# Farmers test new crops for replacing rice fallows

RIU

**Validated RNRRS Output.**

In Nepal, farmers played a key role in choosing and testing new crops to grow on land that previously lay fallow for part of the year. Growing more crops per year means more food, more income and better nutrition. Nearly two-thirds of the land used to be left fallow after the rice harvest because farmers only had seed that was unsuitable, poor, or prone to disease. Farmers tested mungbean, chickpea, lentil, pigeonpea and field peas. To make sure that the overall cropping system worked they also trialled the rice strains that would be planted before the legumes. Now, data from their on-farm trials are being accepted by the official seed registration system. This has major potential for fruitful partnerships between farmers and seed companies.

Project Ref: **PSP01:**
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:**

**Nepal,**

**Target Audiences for this content:**

**Crop farmers,**

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**Document Contents:**



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*Description*

***PSP01***

***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.*

**Dry season crops for replacing rice fallows in Nepal**

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

**Plant Sciences Research Programme (PSP)**

*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.*

**R 8221**

**Nepal**
CAZS-Natural Resources (Dr Krishna Dev Joshi)
Forum for Rural Welfare and Agricultural Reform for Development (FORWARD, Mr. N.P. Khanal)
District Agriculture and Development Offices (DADOs)
Nepal Agricultural Research Council (NARC)
Community based organizations

*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.*

About 60% of land remains fallow after harvesting of rice in Nepal *Terai* due to lack of irrigation and appropriate technological and resource management options (Subbarao et al., 2001). Constraints analyses (Gurung and Khanal, 1990; Subbarao et al., 2001; Bourai et al., 2002) found that farmers either had no or little access to improved legume varieties or were growing obsolete (released often >10-30 years) and disease-susceptible varieties or landraces (Khanal et al., 2006b).

The **rice fallow rainfed *rabi* cropping** (RRC) project was implemented from October 2001 to March 2006 in the ***Terai*** of Nepal. A number of **dry season crop varieties** of **mungbean** (Kalyan, Prateeksha, NM92, VC3960); **chickpea** (KPG 59, GNG469, ICC37, ICCV2, Tara, Awarodhi); **lentil** (Sital, ILL7723); **pigeonpea** (ICP7035) and **field pea** (E6); were validated and promoted through **on-farm testing** employing a **Participatory Varietal Selection (PVS)**

**approach.** These interventions were implemented in a **systems perspective** integrating appropriate **rice varieties** during the preceding *kharif* season. Project farmers also identified a range of more suitable **rice varieties**, (e.g. Barkhe 2001, Barkhe 2014, Sugandha 1, Pant Dhan 10, Barkhe 1027, and BG1442) that could improve **on-farm biodiversity,** overall system productivity and profitability.

Two mungbean varieties (Prateeksha and Kalyan), the first for 31 years, were officially released as the result of a joint (NGO-GO-ARI) release proposal using on-farm data generated through participatory trials. This has important policy implications for future partnerships in crop development and the seed sector in Nepal.

Wide-spread adoption of the aforementioned crop varieties and associated resource management innovations across the *Terai* and foothills of Nepal in lands that remain fallow after rice (and after maize) could contribute enormously to the sustainable intensification of these lands thereby improving the food security, nutritional security and income of poor people.

*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 | 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*

This dossier describes **participatory research and development** implemented with mungbean (Kalyan, Prateeksha, NM92, VC3960); chickpea (KPG 59, GNG469, ICC37, ICCV2, Tara, Awarodhi); lentil (Sital, ILL7723); pigeonpea (ICP7035); and field pea (E6) and rice varieties e.g. Barkhe 2001, Barkhe 2014, Sugandha 1, Pant Dhan 10, Barkhe 1027, and BG1442. The process and approaches adopted in this project are widely applicable under similar conditions elsewhere and for various agricultural commodities.

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

| ***Semi-Arid*** | ***High potential*** | ***Hill Sides*** | ***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/cold*** | ***Dualistic*** | ***Coastal artisanal fishing*** |
|---|---|---|---|---|---|---|
| *x* | | | *x* | *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.*

The value of these outputs could be increased by large-scale seed production and distribution (PSP, Community-based seed production and distribution) and by institutionalization (e.g. official release of varieties) into the national system through the National Seed Board of Nepal. This would facilitate their uptake by governmental institutions and lead to the sustainable adoption of the varieties. For instance, official release of two mungbean varieties has given new impetus to the adoption of other new varieties by governmental and non-governmental sectors (Khanal et al., 2006b). Close links with additional sources of new germplasm (e.g. PSP, Rice varieties for eastern India; Rice varieties for main and *chaite* seasons in Nepal; Rice varieties for upland, medium and lowland ecosystems in eastern and western India, R8221, R8269, R7434 and R8099; Client-oriented breeding of rice for Nepal, R7122, R8071; COB horsegram and chickpea eastern India) are essential.

Use of these varieties within Integrated Pest Management (e.g. CPP, Chickpea ICM, R8427, R8366, R7885; CPP, ICM policy for Nepal; CPP, IPM promotion through improved training manuals, R8417, R8341), Integrated Nutrient Management System (INMS) or Rural Development programmes would generate a high degree of synergy, as would co-promotion of simple technologies such as nutrient seed priming (PSP, 'On-farm seed priming to improve plant nutrition in low fertility soils'). Additional enrichment of the local resource base of farmers (e.g. bio-pesticide recycling units, multipurpose nurseries, product diversification through village level processing units) could increase the value of these outputs and thereby increase their adoption. The latter approach has been very effective in Nepal (PSP, 'Rice-fallow rabi cropping systems', Khanal et al, 2004c; Khanal et al, 2005; Gauchan, 2005).

Many of the legumes tested in the project are raw materials for a number of agro-based industries, and some of the crops and varieties have been validated for their suitability for different products. More processing and market research is needed, however, for the wider scaling up of these outputs (NRSP, Participatory market appraisal tool, R8084).

*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 organization, government department, aid organization, 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 and by whom:*
The end users of the crop varieties – resource-poor farmers who cultivate smallholdings in the rainfed marginal areas of Nepal *Terai* – did the validation. They involved themselves in all the steps of on-farm participatory trials and demonstrations, including evaluation (using various participatory techniques such as matrix ranking, surveys, organoleptic testing, etc.) of the many traits important to them and their families. The target groups were male and female resource-medium and resource-poor farmers from all social groups. Wealth categories (usually three) were determined through local informants using key proxies for wealth such as landholding size. Evaluation of dry season crops included participating farmers (with a representative proportion of women) and their neighbours, relatives and friends (this always included some women). The evaluation of the post-harvest traits always involved women.

As a first step farmers and their families were interviewed to discover their requirements for varieties of different crops. We were then able to match the introduced varieties of various legumes and rice to these requirements. The trials were always replicated to provide a test of statistical significance. Where grain quality was important, end users such as millers, processing companies, traders and consumers helped test post-harvest quality traits. In addition to farmers, many organizations were involved in the validation process [1]. A summary of the trials and demonstrations implemented by FORWARD has been presented in Annex 4. Further validation of these technologies was often done by government organizations in on-station trials. **See also outcome assessments Q 20.**

*Increases in productivity:*
Large increases in productivity were achieved relative to local cultivars in many crops across the country (see Table 1) and stakeholders were also able to identify varieties that have advantages in several other traits important for overall utility (Table 2).

[1] District Agricutural Development Offices (DADOs): Jhapa, Morang, Morang, Saptari, Sirha, Dhanusha, Udapur, Chitwan, Makawanpur, Tanahun, Kaski, Syanja, Rupandehi, Kapilvastu, Surkhet, Dang, Banke

NGOs: Forum for Rural Welfare and Agricultural Reform for Development (FORWARD)

Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Community Development and Research Centre (CDRC), Social Upliftment through Participatory Programmes, Research and Training (SUPPORT) Foundation

Research Institutes: Institute of Agriculture and Animal Sciences (IAAS), Nepal Agricultural Research Council (NARC), International Maize and Wheat Improvement Centre (CIMMYT)
Processing factories: Pathak Dalmot factories, Butwal and Chaudhary Bhujiya and dalmot factory, Biratnagar

**Table 1: Increase in crop productivity after adoption of dry season crop varieties**

| Crop | District | Increase in grain yield (% over local check in farmers' fields) |
|---|---|---|
| Mungbean | Jhapa | 30-75 |
| Mungbean | Saptari | 40-50 |
| Mungbean | Sirha | 30-50 |
| Mungbean | Kapilvastu | 25-45 |
| Mungbean | Tanahun | 20-35 |
| Mungbean | Morang | 40-60 |
| Chickpea | Saptari | 20-30 |
| Chickpea | Sirha | 20-30 |
| Chickpea | Kapilvastu | 20-25 |
| Chickpea | Tanahun | 21-30 |
| Lentil | Saptari | 20-30 |
| Lentil | Sirha | 20-30 |
| Lentil | Kapilvastu | 22-35 |
| Lentil | Tanahun | 25-35 |
| Pigeonpea | Kapilvastu | 25-40 |

Source: Gauchan, 2005

**Table 2: Examples of improvement in traits other than grain yield**

| Crop | Improvement in traits other than grain yield |
|---|---|
| Mungbean | Grain quality, earlier and more synchronous maturity, cooking quality, market price, resistance/tolerance to Yellow Mosaic Virus and other important insect pests and diseases, suitability for processing industries for preparing a range of snacks and breakfast foods, e.g. *Dalmot, Bhujia, Papad* and other confectionaries. |
| Chickpea | More options for earlier and later maturity, grain quality, market price, bold and amber grains, disease and insect pest tolerance |
| Pigeonpea | Earlier maturity, more synchronous maturity, suitability for green pods as a vegetable, disease resistance (Sterility Mosaic Virus) |
| Lentil | Early maturing, bold and attractive grain size, disease tolerance |
| Field pea | Earlier maturity, grain type, disease tolerance |

*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)****.*

This output was mostly validated in rice-based systems of the Nepal *Terai* for four consecutive years, although mungbean was also validated in maize-based systems with farmer groups working with FORWARD and an expanding network of partners. Over a thousand on-farm participatory action research trials, demonstrations and seed production activities were implemented (summarised in Figure 1 and Table 3).

Validation was coordinated by FORWARD and the farmers represent mainly resource-poor, smallholders as the average landholding size per household in Nepal is <0.5 ha. Efforts were made to involve all ethnic groups, wealth classes and both men and women.

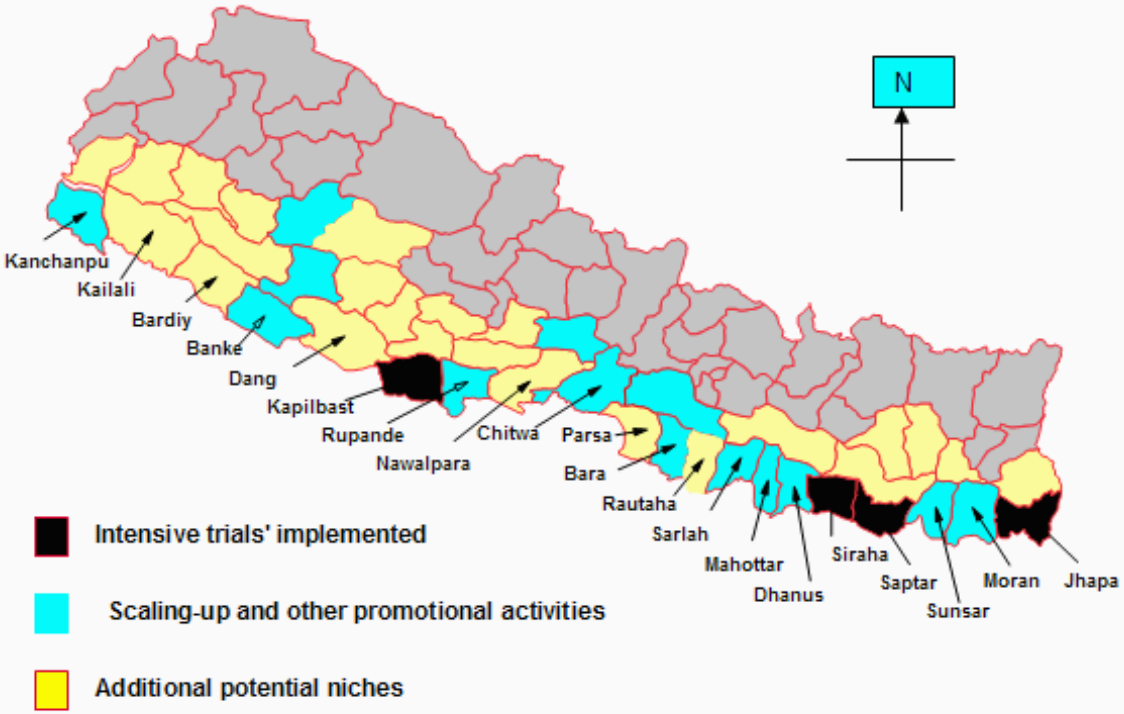


Figure 1. Location of intensive trials, current promotional activities and additional potential areas for scaling up

**Table 3: Where and when the outputs were validated.**

| Crops | Where (districts) | Production system | When | Cropping pattern |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Mungbean | Jhapa, Saptari, Banke, Chitwan, Bara, Kapilvastu Morang, Siraha, Dhanusha, Tanahun, Kapilvastu, Nawalparasi, Mahendranagar | Semi-Arid and High Potential | 2002-2006 | Rice-fallow-mungbean; Rice-winter crop-mungbean Rice+mungbean on rice bunds Banana + mungbean; Rice-vegetable-mungbean; Sugarcane + mungbean; Maize-mungbean |
| Chickpea | Saptari, Siraha, Jhapa, Kapilvastu Dhanusha, Mahottari Tanahun | Semi-Arid | 2002-2006 | Rice-chickpea-fallow; Rice-chickpea-mungbean; Rice-chickpea + linseed; Rice-chickpea + coriander; Maize-chickpea-fallow; Maize-chickpea + rapeseed |
| Lentil | Jhapa, Sapari, Siraha, Kapilvastu, Banke Tanahun | Semi-Arid and High Potential | 2003-2006 | Rice-lentil; Rice + lentil; Rice - lentil+ chickpea |
| Pigeonpea | Kapilvastu, Siraha, Saptari Banke | Semi-Arid and High Potential | 2003-2006 | Rice+pigeonpea on bunds; Pigeonpea-fallow |
| Field pea | Jhapa, Saptari, Kapilvastu | Semi-Arid | 2002-2006 | Rice-field pea |

*Current Situation*

## ***C. Current situation***

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

In addition to usage within the project area (see Q13), the dry season crop varieties promoted by the project have been adopted by many governmental and non-governmental organizations. Some are implementing PVS and IRD while others are producing seed. Fifteen District Agriculture Development Offices and three National Seed Companies have already planned to scale up the technologies through their own channels. Academic and research institutions have also been using these varieties in their own programmes. Most of the dry season crop varieties are widely adopted in the project areas and other districts through governmental and non-governmental channels. The institutions that are using those dry season crop varieties promoted by the project, with their preliminary status, are summarized in Table 4 and Figure 1.

**Table 4: Additional institutions/programmes currently adopting/promoting dry season crop varieties**

| Where (district) | Organization | Crop focus | How | Estimated scale of use (ha) |
|---|---|---|---|---|
| Jhapa | DADO, CGISP, farmers groups, cooperatives | Mungbean, fieldpea, chickpea | PVS, seed production | Mungbean=60 chickpea= 10 field pea=10 |
| Morang | Plan-FORWARD partnership project, CDRC, DADO, Seed Company; farmers groups; cooperatives | Mungbean and chickpea | Seed production; PVS trials | Mungbean=70 chickpea=5 |
| Sunsari | Li-BIRD; DADO; Seed company | Mungbean | See production | Mungbean=20 |
| Saptari and Siraha | Seed Company; farmers groups; cooperatives; APPSP; | Chickpea, mungbean, field pea, pigeonpea, lentil | PVS, seed production, IRD | Chickpea=50 mungbean=40 fieldpea=12 pigeonpea=35 lentil=10 |
| Dhanusha | CGISP; DADO, farmers groups; cooperatives | Chickpea, mungbean, pigeonpea | Seed production | Chickpea=25 mungbean=15 pigeonpea=5 |
| Sarlahi | DADO, farmers groups | Chickpea | IRD | Chickpea=7 |
| Dhankuta | DADO | Mungbean | IRD | Mungbean=1 |
| Kanchanpur | SUPPORT FOUNDATION | Mungbean | PVS, seed production | Mungbean=10 |
| Tanahun | NARDF funded project, DADO, farmers groups, cooperatives | Lentil, mungbean, chickpea | PVS, IRD, seed production | Lentil=20; mungbean=25 chickpea=7 |
| Makawanpur | Plan-FORWARD partnership project; farmers group; cooperative; HMRP | Mungbean | IRD | Mungbean=5 |
| Chitwan | Pithuwa and patihani seed production groups; IAAS Rampur, farmers groups | Mungbean | Seed production | Mungbean=10 |

| | | | | |
|---|---|---|---|---|
| Syanja | DADO | Mungbean | IRD | Mungbean=2 |
| Rupandehi | DADO | Mungbean | IRD | Mungbean=2 |
| Kapilvastu | DADO, farmers groups, cooperatives, SEMI-Nepal | Mungbean, chickpea, pigeonpea lentil | IRD, seed production | Mungbean=75 Chickpea=40 Pigeonpea=30 lentil=35 |
| Banke | DADO, Plan-FORWARD partnership program, farmers groups, cooperative | Mungbean, chickpea, pigeonpea | PVS, IRD, seed production | Mungbean=15 Chickpea=10 Pigeonpea=15 |
| Surkhet and Dailekh | DADO, Helvetas-FORWARD partnership program, farmers groups, cooperative | Mungbean, chickepa | IRD, seed production | |

CGISP= Center for Groundwater Irrigation Support Program; NARDF= National Agriculture Research and Development Fund; SIMI=Small Irrigation and Market Initiatives

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

It has been estimated that about 30000 farm families in rainfed rural farm communities of Nepal have been using these outputs as a part of their livelihood strategies. The scale of use of the released varieties in government institutions was found higher than non-released varieties. With the official release of two mungbean varieties (Khanal et al., 2006b), this usage is expected to increase greatly within the next few years.

A recent survey using focus group discussion (FGD) in the project areas revealed that promising crop varieties promoted during project periods are being scaled up through various formal and informal channels (Figure 1; Table 4). Monitoring reports by the professionals at the project sites revealed that new mungbean varieties were being grown on more than 1000 ha, chickpea on 500 ha, lentil on 400 ha and field pea on 300 ha. This level of uptake, after only four years of participatory research and development, is quite remarkable and could be increased dramatically as dissemination of technical knowledge related to intensifying rice-fallow areas proceeds among the farm communities across the cereal fallows of *Terai* to the foothills of Nepal.

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

The identification and use of these new crops and varieties detailed in Q12 and Q13 has been achieved in 4-5 years, indicating a rapid rate of adoption and spread that is characteristic of participatory approaches to varietal selection and technology development. Usage is still spreading.

*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).***

The government of Nepal has emphasized sustainable intensification and diversification of production systems based on comparative advantage and potential of the local agroecosystems. This has been clearly depicted in the Tenth Five Year Plan and the Agricultural Strategy Paper endorsed and adopted by the government (NPC, 2002). In recent years, for mainstreaming the pluralistic efforts of different actors involved in agricultural research and development, the government has adopted a public-private-partnership approach, realising the potential of concerted efforts for enhancing the livelihoods of poor and marginalized people through agricultural interventions. A National Agricultural Research and Development Fund has been established to promote and strengthen the technical capabilities and managerial skills of various institutions implementing agricultural and NRM interventions in rural farm communities. In 2005, largely in response to the evidence produced by the project and its partners using PVS, the National Seed Board of Nepal revised the procedures for official variety release so that any public or private organization could propose the release of crop varieties and could use data generated through participatory research. Two mungbean varieties, named Kalyan and Prateeksha, have been released in Nepal using this procedure, the first release of varieties proposed by a government-public partnership in the history of Nepal.

Agriculture Service Centers (under District Agriculture Development Offices), Village Development Committees, District Development Committees, NGOs, Agrovets, Clubs, Farmers Groups and their Associations are the main organizations associated with agriculture in the rural communities of Nepal. The Regional Seed Testing Laboratory, seed companies, and Regional Agricultural Research Stations also deliver their services and technologies throughout their command regions. A Crop Diversification Program in western districts of Nepal, the APP support project in the central region and CGISP in the east have been promoting crop diversification in collaboration with local institutions, and have requested the aforementioned crop varieties and associated technological options to promote in their marginal rainfed environments. FORWARD has implemented 15 projects throughout 16 districts of Nepal in collaboration with national and international organizations and has ample experience and legitimacy in the national agricultural system for scaling-up promising dry season crop varieties.

*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).***

Promotion is currently taking place in parts of the dry land farming system in 16 districts of Nepal, representing both *Terai* and foothills using both formal and informal channels (Table 4). These include networks of farmers' groups, seed companies, District Agriculture Development Offices, Agrovets, NGOs, cooperatives and through farmer-to-farmer seed flow mechanisms. FORWARD has also been scaling up the farmers' preferred crop varieties through other projects in 11 districts of Nepal.

***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)**.*

Institutions that have directly worked with the project have adopted the dry farming varieties but further adoption is constrained by **lack of awareness of the potential of new dry land varieties** on the part of growers, and unavailability of quality seeds. Although many farmers' groups and cooperatives have started seed production and marketing of the new varieties, their technical capabilities and managerial skills need to be strengthened for the exploitation of their full potential. The PVS approach was effective in popularizing and promoting new crop varieties, but there is still there is a lack of awareness about differences between PVS and the more traditional approaches being used by GOs during technology validation and promotion.

Another barrier is the **mindset** of GO staff who use a conventional transfer of technology approach. Farmers are unrealistically asked to use the **recommended package of practices** that maximises yields but ignores profitability and exposure to risk.

Mindsets are reinforced by **official policies** on varietal identification, release and dissemination. The recommendation of varieties is a highly formalized process that is regulated by both customary practices and by law (Seeds Acts) that **conflict with the participatory technology development approach.** For example, GOs are officially only permitted to distribute seeds of recommended varieties. Hence, they tend to provide a limited choice to farmers by giving varieties pre-selected under research station conditions. Though the law permits the promotion of truthfully labeled seeds of released/registered crop varieties, government officials recommend only certified seed, which is more difficult to produce, and is thus in short supply. Insistence on certified seed is impracticable considering the diverse climatic and geophysical situation of the country and the limited resources of the GOs.

***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 way to remove barriers is to strengthen the technical and managerial capabilities of the staff of GOs and NGOs and to build capacity of CBOs to conduct participatory action research, community-based seed production and marketing. Many GOs still seem reluctant to internalize participatory approaches to agricultural research and development and NGOs generally also have only limited capacity in this area. The technical and managerial capability of seed production groups and cooperatives that have recently started producing and marketing seeds also needs to be greatly strengthened and the extension personnel of various organizations who have been promoting dry season crop varieties need to be trained further in technological and managerial aspects of dry land farming.

Promising crop varieties need to be released through the formal system, and production and marketing of source seeds also needs to be institutionalised. Marketing networks, for both inputs and outputs, should be strengthened and village level processing companies need to be promoted.

***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).***

In the course of validation and promotion of many dry land crop varieties the following lessons were learnt:

1. On-farm experimentation empowers farmers. When involved at all stages of the variety selection process, farmers become acquainted with the various aspects of crop management. Many farmers who participated in on-farm testing have now started to select by themselves the appropriate crop varieties for their socio-economic circumstances.

2. Technology should be simple, compatible with socio-cultural settings and easily accessible for wider adoption in farming communities.

3. System-based research is needed to fit dry land crop varieties into diverse cropping systems.

4. Resource-poor farm communities have diverse and complex farming systems, and they need to have as many crop/variety choices as possible to maximize their profit from a fixed set of resources.

5. Low soil fertility is the key physical constraint associated with dry land farming systems of Nepal, so integration of at least one legume in a cropping pattern should enhance the overall productivity of the system.

*Impacts On Poverty*

## ***E. Impacts on poverty to date***

***20.*** *Where have poverty impact studies on this output or cluster of outputs taken place? Please list studies here.*

Gauchan, D. 2005. Assessment of the outcomes of rice-fallow rainfed rabi cropping (RRC) project in Nepal Terai. Kathmandu, Nepal: Nepal Agricultural Research Council

***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 new varieties have been adopted by farmers because they offer a range of benefits, including yield increases (Table 1) gained without additional inputs, i.e. at no extra cost, so income per hectare has increased. The trend of variety adoption (Table 4) and increases in productivity (Table 5) for all the dry season crop varieties promoted through the project clearly show real, and increasing, benefits.

Sixty farmers' groups and seven cooperatives were formed during the project period. About 100 Local Resource Persons (LRPs) were trained in various aspects of rainfed cropping. (Annex 1). A recent survey in the project sites revealed that all the grassroot institutions promoted by the project have been running, and some of them are involved in seed production activities. (Annex 2). The financial capital of the groups has risen to NRs 400, 000 ($ 5400) per group. Similarly, cost benefit analysis of the changed cropping patterns after the adoption of technological options showed integration of legumes increased the profitability of the whole system (Tables 5 and 6; Annex 3). The effect on the livelihoods of people was not apportioned into items of livelihoods but the increased yields reduced dependence on the market for food, and increased food security. Outcome assessments showed that improvements in working stamina, health care, schooling and nutrition, and access to institutional services have been increased.

Poor farmers adopting the dry land farming system will benefit as much as resource rich farmers. Poor people dominate poor and marginal lands and the abovementioned legumes are appropriate where farmers have limited choice to grow crops with higher nutrient requirements.

More than 30,000 farm families were aware of the dry land crop varieties, of which about 50% perceived positive change in their livelihoods after adopting them in the study locations (Gauchan, 2005).

**Table 5: Rainfed rice fallow area of sample farmers before and after project intervention**

| Type of participant farmers/ category | Number of sample households | Rainfed rice fallow area (ha) in the project sites | | Reduction in fallow area (%) |
|---|---|---|---|---|
| | | Before project | After project | |
| Direct participant farmers | 108 | 53.4 | 15.3 | 71.4 |
| Indirect participant farmers | 75 | 48.5 | 24.2 | 50.1 |
| Non-participant farmers | 60 | 40.8 | 34.5 | 15.3 |
| All Farmers | 243 | 142.7 | 74.0 | 48.2 |

Source, Gauchan, 2005

**Table 6: Increase in cropping intensity among participant and non-participant farmers after adoption of dry season crop varieties.**

| Type of participant farmers/category | Change in cropping intensity (%) | | |
|---|---|---|---|
| | Before project | After the project | % Change |
| Direct participant farmers | 163.9 | 204.8 | 24.95 |
| Indirect participant farmers | 161.8 | 194.9 | 20.45 |
| Non-participant farmers | 157.9 | 166.9 | 5.69 |
| All Farmers | 161.6 | 191.1 | 18.25 |

Source: Gauchan, 2005

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*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:

- Increased crop productivity without the use of additional external inputs.
- Almost all the crops under this output are legumes and the role of legumes in crop

diversification, soil health, and sustainability of cropping systems is enormous.

- By increasing crop diversity and rotation, minimize the incidence and severity of insect-pests and diseases, and contribute to environmental protection.
- Food and nutritional security as well as cash income of poor and marginalized farm communities will be improved, perhaps lessening pressure on consumption of unsustainable local resources such as animal manure for fuel.

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

The adoption of these outputs will not cause any adverse environmental impacts

***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 100 words)***

Yes, pest tolerant- and earlier-maturing varieties have increased the resilience of farmers by making available extra time for other operations, lowering the cost of production and reducing use of water and nutrients. Early maturing varieties of rice in this case have facilitated an increase in cropping intensity in rice-fallow system. Adopting farmers now have more choices, with consequent increases in flexibility and resilience.

Varietal diversification is a means of coping with climate change because staggered deployment of varieties with different dates of maturity spreads out labour demands and reduces the risk from disasters such as disease and pest outbreaks and natural calamities. Deployment of varieties that do well under rainfed or low irrigation but respond to better conditions is possible with new varieties. This increases the capability of farmers to cope with natural risks. Thus increased accessibility of dry season crops varieties will increase the number of varieties in farmers' portfolios and reduce risk.

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*Annex*

**Annex 1: Different training packages taken by Local Resource Persons**

| **Trainings** | **No of participants** |
|---|---|
| **Farmers training** | |
| Nursery management | 120 |
| Integrated Crop Management including seed production | 115 |
| Participatory Planning Monitoring and Evaluation (PPME) | 60 |

| | |
|---|---|
| Cooperatives' management | 30 |
| Agrovet management | 6 |
| Marketing and processing of seed and preparation of legumes' products | 50 |
| Seed plot management and rouging | 40 |
| HNPV production and management | 30 |
| Organoleptic assessment of munbean varieties | 40 |
| Organoleptic assessment of chickpea varieties | 35 |
| **Staff training** | |
| IPM in legumes | 12 |
| Data management and report writing | 4 |
| Participatory Research and Development | 1 (7 Months) |
| HNPV production and integrated disease management (IDM) in chickpea | 1 (15 days) |

## Annex 2: Functional seed production groups/cooperatives

| District | Group/ Cooperative | Name | Fund size | Status | Members | Seed prodn. focus |
|---|---|---|---|---|---|---|
| Jhapa | Group | Jajaruk mixed farmers group | 40000 | Registered in DADO | 20 | Rice, mungbean |
| Jhapa | Group | Bisal female farmers group | 35000 | Registered in DADO | 25 | Rice, mungbean |
| Jhapa | Group | Pragatisil female farmers group | 50000 | Registered in DADO | 25 | Rice, mungbean |
| Jhapa | Group | Triveni mixed farmers group | 45000 | Registered in DADO | 21 | Rice, mungbean |
| Jhapa | Group | Deurali farmers group | 35000 | Registered in DADO | 30 | Rice, mungbean |
| Jhapa | Group | Sinha Devi farmers group | 20000 | Registered in DADO | 25 | Rice, mungbean |
| Jhapa | Group | Suryodaya farmers group | 15000 | Registered in DADO | 14 | Rice, mungbean |
| Jhapa | Co | Bihani Agricultural cooperative | 500000 | District Cooperative association | 50 | Rice, mungbean |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sirha | Group | Nawadurga female seed production group | 15000 | Registered in DADO | 24 | Chickpea, mungbean, rice |
| Sirha | Group | Nawajagriti farmers group | 35000 | Registered in DADO | 25 | Chickpea, rice, pigeonpea, mungbean |
| Saptari | Group | Jagriti Farmers group | 15000 | Registered in DADO | 17 | Chickpea, rice, pigeonpea, mungbean |
| Saptari | Group | Nawa Jagaran farmers group | 21000 | Registered in DADO | 15 | Chickpea, rice, pigeonpea, munbean |
| Saptari | Group | Siddhartha farmers group | 23000 | Registered in DADO | 20 | Chickpea, rice, pigeonpea, mungbean |
| Saptari | Group | Udaya Farmrs group | 10000 | Registered in DADO | 24 | Chickpea, rice, pigeonpea, mungbean |
| Saptari | Group | Shree Mata farmers group | 14000 | Registered in DADO | 23 | Chickpea, rice, pigeonpea, mungbean |
| Kapilvastu | Group | Kalankari farmers group | 6000 | Registered in DADO | 15 | Chickpea, rice, pigeonpea, mungbean |
| Kapilvastu | Group | Pratisil farmers group | 35000 | Registered in DADO | 20 | Chickpea, rice, pigeonpea, mungbean |
| Kapilvastu | Group | Janajagaran farmers group | 15000 | Registered in DADO | 21 | Chickpea, rice, pigeonpea, mungbean |
| Kapilvastu | Group | Srijana farmers group | 14000 | Registered in DADO | 20 | Chickpea, rice, pigeonpea, mungbean |
| Kapilvastu | Co | Sahayogi mahila multipurpose cooperative | 400000 | District Cooperative association | 80 | Chickpea, rice, pigeonpea, mungbean |

| | | | | | | |
|---|---|---|---|---|---|---|
| Kapilvastu | Co | Adarsa Agricltural cooperative | 50000 | District Cooperative association | 60 | rice, pigeonpea, munbean |
| Kapilvastu | Co | Kapilmuni Agricultural cooperative | 48000 | District Cooperative association | 45 | rice, pigeonpea, munbean |
| Tanahun | Group | Bhairav Babva multipurpose seed production group | 25000 | Registered in DADO | 35 | Rice, mungbean, maize |

**Annex 3: Net benefit and benefit-cost ratio from cropping pattern (US $/ha).** Values in parentheses indicate benefit: cost ratio; Source: Gauchan, (2005). Benefit: cost ratios differ between districts, largely due to differences in production potential, labour and input costs. In general, rice followed by a winter crop is more profitable than rice-fallow although linseed, niger and buckwheat are exceptions because poor plant stand and low yield are major problems.

| Cropping Pattern | Net benefit and benefit-cost ratio from cropping options | | |
|---|---|---|---|
| | **Saptari** | **Kapilbastu** | **Jhapa** |
| Rice-fallow | 209 (1.83:1) | 326 (2.0:1) | 204 (1.49:1) |
| Rice-chickpea-fallow | 567 (2.2:1) | 752 (2.3:1) | |
| Rice-linseed-fallow | 213 (1.64:1) | | |
| Rice-potato-fallow | 869 (1.9:1) | | 761 (1.52:1) |
| Rice-lentil-fallow | 599 (2.4:1) | 857 (2.7:1) | |
| Rice-chickpea-mungbean | 1180 (2.8:1) | 1451 (2.8:1) | |
| Rice-lentil-mungbean | 1212 (2.9:1) | 1333 (2.8:1) | |
| Rice-lentil-mungbean+maize | | 1772 (3.4:1) | |
| Rice-mustard-mungbean | 981 (2.4:1) | 1209 (2.6:1) | |
| Rice-fallow-mungbean | 822 (2.8:1) | 1024 (2.8:1) | 743 (1.8:1) |
| Rice- potato- mungbean | 1482(3:1) | | 1300 (1.66:1) |
| Rice-buckwheat-fallow | | | 255 (1.46:1) |
| Rice-buckwheat-mungbean | | | 794 (1.74:1) |
| Rice-niger-fallow | | | 277 (1.54:1) |
| Rice-niger-mungbean | | | 816 (1.8:1) |

**Annex 4: Summary of trial activities related to dry season crop varieties implemented by FORWARD**

| Crops and trials Mungbean | Years | | | | | Total |
|---|---|---|---|---|---|---|
| | 2002 | 2003 | 2004 | 2005 | 2006 | |
| Mother trials | 7 | 15 | 24 | 24 | 30 | 100 |
| Baby trials | 5 | 144 | 130 | 80 | 60 | 419 |
| Adaptive demonstration and seed production (ha) | 1 | 4.2 | 7 | 20 | 80 | 112 |
| Molybdenum loading through seed priming | | | 24 | 30 | | 54 |
| Effect of mungbean biomass incorporation on cropping system productivity | | 15 | 15 | 15 | | 45 |
| **Chickpea** | | | | | | |
| Mother trials | 21 | 16 | 24 | 10 | 25 | 96 |
| Baby trials | 15 | 80 | 66 | | 20 | 181 |
| Pod borer management trials | | | 15 | 15 | | 30 |
| Adaptive demonstration and seed production (ha) | 3 | 3 | 20 | 15 | 40 | 81 |
| Nutrient management trials | | 15 | 15 | | | 30 |
| Molybdenum loading seed priming | | | 24 | 24 | | 48 |
| **Lentil** | | | | | | |
| Molybdenum loaded trials | | 24 | | | | 24 |
| Seed production (ha) | | 5 | 7 | | 25 | 37 |
| Disease management trial | | | | 8 | | 8 |
| Adaptive observation (No) | | 15 | 10 | | | 25 |

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