Project no. **032055**

Project acronym: **FOSRIN**

Project title: **Food security through ricebean research in India and Nepal**

**Instrument: STREP**

**Thematic Priority:** 10.3.1.A.3.2: biodiverse, biosafe and value added crops: research to increase the sustainable use and productivity of annual and perennial under-utilised tropical and sub-tropical crops and species important for the livelihoods of local populations.

# Title of report: First periodic activity report, April 2006 – March 2007

This document has been edited prior to publication on the project website

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**Project coordinator name:** Dr PA Hollington
**Project coordinator organisation name:** CAZS Natural Resources, University of Wales Bangor

**Revision:** Final

## Abstract

This document summarises the activities that took place within the FOSRIN project in the period 1 April 2006 – 31 March 2007. Achievements and work progress are described for all relevant workpackages, and additional information is provided on project management, coordination activities, and dissemination and exploitation of results. The document contains a 4-page *Publishable Executive Summary*. The document has been edited prior to publication on this website.



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## Publishable executive summary

**Introduction.** This document describes the first year's work of the FOSRIN (**Fo**od **S**ecurity through **R**icebean Research in **I**ndia and **N**epal) project, a consortium of eight partners, universities, NGOs and government research organisations in Europe and South Asia, working to popularise the underutilised grain legume crop ricebean (*Vigna umbellata*) and promote its cultivation over a wider area of the environments to which it is suited than is currently the case. The work involves research on the supply chain and marketing of the crop, the diversity and adaptation of germplasm, farmers' preferred traits and indigenous knowledge of the crop, and its health and nutritional aspects. The project, funded by DG Research of the European Commission under the 6th Framework Programme (FP6) began in April 2006, and continues until March 2009. The work of the project is showcased on the website of The Ricebean Network (www.ricebean.org).

**Background.** Production of cereals in South Asia has far outstripped the production of legumes, with serious consequences for the food security and nutritional well-being of poor farmers in marginal areas. Ricebean is a grain legume grown in Western, Northern and Eastern (WNE) India and Nepal. It is widely grown as an intercrop, particularly of maize, and was widely grown in the past on residual water after rice. There is little or no choice of improved varieties as there has been almost no modern plant breeding, landraces predominate and seed supply is limited or non-existent. Consequently, it is not grown widely despite its suitability for marginal agricultural areas where many poor people live. Ricebean grows well on a range of soils. It has rapid establishment, is pest resistant, and has the potential to produce large amounts of nutritious animal fodder and high quality grain, and there is great scope for genetic improvement in this neglected crop.

**Objectives.** The overall objective is to make ricebean more than locally popular by identifying and measuring the diversity within the range of germplasm available in India and Nepal and characterising it for suitability to the cropping systems of the region. We will match farmer-preferred varieties to diverse seasons, environments and markets, using a combination of genetic, agronomic, and socio-economic approaches and using client-orientated principles to identify genotypes and parents for breeding programmes suitable for integrating ricebean into rice- and maize-based cropping systems in WNE India and Nepal. Our specific scientific objectives are as follows:

1. To analyze the legumes supply-chain for stages and linkages where product value of improved ricebean is potentially lost or where information on product quality may be compromised or lost
2. To assess genetic diversity and indigenous knowledge on ricebean in Nepal and India
    - 2.1. To assess genetic diversity and uses of ricebean using indigenous knowledge of the crop
    - 2.2. To characterise the germplasm diversity using molecular marker techniques
    - 2.3. To characterise the germplasm for phenological traits and suitability for a range of diverse environments and cropping systems using participatory approaches
3. To assess the potential impact of enhanced pulse availability on local human nutrition
4. To develop a Market-based Legumes Traits Value-Index (MLTVI) that allows breeders to assess *ex ante* the value of new legumes in terms of their monetary value to consumers
5. To develop innovative and efficient marketing methods for high quality, protein-rich products from the crops to increase market accessibility, product value and promote export value
6. To develop policies to support and promote equitable access to such protein-rich foods, building sustainable medium and long term food security

In addition, we have 3 management objectives to ensure the smooth running of the project: these are detailed in the full report.

### *Contractors involved and coordinator contact details*

| Contractors | Senior staff involved |
|---|---|
| Coordinator: Dr Philip Hollington, CAZS Natural Resources, University of Wales Bangor, UK (CAZS-NR) email: p.a.hollington@bangor.ac.uk; Phone: +44 1248 382285; Fax +44 1248 364717 ; Web: http://www.ricebean.org | Prof John Witcombe, Dr David Harris, Dr KD Joshi (Kathmandu office) |
| Dept. of Agricultural Economics, Christian Albrechts University of Kiel, Germany (CAU): | Prof Dr Rolf Mueller, Prof Dr M von Oppen; Ms Doreen Buergelt |
| Department of Geography, University of Bergen, Norway (UB) | Dr Peter Andersen |
| Crop Research Component, Gramin Vikas Trust, Dahod, Gujarat, India (GVT) | Dr JP Yadavendra |
| Ch. Sarwan Kumar Krishi Vishwa Vidyalaya**,** Palampur, Himachal Pradesh, India (CSKHPKV) | Dr Naveen Kumar, Dr JC Bhandari, Dr RK Chahota, Dr DK Banyal, Dr Harbans Lal, Dr Rajan Katocht |
| Assam Agricultural University, Jorhat, Assam, India (AAU) | Dr Mrs SB Neog |
| Nepal Agricultural Research Council, Kathmandu, Nepal (NARC) | Dr Mrs Jwala Bajracharya, Mr Man B Shrestha |
| Local Initiatives for Biodiversity, Research and Development, Kaski, Nepal (LI-BIRD) | Dr Pratap K Shrestha, Mr Resham Gautam |

### *Work performed and results achieved*

To meet the scientific objectives, we developed five workpackages. The first was concerned with the marketing and supply chain of the crop and led by CAU. Literature on the hedonic demand functions and on supply chain analysis was surveyed. A set of laboratory analyses was developed to assist in the development of a market-based legume traits value index (MLTVI) – a measure to assign a monetary value to particular characteristics of a variety and so assist plant breeders to develop varieties which best meet the market requirements. Finally, methods to be adopted in the field work were developed and discussed at a conference held in Austria in early 2007.

A typical ricebean growing area near Gulmi in the mid hills of Nepal (Photo courtesy PK Shrestha, LI-BIRD)

The second workpackage was concerned with assessing genetic diversity and indigenous knowledge, and led by the Nepalese NGO LI-BIRD. An initial assessment of potential ricebean-growing districts was carried out in Nepal. Over 150 ricebean accessions were collected from 16 districts in Nepal, together with over 100 from the historical collection at NARC and almost 90 from 16 districts in India. Local knowledge on the crop was also collected in both India and Nepal. Finally, the collected accessions from Nepal were evaluated for agro-morphological traits and phenotypic diversity on-farm at Gulmi in the middle hills by LI-BIRD, and at NARC headquarters.

Although adapted to a range of climatic conditions, in Nepal ricebean is mostly found in drought-prone sloping areas and unirrigated flat river fans between 700 and 1300 m. It is also grown in home gardens from 200 m in Chitwan up to 2000 m in Ilam district. Passport data was recorded using standard procedures developed by the project partners.

The germplasm evaluation was carried out under normal farmers' conditions without chemical fertiliser, although spraying was carried out against pests. There was considerable variation between accessions in time to maturity, and in seed size and colour, time to maturity and yield. The NARC evaluation also showed differences in growth habit (twining or non-twining, determinate or indeterminate flowering). A Principal Components Analysis showed that a cluster of genotypes from the mid to high hills in W Nepal were similar. The degree of diversity shown suggested considerable possibilities for plant breeding to improve the crop.

Germplasm evaluation on-farm in Gulmi, Nepal (Photo courtesy PK Shrestha, LI-BIRD)

Assessment of diversity as seen by farmers identified 4 main types of ricebean in each of Gulmi and Ilam districts in Nepal, and 7 in India (although in Himachal Pradesh only a mixture of landraces was grown). The main criteria used were grain size and colour, maturity, and growth habit. In both countries, ricebean was grown mainly as an intercrop or a mixed crop with maize, as well as on its own as a sole crop, although in some areas it was mixed with cowpea or sorghum. Most was planted in June before the onset of the monsoon. Farmers identified a number of production constraints including low yield potential, availability of other legumes in the market, unavailability of improved material, and low interest by research and extension services. They were aware of a number of medicinal and nutritional benefits, and noted that ricebean had cultural significance in a number of areas. However, they were also aware of its flatulence-causing properties. There were no established markets for ricebean – it was not grown for commercial purposes and was usually exchanged between farmers or sold in local markets.

In WP3, work on molecular diversity of ricebean was begun by NARC. From the Nepalese germplasm collected and evaluated in WP2 a stratified sample of 34 accessions, based on agro-ecological diversity, diversity of local names, and seed availability was selected and DNA isolated using standard protocols with the aim of screening SSR markers from other *Vigna* spp and to detect polymorphic markers for the large number of genotypes to be screened from India and Nepal. However, the process has not yet been successful in amplifying the DNA, and work is continuing.

The fourth scientific workpackage, on germplasm characterisation, was led by the Indian NGO GVT, with inputs from the other Asian partners. In the first year, farmer-preferred trait analysis was carried out in both India and Nepal, in the same districts as the germplasm collection in WP2 and using focus-group discussions with mixed groups of between 10 and 20 male and female farmers. Data collected included the assessment of organoleptic traits such as taste and cooking quality. Attempts have been made to exchange germplasm between the two countries, but this has so far not proved possible. Of the collected and evaluated germplasm in WP2, the most promising accessions that meet farmers' requirements have been identified for sowing in mother and baby trials in 2007.

Ricebean did not compare well with other locally-grown legumes: out of eight crops, farmers in both Nepal and India preferred black gram (*Vigna mungo*) and kidney bean (*Phaseolus vulgaris*), with ricebean placed seventh, ahead of only lentil (*Lens culinaris*).

All parts of the crop were used for various purposes. Food was the most important use, followed by fodder production and green manuring. Positive and negative traits were identified for the various uses in both countries. Large-seeded determinate and synchronous varieties were preferred for food production, and late-maturing indeterminate types with soft palatable herbage for fodder and green manure. Early maturing varieties were not favoured as their maturity coincided with the peak rainy season, and they also had low yields and small grains. Pest and disease resistance, and suitability for intercropping or mixed cropping were regarded as less important, as was tolerance to high rainfall during flowering. Overall, in Nepal preference was given to the landrace *Seto Thulo* (white bold [large]) while in India the three preferred types were all bold-seeded. It was felt important for any breeding work to include organoleptic traits.

UB were responsible for the 5th scientific WP, on the health and nutritional aspects of the crop. A comprehensive literature survey on the nutritional qualities of ricebean, the state of the art of nutritional survey design, and the extent of malnutrition in the region was carried out. The survey showed that the suggested strategy of WP5 was justified, as no comprehensive studies in the region have been published on diet composition and adequacy, and the relative contribution of pulses in the diets is largely unknown. The dietary survey will provide new scientific knowledge essential to FOSRIN but also generally publishable. An intensive training session was held in Palampur to train Asian project staff in the various techniques needed to carry out the dietary surveys, and to standardise methodologies: this was followed by a practical session in the field.

### *Expected end results*

We anticipate that by the end of the project we will have developed a hedonic demand function for legumes and completed and quantified the MLTVI, as well as designed a strategy for the introduction of ricebean into the legumes supply-chain in India and Nepal. We will have an understanding of ricebean's distribution in India and Nepal, of its diversity in terms of farmers' names, of phenology and morphology, and on a molecular basis, and of the indigenous technical knowledge on the crop's production and use. We will also have a workable set of polymorphic markers for the crop which may also be of use to workers on other *Vigna* species. We will know the traits that farmers regard as being important, and have identified particular varieties that meet those requirements. Finally, we will understand the potential impact upon human health and nutrition that the introduction of ricebean into the diets of a larger proportion of the population could have.

### *Intentions for use and impact*

The results of the project will be of interest to a wide range of audiences. These include scientists working in project-related areas, including on other grain legumes, as well as farmers and farmers' organisations in the region, market traders, intermediaries and their organisations, urban and rural consumers, and policy makers.

It is our intention that farmers in the region will adopt the new technologies and germplasm developed by the project. Based upon our previous experience, we expect this to be as much by informal farmer-to-farmer dissemination as by the extension activities of the project partners. This will have a direct impact in terms of improving the farmers' livelihoods and food security through increased use of legumes with inherent abiotic stress resistance, high biomass production and good nutritional quality that would obtain a good market price. Improved fodder production will improve livestock health and production, and greater use of legumes in the farming system will reduce erosion, fix nitrogen, and increase soil organic matter. By illustrating the value of research into underutilised crops we will impact on policy, and we will improve equity by targeting the results at resource-poor farmers. We also believe that in the longer term the knowledge generated by FOSRIN will greatly assist the breeding of improved and well-adapted varieties of ricebean. The development in particular of the MLTVI will provide an exceptionally useful tool for plant breeders, not only of ricebean but also of similar grain legumes in S Asia, by enabling them to allocate a monetary market value to the traits they are breeding or selecting for.

### *Main elements of the publishable results of the plan for using and disseminating the knowledge*

Although the project has now been in operation for one year, most of the partners have so far contributed to it for only six months. As a result, there are at this stage no publishable results available. However, a comprehensive ricebean bibliography is available on the project website at http://www.ricebean.org/references1.htm.

## Section 1 – Project objectives and major achievements during the reporting period

### 1.1 Overview of general project objectives and current relation to the state-of-the-art

**Introduction.** Cereal production in S. Asia has far outstripped that of legumes, with serious consequences for the food security and nutritional well-being of poor farmers in marginal areas. Ricebean (*Vigna umbellata*) is a legume grown in Western, Northern and Eastern (WNE) India and Nepal. It is widely grown as an intercrop, particularly of maize (Lawn, 1995), and was often grown in the past on residual water after rice. There is little or no choice of improved varieties as there has been almost no modern plant breeding, landraces predominate and seed supply is limited or non-existent. Consequently, it is not grown widely despite its suitability for marginal agricultural areas where many poor people live. Moreover, well-functioning marketing channels for the crop do not exist. Ricebean grows well on a range of soils. It has rapid establishment, is pest resistant, and has the potential to produce large amounts of nutritious animal fodder and high quality grain, and there is great scope for genetic improvement in this neglected crop.

**Objectives.** The overall objective is to make ricebean more than locally popular by identifying and measuring the diversity within the germplasm available in India and Nepal and characterising it for suitability to the cropping systems of the region, matching farmer-preferred varieties to diverse seasons, environments and markets, using a combination of genetic, agronomic, and socio-economic approaches firmly based on client-orientated principles to identify genotypes and parents for breeding programmes suitable for integrating ricebean into rice- and maize-based cropping systems as well as into the diets of consumers in WNE India and Nepal.

The scientific objectives of the project are as follows:

1. To analyze the supply-chain for stages and linkages where product value of improved ricebean is potentially lost or where information on product quality may be compromised or lost
2. To assess genetic diversity and indigenous knowledge on ricebean in Nepal and India
   - 2.1. To assess genetic diversity and uses of ricebean using indigenous knowledge of the crop
   - 2.2. To characterise the germplasm diversity using molecular marker techniques
   - 2.3. To characterise the germplasm for phenological traits and suitability for a range of diverse environments and cropping systems using participatory approaches
3. To assess the potential impact of enhanced pulse availability on local human nutrition
4. To develop a Market-based Legumes Traits Value-Index (MLTVI) that allows breeders to assess *ex ante* the value of new legumes in terms of their monetary value to consumers
5. To develop innovative and efficient marketing methods for high quality, protein-rich products from the crops to increase market accessibility, product value and promote export value
6. To develop policies to support and promote equitable access to such protein-rich foods, building sustainable medium and long term food security

In addition, we also aim:

7. To ensure effective integration of results, hypotheses and germplasm, and their wide dissemination to stakeholders and other interested parties
8. To ensure dialogue between participating institutions, research teams, other projects, participating communities and governments
9. To strengthen sustainably the research capability of the Asia Partner Country institutes involved in the project

**Current relation to state-of-the-art**

The sustainability of continuous cereal systems is in doubt unless broken by a legume. However, in Northern and Eastern hill areas of India and in Nepal, farmers have only a limited choice, usually greengram (*Vigna radiata*) or blackgram (*Vigna mungo*). Neither is ideal due to their high water use and long duration. Farmers preliminary consultations suggest that they need a short duration legume, with few disease and pest problems. Ricebean has all the required traits except grain quality and photoperiod-insensitivity. It grows well on a wide range of soils, and has good pest resistance. Some genotypes are drought tolerant, and the twining habit of some genotypes makes it suitable to intercrop with maize, although difficult to harvest mechanically. With its quick growth and good biomass production it can be used as animal feed during the fodder-scarce summer, and as a green manure.

***Germplasm and indigenous technical knowledge.*** There has been no systematic attempt to collect Nepalese ricebean germplasm, very few studies on its diversity, and no systematic documentation of indigenous technical knowledge on the crop, and little in India since the 1960s, although indigenous and exotic collections evaluated in the 1970s[1] showed a wide range of genetic variation for morpho-agronomic attributes. Existing indigenous knowledge on ricebean in both countries needs documenting and collating. We have previously developed participatory methods to systematically collect germplasm and relate it to various socio-economic questions, so germplasm evaluation will not rely on field evaluation or molecular marker diversity alone, but be supported by these other approaches to allow a better understanding of genetic diversity.

***Farmers' perceptions and knowledge of diversity.*** Farmers grow landraces to meet their agronomic and cultural needs, and have a well-developed indigenous knowledge of their crops and varieties. Farmers' diversity management consist of seed flows, variety selection and adaptation, and seed selection and storage[2], all influenced by agro-ecological, socio-economic and cultural conditions, many of which affect the management of landrace diversity, so farmers' indigenous knowledge is linked to the maintenance and management of genetic diversity[3,4]. Landrace choice is first of all determined by adaptation to the agro-ecological domain and farm management practices, followed by selection for phenotypic features that best meet farmers' preferences.

***Analysis of genetic diversity using morphological and molecular data.*** Using recombinant DNA technology, variation in DNA sequences can be examined directly, avoiding environmental effects which could confound morphological evaluation, and possibly biased allozyme estimates. Recent work has assessed between-farm diversity in cowpea (*Vigna unguiculata*) landraces using AFLP and SAMPL markers to determine the distribution of genetic variation[5], genetic diversity in blackgram has been studied using RAPD and ISSR markers[6], and in greengram using AFLPs[7]. Molecular markers have been used to study

[1] Chandel, KPS et al (1988). Rice bean - a potential grain legume. NBPGR Sci. Monogr. No. 12. NBPGR, New Delhi

[2] Bellon, MR et al (1997) Genetic conservation: a role for rice farmers. In Maxted BV *et al* (eds) Plant genetic conservation: an in-situ approach. London, Chapman Hall

[3] Eyzaguirre, P & Iwanga, M (1995) Farmers contribution to maintaining genetic diversity in crops, nd its role within the total genetic resources systems. P 9 – 18 in Proc Workshop on Participatory Plant Breeding, July 1995, Wageningen. IPGRI, Rome

[4] Jarvis, DI et al (2000) A training guide for *in situ* conservation on farm. Version 1. IPGRI, Rome

[5] Tosti, N & Negri, V (2005) On-going on-farm microevolutionary processes in neighbouring cowpea landraces revealed by molecular markers. Theor Appl Genet **110**: 1275-1283

[6] Souframanien, J & Gopalakrishna, T (2004) A comparative analysis of genetic diversity in blackgram genotypes using RAPD and ISSR markers. Theor Appl Genet **19**: 1687-1693

[7] Bhat, KV et al (2005) Amplified fragment length polymorphism (AFLP) analysis of genetic diversity in Indian mungbean [*Vigna radiata* (L) Wilczek] cultivars. Ind J Biotech **4**: 56-64

genetic diversity in rice landraces in Nepal[8]. Twelve *Vigna* microsatellites were identified earlier[9], and an integrated consensus map developed for cowpea, containing over 400 markers[10]. However, no molecular information is yet available for ricebean.

***Germplasm characterisation – participatory methods.*** Germplasm characterisation using agromorphological and molecular data is valuable for breeding programmes, but as well as testing across environments complete evaluation additionally requires measures of farmers' preferences for varieties and traits. Well established participatory methods for variety evaluation in farmers' fields often use single replicate, multi-entry trials (mother trials) and single intervention trials of a new entry versus a local check (baby trials)[11]. Mother trials sample more environments than replicated on-station trials[12] , and baby trials allow the cost-effective use of many replicates[13], contributing major improvements over more conventional varietal testing:

(1) Participatory trials allocate more resources to more advanced lines than many conventional breeding programmes[14].

(2) Farmers can evaluate varieties for all traits and make trade-offs of, e.g., grain yield against fodder yield, maturity, and grain quality.

(3) Varieties are tested under realistic management, across more physical niches as trials are replicated in more locations, and also across social niches where food preferences might vary.

Although these, or similar, approaches have been applied to several crops, no work has been done on ricebean.

***Market requirements.*** Crop breeding adds economic value in two ways, by lowering the costs of produce, and by adding value through improved cooking and keeping qualities. Conventional breeding focuses on crop traits that reduce production costs or storage losses, or both, but traits that add value or reduce costs at the household level are usually ignored for lack of information. Current economic demand theory and econometric methodology added to experience from applied studies allows us to develop an index to guide breeders towards adding value by satisfying consumer wants[15]. Ricebean is mostly produced for subsistence and it is not well introduced into supply-chains, but without market sales the benefits of improved varieties would not reach urban consumers. Developing markets for improved ricebean will be based on an analysis of existing legumes markets, and will require mechanisms that assure both the flow of the material product and of product information from

8 Bajracharya, J (2003) Genetic diversity study in landraces of rice (*Oryza sativa* L) by agromorphological characters and microsatellite DNA markers. PhD Thesis, University of Wales, Bangor, UK

9 YuKang Fu et al (1999) Abundance and variation of microsatellite DNA sequences in beans (*Phaseolus* and *Vigna*). Genome **42**: 27-34

10 Kelly, JD et al (2003) Tagging and mapping of genes and QTL and molecular marker-assisted selection for traits of economic importance in bean and cowpea. Fld Crops Res **82**: 135-154

11 Snapp, S, 1999. Mother and baby trials: a novel trial design being tried out in Malawi. In: TARGET. *The Newsletter of the Soil Fertility Research Network for Maize-Based Cropping Systems in Malawi and Zimbabwe*. Jan. 1999 issue. CIMMYT, Zimbabwe

12 Johnson, JJ et al (1992). Replacement of replications with additional locations for grain sorghum cultivar evaluation. *Crop Science* 32:43-46

13 Witcombe, JR et al (2005) Participatory plant breeding is better described as highly client-oriented plant breeding. I. Four indicators of client-orientation in plant breeding. Expl Agric **41**: 299 - 319

14 Witcombe, JR et al (1998). The extent and rate of adoption of modern cultivars in India. In *Seeds of choice: Making the most of new varieties for small farmer* 53-58 (Eds JR Witcombe et al). New Delhi: Oxford IBH, and London: Intermediate Technology Publications

15 Jeminez-Portugal, LA (2004) Relevant quality attributes of edible dry beans – An application of the hedonic price analysis. Osnabrück, Germany: Der Andere Verlag

producers to consumers. The information flow requires research, as some quality characteristics valued by consumers are likely to be invisible and will not be automatically passed on along the supply-chain, so must be communicated by other means. Whenever information about quality characteristics is separate from the good that has the characteristics this information may be lost, misrepresented, or otherwise become corrupted, so that buyers' valuation of improved ricebean products will be reduced. Also, if ricebean's true quality is misrepresented consumers' willingness to pay for improved varieties will be reduced.

***Health and nutrition.*** Average legume consumption in Nepal is below suggested FAO levels[16], and in India only just reaches them[17]. Pulses are expensive for poor people, and farmers' yields are low. As pulses have only been replaced to a small extent by animal source foods, there has been a strong decrease in micronutrient density in the diet, and a steady rise in the proportion of people suffering from anaemia and other deficiencies[18], with around 95% of the population of S. Asia at risk of zinc deficiency[19]. Food-based strategies are of specific interest in poor populations, especially allied to increasing production, profitability and sustainability of smallholder agriculture. Fortifying food products with protein-rich ricebean flour can improve diets, so expanded ricebean consumption in marginal areas could increase access to food with high protein and essential mineral content, but its reputation as a food for the poor may hinder to its spread. One factor limiting the spread of the positive effects of the Green Revolution among many of the world's poorest rural communities is lack of recognition of inter-farm heterogeneity[20], which requires similar heterogeneity in the innovations provided.

### 1.2 Summarise the objectives for the reporting period, work performed, contractors involved and the main achievements in the period

**Table 1.1:** Workpackages and WP leaders

| WP No. | WP Title | WP Leader | Objective |
|---|---|---|---|
| ***Scientific*** | | | |
| 1 | Supply chain, demand and marketing | CAU | 1, 4, 5, 6, 9 |
| 2 | Genetic diversity and indigenous knowledge | LI-BIRD | 2, 9 |
| 3 | Molecular markers | NARC | 2, 9 |
| 4 | Germplasm characterisation and adaptation | GVT | 2, 9 |
| 5 | Nutrition and health | UB | 3, 5, 6, 9 |
| ***Management*** | | | |
| 6 | Coordination and management | CAZS-NR | 7, 8, 9 |
| 7 | Dissemination | CAZS-NR | 7, 9 |
| 8 | Review | CAZS-NR | |

To meet the project objectives, we are carrying out 5 scientific and 3 management workpackages, as noted in Table 1.1. Work was carried out in all of these to meet the specific objectives for the first reporting period, April 1, 2006 – March 31, 2007 , which were as noted

[16] Lekhak, HD (2003) "Nepal". Chapter 10 in Processing and Utilization of Legumes. Asian Productivity Organization, Tokio, Japan ISBN 92-833-7012-0

[17] Govindan, A 2001: India Grain and Feed. Shopping for Pulses. GAIN Report # IN 1065. GAIN/USDA Foreign Agricultural Service

[18] Kennedy, G et al 2003: The scourge of 'hidden hunger': global dimensions of micronutrient deficiencies. *Food, Nutrition and Agriculture* **32**: 8-16

[19] Brown, KH & Wuehler, SE 2000: *Zinc and human health*. The Micronutrient Initiative, Ottawa

[20] Zilberman, D & Sunding, D (2001) The Agricultural Innovation Process: Research and Technology Adoption in a Changing Agricultural Sector. Chapter 4 in BL Gardner & GC Rauuser (eds.) *Handbook of Agricultural Economics* Vol 1A, Elsevier, Amsterdam ISBN 0-4448-2588-6

in Table 1.2. The timing of these milestones was altered substantially from that foreseen in Annexe 1 due to delays in signing the contract with the consequent effect on the relationship of the project to the crop calendar, although some work was able to take place before the contract was signed. An updated, frontlined barchart is appended in Section 3.

**Table 1.2:** Objectives for the first reporting period

| Objective | WP | Partner | Month* |
|---|---|---|---|
| To carry out a literature review on nutritional aspects of ricebean | 5 | UB | 0 (0) |
| To hold the initial workshop | 6 | CAZS-NR | 2 (0) |
| To identify traits needed by farmers | 4 | GVT | 8 (4) |
| To review literature on the ricebean supply chain and test the proposed methodology | 1 | CAU | 9 (7) |
| To produce the project website | 7 | CAZS-NR | 9 (6) |
| To carry out a field survey on diet and nutrition | 5 | UB | 10 (4) |
| To document national distribution of ricebean | 2 | LI-BIRD | 12 (3) |
| To complete a survey of ricebean diversity in the study sites | 2 | LI-BIRD | 12 (10) |
| To identify polymorphic DNA markers | 3 | NARC | 12 (12) |
| For each partner to be an active member of at least 1 relevant network | 6 | CAZS-NR | 12 (12) |
| To finalise the dissemination strategy (although this will be reviewed over the course of the project) | 7 | CAZS-NR | 12 (6) |

*Revised at the initial meeting due to the late start of the project. Initial month foreseen in parentheses.

***Work in WP 1***

In WP1 the literature on the estimation of the hedonic demand functions and on supply chain analysis was surveyed by CAU Kiel, and digital biographies assembled. A robust set of laboratory analyses for measuring ricebean and other pulse characteristics were designed and pre-tested, and a number of samples collected for analysis. This will eventually enable the development of the Market-price based Legumes Trait Value Index – a tool to allot a monetary value to particular traits of a variety which can be used to guide plant breeders when selecting traits to breed for. Methods for the field work were developed and presented in a conference, and linkages were established to enable the main field work to begin in 2007, in consultation with the Asian partners.

***Work in WP2***

An initial assessment of potential ricebean-growing districts was carried out in Nepal by LI-BIRD. In addition, over 150 ricebean accessions were collected from 16 districts in Nepal, together with over 100 from the historical collection at NARC and almost 90 from 16 districts in India. This work was assisted by the other Asian partners. Local knowledge on the crop was also collected in both countries. Finally, the collected accession from Nepal were evaluated for agro-morphological traits and phenotypic diversity on-farm at Gulmi in the middle hills by LI-BIRD, and at NARC headquarters.

The data collected showed that ricebean could be grown in a range of climatic conditions, but in Nepal is mostly found in drought-prone sloping areas as well as on unirrigated flat river fans between 700 and 1300 m. It is also grown in home gardens from 200 m in Chitwan up to 2000 m in Ilam district. Passport data was recorded using standard procedures developed by the project partners.

The germplasm evaluation was carried out under normal farmers' conditions without chemical fertiliser, although spraying was carried out against pests – standard protocols were developed and used to record the data. The on-farm evaluation showed considerable variation between accession in time to maturity, as well as in seed size and colour, time to maturity and yield. The NARC evaluation also showed differences in growth habit (twining or non-twining, determinate or indeterminate growth habit). A Principal Components Analysis showed that a cluster of genotypes from the mid to high hills in W Nepal were similar. The degree of diversity shown suggested considerable possibility for plant breeding to improve the crop.

Assessment of diversity as seen by farmers identified four main types of ricebean in each of Gulmi and Ilam districts in Nepal, and seven in India (although in Himachal Pradesh only a mixture of landraces was grown). The main criteria used by farmers were grain size and colour, maturity, and growth habit. In both countries, ricebean was grown mainly as an intercrop or a mixed crop with maize, as well as on its own as a sole crop, although in some areas it was mixed with cowpea or sorghum. Most of the crop was planted in June before the onset of the monsoon. Farmers identified a number of production constraints including low yield potential, availability of other legumes in the market, unavailability of improved material, and low interest by research and extension services. They were aware of a number of medicinal and nutritional benefits, and noted that ricebean had cultural significance in a number of areas. However, they were also aware of its flatulence-causing properties. There were no established markets for ricebean – it was not grown for commercial purposes and was usually exchanged between farmers or sold in local markets.

***Work in WP3***

This work is carried out by NARC, with back-up and assistance from CAZS-NR. From the Nepalese germplasm collected and evaluated in WP2 a stratified sample of 34 accessions, based on agro-ecological diversity, diversity of local names, and seed availability was selected. DNA was isolated from these using standard protocols with the aim of screening SSR markers from other *Vigna* spp and to detect polymorphic markers for the large number of genotypes to be screened from India and Nepal. However, the process has not yet been successful in amplifying the DNA, and work is continuing.

***Work in WP4***

This WP is led by GVT, with inputs from the other Asian partners. In the first year, farmer-preferred trait analysis was carried out in both India and Nepal, in the same districts as the germplasm collection in WP2 and using focus-group discussions with mixed groups of between 10 and 20 male and female farmers. Standard protocols developed by the project partners were used to collect the data, and included the assessment of organoleptic traits such as taste and cooking quality. Attempts have been made to exchange germplasm between the two countries, but this has so far not proved possible. Of the collected and evaluated germplasm in WP2, the most promising accessions that meet farmers' requirements have been identified for sowing in mother and baby trials in 2007.

Ricebean did not compare well with other locally-grown legumes: out of eight crops, farmers in both Nepal and India preferred black gram (*Vigna mungo*) and kidney bean (*Phaseolus vulgaris*), with ricebean placed seventh, ahead of only lentil (*Lens culinaris*).

All parts of the crop were used, for a range of purposes including *dal* (soup), as a fresh vegetable and snack, as a livestock forage and as a green manure. Food was the most important use, followed by fodder production and green manuring. Positive and negative traits were identified for the various uses in both countries. Large-seeded determinate and synchronous varieties were preferred for food production, and late-maturing indeterminate types with soft palatable herbage for fodder and green manure. Early maturing varieties were not favoured as their maturity coincided with the peak rainy season, and they also had low yields and small grains. Pest and disease resistance, and suitability for intercropping or mixed cropping were regarded as less important, as was tolerance to high rainfall during flowering.

Overall, in Nepal preference was given to the landrace *Seto Thulo* (white bold [large]) while in India the three preferred types were all bold-seeded. It was felt important for any breeding work to include organoleptic traits.

***Work in WP5***

A comprehensive literature survey on the nutritional qualities of ricebean, the state of the art of nutritional survey design, and the extent of malnutrition in the region was undertaken by the University of Bergen (UB). The survey has to some extent reduced the need for chemical analyses, although some additional analyses will have to be undertaken. It also showed that the suggested strategy of WP5 was justified, as no comprehensive studies in the region have been published on diet composition and adequacy, and the relative contribution of pulses in the diets is largely unknown. The dietary survey will provide new scientific knowledge essential to FOSRIN but also generally publishable.

An intensive training session was held in Palampur and attended by the Asian partners. The purpose was to train project staff in the various techniques that would be needed to carry out the dietary surveys, and to standardise the methodologies. The training workshop was followed by a practical session in the field.

***Management activities***

Routine management activities were carried out according to the workplan, with a delay of around 6 months on the scheduled time. However, all procedures had been set up by the conclusion of the kick-off meeting. The kick-off workshop was held just outside Kathmandu in November 2006, and was preceded by a field tour to ricebean growing areas. The event was organised by the CAZS-NR regional office for S Asia in Kathmandu. Both were attended by representatives of other organisations with an interest in the project. This provided the first opportunity for project staff to meet each other and for many of the Europeans was the first time they had seen ricebean. The diversity of the crop in terms of both morphology and phenology was very high. The meeting allowed a formal introduction of the partners, and was followed by presentations to inform partners of the various procedures required by the EC. Detailed discussions were held to finalise experimental protocols, and the work plan and timetable were amended in response to the changes in timing. After the workshop some of the participants were also able to visit the evaluation site at the NARC headquarters in Nepal.

Experimental protocols and workplans were further elaborated during a training workshop in Palampur in February 2007, and at meetings in Kathmandu in April 2006 and March 2007, all attended by a representative of the Coordinator, the Asian partners and the relevant European partner.

A number of relevant networks have been joined and email discussions contributed to.

The project website (www.ricebean.org) was developed by CAZS-NR, and went on-line in December 2006. It is subject to continual updating. An important feature is the extensive bibliography on ricebean and related species, which includes links to the abstracts or to the papers themselves where copyright permits. This list is continually updated. Previously a blog had been set up to allow project staff to communicate, but work is on-going to incorporate a discussion area in the website to allow project staff secure exchange of a wider range of files than would be possible with a blog. The dissemination strategy was developed during the proposal stage, and has been further refined since then. End users and intermediate users have been identified.

**1.3 If applicable, comment on the most important problems during the period including the corrective actions undertaken**

A number of administrative difficulties led to delays in starting project activities. Data collection in Nepal has also been affected by a number of strikes and blockades. Although not affecting project staff directly, they have made it impossible to move in some of the rural areas where data was to have been collected. There have been some similar problems in Assam state in India.

We had anticipated that the accession by both India and Nepal to the International Treaty on Plant Genetic Resources for Food and. Agriculture would have made the exchange of germplasm between the two countries simpler than in the past, but this has not proved to be the case. Project staff from both India and Nepal have has a number of meetings with officials in New Delhi in order to develop a means to send seed of Indian genotypes to Nepal, but this has not yet been possible. There is, however, no problem in sending seed from Nepal into India.

## Section 2 – Workpackage progress of the period

As this is the first reporting period of a novel project, all the workpackages are starting from scratch.

### 2.1 Workpackage 1: Supply chain, demand and marketing

#### *2.1.1 Objectives*

The objective of this WP, which is being conducted by CAU Kiel in conjunction with the Indian and Nepalese partners, involves the supply chain characterisation and analysis of consumer demand for ricebean, through quantifying a Market-price based Legumes Trait Value Index (MLTVI), and characterizing the regional ricebean supply-chain in terms of agents, product flows and information flows.

The research plan for the period included the following activities:

(1) Assemble the research group;

(2) integrate the research group into the FOSRIN-group;

(3) review the scientific literature on the estimation of hedonic demand functions;

(4) design and pre-test a robust battery of laboratory analyses for measuring pulse and ricebean characteristics;

(5) review the scientific literature on food supply chain analysis;

(6) develop a methodology for describing and characterizing food supply chains;

(7) plan field work in India and Nepal and establish local linkages.

#### *2.1.2 Progress towards objectives:*

(1) Assemble the research group: Research staff have been hired; computing equipment and software has been acquired, and office work places have been installed.

(2) Integrate the research group into the FOSRIN-group: Staff from CAU attended the FOSRIN kick-off workshop in Nepal in November 2006 and the meeting held in Nepal in March 2007.

(3) Review the scientific literature on the estimation of hedonic demand functions: Literature on hedonic price analysis was retrieved and a digital bibliography assembled; this will be amended as required over the course of the project.

(4) Design and pre-test a robust battery of laboratory analyses for measuring pulse and ricebean characteristics. Exploratory laboratory analyses of 18 South Asian pulses were conducted at CAU using the facilities and employing the expertise of staff of the Chair of Food Technology. Seventy three samples of ricebean and ricebean substitutes were collected in March 2007 from local markets in Nepal and India and are awaiting laboratory analysis.

(5) Review the scientific literature on supply chain analysis: Literature on food supply chains in developing countries has been retrieved and a digital bibliography has been assembled; this will be amended as required over the course of the project.

(6) Develop a methodology for describing and characterizing food supply chains: Methods for supply chain description and analysis have been reviewed, an innovative methodology has been identified and presented at an European conference for discussion by peers.

(7) Plan field work in India and Nepal and establish local linkages: Contacts have been initiated with a number of research organizations, government agencies, and food trade representatives in Nepal and India (in India: ICRISAT, Hyderabad; in Nepal: ICIMOD, Ministry of Agriculture, Central Bureau of Statistics, Food Research Unit of NARC, Kathmandu). The field work was planned in consultation with GVT, CSKHPAU, AAU and LI-BIRD.

## 2.2 Workpackage 2: Genetic diversity and indigenous knowledge

### *2.2.1 Objectives and the major progress/achievements of Work Package-2*

LI-BIRD is the lead organization for this WP. The other Asian partners are also involved in this activity, and NARC have also supplied a large quantity of ricebean germplasm from their historical collection. The WP has the following four objectives:

- To describe the extent of ricebean diversity and its geographical distribution
- To collect the representative sample of ricebean germplasm together with associated socio-economic data
- To evaluate the collections in the field for phenotypic diversity analysis and,
- To understand the socio-economic and bio-physical factors controlling ricebean diversity and its utilization

### *2.2.2 Major progress*

Under this work package, various activities such as collection of representative samples of germplasm across the country with associated socio-economic information; on-farm planting, evaluation and analysis of the collection has begun. Table 2.2.1 summarises the objectives and the respective tasks performed in this reporting period.

**Assessment of potential ricebean growing districts of Nepal**

There is almost no published literature on ricebean in Nepal, even grey literature with relevant information on crop potential, area and distribution is lacking. The Plant Genetic Resources (PGR) unit of NARC has some collections of ricebean germplasm from various parts of the country, but this does not cover the whole country. In this context an effort was made to collect information on the area and distribution of the ricebean crop in different districts (Table 2.2.2).

**Table 2.2.1:** Summary of objectives and work performed during reporting period

| Objectives | Tasks performed |
|---|---|
| 2.1 To describe the extent of ricebean diversity and its geographical distribution | Initial assessment of potential ricebean growing districts in Nepal, selection of sites for detailed diversity studies |
| 2.2 To collect the representative sample of ricebean germplasm together with associated socio-economic data | 156 accessions of ricebean landraces have been collected from sixteen districts of Nepal, plus 117 from historical collections and 89 from 16 districts in India.<br>Local knowledge of the crop collected in both countries. |
| 2.3 To evaluate the collections in the field for phenotypic diversity analysis | All collected accessions evaluated on-farm based on agro morphological traits in Gulmi.<br>Phenotypic diversity also assessed at Khumaltar. |

**Table 2.2.2:** Methods and approaches used in assessment of potential districts of ricebean

| Steps | Method/approaches | Outcomes |
|---|---|---|
| Consultation with LI-BIRD field staff of different site offices of Nepal | Individual contact | Collection of preliminary information on ricebean based on LI-BIRD's in-house knowledge |
| Literature search and review | Visited Regional Agriculture Directorate, studied District Agricultural Development Offices (DADO) profiles | Improved understanding on the crop status in various districts |
| Information collection from NARC/PGR unit and Commodity Programme and other expert knowledge of scientists who have better understanding of ricebean diversity and distribution in Nepal | Telephone contact<br>Study the collections of PGR unit | Listing of potential districts and sites based on perceptions |
| Consultation with DADOs of potential districts | Telephone contact | Locate the major growing pockets of the district<br>Triangulate other information collected through perception studies |
| Information compilation and discussion in the project team | Project team meeting | Finalize districts and areas for germplasm collection and local knowledge documentation |

From the available information, ricebean growing districts of Nepal were categorized into three categories primarily based on area coverage. This provided some basis for identifying potential districts and pocket areas for collecting germplasm and documenting local knowledge.

The observations and studies show that ricebean can be grown in diverse climatic conditions due to its wide adaptation. The area under this crop is more in the Western region of Nepal. The crop is mostly being grown in drought prone slopping areas as well as flat rainfed *tars*[1] in the altitude range of 700-1300 m. However, in home gardens it is grown from low altitude range of 200 m in Chitwan up to 2000 m in Ilam.

**Germplasm collection**

Ricebean germplasm was collected from 16 districts of Nepal by mobilising local organizations, viz. SUPPORT Foundation (a local NGO working in far-western part of Nepal) and Rapti Agriculture Graduates Society (RAS)-Nepal (a local network of agricultural graduates in the mid western region of Nepal). These two NGOs collected germplasm from 8 and 3 districts of the far and mid western regions respectively of Nepal. LI-BIRD and CAZS-NR / NARC also collected samples from 5 districts in the western and central regions of the country. In total, 156 landrace accessions were collected from 153 households in sixteen districts (Table 2.2.3, Figure 2.2.1), with a further 117 accessions obtained from the

[1] Unirrigated, ancient river fans

germplasm bank at NARC. These were collected at the household level in 25 districts during various missions in the period 1972 – 1994 (Figure 2.2.2).

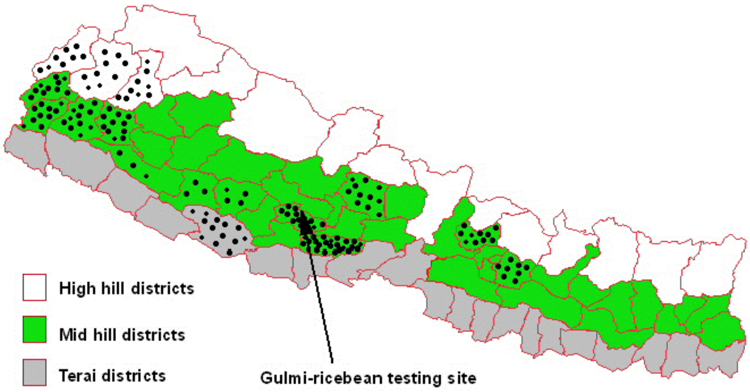


**Figure 2.2.1.** Ricebean germplasm collection in Nepal in 2006. The number of solid dots in a district represents the number of samples collected

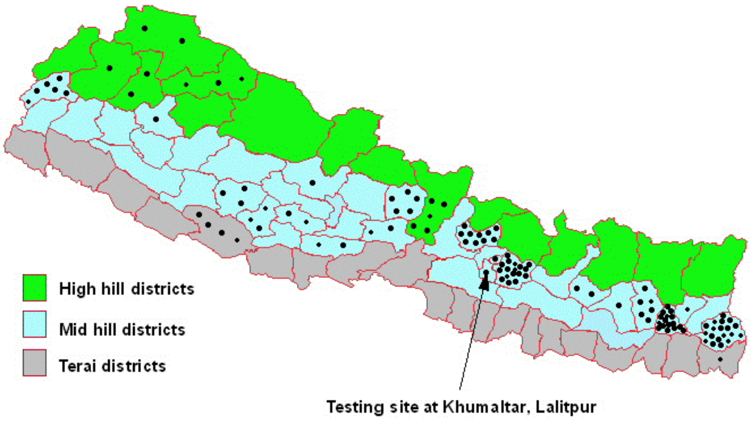


**Figure 2.2.2.** Ricebean germplasm collection in Nepal between 1972 to 1994. The number of solid dots in a district represents the number of samples collected.

In India, visits were made to ricebean growing areas in Assam, Manipur, Nagaland, Arunachal Pradesh, Himachal Pradesh and Madhya Pradesh for the collection of germplasm. Three teams, coordinated by AAU Assam, CSK HPKV and GVT respectively led the missions. Germplasm samples were collected from November to April. Seed samples were collected by visiting individual households from their stores as the crop was not in the field during exploration.

**Table 2.2.3:** Districts and organizations involved in ricebean landraces in collection in Nepal, 1972 – 1994 and 2006 and in India, 2006 - 07

| Name of districts | No. of accessions | Collected by |
|---|---|---|
| ***Nepal*** | | |
| Achham, Bajura, Baitadi, Bajhang, Dadeldhura, Doti, Darchula, Surkhet, | 71 | SUPPORT Foundation |
| Gulmi, Kaski, Palpa | 48 | LI-BIRD |
| Kavre, Nuwakot | 17 | CAZS-NR/NARC |
| Dang, Salyan, Pyuthan | 20 | RAS-Nepal |
| Nuwakot, Lalitpur, Bhaktapur, Gulmi, Arghakhanchi, Pyuthan, Dang, Kabhre, Ilam, Baitadi, Bhojpur, Terhathum, Gorkha, Lamjung, Mugu, Humla, Bajura, Dhankuta, Rampurtar, | 117 | NARC (historical collection) |
| ***India*** | | |
| Tirap, Mokochung, Tuli, East Imphal, Karbi Anglong | 25 | AAU |
| Solan, Bilaspur, Kangra, Mandi | 48 | CSKHPKV |
| Jhabua, Barwani, Dhar, Mandla | 16 | GVT |

During exploration, passport data (name and addresses of the farmers, plant type, seed colour and size and average yield in the region) were collected. The passport data collection protocols were developed at a meeting held in Kathmandu in April 2006, and circulated afterwards to the Indian partners.

**Site selection**

Based upon the above information, germplasm evaluation was carried out at two sites in Nepal in 2006. None was possible in India due to the delays in funding. LI-BIRD identified the Darbar-Devisthan Village Development Committee (VDC[2]) in Gulmi district as a potential site for an initial on-farm trial and evaluation of collected germplasm. Gulmi is situated in the middle hills of the western region of Nepal. The area is dominated by sloping *Bari* land (upland with big terrace risers) and receives low average rainfall as compared to other parts of the country. LI-BIRD collaborated with an existing farmers' group: Resunga Multipurpose Innovative Farmers Group of Darbar- Devisthan for conducting on farm observation nursery of ricebean in 2006. Traditionally, farmers of Gulmi are growing different legume species in their *bari* land from time immemorial and ricebean is one of the legumes being grown by many farmers thus they are very experienced in terms of indigenous knowledge related to the cultivation and utilisation of this crop. Ricebean currently occupies over 100 ha in Gulmi district (DADO, personal communication). Therefore, study at Gulmi could be beneficial to have additional knowledge on indigenous practice adopted by farmers in various legumes cultivation including ricebean. Further evaluation was carried out at NARC headquarters at Khumaltar.

**On farm germplasm evaluation**

LI-BIRD rented about 1700m$^2$ (3.4 *Ropani*[3]) *Bar*i land from Prithvi B Karki of Galam, (Darbar-Devisthan-2) in June 2006 for ricebean trials (Table 2.2.4). 156 accessions collected from various parts of Nepal were planted on 15-16 June 2006, each grown as a sole crop in a plot size of 8m$^2$ (2m x 4m).

[2] A Village Development Committee (VDC) is the smallest political unit in Nepal
[3] *Ropani* is the local unit of measuring the land area. 1 *Ropani* = 500m$^2$ area.

Three weedings were done, first after 48 days after seeding (DAS), second at 75 DAS and third at 104 DAS (at the time of flowering). Since most of the accessions were of indeterminate growth habit, and were grown in sole planting, staking with bamboo sticks was provided for all plants with indeterminate growth habit 72 DAS.

**Table 2.2.4:** Details of on farm observation nursery of ricebean, Darbar-Devisthan, Gulmi, 2006

| Activities | Remarks |
|---|---|
| Land Preparation | Land preparation was done as per the farmers practice (2 ploughings) |
| Design and plot size | Non-replicated observation nursery, 2 rows each of 4 m length, raised beds (16 plants/plot) |
| Seeding | Planted three seeds per hill but retained only single plant after full establishment |
| Spacing | 1 metre between rows and 50 cm between plants |
| Manures and fertilizers | As per farmers' practice; farm yard manure (FYM) at 7.5 ton $ha^{-1}$ (no chemical fertilizers) |

Field based staff regularly supervised the trial plots. During critical stages of crop growth (active growth, flowering, maturity), other members of the project team including plant breeder visited field. The project leader also visited the field during flowering time of ricebean in the third week of September. Necessary data were collected using a standard format available on the website. The following agro-morphological information was recorded for evaluation.

- Date of planting
- Date of flowering
- Date of maturity
- Plant height at maturity
- Growth habit
- Flower colour
- Pod length
- Number of pods per plant
- Number of seeds per pod
- 100 seed weight
- Seed colour
- Total grain yield per plant

Some of the accessions of collected germplasm in 2006 did not germinate and several others had poor growth. A probable reason for low germination may be poor seed quality, while others were hard seeded. Other accessions were morphologically similar to cowpea and black gram. So, agro-morphological data were collected and analyzed only from 74 ricebean accessions

At flowering stage (2nd week of September), the genotypes with indeterminate growth habit were affected by a blister beetle (*Mylabris pustulata*), known as *kage kira* in the local language. The insect population was quite high and attacked on tender flower buds damaging the crop. Ricebean field of peripheral farmers were also affected by this insect. To protect the crop from probable loss, Paradol at a rate of 2 ml $l^{-1}$ was sprayed on 13th September and other farmers of the area were also advised to control the pest.

The time to maturity varied greatly between accessions, this meant that harvesting time ranged from September to November. After drying and taking relevant data the harvested grains were stored for further use. Based on days to maturity, 74 ricebean accessions were grouped into three major categories (Table 2.2.5). Details of agro-morphological information of each accessions are available on the project website.

**Table 2.2.5:** Category of accessions on the basis of maturity period in 2006

| Category | Maturity days after seeding | No. of accessions |
|---|---|---|
| Early maturing | <130 days | 4 |
| Medium maturing | 130-140 days | 48 |
| Late maturing | >140 days | 22 |

The data showed that 48 accessions matured between 130-140 days after planting. Of these, 14 performed well for number of pods per plant, grain yield as well as 100 seed weight and also based on diversity in seed colour. All these were selected for further evaluation in mother and baby trials in 2007 season (WP4). There were 22 late maturing accessions identified from the on-farm trial. Among these, only 8 were found promising and were selected considering diversity in seed colour, number of pods per plant, grain yields and 100 seed weight. These will also be further evaluated in mother and baby trials in 2007 season (WP4).

In the work at Khumaltar, 117 accessions were grown on a single row of 2 m length. Three seeds were planted per hill and subsequently two poor seedlings were thinned out after the crop was fully established. The plots were managed similarly to customary farmers' practices and neither fertilizer nor irrigation was applied. 25 agro-morphological traits were recorded at various stages following the "Descriptors for grain legumes and oil seed crops, 1995" developed by Plant Genetic Resources Centre, Department of Agriculture, Sri Lanka. These descriptors include phenological data, yield and yield components, and other quantitative and qualitative traits. In addition, the disease and pest reactions were also recorded with the help of plant pathologist from Plant Pathology Division, NARC. Quantitative and qualitative traits were recorded on all individual plants of the plot.

Ricebean accessions were analyzed on the basis of various agro-morphological characteristics including important yield components, e.g. number of pods per plant, 100 grain weight and grain yield per plant. As in the work at Gulmi, promising accessions from medium and late categories maturity were selected for further analysis during coming season in mother and baby trials.

High diversity was found between the accessions for most qualitative and quantitative traits measured and two distinct groups were identified (Figure 2.3). Accessions: NPGR-05384, NPGR-05386, NPGR-05388, NPGR-05435, NPGR-05436, NPGR-6591, NPGR-06725, NPGR-06756 and NPGR-07883 from high altitude sites (Humla, Mugu and Bajura) and a mid-hill site (Baitadi) were distinct and showed geographical differentiation. The important traits for this differentiation were growth patterns, twining tendency, days to 50% flowering and days to first pod maturity. All these accessions were determinate with non-twining tendency but varied in flowering and first pod maturity, which ranged from 61-102 days for flowering and 99-134 days for maturity. Most of the accessions from Humla were early maturing but determinate accession from Mugu (NPGR-05384) was as late as the indeterminate types. Phenotypic diversity was higher for leaf pubescence (Shannon-Weaver index H = 0.67), flowering period (0.78), pod pubescence (0.77), number of seeds per pod (1.15), seed shape (0.55) and seed colour (0.50) with the overall index H' = 0.525.

However, coefficient of variation for some of the quantitative traits was not high (7-19%) (Table 2.2.6). Yield and yield components showed great variation between the accessions. Most of the accessions had average grain yield but a few of them were very high yielding, for example NPGR-00195 (1300 g $m^{-2}$) and NPGR-05432 (1200 g $m^{-2}$). Range of variation for flowering and maturity between the accessions was also quite high and ranged from 77-102 days for flowering and 103-134 days for maturity for accessions with indeterminate growth pattern. NPGR-05565, NPGR-06657 and NPGR-08380 were early maturing accessions.

**Table 2.2.6:** Descriptive analysis of quantitative traits in ricebean landraces, Khumaltar, Nepal, 2006

| Quantitative traits | Mean | Range | Standard deviation | Coefficient of variation |
|---|---|---|---|---|
| Leaflet length (cm) | 11.7 | 7.0-14.3 | 0.89 | 0.08 |
| Leaflet width (cm) | 8.3 | 4.5-10.4 | 0.66 | 0.08 |
| Days to flowering | 87.1 | 61-104 | 9.02 | 0.10 |
| Days to first mature pod | 121.6 | 99-134 | 8.25 | 0.07 |
| Pod length (cm) | 7.7 | 5.3-11.6 | 1.38 | 0.19 |
| Number of seeds per pod | 6.7 | 5-9 | 0.88 | 0.13 |
| 100 seed weight (g) | 6.8 | 5.2-8.9 | 0.77 | 0.11 |
| Yield g-$^{m2}$ | 939.7 | 500-1300 | 150.87 | 0.15 |
| Seed length (mm) | 6.1 | 4.26-7.8 | 0.80 | 0.14 |
| Seed width (mm) | 3.3 | 2.54-3.98 | 0.33 | 0.10 |
| Seed thickness (mm) | 4.1 | 3.1-4.76 | 0.31 | 0.07 |

Some of the accessions became infected with diseases and insects at the initiation of flowering and pod formation. Rust, *Cercospora* leaf spot and web blight (*Rizoctonia* sps) were the major diseases recorded: these were scored according to the amplitude of infection based on damage. Web blight greatly affected the plants with drying of foliage in NPGR-05382, NPGR-05432, NPGR-06591, NPGR-06657, NPGR-08380. Incidence of aphids was also recorded on the crop. Most of the accessions from Ilam, Bhojpur and Dhankuta were less infected by rust, blight and *Cercospora* spots than those from elsewhere.

Possible varietal mixture was seen in several germplasm samples; some of the collections were similar to black gram and cowpea. Therefore, all the mixed seeds were removed from seed samples to maintain uniformity. However, to further validate, the suspicious genotypes have also been kept and will be further evaluated in the coming season.

A Principal Components Analysis of the qualitative and quantitative data was performed to show the genetic relationships between the accessions and agro-ecological differentiation (Figure 2.2.3). The observed traits explained 38.4% of total variation and showed a geographical cluster of genotypes of western part of Nepal from mid to high-hills. Qualitative traits like growth pattern, flowering behaviour and maturity were the important traits for this clustering

In this diversity study growth habit, duration of flowering, seed colour and size were the important traits with high phenotypic diversity. The greatest variation was observed between ricebean accessions for flowering period, maturity and yield potential. These findings indicate a great scope for improving ricebean through breeding, although they are still preliminary and therefore need further study in order to confirm the results.

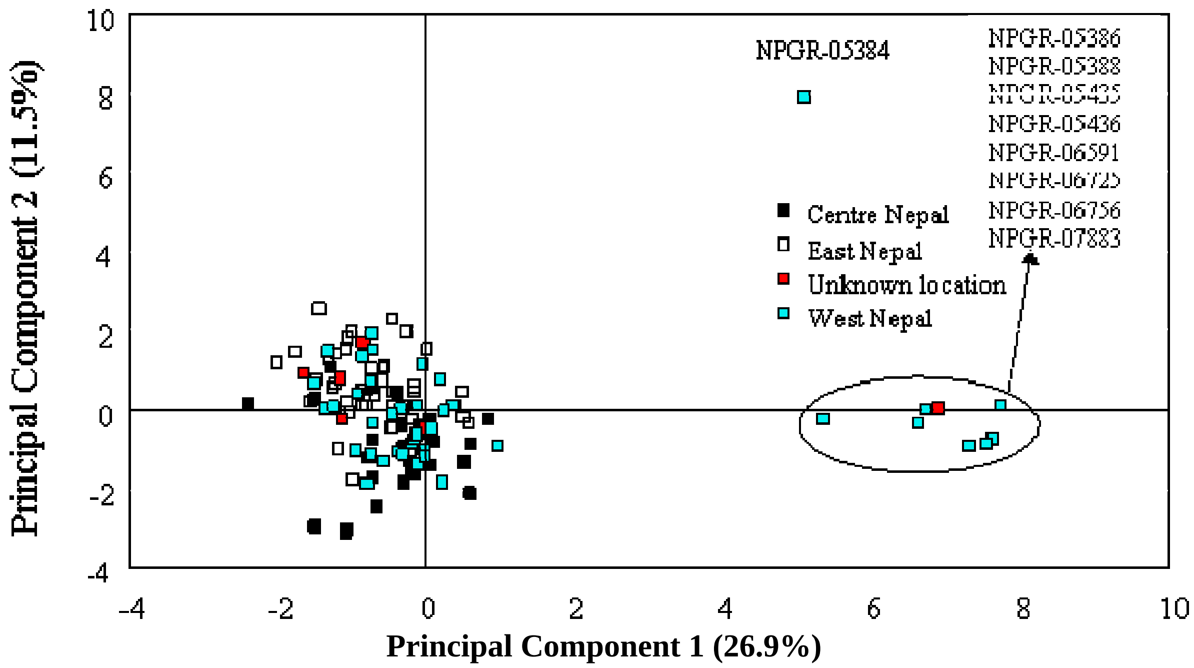


**Figure 2.2.3:** Scatter plot of ricebean landraces of Nepal

**Farmers' measures of diversity**

Preliminary findings (Table 2.2.7) reveal that in India, farmers have been growing various landraces that vary according to the colour and seed size (e.g. *Mathia* in Madhya Pradesh and *Anagoubi, Arnagbi, Arangbi Macha* in Manipur and *Tanakla, Tmusingla* and *Teremla* in Nagaland) with the following distinguishing traits described by the farmers. In Nepal, four main types of landraces were documented by the farmers.

**Assessment of indigenous knowledge**

Attempt to identify an appropriate methodology for local knowledge documentation representing different pocket areas of Nepal has been made and tested both in Nepal and in India. Preparing checklist and its refinement for the documentation of local knowledge on diversity and its associated knowledge is also in progress. This work will continue over the next reporting period. Initial results are presented below.

***Planting season and common cropping patterns***

Generally, in India and Nepal ricebean is grown as an inter or mixed crop with maize as well as sole crop but in some pockets it is also grown with sorghum and cowpea. In sole cropping, ricebean is commonly sown in rows but in Nepal majority of farmers broadcast ricebean in the field during rainy season. In certain areas it is also grown on the terrace risers and bunds of the rice fields. Therefore, majority of the crop is planted between second and third week of June before the onset of monsoon.

The most common and popular cropping patterns of ricebean are:

- Maize: Ricebean (Inter-cropping/mixed cropping), terrace risers
- Ricebean: Sorghum (Inter-cropping)
- Sole Ricebean
- Rice: On the field bunds

**Table 2.2.7.** Farmers' descriptors of major ricebean types in, Nepal (Durbar Devisthan, Gulmi)

| Local name | English translation | Farmers' distinguishing traits |
|---|---|---|
| **Nepal (Gulmi)** | | |
| *Rato Jhilinge* | Red ricebean | Red, small to medium sized grain, medium maturity, drought tolerant, low yield |
| *Khairo Thulo Jhilinge* | Brown and bold grain | Brown with stripes and bold grains, late maturity, high yielding |
| *Seto Thulo Jhilinge* | White bold grain | Bold white to yellowish grains, late maturity, high yields |
| *Bhadaure Jhilinge* | Early small seeded | Greenish to yellowish, small grains, early maturity, low yields |
| **Nepal (Ilam)** | | |
| *Rato masyang* | Red ricebean | It is rare and was not observed during the survey |
| *Ghore* | Brown ricebean | Large, brown or speckled beans, grows on stakes and plant can be quite large. High fodder yields |
| *Pahenlo masyang* | Yellow ricebean | Short form grown on *khet* (rice field) terraces ,larger one intercropped with maize |
| *Thulo masyang* | Large ricebean | Climbs strongly and can reach 5-6 meters if grown on poles or in trees, seeds are yellowish with some speckled ones occurring on the same plant |
| **India(Manipur)** | | |
| *Angoubi* | | Seed bold and white |
| *Arangbi* | | Seed bold, black & white |
| *Arangbi macha* | | Seed small, black & white; trailing habit |
| **India (Nagaland)** | | |
| *Tanakla* | | Seed small to bold, black |
| *Temusingla* | | Seed small to bold, white |
| *Teremla* | | Seed bold, wine red |
| **India (Madhya Pradesh)** | | |
| *Mathia* | | Small seed, brown, medium maturity |
| **India (Himachal)** | | |
| Mixture of landraces | | Small, bold seed/black, white |

In Jhabua (MP, India), farmers also cultivate ricebean as a sole crop as well as intercropping with sorghum in both seasons (rainy and post-rainy seasons).

***Production constraints identified by the farmers***

A number of constraints to the production of ricebean were identified. These included the low yield potential of existing landraces; small and fragmented land holdings; the availability of other legumes and pulses in the market; the fact that less importance was given to ricebean by the research and extension services; and the unavailability of improved ricebean varieties.

***Medicinal and cultural values of ricebean***

Ricebean is considered to be useful in warm seasons while taking as soup (*dal*). It has cultural importance as well as used in local feasts or social gatherings for soup (*dal*), curry and as a snacks. Among farmers, ricebean is well known for its adaptation and production even in marginal lands but most of the farmers believe that it causes flatulence (irrespective of landraces). They also expressed that ricebean is not good for consumption during winter seasons particularly for children and elders as it is perceived to be a cold food. However, there are some contradictions also in the opinions of the farmers regarding the best season of its consumption as most of the Indian farmers prefer its use during winter months conversely it is also considered as a cold food in Nepal although it is mostly consumed during winter.

***Ricebean marketing***

Ricebean is not generally grown for commercial purposes therefore, there are no established markets. However, it is sold in the local market or it is commonly exchanged among the farmers in the villages. In the study area, only 10-20 percent ricebean growing farmers sold ricebean through informal system of marketing or in the local market. Selling price ranged between $ 0.4 to 0.6 in India and it was slightly higher in Nepal.

***Value addition***

Most of the farmers believe that ricebean causes gastritis and hesitate to take it as soup (*dal)* but they do not know the reason. Thus, farmers emphasized for research on nutritional and chemical composition of the crop and also on creating awareness among the farmers based on the research findings.

## 2.3 Workpackage 3: Molecular markers

### *2.3.1 Objectives*

WP3 addresses the characterization of ricebean diversity using molecular markers, and is led by NARC, with assistance from CAZS-NR. The molecular diversity assay to identify the set of polymorphic loci will be carried out on a stratified sample of landraces from Nepal and India with a consideration of geographical and phenotypic diversity. The relationships and diversity between the genotypes will be determined and these estimates will be used in the identification of the genotypes for improvement. The relevant objective is "to evaluate the ricebean germplasm for molecular marker diversity", and tasks for the current period are "to extract and assay DNA for hypervariable markers in bulk and individual plant samples of selected accessions"

### *2.3.2 Progress towards objectives*

Three areas of activity have been carried out: these are described in more detail below.

1. Stratified sampling of the germplasm from Nepal
2. Isolation of DNA
3. Optimisation of the protocol

Molecular markers, e.g. single sequence repeats (SSRs) were used to elucidate the genetic distinctness in addition to the phenotypic diversity (WP1). For this a small set of stratified samples of ricebean germplasm from Nepal was identified based on agro-ecological diversity, landrace diversity in local names and quantity of seed available. 34 Nepalese accessions from a total of 117 evaluated in the field trial were randomly selected and individual DNAs were isolated following the modified CTAB (Cetyltrimethyl ammonium based) DNA isolation method (Roger and Bendich, 1988[4]). This was done for screening SSR markers for other *Vigna* species and for the detection of polymorphic markers that will be applied to the larger number of samples from Nepal and India. The extracts were checked for DNA concentration on 0.8% agarose mini-gel in 1xTBE buffer (0.09 M Tris-borate and 0.5 M EDTA) at 80 volts

[4] Roger OS and Bendich AJ (1988). Extraction of DNA from milligram amounts of fresh, herbarium and mummified plant tissues. Plant Mol.Bio. **5**:69-76

for 90 min with ethidium bromide staining. Eighteen microsatellite primer pairs isolated from cowpea (*Vigna unguiculata* L.) microsatellite-enriched libraries constructed from DNA of a cowpea breeding line and designated VM were used (Li et al, 2001). These were provided by CAZS-NR, University of Wales, Bangor. PCR (polymerase chain reaction) reactions were carried out in MJ Research PTC– 100$^{TM}$ Programmable Thermal Controller (MJ Research, INC, Waltham, MA, USA) following the protocol developed by Don et al (1991)[5]. A different combination of PCR concentrations and the thermal cycling of touchdown programme were tested for a good amplification. The amplified PCR products were separated on 3% agarose gel and stained with ethidium bromide.

## 2.4 Workpackage 4: Germplasm characterization and adaptation

### *2.4.1 Project objectives and major achievements during the reporting period*

**Table 2.4.1** Summary of objectives and work performed during reporting period

| Objectives | Work performed |
|---|---|
| 4.1 Identify a set of accessions that best meet farmers' needs in terms of morphology, flowering time and grain quality traits in Nepal and India. | Farmer preferred trait analysis has been carried out in both countries and accessions meeting farmers' requirements identified |
| 4.2 Attempt to exchange selected germplasm through official channels in order to have across-country testing of selected genotypes. | The concerned authorities for germplasm exchange have been approached in both the countries to facilitate the exchange of ricebean germplasm, although administrative delays have been a problem. |
| 4.3 Test selected accessions in Mother and Baby trials. | Promising landraces have been identified for mother and baby trials |

Gramin Vikas Trust (GVT) is the lead organization for WP4: *To characterise the germplasm for suitability for a range of diverse environments and cropping systems*. Assam Agricultural University (AAU) and Chaudhary Sarwan Kumar Krishi Vishwa Vidyalaya**,** Palampur, Himachal Pradesh (CSKHPKV) are the other two partners of WP 4 in India and Local Initiatives for Biodiversity, Research and Development (LI-BIRD) in Nepal. The project aims to achieve following objectives (Table 2.4.1):

- To characterise ricebean germplasm using participatory approaches and identify that best meet farmers' needs in terms of morphology, flowering time and grain quality traits in Nepal and India.
- To analyse and understand farmers preferred traits for ricebean in India and Nepal
- To test selected accessions in Mother and Baby trials.

### *2.4.2 Workpackage progress of the period*

**Farmers preferred trait analysis**

***Preference ranking of ricebean against most commonly grown legumes in the area***

In India and Nepal most commonly cultivated legumes in the areas where ricebean is grown are black gram (locally called *Urd*, *Mash* in India and *Mash* in Nepal), *Rajmash* (kidney beans), pigeon pea (*Tur*, *Arhar* in India and *Arhar*, *Rahar* in Nepal), mungbean (*moong*), pea, lentil (*Masoor*), cowpea and ricebean. Among these legumes, farmers ranked blackgram and *Rajmash* as first followed by pigeon pea, cowpea and mungbean in terms of taste, nutrition

[5] Don RH, Cox PT, Wainwright BJ, Baker K and Matrick JS (1991). Touchdown PCR to circumvent spurious priming during gene amplification. Nucleic Acids Res. **19**: 4008

and common use value. In overall preference of farmers ricebean stands at seventh position in the ranking (Table 2.4.2).

**Common uses of ricebean:** The farmers use all parts of ricebean for a number of purposes They ranked food, fodder and green manure as 1st, 2nd and 3rd important uses of ricebean respectively (Table 2.4.3).

For food purpose, *Dal*, soup, fried, *Masaura*[6], and *Batuk*[7]were considered important uses. Farmers preferred *Seto Thulo* (white big) and *Khairo Thulo* (brown big) landraces for these. Similarly for fodder, farmers considered the landraces that yield high biomass. They therefore, preferred late maturing landraces having luxurious plant growth with indeterminate vines. *Seto Thulo* (white big) and *Khairo Thulo* (brown big) have been identified as suitable landraces for fodder purpose. For green manuring and soil improvement, farmers preferred landraces with many broad leaves and more vines having medium to late maturity. Fodder yields are important in Nepal, where livestock play a major role in the farming system.

**Table 2.4.2.** Farmer's preference ranking for common grain legumes in India and Nepal†

| Commonly grown legume | Taste | Nutrition | Used as *Dal* | Total | Farmers overall preference ranking |
|---|---|---|---|---|---|
| Black gram | 1 | 3 | 1 | 5 | I |
| Kidney bean | 1 | 2 | 2 | 5 | I |
| Pigeon pea | 2 | 3 | 2 | 7 | III |
| Mungbean | 3 | 2 | 3 | 8 | IV |
| Cowpea | 3 | 3 | 2 | 8 | IV |
| Pea | 3 | 3 | 3 | 9 | VI |
| Ricebean | 3 | 4 | 3 | 10 | VII |
| Lentil | 4 | 4 | 4 | 12 | VIII |

†Ranking based on the scores where lowest score is best and highest is worst

**Preference trait analysis of ricebean in project sites**

The summarized information is based on the farmers' perceptions taken during the focus group discussions on ricebean. Variable numbers of villages were selected from the Madhya Pradesh, Manipur, Nagaland and Himachal Pradesh in India and Darbar Devisthan in Nepal. Ten to twenty farmers including women participants from each village participated in the FGD on ricebean that covered cultivation, cropping patterns, seed availability, uses of ricebean, specific characters, identifying various constraints of ricebean cultivation and marketing.

In Nepal, farmers did not like early accessions due to their low grain yield and very small grain size. According to farmers, early ricebean matures during the peak rainy season (August) and has a higher number of pods without seed. Since most of these lands remain fallow until April, the earliness in maturity could not be capitalized on. However, the genotypes will be kept for future research as potential parents, especially for developing early maturing varieties. The genotypes will be planted as a non-core collection and the seed will be maintained. Since these genotypes mature quite early, these may open up the option for growing some short duration winter crops in residual moisture in future. Out of seventy four accessions evaluated in 2006 only, four accessions were early.

[6] *Masaura* is a kind of nugget made from the legume paste mixed with the chopped stalk of taro, which is preserved over several months and eaten in the form of curry together with potato and other vegetables.
[7] *Batuk* is a deep fried cake made up of paste from the soaked ricebean grains

**Table 2.4.3** Farmers' ranking of preferred traits and landraces of for different uses

| Rank | Use value in order of preference | Preferred traits | Preferred landraces |
|---|---|---|---|
| 1 | Food (Gulmi, Nepal): *Dal* / soup, fried grain, *Batuk* and *Masaura* | Bold grains, higher yield, medium maturity, non-shattering determinate to semi determinate type, tasty, tolerant to high intensity of rainfall during early flowering stage | White big, brown big in terms of yield and grain size, taste but lack on other traits |
| | Food (NE India): *Dal* / soup and chutney | High yield with bold grains, early maturing, non-shattering, determinate, tasty and tolerant to high rainfall, drought and pod borer | |
| | Food (Madhya Pradesh, India): *Dal* / soup, chapatti and fried grain | High yield with bold grains, early maturing, non-shattering, determinate, tasty and tolerant to high rainfall and drought | No choice in the area, only the landrace *Mathia* with brown seeds is grown |
| | Food (NW India): Dal, Stuffed chapatti, *Khichadi* | High yield with bold grain, early maturing, non-shattering, determinate, tasty and tolerant to rains, drought, & anthracnose, blister beetle. | |
| 2 | Fodder for livestock | Indeterminate type with luxurious vine growth, late maturity | Any late maturing, indeterminate landraces |
| 3 | Green manuring crop | Indeterminate type with luxurious vine growth | Any late maturing, indeterminate landraces |

**Important traits of ricebean and farmers preferences:** For grain production, farmers always prefer bold grain, medium maturity and semi determinate growth habit when compromised with fodder yield. They felt that they lacked such landraces or varieties currently having such traits. Table 2.4.4 shows the positive and negative traits identified by farmers in India and Nepal.

**Table 2.4.4:** Farmers' description of positive and negative traits of landraces

| Name of landraces | Positive traits | Negative traits |
|---|---|---|
| Gulmi, Nepal | | |
| *Rato Jhilunge* (red) | Somewhat tolerant to heavy rain during early flowering stage, maturing at proper time (3rd -4th week of October) | Not so tasty, coarse grain, lower yield |
| *Khairo Thulo* (brown big) | Tastier than red, better yield, good fodder yield | Late maturing (3rd week of November) |
| *Seto Thulo* (white big) | Tasty, soft, high yielding grains, better fodder yield | Late maturing (3rd week of November) |
| *Bhadaure* (early and small grained) | Early maturing (3rd week of September), other crops can be grown after its harvest on the same land | Low grain and lower fodder yields, matures with maize making difficult to harvest |
| **NE India** | | |
| Manipur | | |

| | | |
|---|---|---|
| *Angoubi* | Good cooking quality | |
| *Arangbi* | Good taste | |
| *Arangbi macha* | Not good as above | It is trailing |
| Nagaland | | |
| *Tanakla* | Good taste | |
| *Temusingla* | Good taste | |
| *Teremla* | Good taste | |

**Preference ranking of common landraces*:*** Farmers in Gulmi ranked *Seto Thulo* as the most preferred landrace overall, followed by *Khairo Thulo, Rato* and *Bhadaure, w*hile those in India preferred *Arangbi* bold, *Angoubi* bold and *Teremla*, although differences were not nearly so marked as in Nepal (Tables 2.4.5 and 2.4.6). Farmers always preferred ricebean with good grain and fodder yield potential. Most of the farmers gave equal weights to grain and fodder yields while selecting the variety as livestock is the integral part of the farming systems. Seed colour was not considered as important criteria for ricebean. Farmers emphasized on the softness and palatability of the fodder quality by the animals The farmers identified the following traits as important for the most suitable variety.

- Higher grain yield (bold seed size and more number of pods).
- Determinate growth habit with erect plant type.
- Synchronous maturity.
- Early to medium maturity.
- Good taste and easy to digest.
- Tolerant to drought.
- Low shattering.
- Tolerant to high rainfall during flowering
- Suitable for intercropping and mixed cropping.
- Disease and pest tolerant.

A separate report on preference trait analysis of ricebean was produced and circulated in November 2006 by LI-BIRD. Based on the preference trait analysis, six landraces of ricebean were made available to CAZS-NR, Bangor, UK to study the seed priming response and two, *Seto Thulo* and *Khairo Thulo,* for breeding purposes.

For market purposes, the farmer-preferred traits are:

1. Bold seed size
2. Good taste
3. Attractive grain quality
4. Uniformity-no varietal mixtures

**Table 2.4.5.** Preferred-trait ranking of ricebean land races growing in India†

| Traits | ***Arangbi* bold** | ***Angoubi* bold** | ***Angoubi* small** | ***Tanakla*** | ***Temusingla*** | ***Teremla*** | ***Mathia*** |
|---|---|---|---|---|---|---|---|
| Yield potential | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Grain type | 1 | 1 | 2 | 2 | 2 | 1 | 2 |
| Grain colour | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| Maturity | 5 | 5 | 5 | 5 | 5 | 5 | 3 |
| Shattering | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Pod size | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| Drought tolerant | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Taste | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Nutrition | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Market potential | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| Total | 26 | 26 | 27 | 27 | 27 | 26 | 27 |
| Rank | **I** | **I** | **IV** | **IV** | **IV** | **I** | **IV** |

† Rankings are based on the scores, where lowest score is best and highest is worst

Grain colour does not seem to be of particular importance in ricebean as farmers did not attach any special importance to this in their preference ranking. Although farmers have some landraces with good yield potential but those do not exactly match with their preferences in terms of overall combination of traits (particularly growth habit and crop duration).

**Table 2.4.6.** Preference ranking of ricebean landraces in Nepal†.

| **Traits** | ***Rato*** **(Red)** | ***Seto Thulo*** **(White bold)** | ***Khairo Thulo*** **(Brown bold)** | ***Bhadaure*** |
|---|---|---|---|---|
| Yield potential | 1 | 1 | 2 | 3 |
| Grain type | 2 | 1 | 1 | 3 |
| Grain colour | 3 | 1 | 2 | 3 |
| Maturity | 1 | 3 | 3 | 2 |
| Shattering | 2 | 2 | 2 | 1 |
| Pod size | 2 | 1 | 1 | 3 |
| Drought tolerance | 4 | 1 | 2 | 3 |
| Taste | 4 | 1 | 2 | 3 |
| Market potential | 4 | 1 | 2 | 3 |
| Rainfall tolerance | 2 | 3 | 3 | 1 |
| Total | 24 | 16 | 20 | 25 |
| **Rank** | **III** | **I** | **II** | **IV** |

† Rankings are based on the scores where lowest score is best and highest is worst

In the Focus Group Discussions, most of the farmers emphasized the importance of developing improved varieties of ricebean, marketing facility with reasonable market price, improvement in the nutritional quality of grain as well as fodder and need for raising awareness among the community about the importance of ricebean. They would select several varieties to match the specific niches in their farming systems. They have clear preference for larger, bold seeded varieties with determinate growth, giving more grain and fodder yield and a plant type suited for growing as an inter or mixed crop with maize, sorghum or on terrace risers. However, incorporating some of the organoleptic traits of the most preferred existing landraces will probably help strengthen the role of ricebean in the farming systems.

**Finalisation of the technical programme**

The technical programme for the forthcoming rainy season (2007-08) was finalized for all the sites in India. Six ricebean entries (three from CSKHPKV, Palampur, two from AAU, Jorhat and one by GVT) for mother trial were selected on the basis of the passport data and the scientists' expert knowledge. Twenty five Mother trials will be conducted at farmers' fields and also two will be conducted at research stations. In baby trials three entries will be evaluated across 105 farmers' fields.

## 2.5 Workpackage 5: Nutrition and health

### *2.5.1 Objective*

The objective of WP 5 is *"to assess the potential impact of enhanced pulse availability on local human nutrition"*. The WP is led by Bergen, with field work in Asia carried out by GVT, CSKHPKV AAU, NARC and LI-BIRD.

### *2.5.2 Activities and achievements*

During the period before Brussels signed the contract and before the kick-off meeting in November 2006, an extensive literature search on the nutritional qualities of ricebean as well as state of the art of nutritional survey design and known facts on extent of malnutrition in the region was undertaken. In extension of the kick-off meeting, a preliminary field appraisal was carried out in Ilam district, Eastern Nepal. This provided very valuable information on different types of cultivation as well as the integrated role of ricebean in the farming system. Knowledge on preferential traits was collected, providing a good basis for the design of more extensive field efforts in mid-2007.

It can be summarised that a fair amount of research on nutritional factors in existing varieties of ricebean has been published, to some extent reducing the need for chemical analyses. Still, some additional analyses will have to be undertaken.

The review of literature on human nutrition in the region has shown that the suggested strategy of the WP5 has been justified. No comprehensive studies in the region have been published on diet composition and adequacy, and likewise, the relative contribution of pulses in the diets is largely unknown. The dietary survey strategy will provide new scientific knowledge essential to FOSRIN but also generally publishable.

An important activity during the reporting period was an intensive workshop held in Palampur, Himachal Pradesh, in February 2007. The workshop was used to fine-tune the survey strategy and train supervisors of the field work. In addition, detailed planning was carried out in terms of field sites etc. Two days were spent on 'hands-on' testing of the survey methods in different locations, and testing and refining the questionnaire to be used during the survey. The workshop was attended by 7 representatives from Bergen, CSKHPKV, AAU, NARC and LI-BIRD.

The main surveys will take place during a period of about 6 months in April-October 2007. Four field teams of two people will visit a total of 800 households three times for dietary recalls and food frequency records. Data processing will take place accordingly.

**Table 2.6: Deliverables list for the period**

List all deliverables, giving date of submission and any proposed revision to plans.

| Del. no. | Deliverable name | Workpackage no. | Date due | Actual/Forecast delivery date | Estimated indicative person-months *) | Used indicative person-months *) | Lead contractor |
|---|---|---|---|---|---|---|---|
| 7.1 | Dissemination strategy established and reviewed quarterly | 7 | 9, 12 | 9, 12 | 4.5 | | CAZS-NR |
| 7.2 | Project website set up | 7 | 9 | 9 | 1.5 | 1.5 | CAZS-NR |
| 7.5 | Press articles and broadcasts | 7 | 12 | 18 | 2 | | CAZS-NR |
| 7.6 | Demonstrations “on-farm” | 7 | 6 | 6 | 5 | | CAZS-NR |
| 2.1 | National distributions of ricebean published | 2 | 12 | 15 | 24 | | LI-BIRD |
| 5.1 | Diet and food preparation documented and published | 5 | 10 | 24 | 30 | 6 | UB |
| 7.3 | Project brochures | 7 | 11 | 18 | 3 | | CAZS-NR |
| 7.4 | Technical documentation for dissemination to farmers and extension workers | 7 | 11 | 18 | 3 | | CAZS-NR |
| 7.7 | Outputs on CD-Rom and/or video | 7 | 11 | 18 | 3 | | CAZS-NR |

***) if available**

**Table 2.7: Milestones List**

List all milestones, giving date of achievement and any proposed revision to plans.

| Milestone no. | Milestone name | Workpackage no. | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 1 | Initial workshop | WP6 | 0 | 8 | CAZS-NR |
| 2 | Documentation of nation distribution of ricebean | WP2 | 3 | 15 | LI-BIRD |
| 3 | Identification of traits needed by farmers | WP4 | 4 | 9 | GVT |
| 4 | Field survey, India and Nepal | WP5 | 4 | 18 | UB |
| 5 | Dissemination strategy | WP7 | 6 | 12 | CAZS-NR |
| 6 | Website | WP7 | 6 | 9 | CAZS-NR |
| 7 | Literature review, supply chain | WP1 | 7 | 12 | CAU |
| 8 | Ricebean diversity surveys | WP2 | 10 | 12 | LI-BIRD |
| 9 | Report on dietary patterns and nutrition | WP5 | 10 | 24 | UB |
| 10 | Identification of polymorphic markers | WP3 | 12 | 18 | NARC |
| 11 | Annual meeting | WP6 | 12 | 18 | CAZS-NR / all |
| 12 | Completion of first year of mother and baby trials | WP4 | 12 | 21 | GVT |
| 13 | Membership of networks | WP6 | 12 | 12 | All |

## Section 3 – Consortium management

### 3.1 Consortium management tasks and their achievement; problems which have occurred and how they were solved

Management tasks for this period were as follows:

**WP6: Coordination, management, integration and synthesis**

***To establish internal procedures for the project***. The various internal procedures were finalized at the initial workshop held in Kathmandu, and will be kept under review over the duration of the project.

***To hold the initial workshop.*** This was held in Kathmandu in November.

***To elaborate the detailed workplan.*** This was adjusted at the Initial Workshop to take account of the delays, and technical details were finalized at meetings held in Palampur (for WP5) and in Kathmandu and Jorhat (for WP2, 3 and 4).

***To ensure partners joined relevant S Asian and other networks of relevance.*** A number of networks have been joined, and staff are involved in electronic discussions and on mailing lists. Staff participated in the Agrofolio electronic conference, and established links with that project (http://www.agrofolio.eu), which looks to maintain agricultural diversity and to improve the agricultural portfolio, by supporting the use of neglected and underutilised species in Asian countries. Other networks include the Global Forum on Underutilized Crops, the European and International Associations of Agricultural Economists and a number of German organizations including the Arbeitsgemeinschaft für Tropische und Subtropische Agrarforschung (Council for Tropical and Subtropical Agricultural Research).

***To set up financial reporting and monitoring procedures.*** The various procedures were discussed and finalized at the initial project workshop. Assistance has been given to the various partners since then with regard to completion of the various reporting formats.

***To provide assistance to partners with travel arrangements.*** Assistance has been provided to the Asian partners with their travel arrangements both for internal travel (within India) and internationally (India – Nepal, Nepal – India, and Nepal – UK). This has included invitation letters for visas, as well as requests to institutional administrations to allow staff to travel – obtaining permission to be “off-station” is often a problem for even senior staff in the Asian institutions.

***To set up a quality control and evaluation committee.*** This was set up at the initial workshop, and consists of one senior staff member, not involved in the project, from each participating institution.

**WP7: Output and dissemination / knowledge management**

***To develop the dissemination strategy.*** This had already been drafted during the project preparation phase, and was refined during the first year of the project. The Asian partners are particularly experience in disseminating outputs, and will play a major role in these activities. For example, in Chitwan about 25-30 % of the land was covered by *Rajmah (*kidney bean), the result of a campaign by LI-BIRD and the NARC Grain Pulse Division (Srivastava), along with the CAZS-NR office in Kathmandu. The use of participatory approaches, for example mother and baby trials, by the formal sector organizations (research council and universities) will greatly assist in the acceptance of these approaches, so paving the way for their institutionalization into government organizations

***To identify intermediate and end-users.*** A number of intermediate and end-users of the project outputs have been identified. For example, in Nepal the NARC Food Research Unit develop different new foods and publicise recipes etc. Other intermediate users include local NGOs such as the SUPPORT foundation and RAS-Nepal, and farmers' groups like Resunga Multipurpose Innovative Farmers Group of Darbar- Devisthan.

The findings from the participatory evaluation of ricebean germplasm in India and Nepal will be summarized in local languages and disseminated to the communities through most effective media, for example FM Radio networks (particularly in Nepal), TV, local papers and magazines. The scientific findings from these studies will be published in refereed journals and also posted in the web site of FOSRIN project and linked with the web site of under utilized crops networks. They will be further disseminated through networks in India and Nepal, and efforts will be made to strengthen the effectiveness of these networks by creating linkages between the networks of both the countries.

***To produce the project website.*** The domain name http://www.ricebean.org was registered as soon as the project was approved, and the website went live in December 2006. It has so far received over 1200 hits (verified by http://www.statcounter.com). Content so far includes staff and institutional profiles, a description of the project, and detailed information about ricebean cultivation, including a comprehensive and regularly updated bibliography of work on ricebean and related species (in particular other *Vigna* spp. and *Phaseolus vulgaris*). This includes links to either abstracts or to full papers where copyright restrictions permit. The website also includes a forum where ricebean researchers and other stakeholders can contact each other, and links to other individuals, organizations and networks of relevance. Work in progress includes the provision of a secure area for to allow project staff to exchange documents and other material that needs to remain confidential – this is currently delayed owing to technical problems with the server. This will replace the ricebean blog (www.ricebean.blogspot.com) which has a number of limitations with regard to the type of files that can be sent as attachments.

### WP8: Monitoring and review

The tasks for this WP were to ensure physical progress in accordance with schedule and budget; assess the preliminary response by stakeholders to project activities; reporting to the coordinator and pre-meeting briefings.

## 3.2 Coordination activities

We have contacted scientists working on other underutilized crops, and have submitted one oral and two poster presentations for an International Conference to be held in the UK in September 2007. The methodology developed for the supply-chain analysis was discussed at a conference in Austria in early 2007. Project staff have joined a number of relevant networks, including the Global Forum on underutilized crops, and contacts have been made in India with the All India Coordinated Research Project on Underutilised Crops of the Indian Council of Agricultural Research. In Nepal, linkages have been made with several NGOs working in the region, for example the SUPPORT Foundation (a local NGO in the far-western part of Nepal) and Rapti Agriculture Graduates Society (RAS)-Nepal (a local network of agricultural graduates in the mid-western region of Nepal), as well as with the International Centre for Integrated Mountain development (ICIMOD). Other working relationships have been established with farmers' groups and government Agricultural Development Offices in Nepal.

**Table 3.2.1.** Details of meetings held in year 1

| Date | Location | Attendance | Purpose | Management outcomes* |
|---|---|---|---|---|
| April 5, 2006 | Kathmandu | Dr SL Maskey, Director, Crops & Horticulture, NARC; Dr PK Shrestha, Executive Director, LI-BIRD; Dr J Bajracharya, NARC; Dr KD Joshi, CAZS-NR | Planning work for year 1 in Nepal: literature review, identify sites, germplasm collection and decision on passport data, germplasm assessment, molecular analysis | Work allocations, estimates of resource use (staff, travel etc) |
| November 3 – 7, 2006 | Kathmandu | Dr PA Hollington (Coordinator), Prof JR Witcombe, Dr D Harris, Dr KD Joshi (CAZS NR); Ms D Bürgelt (CAU); Dr P Andersen (UB); Dr E Gjengedal (Norwegian University of Life Sciences); Dr JP Yadavendra, Dr A Prasad (GVT); Dr N Kumar (CSKHPKV); Dr SB Neog (AAU); Dr J Bajracharya, Mr SB Pandey, Mr PL Karna, Mr BK Baniya, Mr S Srivastava (NARC); Dr PK Shrestha, Mr R Gautam, Mr B Bhandari (LI-BIRD), Mr H Bhandari (Dept. of Agriculture, Nepal). | Project planning: protocols for administrative and financial procedures, exposure to ricebean growing areas, discussion and agreement of scientific methodologies and protocols | Financial and administrative procedures agreed; reporting schedules explained; |
| February 21 – 22, 2007 | Palampur | Dr P Andersen (UB); Dr JP Yadavendra (GVT); Dr N Kumar (CSKHPKV); Dr SB Neog (AAU); Dr. RK Chandyo (Teaching Hospital, Kathmandu); Mr MB Shrestha (NARC); Mr B Bhandari (LI-BIRD) | To develop protocols for the various nutrition surveys to be carried out in Nepal and India, and to train staff in the techniques to be used. | |
| March 7, 2007 | Kathmandu | Prof JR Witcombe, Dr KD Joshi, CAZS-NR; Dr M von Oppen, Ms D Buergelt, CAU; Dr P Anderson, UB; Dr Bimal K Baniya, Dr J Bajracharya, Agric Botany Div, NARC; Dr Man B Shrestha, Food Research Unit, NARC; Dr Surendra Srivastava, National Grain Legume Research Programme, NARC; Tara Lama, Resham Gautam, LI-BIRD | Planning work for year 2 in Nepal: testing sites and protocol for germplasm evaluation, germplasm exchange with India, sites for health and nutrition studies, market research, financial matters, linking field studies with university students, reporting deadlines and formats | *Per diem* rates for field staff established, agreed to investigate establishing links with Tribhuvan University and elsewhere to involve students as researchers in relevant PhDs to transfer skills. Options for co-supervision of PhD students by EU institutions investigated. Reporting deadlines and formats noted. Date for next annual meeting set. |

*Scientific outcomes of the meetings are noted in the respective section of the progress report.

Partners have been in almost continuous communication by email and telephone, as well as face to face meetings, and the CAZS Regional Coordinator has visited all the Asian partners at least once. In addition to the kick-off meeting in November, several other meetings have taken place (Table 3.2.1).