TRANSFORMING LIVELIHOODS
DELIVERING IMPACT

An Investment Case for Small Tank/Ditch (Happa) Irrigation models for SMALL and MARGINAL FARMERS

July / 2015

Is it possible to simultaneously impact the livelihoods of small and marginal farmers in dry arid regions by not only addressing their water needs but also enabling them transition from chemical intensive mono-cropping to ecologically sustainable farming practices?

HOW ? MODEL

Yes,
through Happa (Small Ditch) irrigation models effectively linked with Bio Integrated Farming System

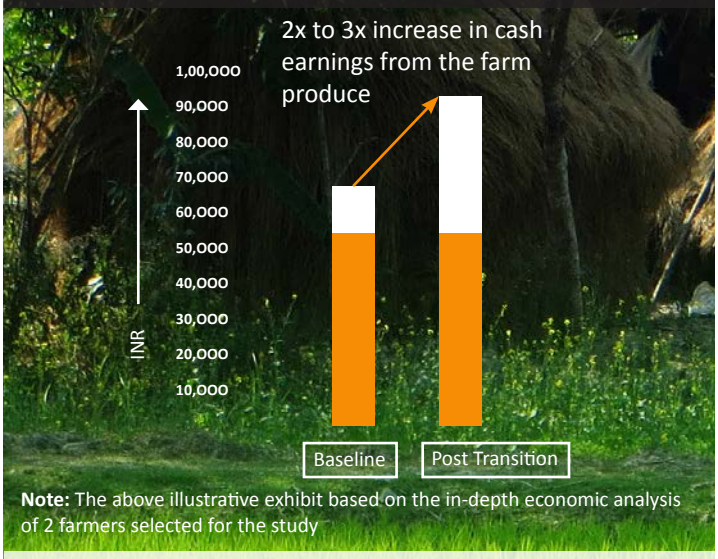
WHAT ? IMPACTS

A continued and easy access to water for irrigation through a mud-excavated structure (Happa) enables the farmer in dry region, shift from mono to multi cropping practices all throughout the year. Generation of significant quantities of farm produce from diversified sub-systems including Happa result in cash earnings for the farmers.

WHO ? ENABLER

The model implemented by DRCSC, an enabler, is already showing signs of sustainability and scalability in the dry agro-climatic zone of West Bengal.

An illustrative snapshot of Pre Happa-IFS economic value creation and value created post transition to Happa linked IFS



Note: The above illustrative exhibit based on the in-depth economic analysis of 2 farmers selected for the study

Key Investment Features for a Farmer

- Total Investment: INR 20,000
  - Farmer's contribution: INR 5,000
  - Loan Amount: INR 15,000
- Loan Period: 5 years
- IRR: 88%
- Target Landholding Size: At least 1 acre

SCALING UP PARTNERSHIP OPPORTUNITIES: Do you want to be a part of it?

Scaling the Happa linked IFS model to impact the livelihood of

500

Small and Marginal Farmers

In the dry agro-climatic zones of West Bengal

Scaling up Investment for 500 farmers: Total Investment INR 3 crores

- **Grant Component INR 1 crore for enabling Organisation**
- **Loan Component INR 1.25 crores**
- **Farmer's Contribution INR 75 lakhs**

About DRCSC

Development Research Communication and Services Centre (DRCSC), a non-profit development organization, formed in 1982 has been working as a resource centre for collection, collation and dissemination of information on various socio-economic issues and to highlight the struggles of various NGOs, CBOs and individuals to ensure social justice; especially for informal sector workers, indigenous communities and small & marginal farmers/landless labourers as well as self employed artisans. Along with that, since 1992, the centre focused on Sustainable Agriculture & Natural Resource Management for improving food & livelihood security of the rural poor. The centre stands for ensuring food and livelihood security of the rural poor through sustainable management of natural resources on the basis of principles and action.

About Change Alliance

Change Alliance, a wholly owned subsidiary of Christian Aid, UK has been working a various portfolio of projects with an ambition of bridging the social and economic gap in the Indian Masses and make growth inclusive and sustainable. Change Alliance provides market-leading development services and training, high quality technical and advisory consultancy, and capacity building to the development and private sectors and to government. Change Alliance is committed to working in partnership as a catalyst for change and understands the need to bring strategic stakeholders together to tackle complex challenges in a fast-moving development landscape.

About Re-emerging World

Re-emerging World (ReW) is a strategic advisory firm working with leading Multinational Corporations (MNCs), Businesses, Social Entrepreneurs and Institutions on their inclusive growth agenda in emerging markets. ReW focuses on innovation, insights and models at the intersection of business value creation, social and environmental impact. ReW was given the responsibility for conducting this study and report preparation.

Table of Contents

Executive Summary

While agriculture share in India's economy has declined to less than 15% due to the high growth rates of the industrial and service sector, the sector's importance in India's economic and social fabric goes beyond this indicator. The sector's growth performance is largely attributed to the substantial increase in the irrigated area and remains India's largest water user accounting over 80% of the water use.

Traditionally, the investment focus on irrigation sector in India has been biased to the needs of medium and large farmers with more than 60% of the irrigation budgets and investments targeted to the major and medium cultivable area. Massive investments from the Government of India and the International donor community led to the construction of large dams and barrages which mostly suited the irrigation requirements of the medium and large scale farmers. The long term implication of such constructions is the increasing depletion of the ground water levels, with recent NASA support stating India being the worst off country in terms of ground water depletion[1].

In addition, the rain fed areas without any sources of irrigation in the country still account for 60% of the cultivated areas and these areas are home to the majority of small and marginal farmers. Without access to any assured sources of irrigation, the sustainable living of these small and marginal farmers are greatly jeopardized.

In this backdrop, a major breakthrough is needed for farmers particularly in arid and semi-arid regions of the nation which have low water tables and limited annual exposure to monsoons. One such innovation is the Happa (Small Tank) model which leverages the principles of integrated natural resource management for the small and marginal farmers.

The following study highlights the potential of Happa as an investment based on the early evidences from the in-depth study of small section of marginal farmers in the undulating region of Purulia, West Bengal. The successful farmers who have been using the Happa model have not only shifted from mono-cropping to multi-cropping but also from rain-fed cropping to multi-season cropping, contributing significantly both to food security and farm cash income. The key success factor of Happa model is its integration as one of the sub-systems in the overall farming system. The study also highlights the various socio-economic benefits and also the key risks associated with the Happa Model.

The study acknowledges the key enabling role played by DRCSC in introducing and implementing these innovative and sustainable models of irrigation in the dry lateritic zones of Purulia, West Bengal.

[1] http://www.business-standard.com/article/news-ians/groundwater-depletion-in-india-worst-in-world-nasa-115061800734_1.html

The compelling case for integrated and sustainable irrigation systems

Irrigation investments in India have traditionally taken a 'large scale nature'

The increase in the agricultural productivity in India gets partly attributed to the substantial increase in the irrigated area. Massive investments from the Government of India as well as from the international donor community began in the large scale irrigation projects since 1960s and then peaked up in the decade of 80s. The results were construction of large dams and barrages. However, these constructions suited the water input needs largely for the medium & large scale farmers. One of the long term implication of such large scale irrigation projects as its becoming increasingly evident now is the substantial decline in the ground water levels across various agro-climatic regions in India.

The Irrigation landscape in India: Major Categories

On the basis of Method of Irrigation

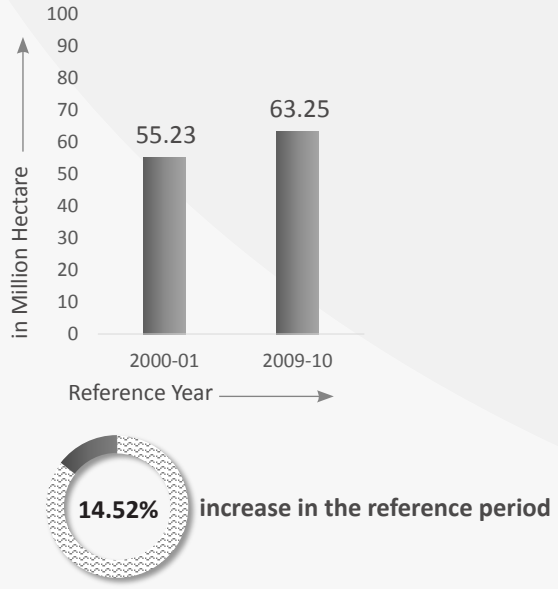
1. Canal Irrigation
2. River Lift Irrigation
3. Tube Well Irrigation
4. Tank (water harvesting structure) Irrigation

On the basis of Cultivable Command Area (CCA)

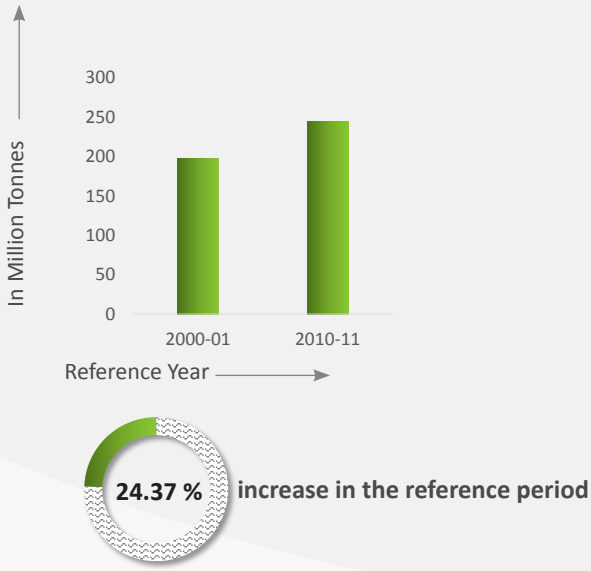
1. Major CCA (above 10,000 hectare)
2. Medium (between 2,000 and 10,000 hectare)
3. Minor (below 2000 hectare)

The past decade has witnessed a medium scale increase in the net irrigation area under cultivation as compared to total food grain production

Net area Under Irrigation by all sources[1]



Total food gain production in India[2]



Sources:

1. *MOSPI; http://mospi.nic.in/Mospi_New/upload/SYB2013/CH-12-IRRIGATION/Irrigation-writeup2013.pdf*
2. *Trends and Pattern of Food Production in Punjab, http://gistadvisory.com/admin/pdfs/Module%201%20-%20Trends%20&%20Patterns%20of%20Food%20Production%20in%20Punjab%20-%2019%20March%202013%20Version.pdf*

The emerging needs for Irrigation Options Assessment and the potential of alternative sustainable irrigation models in the context

Since the last two decades, the irrigation's steady boom has begun to wane[2]. The largest portion of irrigation budgets and investments (more than 60%) which pre-dominantly have been targeted to major and medium cultivable area (CCA) have not yielded the desired results. The projects by its nature had limited impact for suiting the water needs of the small and marginal farmer's category, the largest farming segment of Indian Agriculture.

While there has been innovations on alternative irrigation techniques including drip irrigation, sprinkler irrigation, seepage irrigation, etc. a major breakthrough is needed for farmers in arid and semi-arid regions of the nation which have low water tables and limited annual exposure to monsoons. One such innovation is the Happa (Small Tank) model which leverages the principles of integrated natural resource management for the small and marginal farmers.

[2] Thematic Review: Assessment of Irrigation Options in India

Sustainable Small Scale Irrigation with Happa in Semi-Arid regions of West Bengal

Irrigation in a tropical developing country like India has been practised over the centuries. However, the dominant approach in irrigation in India is of large scale irrigation projects and transfer of water. The approach neglects the basic fundamentals of irrigation including the dynamics of the user, cropping practices, soil characteristics, and the topology. These aspects are extremely crucial for small and marginal farmers keeping in consideration their resources to build irrigation systems.

The Happa model can be a potential breakthrough for small and marginal farmers in semi-arid regions

A continued and easy access to water is a central issue for small and marginal farmers particularly in the semi-arid agro climatic zones. The Purulia district of West Bengal is one such locational example. Here, the amount of rainfall is insufficient. In addition, due to the high run off and red lateritic soil, the amount of moisture content in the soil is quite low than what is required for crop survival. In such an agro-climatic context, Happa, a mud–excavated rain water harvesting structure in the cultivatable land of the farmer plays an imperative role in satisfying the water requirements for cultivation.

About the model

A Happa model in Purulia

- A water harvesting structure
- Typical size: 20’ x 12’ x 8’
- Located usually in the medium high land

The Happas are built as a response to the challenge posed by the undulating land of region. In Purulia, for example, the topology of land is categorized into four distinct types: high land (Tora), medium high land (Baid), medium low land (Kanali) and low land (shol).

With high runoff of rainwater, the high and medium high land fail to retain water and remain fallow. The Happa which usually gets excavated in the medium low land or in the low land takes advantage of recharge of ground water as well as the collection of rain water from the seepage from uplands. Thus, the very design of a Happa ensures to reap the maximum benefit by ensuring and enhancing crop production and simultaneously increasing the given land use.

The Happa model interlinked with integrated resource management delivers optimal impact:

- From the integrated farming approach, Happa gets introduced as the first and core sub-system which ensures a perennial access to water to all other sources including crops and livestock.
- The Happa along with integrated farming systems is a potential combination for small and marginal farmers leveraging the basic principles of natural resource management.

The benefits from the model

Adds Ons	How it benefits?
Multi-season cropping 	In dry and semi-arid areas, the farmers traditionally cultivate rain fed crop (Kharif). The introduction of Happa allows the farmers to grow winter (rabi) crops as well as Pre-Kharif crops in a portion of their land which can be irrigated by water from the Happa.
Diversification of cropping pattern 	With easy and increased access to water for irrigation, farmers can potentially shift their cropping practice from mono-cropping to multi-cropping. Inter cropping practices with range of crops particularly vegetables allows the farm to produce enough marketable surplus.
Increased food security 	The Happa coupled with the integrated farming approach ensures a flow of food from multiple sources including paddy land, nutritional garden, livestock, pond. This renders increased food security to the farmer's family.
Enhanced intake of nutritious and organic food 	A key advantage delivered by the IFS model is all year intake of nutritious and organic food completely devoid of chemical inputs.
Higher Cash Earnings 	The most tangible remuneration is in form of higher cash earnings from the marketable surplus coming out of each of the sub-systems.
Restoration and preservation of soil fertility 	IFS use organic fertilisers and bio pesticides for all farming thus resulting in restoration of soil fertility and conservation.
Cessation of seasonal migration 	Irrigation options along with IFS produce sufficient cash income for the households through marketable surplus. This in turn reduces the compulsion of the farmer to migrate to the nearby town in search of daily labour work during lean season.
A perennial community water source 	Given the dry nature of the land, the Happa not only serves as a source of water for the farmer household but also for the village community especially during dry summer months.

Happa Irrigation model is an investment case for small and marginal farmers

The Happa irrigation model along with the associated Integrated Farming system makes a viable investment model for the farmers. The investment yields an approximate IRR of 85%. The farmers benefit from shifting primarily from a single kharif season crop to multi season cropping. The introduction of irrigation option like Happa followed by Integrated Farming System further increases the yield of the farmland. The marketable surplus generated from this investment in Happa and subsequent irrigation model is sufficient to pay back the loan undertaken by the farmer for investment in Happa and other farming subsystems like vermicompost and biogas.

Investment Features	Dry Zone
Typical land size	2 acre - 3 acre
Typical size of Happa	Length: 28 feet Width: 12 feet Depth: 11 feet
Initial Investment (for Happa and along with all other sub-systems)	INR 35,000-40,000
Subsystems available	• Happa • Livestock • Vermicompsot Pit • Land • Biogas

Investment Break-Up	Subsystems	Investment
	Happa	INR 15,000
	Vermi compost Pit	INR 5,000
	Biogas Plant(with Subsidy)	INR 16,000
	Livestock	INR 1,000
	Farm Input Cost	INR 3,500
	Other overheads	INR 4,000

Farmers Contribution	INR 10,000
Time Period for Implementation	1-2 years

Loan Repayment		Can be considered starting from the 3rd year after the introduction and stabilisation of the sub-systems
Internal Rate of Return[3] (without opportunity cost of labour[4])		88.5%

Note: *The above conclusions are based on detailed in-depth interviews, review of diary and analysis of 2 farmers supported by DRCSC in the dry zone.*

The key investment features of the standalone Happa model

While the farmers in the regions of Purulia and Bankura have adopted Happa linked with bio integrated farming systems, a standalone Happa model can be as significant given the climatic context of the dry arid zones. Previously, the Government of India had introduced the construction of the Happa model in state of West Bengal under the MGNREGA scheme yet most of the Happa have failed primarily due to the wrong selection of sites of Happa construction.

In this context, the enabling organization (DRCSC) can propagate the standalone happa model as an investment decision to desired farmers with two distinct sets of features:

- Assessment of the land and appropriate site selection for the Happa: The placement of Happa in the farmland should be cognizant of number of factors including its topology and the kinds of crops to be grown. DRCSC can provide a strategic assessment of the land before the construction of Happa.
- Handholding and monitoring support: The initial years post introduction of Happa requires continuous handholding and monitoring support

Key Investment features of Standalone Happa model

Total Investment	Interest Rate	Payback period
INR 15,000-20000	**5% per annum**	**3rd year from implementation**
Farmer's contribution: INR 3,750-INR 5,000		

[3]Internal Rate of Return (IRR) is a rate of return used in capital budgeting to measure the profitability of investment. The higher a project's IRR, the more desirable it is to undertake the project. And an investment is considered to be acceptable if its IRR is greater than cost of capital

[4]Opportunity cost of labour is the real cost of next best choice of the labour foregone

Case studies

Success stories from the field- Case studies of farmers who have successfully adopted the happa model along with an integrated farming approach

DRCSC has been pioneering the task of introducing, developing and popularizing the Happa/Small tank(ditch) models embedded with an integrated farming approach in the undulated and dry lands of Purulia, West Bengal. The success stories of two marginal farmers from the district testifies the potential of these sustainable and innovative irrigation models in addressing the acute water needs and making transformative impact on the lives of small and marginal farmers.

Adoption of Happa not only delivers substantial impact on the livelihood but also creates a 'farmer entrepreneur'

Farmer's Profile

Mahadev Tudu, aged 25, is a 'farmer entrepreneur' in making. He is one of the 'successful farmer' in the drylands of Purulia district of West Bengal who has successfully adopted and leveraged the Happa model in effectively meeting the water requirements for his farming system. The introduction has not only enabled him to earn higher cash earnings from the farm's marketable surplus but also changed his attitude from just being a farmer to become an entrepreneur farmer.

At a Glance		
Total Land Size	Adopted the Happa model	Average annual cash earnings since adoption
2.31 acre	Year 2012	INR 81,268

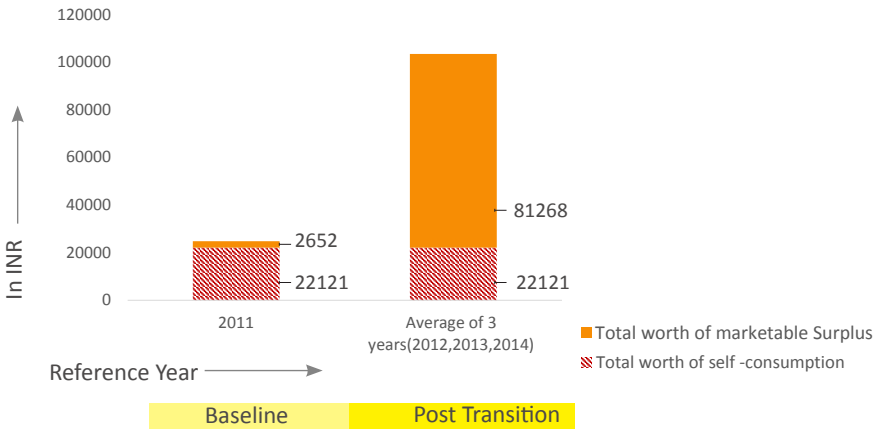
The effectiveness of the Happa is corroborated by the substantial increase in the marketable surplus and the subsequent cash earnings from the various products of his farmland

During the period of 2008-2011, Mahadev had started eyeing alternative livelihood opportunities. The reason being his ancestral livelihood practice of farming was failing to meet the basic food requirements of the three member family. Given the topographical conditions of the region and with no access to a perennial water source, his crop cultivation was restricted to only paddy and few other vegetables particularly in the Kharif season.

Mahadev was one of the first farmers in his village to experiment with the Happa model under the guidance of DRCSC. Three years post adoption of Happa irrigation he is now able to generate enough marketable surplus without compromising the nutritional needs of his family.

A snapshot of Pre Happa adoption economic value creation and value created in 2013 & 2014 : the model has created sizable marketable surplus for Mahadev

Mahadev Tudu's case of value creation post adoption of Happa and Integrated farming model



Notes:

1. *Cash earnings and worth of self-consumption is considered only for farmland; labour cost is not factored in*
2. *The worth of self-consumption is considered equivalent for year 2011 & average for years 2012, 2013 & 2014 as in both periods Mahadev was able to produce for self consumption*
3. *The cash earnings in year 2011 have been adjusted to 2014 prices, Net Cash earnings of Mahadev Tudu in year 2011 was INR 1,435*
4. *The earnings do not include other income sources like daily labour*

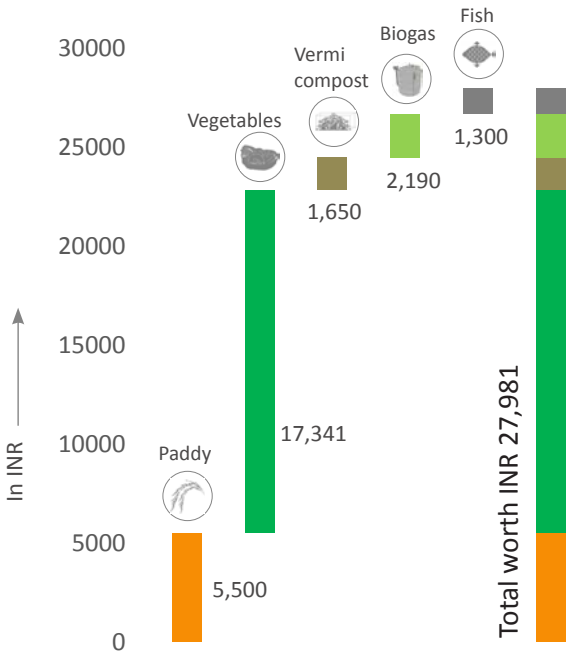
The combination of the integrated farming approach along with Happa irrigation has enabled Mahadev to unlock to unlock optimal value from his farm

Mahadev success in the Happa irrigation technique is significantly explained by the presence and the effective integration of various sub-systems in his farmland. Happa /ditch was introduced as the first sub-system followed by the other sub-systems including vermicompost, livestock and biogas.

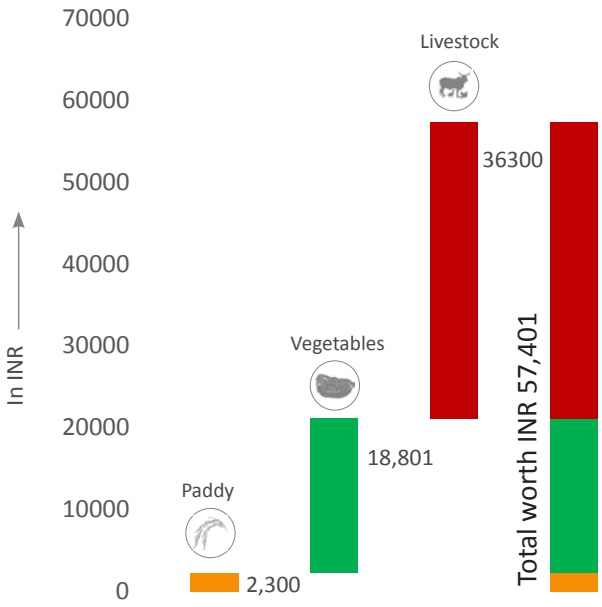
Happa plays an indispensable role in maintaining all these sub-systems given water is a critical requirement for all of them. The successful management has resulted in significant decline in cash input cost on one hand and increase in the cash earnings from each of the sub-systems.

Happa model along with IFS approach has created economic value both for internal consumption as well as by selling surplus in markets as in the case of Mahadev Tudu

Average worth of self-consumption in the period 2012-14



Average cash earnings generated from the marketable surplus in the period 2012-14



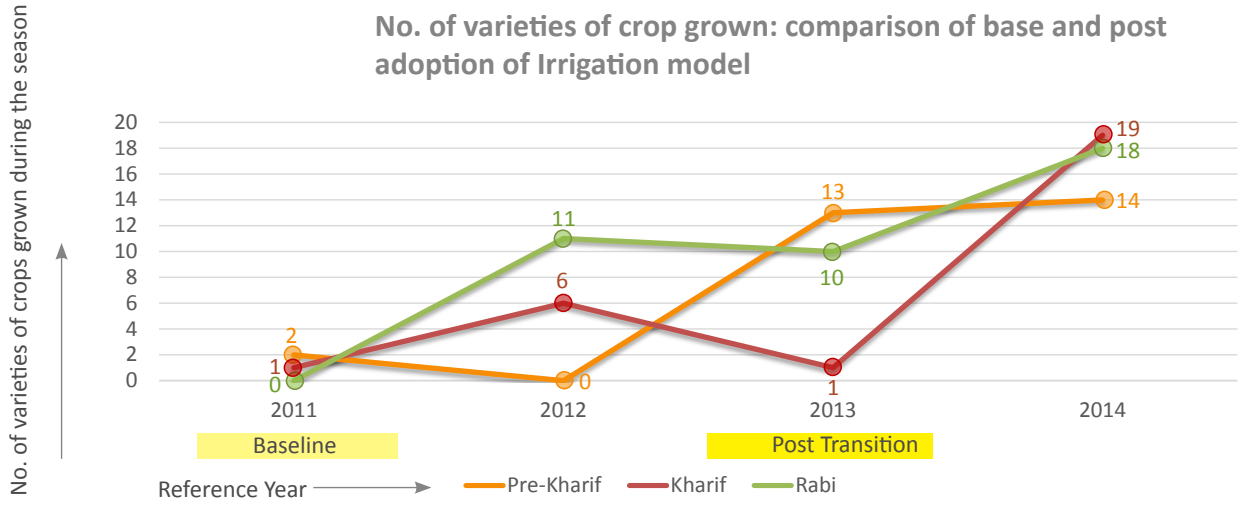
Happa Irrigation has enabled Mahadev to grow diverse basket of crops as well all along the three cropping seasons

Pre-adoption of Happa irrigation Mahadev, like other farmers of his village restricted his crop varieties to 2-3 vegetables along with paddy. The cultivation was majorly used to be carried out in the Kharif seasons and in the other seasons Mahadev had to migrate to other catchment villages in search of work.

Now, Mahadev has been successfully able to transition to a multi-cropping technique in all the three cropping seasons in a year.

Happa Irrigation enables a transitional shift from mono to multi cropping practice as well as growing across all the seasons of year

No. of varieties of crop grown: comparison of base and post adoption of Irrigation model



The investment is poised to deliver an Internal Rate of Return of 86 % over a 12 year period based on his marketable surplus and generated cash to pay back loan

The initial investment of construction of Happa followed by introducing the other sub-systems has not only led to increase in the cash earnings but more importantly has turned Mahadev to an entrepreneur.

Key Investment Features	
Net Present Value	INR 2,18,903
Internal Rate of Return	86%
Assumed discount rate	12%

He has buying portions of land since 2012 from the cash earnings. He rightly considers this as a valuable investment to upscale his production.

A Happa Model embedded with Integrated Farming System Approach unlocks the true agricultural potential of Sunil Murmu' cultivable land

Farmer's Profile

Sunil Murmu, aged 40, is a resident of Natundihi village of Kashipur Gram panchayat in Purulia. Like most of the villagers, Sunil's principal source of livelihood is farming. Among them, Sunil is one of the farmers who has successfully adopted the Hapa Model with an integrated farming approach. The construction of Happa has not only delivered a strong impact on the livelihood security to his family but also resulted in improved productivity, intensity and diversity of crops in his farmland.

At a Glance		
Total Land Size	Adopted the Happa model	Average annual Cash earnings since adoption
3.3 acre	Year 2012	INR 46,849

The introduction of Happa has fetched significant marketable surplus and cash earnings for Sunil with his given amount of cultivable land

With limited annual rainfall coupled with the red lateritic nature of the soil, Sunil had been largely practising mono-cropping of paddy for years. The mono cropping style along with dependence of chemical fertilizers had further abated the average productivity of his farmland. Due to lack of sufficient earnings, particularly during the lean seasons he had to work as a labourer under the MGNREGA scheme. With limited cash earnings from agricultural production, he had to borrow INR 1,500-2,000 per month and pay back with a significant interest.

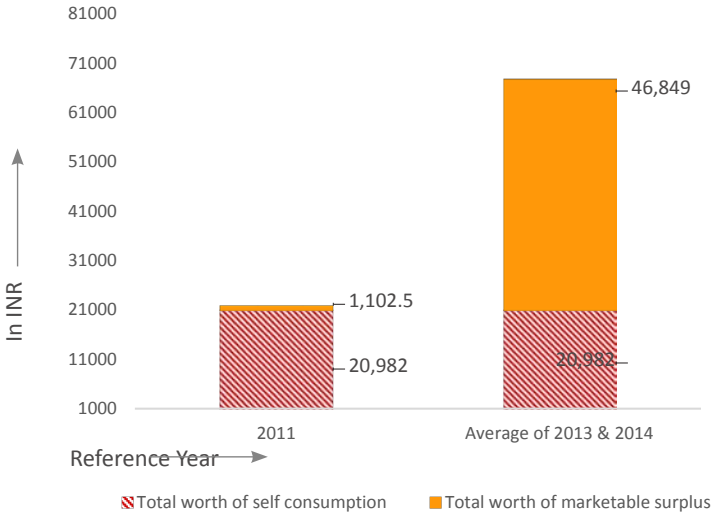
Things took a different turn in 2010, when Sunil was introduced to the Happa Model along with practice of integrated farming. In 2012, after undergoing training in DRCSC local office, the construction of Happa Model was financed by DRCSC (75% of total investment) and partly by himself (25% of total investment).

With this, Sunil has been able to grow more variety of crops (multi cropping) and also generate cash earnings which is attributable to the Happa model.

A snapshot pre IFS economic value creation and value created in average (2013-2014) Happa and IFS have created sizable market surplus

Notes:

1. *Cash earnings and worth of self-consumption is considered only for farmland; labour cost is not factored in*
2. *The worth of self-consumption is considered equivalent for year 2011 & average for years 2013 & 2014 as in both periods Sunil was able to produce for self consumption*
3. *The cash earnings in year 2011 have been adjusted to 2014 prices, Net Cash earnings of Mahadev Tudu in year 2011 was INR 1,102*
4. *The earnings do not include other income sources like daily labour*



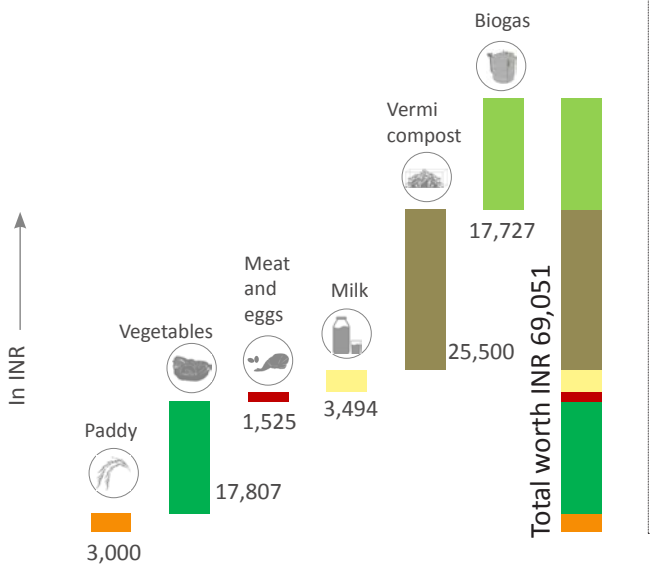
The efficient and interactive sub-systems linkage along with the Happa Model has definitive role in ensuring the long term economic viability and the growth of Sunil's farming system

The success of the Happa irrigation technique is significantly explained by the presence and the effective integration of various sub-systems in his farmland. Happa /ditch was introduced as the first sub-system followed by the other sub-systems including vermicompost, livestock and biogas.

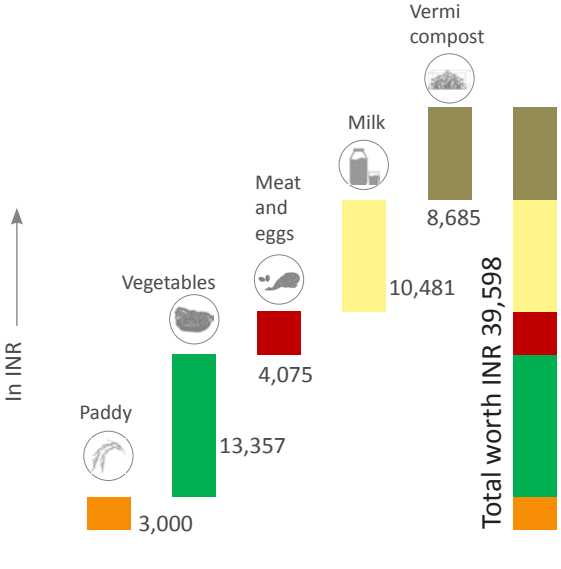
Happa plays an indispensable role in maintaining all these sub-systems given water is a critical requirement for all of them. The successful management has resulted in significant decline in cash input cost on one hand and increase in the cash earnings from each of the sub-systems.

The Happa model along with IFS model created economic value for both self consumption and marketable surplus in case of Sunil Murmu in 2013-14.

Total worth of self consumption in INR (2013-14)



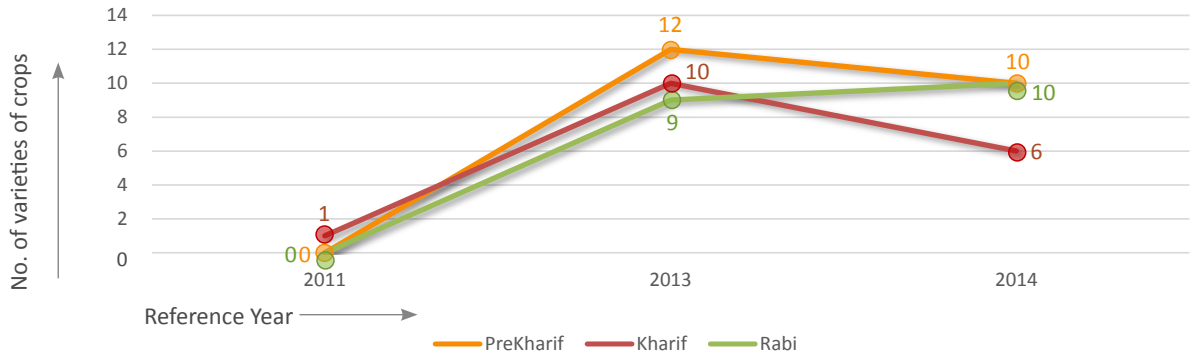
Total worth of marketable surplus in INR (2013-14)



The transitional shift from mono cropping to multi-cropping practice has enabled Sunil grow a diverse variety of crops across three cropping seasons in the year

Prior to the introduction of IFS, the only crop that Sunil used to produce is paddy. But after IFS he produces different variety of crops which he can use both for self-consumption and selling in the market. Sunil took a loan of INR 10,000 which was supported by DRCSC and also made some contribution of his own. The NPV of the entire project is now INR 2,42,997 along with 90% IRR shows the success of the Happa model along with IFS.

Happa irrigation model helps in transition from mono cropping to multi-cropping



The investment is expected to deliver an Internal Rate of Return of 91 % over a 12 year period based on his marketable surplus and will generate sufficient cash to pay back his loan

The Net Present Value of the entire project is now INR 2,42,997 along with Internal Rate of Return of 91% which shows the success of the Happa model along with IFS.

Key Investment Features	
Net Present Value	INR 2,42,997
Internal Rate of Return	91%
Assumed discount rate	12%

Critical Success factors for the Happa model

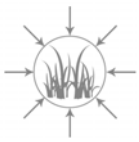
The success of the Happa model both at the individual farmer level and also at the macro level will depend on certain specific enabling factors.

Success factors

Factors	Impact
Proper assessment of farmer's profile and the farmland where Happa is to be introduced	A critical assessment of the farmer's profile both in terms of tangible and intangible attributes as site selection in the land where the Happa will be introduced is key to the success of the Happa model
Continuous handholding and monitoring support	The initial handholding support to the farmer in the initial period post introduction of Happa is crucial for the longevity and the success of the model.
A marketing arm in the 2nd year of the project to link the farmer's produce to the market and derive optimum value	A marketing outlet for linking the organic farm produce to the market will ensure that the farmers get the right value of their produce and able to generate adequate cash to pay back the loan.

Key risks to be mitigated in the Happa Irrigation model

The potential of Happa as small and sustainable irrigation systems particularly for the small and marginal farmers in the semi-arid regions is quite evident from the study. However, there are certain key risks that needs to be mitigated to ensure the model reaches to maximum number of small and marginal farmers and so that their livelihood gets transformed.

Risk	Nature	Mitigation Steps
Low cash returns in the initial years 	The initial years post adoption of Happa with an integrated farming approach fetches low marketable surplus. This is due to fact that the sub-systems requires some period of time to integrate among themselves and transition from external and chemical input based model to internal and organic based model. The low cash earnings post investment can impact the famer's commitment and motivation to continue to with the bio-integrated farming approach.	• Introduction of crops with high market value in the initial crop mix for the farmer • Regular handholding and training support from the organization(DRCSC in this case) is indispensable to keep the famer's commitment high in continuing with the IFS approach
Inefficient management of the entire farming model 	The critical success factor is the efficient management of the resource flow in the sub-systems of the farming model. Inefficiency in creating interlinkages among the sub-system can hamper the production as well increase the overall cost of the maintaining the farming system.	• Proper technical training about the science of creating the interlinkages and resource flow • Continuous monitoring support to the farmers to ensure they correctly get the fundamentals of integrated farming system
Unavailability of adequate family labour 	Among other farming approaches, Happa linked with IFS is a relatively labour intensive model. Since, labour is core input to the model, lack of it can lead to inefficient management and disintegration of the model.	• The farmer's family profile should be taken into consideration while introducing the model • Presence of atleast 2 adult family members is a necessary criteria for the amount of required labour input in the model
Low land size and Location of the land 	Land size and location of farm land are two important factors which determines the potential and scalability of Happa Model linked with an IFS model. A smaller land size (<0.5 acre) and far location of land from other subsystems and market can have a negative impact. This is due to the fact construction of with a very small land size may not be appealing idea to the farmer.	• The target farmer's should have landholding size of 0.6 acre to 1.5 acre so that marketable surplus can be produced and sub systems can feed each other

Annexure

Introducing the context of the study

The study of the economic viability and the assessment of the investment case of the Happa Irrigation Model was done through 3 case studies of farmers practising the model in the Purulia District of West Bengal.

Locational profiles

The locational profiles has been deliberately chosen from distinct agro-climatic zones within a same geographical region to assess the success of the Happa model linked with IFS model taking into consideration multiple external factors.

West Bengal Map

Study area	Physical features	Climatic features	Livelihood features
Purulia 	1.Westernmost district of West Bengal 2.Has hills, plateaus and plains 3.Soil reddish in colour with high iron content	1.Drought prone district 2.Sub-tropical climate with very high temperature in summer and low nippy temperature in winter 3.Uneven, scanty rainfall	Agriculture is the principal source of livelihood

Data Collection Methodology

- In-depth interviews with 3 farmers in Purulia district of West Bengal
- Review and verification of the farmer's diary where past season's crop-wise production volume, marketable surplus and costs were recorded
- Review of the database of DRCSC of about 50 farmers where farmer wise production and costs were recorded for the past years.

Limitations of this study

- Limited Sample size

We have analysed primarily from economic point of view and whether irrigation model makes a good investment case for small and marginal farmers. We have highlighted the detailed cases studies of those farmers who have been able to make the transition and benefitted at varied degrees of success from this transition.

Key Assumptions of the study

- The project life time of a Happa model is assumed to be 12 years with first 2 years dedicated to implementing the sub-system, which forms the basis of calculation of IRR.
- The growth rate of cash earnings is assumed to be 5%.
- The IRR analysis for the farmers presented in the case study does not include the opportunity cost of labour.
- The terminal value of the investment on the Happa model is considered to be zero.

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