Oiling the wheels of groundnut production

RIU

Validated RNRRS Output.

By using an improved variety of groundnut and treating their seed with fungicide, farmers in India's leading groundnut production zones are cutting their losses and limiting applications of fungicide. Previously, late leaf spot and rust caused crop losses of more than 70%. Now, groundnut crops are producing more and better oil for human consumption and fodder for ruminants, which translates into higher milk yields. The integrated management techniques the farmers are using are promoted through farmer-to-farmer extension. A village-level seed system is helping to ensure supplies of quality seed. The new technologies have already made a big difference to the lives of more than 10,000 poor farmers, in particular women, in more than 120 villages.

Project Ref: **CPP15:**
Topic: **2. Better Lives for Livestock Keepers: Improved Livestock & Fodder**
Lead Organisation: **ICRISAT**
Source: **Crop Protection Programme**

Document Contents:

Description

CPP15

Research into Use
NR International
Park House
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Geographical regions included:

India,

Target Audiences for this content:

Crop farmers, Livestock farmers,

A. Description of the research output(s)

1. Working title of output or cluster of outputs.

Promotion of crop residues for fodder

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

Validated integrated disease management technologies in groundnut for more pods, nutritious crop residue-fodder, income, and livelihood in the Deccan Plateau.

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

- Crop Protection Programme (CPP)
- Livestock Production Programme (LPP)

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.

ZA 0286(R7346): 01April 1999 - 31March 2002
ZA 0598 (R8339): 01April 2003 - 31March 2005
ZA 0675 (R8450): 01April 2005 - 31Januaruy 2006

ICRISAT:
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Farmers Self Help-Groups (SHGs): in operational villages in AP, Deccan Plateau, India.

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.*

The output is clustered as Integrated Disease Management (IDM)-Technology in Groundnut *(Arachis hypogaea.* L.). It was produced in 2005 in the villages of Anantapur district, Andhra Pradesh, Deccan Plateau, India. Anantapur is the largest (800 000 hectares) groundnut growing district in the world. Groundnut is an important oil seed crop that provides high quality oil for human consumption and fodder for ruminants. Its yields are low due to two foliar diseases: late leaf spot *(Phaeoisariopsis personata)* and rust *(Puccinia arachidicola)* and together they cause more than 70% loss in pod and fodder yield and fodder quality. Therefore the output aims to address the management of foliar diseases. Presently, about 80% of the area under groundnut in the Deccan Plateau is covered by the traditional cultivar "TMV 2", which is highly susceptible to foliar diseases, additionally the IDM was aimed to replace TMV 2 with IDM responsive groundnut cultivar ICGV 91114.

Scientists at ICRISAT came out with an early-maturing, dual-purpose cultivar, ICGV 91114 that is highly responsive to IDM. The IDM technology includes improved **early-maturing cultivar ICGV 91114**, **fungicide seed treatment** with bavistin + thiram @ 2.5 g/kg seed, and one **foliar** application of fungicide kavach (Chlorothalonil) at 65-70 days after sowing.

The evaluation and promotion of IDM technology was carried out in three phases (1999-2005) in participation with ANGRAU, INGOs, NGOs, **self help groups (SHGs)** and farmers from villages in Ananthapur. From 1999-2002, several on-station experiments were conducted to identify IDM components to develop farmer friendly IDM technology. This phase was supported by ICRISAT and DFID [ZA 0286 (R 7346). The second phase was supported by DFID [ZA 0598 (R8339)] from 01 April 2003 to 31March 2005, where on station integration, refinement of IDM components, and evaluation of IDM at farmers' fields were initiated. In the third phase, from 01 April 2005 to 31 January 2006, IDM technology was promoted in more villages and farmers and **village level seed system** was initiated with SHGs taking the lead role. In all three phases, and on farmers' fields the IDM technology performed well, exhibiting l**ower severities of foliar diseases** and **higher pod and fodder yields**. Moreover, ***in vitro*** **tests** showed that the fodder from IDM-plots had higher **digestibility** than TMV 2. Participating farmers felt the new IDM responsive cultivar gave them higher quantities of pods as well as higher quality fodder (haulms) that in turn translated into higher **milk** yields.

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 main commodity is **Groundnut Crop,** upon which the output "Integrated disease management (IDM)" is focussed. Groundnut is a dual purpose crop, where its **pods/kernels** are used for food and oil, and crop **residues (haulm)** as animal fodder. The basic principle of identification of components of IDM (for example: host plant resistance, need based eco-friendly user friendly application of biocides/fungicides, seed treatment etc) and process of involving farmers' in evaluating, validating, and adopting the IDM technology are applicable to a range of on-farm fungal foliar disease management in several crops such as chickpea, peas, lentils and potato etc. However, there is need to modify and or refine the components according to targeted commodity, disease(s), and the environment in which a particular disease occurs. For example IDM of Ascochyta Blight (*Aschochyta rabiei*) and Botrytis Gray Mold (*Botrytis cinerea*) diseases of chickpea (*Cicer arietinum*) can be successfully managed following the similar procedures (including the fungicides) and approach in **Bangladesh, India, Nepal, and Pakistan**.

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				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***	***Dualistic***	***Coastal artisanal fishing***
				X		

*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.

Though promotion of IDM technology in groundnut was the main output of the project, non-availability of seeds of the ICGV 91114 (as one of the components of IDM) to farmers was identified as the major constraint. Therefore, initiation of community owned seed system and disease management system at the project sites was considered essential to add value to the main output (IDM).

The village-based seed and crop protection system, involving both men and women from self help groups (SHG), not only facilitated the faster expansion and adoption of IDM technology by the beneficiaries in the Deccan Plateau but also sensitized the non-participating farmers in the project villages, as well as the visiting farmers and

community leaders from the neighboring groundnut growing states on the Deccan Plateau (Karnataka, Tamil Nadu and Maharashtra) to adopt the technology. In the previous project we had initiated the process of establishing the Seed Village to a limited extent in few villages. The technology has a potential for adoption in similar environments where groundnut is grown in Africa (for example, Uganda: R8104, R8435, 8442, R 8105), and Asia (ICRISAT: R8483, R8298).

Additionally the development of Mycotoxins by fungi on the crop residues is a serious threat to animal health and, through milk to human health. In an attempt to tackle this problem the IDM projects (R8339, R 8450) were linked with the project on "Reducing Aflatoxin Levels in Groundnut" (R8483, R7809, R8298) and it was found that ICGV 91114 is tolerant to aflatoxin infection and contamination.

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. endusers, 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)**.*

The process of application, replication, and adoption in the context of partner organizations and users groups involved in IDM-Technologies projects (R7346, R8339, and R 8450) and their linkage to R8483 and R 8298 are:

a. On-station identification of components of IDM: To identify high yielding dual purpose groundnut cultivars responding to economical level of foliar disease management, a replicated trial consisting of 10 early maturing genotypes with six disease management levels [fungicide Chlorothalonil (Kavach @ 2 g L^{-1} water)] was conducted at ICRISAT-Patancheru during 2001 and 2002 rainy season. At harvest, foliar diseases were rated on a 1-9 scale, dry weights of fodder and pods were calculated per hectare. Among 10 test-genotypes and control (TMV 2), ICGV 91114 gave highest pod yield (2.6 t ha^{-1}) and healthy fodder yield (2.5 t ha^{-1}) with low foliar disease severities (< 4 for LLS and <5 for rust) with one fungicide spray at 60 days after sowing.

b. On-farm validation, evaluation and promotion of (IDM) technology: Two hundred and fifty-eight farmers were selected between 2003 to 2005 rainy seasons from five villages, (Jalalapuram, Lingareddypalli, Talupuru, Antaraganga and Jonnalakothapalli), district Anantapur to validate and evaluate ICGV 91114 based IDM technology with local cultivars (TMV 2). Each trial with two sub plots: IDM and Non-IDM was planted on 0.5 to 0.75 acre plot (0.2 to 0.35ha). Following standard procedures, data on disease development, pod and fodder yields were taken. Both men and women farmers including backward class and tribal areas participated in the process of on-farm validation. Farmers were treated as replications for data computation and analysis.

These trials were conducted in partnership with the District Agricultural Advisory and Transfer of Technology Center (**DAATTC)**, ANGRAU-Anantapur, Rural Development Trust (**RDT, NGO**), Agricultural Man Ecology (AME, NGO) and its associated NGOs (MYRADA, RRSAP, APRRMAR, RRESK,PAKRUTI, PRAYOG, etc.), and women-farmer self help groups (**WFSHGs**). Farmer orientation schools were organized twice during the crop season. Information handouts on diagnosis and management options of the production constraints were published in the local language (*Telugu*) and distributed to farmers. On-farm trials indicated that ICRISAT-developed IDM technology is capable of containing foliar diseases, producing more pods (2.08 t ha^{-1}) and healthy fodder (2. 46 t ha^{-1}) and ICGV 91114 can tolerate drought better in comparison to TMV 2. The IDM technology was identified by the farmers as the most suitable for adoption.

c. Evaluation for nutrition and feeding: *In-vitro* analysis of haulms of ICGV 91114 and TMV2 revealed that percent fermentation, gas, nitrogen, crude protein and digestibility were higher in haulms of ICGV 91114 produced with IDM as compared to non-IDM plots and TMV. Secondly, IDM produced ICGV 9114 was found to be positively correlated to mycotoxin resistance. Animal feeding trials conducted in the project villages confirmed that IDM plots produced healthy fodder, which has higher nutritional value and better digestibility in cattle and buffaloes. Feeding trials with crop residues from IDM plots showed increase in milk yields (0.4-0.5 liters/day/ animal).

*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)**.*

The IDM technology was validated in the rainy season of 2005 in Jalalapuram, Lingareddypalli, Talupuru, Antaraganga and Jonnalakothapalli villages in the district of Ananthpur in the state of Andhra Pradesh on Deccan Plateau, India.

Ananthapur district has 866 villages with a **population of 3.6 m people**. The economy is largely agrarian, mainly groundnut based, grown under low rainfall conditions and prone to frequent droughts. Incidentally, the district is most backward in Andhra Pradesh. The socio-economic group consists of marginal rainfed groundnut growing farmers belonging to local communities drawn from all castes (forward and backward) and religions. The implementation of the project was farmer participatory and in each group women farmers and members from SHGs were well represented. One village (Nusikotalu), where the IDM technology was introduced was dominated by poor marginal tribal farmers.

The Deccan Plateau is located in the semi-arid and peri-urban production system comprising smallholder rainfed dry farming system. Mono cropping of groundnut is practiced on 0.8 m ha of Alfisols in Anantapur. Length of crop growing season varies between 100-135 days, and is constrained by low and erratic rainfall and drought at least twice in five years. In these 5 years farmers get back at least seed and haulms (crop residues) to feed their dairy cattle. Since groundnut haulms are the main source of fodder, demand for healthy and nutritious fodder is high. Replacing groundnut with other crops is not readily acceptable to farmers; hence IDM technology was identified as the most appropriate for the cultivation of groundnut for sustainable livelihoods.

Current Situation

C. Current situation

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

Small-scale groundnut producers (including poor and women farmers) are mainly using the improved technology since higher haulm yields besides pod yields are an important requirement for them. Additionally NGOs involved in the earlier phase of the project are engaged in seed multiplication and expanding the IDM technology to more farmers and to new locations in the states of Karnataka and Tamil Nadu. Farmer-to-farmer extension and use of IDM output is continuing at a slower pace.

Scientists at ICRISAT, in collaboration with participating NGOs, (DATTAC, AME) and lead farmers, are in constant touch with participating and other farmers by advising, monitoring of their IDM managed crop, and providing them hands-on training to a limited extent. This is facilitating the process of further expansion of outputs of IDM technology. Both men and women farmers are maintaining contacts with us for further advice and suggestions particularly if any new production constraint is experienced by them; for example, management of the recent endemic outbreak of disease (collar rot caused by soil borne fungus *Sclerotium rolfsii*). However, non-availability of seed and limited hands-on training in IDM technology is slowing down further expansion of the technology.

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).***

The outputs are currently being used by poor farmers, women self help groups, and NGOs in the project villages Jalalapuram, Lingareddypalli, Talupuru, Nusikotalu, Antaraganga and Jonnalakothapalli in Ananthapur district on the Deccan Plateau of India. Based on reconnaissance surveys it was found that improved groundnut cultivar ICGV 91114 is grown in more than 120 villages covering 4 districts in Andhra Pradesh and 3 districts in Karnataka. Two-thirds of the villages are located in Ananthapur district. The location of these villages was recorded using GPS instrument. The number of farmers involved in production of the improved variety was estimated to be more than 10,000. A majority of the villages are located in the low-to-medium rainfall ***mandals*** (cluster of villages) indicating the importance of this cultivar for resource poor farmers in marginal environments. According to informal information the IDM output has been successfully used in theses states. Farmers from the states of Karnataka and Tamil Nadu who have attended the IDM Field Days conducted during 2003-05 have also adopted the technology in their respective villages with minimal support from the project.

The Technology spread rapidly during the life of the project (last two phases from 2003-2006) across villages and districts in a progressive manner ie, 2180 farmers in 2001, 3230 farmers in 2003, 5650 farmers in 2003, and 8940 farmers in 2004 and 2005.

14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading

(max 250 words).

More than 10,000 farmers were estimated to be currently using the IDM technology during the 2006 rainy season. At the current rate of expansion, it is estimated that some 80,000 hectares – about 10% of the total crop area (800,000 hectare) – in the district of Ananthapur alone will be under IDM technology and its important component cultivar ICGV 91114 by 2011. It will also expand into the adjoining states of Tamil Nadu and Karnataka in the Deccan Plateau of India. Its usage is still spreading from farmer to farmer, through NGOs, and through village-level self help groups. However, non-availability of seeds, need for further on-farm validation of IDM technology in participation with farmers, village level hands-on IDM training and awareness camps, and establishment of IDM orientation schools are the major constraints in the exponential spread of IDM technology to new villages, ***mandals***, districts and states on the Deccan Plateau.

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 facts of success? ***(max 350 words).***

In our experience institutional structures such as **State Agricultural Universities (SAU)** such as Acharya N G Ranga Agricultural University (ANGRAU), Andhra Pradesh (AP), India, and its district level centers such as District Agricultural Advisory and Technology Transfer Center (DAATTC), and their village level programs; **NGOs** (Agricultural Man Ecology [AME], and its associate NGOs [Mysore Resettlement and Development Agency (MYRADA) in Andhra Pradesh and Karnataka); Rural Reconstruction Society (RRS), AP; Andhra Pradesh Rural Reconstruction Mission (APRRM) AP; Department of Agriculture and Extension Services (**DOAE**) of Govt. of AP and village-level Self Help Groups (**SHG**), and above all individual and collective participation of farmers have assisted with the promotion and adoption of the IDM Technology for groundnut in the targeted villages. The collective and joint action plan of these agencies has acted as an important platform for the promotion of the IDM technology. At government levels (both state and national) pro-oilseed policies as reflected in trade and marketing policies for groundnut (tariff on edible oils, oil seeds procurement policies at the national level) have greatly assisted in the promotion of the groundnut crop, and therefore the IDM technology in the villages of Anantapur in Andhra Pradesh, India.

In terms of capacity strengthening, involvement of farmers, SHGs, NGOs, DOAE and SHU right from the inception of the project and their active participation in stakeholder meetings, development of joint workplans, identification of components of IDM (high-yielding, drought-tolerant, and cost effective IDM management cultivar), their integration and validation and joint monitoring of on-station and on-farm IDM-trials were the key factors contributing to success. Capacity strengthening activities were operational at district, ***mandal*** (sub-unit cluster of villages), and village levels for the key persons responsible for implementing programmes.

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).***

Currently the promotion of IDM for groundunut crop for more pods and healthy haulms (fodder) is taking place within project villages and neighboring villages in the Anantapur district of Andhra Pradesh, **India**. The promotion of the two main components [seeds of ICGV 91114 and, IDM components (seed treatment and need-based foliar application with fungicides)] are occurring simultaneously. The IDM technology has also been extended to two more districts (Kurnool and Chittoor) in Andhra Pradesh and is slowly gaining ground in the districts of Kolar and Dharwad in the state of Karnataka, and in two villages in Dharmapuri district of Tamil Nadu, India. The main process of introduction is through ICRISAT in collaboration with SAU and DOA and NGOs. The scale of current promotion is up to a total of 50 hectares in these two states. The promotion is constrained by the non-availability of technology to many more farmers.

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)****.*

Non-availability of seeds of IDM-responsive groundnut variety ICGV 91114 is the main barrier that is preventing the faster adoption of IDM technology to greater numbers of farmers. Lack of awareness about IDM technology and importance of using healthy crop residues for more milk is another constraint, existing at village/community level, and limiting expansion of technology. Seed production is constrained by non-existence of organized seed system for groundnut. The private seed industry is not active in groundnut seed production. Farmers store their rainy season produce as seed for the following season. As seed-to-seed ratio is very low in groundnut, it is not possible for a single agency to supply seeds in the entire Deccan Plateau. The governmental agencies produce groundnut seeds but are not able to meet the demand (eg, 120 kg kernels/ha). There are no major constraints in the marketing of pods and haulms. Haulms are used within the village, either exchanged for other crop residues or sold at premium rates to peri-urban dairy owners. For the marketing of pods there are regulated markets within the vicinity of crop production areas.

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).***

For the successful adoption and expansion of IDM technology, the establishment of a community-owned **"Seed Village System"** is necessary. The Seed Village concept was visualized and initiated along with **"IDM Orientation Schools"** by ICRISAT in the previous project. It is important for each and every groundnut growing village to produce seed and adopt IDM technology for maximum pods yields and healthy haulms for dairy animals. Village-based SHGs and NGOs can play a great role in collaboration with research institutions in the establishment of "Seed Villages", and "IDM-orientation Schools" concept in each and every village. Only then will IDM technology be adopted by large numbers of farmers in bigger areas for improving livelihoods with assured income on a sustainable basis.

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).***

The huge gap between the technology generation and its promotion and expansion at the farm level was the main lesson learnt during the process of development and validation of the IDM technology. Therefore **"Farmers'**

Participatory Approach" was chosen and implemented in partnership with the village level stakeholders operational at village level directly in contact with farmers/end users of the technology. In this context NGOs, SAUs, and empowerment through self help groups was found to be the best way to get the output used by large numbers of poor farmers. For example, establishment of village level **"Seed System", "IDM Orientation Schools"** and **"Trainers Training Camps"** was found to be of utmost use in the transfer and adoption of technology by large numbers of poor beneficiaries in the targeted villages. These methodologies and procedures are replicable and repeatable for enhanced impact.

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.

We have not conducted any formal structured impact studies on poverty in relation to the output on IDM technology at the project sites as we felt that the expansion and adoption of the technology was still in its infancy stage. However, less formal studies were conducted on social mapping and periodical monitoring records noted to analyze farmers' perception about the technology. Based on participatory approaches farmers' perception and preferences were collected during the project period. Besides collecting information on structured questionnaires, some information on the indirect impacts on poverty, were collected during the implementation of CPP Project (R7346).

The salient features are:

- Social mapping, followed by wealth-ranking, led to the characterization of households into three distinct socio-economic groups (rich, medium-wealth, and poor) in the "Low Dairy Village" and four groups (rich, medium-wealth, poor and very poor) in the "Intensive Dairy Village", based on the criteria used by the villagers. The criteria included size of landholding, extent of irrigated land, mulberry crop, ownership of well/borewell, access to tank irrigation, ownership of cows and bulls, area under vegetable crops, and employment status in the family.
- Groundnut fodder is the most important fodder for farmers for both dairy systems, and summer months are the crucial period when it is fed to animals.
- A majority of the farmers in the "low dairy village" grow groundnut and use its residues as an important source of fodder.
- Sale and purchase of fodder does not take place in the "low dairy village" as all the producers use the fodder for their own livestock.
- Groundnut fodder is bought and sold within the "intensive dairy village" itself but volume of transactions is low. Fodder buyers are milk vendors, whilst fodder sellers are those who do not own ruminants but cultivate

groundnut.

- Farmers identified IDM responsive new groundnut cultivar ICGV 91114 to meet their multiple requirements. The cultivar is resistant to drought and early maturing, thus escaping end-of-season drought, having higher pod, haulm yield, and superior nutritive value of haulm, thereby contributing to higher milk production.
  - Economic analyses have shown that gross returns on farm are much higher for ICGV-91114 grown with IDM than for traditional groundnut varieties. Although cultivation costs are higher, the overall per unit costs of production for ICGV-91114 with IDM were lower. Net returns from the growing of ICGV-91114 with IDM were about 25% higher under rainfed conditions.
  - Milk yields per animal on farm are 0.4-0.5 liters/day higher with IDM responsive-ICGV-91114 than from those with local varieties. Some 70-80% of milk is sold through both formal and informal channels, and income from sales ranges from 15-25% at the household level.

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;*

Disease-free groundnut haulms (fodder), rich in nutrition were made available to both small and large dairy owners up to 8 months per year which reduced their dependency on the external source of fodder and concentrate needed for milk production. The continuous supply of healthy fodder made a positive impact on the livelihoods of the small dairy owners in the “low dairy village” in particular. An informal study in project villages indicated that positive impact of introducing the IDM technology started appearing to a limited extent mainly with respect to financial assets in the third year of the introduction of the technology. In the short run, the impact would be mainly restricted to higher income from growing improved groundnut cultivars following IDM technology. Given the small size of farms the impact initially is on financial asset only, that too from a low base. The potential impacts on marginal and small farmers would depend on the linkages between small farmers, the public sector actors and other stakeholders in the groundnut and milk economy. The linkage between adoption of the improved technology, higher incomes, asset acquisition reinvestment in agriculture and improvement in overall quality of life will have to wait until the technology is adopted on a larger scale at the household level.

- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*

The project impacts will be mainly for **moderate poor (**most likely to access new livelihood opportunities and use as stepping stone out of poverty) and **extreme vulnerable poor** (asset-less or near asset-less) male & female headed households in rural areas). This includes subsistence farmers who may have small areas for food production or landless livestock keepers.

Women had a positive impact since at household level they are involved in feeding the dairy animals. Women thus have clear perception about the relationship between quality of the fodder, animal health and milk production. The exclusive interactions with women on the feeding of diseased and IDM produced healthy groundnut haulms to dairy cows revealed that diseased

groundnut haulms are not preferred by the lactating cows as it makes them sick. Normally such animals get diarrhoea and refuse to eat any fodder which in turn reduces the milk yield. This affects their regular source of income through milk sale. The women also said that diseased haulms not only reduce the milk yield but also cause abortion and physical deformities such as a limp, etc.

- *Indicate the number of people who realized a positive impact on their livelihood;*

Approximately 80% of the 10,000 participating farmers, until 2005, have realized a positive impact on their livelihood.

- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded;*

The IDM technology of the groundnut cultivar ICGV 91114 has increased both pod and fodder yields by 20-25% per hectare and increased the monetary returns of a farmer by 25-30% / ha. The use of haulms for feeding / selling has further contributed to their returns.

At the current rate of expansion of IDM technology, it is anticipated that some 20,000 hectares (2.5 % of the total crop area [800,000 hectares]) in Anantapur district is under the IDM technology and its components.

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.

The IDM technology for groundnut crop is exclusively eco-friendly and user friendly. None of its components are hazardous to human health and animal health. The IDM technology does not produce any pollutants to contaminate the environment. The identification of high yielding, dual purpose, moderately resistant and minimal management responsive groundnut variety ICGV 91114 made the technology safe to produce, ‘safe food’ for human beings and ‘healthy fodder’ for cattle. Fungicide use is minimal and is applied as seed treatment and foliar protection at least 150 days before storage, and feeding of crop residues to cattle. On the contrary when diseased crop residues are fed to animals they get diarrhoea and flatulence creating more emission of methane gas that could add to the phenomenon of global warming. Hence the IDM technology has positive benefits for the environment.

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

No, there are no adverse environmental impacts related to the output, IDM technology and its outcome (more pods, healthy and nutritious haulms used as fodder and more milk). On the other hand when diseased crop residues are fed to cattle, they suffer indigestion, frequent flatulence, and diarrhoea, that leads to the emission of more methane and contribute to global warming.

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)***

The IDM technology is based on dual-purpose foliar disease management responsive and high yielding cultivar of groundnut ICGV 91114. It is a short duration cultivar and capable of mitigating 'Terminal Drought', which occurs frequently in the rainfed Deccan Plateau of India and in several groundnut growing countries in Africa. Additionally, it has the plasticity to recover from mid-season drought. Apart from these characteristics, it has been found to be tolerant to Aflatoxin infection and colonization. Aflatoxin invasion is more when groundnut is predisposed to end-season drought. Therefore the technology increases the capacity of smallholder rainfed dry farming system farmers in the semi-arid production system to cope with the effects of climate change, frequent drought, and reduce the risks of natural disasters and increase resilience.

Annex

Annex A:

1. **Pande S, Sreenivas B, Parthasarathy Rao, Narayana Rao J,** and **Lakshmi Reddy P.** (eds.). 2006. Farmers' participatory management of diseases for higher yield and nutritive value of crop residues of groundnut, Deccan Plateau, India. Proceedings of a workshop 3-4 January 2005, ARS, ANGRAU, Rekulakunta, Anantapur, Andhra Pradesh. Patancheru, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 168 pp.

2. **Pande, S., Parthasarathy Rao, P., Blummel, M., and Lakshmi Reddy.** 2006. Effects of plant diseases on crop residues used for peri-urban dairy production on the Deccan Plateau. Pages 145-146 in Perspectives on Pests II: Achievements of research under UK department of International development Crop -protection program 2000-05.Sweetmore, A., Kimins, F., and Silverside, P. (eds). Natural Resource International Limited, UK.

3. **Pande S, Upadhyaya HD, Narayana Rao J, Lakshmi Reddy P** and **Parthasarathy Rao.** 2005. Promotion of Integrated Disease Management for ICGV 91114, a dual-purpose, early maturing groundnut variety for rainfed areas. Information Bulletin No. 68. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp.

4. **Joshi PK, Suresh Pal, Birthal PS,** and **Bantilan MCS**. (eds.) 2005. Impact of Agricultural Research: Post-Green Revolution Evidence from India. National Centre for Agricultural Economics and Policy Research

(NCAP). Indian Council of Agricultural Research, PO Box. 11305, Library Avenue, Pusa, New Delhi 110 012. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute For the Semi-Arid Tropics. Published by Dr Ramesh Chand, Director, NCAP. Printed at Chandu Press, D-97, Shakarpur, Delhi 110 092. 342 pp.

5. **Pande S, Narayana Rao J, Upadhyaya HD** and **Lenne JM.** 2001. Farmers' participatory integrated management of foliar diseases of groundnut. *International Journal of Pest Management* **47**(2):121-126.

6. **Rama Devi K, Bandhyopadhyay R, Hall AJ, Indiara S, Pande, S,** and **Jaiswal P.** 2000. Farmers' perceptions of the effects of plant diseases on the yield and nutritive value of crop residues used for peri-urban dairy production on the Deccan plateau: findings from participatory rural appraisals. Information Bulletin no. 60. (In En. Abstracts in En, Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.44 pp.

7. **Carine Alders, Bertus Haverkort** and **Laurens van Veldhuizen** (ed.) 1993. Linking with farmers: networking for low-external-input and sustainable agriculture. Published by Intermediate Technology Publication 103/105 Southampton Row, London WC1B 4HH, UK. 308 pp.

8. **Nigam SN**. (ed.) 1992. Groundnut – a global perspective: proceedings of an international workshop. 25-29 Nov 1991, ICRISAT Center, India. (In En. Abstracts in En, Fr, Es.) Patancheru, 502 324, Andhra Pradesh, India: International Crops Research Institute For the Semi-Arid Tropics. 548 pp.

9. **Wim Hiemstra, Coen Reijntjes and Erik van der Werf** (ed.) 1992. Let farmers judge: experiences in assessing the sustainability of agriculture. Published by Intermediate Technology Publication 103/105 Southampton Row, London WC1B 4HH, UK. 220 pp.

10. **Bertus Haverkort, Johan van der Kamp** and **Ann Waters-Bayer** (ed.) 1991. Joining farmers' experiments: experiences in participatory technology development. Published by Intermediate Technology Publication 103/105 Southampton Row, London WC1B 4HH, UK.182 pp.

11. **Mutsaers H J W,** and **Walker P.** (ed.) 1989. On-farm research in theory and practice. Proceedings of a workshop on design and analysis of on-farm trials, 27 February to 3 March 1989, Oyo Road, PMB 5320, Ibadan Nigeria: International Institute of Tropical Agriculture. 216 pp.

12. **Reddy PS**. (ed.) 1988. Groundnut. Indian Council of Agricultural Research, PO. Box. 11305, Library Avenue, Pusa, New Delhi 110 012. Printed at Ajanta Offset and Packagings Ltd, 95-B, Wazirpur Industrial Area, Delhi 110 052 and Published by Jagadish Chandar, Under-Secretary, for the Publications and Information Division, Indian Council of Agricultural Research, New Delhi 110 012. 586 pp.