**Survey of Rice farmers in Andhra Pradesh, India-Farming practices posing threat to Biodiversity**

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**ABSTRACT**

Survey was conducted in Southern zone of Andhra Pradesh in 9 Agricultural sub divisions (blocks), 22 mandals and 3 districts to study the farmers attitudes, knowledge on rice farming practices. Data was collected from 210 farmers from 50 villages by face-to-face interview using Open Data Tool Kit based survey developed by CSISA through preliminary survey and deployed in smart phones.Excessive usage of agro chemicals was observed accounting for about 70-75% which is a major threat to insect biodiversity. Using of agrochemicals discriminately is being proposed to protect the biodiversity.

**Keywords:** Herbicides. Open Data Tool Kit, Pesticides

**JEL codes**: Q53, Q54, Q57

**INTRODUCTION**

Rice is the major cereal crop in Andhra Pradesh holding first place in consumption. People are getting 700 calories per day by each person through rice consumption (Sangeetha and Baskar, 2015). Rice is an important staple food crop for more than 60 per cent of the world people and contributes about 40 per cent of the total food grain production (Ganesh *et al*. 2023). India contributes about 22 per cent of world rice production ranking in second place after china followed by Indonesia with 8 per cent, Bangladesh with 7 per cent, and Vietnam with 6 per cent (Shah, 2019). India occupies an area of 4366 lakh ha and production of 11,887 lakh tonnes with an average productivity of 2,722 kg/ha (Anonymous, 2023). Andhra Pradesh is called Rice Bowl of India.

 In order to be sustainable, more productive and to be functional biological diversity is important and need to maintain it through integrated farming systems. Biodiversity conservation is the key factor to achieve sustainability. Farming practices like mono cropping, excessive and indiscriminate use of fertilizers and pesticides, poor management practices, burning of residues, deployment of natural resources are dangerous to biodiversity.

Farmers are the custodians of biodiversity and their management and farming practices can help to estimate the health and diversity of a farming system (Anonymous, 2001; Wood and Lenne, 1999).

 Hence, the survey was conducted with farmers of Annamayya, Tirupati and Chittoor districts in Southern zone of Andhra Pradesh to identify the farming practices being followed by farmers which are potential threats to biodiversity.

**METHODOLOGY**

Survey was conducted in Southern zone of Andhra Pradesh in 2 Agricultural sub divisions (blocks) and 5 mandalsin Annamayya district; 3 Agricultural sub divisions (blocks) and 8 mandalsin Tirupati district and 4 Agricultural sub divisions (blocks) and 9 mandalsin Chittoor district (Table 1 and Fig 1). Data was collected from 210 farmers from 50 villages by face-to-face interview using Open Data Tool Kit based survey developed by CSISA through preliminary survey and deployed in smart phones. Interviews were conducted to randomly selected farmers of the villages with cooperation from Department of Agriculture. Interviews were conducted at the common place where all the farmers meet during evening times and also in rice fields. Interview time was about 60 min-90 min. Interview gave clear cut picture of farming practices in rice being followed by farmers.Questions were asked to each farmers in local language (Telugu) and translated to English and completed the survey. GPS locations of each farmer field were also recorded.

**Table 1. Details of the villages surveyed:**

|  |  |  |  |
| --- | --- | --- | --- |
| **District** | **Agrl. Sub division (Blocks)** | **Mandal** | **Villages** |
| Annamayya | Piler | Chinnagottigalli | Kumaripalli,Thippireddigaripalli, Kodekambhamvaripalli |
| Rompicherla | Rompicherla, Bestapalli, Kuripartivaripalli, Vankireddigaripalli |
| Sodum | SM Palli, Sodum, Nadigadda, Bayareddigaripalli, Bandaruvaripalli, Yerrathivaripalli |
| Kambhamvaripalli | Garnimitta |
| Madanapalli | Mulakalacheruvu | Mulakalacheruvu |
| Tirupati | Tirupati | Chandragiri | Mittapalem |
| Pakala | Vallivedu, Pakala |
| Pulicherla | Yerravandlapalli, Mangalapalli, Ayyavandlapalli |
| Renigunta | Venkatapuram |
| Srikalahasti | BN Kandriga | Kallivettu |
| Srikalahasti | Vedam, Inagalur |
| Thottambedu | Thottambedu |
| Satyavedu | Varadaiahpalem | Santhavellore |
| Chittoor | Punganur | Chowdepalli | Chintamakulapalli, Agasthapalli, Diguvapalli, Etavakili, chinagornigunta, peddagornigunta, P L Kothuru, Kateperi |
| Gangavaram | Gandrajupalli, Dandapalle |
| Peddapanjani | Appinapalle, Gutturu, Chinnappareddipalli, Sankarayalapeta |
| Puttur | Karvetinagar | Gopichettipalli |
| Narayanavanam | Thiruvatyam |
| VeduruKuppam | VedurKuppam |
| Nagari | Nindra | Elakatur |
|  | Srirnagarajapuram | Pullur |
| Puganur | Punganur | Etavakili, Prasannayyagaripalli, Kuravuru, Nethigutlapalli |



**Fig.1 GPS map of surveyed farms**

**Data analysis**: Data obtained from farmers through questionnaire was entered in MS Excel and frequencies and percentages were calculated.

**RESULTS AND DISCUSSION**

**Educational level, gender and age group of the farmers:**

**Educational level:**

Out of 210 farmers surveyed, 26.7% of the farmers were illiterate, 31.9% of the farmers had attained education upto primary school, 17.6% of the farmers completed matriculation, 9.0% of the farmers attained senior secondary education, 11.9% had graduated with degree and 2.9% were mastered (Table 2 and Fig. 2). Importance of agriculture in India is clearly visible as well educated were also involved in farming.

Eventhough few farmers had attained formal education, most (58.6%) of the surveyed farmers were illiterate or having average literacy rate. Due to low literacy rate, communication is the major barrierto the farmers which made it very difficult to make policies or to conduct training on pest management through integrated practices. Trainings can be organized in local language to prevent the communication barrier between farmer and resource person. Heong*et al*., (2008) reported the same trend in terms of education levels of rice farmers.Most of the farmers had elementary education and the average years spent in school by the farmers was 8 years, an equivalent level of 2nd year high school before quitting (Florencia G.Palis, 2020)

**Table 2. Age group, gender and Educational qualification of farmers in surveyed villages**

|  |  |  |
| --- | --- | --- |
| **Gender of the farmers** | **Educational levels of the farmers** | **Age groups of the farmers** |
| Gender | Frequency | Percentage | Education level | Frequency | Percentage | Age groups | Frequency | Percentage |
| Female | 25 | 11.9 | Illiterate | 56 | 26.7 | Young (Upto 30 years) | 20 | 9.5 |
| Male | 185 | 88.1 | Primary (Upto6th grade) | 67 | 31.9 | Middle aged (30-45 years)  | 76 | 36.2 |
|  |  |  | Matriculation | 37 | 17.6 | Old (>45 years) | 114 | 54.3 |
|  |  |  | Senior secondary (Upto 12th) | 19 | 9.0 |  |  |  |
|  |  |  | Bachelors | 25 | 11.9 |  |  |  |
|  |  |  | Masters | 6 | 2.9 |  |  |  |

**Fig. 2 Distribution of farmers based on their education**

**Age group of the farmers:**

Out of 210 farmers surveyed, young farmers (< 30 years) are contributing 9.5%, middle aged farmers (30-45 years) are contributing upto 36.2% and old aged farmers (>45 years) are contributing to 54.3% (Table 2). It is clearly visible that most (90.5%) of the farmers were above 30 years, which indicates that young people of below 30 years are less engaged in Agriculture and middle aged ad old aged people are more engaged in Agriculture. Muhammad Asghar *et al*., (2013) reported that most of the farmers belong to age of above 30 years.The overall percentage of farmers with ages 30 years old and below was 2.3%: 0.7% in Iloilo, 2.0% in Agusan, and 3.6% in Isabela ((Florencia G.Palis 2020).

 Results indicate that young generation is less involved in agriculture. Old aged people who are unable to do farming actively were involved which shows an increasing trend with age.

**Gender of the farmers:**

11.9% of the farmers were female and 88.1% were male out of 210 surveyed farmers (Table 2). It shows the interest of women towards agriculture. Results indicate that mostly male farmers were actively involved in agriculture and there is need to increase the involvement of women also as labour scarcity is the major problem in farming in India.. Adamon*et al* (2016) stated that in agriculture particularly, women face daunting constraints that significantly limit their potential and enmesh them into a gender productivity trap.

**Land holding and Area under Rice:**

Most of the farmers (82.8%) has land holding of < 2 ha out of which 35.7% were marginal farmers with land holding size of < 1 ha and 47.1% were small farmers with area of 1-2 ha. 14.8% of the farmers belonged to semi medium category with 2-4 ha of land holding size and 2.4% were medium farmers having land of 4-10 ha (Table 3 and Fig. 3). Out of the total 210 farmers 71.0% of the farmers are growing rice in < 1 ha, 27.1% of the farmers are growing in 1-2 ha ad 1.9% I 2-4 ha. It is clearly evident that semi medium and medium farmers are diverting lands to other crops also along with rice. These results are in conformity with statement of Mironga (2005)

 Results showed that no large farmers were there in these districts. Small and marginal farmers uses more chemicals for pest and disease management compared to medium and large farmers as they have a fear of losing yields and income due to pest damage. Hence, vigorous use of fertilizers and pesticides can be observed in farmers fields which is a major threat to Biodiversity.

**Table 3. Land holding and Area cultivated under Rice of the surveyed farmers**

|  |  |
| --- | --- |
| Land holding | Area cultivated under Rice |
| Farm size | Frequency | Percentage | Area | Frequency | Percentage |
| Marginal (< 1 ha) | 75 | 35.7 | < 1 ha | 149 | 71.0 |
| Small (1-2 ha) | 99 | 47.1 | 1-2 ha | 57 | 27.1 |
| Semi medium (2-4 ha) | 31 | 14.8 | 2-4 ha | 4 | 1.9 |
| Medium (4-10 ha) | 5 | 2.4 |  |  |  |

**Fig. 3 Distribution of farmers based on their farm holding size**

**Area of different varieties and source of seed& fertilizers:**

It is clearly showed that farmers are growing wide range of varieties in their fields (Table 4 and Fig. 4) but 70.0 % of the farmers are purchasing seed from private input dealers (Table 5). As farmers are relying on private dealers for seed admixture is the major problem being faced by farmers and due to lack of quality seed crop is more prone to pests and diseases which increases the usage of pesticides and posing threat to biodiversity.

 75.2% of the farmers are purchasing fertilizers from private input dealers (Table 5). Due to lack of quality of fertilizers, farmers are dumping excess fertilizers into their fields to improve yields which results in deteriorating plant health and soil health due to toxicity and also excess nutrients improves succulence of the crop which makes the crop susceptible to pest and disease.Due to this farmers need to use more pesticides to control pests and diseases which affect biodiversity.

**Fig. 4. Distribution of different rice varieties**

**Table 4. Area sown under different rice varieties**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variety** | **MTU 1010** | **NDLR 8** | **RNR 15048** | **NLR 34449** | **NLR 3041** | **NLR 9674** | **BPT 5204** | **BPT 3291** | **Sreeram gold** | **Others** |
| Frequency | 9 | 8 | 28 | 54 | 36 | 21 | 30 | 9 | 12 | 3 |
| Percentage | 4.3 | 3.8 | 13.4 | 25.7 | 17.1 | 10.0 | 14.3 | 4.3 | 5.7 | 1.4 |

**Table 5. Source of seed and fertilizers**

|  |  |
| --- | --- |
| **Source of seed** | **Source of fertilizers** |
| **Source**  | **Frequency** | **Percentage** | **Source**  | **Frequency** | **Percentage** |
| Cooperative | 1 | 0.5 | Agriculture department | 52 | 24.8 |
| Government institutes | 28 | 13.3 | Input dealers | 158 | 75.2 |
| Neighbors/Relatives | 14 | 6.7 |  |  |  |
| Private dealer | 147 | 70.0 |  |  |  |
| Self saved | 20 | 9.5 |  |  |  |

**Crop establishment methods and Ecology of rice:**

95% of the farmers established rice through random transplantation in puddle fields manually followed by line transplanting (7%) and direct broadcasting (3%) (Table 6). Farmers of these areas lack mechanization and crop establishment is labour consuming process. Eventhough there is scope for usage of machinery, transplanting and sowing is done manually. In manual transplantation more number of seedlings were sown per hill compared to machine transplantation. As plant population is more, to supply nutrients and manage pests and diseases, excess fertilizers and pesticides were being used. Most of the rice is cultivating in medium lands accounting for 80% of the total rice cultivated area followed by low land (17%) and only 3% of total area is from upland (Table 6). The tractor operated rice transplanter increases the labor productivity by 32.22 times and saved about 66.69% average transplanting cost compared to manual transplanting (Neeraj Kumar Singh *et al*., 2023).

**Table 6. Crop establishment methods and Ecology**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Establishment method** | **Frequency** | **Percentage** | **Ecology** | **Frequency** | **Percentage** |
| Direct Broadcasting | 3 | 2 | Upland | 7 | 3 |
| Random transplanting in puddle fields manually | 202 | 95 | Medium land | 168 | 80 |
| Line transplanting in puddle fields manually | 7 | 3 | Low land | 35 | 17 |

**Cropping systems:**

Fig 5 clearly shows that 42% of the farmers are following Rice-Rice-Rice cropping system. 14% of the farmers are following vegetables-rice-vegetables, 12% of the farmers are following pulses-rice-fallow, other 12% of the farmers are following cereals-rice-fallow, 6% groundnut-rice-vegetables, 5% groundnut-rice-groundnut, 5% vegetables-rice-groundnut, 4% vegetables-rice-rice. Growing same crop without crop rotation adversely affects the biodiversity by acting as a host to pests and diseases. Crop rotation with pulses/vegetables should be followed to reduce pest & disease attack and also to protect soil health. Growing of same crop require more pesticides compared to crop rotation. Crop rotation is a traditional and practical way for managing agroecosystem biodiversity by enhancing soil health, repressing pests and disease outbreaks ([Barbieri](https://www.sciencedirect.com/science/article/pii/S2351989420304790%22%20%5Cl%20%22bib10) *[et al](https://www.sciencedirect.com/science/article/pii/S2351989420304790%22%20%5Cl%20%22bib10)*[., 2019](https://www.sciencedirect.com/science/article/pii/S2351989420304790%22%20%5Cl%20%22bib10))

**Fig 5. Cropping systems of surveyed farmers**

**Indiscriminate use of chemical fertilizers:**

51.9% of the farmers are using Farm Yard Manure which is a very good practice and only 30.0% of the farmers are using green manures (Table 7). FYM and green manures are abundantly available in these areas but due to some circumstances farmers are not interested in using organic manures completely which can replace 25% of the chemical fertilizers.

 Among 210 farmers, 6.2% of the farmers are not using urea, 52.9% of the farmers are using 50 kg urea, 31.9% of the farmers are using 51-100kg urea and 9.0% are using 101-150 kg urea. 62.4% of the farmers are not using DAP, 37.6% are using 50 kg DAP. 100% of the farmers are using upto 50 kg MOP. DAP and Urea both supplies nitrogen but farmers are using both fertilizers to get higher yields for higher profits. Excess nitrogen is not only toxic to crop but also attracts pests & diseasesand severe weed growth which leads due to higher usage of pesticides.The average yield of excessive nitrogen application (345 kg N ha−1) was 2.68–6.31% lower than that of appropriate nitrogen application (270 kg N ha−1) (Can Zhao *et al*., 2022).

**Table 7. Organic manures/Inorganic Fertilizers used by farmers (Basal + Top dressing)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Amount of fertilizers (Kg)** | **FYM** | **Green manure** |  | **Urea** | **DAP** | **MOP** |
| **Frequency** | **Percentage** | **Frequency** | **Percentage** | **Frequency** | **Percentage** | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| **Organic manures** |
| Not using | 101 | 48.1 | 147 | 70.0 | - | - | - | - | - | - |
| Using | 109 | 51.9 | 63 | 30.0 | - | - | - | - | - | - |
| **In organic fertilizers** |
| No use | - | - | - | - | 13 | 6.2 | 131 | 62.4 | 0 | 0.0 |
| 0-50  | - | - | - | - | 111 | 52.9 | 79 | 37.6 | 210 | 100 |
| 51-100  | - | - | - | - | 67 | 31.9 | 0 | 0.0 | 0 | 0.0 |
| 101-150  | - | - | - | - | 19 | 9.0 | 0 | 0.0 | 0 | 0.0 |

**Source of irrigation and number of irrigations:**

Table 8 shows that 59.0% of the farmers get irrigation water from deep tube wellsfollowed by canals (13.3%), canals + deep tube wells (12.9%), canals + shallow tube wells (10.5%) and shallow tube wells (4.3%). Most of the farmers (63.8%) irrigating 6-10 times followed by 11-15 times (35.2%) and 5 times (1.0%).

 Results clearly showed that farmers are giving more number of irrigations than required. Eventhough, rice is a water loving crop, excess water causes root rot, sheath blight, attracts insects like BPH which leads to excess usage of pesticides.Haonan Qi *et al*., 2022 reported that alternate wet and dry irrigation had a significant yield-increasing effect (average 2.57% increase)

**Table 8.Irrigation source and no. of irrigations**

|  |  |
| --- | --- |
| **Source of irrigation** | **No. of irrigations** |
| **Source**  | **Frequency** | **Percentage** | **Number** | **Frequency** | **Percentage** |
| Canals | 28 | 13.3 | 5 | 2 | 1.0 |
| Deep tube wells | 124 | 59.0 | 6-10 | 134 | 63.8 |
| Shallow tube wells | 9 | 4.3 | 11-15 | 74 | 35.2 |
| Canals + Deep tube wells | 27 | 12.9 |  |  |  |
| Canals + shallow tube wells | 22 | 10.5 |  |  |  |

**Pesticide application:**

Most of the farmers are using pesticides once. 69.5% of the farmers are using herbicide once 84.8% using insecticides once and 82.4% using fungicides once (Table 9). 2.4% of the farmers are using herbicides twice. Only few farmers i.e. less than 30% of the farmers are not using any kind of pesticides. Farmers need to spray pesticides to control pests but proper usage is also important. Farmers are using wrong pesticides, wrong place, wrong dose, wrong time as they are not aware of the symptoms of nutrient deficiencies, toxicity, disease damage, pest damage and type of weeds. Using wrong insecticide/fungicide may not control the insect/disease but using wrong herbicide at wrong dose and time is harmful to crop. The estimated economic loss due to excess use of nitrogenous and plant protection chemicals for the TBP area as a whole was Rs. 8618.4 lakhs (Savita patil*et al*., 2014).

Table 10 clearly shows that 74.8% of the farmers are using pesticides by consulting private dealers. As some of the unauthorized dealers are not aware of the pests farmers end up in using growth regulator, fungicide and insecticideat once to control only one kind of pest. It not only increase cultivation cost but also causes environmental, soil, water pollution and also hazardous to human health. So farmers should be aware of ETL levels of pests, type of weeds before going for chemical sprays or they need to consult any agriculture specialist. Bandong *et al* (2002) reported that most of the farmers rely on pesticides leading to overuse.

**Table 9.Average number of pesticide applications**

|  |  |  |  |
| --- | --- | --- | --- |
| **Particulars** | **Once** | **Two times** | **Not used** |
| **Frequency** | **Percentage** | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| Herbicides | 146 | 69.5 | 5 | 2.4 | 59 | 28.1 |
| Insecticides | 178 | 84.8 | 0 | 0.0 | 32 | 15.2 |
| Fungicides | 173 | 82.4 | 0 | 0.0 | 37 | 17.6 |

**Table 10. Practices of pesticide application**

|  |  |  |
| --- | --- | --- |
| **Particulars** | **Frequency** | **Percentage** |
| Not using | 2 | 1.0 |
| After observing pest/disease without consulting anyone | 23 | 11.0 |
| After observing damage without consulting anyone | 15 | 7.1 |
| After observing by consulting agriculture department or university scientists | 2 | 1.0 |
| After observing by consulting private dealers | 157 | 74.8 |
| Following neighbor | 11 | 5.2 |

**Yield:**

**Fig 6. Histogram of rice yield**

The average grain yield was 6.7 t/ha ranging from 3.5-10.0 t/ha in surveyed farmers fields (Fig 6). 7.1% farmers got yields ranging from 3.5-4.5 t/ha, 22.9% farmers recorded yield ranging from 4.5-5.5 t/ha, 19.0% of farmers got yields between 5.5-6.5 t/ha, 22.9% farmers recorded yield ranging from 6.5-7.5 t/ha, 5.3% got yields ranging between 7.5-8.5, 13.8% farmers recorded yield range of 8.5-9.5 t/ha and 9.0% farmers recorded yield range between 9.5-10.5 t/ha. Variation in yield was due to different crop establishment methods, different time of sowings/plantings, different varieties and other management practices.

Variety wise average grain yield of rice is depicted in Fig.7. NLR 34449 recorded higher yields (8.1 t/ha) followed by NLR 9674 (7.0 t), NLR 3041 (6.7 t). NDLR 8 recorded lowest yield of 5.6 t/ha. Survey was conducted in southern zone and varieties released from southern zone are performing well in these areas compared to other varieties.

 Among crop establishment methods, manual transplanting methods recorded higher yields compared to direct seeding. Yield of 7.0 t/ha was obtained in Random transplanting method in puddles fields manually followed by 6.6 t in line transplanting method. Direct seeding recorded yield of 4.0 t/ha. Among different planting times, June transplanted Paddy recorded highest yield of 8 t/ha and yield reduction was observed with delay in transplanting rice from July to August. Among different weed control methods, one time herbicide usage and one time hand weeding got higher yield of 8.2 t/ha followed by 2 hand weedings (6.3 t/ha). Lowest yield of 5.8 t/ha was obtained in 1 hand weeded fields (Table 11).

 Results indicate that proper time of plating and management practices gives higher yields. Sowing in may or early june to transplant in correct time, transplanting the crop instead of direct sowing and appropriate usage of pesticides will not only reduce cost but also gives higher yields. Improper management practices not only increase cost but also poses threat to biodiversity.Maximum yield potential of a rice crop is usually achieved when the crop is exposed to the most appropriate temperature range, which can be controlled by sowing at the proper time (A R Patel., 2019).

**Fig 7. Average yield of different varieties**

**Table 11. Yield of rice as influenced by different management practices**

|  |  |
| --- | --- |
|  | **Grain yield (t/ha)** |
| **Crop establishment methods** |
| Direct Broadcasting | 4.0 |
| Random transplanting in puddle fields manually | 7.0 |
| Line transplanting in puddle fields manually | 6.6 |
| **Time of transplanting** |
| June | 8.0 |
| July | 6.1 |
| August | 5.9 |
| **Weed control methods** |
| 1 hand weeding | 5.8 |
| 2 hand weedings | 6.3 |
| 1 hand weeding + one time herbicide application | 8.2 |

**Burning of rice straw:**

Large number of farmers (68.6%) are using rice straw as feed to cattle. 24.3% are ploughing in the field, 4.8% are selling rice straw and only 2.4% are burning (Table 12). Eventhough straw is being collected and used for different purposes, stubbles in the rice field are being burnt sometimes which caused pollution. The farmers were feeding rice straw to their cattle either after collecting from fields or by grazing animals in harvested field (Praweenwongwuthi*et al*., 2010)

**Table 12. Residue burning in the field**

|  |  |  |
| --- | --- | --- |
| **Particulars** | **Frequency** | **Percentage** |
| Residue burning | 5 | 2.4 |
| Ploughing in the field  | 51 | 24.3 |
| Sale | 10 | 4.8 |
| Feed to cattle | 144 | 68.6 |

**CONCLUSIONS**

Socio-economic condition of the farmers is very poor. Farmers are not taking advices from experts while purchasing seed or other agrochemicals.Excess fertilizer usage and pesticide usage is observed which is not at all good for environment, soil and also hazardous to human health.Sowing same crop every year and season subjecting to more pests and disease which in turn increase the usage of pesticides.

 Farmers should follow the recommendations give by the experts in selecting variety, using fertilizers and other agro-chemicals. It not only reduces the cost of cultivation and pollution but also gives good yields.Farmers should be well trained on good agricultural practices to reduce usage of agrochemicals. Using of agrochemicals discriminately is being proposed to protect the biodiversity.

**REFERENCES**

Adamon, N., Mukasa, Adeleke, O., Salami1. (2016). Gender equality in agriculture: What are really the benefits for sub-Saharan Africa? . *Africa Economic Brief*. 7 (3), 1-5.

Anonymous (2001). Country status report Nepal, a national case study on the integration of biodiversity into EIA, for the IAIA backed action programme on biological diversity and impact assessment under the UNEP/UNDP/GEF biodiversity planning support programme, Kathmandu, Nepal.

Anonymous (2023). Area, production and productivity of rice of major cereals in India. Available at [www.indiastat.com](http://www.indiastat.com). Accessed on 29.05.24

Bandong, J.P., Canapi, B.L., dela Cruz, C.G., & Litsinger, J.A. (2002). Insecticide decision protocols: a case study of untrained Filipino rice farmers. *Crop Prot, 21*, 803-816.

Barbieri, P., Pellerin, S.,  Seufert, V., & Nesme, T. (2019). Changes in crop rotations would impact food production in an organically farmed world. *Nat. Sustain*, *2*, 378-385.

Can Zhao GuangmingLiu, YueChenYan Jiang, Yi Shi, Lingtian Zhao, Pingqiang Liao, Weiling Wang, Ke Xu, Qigen Dai, & Zhongyang Huo. (2022). Excessive Nitrogen Application Leads to Lower Rice Yield and Grain Quality by Inhibiting the Grain Filling of Inferior Grains. Agriculture, 12(7): 962.

Florencia, G., Palis. (2020). Aging Filipino Rice Farmers and Their Aspirations for Their Children *Philippine Journal of Science, 149* (2), 351-361.

Ganesh, V., Suman, L., Ajayakumar., & Madhu, D.M. (2023). The changing landscape of paddy cultivation in Andhra Pradesh: A statistical assessment of area, production, and productivity. *International Journal of Statistics and Applied Mathematics, 8*(6), 155-164

[Haonan Qiu](https://pubmed.ncbi.nlm.nih.gov/?term=Qiu%20H%5BAuthor%5D), [Shihong Yang](https://pubmed.ncbi.nlm.nih.gov/?term=Yang%20S%5BAuthor%5D), [Zewei Jiang](https://pubmed.ncbi.nlm.nih.gov/?term=Jiang%20Z%5BAuthor%5D), [Yi Xu](https://pubmed.ncbi.nlm.nih.gov/?term=Xu%20Y%5BAuthor%5D), & [Xiyun Jiao](https://pubmed.ncbi.nlm.nih.gov/?term=Jiao%20X%5BAuthor%5D). (2022). Effect of Irrigation and Fertilizer Management on Rice Yield and Nitrogen Loss. *Plants (Basel), 11*(13), 1690

Heong, K.L., Escalada, M.M., Huan, N.H., Ky Ba, V.H., Quynh, P.V., Thiet, L.V., & Chien, H.V. (2008). Entertainment-education and rice pest management: A radio soap opera in Vietnam. *Crop Prot, 27*, 1392- 1397.

Mironga, J.M. (2005). Effect of farming practices on weetlands of Kissii district, Kenya. Appl. *Ecol. Environ. Res, 3*(2), 81-91.

Muhammad Asghar., Muhammad Arshad., Muhammad Fiaz., Anjum Suhail., & Arshad Makhdoom Sabir. (2013). A survey of rice farmers’ farming practices posing threats to insect biodiversity of rice crop in the Punjab, Pakistan. *International Journal of Biodiversity and Conservation, 5*(10), 647-654.

[Neeraj Kumar Singh](https://www.tandfonline.com/author/Singh%2C%2BNeeraj%2BKumar)., [Mahesh Kumar Narang](https://www.tandfonline.com/author/Narang%2C%2BMahesh%2BKumar)., [Surinder Singh Thakur](https://www.tandfonline.com/author/Thakur%2C%2BSurinder%2BSingh)., [ManjeetSingh](https://www.tandfonline.com/author/Singh%2C%2BManjeet)., [Shashi Kumar Singh](https://www.tandfonline.com/author/Singh%2C%2BShashi%2BKumar)., & [Apoorv Prakash](https://www.tandfonline.com/author/Prakash%2C%2BApoorv). (2023). Influence of transplanting techniques and age of wash root type seedlings on planting attributes of paddy rice. *Food & Agriclture, 9*(1).

[Patel](https://www.researchgate.net/scientific-contributions/A-R-Patel-2146189358?_sg%5B0%5D=Lta_aXiaMNjIzsLW5F4u40MPBI9mMsJR5APJo-soOlix5Up1BXJE6uXLBA1EFM1i78za34s.avzaIZ3wlvu_qZsLPhThFoQziACa27oqwAaDdxWzBB2ciDye_YDKQuEHXemI9JCIg3aMM8PhZa--TKL8v3yWMQ&_sg%5B1%5D=SNcY5WljALWVrhWR52-yQdltWSiTXKJqE7Xtdo8cwAgs1J0YkpUV59HmzDBmvIzRvOUPccs.HtvN-o6SDZXfwVebev5p6yGLA5dTeP5xfH1E5D_rTQ8APaFHN3T6i2nxgL06xv67fdell3lBJYdkPY2xuBSgiw), A.R., [Mukeshkumar, L., Patel](https://www.researchgate.net/profile/Mukeshkumar-Patel-4?_sg%5B0%5D=Lta_aXiaMNjIzsLW5F4u40MPBI9mMsJR5APJo-soOlix5Up1BXJE6uXLBA1EFM1i78za34s.avzaIZ3wlvu_qZsLPhThFoQziACa27oqwAaDdxWzBB2ciDye_YDKQuEHXemI9JCIg3aMM8PhZa--TKL8v3yWMQ&_sg%5B1%5D=SNcY5WljALWVrhWR52-yQdltWSiTXKJqE7Xtdo8cwAgs1J0YkpUV59HmzDBmvIzRvOUPccs.HtvN-o6SDZXfwVebev5p6yGLA5dTeP5xfH1E5D_rTQ8APaFHN3T6i2nxgL06xv67fdell3lBJYdkPY2xuBSgiw&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIiwicG9zaXRpb24iOiJwYWdlSGVhZGVyIn19) [Rakesh K., Patel](https://www.researchgate.net/profile/Rakesh-Patel-22?_sg%5B0%5D=Lta_aXiaMNjIzsLW5F4u40MPBI9mMsJR5APJo-soOlix5Up1BXJE6uXLBA1EFM1i78za34s.avzaIZ3wlvu_qZsLPhThFoQziACa27oqwAaDdxWzBB2ciDye_YDKQuEHXemI9JCIg3aMM8PhZa--TKL8v3yWMQ&_sg%5B1%5D=SNcY5WljALWVrhWR52-yQdltWSiTXKJqE7Xtdo8cwAgs1J0YkpUV59HmzDBmvIzRvOUPccs.HtvN-o6SDZXfwVebev5p6yGLA5dTeP5xfH1E5D_rTQ8APaFHN3T6i2nxgL06xv67fdell3lBJYdkPY2xuBSgiw&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIiwicG9zaXRpb24iOiJwYWdlSGVhZGVyIn19), & [Balaji Mohan Mote](https://www.researchgate.net/profile/Balaji-Mote-2?_sg%5B0%5D=Lta_aXiaMNjIzsLW5F4u40MPBI9mMsJR5APJo-soOlix5Up1BXJE6uXLBA1EFM1i78za34s.avzaIZ3wlvu_qZsLPhThFoQziACa27oqwAaDdxWzBB2ciDye_YDKQuEHXemI9JCIg3aMM8PhZa--TKL8v3yWMQ&_sg%5B1%5D=SNcY5WljALWVrhWR52-yQdltWSiTXKJqE7Xtdo8cwAgs1J0YkpUV59HmzDBmvIzRvOUPccs.HtvN-o6SDZXfwVebev5p6yGLA5dTeP5xfH1E5D_rTQ8APaFHN3T6i2nxgL06xv67fdell3lBJYdkPY2xuBSgiw). (2019). Effect of different sowing date on phenology, growth and yield of rice-a review. [*Plant Archives*](https://www.researchgate.net/journal/PLANT-ARCHIVES-2581-6063?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIiwicG9zaXRpb24iOiJwYWdlSGVhZGVyIn19)*, 19*(1), 12-16.

Praweenwongwuthi, S., Laohasiriwong, S., & Terry Rambo, A. (2010). Impacts of rice combine harvesters on economic and social of farmers in a village of the Tung Kula Ronghai region. *Res. J. Agri. Biol. Sci, 6*(6), 778-784.

Sangeetha, C., & Baskar, P. (2015). Influence of different crop establishment methods on productivity of rice–a review. *Agri. Review, 36*(2), 113-124.

Savita, K., Patil, Reddy, B.S., & Ramappa, K.S. (2014). Excessive use of fertilizers and plant protection chemicals in paddy and its economic impact in Tungabhadra Project Command area of Karnataka,India. *Eco. Env. & Cons, 20* (1), 297-302.

Shah, I.A. (2019). Trend Analysis of Area, Production and Productivity of Apple Fruit in Jammu and Kashmir. Production and Productivity of Apple Fruit in Jammu and Kashmir. J *Gujarath Res. Society, 21*(15), 601-611.

Wood, D., & Lenne, M. (1999). Agrobiodiversity: Characterization, utilization and management. *Cons. Bio, l15*(1), 294.