



*Working Group Meeting on*

# “Research Priorities in Rainfed Farming”

**Venue:** CWS Conference Hall, Secunderabad, Andhra Pradesh, India

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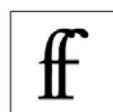
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## **Working Group Meeting on “Research Priorities in Rainfed Farming”**

Today, agriculture in general and dry land agriculture in particular are in peril. Agriculture has become almost an unviable occupation for farmers as is reflected by recurrent spates of farmers' suicides. Recent National Sample Survey reveals that several of them wish to quit farming if given an option. If agricultural researchers are serious about sustaining agriculture in the country, the pivotal concern of agriculture research should be to find a way out of this predicament.

In the absence of a dear agriculture policy at the national level, India draws much of the policy directions from the Green Revolution (GR) model. All the agriculture support systems in terms of extension, credit etc are based on this frame work. Technology development is no exception. Many of the recent studies, and experiences from civil society initiated works strongly points to the need for a separate dispensation for rainfed areas.

Centre for Sustainable Agriculture and WASSAN have initiated discussion with a small group of eminent scientists and thinkers to analyse the present status of agricultural research *vis a vis* farming situation in dryland areas and tried to evolve some suggestions/recommendations regarding research priorities.

The group of scientists and thinkers unanimously feel that an Integrated farming systems based on mapping the agriculture situation, soils, resources and suitable crops in them with special stress on making best use of local resources, farmers' knowledge and preservation and use of bio-diversity as the key for sustaining farmers and farming in rainfed areas.

Planning commission has formed working groups to look into different aspects of agriculture. The group on dryland agriculture, along with the other groups, has called for inputs from the people in general. The suggestions/ recommendation evolved in this Working Group Meeting will be submitted to the Planning Commission's working group and all the concerned.

## I. Contextualizing the Present Scenario of Agricultural Research and Development

*The discussion was initiated and contextualized by Dr NK Sanghi, Shri. Devinder Sharma, Dr Ramanjaneyulu and Shri. Ravindra.*

Planning commission has set up working groups to look into the agricultural scenario and find ways and means to sustain agriculture. One of the groups working on rainfed agricultural research is keen to get inputs from the public, NGOs etc. There is evidence of feasible alternatives to the existing high external input based green revolution model. Suggestions and recommendations based on this knowledge would help the planning commission to think and evolve strategies in right direction.



At present, all the thinking about agriculture is influenced by the green revolution paradigm. Even, Public support in terms of subsidies, seed etc is based on this. We have a deliberately unified agriculture policy which considers irrigated agriculture as everything. We don't have differentiated policy for rainfed areas. There is a need for having differentiated policy for rainfed areas.

Entire agricultural research is going in a direction quite indifferent to the ground realities. We need a paradigm shift in terms of our thinking and work keeping in mind the global scenario, which includes Indo-US initiative and WB projects *etc.* and the ground realities to come to correct conclusions. There is a need to redefine agricultural research for the coming 11th plan.

Should we look at it as rain-fed agriculture or rainfed areas? We should look at it in terms of rainfed areas as area would include climate changes and environmental impacts. Should we look at it as rainfed agriculture or rain-fed farming? We should look at it as rainfed farming as farming includes livestock, trees, *etc.* within a single framework. We



will have to think of specific aspects of farming i.e. livestock, trees and horticulture a manner so as to integrate all of them in a single framework.

Looking at different aspects separately without considering the interconnectivity among them has led to desperate situations. For instance, the agricultural policies were found to be anti-livestock. If the approaches remain sectoral, there is the possibility of one sector going against the other. A good framework, which synthesizes all aspects into a single, integrated framework, an integrated approach for sustainable agriculture, is required. We need to articulate the existing policies to achieve this.

Neither do we have a distinct policy for soil health or livestock nor do we have a policy on enhancing soil fertility or getting necessary biomass to feed cattle.

Community controlled seed systems have gone out of practice. The green revolution model made external inputs inevitable and agriculture a very expensive affair. Livestock has been taken out of agriculture and is treated as a stand-alone thing. Questions such as what kind of breeds should be promoted in the rainfed areas are simply swept under carpet.

The practice of intercropping has been replaced by mono cropping. Common Property Resources are looked at as something separate from agriculture proper and are used only for fuel etc. They are not considered as an integral part of farming.

All these things, along with climatic changes like rainfall patterns becoming abnormal, make farming and farmers vulnerable. Agriculture in dry land areas is so discouraging that 40% of farmers want to quit farming if any viable alternative is available. Apathy of the farmers towards agriculture in rainfed areas is increasing day by day.

Research priorities have shifted during green revolution. Food security is no longer a priority. Regional food security is given a go by. Dr. Mangala Rai, Director General, Indian Council of Agriculture Research (ICAR), once said that what ICAR is talking about is commercial agriculture but not sustainable agriculture.

Globally, a major part of agriculture research has been taken over by the private sector. Research is taking place mainly in private sector. Nothing much happens in the public sector. Even in US, only 25 scientists, working on maize, work in the public sector while 600 scientists work in the private sector. Focus of research today is not on developing technologies according to the needs but only on transferring technology to whoever pays for it. There is no focus on dry land agriculture. Focus is only on hybrids and Genetically Modified Organisms (GMOs) as they are linked to industry and trade.

World wide, focus is on cash crops. We are told that production of staple food must be left to the west as they have the efficiency to do it and the 3rd world should produce cash crops. This, essentially, is the politics of technology.

The two dear paradoxes, thrown up by Green Revolution are-highly subsidized agriculture and highly subsistence agriculture. We refused to see the pitfalls and went ahead with the Green Revolution paradigm. 'Path to hell was paved with good intentions' were the words used by people like Dr Swaminathan. It applies more to the present thinking of the planners. We all looked at the west for answers to our problems while neglecting our precious resources or losing them to others.

Import every thing has become the catchword. Even Indian cattle are not productive; so, should be imported; we were told. But all the cattle they talk about are suitable only for irrigated and high-external-input agriculture. To quote from a FAO report.... Brazil took 4 breeds from India for beef in 1960s. Brazilians found them good for milk production also. Now Brazil is leading in exporting these breeds while we look at the west for suitable breeds. We didn't look at ourselves and what was good in our stock and in our practices.

Now, IRRI says, in a recent report, that there is no difference between broadcasting and transplanting rice. Then, why were we told to go for transplanting model? Why was it so vigorously promoted? Obviously, it was done to promote tractor sales. They recommended different nozzles for the knap sack sprayers for different crops. Now, they say that there is no need for different nozzles. Why did they recommend them if not to promote the concerned industry?

Pesticides are not required in rice; now they realize after long time of promoting them. Even now, Indian scientists refuse to accept it. Even now, they promote hybrids over varieties in dry land areas which use more water, as more water goes out through transpiration of leaves. It goes against the very spirit of dry land agriculture. In Green Revolution paradigm, it is industrially oriented outlook And this is the reason behind this anti-rainfed areas attitude.

Two models, the green revolution model and the alternative for sustainable agriculture, cannot co-exist. For instance, GM and non-GM cannot co-exist. Companies like Monsanto are not for good technologies per se and are dear in this regard. They advocate transferable i.e. salable technologies irrespective of their suitability to the conditions on ground.

Why do we grow hybrid rice and hybrid maize in rainfed areas? Hybrid based and GM based agriculture must be opposed as it is environmentally destructive, water intensive and soil destructive. It goes against the spirit of biodiversity, which is the core of dry land farming. The scientists' community must stand up and say that not only it is not required but also dangerous. When nuclear deal was signed, scientists' community stood up against it; but when agricultural deal was signed, scientists kept quiet. It is high time that scientific community stands up and says what is right for the country. In Maharashtra, sugarcane consumes 99% of ground water while all other crops use only 1% of it. How can we sustain agriculture unless such imbalances are corrected?

Words like organic farming are frequently used even by the planners but only as saving clauses, in a loose manner, without seriousness. It's better to spare them, the small and marginal farmers of the dry land areas, from Chemical and GM farming.

Do we need to keep farmers in farming? How? Why can't it (Govt.) compensate farmers, especially the poor and marginal farmers in rainfed areas, so that they can keep up with farming? But for a few cosmetic changes, there have been no substantial changes in the last 10 or 15 years. Organizations like Ramakrishna Mission are working to some extent on these lines on their own. It is time for the defenders of sustainable agriculture to build up collective voices based on a mass of concrete evidence.

## II. R&D Needs for Improving Rain-fed Agriculture - *Key note: Dr. J. Venkateswarlu*



What we need is a dry land agriculture based on farming system. Health, environment and economic viability must be taken into consideration. We must look at not only national but also district and regional food security. 25 years back government took up promotional schemes to promote wheat and rice. This was an instance of looking at food security without consideration for regional needs. If we focus on district/regional food security, all regional crops will come back. We have to think in terms of decentralizing Food Corporation of India (FCI).

There is a danger in the talk about decentralization of the Public Distribution System (PDS). Government, when it talked of decentralization, it was actually paving way for dismantling of the PDS. PDS must be preserved and further expanded by including millets, pulses and other crops in it.

60% of the Net Cultivated Area (NCA) in the country is rainfed. 70% of the net cultivated area, around 138.3 m ha is rain dependent. 60 millions of our people eke out their living from 30 m ha of very poorly endowed soils. 100 million earn part of their living from Common Property Resources (CPRs).

National Council for Farmers headed by Dr Swaminathan or the Economic Advisory Council (EAC) headed by Rangarajan, say that chemical agriculture has no alternative. They don't realize that universalized recommendations do not work. This kind of thinking doesn't reflect the needs of the rainfed areas.

There must be an articulated campaign with well-documented evidence in favor of organic farming. Crops use only 50% of N supplied in the form of inorganic fertilizer, but what goes as waste, pollutes the environment. Out of 28 m tonnes of NPK applied only 7 m tonnes are used by the plants/crops. The rest of 21m tonnes, is lost. To get rid of the situation, removal of subsidies on chemical inputs could be a solution. But, will it be accepted? However, subsidies must be restructured to favor organic farming. That would go a long way in stabilizing agriculture in rainfed areas.

Soil Organic Matter (SOM) is declining. Policy makers must recognize the necessity of SOM. We must think in terms of subsidizing SOM; but how? There must be ways and means to implement it as some earlier instances have failed. We need to do it in the form of a pilot project. Government is proposing soil health cards. We need to have measurement for soil health improvement. We need to define quality of the organic material, especially as private industry is slowly getting into this business.

Soil health card is a good idea. Every farmer must have a card. Yaswanth Sinha of the previous regime, once, promised to earmark 100crores to subsidize organic farming and asked us, how to implement the idea? We had no answer at that time. We need to work it

out.

We have to look at it entirely in terms of soil health. We should not feel shy of telling forthright that chemicals degrade soil health. We are told that if we don't use chemical fertilizers, crop will collapse. Dr Partha Sarathi, an organic farmer, says 'if you have one cow, you can fertilize one acre'. We have to categorically say no to chemical fertilizers. The problem is that nobody told us earthworms would be the first victims of chemical agriculture. Even America imported earthworms from India though they didn't survive there. Let us not follow the mindset of Green Revolution, which kills earthworms. Let us follow the mindset that enhances earth worms and other soil organisms and soil health.

There is an instance of cadmium found in organically produced food. They sighted it to discourage organic production. They forgot conveniently that cadmium has been there in the soil and it takes time for the organic production system to get rid of it. They found it in the organic produce only because they tested only this stuff. If they tested inorganic food, they would have found cadmium in that too. This kind of attitude to promote chemicals must stop.

Ground water usage has reached perilous proportions. No wonder that several of the farmers' suicides are due to the dried up bore wells in dry land areas. Mechanisms have to be evolved to regulate ground water usage with the full participation of the communities. For instance, in Zimbabwe no bore well is dug unless the council permits it. This practice is observed even in the times of crisis in that country.

There are problems in post harvest operations. Post harvest losses are 20% in perishables, 15% in semi perishables and 10% in durables. Annually country loses to the tune of Rs. 900,000 on this account.

Instead of giving only one option, we must think in terms of giving two or three options to farmers so that they can choose the most suitable to them, depending on the resources available to him, nature of the soils, local climate and topography etc. Crop rotation is vitally important to enhance soil fertility, but it should be done based on the information about the types of soils, climate and local resources and needs. Information on, which crop is most suitable in which year and which region, must be readily available to farmers.

Today options are there and available. But the problem is decision-making is not in the hands of the farmers. That is the problem. Research must be designed to support the process of decision making by farmers. When we are clear about what kind of agriculture we need, it must be followed by what kind of research we must have. We must probe into the kind of gaps we have to fill.

Researchers working in dry land agriculture arena must have different dispensation. For those working on irrigated crops, opportunities to publish papers etc are more. So, there must be special incentives to those who work on dry land agriculture. For instance, more weightage could be given to research papers on dry land agriculture.

Now we are importing 5.2 m tonnes of vegetables, 2 m tonnes of fruits and 5.5 tonnes of wheat per year. Much of these imports could be avoided if we work in right perspective on agriculture.

### III. Different sectors of the rainfed farming system

#### a) Cropping Systems In Rainfed Areas - *Key note:* *Dr. A Seetharam*



There are three cropping systems in rainfed agricultural areas.

1. Millet based cropping system
2. Oil based cropping system
3. Cotton based cropping system

Eight kinds of millets are grown in India. Millets cultivation in India has a very long history, almost of 5000 years. India has highest millet diversity. Lot of domestication and land races have evolved through generations of farmers. Varieties are selected by farmers. Millets are eco friendly crops. Problems of diseases and pests are very less. Millets are highly adapted to specific conditions of dry land agriculture.

Traditionally, farmers practiced inter cropping. Obviously, they wanted to grow every thing that they needed in the farms. But slowly mono cropping stepped into millets cultivation also. Though there was the advent of some millet crops with the introduction of high yield varieties and hybrids. Mono cropping increased in the name of productivity and profitability.

Pesticides are not widely used in the farming of millets. Finger millet is one totally devoid of pesticide. Cultivation of millets has declined and is still declining for several reasons. We will lose some more area of millets to other crops, if the present trend continues. Net cultivation area of millets in 50s and 70s was 38 m ha. Now, only 22 to 24 m ha of land is under millets. About 4.5 m ha is under ragi and sorghum.

Government policies tended to displace these crops. Millets have fallen prey to these policies. They were replaced by oil seeds as the later seemed more profitable and commercially more viable. Oil seed development has been market oriented rather than being oriented to productivity increase.

In Karnataka, ragi has some prestigious position. Every one in the state eats ragi. The state earmarked 100 crores to promote ragi and fixed support price for it. A major community in the state which is also politically powerful grows and eats ragi. It is one of the reasons why Karnataka holds on to millets, especially ragi. It has a large area in the state.

Pearl millet didn't decrease much as there has been no crop to replace it in that eco system. Kharif Sorghum has decreased. Decline may further increase in sorghum and ragi

but bajra will hold on as no other crop is there to replace it. Area of finger millets and pearl millets has decreased. Other small millets also have lost a lot of area in the past 6 to 8 years.

#### Reasons for the decline:

1. There is no marketing facility and support from the government
2. Demand has not increased in proportion to population increase. Consumption declined as rice and wheat stepped in massively in the recent years.
3. Farmers prefer to grow rice and wheat because they have high prices.
4. Generally, millets are looked down as coarse cereals. Cultural attitudes contributed to the decline.

#### Importance of Millets:

Millets provide easy food security. Local crops will regain their previous prestige. We have to think seriously to promote millets in the background of crop failures in the last 6 - 7 years. Millets cultivation would contribute to sustaining agriculture and food security in dry land areas. Regional food security can be achieved only if it is based on regional food crops.

Mineral composition and protein content in millets is very high. They are high dietary fibers. Ragi is high source of calcium. We don't need golden rice when there is *same*, a millet. *Same* are rich in beta carotin, which the golden rice is supposed to contain.

Pulses and oil seeds production is market oriented and price driven. Among them, also pests are increasing. For example, Bud necrosis, in sunflower, even today is not solved. But the pulses and oil seeds stay as they have incentives in the form of higher prices, unlike millets.

States were told by central government to promote local crops like millets and pulses in the Public Distribution System (PDS), but they didn't do it. Now, fortunately, there is a rethinking. Every body is singing the virtues of millets as healthy food. We must take advantage of it to sustain agriculture in rainfed areas. We have to bring back millets to the food basket.

#### Strategies to promote millets and research options:

1. Millets' major use has to be food. So, our focus must be to promote them as food items. People must be made to realize the importance of millets in terms of their nutrient value and general well being. We must promote and campaign to widen the food baskets by including millets. A respectful attitude must be built around them. Ragi can be used along with rice. If the middle class consumers are exposed to home-processed millets, the demand will go up. A silver line is that there is a new trend of growing awareness about millets as healthy food.
2. Nutrition through millets must be taken up as a scientific agenda. 15 years back a center was started at CFTRI. It must be pursued in right earnest.

3. Some work has been done in the direction of value chain. Malting in ragi is an industrial activity. Couple of industries came up in TN and Karnataka in ragi malt production. Manufacturers of these commodities around Nasik are doing it a bit secretly.
4. Well-packaged grain is also gradually getting available. Other form of the commodity in the form of flour is becoming popular. Blended flours like that of ragi and pearl millet are also gaining ground.
5. Ragi is being used in the midday meals scheme in Karnataka. This must be enhanced.
6. Milling technology has to be developed for ragi and some other small millets like fox tail millets.
7. Millets are used as dairy and poultry feed. There is a demand of 30 m tonnes of grains in dairy and 6 m tonnes in poultry. This has to be further enhanced.
8. Grain mould is a problem in storing Kharif sorghum. The traditional long duration variety is resistant but the short duration hybrids are susceptible to it. Charcoal rot, shoot fly keep lingering. We need to find ways and means to protect grain from it, as a priority research area.
9. Sweet sorghum is experimented for bio energy and bio fuel.
10. Starch and textile industry can also help promoting millets.
11. Indian exports of the millets amount only to 1% of the world exports. Millets are exported for bird feed etc. We must study the exporting opportunities for millets.
12. The policy of promoting some crops at the cost of other must be stopped. Oil seeds' prices are always higher than millets, making millets less economical. Oil seeds like linseed and niger are sidelined even in research.
13. The research is highly hybrid driven. It must take into account indigenous varieties. Frequent re-sowing is done because of monsoon vagaries but hybrids do not withstand such adverse conditions and they need more water. Failures because of the types of soil too must be probed into. Oil seeds' prices are always higher than millets, making millets less economical. There is a fatigue in crop varietal development. Hence there is a need to go for our own gene pool.
14. At present productivity is low in millets. We need to work towards increasing it.
15. Politically there is a need to correct prices of millets and work towards raising prices.
16. The research on farm level processing, low cost milling technology for millets, could act as a trigger. There are problems with the existing ones. Therefore, fine-tuning of the processing technology is needed.
17. Storage facilities for the processed millets should be developed.
18. We must look into biscuit industry and other industries to raise demand for millets. Flaking technology can be further developed. Millets are used in cattle feed stock. Ragi is used for elephant feed. These areas must be expanded.
19. We need to prepare a detailed mapping of the crops and soils/regions, develop strategies for these rainfed areas and assess water availability etc. This should be the precursor for the research rather than promoting what the researchers have developed. The experiments with Jatropha and oil palm and the disastrous consequences must be kept in mind.

20. We should assess whether these rainfed areas should have cotton or not and take a stand. We need to find ways to push pulses into rainfed areas so that it would be economically more viable.
21. On crop synergism, not much work has been done.

Not only minor cereals (millets), even minor oil seeds, face an apartheid attitude. Castor and Sunflower were promoted only after hybrids in them were developed. Safflower has been neglected. This is how the hybrid driven research works.

If at all we consider hybrids in dry land agricultural areas, we must be specific on which millets to be grown in which place. It should not be universal. Some crops with good price incentive, like maize, are grown in sorghum area, especially that of yellow sorghum. It is risky because the soils are too shallow. Same is the case with Bt cotton, which is risky for dry land areas. Farmers must be told not to go for such crops in such areas. So, there must be a map of the areas and the compatible crops to guide the farmers.

This happens because factual data is not given out by the universities. Government extended GR technologies indiscriminately to dry land areas. It must be stopped. There must be research to map the areas and crops to be grown in those areas.

If the farmer doesn't get economically right price, he will not stay with the crops like millets. We must work towards raising prices for these crops. That sort of correction has to come from the scientists.

We are major consumers of pulses and import from Australia. We must promote pulses production in dry land areas. Machines to process dal must be made available to farmers and existing machines should be fine tuned.

Exportable crops that can be grown in dry land areas must be identified.

Crop planning is necessary. It has given good results in Russia, where they do not grow sunflower for certain period. Contingency crop planning must be done at the farm level.

Mono cropping leads to loss of yields even in millets and pulses whereas inter cropping helps in increasing productivity. This must be probed and established.

Regarding rice in rainfed areas, it is said that 5000 liters of water is needed for 1 kg of rice in America and 3000 liters of water for 1 kg in India. If that is the case, how can we promote rice in dry land areas?

Rice picked up enormous demand because of the schemes like 'two rupees a kilo rice'. No such support systems are there for other crops. We must study how these things have affected cropping patterns and sustainability of agriculture in dry land areas. A comparative study should be made on the amount of water used by farmers for 1 acre of rice and 5 acres of millets.

If at all rice is to be promoted in dry land cropping system, it should be in the form of System of Rice Intensification (SRI). Problems of SRI must be a priority research area for dry land agriculture.

We should see if inter cropping is possible in SRI and whether it would help in lessening the problem of weeding and the need for mechanical weeding? It is shown to be possible. Red gram is grown in northeast. We should probe into the possibility and efficacy of growing some crop in the space between the rows of rice and plough it down as green manure. We can grow a mulch crop, by sowing it a month before transplanting rice and ploughing it down when rice reaches a stage to take up the space. Crops like *pillipesara* can act as good mulching crops.

Alternative methods to replace mechanical weeding can be a research priority. The problem of labor in SRI and the problem of rainfall vagaries are areas that need attention.

#### b) **SOIL MANAGEMENT** - Key note: Dr. J. Venkateswarlu

Soil microbes fix nutrients like N in the soil. To increase the availability of nutrients in soil we must increase the population of microbes in it. For that, we have to go for organic matter. Most of the soil organisms are heterotrophic. They need energy that comes from organic matter. If the soil is sterile, no microorganism will survive in it. Only biomass gives that facility for microorganisms to survive and thrive. Chemical fertilizers do not give that facility. So, we have to increase Organic matter within the farm itself.



At present soil is not responding to chemical fertilizers at the same level as it used to in the beginning. Inherent ability of the soil to respond to fertilizers has gone down because of the chemicals. How best can we produce organic matter on the farm itself is the question. We produce only 50 to 60 m tonnes which is not sufficient. We can't go immediately for organic fertilizers. So, we must first adopt a mix of organic fertilizers and inorganic fertilizers and then gradually shift to organic fertilizers.

To avoid further soil degeneration organic fertilizers are necessary. But organics by themselves are not able to support the soil needs now, though organic yields have never been less than the inorganic yields. To supply NPK with the amount of biomass now available is not possible. For this, soil microorganisms have to be enhanced, but how to do it? The research must be oriented towards that end.

We have vermicompost etc in the market; but how far can the farmers rely upon it? Can the industry be relied upon for quality organic matter? How to define the quality? These are some of the questions and we must try to define some standards. Farmers must have subsidy for organic fertilizers but in what form should be the subsidy? Should it be a process subsidy or product subsidy? However, it should not be in any way to promote commercialization of the organics.

There are some difficulties in the preparation of organic fertilizers when compared to inorganic source. Organic fertilizer preparation takes time. Organics require a decomposition period of at least 40 days while inorganic fertilizers are readily available. We must find ways and means to shorten the duration for the preparation of the organic fertilizers.

We should plan according to zones depending on the availability of humidity etc. It is difficult to prepare organic fertilizers in arid zones because of high temperatures. Here organic production is not able to support food production. In the semi arid zones, organic sources exclusively are never equivalent to mixed practices (organics and chemicals) even in the times of good rainfall. Assured zones (high rainfall and so, high microbe population) should be our focus in the beginning. Research is needed to overcome these difficulties in the arid and semi arid zones.

Composting different plant materials must be popularized keeping the needs of different zones in mind. It would be better to go first for integrated nutrient management (INM) and then to fully organic farming. But, we have to raise our voices to say 'no' to chemicals and we need evidence to support the voices. Data on Organic Farming has to be collected and collated.

Another reason for the disappearance of organic farming is the rise in labour costs. It needs incentives to overcome such problem. Will there be reduction in costs while maintaining yields at the same level? We have to compile case studies to show that yields will be the same while reducing costs in organic farming.

Actually, lots of information is already available on that but people refuse to look at it. When told about Pudukkula experience, Mangla Ray asked for three years time to support it. Would they take that much of time, if it was Monsanto? But, in order to convince all, we must also show dangers of chemicals. For instance, N<sub>2</sub>O left in the soil is dangerous and it has long lasting effects.

We must also need to look at the processing systems, which take away all the organic matter out of the field. For example, taking away of the groundnut shells. The processing systems must be reviewed and necessary changes made to enhance soil bio mass.

We must rely upon indigenous resources for raw materials like Rock Phosphate rather than importing them. Mussourie rock -in flakes- is useful for this purpose.

Some of the research priorities in soil management should be:

1. Some support in decreasing composting time.
2. Efficient methods of using organic material.
3. How to make organic matter affordable by lessening the costs.
4. How to use the residues left in the field to build up organic material. If they decomposes on the field, they will improve soil structure too. Minimum tillage options must be considered. We must find ways and means of doing it in different agro-climatic regions.

5. Incentives to induce farmers to plough back organic matter in the field.
6. Minimum Support Price (MSP) for organic produce.

c) **SEED** - *Key note: Dr. GV Ramanjaneyulu*

Different seeds must be available to farmers in rainfed areas according to location, time of sowing etc, which depends on weather fluctuations. Seeds must be available whenever the farmers want to sow and there must be facilities for the farmers to reuse the seed.



Seed production must be integrated with crop production. Diversity is the mantra in rainfed areas. Seed must be locally available. Traditional varieties are the most suitable to the rainfed areas. So, they must be preserved and made available to the farmers.

Environment in rainfed areas varies substantially across the region. Genetic expression depends on the environment. So, GM and hybrids should not be our focus in dry land crop improvement research. But, these happen to be the focus of the research today.

Mixed and contingency cropping seeds must be made available to farmers as industry cannot supply those seeds.

If all public sector undertakings work on hybrids but not local varieties, then the 'right to use one's own seed' becomes meaningless. Public sector is only imitating the industry in research. They must keep farmers' interests as their priority, not those of the industry. Wherever private sector is strong, public sector has lost. Now, the public sector is also using methods of private sector. Consequently, farmers are made to pay royalty.

How do we build seed systems at the village level? We must see if the village level seed production can be networked with mandal level and above. They should be in the form of seed banks and must help timely sowing. Seed corporations are dosing down, as government wants to give it over to the private sector.

Community managed seed banks should be our answer. It needs some probing. What kind of research we need to support it? How to build PPB (Participatory Plant Breeding) and PVS (Participatory Varietal Selection) into this process? Why is PPB receding? We must look into these things. Access to the breeding material should be provided while transferring breeding rights. Finally, Seed selection should always be done by the communities and individual farmers. Alternate criteria for different crops and ecological requirements to tailor the varieties- should be focus areas in the research for rainfed small holders.

Today, farmers are convinced of NPM, but they are unable to practice it as seeds are not available. Research must be oriented towards the kind of seed systems we must have. It depends on what kind of agriculture we must have. Every variety of seed needs specific soil depth. All varieties do not thrive in soils of different depths, especially for rabi crops

grown with soil moisture. Tailoring the varieties to the soils or mapping is very important.

Can we agree to Genetic manipulation and hybrids in research if it is said for public good? In that context, we have to see what is good for public and how to define it? What the Industry does, farmers can't replicate, so can't be said that it is for the general good of the public.

Politics of seed is being pushed. The wheat seed we imported from Mexico was just a deaned grain. The concept of certified seed is promoted by National Seed Programme (NSP). It was the case even when seed was taken from Mexico during Green Revolution. Farmers know that there is no difference between the seed certified by NSP and their own. NSP is privatizing the seed research in India. Over the time, seed has completely gone into private control. The journey from hybrids to terminator is a journey towards implicitly suicide seeds or programmed seeds. They are programmed to fight particular pest etc. In this way, companies can even control production. Unless you use particular chemical, your yield will not be good because it is so programmed.

Then, there is the problem of patents. 2004 was year of rice. Why that particular year? It was because Syngenta of Switzerland mapped the rice genome in that year. Syngenta patented rice genome. Out of 37000 genes of rice, 30000 are in the hands of Syngenta. The company made a public announcement that it will not give seed free of cost. This will make the infra structure of seed redundant. ICAR had to buy genes at exorbitant rates. Thus, even the institutions are caught in the web of patents. Scientific community has not stood up against it. Even universities are taking up outsourced works. Future of the very agriculture research is in peril.

Our concern must not be just transferring seed. How can we transfer breeding technologies to the farmers? Instead of giving seed, can we give the science of seed production to them? Even if farmer produces, who owns the parent material will remain a question? At present, farmers are doing it under the aegis of the companies. How can we facilitate farmers to use the techn Different seeds must be available to farmers in rainfed areas according to location, time of sowing etc, which depends on weather fluctuations. Seeds must be available whenever the farmers want to sow and there must be facilities for the farmers to reuse the seed.

Seed production must be integrated with crop production. Diversity is the mantra in rainfed areas. Seed must be locally available. Traditional varieties are the most suitable to the rainfed areas. So, they must be preserved and made available to the farmers.

Environment in rainfed areas varies substantially across the region. Genetic expression depends on the environment. So, GM and hybrids should not be our focus in dry land crop improvement research. But, these happen to be the focus of the research today.

Mixed and contingency cropping seeds must be made available to farmers as industry cannot supply those seeds.

If all public sector undertakings work on hybrids but not local varieties, then the 'right to use one's own seed' becomes meaningless. Public sector is only imitating the industry in research. They must keep farmers' interests as their priority, not those of the industry. Wherever private sector is strong, public sector has lost. Now, the public sector is also using methods of private sector. Consequently, farmers are made to pay royalty.

How do we build seed systems at the village level? We must see if the village level seed production can be networked with mandal level and above. They should be in the form of seed banks and must help timely sowing. Seed corporations are dosing down as government wants to give it over to the private sector.

Community managed seed banks should be our answer. It needs some probing. What kind of research we need to support it? How to build PPB (Participatory Plant Breeding) and PVS (Participatory Varietal Selection) into this process? Why is PPB receding? We must look into these things. Access to the breeding material should be provided while transferring breeding rights. Finally, Seed selection should always be done by the communities and individual farmers. Alternate criteria for different crops and ecological requirements to tailor the varieties- should be focus areas in the research for rainfed small holders.

Today, farmers are convinced of NPM, but they are unable to practice it as seeds are not available. Research must be oriented towards the kind of seed systems we must have. It depends on what kind of agriculture we must have. Every variety of seed needs specific soil depth. All varieties do not thrive in soils of different depths, especially for rabi crops grown with soil moisture. Tailoring the varieties to the soils or mapping is very important.

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Our concern must not be just transferring seed. How can we transfer breeding technologies to the farmers? Instead of giving seed, can we give the science of seed production to them? Even if farmer produces, who owns the parent material will remain a question? At present, farmers are doing it under the aegis of the companies. How can we facilitate farmers to use the technology? Indigenously, farmers are breeding and developing seeds. For example, farmers in Maharashtra evolved a number of grape varieties on their own. This process must be encouraged and helped.

**d) PEST MANAGEMENT** - *Key note: Dr. G.V. Ramanjaneyulu*

There is a move towards paradigm shift in pest management in dry land agriculture areas. Last two years, in the up-scaling program, we had encouraging results. From limited crops of castor and pigeon pea, we went for other crops like groundnut and rice. We have observed that individual action gives results but community action gives better results.

The green revolution model created a belief in farmers that high yields were possible with higher external inputs. It is input-centric, involving high costs. IPM (Integrated Pest Management) is mainly a process of managing resistance of pests to pesticides. In the industry language, it is IRM (Insect Resistance Management). In NPM, our concern is how to reduce pests in the fields. We have to think beyond technology and we must focus on how to raise farmers' ability to take decisions and to intervene in pest management. For this, the focus must be on raising farmers' knowledge in pest biology and crop ecology.

Research must look into the problems of using local resources and internal inputs and on how to make efficient use of them. There are some constraints in using local resources. All the neem available won't be sufficient for pest management. How do we cope with it? Unnatural combination of natural elements might pose problems. Recycling mechanisms will not be there. If we use natural solution it decomposes naturally but if we use isolated azardictine the process of degradation would not take place. This must be kept in mind while considering industrializing the use of local resources.

More research is needed on the relationship between soil moisture, soil biology and pest/disease management. Such insights would help promoting organic farming. People like Dr. S. Jayaraj, the former vice-chancellor of Tamil Nadu Agriculture University (TNAU), correctly opined that IPM would have been more effective if it were taken up along with INM (Integrated Nutrient Management). He felt that doable technologies like NPM are making a silent revolution. But it has been found difficult to convince conventional researchers even with a good database.

Both IICT and IIHR say pesticides are not necessary to control pests. But when the industry is promoting technology in the name of high pest incidence, they keep mum.

ICAR said that brinjal needs no pesticides. Pheromones are enough. But the companies are trying to build a case for Bt brinjal by propagating that there is a serious threat of pests in brinjal. TNAU, as a partner of CWS in NPM of brinjal, accepted its efficacy but didn't hesitate to take up the work on Bt brinjal.

How can a prestigious institution like the university do two contradictory things? It should be brought out in the public. We have answers to problems but we do not know how to bring them out forcefully. This needs to be strategized.

Department of agriculture and Agriculture university are not taking NPM as a model. They still go on saying that pest management is impossible without pesticides. Any amount of data from the field won't convince them. They religiously hold to their previous beliefs even when ground realities go against them. We, now, know that among all nutrients required for plant life, chemicals supply only six. Remaining nutrients have to come from the organic matter in the soil. While all evidence shows that GM crops are risky for the dry land areas, they still say that GM crops are useful in drought conditions. They do not care about facts. How to convince them? Researchers/scientists do not release data, when it goes to prove that chemicals are not useful. There must be mechanisms to get such data collected, collated and released.

If these technologies like NPM take considerable space, they will get accepted. We have evidence and we can publish. Over the period, all the others will come around. For instance, there is lot of data to prove that nutrition enhances plant's immunity to diseases just like it does in human beings. Technology, if it has strength, spreads on its own. For instance, thousands of plant varieties were released but only very few survived as farmers found them useful. So, should we be so much concerned to convince others?

Yes, we need to be concerned. Some technologies like SRI are not yet perfect, though the philosophy behind them is appropriate to the dry land areas and agriculture in general. NPM, as a technology, is management based. It's not packaged to be given to be used instantly. Moreover, there is an aggressive campaign with huge investments for chemicals and GM. So, in this situation, the farmers need to be supported and encouraged to take up NPM and organic farming.

Critical decision making is very much influenced by assumptions and lack of awareness. After achieving critical mass in propagating alternatives in agriculture, we need government support. Government says that it relies on the University for making decision. Whereas, University says it depends on its own data for recommendation. As it has no data of its own, it simply says no to alternatives. More over, we have to be aware and react to things in advance. Bt cotton is a good example. Now, situation has reached such a stage that there are no non-Bt seeds available. Farmers are left with no choice even after getting convinced that Bt isn't good for them.

Strength alone is not sufficient. One lakh farmers have died but still farmers are not convinced of the maladies of green revolution model. Support systems and promotional activities play an important role. Material culture spreads faster than non-material culture. Alternatives like NPM involve non-material cultures. For instance, farmers' knowledge

makes the backbone of NPM. So, we have to probe into the ways and means to promote organic farming. It will not spread on its own or just by strength.

We have to campaign. We have to take the factual data to the people and decision makers. Plants undergo bio chemical changes because of pesticides. Pesticides make them more susceptible to pests and diseases besides degrading soil. Balanced nutrition in the form of bio mass contributes to better pest management. This message must be taken to the farmers. People must be made aware of the facts like the negative impact of pesticides on human health. For instance, now it is found that there is no vitamin C in apples and chilli is getting white because of the pesticides.

We must also probe into the cumulative effects of the pesticide residues on human body. What is the body burden (amount of harmful chemicals in human body), how it acts on body, especially in persons with malnutrition, how much of pesticides are accumulated in the soil and get into food chains... all these things must be probed and brought into light.

With regards to framework, we must move from IPM to NPM and from NPM to EPM (Ecological Pest management), as it is reported to be happening in Pudukkula. Farmers have started to intervene in pest management not only by using alternative ingredients like Neem Seed Kernel Extract (NSKE) but also allowing the natural and ecological factors of balance to take care of pest management. "Giving science to the people" must be the central point. Present research designs are based on very few aspects. We have to look into how to expand and integrate the research designs with Farmers Field Schools and data collected from farmers etc.

There is a need for Standardization of the NPM and organic farming methodologies. For instance, how old neem seed should be used, what are the proper concentrations and proportions of the solutions for different stages of the crop etc. But, too much of standardization is also not good as some of the standards would not work at the field level. If the principles are given to the farmers, they will learn through experience. Then they will be able to adopt the technology to their specific conditions. Needs and experiences differ from region to region. Too much of standardization might hamper this flexibility.

#### e) **WATER AND CLIMATE**

##### **Social Regulation Against Over Exploitation of Ground Water - Key Notes:**

*Dr NK Sanghi, Sri S.K. Anwar, Sri A. Ravindra*

Intervention in water management is a software activity. Government investment is also needed in this. We must continue surface water collection but not ground water extraction. Situation in ground water extraction has already reached an alarming stage. In this regard, there is an instance where we could document nine bore wells in one acre of land, of which, only three bore wells are functioning now. As a result, all open wells around have dried up.



Water sharing and strict regulation of ground water extraction are necessary. There are regulations that prevent bore well digging within 200 meters and drawing water beyond 65% of rechargeable water. But all these regulations are flouted in practice. If information is given to the village community, they make decisions on digging new bore wells and sharing of water among farmers. There must be some kind of incentive to share water, which in turn must be developed into a working system. Sharing needs decisions on timings etc. We have to think about how to fine tune the methods of sprinklers?

There are some instances where village community has come forward to regulate ground water extraction. The Village panchayat of Narayana Reddy Palli of Seetharampuram mandal of Nellore district in AP has decided not to dig any bore wells. They are using only surface water. Decisions on how to share the limited resource are made and implemented through the committee. But this experience didn't replicate. Ground water level has gone down in the nearby village. They are facing problems. Another instance is the village, Indere Bazar, in the state of Maharashtra. But even there, the experience could not be replicated as neighboring villagers went for deeper bore wells.

Farmers with good bore wells do not come to the table to discuss. Only those with difficulties because of dried up bore wells come for discussions. It won't serve the purpose unless all, including those with functioning bore wells, join in the efforts. The question is how to get everyone in the community into the fold? Sprinklers etc are used only for concentrated irrigation but not for distribution. Many villagers buy sprinklers for the pipes to be used in the field but not for sprinkling. Do we need irrigation distribution network and the necessary infrastructure? These are the questions to be probed in the case of water in dry land agricultural areas.

**f) Drought Adaptation and Climate Changes -**

*Key note: Dr Jeevanatha Reddy*

Cloud seeding is not useful for our country. It also affects the ecosystem negatively. AP government has spent Rs. 40 crore on cloud seeding last year and approximately the same amount this year.



Contrary to the popular opinion, climate change has not affected the rainfall patterns or intensity. There is some impact in terms of skewness of the rainfall. Early withdrawal of rains and excess rainfall when the crop is ripe are the problems to be looked into in agricultural research.

**g) Climate Changes And Dry Land Agriculture -**

*Key note: Dr KPR Vittal*

Backbone of rainfed farming is rainfall. Moisture loss due to evaporation is going up. Moisture index in deserts is going high on negative side. At several places, new pockets of dry areas are coming up. A new strip of reduced rainfall from Jammu Kashmir and Punjab to MP



is coming up. It is not an isolated thing. It is related to the reduction of rainfall by northeast monsoon and reduction in glaciers etc. The rainfall is moving away to Myanmar. Glaciers are going back. North East is getting dried up because of the reduced rainfall and lack of inflows into Brahmaputra. Dr Parthha Sarathi of The Indian Institute of Tropical Meteorology has shown the data to demonstrate how rainfall is reducing in Tamilnadu.

Possible solutions in this context are:

1. River linkages. But we may not have inflows into the rivers which is a challenge.
2. Farm pond technologies. But we may not have inflows at several places.
3. In situ conservation. But we cannot expect much except in summer harvesting.

A combination of these can be thought of.

Water harvesting is a costly affair. In the light sandy soils, it needs plastering. Ground water usage along with farm ponds is observed to be of highest efficiency.

Most of the times our recommendations are district based. Districts are being changed, though there is some stability in terms of blocks. The approach should be based on agro-ecological zones.

Rainfall with short duration and high intensities is changing the eco-system. We need to probe for less risky technologies. We require an integrated farming/cropping system, which can take care of all these things.

We need a well-defined water harvesting policy. Watershed is sustainable only when water is harvested. Water harvesting needs support. Aggressive campaigns for watersheds in the 10th plan affected the perennial systems.

We have forgotten multiple cropping systems and alternate land use systems went out. We need to work towards getting those practices in again.

#### **h) TREES** - *Key note: Dr J Venkateswarlu*

Trees are disappearing fast. What are the ways and means to protect them? Farmers take care of trees only if they feel like having them on their fields. So, those trees must be valuable to the farmers. They must get good price in the market. They also should be multipurpose. They should be useful as fodder to the cattle, green manure to the crop and timber for personal use and for selling in the market etc. It is ideal to have 5% of the land occupied by trees, but they should not shade the crop denying sunlight to the main crop.

The monoculture of raising trees is widespread. For example, the practice of raising only subabul in Prakasham district led to economic disaster. Monoculture in trees happens because of the prices that particular trees fetch in the market. Several times, farmers lose

because of the wrong and shortsighted advice, for example Jatropha, Pongamia and subabul.

We have to see if we can integrate fruit trees with crops. There are instances of multiple rising of trees. At Akola, a farmer raised 12 different fruit trees in a 2 acre land. It was found to be very useful agro-ecologically and economically.

India is number one in fruits production and number two in vegetable production. Fruit production in India is 700 grams per head while the necessity is estimated to be 80 grams and actual consumption is only 40 grams per head, which means there is over production. In that case, should we further encourage farmers to have fruit trees? Do we need to focus so much on horticulture? We have to consider these questions.

Farmers take care not to have any other vegetation in the orchards of fruit trees like oranges. They fear that trees will be subjected to root competition with other vegetation. So, they keep the land dean of every thing other than the particular trees. It is a misplaced notion. Legumes like stylo, grown in the orchards, would enrich soil. Even animals can be introduced in horticulture. The biomass thus provided in the form of leftovers of the vegetation and droppings of the animals goes a long way to make the land fertile.

Moving from monoculture to multi-culture is good for horticulture also. Different trees can be grown in the same land. Fodder trees and multi-purpose trees can be added to the orchards of fruit trees. Mixed cropping and inter cropping in horticulture is good, though it must be planned properly. Bund plantation and mass plantation are different modes. This aspect has to be further researched

Certain trees grow well in certain types of lands. For instance, pongamia needs lots of water. In the past, pongamia used to be seen only near water sources. Now, they are planted everywhere and anywhere. This practice will boomerang at us sometime later. Different fruit trees and suitability of different soils to them must be taken into account. There should be a mapping of soils and different trees suitable for those soils. For instance, coconut, ber and pongamia grow well in the soils with saline water, trees bearing citrus fruits need quality water while mango grows in both types of soil. Soils with hard rock within two or three meters of depth must be avoided for growing trees.

**i) Livestock - Key notes: Dr P Sreeramulu and Sri Dinesh Reddy**

Livestock is a critical component of the farming mechanism to cope with drought in rainfed areas. We do not see any suicides among livestock farmers. It could be because they had some alternative in the times of crop failures. But in policy decisions, livestock is considered as a stand-alone thing. How to integrate it with farming is the question we have to resolve. When we look at the nutrient flow among different systems, we find that livestock plays a prominent role in it.



If we look at the national scenario, livestock production system, which is dependent on fiber content (straws), is declining. For instance, camel population in Rajasthan is only 50 % of what used to be 10 years back. Reasons are obvious- no common lands, scarcity of fodder and mechanization of agriculture. Our livestock, unlike industrial livestock, is mostly fiber dependent i.e. dependent mostly on crop residues. 60% of feed requirement



comes from crop residues. Only 3% comes from cultivated fodder, depending on seasonality and government budgets.

There is no separate livestock/feed-fodder policy. We have only forest policy, which prevents animals entering forest to graze. There are no pastures, no grazing lands. And the first victims are sheep and goat. Whatever policies we have, they are with negative approach to livestock. There are policies, which address only crisis management. Government tried but could not provide

fodder during the times of drought.

Today farmers do not have fodder. Fodder seed is not readily available near home to cultivate fodder. We can make use of the moisture, which is not useful to crops to cultivate fodder but required seed is not available. Some legumes are disappearing. Along with them some animal breeds are also disappearing. Cultivated legume fodder as a pure crop can be thought of in specific cases. It has come up in the north where legumes were raised in the CPRs. Their research results in this aspect were positive. It needs further probing.

Fodder problem is not only a problem of animal husbandry but it concerns all. Unlike Israel, 65% of our fodder is from crop residue, but we are asked to adopt Israeli model. Goat population in our country is multiplied by three times even without any intervention. Forest personnel say it is harmful. But the poor find it as a succor. Then, where to find a niche for livestock development? We can find space for it only in the farming system. We must work out how much fodder we need and how much of the common lands must be left for fodder raising.

Cultivated fodder has never been successful. All our research, hitherto, has been only on cultivated fodder. Can we leave certain percentage of land for fodder raising? Not simply possible. Biomass is available but it is not accessible. Farmers developed some mechanisms for instance fallow lands; but they can only use what is there as they cannot produce fodder on it. Making use of residual moisture in tanks is a way. It has been successful. Community can take care of fodder security. But there must be a policy to support this.

In rainfall dependent systems, sheep and goat play predominant role. Goats and sheep can be good support systems for the poor and women in these areas. We must find ways and means to support it. Loss of intercropping system is affecting the livestock and there is a need to develop it again.

We have to enhance biomass in Common Property Resources. Increased milk production can act as a good incentive. We need to study on regeneration and introduction of improved grasses and improved pastures. Local breeds must be encouraged and developed with the type of fodder available and other conditions in the rainfed regions. For instance, in Chitrakut, Nanaji Deshmukh raised traditional livestock like the Rathik cow, which eats and thrives on dry fodder and gives good milk. That is how we can balance production costs with output prices and sustain livestock in our farming systems.

But all our attention has been on foreign breeds. We looked for high intensive milk livestock. For instance, in Chittoor today 55% of the of the animals are cross breeds. Improvement must be focused on local breeds. They survive better on existing fodder and other conditions here. Every one, who visits Israel, after returning from there, starts asking for Israel model. They plead even for importing the breeds of cattle and goats.

There are instances, which demonstrate the fallacy of this thinking. Goats and sheep were imported by the AP government some time back. It was done in such a mindless manner that 229 goats from Australia had to be quarantined until they met their natural death. There are 16 crores of cattle in Brazil. Out of them, 11 crores are the Ongole breed. Bulls from Ongole transformed Brazilian economy. But, we don't rear them here. Even embryos are being exported. It shows the lack of balance in our policy.

Government policy on cattle breeding focuses mainly on pure foreign breeds. Only 50% are Indian breeds in our breeding program. Even the effort to describe Indian breeds was not done properly. After identifying 45 breeds, there has been no attempt to describe animals. AP was one of the first states to implement this breeding policy.

There is 60% deficiency in feed and fodder requirement. How to improve the situation? Problem of fodder becomes more acute during the times of drought. Cultivated fodder comes in handy during such times. We must probe if there is any difference between the feed from hybrid bazra and feed from traditional bazra. Fortunately, it is found that there is no difference in terms of body weight of the animals, if the feed is broken into bits and fed. So, there must be facilities/ implements available to farmers to chop fodder into bits. We can harvest one lakh tonnes of fodder from forests but how to do it is a research priority.

75% of the small landholders are in milk production. How to carry farmyard manure to far off fields is a problem that has to be looked into.

We must find a way to provide water to livestock during the times of drought. Only fodder is being supplied during drought. Water remains a problem.

Another major problem is the delivery of the medical services for animals. Services are available but delivery/access is the problem. Can a system of para workers solve the problem? It would, if there is a proper policy. Diagnosis kits for some common diseases and implements should reach farmers.

Economically speaking, livestock is a sleeping giant. Every 6th animal on the globe is from India. Worth of livestock in India is 1.6 lakh crores. It is a fast growing economy but the apathy reflected in the lack of policy and research is unwarranted.

It is not simple apathy. Policy tends to promote industry model in livestock. The industrial method of thinking considers things in isolation. Anti-livestock policies are a result of isolated thinking. We need a different model, which integrates all these in a system of coexistence. Our focus should be on the non-stall-fed rather than on the stall fed livestock, as is the case of industrial model.

The notions about methane emissions etc. should be contested. We need some research to effectively refute them. People are selling small ruminants to buy large ruminants. We have to probe what are the factors that affect the sustainability of the small ruminants.

#### Backyard or family poultry in DA area:

We don't have much choice in backyard poultry. It has great potential in the rainfed agriculture areas. Some more strains must be identified for backyard poultry. There is deficit of chicks to be supplied to farmers.

We can look into breed improvement in poultry. It must depend on the feedback we get from the farmers. Based on such feedback, some useful breeds were developed and improved. The giriraja and vanaraja and then the recent Gramapriya strains are good examples. Researchers need to develop strains that give meat and can fly away from predators. (Grama priya is one such strain developed). The bird flu episode destroyed backyard poultry. There must be some measures to be taken at such times.

Can backyard poultry be taken up on a large scale or should it remain as a family affair as it is now? We must look into the question if it can be developed into a more remunerative enterprise for the farmers. Then, there is the question of feed to be probed.

#### **IV. What is to be done**

- We must integrate all the aspects of farming including agriculture in a single frame work so that one sector will not act against the other but each would contribute to the sustainability of the other.
- Sectoral priorities must be decided for each aspect of farming with appropriate consideration for its role in rainfed farming.
- Inter cropping and mixed cropping must be promoted even in millets and horticulture.
- The much trumpeted issue about micro-nutrients in soil management is another fallacy of the green Revolution model. Chemical fertilizers do not serve the purpose.
- There must be incentives for building biomass in dry land agricultural areas.
- There must be Minimum Support Price (MSP) for organic products and other incentives for organic farming.

- Bio-diversity in dry land agriculture area is getting lost very fast. Wild varieties of various crops are very important. We must preserve and spread them, especially in the dry land agriculture areas.
- Livestock should have a distinct policy and it should be integration with other aspects of dry land farming.
- Mechanisms like leaving lands fallow and using CPRs for fodder raising must be looked into.
- Investments must be made to maintain native breeds of the livestock
- Diversity in cropping, preservation and propagation of the locally suitable seeds and crops.
- Millets must be promoted as a food security component with special incentives to the farmers including MSP.
- Food security must be considered on regional level so that local crops will find place in it. PDS must be restructured for this purpose.
- We must work towards lowering the costs of Agriculture. Lower cost itself would act as an insulation mechanism for rainfed farming.
- GR technology destroyed natural balance and forced people to spend double on pest management and other aspects. There must be a campaign towards a paradigm shift from this model.
- Input prices have gone up and output prices have not. Scientists must ask these sorts of questions too. Farmers' income has not increased a wee bit in the last 20 years.
- It's not credit that the farmers need. They need income, decoupled income. Like all other members of the society, farmers too must have certain level of income irrespective of the lower or higher yields in agriculture.
- There are no storage facilities for the dry land crops. Farmers lose a lot on this account. Research must focus on developing organic techniques to store the grain and preserve it from pests like grain mould.
- Advices like cultivating maize in the shallow low rainfall areas and Bt and hybrids, which need lots of water, must not be recommended in the rainfed areas.
- Even in normal years, 25 % of the people face the problem of food insecurity. We must find ways and means to address this problem.
- Zonal mapping of the soils, climate and other conditions and the crops suitable for the zones must be done as early as possible. It would go a long way in sustaining agriculture in dry land areas. Such a mapping also would contain us from over enthusiasm.
- We must think of the strategies to bring in a change of mindset in the researchers. It needs a special campaign.
- Non Pest Management of crops has been very successful at the ground level. Technology being successful is one thing and scaling it up is another; it needs support from institutions.
- Development initiatives are as important as research per se. We must be clear about what kind of agriculture we want to have and then, about what kind of research to follow it.

- Research emanating from civil society is not much accounted for. We must see that it finds place in formal research activities.
- We must keep in mind the connection of agriculture in dry land areas with rural livelihoods and food security.
- There must be a special stress for the small holders in the dry land areas. They are the most vulnerable.

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