….. Notwithstanding the severe drought we have experienced in Zimbabwe this year, I am happy to inform you that I managed to reap 1 x 50 kg sorghum from a small piece of land (50 m x 20 m). This yield was very unexpected, considering the erratic rains we received throughout the country, particularly in Masvingo. Hoping that we shall have good rains this coming year, we have already started preparing our nursery and plot. We shall keep you informed of any developments - the sorghum is very good for both sadza and bread."*

*14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading **(max 250 words).***

As described in 13, transplanting has been incorporated into another project in northern Ghana. Twelve communities in four districts were selected: Kudur, Nwariko and Kabingo in **Bawku East district,** Siribo, Amontanga and Miligo in **Kassena-Nanakana district,** Zarantenga and Naarori in **East Mamprusi district** and Nayorko, Grushefon, Sayoo and Jaabjani in **West Mamprusi district.** In all there were 80 farmers 21 of whom were women, with some non-participating farmers adopting the technique. To our knowledge this is the most successful example of current use.

It has not been possible to ascertain whether there is any transplanting activity continuing in Zimbabwe. The partner NGO has diverted its attention away from agriculture to humanitarian aid and is not aware of the current activities of their former farmer groups.

In Eritrea/Sudan there is anecdotal evidence (unsubstantiated) that a few Beja pastoralists have adopted the 'jerry can' nursery technique and are transplanting in areas irrigated by spate river water. However, this is a war zone and the information cannot easily be verified.

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key factors of success? ***(max 350 words).***

The transplanting project related to one project, funded from 1998-2003 by CAZS-NR in the first instance and then by the DFID flexibility fund and there hasn't been a further stage of promotion or adoption. However, during the project years the capacity of farmers to manage their risk was increased. They were able to improve their use of dry season water by establishing nurseries, they were able to modify the way they grow sorghum or millet, or both by transplanting from nurseries rather than just gap-filling. Some, in Zimbabwe in particular organised themselves into co-operatives for managing nurseries and in both countries they interacted with researchers and extension agents to contribute to the modification of the technique in their own location. One notable example of this farmer to farmer exchange of ideas was seen in Northern Ghana where farmers from Wiega in Bawku West district were of the opinion that it is impossible to transplant early millet – in fact there is a taboo against gap filling this according to perceived wisdom from their ancestors. The taboo did not apply in Zebilla, Bawku East district and the farmers in this area were able to show their visitors some astonishing differences between their direct sown and transplanted early millet.

Researchers and extension agents benefited from the interaction with farmers, leading to the development of a 'ripple methodology' for disseminations (see Figure 1 Q23) emphasising the importance of a high level of interaction during the first few years after the introduction of the technique.

Current Promotion

D. Current promotion/uptake pathways

*16. **Where** is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion **(max 200 words).***

See 14.
No widespread promotion is taking place anywhere.

*17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. **(max 200 words)**.*

An artificial division exists in the world of project funding with budgets allocated either to research or 'development'/extension work, but rarely to both. Transplanting is a technique which would benefit from a longer term collaboration between farmers, researchers and extension agents and is particularly suited to 'action research'.

Another barrier to dissemination is the neo-colonial 'if it's such a good idea, why aren't they already doing it' attitude and the expectation that if farmers see a good idea once they'll adopt it immediately. It is unrealistic to expect low-resource farmers to adopt transplanting as an off-the-shelf one-size-fits-all package. If they don't grasp the importance of having a series of nurseries, or if they for some reason are distracted from this activity, they may well find that transplanting doesn't work and thus unfairly dismiss a technique which could offer them the benefits described earlier.

On the other hand if there is concerted effort by researchers/extension service in the early years to work with farmers and groups of farmers supporting them and giving them feedback as they fine-tune the technique to their own circumstances success and farmer to farmer dissemination will follow.

*18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues **(max 200 words).***

The most important factor is to decompartmentalise research and development and to encourage researchers to continue their partnership with farmers and partner GO/NGOs through the dissemination process.

Transplanting offers a farmer an element of control over his/her environment. However, there isn't a neat formula for success in a world where the effects of climate change, especially in marginal areas, are becoming more apparent. There is a great need therefore to facilitate on farm participatory research that enables farmers to explore whether an idea such as transplanting is suitable to their needs. In order to do this, they need back-up and support to make sure that they grasp details such as the need for several nurseries, that there is no point transplanting seedlings that are too old etc. and not to get discouraged when it doesn't work perfectly in the first year. They are very likely to get some aspects wrong during the first year which is why discussion groups and visits to other farms are crucial.

Extension agents often perceive themselves as the official source of 'answers', as 'one up' from the farmer, the disseminator of wisdom passed down from the weekly Ministry of Agriculture meetings. In many instances they are valuable sources of information and support, but when disseminating information on transplanting they need to be able to combine their skills as instructors with those of a facilitator. A balance is needed between knowing

the critical features of the technique (e.g. a series of nurseries is essential, seedlings can be too young or too old for transplanting- see 10 above) and what farmers can experiment with in order to modify the technique for their individual circumstances. Farmers also need to be encouraged to accept the idea and make their own contribution to its success.

Policy makers need to be involved and there need to be changes in curricula in Universities to mainstream participatory approaches.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

Using Rogers (2003) diffusion of information as a framework for the lessons learnt:

1. The relative advantage of a technology compared to what it is replacing;
Although it is not intended to replace direct sowing, the advantage of including at least some transplanting as an option is generally high

2. The compatibility of the technology with existing systems and ways of doing things, which is closely related to culture;
Transplanting has several features. It can be applied to varieties which are already cultivated locally. The simple nursery construction and transplanting techniques required are already known to most farming communities familiar with transplanting of trees, vegetables or tobacco and gap filling. Only small amounts of supplementary water, albeit essential, are required. The raising of nurseries can be staggered from an initial planting until the rains begin and beyond, offering a variety of ages and transplanting options if the rains are delayed or if there is a false start. Transplanting is labour demanding but partially offset by lower labour requirements later in the season.

3. The complexity of the technology in terms of what people need to learn to make it work;
The complexity is low for farmers (see above) but of moderate complexity for facilitators, who need to listen to and support farmers, not to lecture them

4. The observability of a technology in terms of how easy it is to demonstrate and observe performance;
This is high as the differences between transplanting and direct sown crops can be dramatic for multiple, easily observable traits such as biomass and maturity.

5. The trialability of a technology in terms of how easy it is to test it before deciding to adopt.
This is high ('easy') but requires location/farm specific fine tuning (can be difficult).

Hence dissemination to stakeholders (as described in section G23) becomes the most important factor in getting this research into use.

Impacts On Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

No impact studies on poverty as such have taken place, however some participating farmers were so impressed by the results from their 10 mx10 m trial plot that they created additional nurseries for transplanting in their bush farm. Mr Adam Abumumuni from Fumbisi, Builsa District, claimed that by doing this, transplanting had "saved" his late millet. Most participating farmers claimed that they would extend their transplanted area after the end of the project and >50% non-participating farmers were expected to try the technique for themselves. See also Q21.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*
- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded*

The impacts listed are relevant to Zimabawe and Ghana and refer only to the work conducted between 1998 - 2003. However, if the technique was applied more widely it is likely that the impacts would be similar.

Transplanting early millet seedlings of the optimum age (approximately 20-days-old) can result in a harvest of up to two weeks earlier than the normal direct-sown crop. As early millet is of major importance to farmers in the Upper East Region of Ghana, because it is harvested first to break the ‘hunger gap’ from the previous season, this reduction in time to harvest represents a major advantage. Similarly in Zimabawe, producing early crops in time for Christmas is a benefit. In all cases women are important beneficiaries as they are the ones who have to feed the family.

In addition to earlier harvest, in 87-90% of cases transplanting increased yields up to 166% for early millet, and up to 500% for the late crops. Particularly high yields are obtained where Striga is a problem. As Striga is such a major problem for farmers in many semi-arid areas the effect of transplanting on the incidence of Striga warrants further research in the future.

Much of the sorghum and millet stover is used for animal feed, and for roofing and fencing. The production of stover therefore, although less significant than grain for these food crops, is important. Eighty-four percent of farmers harvested more stover from transplanted early millet and 94% and 92%, respectively, harvested more stover from late maturing sorghum and millet. This increase is mainly attributed to the fact that only one plant is transplanted per hill/position compared to many seedlings germinating per position in the direct-sown field. Although these are usually thinned, a number of seedlings are still left in the same position that then compete for light and resources, resulting in thinner and weedier plants and so producing less stover.

One of the less tangible benefits, but nonetheless important, is the 'feel-good' factor, with farmers reporting that access to new knowledge gives them a sense of being more in control of their own destiny, providing a sense of happiness and hope for the future at the end of a long dry spell.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

Direct and indirect benefits:

- The adoption of transplanting enables farmers to minimise the risks associated with attempting to produce food in a marginal environment.
- Increased productivity per unit area without the use of additional external inputs is environmentally beneficial.
- Growing seedlings in nurseries is a more efficient use of water
- Increased productivity and concomitant food security will reduce the pressure to increase the area under cultivation.
- Transplanting will help reduce crop loss due to erratic rainfall, thus minimising the need for re-sowing and conserving seed.
- Although rainfed mixed, relay or double cropping forms a major part of the farming system in semi-arid areas this is generally integrated with livestock. The animals produce manure for the fields and act as a buffer against the risk associated with cropping in unpredictable climates. The higher stover yield of transplanted crops improves fodder availability at farm level and helps in improve animal nutrition. It will also have positive effects on animal health and milk and meat production.
- Stover is used for fencing and building – increased availability of sturdier stover means less use of clay, reducing soil erosion.

Effect on policy: Transplanting is increasingly being seen as an option in developing countries for minimising risks associated with erratic climate conditions. This trend may persuade policy makers that a comprehensive dissemination package, where farmers are introduced to the idea and encouraged to adapt the technique to their own situation, is put in place with adequate appropriate support from researchers and extension agents.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

Transplanting is unlikely to have any adverse environmental impact and does not require any cultural, management or production input that's likely to damage the environment.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

Agriculture and food security are likely to be affected by climate change. Global Circulation Models (GCMs) predict a 1.5ºC to 3.0ºC rise in summer and 1.8ºC to 2.2ºC rise in winter in the Sahel over the next 100 years. In southern Africa and the Horn of Africa precipitation is predicted to decrease by 10% by 2050, and there is great uncertainty between GCMs for the tropics and at a regional scale. It is likely that such changes in climate will have a negative effect on the food security of resource-poor farmers in semi-arid and arid areas of Sub-Saharan Africa.

Many research and development programmes have sought to alleviate and minimise the fundamental challenge of achieving better food security and improved livelihoods in areas faced with rainfall irregularity and unreliability. Interventions include development of early maturing, short-duration ("drought-evading") sorghum and millet varieties, introduction of water harvesting and conservation techniques and use of supplementary irrigation from ground water and other sources. Transplanting is another option in the basket of choices available to farmers, to minimise the risk of failed crops or patchy stands, so achieving better yields during years when the rain is late, and providing a 'safety net' when the rains are erratic.

Annex

References

Rogers, E.M. (2003). Diffussion of innovations. 5th Edition. New York: Free Press.