Doubling farmers' income: An action research initiative in Bihar (India)

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September 2017

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Abstract

Agriculture is the backbone of Bihar's economy. It still provides employment to nearly 77% of workforce and generating nearly 24.84% of the State Domestic Product. Agricultural growth is not keeping pace with the growth in other economic sectors and is lagging behind the manufacturing and service sectors, further, share of agriculture in state GDP has fallen steeply over years. It is with this background, the Government of India has set a policy target of doubling farmers' income by 2022. This is a herculean task whose gravity can be understood by the fact that Indian farmer's income has increased only 3 folds in the last 30 years (1983-2013) on constant prices. This goal of doubling farmer's income has met with response varying from doomed failure to optimism. This project is being proposed to evaluate the potential of doubling farmers income by socio-technical interventions across a diverse social groups having varied resource base i.e., Medium, small, marginal, sub-marginal and landless farmers. The approach to double the farmers' income can be two pronged strategy, by increasing production and productivity or by reducing cost of cultivation/production. Keeping the above facts in mind the present study is proposed to access the impact before and after providing a full proof agriculture technological help to a selected village for a period of at least three years.

Key words: Doubling farmer's income, Bihar agriculture, Cost reduction in agriculture, efficient irrigation

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Introduction

Agriculture is the backbone of Bihar's economy. It still provides employment to nearly 77% of workforce and generating nearly 24.84% of the State Domestic Product. The percentage of population employed in agriculture production system in Bihar is estimated to 77%, which is much higher than the national average. Nearly 24.84% of GDP of the state (2011-12) has been from agriculture sector (including forestry and fishing). The state has attained self sufficiency in food grains production. Barring maize and pulses productivity of various farm produce in Bihar is much below the national average. Though the area under cultivation is shrinking, there is a lot of scope for income generation, by improving productivity. Adverse climatic condition, like draught and floods, do play a role in decreasing products. But these adverse conditions can be overcome to some extent by enhancing irrigation system, providing cheaper means of irrigation, taking flood control measures. The agriculture production can only be increased to some extent through increasing cropping intensity, change in cropping pattern, providing quality and disease resistant seeds of high yielding varieties to the farmers, imparting technological knowhow of cultivation practices and with the availability of better post harvest technology etc.

Agricultural growth is not keeping pace with the growth in other economic sectors. It is lagging far behind than that of the manufacturing and service sectors. The share of agriculture in GDP has fallen steeply over years but overall dependence on agricultural sector for livelihood remains quite high. About 40% of farm households have a desire to quite agriculture but they remain in it because of limited opportunities outside it. It is disheartening that farmers are not getting due credit for their contribution towards making the state as well as the country self sufficient in food production in spite of the fact that farmers' incomes are very low. State Govt. is also trying to re-orient agriculture through diversification policy and other measures. Agriculture is the single largest private sector occupation in Bihar. The goal of the agriculture production system should be to maximize income of land owing and landless rural populace to improve their livelihoods.

It is with this background, the Government of India has set a policy target of doubling farmers' income by 2022. The shift from production to income has various implications in evolving strategies, identifying options and exploring innovative institutional mechanisms. It requires a new strategy at state and as well as on national level and implementation plans at ground level. Several options may be available for increasing farmers' incomes. Some included: (a) increase crop area through intensification, (b) lowering yield gaps and raise yields, (c) reduction in cost of cultivation by improving production efficiency, (d) agricultural diversification towards more remunerative commodities, such as horticulture, livestock and fish, (e) increasing prices of food commodities, (f) value addition, packaging and branding to the agricultural produce, (g) reducing the transaction cost by improving the supply chain, and (h) providing job opportunities outside agriculture sector. The task is not easy to execute any option. It requires complete revamping and re-orientation of agri-food system, and

strengthening of infrastructure and institutions in terms of new production systems, and farmers' access to remunerative markets, credit, inputs, information and technologies. There are number of examples within state which demonstrate that farmers with limited land are fetching significantly higher incomes than those with similar landholdings. However, such examples are few. We can also learn lessons from south and Southeast Asian countries where landholdings are small and policy focus is more on farmers' income security than production.

Hon'ble Prime Minister has declared goal of doubling Indian farmers' income by 2022. This is a herculean task whose gravity can be understood by the fact that Indian farmer's income has increased only 3 folds in the last 30 years (1983-2013) on constant prices. This goal of doubling farmer's income has met with response varying from doomed failure to optimism.

There is absence of adequate information on farmers' income to really know its adequacy, fluctuations and growth in farmers' income, thereby making it difficult to know how various factors affects farmers' income. A NITI Ayog study by Ramesh Chand and others (2015) provides estimates of total and per cultivator farm income for 1983-84 to 2011-12 and identifies sources of growth in farm income. They reported that increase in productivity, rise in real farm prices and shift of labour force from agriculture are the important determinants of growth in farm income. The study also indentified agrarian distress as farmers suicides, increased when growth in farm income was low and the same went down when farmers income experienced high growth rate. The study noted that the income earned from agriculture was not adequate to keep 53 percent households out of poverty, which operated on less than 0.63 hectare of land holdings.

Two national level surveys of NSSO titled Situation Assessment Survey of farmers in 2003 (59th round) and Situation Assessment Survey of Agricultural Households (SAS) in 2013 (70^{th} Round) provided estimates of farmers income from various sources including agriculture. As per SAS for 2012-13, the average annual income from farm and non-farm source was Rs. 77,112 of which sixty percent was from farm activities i.e., cultivation and farming of animals and rest 40 percent from non- farm sources like wages, salary and non-farm business. In absolute terms, cultivation generated 36,938 and livestock provided Rs. 9,176 per agricultural household.

This project is being proposed to evaluate the potential of doubling farmers income by socio-technical interventions across a diverse social groups having varied resource base i.e., Medium, small, marginal, sub-marginal and landless farmers.

The approach of doubling farmers' income will be:

a) Increasing production and productivity
b) Reducing cost of cultivation/production.

Keeping the above facts in mind the present study is proposed to access the impact before and after providing a full proof agriculture technological help to a selected village for a period of at least three years. With the pre-structures schedule, first a bench mark survey will be done

and for a period of three years all sorts of inputs, technical and technological guidelines will be provided to the farmers of the selected village. Every year an impact assessment survey will be conducted with applying suitable statistical tools. With the objectives to:

1. Improve the productivity and profitability of cropping system through interventions in irrigation; Seed replacement rate (SRR); optimum fertilizer application; reducing cost of human labour through mechanization; and value addition through post- harvest technology.

2. Assess the potential of non- field livelihood options for increasing the income of landless farmers.

3. Evaluate the enhancement of income and employment by all these interventions

Practical / Scientific utility:

This study will provide a model for enhancing income of farmers belonging to different socio-economic strata which is replicable elsewhere. It will also give an idea of investment required, physical infrastructure to be created and also bottlenecks in executing such programmes as well as the benefit-cost ratio both in terms of tangible and intangible benefits. The result of the study will provide a base data for such programme to enhance farm income which can be funded by NABARD which is the core function of this organisation.

Review of past research

Irrigated crop land is twice as productive as rain-fed agriculture (World Development Report 2008), but many farmers do not have access to irrigation infrastructure, including a nearby water source and power to move the water to and through their fields. Combining drip irrigation kits, newly affordable photovoltaic panels and off-the shelf, 12-volt pumps can result in a cost-effective system for supplying water for irrigation. Solar-powered irrigation has the potential to increase incomes dramatically, particularly for the most remote producers.

A 1000 Watt solar water pump is capable of drawing and pumping approximately 40,000 litres of water per day from a source that is up to 10 meters deep. This is sufficient to irrigate about 2 acres of land with regular crops. A 1000 Watt solar water pump helps us saveing up to Rs 45,000 when compared to equivalent use of a diesel-operated pump over a year.

Postel, S. et al. proposed that low- cost drip irrigation method in 2010 with help of private enterprises for reducing the hunger and increasing the incomes of 150 million of the world's poorest rural people over the next 15 years. They are estimated and suggested that this initiative could boost annual net income among the rural poor by some US$3 billion per year and inject two or three times this amount into the poorest parts of the developing world's economies.

Otsuka, K. (2013) studied that the process of economic development in land-poor countries in Asia, agriculture faces three distinctly different problems: food insecurity, sectoral income

inequality, and the declining food self-sufficiency associated with the declining comparative advantage in agriculture at the high-income stage. Massive imports of food grains to Asia, if they occur, will aggravate the world food shortage, which will have significant implications for the poverty incidence in the world. He was suggested that in order to avoid such a tragedy, Asia should expand farm size to reduce labour cost by adopting large-scale mechanization.

Kimball, M. S. (1988) recommended that scattering of plots was insurance against crop failures the idea being that if one plot did badly but another did well the former wood still have enough to survives from his entire plot put together. A farmer in Bihar for example, might be paying 30–40 times for a cubic meter of water as his counterpart in Punjab and Haryana (Shah et al. 2009), even though groundwater is more abundant in Bihar.

Groundwater is considered the best bet against drought among all sources of irrigation (Dhawan 1985), is physically abundant in Bihar, but is economically scarce, because of the near complete dependence on expensive diesel as motive power for pump-sets.

Chand Ramesh (2017) analysed in this policy paper reasons of low farm income and how farmer's income can be doubled.

Much work has been done on several of these activities separately but this is probably the first project which touches on the objective of doubling farmer's income through socio-technological interventions comprehensively taking major components.

Technical Feasibility

The Objective of Doubling the farmer income can be achieved by following steps:

By reducing the cost of cultivation through:

i. Better and efficient Irrigation Systems
ii. Balanced Use of Fertilizers
iii. Mechanization

By increasing the productivity of land and other enterprises:

i. Increasing the seed replacement ratio (SRR)
ii. Better grading and packaging of produce
iii. Promoting Local level processing
iv. Better Drying and storage

Strategies for reducing cost of cultivation

The reduction in cost of cultivation/ animal rearing can be achieved with following strategies:

Reducing the cost of irrigation

Presently about 60% of cultivated area is irrigated with ground water. The extraction of ground water is done by diesel engine powered centrifugal pumps. Due to small holding and scattered plots, normal practice is used pump water by hired 5 hp diesel pump. The cost of hiring ranges between Rs. 150 – 200 per hour. The cost of a single irrigation by this system is about Rs. 5000/ to 7500/- per ha. Due to this high cost farmer tend to delay irrigation in kharif till it become acute necessary, and in *rabi*, number of irrigation is just half of required numbers besides reducing depth of irrigation. Further use of centrifugal pump has started limiting extraction when water level goes beyond 6-7 m.

The cost of irrigation can be reduced by changing the prime mover of pumps and replacing centrifugal pumps by submersible pumps. Given the scatteredness of plots, small holdings and electricity distribution network, it is proposed to install single phase 3hp submersible pumps. Studies at Dr. RPCAU has shown feasibility of such system with sufficient availability of single phase power, farmer can reduce cost of irrigation by almost 80%, i.e. a saving of Rs. 10000/- to 15000/- per ha per season i.e. annual saving of Rs. 20000 – 30000/- per annum. For farmers having 2-4 ha land holding, 5hp diesel pumps can be replaced 3phase 5 hp submersible pumps powered by 5KW solar trees. The cost of irrigation will reduce by about 60% which means a saving of Rs. 15000/- to 22500/- per annum.

It is expected that providing irrigation at affordable rate will induce farmers to go for full irrigation, and therefore reduces the losses due to drought. A study by IFPRI (2014) has indicated that droughts significantly reduce the agricultural output of Bihar and retard its growth. *Kharif* paddy, the crop with the highest fraction of gross sown area in the state, is affected the most and in spite of the physical abundance of groundwater and higher fraction of sown area under irrigation, crop output is more vulnerable to droughts in Bihar than in other states of India where farmers have access to cheaper irrigation. Bihar is the most rural state of India and has the highest share of its main working population engaged in agriculture. This high level of dependence on agriculture in Bihar means that drought-induced recession in the agrarian economy affects households' consumption and poverty levels.

By providing irrigation facility at affordable cost, the losses due to any disruption in rainfall will be reduced to almost zero.

Reduction the cost of fertilizer

The application of fertilizer as per the soil health requirement will reduce cost of fertilizer by 20%. The cost of fertilizer annually is about 10000 – 12000/- per ha. An appropriate fertilization will reduce cost by 20% i.e. a saving of about Rs. 2000/- per annum per hectare.

Mechanization

The cost of labour component is about 44% for paddy, 34% for wheat and 33% for rice. While tillage operations are almost mechanized, the other operations transplanting of rice, seeding of wheat, inter cultivar and harvesting is still manual. Mechanization will reduce this cost by 25%. Thus a proper mechanization will reduce cost by about 2000/- per crops or Rs.

4000/- per ha per annum. Thus reducing cost of cultivation by these three steps will increase farmers' income by Rs. 30000/- per annum per hectare.

Increasing productivity and value addition

Increasing Seed Replacement Ratio

Providing good quality seed can enhance productivity straight by 15%. Deducting additional cost of quality seed, the additional benefit can be to the tune of Rs. 10,000/- per ha per annum.

Drying and storage

It has been estimated in a study by RPCAU, Pusa that in wheat, paddy and maize, the storage loses are in between 5 to 10%. If properly dried and stored this can be brought down to 1-2%. Assuming additional cost of drying and storage to be 2%, 4-5% additional income can be generated. This will be about Rs. 5000/- per annum per hectare. In case of vegetables, the transport is done without any grading and packaging. It has been estimated by RPCAU that the post harvest losses in cauliflower, cabbage etc. is 23-27%. If proper grading and packaging is done, this can be easily reduced by a minimum of 15%. For vegetables this can generate an additional net gain of Rs. 10000/- per crop per hectare.

Local level processing:

Local level processing of pulses, spices, drying of vegetables will add up another 10-20% of gross return. Thus, we can reduce cost of cultivation by Rs. 30000/- and add another Rs. 30000/- by increasing productivity and local level processing making an additional income of Rs. 60,000/- per hectare. For landless farmers' three livelihood options will be taken up, i.e. beekeeping, mushroom cultivation and backyard poultry.

Technical Programme for selected villages:

Strategies for reducing cost of cultivation

Bringing the whole village under assured cost efficient irrigation system by :

Bringing rainfed areas (65 ha appro.) within 200 meters of homestead under assured irrigation by 3 phase electric submersible pumps. In addition to above irrigated areas in both the villages (180 ha approx.) can be irrigated more efficiently and economically by replacing 3 or 5 hp diesel pumps by 5 hp single phase submersible pumps which are powered by 5 KW solar trees (32 nos. approx) under cost efficient irrigation system. This is expected to increase the productivity by 25% in these villages.

Reducing cost of fertilizer

All farmers will be assisted in proper and efficient use of fertilizers by promoting soil health card and soil test based fertiliser application. This intervention is expected to reduce input

cost 20%. University would deploy its resources in these two villages to ensure that every farmer uses balanced fertilizers and does not over fertilize the crops.

Mechanization

The cost of labour component is cereal crops like paddy and wheat is about 44% for paddy and 34% for wheat respectively. While some tillage operations are now mechanized, other operations like transplanting of rice, seeding of vegetables, inter culture operations and harvesting are still being performed manually. It is expected that mechanization will reduce this cost by almost 25 percent. Proper mechanization can reduce the cost of cultivation by about Rs. 2000/- per crops or Rs. 4000/- per ha per annum.

Reducing cost of cultivation by adopting these steps will increase farmers' income by Rs. 30000/- per annum per ha. Machine banks/custom hiring centres will be established which would help in reducing labour cost. It is often observed that there a severe shortage of human labour during peak season (transplanting or harvesting). Mechanization would help in creating employment opportunities for unemployed youth of these two villages.

Strategies for increasing productivity and value addition

Increasing Seed Replacement Ratio

Providing good quality seed can enhance productivity straight by 15%. Deducting additional cost of quality seed, the additional benefit can be to tune of Rs. 10000/- per ha per annum. It is proposed to provide quality high yielding seeds to the farmers of these two villages from Dr.RPCAU, Pusa so as to ensure that seed replacement is around 30% per year.

Drying, storage and Value addition

It has been estimated in a study by DRPCAU, Pusa that in wheat, paddy and maize, the storage loses are in between 5 to 10%. If properly dried and stored this can be reduced to 1-2%. Assuming additional cost of drying and storage to be 2%, 4-5% additional income can be generated. This will be about Rs. 5000/- per annum per ha. In case of vegetables, the transportation is done without any grading and packaging. It has been estimated by DRPCAU that the post harvest losses in cauliflower, cabbage etc. is 23-27%. If proper grading and packaging is done, this can be easily reduced by minimum 15%. For vegetables this will be net additional gain of Rs. 10000/- per crop per ha.

Local level processing:

Local level processing of pulses, spices, drying of vegetables etc. will add up another 10-20% to gross return of the farmers of these villages.

Thus, we can reduce cost of cultivation by Rs. 30000/- and add another Rs. 30000/- by increasing productivity and local level processing making an additional income of Rs. 6000/- besides opening new avenue for employment. The post harvest techniques developed by the joint research project by RPCAU, Pusa and University of Illinois at Urbana-Champaign, USA, will be utilised in processing of pulses, turmeric and ginger.

Strategy for increasing income of landless

There are 150-180 landless families in these villages, which rely on working as human labour in nearby farms, involved in various off-farm activities and they are also involved in activies which require no land like animal husbandry for their income. They also work in the nearby cities for various businesses.
It is proposed that to increase the income of these landless villagers, three interventions namely; backyard poultry, beekeeping and mushroom production would be introduced. These families would be provided skill oriented training and livelihood support for doubling their income.

Methodology

Step –1 Selection of two villages from districts Samastipur and East Champaran.

Step -2 only those farm household will be selected whose farm income contributes more than 65 percent of their total income.

Step -3 Bench mark survey to capture baseline data so that the increase in income can be measured correctly. It will also help study the existing farming practices and crops in the village with reference to type of crops, method of irrigation, energy utilization, level of mechanization, fertility management, seed material used and post harvest processes.

Step- 4 Selecting and implementing activities options, with reference to the objectives of the project suitable for farmers of different socio-economic groups

Step -5 Impact and data analysis

Observations:

The main item of observations is to be recorded:

Benchmark survey of changes in different component and how the interventions have resulted in:

i) Change in cropping pattern
ii) Change in cost-input: benefit ratio
iii) Changes in productivity
iv) Changes in income

Duration of project / study
3 years. Activities to be completed

Year-I: Collection and analysis of primary data.Prioritising and initiating activities for income generating endeavours for different socio-economic groups
Year-II: Execution of activities.
Year-III: Operationalization of activities.
Data collection and analysing the changes in income of different socio-economic groups, their spending patterns, change in standard of living etc.

Table I. Intervention wise expected income, reduction in input cost and additional cost involved per hectare (For land owner)

Sl. No	Interventions	Expected Outcome
1.	Providing assured irrigation to rainfed areas	Increase income by 40%
2.	Replacing power source from diesel to solar	Increase income by 40%
3.	Appropriate fertilizer	Reduce cost of cultivation by 20%
		No additional cost except of Soil health card (which is already a program)
4.	Mechanization	Reduce cost by 20%
5.	Seed Replacement	Increase productivity by 15-20%
		Increase in cost by 5%
6.	Post-Harvest Management	Increase in productivity by 15-20 %
		increase income by 5 %

Overall increase in gross income per ha = 80% (x)
Reduction in cost of cultivations = 33 % (Y)
Cost of Interventions = 10% (Z)
Total increase in Income =X+Y-Z= 80+33-10=103 %

Table II. Intervention wise income, reduction in input cost and additional cost involved per hectare (For landless)

Intervention	Expected Increase in Income (Rs/yr)	Additional cost involved (Rs/yr)	Net Income (Rs/yr)
Beekeeping @ 10colony/family	1,20,000	50,000	70,000.00
Mushroom production			
(Button Mushroom30x 30 ft hut)	1,25,000	75,000	50,000.00
(Oyster Mushroom 30x 30ft hut)	75,000	40,000	35,000.00
Back Yard Poultry (25 birds/ family)	18000 from eggs 3750 from bird sale= 21750	1750	20,000.00

Table-III Timeline of various activities

Sl. No.	Quarter/Week (s)/ Day(s)	Activities/Tasks to be Accomplished
1.	Quarter 1 &2 (I Year)	Collection and analysis of primary data. Prioritising
2.	Quarter 3 &4 (I Year)	Initiating income generating endeavours for different socio-economic groups.
3.	Quarter 5 &6 (II Year)	Execution of all related activities, establishment of machine bank
4.	Quarter 7 &8 (II Year)	Operationalisation of activities, starting village level processing of pulses, turmeric and ginger
5.	Quarter 9 &10 (III Year)	Operationalisation of all the activities of the project. Assessment of change in cropping pattern, cost-input: benefit ratio and productivity of farm output
6.	Quarter 11 &12 (III Year)	Data collection and analysis of change of income of different socio-economic groups, their spending patterns, change in standard of living.

Table IV: Flow Chart of the activities to be accomplished

Sl. No	**Activities**	**I Year**				**II Year**				**III Year**			
1.	Collection and analysis of primary data, Prioritising												
2.	Installation of Solar tree												
3.	Establishment of machine bank												
4.	Seed replacement @30 % per year												
5.	Mini dal mill/ turmeric & ginger processing unit												
6	Assessment of change in cropping pattern, cost-input: benefit ratio and productivity of farm output												
6.	Apiary unit												
7.	Spawn production unit												
8.	Back Yard Poultry												
9.	Assessment of increased income for different socio-economic groups.												
10.	Data collection and analysis of change of income of different socio-economic groups, their spending patterns, change in standard of living.												

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