# POLICY RESEARCH STUDY ON ECONOMIC VALUATION OF GENETIC RESOURCES OF WILD RICE RELATIVES IN SRILANKA

GEF

UNEP

Bioversity International

BDS
BIODIVERSITY SECRETARIAT

Wayamba University of Sri Lanka

# TASKS

**Task 1**

*Identify prospective sites (minimum 5) to estimate the total Economic Value of CWR genetic Resources of wild rice species in Sri Lanka*

**Task 2**

*Conduct a survey of literature*

**Task 3**

*Selection of appropriate valuation tools to estimate the Total Economic Value of genetic resources of wild rice varieties found in the sites identified*

**Task 4**

*Carryout field surveys and institutional surveys to gather preliminary / passport data and other relevant information*

**Task 5**

*Identify sources of market failure pertaining to CWR genetic resources*

**Task 6**

*Identifying the sources of non market failure (policy) pertaining to CWR genetic resources with special relevance to the wild rice*

**Task 7**

*Make recommendations to formulate a policy framework and strategic measure for CWR in-situ conservation in Sri Lanka with special reference to wild rice*

**Task 8**

*Suggest institutional network for genetic resource in-situ conservation, sustainable use and benefit sharing of CWR*

# Sri Lanka - Five wild rice species

## *O. eichingeri*

## *O. nivara*

## *O. rufipogon*

## *O. granulata*

## *O. rhizomatis*

# Requirement of an Economic Valuation

- ✓ Economic forces drive much of the extinction of the native Wild Rice Relatives and its genetic diversity

- ✓ The activities of genetic resources conservation generates economic value, which may well not be captured in the market place





# STUDY 1

## Analysis 1

# Assessing the Preferences of Breeders for Setting the Priorities in Conservation Programs

# Objectives

- To understand why the Wild Rice Relatives should be conserved and how this should be done
- To identify the Preferences of Breeders for Setting the Priorities in Conservation Programs
- Providing an optional value for the wild rice relatives to be used in total economic value

# Methodology

## Selection of Attributes

**Identification of the choice alternatives and their relevant attributes**

- **Focus Group Discussions**
  - ✓ **At Puttalum District Secretariat Office**
  - ✓ **CIC seed farm at Palwehera**
  - ✓ **At Plant Genetic Resource Center**
- **Site visits**

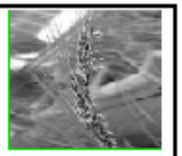
# Data Collection

- ✓ **Questionnaire-based survey (n=30)**
- ✓ **Breeders, Researchers and expertise personals**


SIEMENS


WE'VE
GOT THE
SPIRIT

# CWR Conservation and Sustainable Use Activities into National Planning Process



**This questionnaire will be used in identifying the best attributes and levels of wild rice relatives' conservation (WRRC) options in point of research expertise personals.**

The genus *Oryza* in Sri Lanka is represented by *Oryza sativa* (AA genome), *Oryza nivara* (AA), *Oryza rufipogon* (AA), *Oryza granulata* (GG), *Oryza eichingeri* (CC), and *Oryza rhizomatis* (CC). In Asia *Oryza eichingeri* and *Oryza rhizomatis* are found only in Sri Lanka, while the latter is endemic.

These WRR are essential components of natural and agricultural ecosystems and hence are indispensable for maintaining ecosystem health. Their conservation and sustainable use is very important for improving agricultural production, increasing food security, and maintaining a healthy environment.

Modern cultivars of most crops contain some genes that are derived from wild relatives. Grassy stunt tolerance gene in *Oryza nivara*, perennial gene in *Oryza rhizomatis*, and drought tolerance gene in *Oryza granulata* have potential to improve crop tolerance to pests, diseases and stressful conditions. CC genome of *Oryza eichingeri* and *Oryza rhizomatis* can be crossed with elite lines of cultivated rice. These backcrossed progenies can be used to enhance the rice yield (IRRI, 1988).

Institute :
Age :
Working Experience :

**Select the best choice**

| *Choice A* | *Attribute* | *Choice B* |
|---|---|---|
| Community participation only | **Community and government participation** | Government participation only |
| Decrease up to 50% | **Public access** | Continue the current access |
| Rs 500/= | **Payment on conservation** | Rs 1000/= |
| In situ conservation | **Conservation vehicle** | Ex situ conservation |
| 50% Cost reduction | **BPH cost reduction** | 25% Cost reduction |

**I would prefer: choice A _____ choice B_____ Neither_____**

| *Choice A* | *Attribute* | *Choice B* |
|---|---|---|
| Community participation only | **Community and government participation** | Government participation only |
| Continue the current access | **Public access** | Decrease up to 50% |
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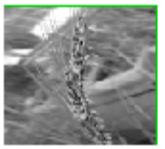
CWR Conservation and Sustainable Use Activities into National Planning Process



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| Rs 500/= | **Payment on conservation** | Rs 1000/= |
| In situ conservation | **Conservation vehicle** | In situ conservation |
| 25% Cost reduction | **BPH cost reduction** | 50% Cost reduction |

**I would prefer: choice A choice B Neither**

| *Choice A* | *Attribute* | *Choice B* |
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| In situ conservation | **Conservation vehicle** | In situ conservation |
| 50% Cost reduction | **BPH cost reduction** | 50% Cost reduction |

**I would prefer: choice A choice B Neither**

*Thank you for your kind cooperation.*





# Example of a Choice sets

| Attribute | **Choice A** | **Choice B** |
|---|---|---|
| Com. & Gvt. participation | Community participation only | Government participation only |
| Public access | 50% reduction | Continue the current access |
| Fines | Rs. 500 | Rs. 1000 |
| Conservation vehicle | In situ | Ex situ |
| Cost reduction | 50% Reduction | 25% Reduction |

**I would prefer choice A ☐ choice B ☐ Neither**

5 Attributes with 2 levels (32 Combinations)

By using Fractional Factorial Design

Reduced up to16 versions with 8 choice sets





$$U_i = V_i + \varepsilon_i$$

$U_i$ = Utility generated by $i^{th}$ alternative

$V_i$ = Objective component

$\varepsilon_i$ = Error component

$$P\{i \text{ chosen}\} = P\{V_i + \varepsilon_i > V_j + \varepsilon_j\} \text{ in } C$$

- Selection of one option over another indicates that the utility of the option *i* is greater than the utility of the other option *j* in the choice sets

- The data obtained were analysed using Multinomial Logit Regression (MNLR) and parameter estimates are estimated

# Analytical Procedure

$$V_{iq} = f\ (X_k, Z_{mq}, \varepsilon_q)$$

$$V_{iq} = ASCq + \beta 1*A + \beta 2*B + \beta 3*C + \beta 4*WTP + \alpha_{mq} Z_{mq} + \varepsilon_q$$

| | |
|---|---|
| *i* | = Option |
| V*iq* | = Probability that individual will choose the *i*th option in the choice set |
| X*k* | = Attributes of the WRR conservation option |
| Z*mq* | = Individual characteristics of the individual interacted with the attribute of the WRR conservation option |
| β*k* | = Coefficients of the attributes, X*k* |
| ASC*q* | = Alternative specific constant for individual |
| α*mq* | = Coefficients of the Z*mq* interacted with, X*k* |
| ε*q* | =Error term to explain other factors affecting the choice that are not include in the model |

A, B, C and WTP are the four attributes of the choice sets

# Marginal Willingness-To-Pay (MWTP)

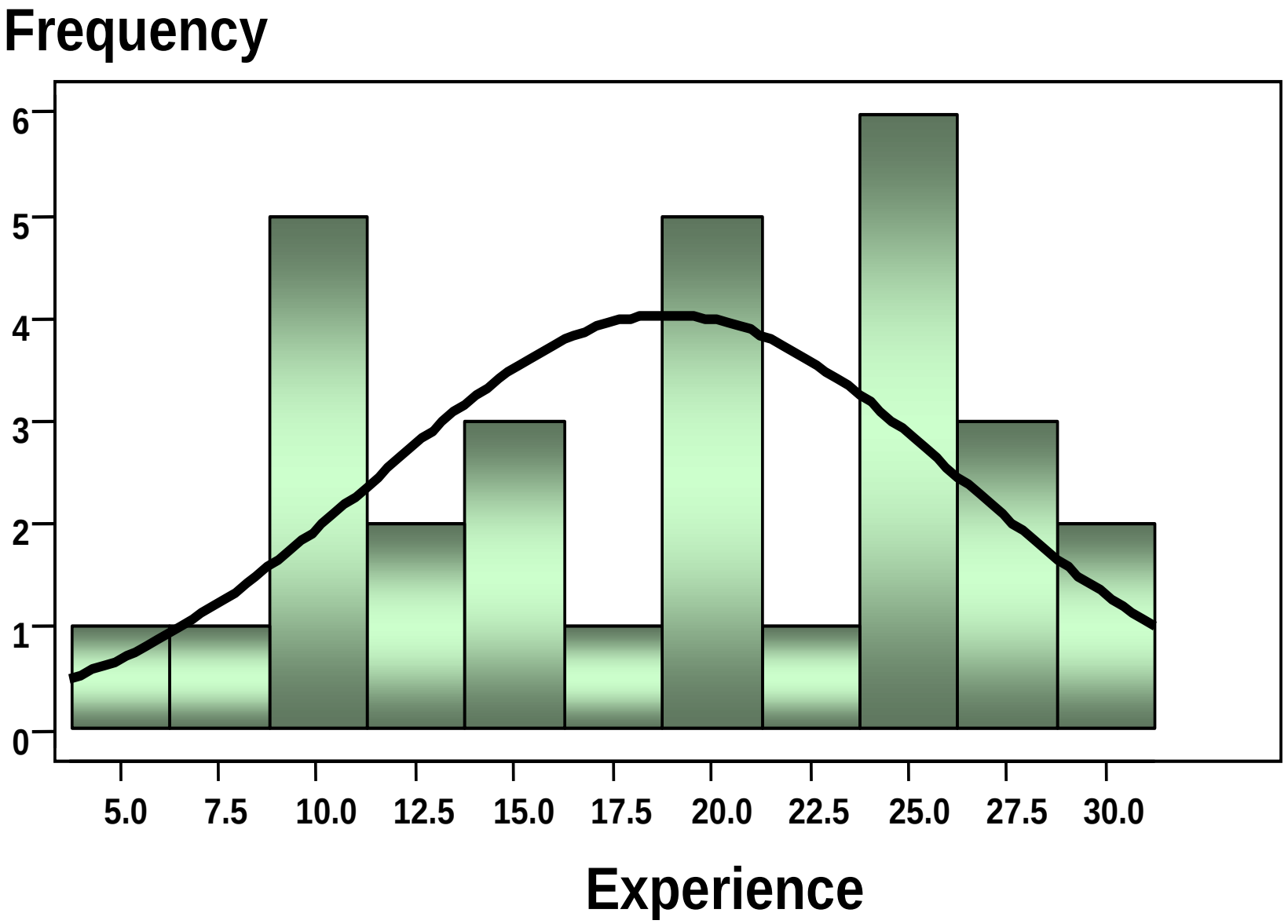
$$MWTP = \beta_{jk} / \lambda_{\gamma}$$

$B_{jk}$ = Coefficients of a non-market attribute

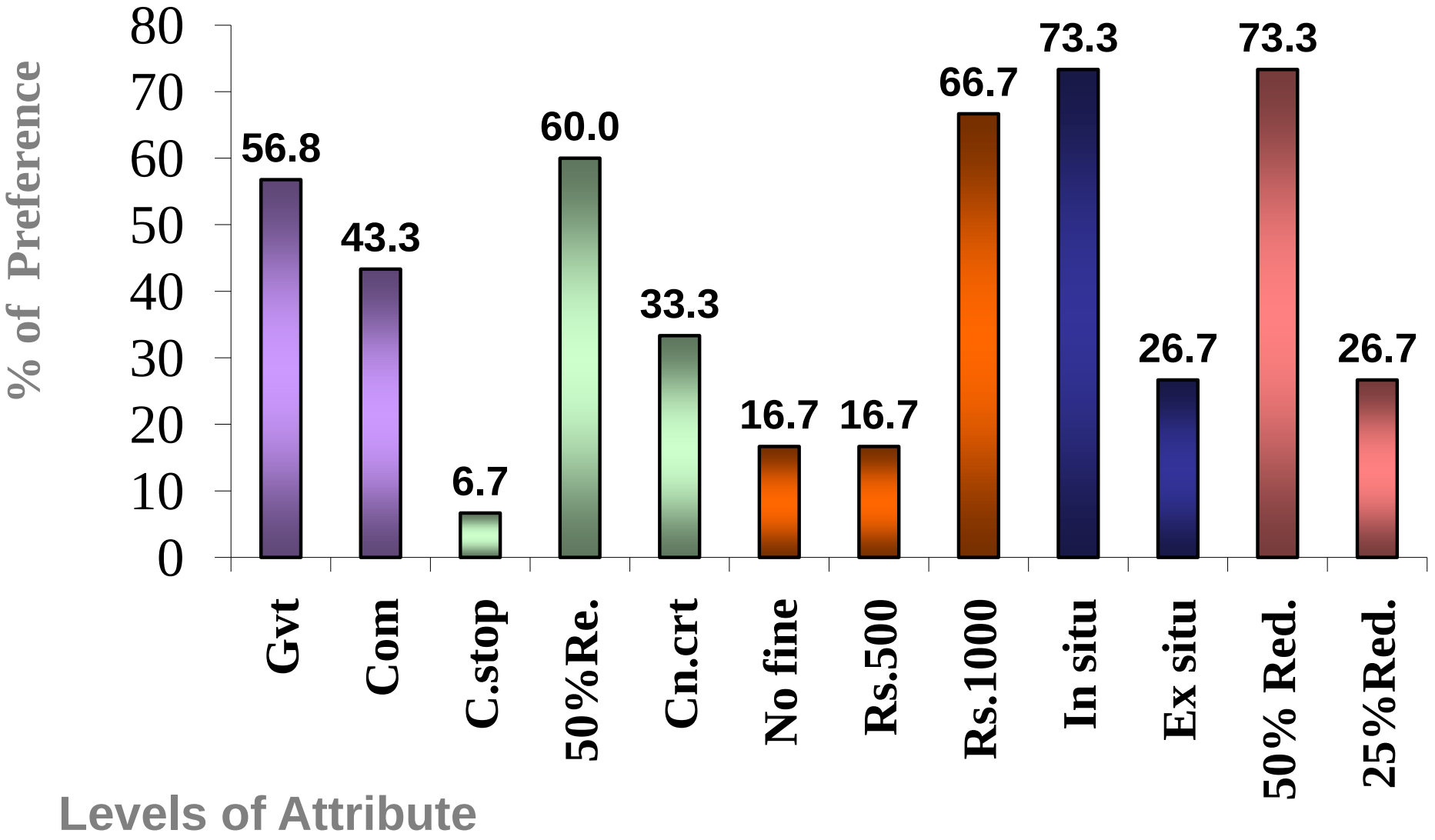
$\lambda_{\gamma}$ = Coefficients of the price attribute

MWTP is the amount people willing to pay for an additional unit of non market attribute of the WRRCP when the other attributes are constant

# Description of the Sample



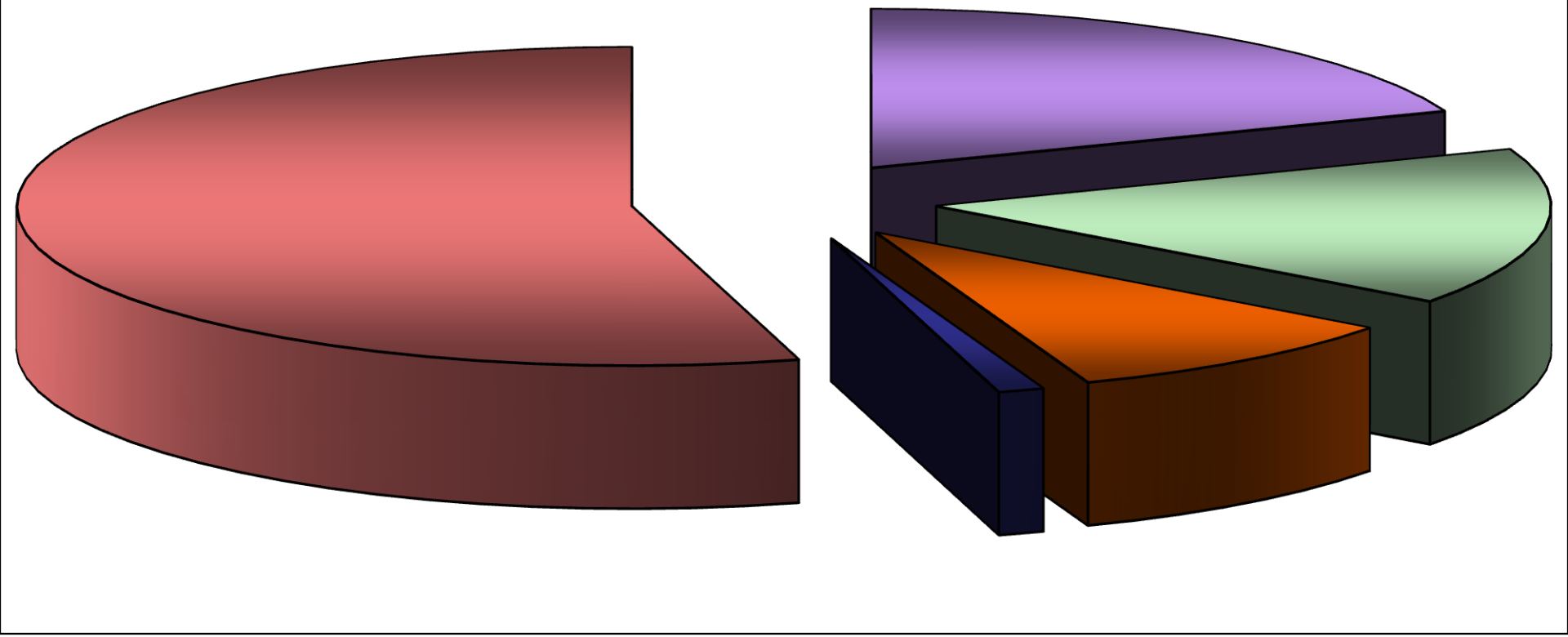
# Breeder preferences on attributes



# MNL Estimate of preferences

| Attribute | Coefficient | SE | P-Val | MWTP |
|---|---|---|---|---|
| $ASC_H$ | 0.185 | 0.170 | 0.027* | |
| **1.** Com. & govt. | 0.127 | 0.136 | 0.006* | 2.116 |
| **2.** Public access | -0.106 | 0.161 | 0.125 | 1.767 |
| **3.** Fine | 0.061 | 0.135 | 0.009* | |
| **4.** Conserv. vehicle | 0.008 | 0.156 | 0.884 | 0.135 |
| **5.** Cost reduction | 0.360 | 0.157 | 0.000* | 5.901 |
| Log likelihood | 30.48 | | Total | 9.99 |

# Relative importance of attributes



- Cost reduction 55%
- Community & Government 19%
- Conservation Vehicle 1%
- Fine 9%
- Public Access 16%

# CONCLUSIONS

- ✓ Best levels - Government involvement in conservation programs, 50% limitation of public access, fine at high premium, in situ conservation and 50% cost reduction through BPH resistance gene

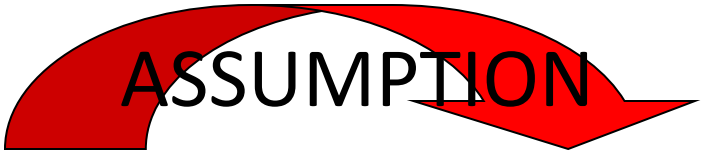
- ✓ Cost reduction by the BPH gene is the most significant attribute in selecting particular choice option and economic valuation too

- The overall implicit price for the desired level of attributes is **Rs.10** per an individual

- This is the amount of money that the respondents are willing to pay in order to conserve the WRR

- As the selected respondents have good knowledge about WRR and its genetic resources this can be precisely estimated as the average value of benefit for an individual by conserving WRR

- ✓ The overall implicit price for the desired level of attributes can be extrapolated to the local, national and global scale too




- ✓ Economic benefits from conserving WRR will be uniformly distributed among globally and on the other hand, costs in terms of forgone development opportunities, will be significant globally

# STUDY 1

## Analysis 2

# ASSESSING THE PREFERENCES OF ADJACENT COMMUNITY FOR IN-SITU CONSERVATION OF ORYZA GRANULATA IN WAVULPANE AREA

# Objectives

- **Specific objective**
  - Analyse **trade offs of people's choices on WRR conservation options**

- **General objectives**
  - Identify five WRR species in Sri Lanka
  - Estimate the **Marginal Willingness-To-Pay** values

# Selected Attributes and Levels

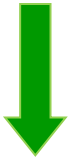
| Attributes | Levels |
|---|---|
| 1. WRR sites willing to be conserved | 1.1 Conserve all the identified sites (ALL) |
| | 1.2 Conserve selected sites (FEW) |
| | 1.3 Do not like to conserve any |
| 2. Hours like to commit for WRRCP | 2.1 Fours hours per day (4HOURS) |
| | 2.2 Two hours per day (2HOURS) |
| | 2.2 Do not like to contribute |
| 3. Most suitable conservation method | 3.1 Both in-situ and ex-situ (BOTH) |
| | 3.2 In-situ conservation (INSITU) |
| | 3.3 Ex-situ conservation |
| 4. Type of Stakeholder Participation | 4.1 Government authorized program with participation of community (GVTCOM) |
| | 4.2 Government body (GVT) |
| | 4.3 Government + community + NGO |

# Fractional Factorial Design

3*3*3*3 = 81

Number of combinations are not manageable

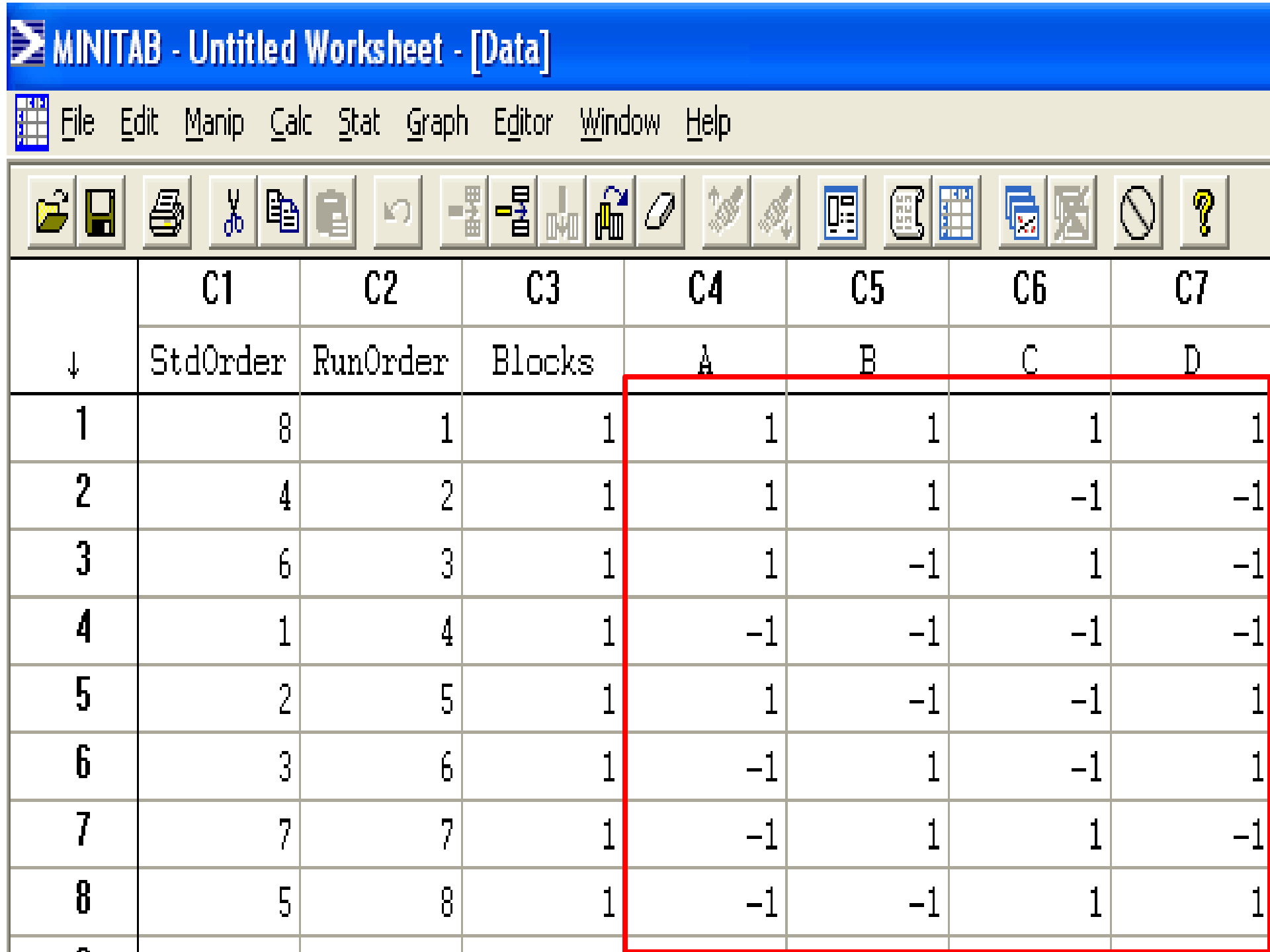
Most important two levels of each attribute was considered



2*2*2*2 = 16

½ Fractional Factorial Design

8 treatment combinations




| | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|---|---|---|---|---|---|---|---|
| ↓ | StdOrder | RunOrder | Blocks | A | B | C | D |
| 1 | 8 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 4 | 2 | 1 | 1 | 1 | -1 | -1 |
| 3 | 6 | 3 | 1 | 1 | -1 | 1 | -1 |
| 4 | 1 | 4 | 1 | -1 | -1 | -1 | -1 |
| 5 | 2 | 5 | 1 | 1 | -1 | -1 | 1 |
| 6 | 3 | 6 | 1 | -1 | 1 | -1 | 1 |
| 7 | 7 | 7 | 1 | -1 | 1 | 1 | -1 |
| 8 | 5 | 8 | 1 | -1 | -1 | 1 | 1 |

# Example

| Choice A | Attribute | Choice B |
|---|---|---|
| Conserve all the WRR sites | WRR sites willing to be conserved | Selected few sites |
| 4 hours per day | Hours they like to commit for WRRCP | 4 hours per day |
| Both in-situ and ex-situ conservation | Conservation method | In-situ conservation |
| Government authorized community participated | Stakeholder participation | Government authorized community participated |

| I would prefer | Choice A | | Choice B | | Neither | |
|---|---|---|---|---|---|---|

# Data collection

- Study area

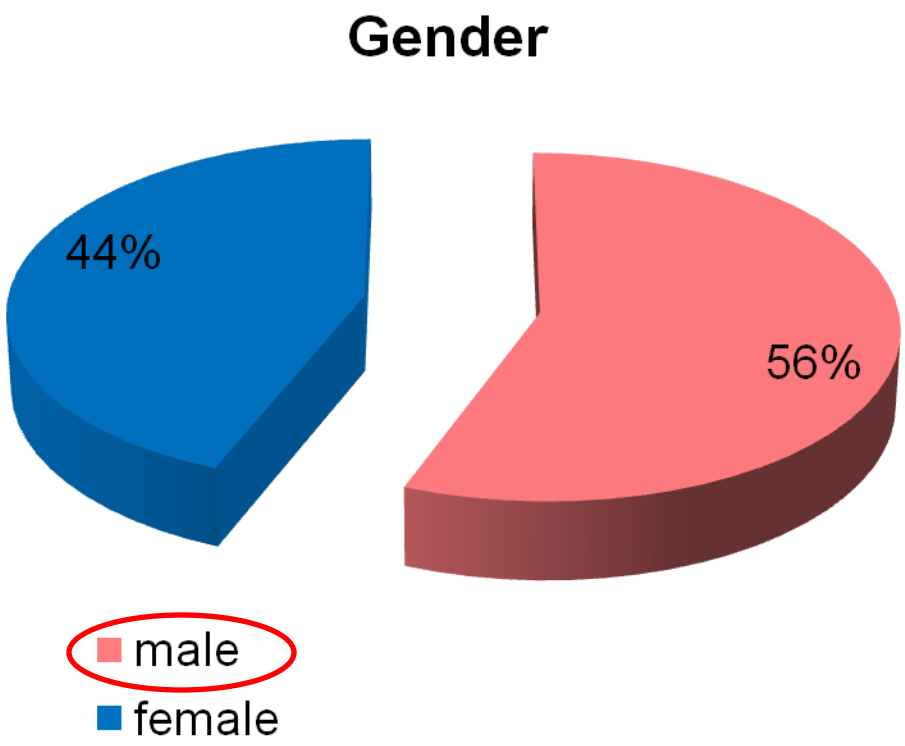
  Wavulpane village located in Ratnapura district

- Justification for the selection
  - Community was aware about WRR
  - O.granulata was predominantly available
  - No weedy rice problem prevailing in the area

- Participatory Community Appraisal (PCA) was conducted in 24th of July 2009 at Wavulpane primary school.

- Ministry of Environment and Natural Resources hosted the event

# Sociodemographic Characteristics

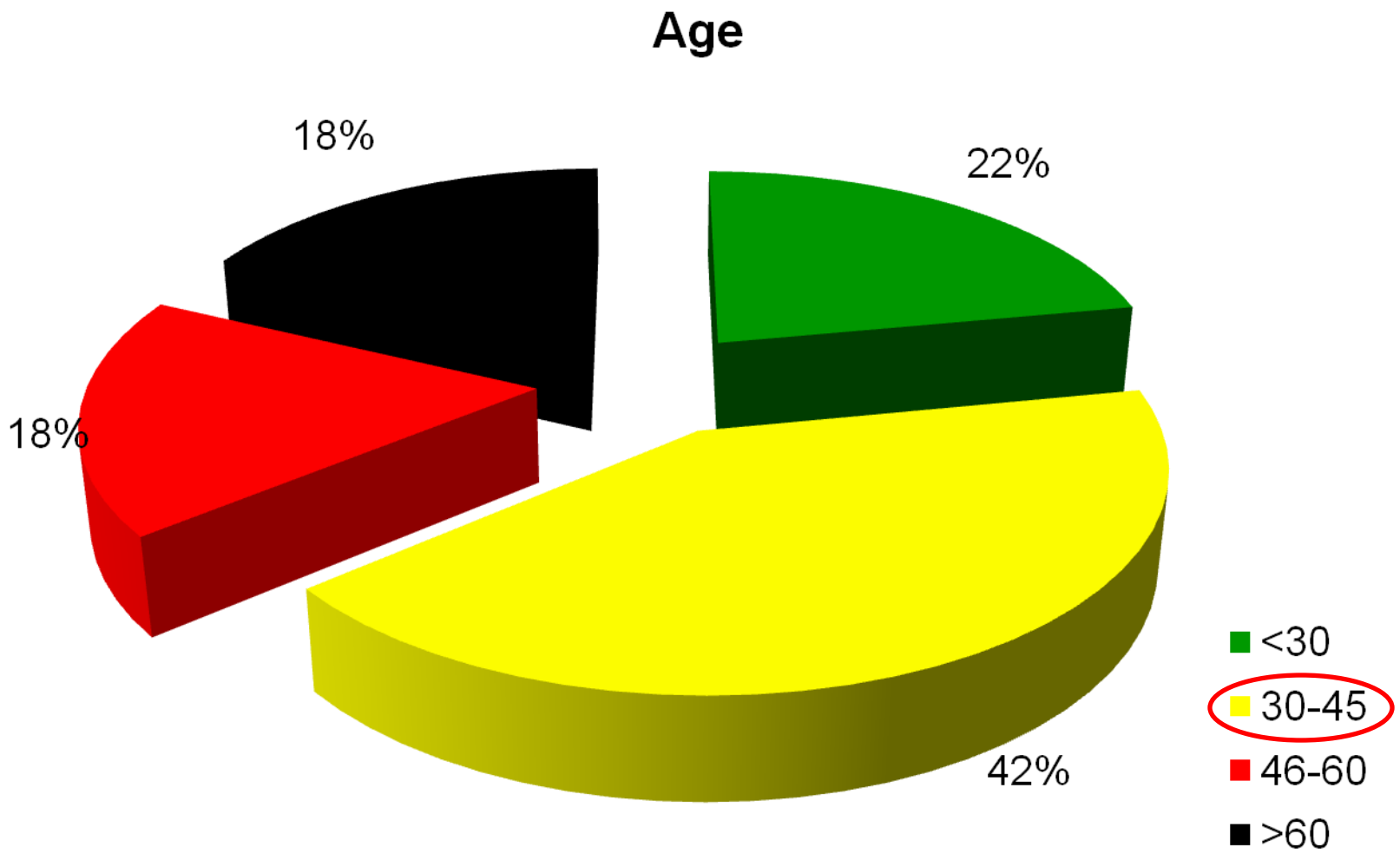



- Due to their low literacy level the questions were read out and were explained

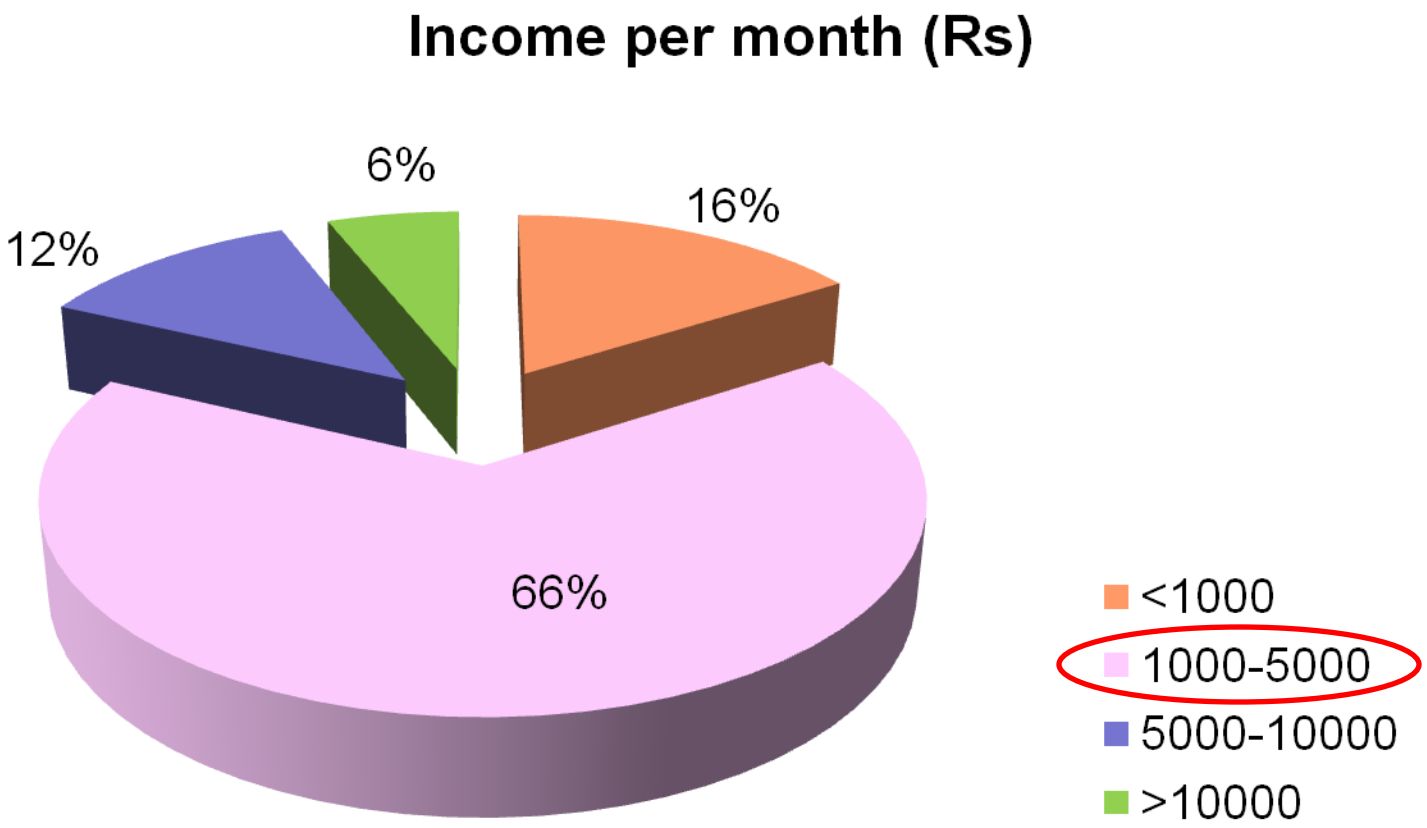




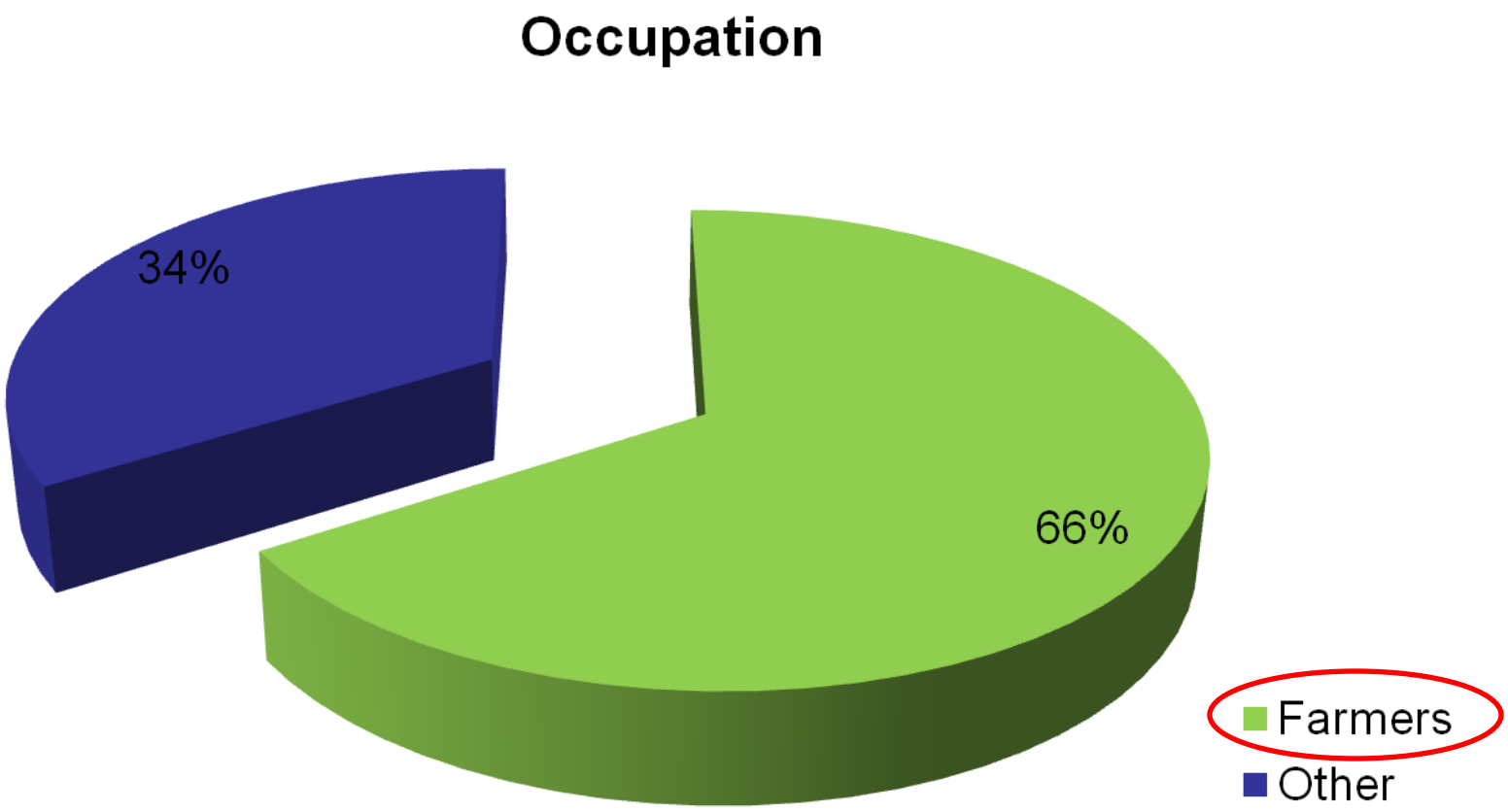

# Sociodemographic Characteristics



# Sociodemographic Characteristics



# Sociodemographic Characteristics



# Marginal Willingness-To-Pay

| Attributes | P value | Std Error | Coefficients | MWTP |
|---|---|---|---|---|
| Intercept | 0.000 | 0.364 | 1.504 | |
| ALL | 0.000 | 0.525 | -2.392 | |
| FEW | | | 2.392 | 31.47 |
| INSITU | 0.000 | 0.498 | 1.940 | 25.52 |
| BOTH | | | -1.940 | |
| GVTCOM | 0.009 | 0.745 | 1.956 | 25.74 |
| GVT | 0.009 | | -1.956 | |
| HOURS | 0.906 | 0.638 | 0.076 | |

- MWTP is the amount of money the respondents are willing to pay in order to receive more amount of the particular attribute holding other attributes constant

MWTP per year → 31.47 + 25.52 + 25.74 = 82.72

- In designing conservation programs the preferred levels of the villagers should be considered for the success of the program

- Community awareness play a major role in protecting the available WRR populations
    - **WRR identification guide**
    - **Scientific studies**
    - **Sign boards**
    - **Press releases**
- Both in-situ and ex-situ conservation is essential

- Regular monitoring and participatory decision making at all levels

# STUDY 1

## Analysis 3

# Assessing the Preferences of Government Officials of the Puttalam District in Setting Priorities for Conservation Programs

# Objectives

- **Specific objective**
  - Analyse **trade offs of government officials on WRR conservation options**

- **General objectives**
  - To evaluate the willingness of the government officials towards the conservation of WRR
  - Estimate the **Marginal Willingness-To-Pay** values

# Selected Attributes and Levels

| Attributes | Levels |
|---|---|
| 01 Opinion on WRR conservation in the Puttalam District (OPINION) | 1.1 Like to conserve all the identified WRR sites **(ALL)** |
| | 1.2 Like to conserve few of the identified WRR sites (FEW) |
| | 1.3 Do not like to conserve any of the WRR sites **(NONE)** |
| 02. Best suited conservation vehicle (METHOD) | 2.1 Ex situ conservation through enhanced information management. **(EX-SITU)** |
| | 2.2 In situ conservation through enhanced information management. **(IN-SITU)** |
| | 2.3 No need of having special conservation program. **(NOT SPECIAL)** |
| 03. Fines on destruction (FINE) | 3.1 No additional fine. **(NONE)** |
| | 3.2 Rs.0-500 for any activity which taken against the existence of WRR. **(Rs.0-500)** |
| | 3.3 Rs.501-1000 for any activity which is taken against the existence of WRR. **(Rs.501-1000)** |
| 04. Type of Stakeholder Participation (STAKEHOLDER) | 4.1 Government authorized program with participation of Community (**GVTCOM)** |
| | 4.2 Government body **(GVT)**<br>4.3 With participation of village community and NGO (**COM)** |

# Data collection

- Study area

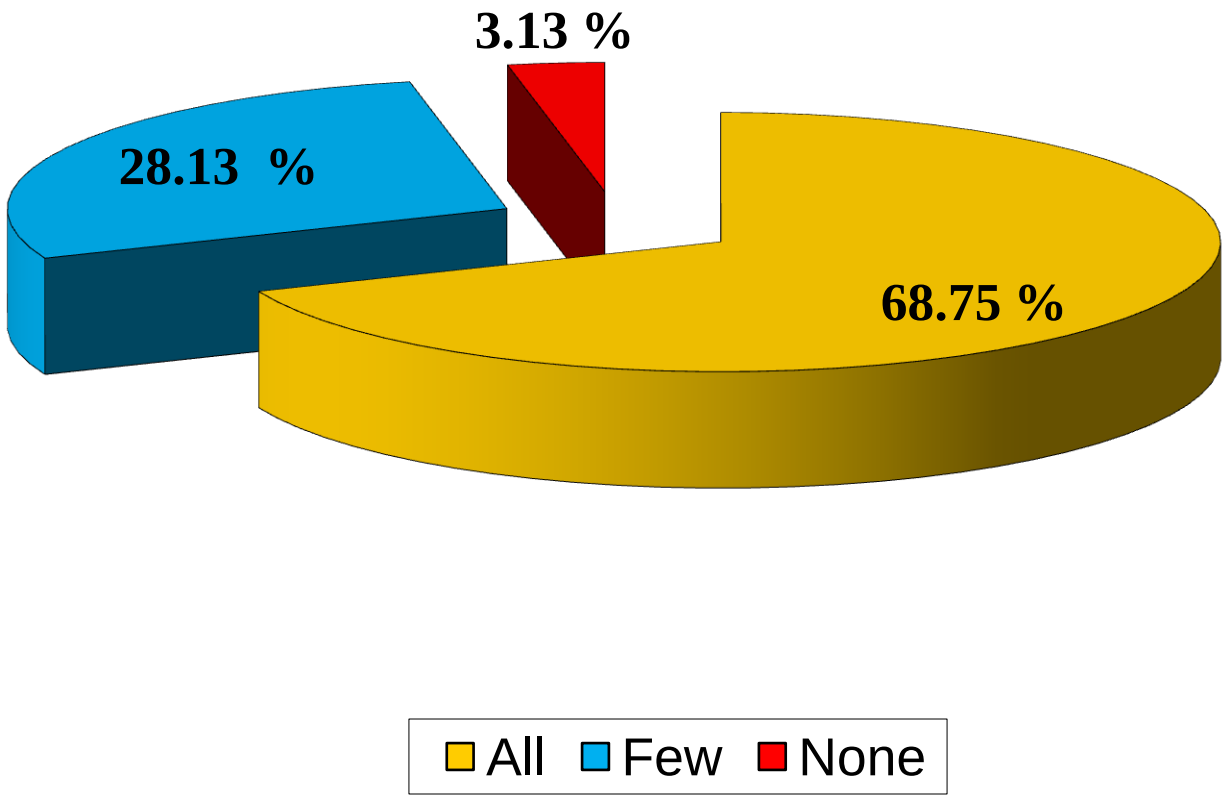
  Puttalam District

- Officials interviewed
  - Grama Niladharies
  - Extension officers

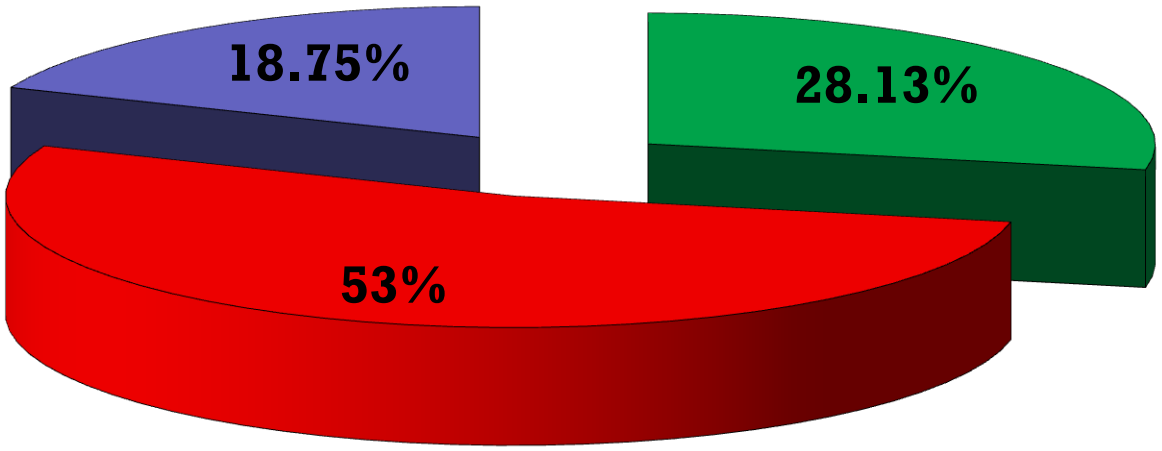
- Justification for the selection
  - Officials play a critical role in the conservation of WRR


CROP WILD RELATIVES

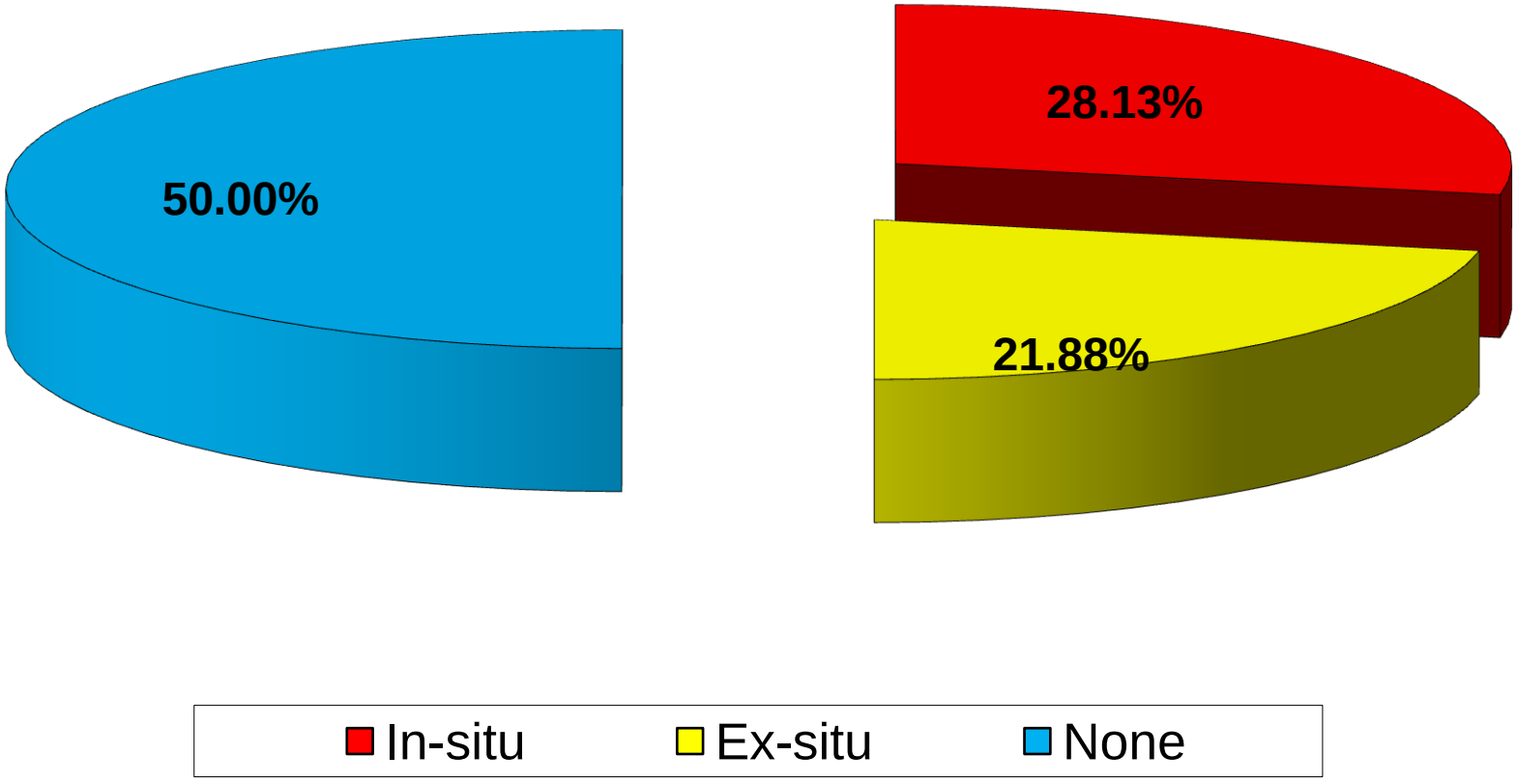
# Opinion on WRR conservation in the Puttalam District



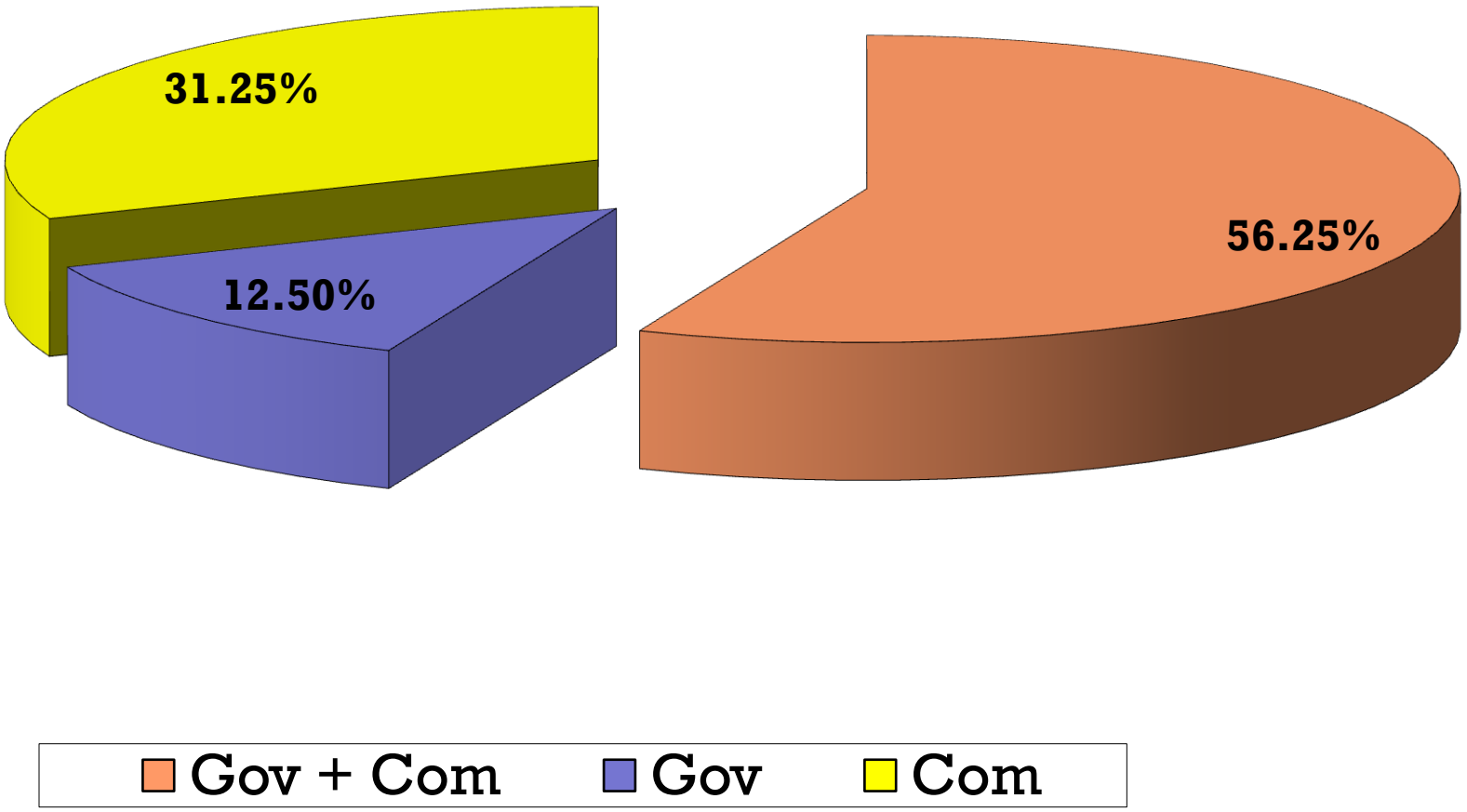
# Impact From Villagers on WRR



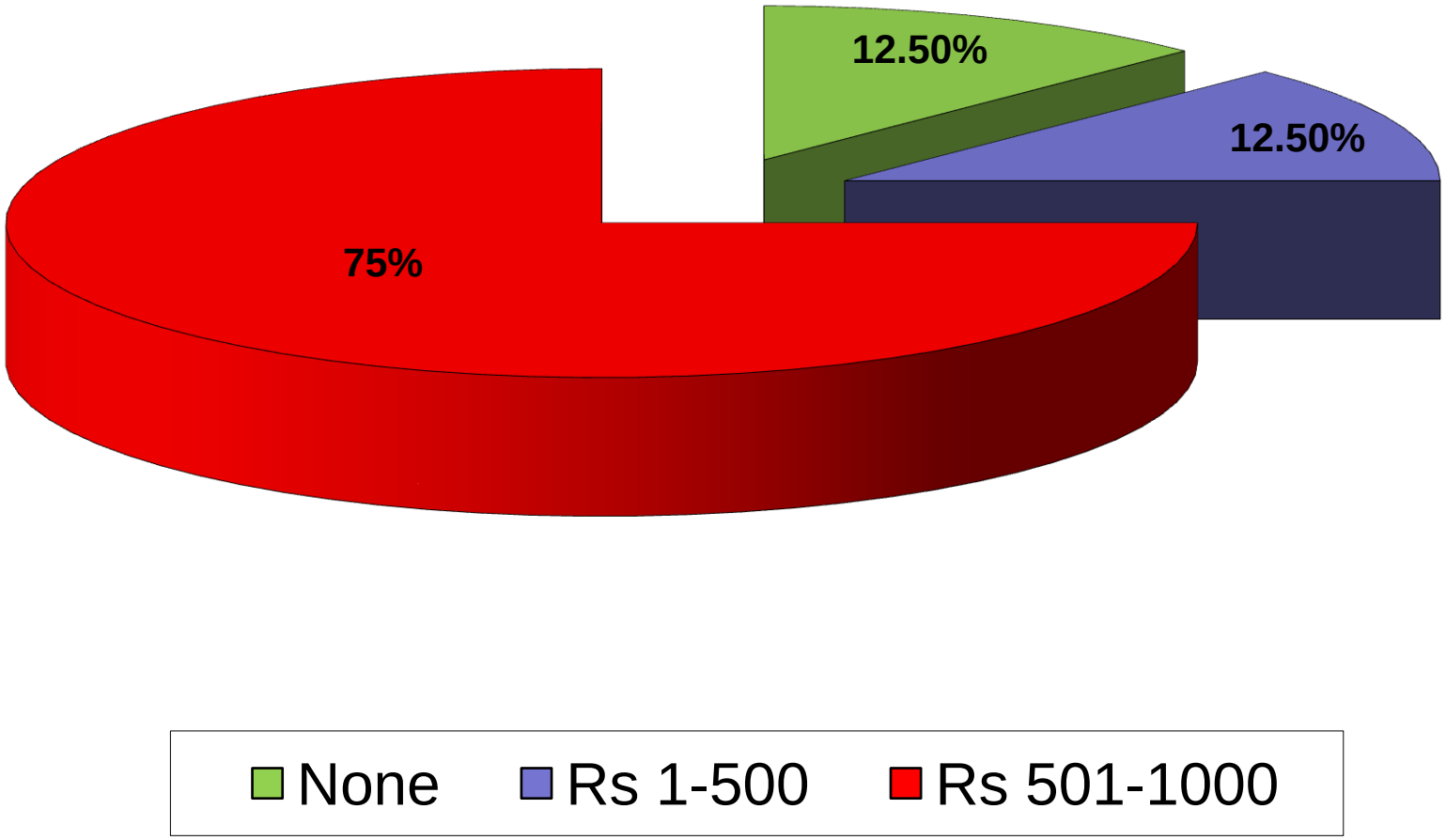
# Conservation Vehicle



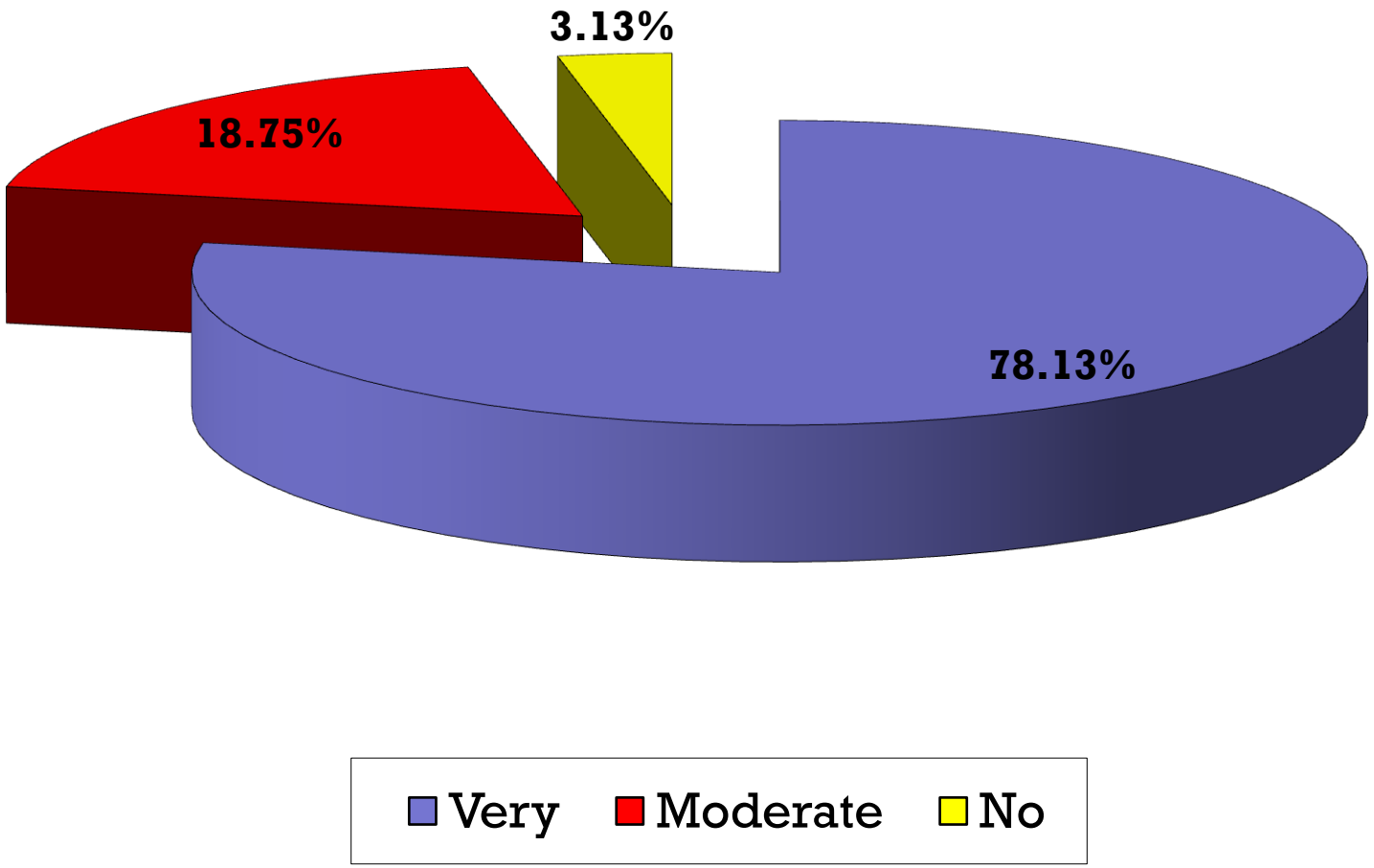
# Type of Stakeholder Participation



# Fine to be Implemented



# Level of Satisfaction From Participating in Conservation



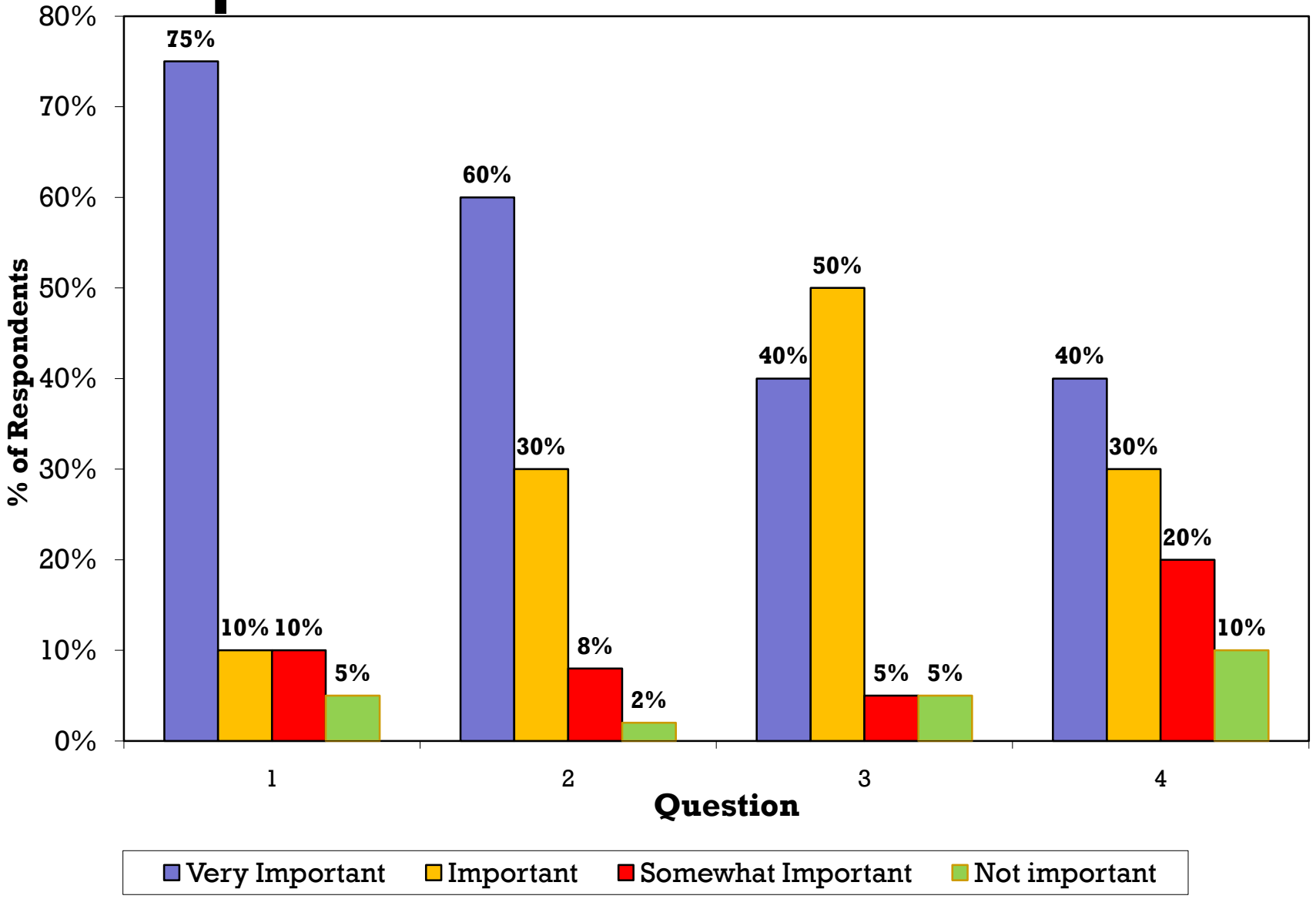
- Do you think it is important for the people to know that there is a use value as well as a non use value in order for them to conserve WRR?

- How important is it to know that future generations will be able to use the genetic resources of WRR for crop improvement, medicinal purposes etc?

- How important is it to know that WRR exist in the identified area even if you do not see them?

- How important is it to allow the existence of some of the endangered / near threatened varieties of WRR in the Puttalam district?

# Rating of the Level of Importance of Conservation



# Selected Attributes and Levels

| Attributes | Levels |
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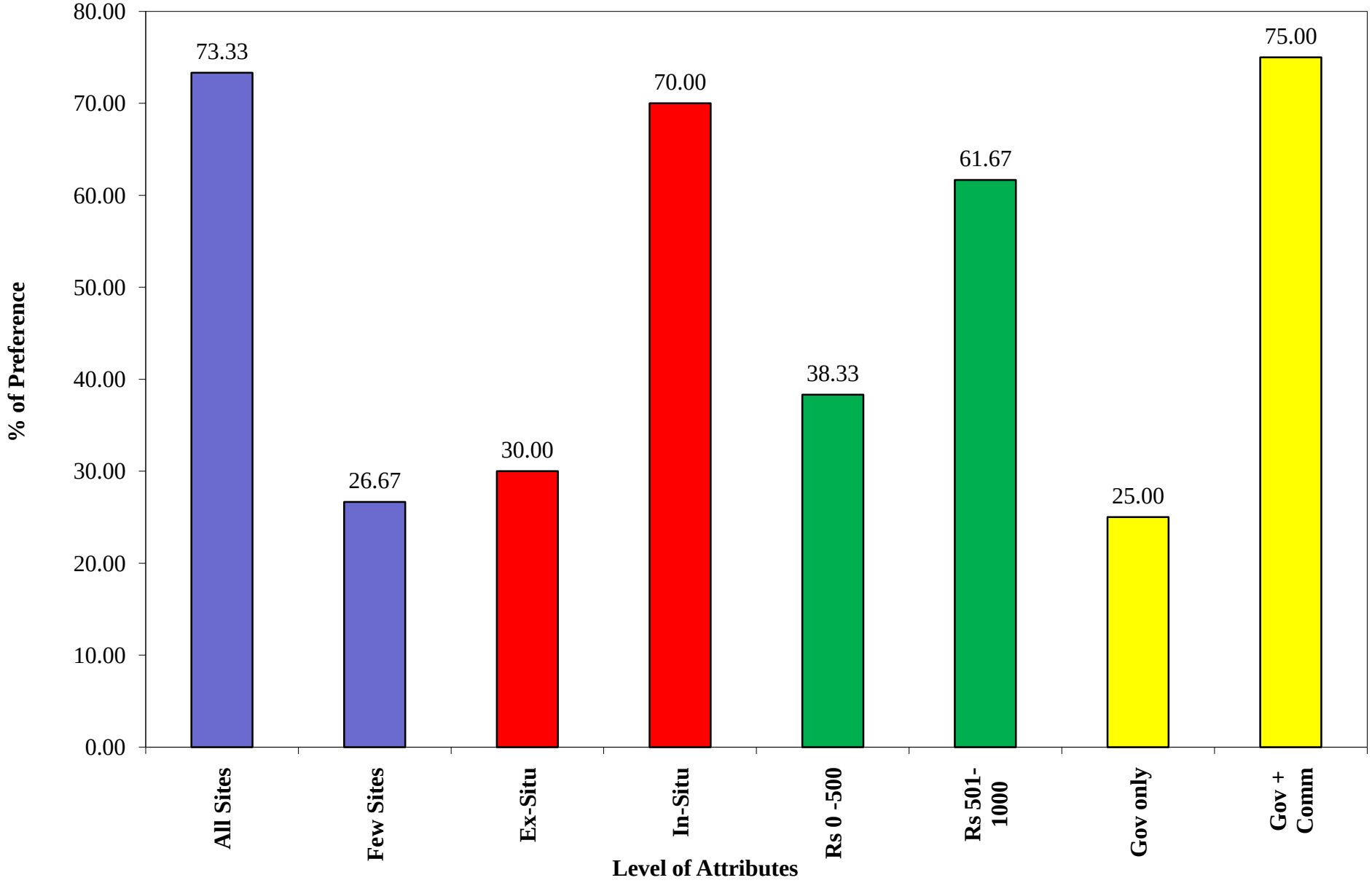
# Preferences on attributes



# MNL Estimate of preferences

| *Attribute* | *Coeff.* | *SE* | *P-Val* | *MWTP* |
|---|---|---|---|---|
| $ASC_H$ | -1.105 | 0.383 | 0.004* | |
| *Opinion* | 1.703 | 0.486 | 0.003* | 6.562 |
| *Conservation vehicle* | -1.669 | 0.530 | 0.002* | 6.444 |
| *Level of fine* | 0.291 | 0.464 | 0.030* | |
| *Comm & Gov participation* | 1.249 | 0.557 | 0.025* | 7.755 |
| *Log likelihood* | 42.53 | | **Total** | **20.462** |
| *Pseudo* $R^2$ | 0.192 | | | |
| *N Observations* | 253 | | | |

# Conclusion

- The amount of money that the respondents are willing to pay in order to conserve the WRR is Rs 20.
- Moral obligations to cooperate in the conservation.

# Mainstreaming of CWR Conservation in to National Policy and Planning: A Case of In Situ conservation of Wild Rice in Sri Lanka

## Alternative conservation methods

# Publications

**14th International Forestry & Environment Symposium, University of Sri Jayewardenepura, Gangodawila, Nugegoda,**
**18 – 19 December 2009**.

- "Economic Valuation of Conservation of Genetic Resources of Wild Rice Relatives: Assessing the Preferences of Adjacent Community for Conserving *Oryza granulata* in the Wavulpane Area

- "Assessing the Preferences of Plant Breeders for Utilization, Benefit Sharing and Prioritization of Conservation of Wild Rice Relatives in Sri Lanka",

# Publications

***At the 9th Agricultural Research Symposium (AGRES)***
*Faculty of Agriculture & Plantation Management, WUSL*

- **“**Economic Valuation of Genetic Resources of Wild Rice Relatives: Assessing the Preferences of Adjacent Community for In-Situ Conservation of *Oryza granulata* in Wavulpane Area”, Pp. 76 – 81.

- **“**Economic Valuation of Genetic Resources of Wild Rice Relatives: Assessing the Preferences of Breeders for Setting the Priorities in Conservation Programs”, Pp. 17 – 21.

- **3rd International Rice Congress**

  Preference of Plant Breeders, Policy Planners and People in Adjacent Communities to Conserve Genetic Resources of Wild Rice Relatives in Sri Lanka: An Economic Analysis

- Publication…. fine tuning

# Way Forward…..

Attitude and Perception of people towards public good

"Carrot and Stick" approach to design conservation programs

Assessing the Transaction cost of conservation

Alternative uses / Income Potential
- Nutrition
- Eco tourism


50
FIFTY RUPEES
20
Central Bank of Sri Lanka
TWENTY RUPEES
10
M 537 144730
Central Bank of Sri Lanka
TEN RUPEES

# Thank you