Identification and Prioritization of Problems in Integrated Agriculture for Community Development: A Case of Amba Village in Sub-humid Region of Western India

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Authors' contributions

This study was carried out in collaboration with all the authors. Authors MM, PS, AJ and IM formulated the objectives, plan the activity, collected the data, performed compilation and analysis of data, wrote the protocol and wrote the first draft of the manuscript. Authors MM, PS performed field survey and managed literature searches. All authors read and approved the final manuscript.

Article Information

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ABSTRACT

Participatory rural appraisal (PRA) is a technique which gives more emphasis on local knowledge end enable locals to do their own appraisal, analysis and planning on the participatory basis. In this study, a transect survey was conducted at Amba village of Ajmer, India to understand the factual needs of the farming community. The rank-based quotient (RBQ) was calculated followed by the value based Index (VBI) in order to prioritize integrated agriculture problems and their solution was given using problem-solution-tree approach. Findings indicated low productivity of animals, unavailability of irrigation water, bacterial blight in marigold, leaf blight in chrysanthemum and low

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yield in pearl millet as important constraints faced by the farmers. Constraints identified were categorized as problems arising out of gaps in research/extension activities in various agriculture and allied disciplines. Based on the results and necessity of the villagers, scope for research/extension and policy implications was made.

1. INTRODUCTION

Agriculture is the principal source of food and livelihood in India as 54.6 percent population is engaged in agriculture and allied activities and contributes 17 percent to the country's gross domestic product [1]. Indian agriculture has witnessed remarkable growth during past decades. Despite achieving growth the agriculture production, particularly, small and marginal farmers are constrained with new challenges like access to inputs, technology for production, marketing and other related factors [2]. An array of such constraints require scientific interventions and extension based solution. The basic aim of research experts/extension workers in agriculture is to enlarge/ demonstrate technologies/ invent solutions based on requirements and problems faced by the stakeholders in actual field condition. In order to understand local requirements, farmers' participation is most important through which farmers influence and share control over priority of problems, resource allocations and access to different sources [3]. Involving farmers in their own problem-solving process enhances their adaptability to solutions suggested. Therefore, need based research is required for proper identification, planning and solution of agricultural problems.

Participatory rural appraisal (PRA) is an exercise/methodology for interacting villagers, understanding them and learning their local needs. It is a tool for getting first-hand information about social issues, resources, land patterns, adoption/awareness about improved methods, participation, location specific problems and their concerned solutions [4]. It is an approach to shared learning between locals and experts to enhance the rural development progression, technology adoption, and linkages between research, training and extensions [5]. Keeping this in view, the present study was conducted on the identification of agriculture problem of villages through PRA techniques and accordingly prioritization and solution of the problems suggested.

2. MATERIALS AND METHODS

2.1 Study Area

This study is conducted in village Amba, Dist. Ajmer, Rajasthan, India as part of field experience training of an Agriculture Research Services (ARS) in 2014. The basic information about the village like location, climate, land use pattern and agro socio-economic features (such as agriculture, population, literacy, etc.) is collected through transect walk, agro-ecological map, resource map, seasonal calendar (activities), seasonal analysis (problems), social map, time line, time trend, mobility map, venn diagram, bio-resource flow, wealth ranking, livelihood analysis, daily activity and routine, indigenous technical knowledge (ITK), technology table and technology map, matrix ranking and consequence diagram tools of PRA. Further, systematic steps have been followed during the identification and prioritization of agriculture problems.

2.2 Identification of Farmers and Key Informants (KIs)

Three (3) progressive farmers were identified as key informants based on their knowledge and experience in agriculture. They all were assigned to list the problems faced by villages in agriculture and allied activities. In addition to key informants, 20 other farmers were also identified using stratified random sample techniques as the representative of the village and their view for problems (Agriculture/allied) as per their social and economic perspective has been taken. Preference ranking with paired comparison techniques applied for effective ranking of these problems.

2.3 Collection and Quantification of Data

PRA is the most suitable and appropriate method to identify existing situation/problems of the community [6]. The constraints faced by the respondents in agriculture production were

identified through participatory approach. Required data collected from selected respondents using well-structured and pre-tested schedule. In some cases, focused group discussions (FGDs) were also used. Quantification of data was done by ranking the constraints based on the responses obtained from the respondents and Rank Based Quotient (RBQ) was calculated [7] using following formulae:

$$RBQ = \frac{\sum f_i\,(n + 1 - i)}{N \times n} \times 100$$

Where,

- f_i = Frequency of farmers for the ith rank of the attribute
- N = No. of farmers contacted for factor identification
- n = Maximum no. of ranks given for various factors.
- i = Rank of the attributes

The magnitude of the problem associated with the village was estimated through Value Based Index (VBI) using following formulae:

$$VBI = \frac{RBQ \times Av.\ Loss\ Experienced \times Area\ of\ Crops}{No.\ of\ Animals} \times 100$$

2.4 Problem- solution Tree

Once problems were identified and ranked, different respondents were interviewed again to get insight into their problems and to know real cause of their problems. On the basis of this discussion, problem-cause tree was prepared. Major problems were also discussed with the nearby research institutes, extension experts, local and community leaders to drawn problem-solution tree. This has indicated scope and point of intervention by research institutes, extension workers and related departments through integration approach to mitigate the problem.

2.5 Indigenous Technical Knowledge (ITK) and Mobility Map

Mobility map was drawn to develop localized marketing strategy for the farm produce. It showed the way in which local people mobilize their produce from village to other places. ITK is the knowledge and experience/practice which are based on cumulative experience in dealing with situation and problems in various aspect of life [8]. A detailed interview of elder villagers has been done to identify ITKs and listed.

3. RESULTS AND DISCUSSION

3.1 Background of the Study Area and Socio-economic Profile of Respondents

The Amba Village lies between 26.37665º and 26.39572ºN and between 74.52712º and 74.54540ºE, with the geographic area of about 380 hectares (cultivated land ~202 ha, Irrigated land ~172 ha and fallow land ~ 90 ha). Crops are irrigated by pond (3 ha), rain (30 ha), open well and bore well (139 ha). The cropping intensity is 155%, approximately. Villages Dumada, Bauta, Ajesar and Massina make east, west, north and south boundary of the village, respectively (Fig. 1). Temperature in Amba village ranges from 43ºC (min) to 44.5ºC (max). Average annual rainfall is ~525 mm. Relative humidity varies from 65 to 75% depends on precipitation and temperature. The total population in Amba village is 1200. Out of which, male population is 605 and female population is 595. Open wells and bore wells serve the need of water in the village apart from rain water. For drinking purpose, 3 water tank and 10-12 hand pumps are present in the village. A seasonal water stream (on east side) and a seasonal pond (on extreme north of village) are present which forms life line for the farmers as water resources in agriculture.

3.2 Result of Transect Walk, Indigenous Traditional Knowledge and Mobility Map

On the basis of transect walk, whole village has divided into four parts *Viz*. Roadside fields, residential area, fallow land and water reservoir in the form of pond. Information regarding agriculture and allied activities, soil type, problems, solutions, weakness, threats and opportunity are mentioned in Table 1. Farmers using local techniques/treatments as a remedy for some of field and animal diseases, which is collected and tabulated (Table 2). Map presented in Fig. 2 indicates mobility of villagers to know their marketing destination for daily livelihood. This helps to understand to develop market strategies for the benefit of farmers.

3.3 Identification and Prioritization of Problems Faced by the Farmers

To express the importance of the problem faced by the respondents and key informants, "Rank Based Quotient" (RBQ) and Value Based Index

(VBI) is formulated and presented in Table 4 and 5. To categorize problems, all 20 farmers were asked to rank the problems based upon the severity and percentage of loss they are facing due to that problem. Since selected farmers represented all the sectors varying from rich farmers to landless farmers, the ranking pattern was also diverse. As obvious, landless farmers did not rank crop problems and majorly concerned towards animal husbandry related problems. The extent of damage (per acre) to affected crops due to particular problem in the village was determined by the farmers. The data for damage was further validated by KVK, Ajmer and ICAR-National Research centre of Seed and Spices (NRCSS), Ajmer, India.

Calculation of the RBQ and VBI shows that low milk productivity was the major problems faced by the villagers (Rank 1) followed by unavailability of irrigation water (Rank 2) particularly for wheat crop at critical stages. Since study area is dominated by flower cultivation, bacterial blight in Marigold (Rank 3) and leaf blight in chrysanthemum (Rank 4) were observed. Further, low yield in pearl millet (Rank 5), blight disease in Tomato (Rank 6) and *Cochliobolus* disease (Fungal Disease) in Barley (Rank 7) were indicated from farmer's response.

3.4 Problem and Solution

3.4.1 Low yield of milk

All the problems were discussed with the farmers for all possible reasons using top-down approach. The possible solution for each cause was also discussed with the farmers. Based on the ranking method it was found that low productivity of animals (low milk yield) was the mostly attached problem with the villagers. The livestock in village are more labour demanding than crop cultivation and it has highest prospective for income encashment with low outlay. In study area majority of cattle's and buffaloes are non-descript and have very low milk yield. Regarding this issue after discussion with the key informants, progressive farmers, official of Department of Animal Husbandry, we prepared a problem- solution tree (Fig. 3) to deal with particular problem.

3.4.2 Unavailability of irrigation water

Scarcity of the irrigation water is the next severe problem for the villagers according to ranking method. This situation arises due to the neglect

of traditional water bodies, lack of positive approach towards water management bodies and low adoption level of soil and water conservation techniques during wheat cultivation [9]. Since water is major concern in the village, related problem solution tree drawn to address the problem (Fig. 4). Similar results were identified by [10].

3.4.3 Insect pest attack in flowers

Since identified village near to *Pushkar* (Brahma temple), so the demand is shift towards the cultivation of flowers. Therefore, some flower related disease identified as the constraints for the farmer, which required scientific input and action plan in coordination with other departments to address the problem.

3.5 Post PRA Interventions

Problems identified were categorized as problems arising out of gaps in research in various agriculture and allied disciplines and gaps in extension activities. Main problems related to extension and research identified have been enumerated as follows:

3.5.1 Research, extension scopes and policy issues

1. Awareness about animal health related issues, proper management of diseases, type of vaccinations and its procedure. Health and sanitation condition of the cattle's should be the key focus to secure the livelihood. Scientists can work on molecular epidemiological studies of FMD, HS and Mastitis development in order to help farmers in better way.
2. Livestock sector has a great prospective for creating self-employment at the lowest possible investment per unit. Therefore, animal husbandry department in coordination with extension officials need to create awareness about high yielding breeds, breed improvement programs, veterinary health care and other disease control programmes.
3. To Understanding the population dynamics of low milk yield in cattle in relation to current environmental conditions, a study on that issue will be helpful to researcher to produce quality results for betterment of farmers. Further, availability of green fodder can also enhance milk yield.
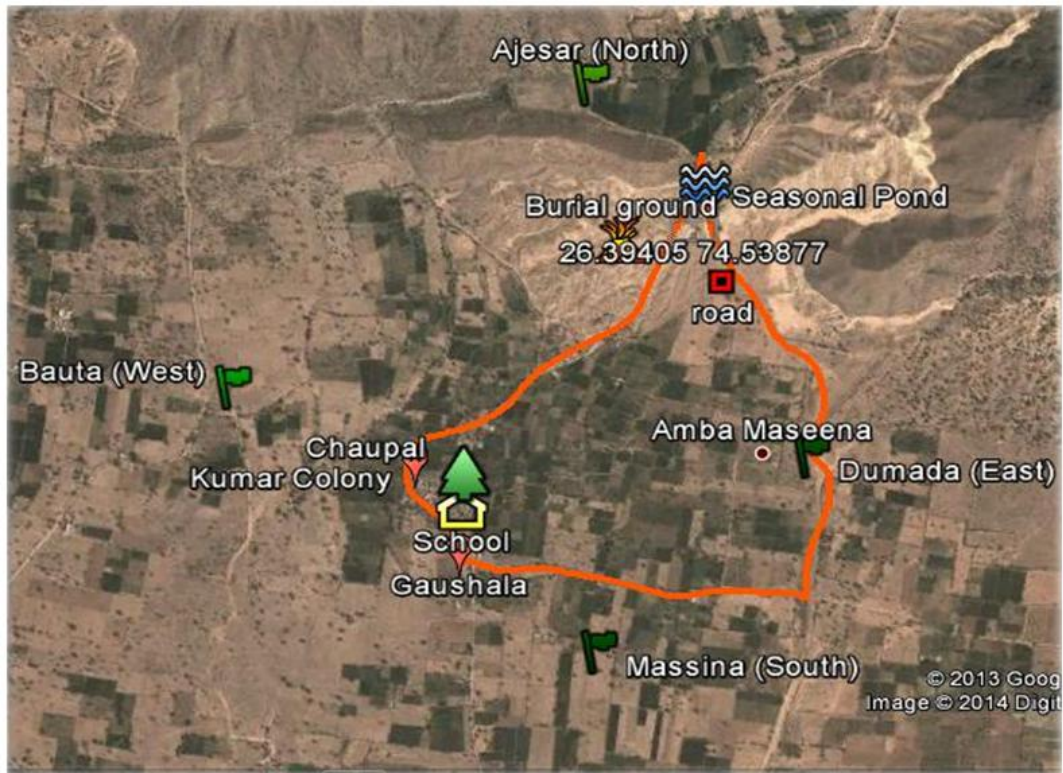
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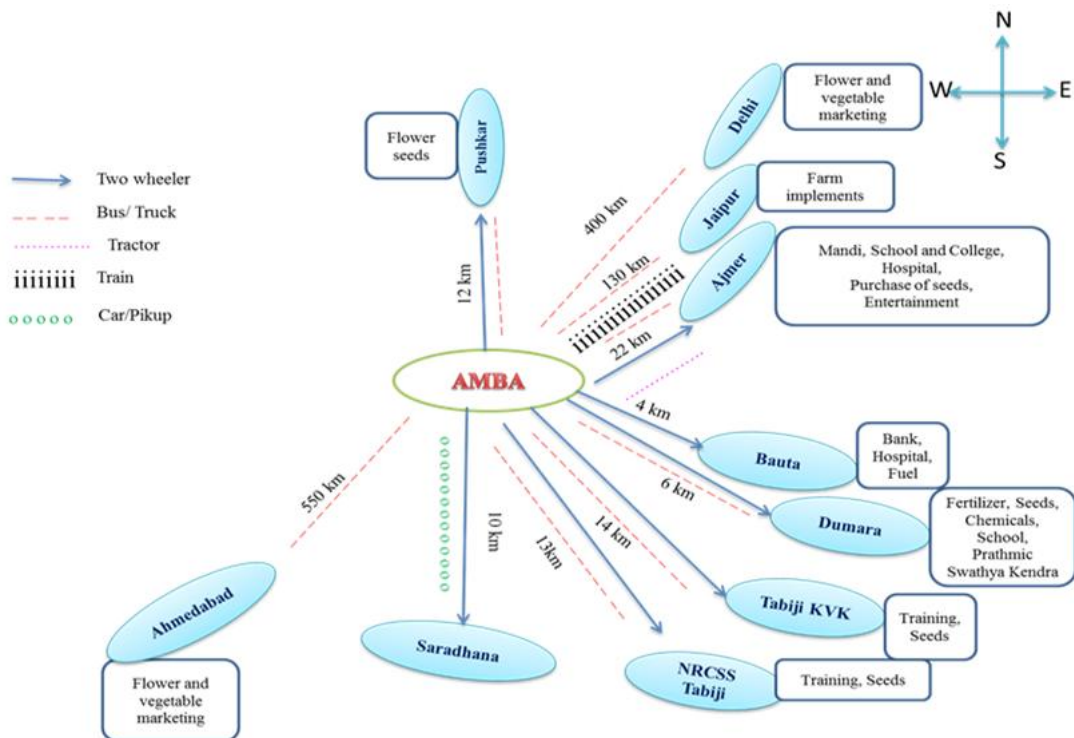**Fig. 1. A satellite image of Amba village**

Fig. 2. Mobility map

Table 1. Basic information of Amba village

Particulars	Roadside fields	Residential area	Fallow land	Water reservoir
Soil Type	Sandy Loamy	Sandy Loamy	Sandy Loamy	Loamy
Major cereal &fruit crops	Barley, pearl millet, Wheat, Maize, Amla, Ber	-	Amla	-
Flower crops	Chrysanthemum, Marigold	-	-	Marigold
Vegetable crops	Tomato, Guar, Chilli, Fenugreek	-	-	Tomato
Other crops	Lucern	-	-	-
Implements	Seed drills, Disc harrow, Cultivator	Electric chaak, Electric motor	-	-
Trees	Neem	Neem	*Prosopisjulifera*, Acacia (Babool)	*Prosopisjulifera*, Acacia (Babool)
Weeds	*Argemone*, *Calotropis*, *Chenopodium, Orobanchae spp.*	-	*Argemone*, *Calotropis*	*Orobanche spp.*
Pest & Diseases (Plants)	Tomato leaf blight, *Alternaria*, Termites, Aphids, Fruit borer	-	-	-
Diseases	-	Human: T. B. , Mouth cancer Animal: Foot & Mouth disease, Afra (bloating)	Animal: Foot & Mouth disease	-
Water sources	Bore well, Open well	Water tank and Hand pumps	-	Pond
Livestock	-	Buffalo, Cow, Goat, Sheep, Bullocks	Goat, Sheep	-

Table 2. The General transect (Problem, solution and opportunities)

Particulars	Roadside fields	Residential area	Fallow land	Water reservoir
Problems	Water scarcity Low fertile land Lack of agricultural consultancy *Orobanche*(parasite) problem Stray animals	Social problems: Alcoholism, Consumption of tobacco, improper distribution of work among man and woman. No health care facilities for people and animals No higher education facilities. Low milk producing breed Inferior quality of fodder	1. Uneven land 2. Low water retention 3. No market demand for Amla tree	1.Submerging of horti -produce during heavy rain
Solutions	Adopt drip irrigation Improving soil fertility by promoting use of organic manures such as compost and vermi-compost. Training programme for awareness and adoption on precision farming. Go for crop rotation to get rid of problem of Orobanche spp. Wiring around the fields for eliminating the problem of grazing animals	Community initiation to solve social problems like alcoholism, consumption of tobacco and proper distribution of work. Good transport facility for easy access of education and health care facilities. Improvement of breed status of local goat and cattle by selective breeding. Adopt Azolla cultivation (at farmers' fields) for supplementary feeding of livestock.	1. Evenness can be obtained by mechanically. 2. Rain fed crops can be grown. 3. Hand on training can be given to Farmers for value addition in amla.	1.Increase the depth of pond during dry season
Opportunities	Protective cultivation can be practiced to get rid of major pest and diseases of crops. Seed spices can be grown for income enhancement (As climate is suitable and quality seeds can be obtained by nearby institute NRCSS, Ajmer) Hybrid seeds for high yielding varieties of vegetables	Seed spices can be grown for income enhancement. High milk producing breed can be practiced. *Spirulina* cultivation (at farmers' fields) for supplementary feeding of livestock. Local transport facilities can be an opportunity to local people for income generation. Vaccination for animal diseases. Land less people can earn from livestock. Shelf help group (SHG) can play major role	Land can be used for infrastructure development. Fallow land can be used for vermincompost, super-compost development.	High value crops like Lotus stem can be grown Pond can be used for aquaculture activity. Flower crops can be used for natural dye extraction

Table 3. List of ITKs of Amba village

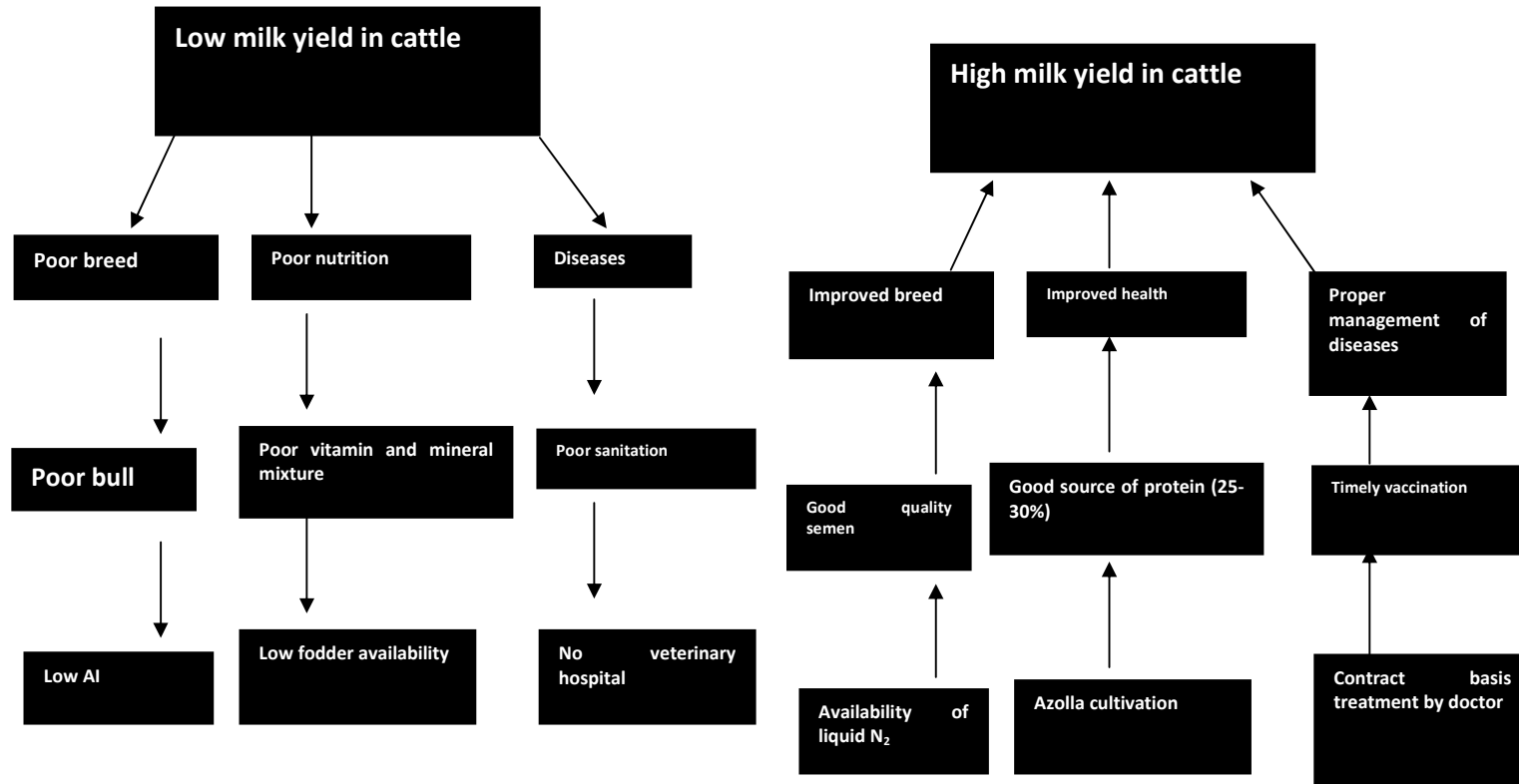| Technique	Treatments	Scientific reasons
Haldi (turmeric) powder	Healing wounds	Anti-inflammatory compound curcumin
Neem leaves	Used in grain storage	Chemical compound azadiractin, act as insect deterrent
Neem sticks	Used to prevent tooth decay	Anti-bacterial compound mahmoodin
Turmeric + sesame oil	Treatment for gastric problem in goats	Anti-inflammatory compound curcumin (turmeric) and anti-ulcer compounds in sesamone and sesamolin
Sesame+ jaggery+ fenugreek	treatment for arthritis	Anti-inflammatory compound sesamone and sesamolin (sesame) and presence of an alkaloid pyridine in fenugreek
Peralmillet+ jaggery+ salt	Extract is heated, allowed to cool down, this is given as a treatment against cold	NA
Addusa leaves	Chewing of its leaf keeps the children healthy	NA

Fig. 3. Problem solution tree for low milk yield in cattle

Low water availability for wheat production

High water availability for wheat production

Water scarcity

Sandy soil

Inefficient water use

(Flood irri.)

Recharge of water table

Less no. Of irrigation needed

Low water consumption

Low water table

Low WHC

More water consumption

Rain water harvesting

High water retention

Sprinkler system

More water suction from wells

More No of irrigations

Watershed management

(farm pond)

Application of compost, vermicompost

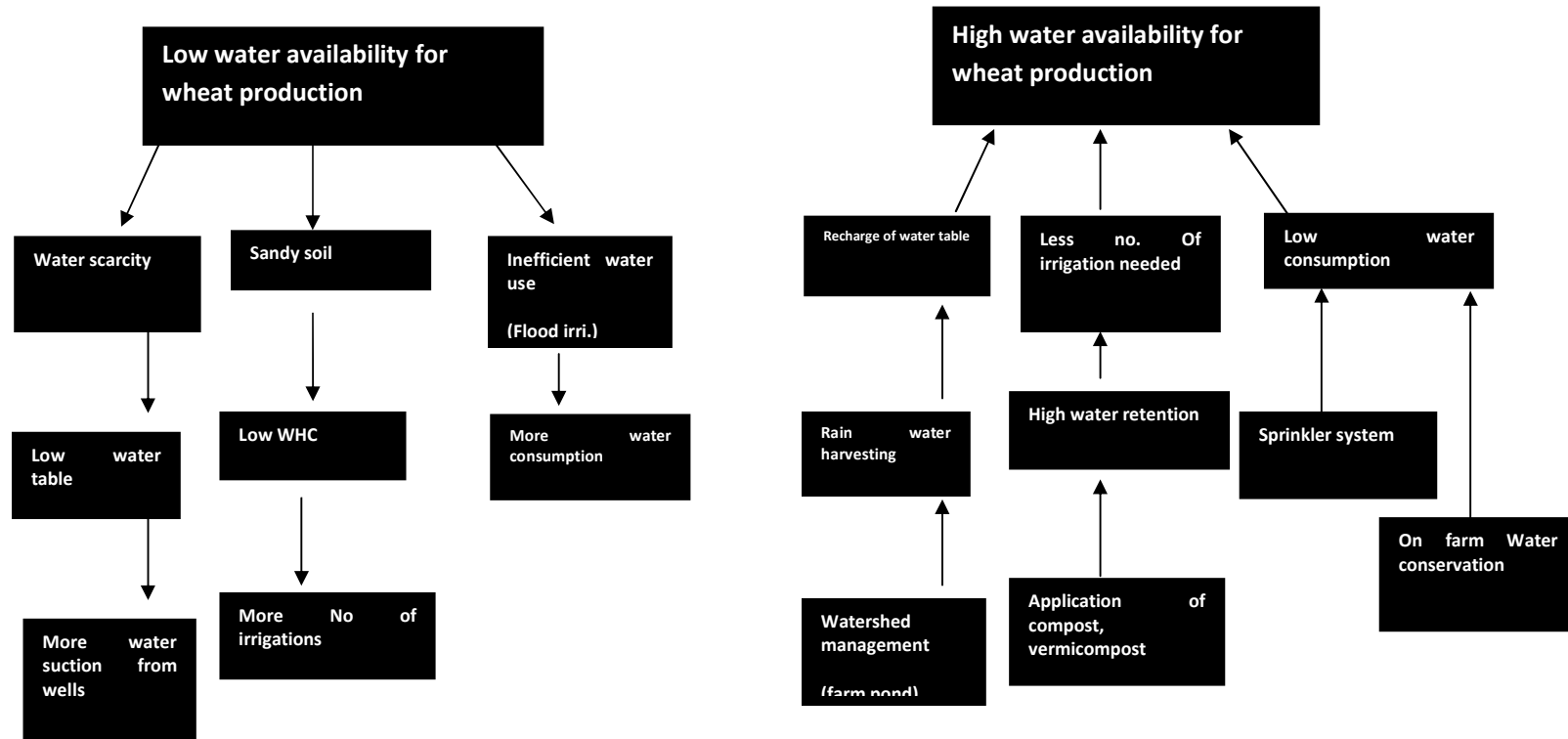**On farm Water conservation**

Fig. 4. Problem solution tree for water scarcity in wheat

Table 4. Problems identified in Amba village; rank frequency table

S. no.	Problems identified	Ranks							
		1	2	3	4	5	6	7	Total farmers
1	Low Milk Yield in Cattle	20	-	-	-	-	-	-	20
2	Unavailability of Irrigation Water (Wheat)	0	10	5	3	2	-	-	20
3	Bacterial Blight in Marigold	0	3	10	3	2	2	-	20
4	Leaf Blight in chrysanthemum	0	2	3	8	3	2	2	20
5	Low Yield in Pearl Millet (Bajra)	0	3	2	3	6	3	3	20
6	Blight in Tomato	0	2	0	3	6	7	2	20
7	*Cochliobolus* Diseases in Barley	0	0	0	0	1	6	13	20

Table 5. Problems identified in Amba village; RBQ and VBI table

S. no.	Problems identified	RBQ	% loss	VBI	Rank
1	Low Milk Yield in Cattle	100	14.8	1488	I
2	Unavailability of Irrigation Water (Wheat)	73.5	12.	919.7	II
3	Bacterial Blight in Marigold	64.2	14	899.9	III
4	Leaf Blight in chrysanthemum	52.8	9.7	513.8	IV
5	Low Yield in Pearl Millet (Bajra)	47.8	6.2	299.1	V
6	Blight in Tomato	41.4	4.8	198.8	VI
7	*Cochliobolus* Disease in Barley	20	6.2	125	VII

4. Rain water harvesting and soil-water conservation techniques highly required in drought prone areas. For this extension department, has to demonstrate water conservation methods at the farmer's field on participatory basis.

5. Impact of dry land development programs, including watershed management on productivity and socio-economic wellbeing of the community has to be exercises and formulate course of action for filling the identified gap.

6. Allocation of superior quality seed is more significant for enhancing productivity of the area. It is a vital input for attaining higher yield and sustained growth in agriculture production. But high quality seeds are out of reach with most of farmers especially small and medium landholders.

7. Research bodies/ policy forming institutes can study on Impact assessment of the regulated markets for particular area to know the system of competitive buying, eradicating malpractices, standardized weight and developing standard marketing chain for farmers.

8. Study on the effect of different planting methods and nutrient doses on yield, runoff, soil loss and nutrient loss is needed. On the basis of result researcher can develop an intensive vegetable production model by using runoff water harvesting.

9. Value addition for flowers and vegetables by setup cold chain at nearby village for transforming traditional selling system into a value chain marketing system in horticulture and increase the flower aspect to get better price.

10. Participatory varietal selection for wheat and pearl millet, for draught tolerant traits and development of IPM and IDM for marigold and chrysanthemum/ introduction of resistant/tolerant varieties, effective use of bio control agents and reduce pathogen inoculum in field for bacterial blight diseases of tomato.

4. CONCLUSION

Agriculture, horticulture and livestock sector has a great potential to create self-employment in the villages. In this study, we recorded that farmers facing problem with low productivity of animal (milk yield) and unavailability of irrigation water. To address the issues, strategies to improve the early lactation performance and higher peak milk yield should be developed. Awareness need to be developed for soil and water conservation techniques (intercropping, mixed cropping, improved tillage practices, micro irrigation) to maintain native moisture in the field. Long term requirements are not in top priority to farmers, they are thinking about short term gains and wants immediate benefits. For this purpose, as a scientific community, it is essential to create awareness about long term benefits of ongoing research and developing action plan on participatory basis to disseminate proper information. Participatory rural appraisal is

technique which gives more emphasis on local knowledge end enable locals to do their own appraisal, analysis and planning on participatory basis. The basic idea of this approach was to estimation of the magnitude of the problem in given village and aware the farmers in the area along with suggesting possible solutions. This paper essentially explain techniques in combination with ranking method with a group of villagers to identify major problems and their possible solution. These findings may act as good references for policy makers to sketch the activities for betterment of farmers in rural areas like Amba village.

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COMPETING INTERESTS

Authors have declared that no competing interests exist

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