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SUMMARIES OF GROUP DISCUSSION

Subject I

Dryland Agriculture: Technological, Institutional, Infrastructural and Policy Imperatives

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The emerging threats to dryland agriculture are climate change leading to frequent droughts, depleting groundwater, infructuous investments on wells, imperfect markets and lack of competitiveness of dryland agriculture. However, the threat to dryland sustenance has accentuated with the rise in non-farm wages, opening up of employment opportunities as also constraining dry land agriculture affecting its profitability severely. The agrarian crisis is deepening in dry land areas, due to adverse terms of trade leading to squeeze of net margins. The farm business income of most dry land food crops are turning out to be negative. As a result, the focus of the dry land farmers is shifting from farm to non-farm activities, migration of farmers and labourers to other ventures in following the opportunity cost principle.

Despite the challenges of physical and socio-economic environment, dry lands have potential to be "hot spots of growth" from integrated farming systems with protective groundwater irrigation. In order to realise this potential, technological, institutional, infrastructural and policy support are required for ensuring security to investment by farmers. Rain water management plays a critical role as a saviour of dry land agriculture and hence the role of dry land agriculture as a farming system. Both technological and policy fatigue plague dry land agriculture. We thus need pragmatic sustainable economic solutions in dry land agriculture including road, market linkage, infrastructure and so on.

The agro-economic researchers submitted 39 papers for the session, of which 12 were presented in the conference. There were active discussion and deliberations from the participants on the following issues.

- Economic viability of dry land agriculture areas focusing *inter alia* on the size of holdings, crops, integrated farming systems, technologies adopted, governmental support, governance, levels of adoption of technologies, off farm employment, wage rates, in the period of post-economic liberalisation will reflect the predicament of economic viability of marginal and small farmers in dryland agriculture.

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- Considering periodic drought, alternate employment opportunities, increasing reservation wages, tendency towards current fallows is increasing with different causal factors. In some areas, fallows are due to increasing real wages, while in others, it is due to inadequate rainfall.

- Integrated farming is crucial for the economic viability of dry land agriculture. With the decreasing fodder availability on the one hand and declining CPRs on the other, small ruminants and backyard poultry are as crucial as milch animals in the integrated farming system (IFS). The outreach efforts are vital in heralding such promising IFS models.

- The economic viability of dryland farms is impacted by natural resource constraints and human-made constraints. The natural resource constraints are addressed with promising dry land technologies by the farmers on collective action mode. Human made constraints are addressed by pooling resources for input procurement, product marketing, strengthening the bargaining power of the collective action, etc. Collective action in buying inputs and marketing output are institutional innovations as it is largely a function of group dynamics. Thus, the experience in collective action in one area in one crop is difficult to be replicated in another area for another crop or even for the same crop. Thus, while biological cloning is attainable 'social cloning' is not due to group dynamics, and not because of technology.

- The dryland areas have greater biophysical and socio-economic diversity and hence it is difficult for a single policy prescription to work in all areas. Seasonal migration and remittances from migration, dry land horticulture, milch animals and small ruminants are the major coping mechanisms adopted. The average holding of livestock is higher in dryland than in irrigated holdings.

- Institutional gaps exist in the implementation of rural developmental programmes in general and agricultural programmes in particular. For instance, in case of a study farmers in proximity to headquarters (Bangalore) as well as at a distance (Gulbarga), were unaware of Bhuchetana scheme (which rejuvenates soil health).

- Traditional millets which are also climate smart crops cultivated on rainfed lands, such as fox tail millet, kodo millet, proso millet, barn yard millet, little millet, the demand is dwindling which is responsible for supplies to dwindle. The supply of rice and wheat in the public distribution system (PDS) at highly subsidised price have further reduced the demand for the traditional millets even though they are nutritionally superior to rice and wheat. Even the National Food Security Act has no *quid pro quo* creating the consumer demand for traditional millets, and unless the supply of rice, wheat is tagged with compulsory purchase of traditional millets, the demand for millets will further dwindle.

- Considering the economic viability of groundwater irrigation in dry land agriculture, the demand side (drilling wells, deepening wells, increasing pump capacity, crop pattern and so on) has received considerable emphasis than the supply side (recharge of groundwater on farm and on watershed basis). Thus, on farm groundwater recharge through *in-situ* water conservation is crucial, as it costs not more than 10 to 20 per cent of the investment on well/s. Chennai's compulsory roof top harvesting has brought self sufficiency in domestic water supply and will be an eye opener for recharge efforts.

- Extension efforts need to focus on supply side of groundwater adequately towards sustainable groundwater use, in addition to improving the water literacy in terms of the need for water budgeting, drilling to the right depth, installing the right pump capacity, providing the right volume of irrigation to different crops.

- Hard rock areas (HRA) are fraught with negative externality in groundwater irrigation due to cumulative interference of irrigation wells. Here, in groundwater estimation, the cost of well failure on the farm over the years needs to be included in valuing investment, instead of an uniform life/age of wells to obtain the realistic estimate of cost of water in well irrigation.

- Studies in different parts of HRA considering both scientific measurement of groundwater extracted across variants *inter alia* in the levels of use of energy (electricity/diesel), well depths, HP of pumps, externalities, size of holdings, crop patterns, well failure probabilities, urban and peri-urban influence, water requirement of crops, technologies in water use (drip/sprinkler/flow) market forces (demand – supply factors), levels of availability of electricity, economic scarcity of labour, transaction costs of metering and meter reading, (gender) equity and efficiency considerations and relative comparison with appropriate variants in the use of surface water for irrigation are the need of the hour. For instance, in one of the research papers submitted in this session, the depth of irrigation for paddy is indicated as 75 mm, while that for sorghum and pearl millet are indicated as 107 mm and 168.7 mm respectively. In another research paper submitted in this session, water for potato is shown as 13965 M3/ha, which is unrealistically higher than that for paddy. Economists need to consult water management specialists in providing pragmatic volumetric measurements of water use, since the estimation of economic efficiency and physical efficiency depends upon the volume of groundwater used.

- The proposal for pricing of groundwater for irrigation (through charging for electricity, or any other means) is premature, considering the large scale failure of irrigation wells in hard rock areas, lack of quality energy infrastructure, lack of quality power supply, equity angle considering the spread of groundwater irrigation across marginal and small farmers and the current agrarian crisis. It is in order to note that the cost of electricity forms only the tip of the iceberg (about 10 to 20 per cent) of the cost of groundwater. Also as bulk of the investment on groundwater is private investment, borne solely by the farmers, it is socially and economically inequitable to charge for electricity for irrigation without creating awareness regarding the value of water for agriculture. Considering efficient use by default farmers are found to be efficiently using groundwater using micro irrigation even without subsidy for closely spaced high value crops like leafy vegetables, coriander, tomato. The farmers are also found to use protective drip irrigation for low value crops like rainfed ragi (finger millet) and sprinkler irrigation for rainfed groundnut and onion (in Kolar, Tumkur, Chitradurga districts of Karnataka). Thus, there are other avenues of achieving groundwater use efficiency at lower societal cost achieving greater social welfare than electricity pricing. Thus there are no compelling reasons to accept the hypothesis that marginal costing of water / electricity / diesel will bring efficiency in groundwater use in irrigation.

- Regarding the proportion of groundwater wells with small and large farmers, India has the largest number of (around 25 million) irrigation wells in the world. In addition, the proportion of small and marginal farmers is more than 80 per cent. Thus, a majority of the irrigation wells belong to small and marginal farmers.

- Methodological issues especially in sampling for drawing contrasts are crucial determinants of the use of methods analysis. For instance, the caveats in using limited independent variable models (logit/probit) for pre-drawn sampling criteria needs the attention of researchers. Here, the logit/probit models need to be applied for random sample, and not for a predetermined sample size of the categories of samples. For instance, if this is applied for a predetermined sample size of n1 = 30 farmers, n2 = 30 farmers, then the logit probability of choice will be 0.5, 0.5 and is not tenable.

- Determining the counterfactual is at the core of evaluation design, especially for impact assessment using economic surplus/partial budgeting methodologies. In economic surplus methodology, the crucial parameter is that of elasticity of supply. In most studies, elasticity of supply is obtained from the review of other studies, rather than that resulting from the current technology. Thus, studies using economic surplus methodologies need to be cautious in using the right supply elasticity.

- Detailed discussion took place on a research paper using Tobit model for regressing investment on drip irrigation (equal to cost of drip irrigation system by drip irrigation farms and zero cost for flow irrigation farms) on net returns and ground water used. The discussion focused on (1) the problem of endogeneity and (2) latent dependent variable on Tobit model. It was clarified that there is no endogeneity as groundwater use is inversely related to the dependent variable. The more a farmer spends on drip irrigation system making it more water use efficient, the less water, the farmer needs to use. Regarding the latent dependent variable, it was clarified that if drip irrigation is the observed variable (Y), the expenditure on drip system is the latent variable (Y*). Then if Y*>0, we observe Y. If Y* = 0 or < 0, we do not observe Y. Thus, if Y* = 0, farmer has zero expenditure on drip irrigation for several latent reasons such as (1) as s/he has no provision to go for drip irrigation (perhaps like upward slope, where the pressure cannot pump water up, or due to other technical constraints which constrain the adoption of drip irrigation), (2) cannot afford the colossal investment (3) awaiting for drip irrigation subsidy, a complicated procedure entailing transaction costs. Thus, there can be umpteen number of unobserved or latent reasons for farmers not investing in drip irrigation. Thus, Tobit as censored regression is appropriate. If some farmers not adopting drip due to complicated procedure of getting subsidy are dropped from the sample, then it becomes truncated Tobit.

- Studies need to be undertaken on the economic appraisal of investment on deepening borewells/additional borewells and depleting groundwater versus investing on micro-irrigation technologies and conserving water and energy.

- Estimating the rate of returns to the life saving/stress relieving irrigations in the case of dry land crops provides crucial information on water use efficiency.

- How to attribute the incremental benefits accrued after micro irrigation adoption entirely to the technology, or the risk farmers are willing to take by adopting a new crop. This issue was partially addressed by considering net returns to groundwater as gross income minus all costs other than groundwater cost, as a function of groundwater used for irrigation. However, this method needs further improvement.

- Why the Micro Irrigation (MI) technologies have been spreading very fast in some regions and not in other regions. Whether large scale adoption of MI for cash crops, will lead to decline in area under coarse cereals leading to regional food insecurity?

- The access to road infrastructure, markets, the entrepreneurship of the farmers and economic scarcity of water determine the adoption of MI technologies.

- Trade off analysis for augmenting productivity in dry land crops through natural resource conservation with incentives through price and market support Vs enhancing productivity through input and resource intensification is required.

- The size of investments on institutional and infrastructural interventions V/s rate of returns to such interventions for dry land crops needs evaluation for prioritising the investments. The burning issues of groundwater scarcity, labour scarcity and market linkage for dry land agricultural products need to be addressed.