CHAPTER 7

“SAWAH” EMPOWERMENT

This chapter looks at how farmers are empowered through organization and equipping them with information on modern rice production methods under the “sawah” system (formation of farmer-groups, on-the-job capacity building, organization of field days/farm tours/meetings) with the broad objective of empowering them economically and financially.

There is the need to identify communities with potential for rice cultivation

A welcome reception into a community. Such warm receptions make technology acceptance transfer easier and at a faster adoption rate.

Explaining to opinion leaders the need for the adoption of modern rice production methods (Sawah Eco-technology) that can increase productivity and empower them economically

Thorough discussion with identified communities on “sawah” system development and roles needed to be played by each (farmer groups, extension and scientists)

An expert explains to the community about "sawah" system. Such basic understanding between scientist and farmers facilitates technology transfer with faster impact on communities.

Exchange of ideas as community members ask to know more about "sawah" system and the advantages/benefits that the technology provides to farmers through empowering them economically.

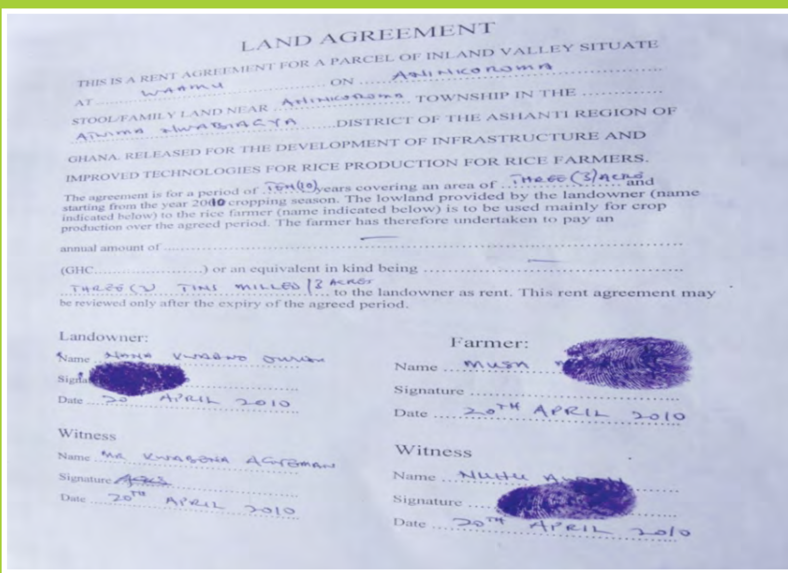
A community that has adopted "Sawah" under the Fadama Project in Nigeria and have testified to the economic benefits of Sawah Eco-technology

Women play a major role in creating the foot basket for the family. They should be involved in all discussion and technology transfer activities.

Land problems are critical in West Africa and chiefs/traditional rulers are the custodians of most lands. They need to be consulted and request for their permission, assistance and co-operation

Small surveys to know the background of potential farmers. Farmers also need to be educated and assisted to secure documented land tenancy agreements for longer periods in order to guarantee land use for technology acceptance and adoption

Land owners should be made to agree on terms of land leases through tenancy agreements which must be signed (signature/thumbprint) by land owners or their representatives



LAND AGREEMENT

THIS IS A RENT AGREEMENT FOR A PARCEL OF INLAND VALLEY SITUATE AT ....[illegible].......... ON ....[illegible].......... STOOL/FAMILY LAND NEAR ....[illegible].......... TOWNSHIP IN THE ....[illegible].......... DISTRICT OF THE ASHANTI REGION OF GHANA. RELEASED FOR THE DEVELOPMENT OF INFRASTRUCTURE AND IMPROVED TECHNOLOGIES FOR RICE PRODUCTION FOR RICE FARMERS.

The agreement is for a period of ...TEN (10)...years covering an area of ...THREE (3) ACRES... and starting from the year 2010 cropping season. The lowland provided by the landowner (name indicated below) to the rice farmer (name indicated below) is to be used mainly for crop production over the agreed period. The farmer has therefore undertaken to pay an annual amount of ....—..........

(GHC......................) or an equivalent in kind being ....—..........

...THREE (3) TINS MILLED / 3 ACRES... to the landowner as rent. This rent agreement may be reviewed only after the expiry of the agreed period.

Landowner:

Name ....[illegible]..........

Signature ....

Date ...20 APRIL 2010...

Witness

Name ...MR [illegible]...

Signature ....

Date ...20TH APRIL 2010...

Farmer:

Name ...[illegible]...

Signature ....

Date ...20TH APRIL 2010...

Witness

Name ...[illegible]...

Signature ....

Date ...20TH APRIL 2010...

A copy of a land tenancy agreement signed by the land owner

During the initial stages, farmer-groups need to be assisted with some basic tools

A village market where common and basic tools are available and assisting poor resource farmers to acquire such tools may be necessary.

The power tiller is a basic machine which is very essential for effective land preparation. Such smaller and less costly machines are preferred to heavier machinery which have high maintenance cost and are also not good for our soils.

Unveiling a new power tiller that has just been introduced to farmers in a local community in Nigeria.

Locally manufactured machines (by NCAM in Nigeria) mounted with a PTO for bund construction, promotes mechanisation.

Farmers/farmer-groups should be supported partially (e.g. credit facilities) with such machinery to empower them to produce more under improved conditions

To empower farmers to adopt modern farming methods and techniques, training on the use of introduced machinery is necessary. Training a farmer on how to operate power tiller.

A power tiller operator testing his driving skills as the machine is mounted with a trailer

Demonstrating the use of farm machinery to farmers

Testing the effectiveness and efficiency of the machine for bund construction to ease the burden on farmers of manual construction

Training the trainers (field technical staff from Togo and Benin) on Land preparation in Ghana

On-the-job training for field staff from Togo and Benin in Ghana

Training in the art of producing a fine micro-environment very conducive for rice growth

Women should not be left out in the training program for training the trainer For easy and effective technology transfer.

Farmers should be trained on not only good bund construction but also effective water management (control). A scene from Nigeria.

Empowering and encouraging farmers to become economically independent. A farmer group after a training session in Ghana

Farmers communicate easier and faster amongst themselves. Farmer-to -farmer "sawah" technology transfer is very effective as observed in Ghana.

Leveling plays a very important role in crop establishment and growth. Leveled fields provide effective water and nutrient management. A training session on field levelling in Ghana

Effective land preparation creates a very conducive environment for rice growth. A training session in Ghana, for young scientists from Nigeria

On-the-job "sawah" eco-technology training including PhD program at the National Centre for Agricultural Mechanization (NCAM) in Nigeria

The use of local materials (soil and wooden) to construct weirs/dyks through farmers' self-support for affordability and sustainability is encouraged under Sawah

On-The-Job training: "Sawah", Fadama /ADP staff and farmers in Nigeria. Such groups have started enjoying the benefits of sawah eco-technology.

Farmers day organized for farmers to observe and see for themselves yields obtained and the necessary steps to follow in the "sawah" system in Ebonyi state of Nigeria

A farmers day at Zaria, Nigeria. Farmers testify to obtaining record high yields under sawah compared to traditional methods.

Families get excited and feel empowered as 'Sawah' rice fields record exceptionally high yields

Scientists working to improve rice production through innovative research and development on "sawah" in Nigeria hold a workshop on the forward.

Training and discussion session for farmers to empower them with information on modern rice production methods (Sawah Eco-technology)

A field day for all stakeholders: farmers, scientists, policy makers, field technical and the media on “sawah” in a state in Nigeria

The press interview an expert in ecological engineering (Prof. Wakatsuki) to know more about “sawah” in Nigeria and to assist in information dissemination for the benefit of farmers.

Communication is very important in technology transfer. An extension staff talks to colleagues and farmers during training in the field

Lessons on water harvesting techniques for young scientists by Prof. Wakatsuki, in Nigeria.

Transporting farmers to observe improved production methods is one form of empowerment.
Farmers who have heard about “sawah” but yet to start adopting undertake a field tour of Sawah sites

A field tour for participants from different countries who attended the 1st international workshop on the "sawah" technology organized in Ghana

Small pump based Oasis type "sawah" development in a savanna flood plain produced paddy yield of over 7.0 t ha^{-1} at Jega, Kebbi state in Nigeria

On-the-job training has expanded to the staff of Africa Rice, Togo and Benin on various skills of "sawah" eco-technology (Afari, Ghana, Nov.2011)

Leading farmers at Afari, Kumasi, Ghana could develop more than 10ha of new "sawah" fields within 2 years using one power tiller and could produce more than 40 ton of paddy per year (Nov. 2011, Excursion at the 1st International "Sawah" workshop)

A Press interview with head of Nigerian team during a field tour for participants from different countries who attended the 1st international conference on the "sawah" eco-technology organized in Ghana

With higher paddy yields, economic returns are better as income of Sawah rice farmers is improved.

Stake holders feel and share thoughts and satisfaction among themselves as they tour "sawah" fields in Ghana during the 1st International workshop field excursion

Nutrient management (particularly mineral fertilizer use) is critical for good yields. A field tour for farmers to observe different nutrient management options which will help them to maximize yields through efficient fertilizer use.

A field day for farmers to compare crop performance under the improved system ("sawah") with the traditional method (non-"sawah") in Bida, Nigeria

Farmer to farmer empowerment. Mr. Adu Tawiah (a leading "sawah" farmer in Ghana) trained another farmer to develop 3ha of "sawah" using small spring water source. Only local farmers know such water sources.

"Sawah" fields look attractive with good crop growth, an indication of better/higher yields that will provide higher income and better living conditions.

"Sawah" fields can produce several tons of paddy per ha depending on the variety. Higher yields and good markets economically empowers farmers.

Harvesting under improved condition for good quality rice, good markets and higher Revenue/income

With good yields, farmers are empowered to produce and process under improved conditions for high quality grain.

In the rural areas, milling process is not only improved to provide quality grain with a higher market value, but by-products (husks, etc.) are used to generate extra income (sold to animal farmers) of rice farmers.

CHAPTER 8

ECONOMIC ANALYSIS OF ‘SAWAH’ ECO-TECHNOLOGY AND PROPOSED ROUTE FOR A RICE REVOLUTION IN AFRICA

Proposed road map to realize Africa Rice Green Revolution through the "Sawah" Eco-technology (site specific farmers' personal irrigated "sawah" development by farmers' self-support efforts)

(1) 1994-2002 : (10 sites, 6ha of 'sawah'): JICA/CRI & MEXT assisted 'Sawah' Project: West African wide survey on traditional rice farming and basic research on Site Specific 'Sawah' development by farmers' self support efforts at Bida in Nigeria and Kumasi in Ghana

(2) 2003-2007: (20 sites, 30ha, benchmark watershed): MEXT assisted basic research: Basic Action Research to develop Site Specific Personal Irrigated 'Sawah' development by farmers at Bida in Nigeria and Kumasi area in Ghana

(3) 2007-2011:(>100 sites, > 200ha, 'Sawah' Eco-technology): MEXT assisted specially promoted research: Kinki Univ./NCAM/Fadama III/SRI/CRI,JIRCAS,and SMART-IV:'Sawah' eco-technology establishment and to prepare large scale action research on 'Sawah' eco-technology dissemination in Nigeria, Ghana, Togo and Benin

(4) 2012-2016: (> 500 sites, > 5000ha of 'sawah' in Nigeria and Ghana respectively): 'Sawah' eco-technology and Marketable Rice Farming(SERIF) project proposal under JICA Yen /World bank loan: NCAM/Fadama/Kinki & Shimane Univ. in Nigeria, SRI/CRI/MOFA in Ghana, JIRCAS, SMART-IV and JICA-CARD; To start national and West Africa as well as SSA wide dissemination of 'Sawah' eco-technology

(5) 2017-2026: (>100,000ha of 'Sawah'): Establishment of Institutional organizations for Africa wide dissemination and endogenous 'Sawah' Eco-technology development

(6) 2027-2036: (> million ha of 'Sawah'): African wide spontaneous and rapid 'sawah' expansion and the Realization of African Rice Green Revolution: Realization of Africa's Rice Potential and Rice exportation to Asia and other part of the world (a reverse of the current situation.

Table 1 Comparison of farmers' site-specific personal irrigated 'sawah' system development and 'sawah' based rice farming ('sawah' technology) with large- and small-scale ODA-based developments, and traditional rice cultivation system in inland valleys of Ghana and Nigeria.

Item/Activity	Large-scale development	Small-scale development	'Sawah' Eco-technology	Traditional system
Development cost (US $/ha)	10000 – 30000	10000 – 30000	1000 - 3000 (10 years ago 3000-7000)	30 – 60
Gross revenue (US $/ha)†	2000 – 3000	2000 – 3000	2000 – 3000	500 –1000
Yield (t/ha)	4 – 6	4 – 6	4 – 6	1–2
Running cost, including machinery (US $/ha)	600 – 800	600 – 800	400 – 600	200 – 300
Farmer participation	Low	Medium–High	High	High
Project ownership	Government	Government	Farmer	Farmer
Adaptation of technology	Long,	Medium – short	Medium to short, needs intensive demonstration and on-the-job training (OJT) program	-
Technology transfer	Difficult	Difficult	Easy	No technology transfer
Sustainable development	Low (heavy machinery used by contractors in development)	Low – medium	High (farmer-based and small power-tiller used in development and management)	Medium
Management	Difficult	Difficult	Easy	Difficult
Adverse environmental effect	High	Medium	Environmental friendly	Medium

† Assuming 1 ton paddy is worth US$ 500; one power-tiller costs $3000-9000 in West Africa depending on the brand quality and accessories (2009 values). Selling prices, however, are $1500-$3500 for farmers in Asian countries.

Table 2 **Cost and Income (US $) of New 'Sawah' development and rice farming (Ghana and Nigeria, 2009).**

Activity	Cos/income elements, performance or durability o	Spring-based (slope 1.5%)	Floodplain-like (mean slope 0.5%)	Stream dike-based (slope 1%)	Pond-based (mean slope 1%)	Pump-based (mean slope 1%)	Non-'sawah' (mean slope 2%)
A. Sawah development activities (first year only, per ha)							
Clearing, Bunding	30–50 work-days†	200	150	150	150	150	50
Plow, Puddling, leveling	14-21 days powertiller operation	300	200	250	250	250	NA
Pumping cost	3 ha/year‡	NA	150	NA	100	450	NA
Powertiller cost §	2–3 ha/year, 6–15 ha/life	700	500	600	600	600	NA
Canal	$1000 for 100 m per ha	100	50	200	200	100	NA
Dike/weir	$400 for 20 m x 5 m x 3 m per 3 ha / 3	NA	NA	150	NA	NA	NA
Flood control	$700 for 150 m x 2 m x 2 m per 3 ha / 3	NA	300	100	NA	NA	NA
Pond construction	$1400 for 20 m x 20 m x 2 m per 3 ha / 3	NA	NA	NA	500	NA	NA
Personnel cost for on the Job training ($/ha)		Scientists/engineer ($1000/ha) , Extension officer ($500/ha), Leading farmers($250/ha)					
Cost		2300-1550	2350-1600	2450-1700	2800-2050	2550-1800	50

† 1 work-day costs $3.5.
‡ Pumping machine: 7 years life, 15% depreciation, 20% spare parts.
§ Power-tiller cost: $5000 for 3–7-year life, 20% depreciation, 20% spare parts; initial 'sawah' development claims heavy load on power-tiller, which comprises 50% of cost of development.

Table 2 continued **Cost and Income (US $) of new ‘sawah’ development and rice farming (Ghana and Nigeria, 2009) continued**

Activity	Cost/income elements, performance or durability	Spring-based (slope 1.5%)	Floodplain-like (mean slope 5%)	Stream/ dyke-based (slope 1%)	Pond based (slope 1%)	Pump based (slope 1%)	Non-sawah (slope 2%)
B. “Sawah”-based rice farming cost (first year only, per ha)							
Nursery, seed	3 work-day, 60-90kg	90	90	90	90	90	130*
Water management	20–50 work-days†	50	50	50	50	150	NA
Transplanting	15 work-days	50	50	50	50	50	NA
Weed control Herbicide	5-7 work-days	50	50	50	50	50	50
Fertilizing	3 work-days	120	120	120	120	120	NA
Bird-scaring Harvesting	20-30 work-days	80	80	80	80	80	70
Threshing	15 work-days†	50	50	50	50	50	20
“Sawah”-based rice farming cost except for training		490	490	490	490	590	270
Total cost in the first year		1790	1840	1990	2290	2290	320
Yield	4–5 t/ha	4.0	4.5	4.5	4.5	5.0	1.5
Gross income	$500/t of paddy	2000	2250	2250	2250	2500	750
Net income		210	410	310	-40	210	430

† 1 work-day costs $1.5-3.5,

*direct sowing and/ or dibbling

Although “sawah” approach gives sustainable low-cost personal irrigated “sawah” system development, which costs about 10% of ODA-based irrigated development, there may need to be special subsidization to encourage “sawah” development by farmers in the first year.

Table 3 **Cost and Income (US $) of new 'sawah' development and rice farming (Ghana and Nigeria, 2009) continued**

Activity	Cos/income elements, performance or durability	Spring-based	Floodplain-like (mean slope 5%)	Stream dyke	Pond-based	Pump-based	Non-'sawah ' (slope 2%)
C. 'Sawah'-based rice farming cost (subsequent year, per ha)							
Pump	2–10days ($15/day)	NA	50	NA	30	200	NA
Power-tiller, Plow, Puddling	10 days per powertiller 10 ha/year, life 5–7 years	150	150	150	150	130	NA
Maintenance, canal,dyke	15% of new construction	20	70	70	90	20	NA
Water management	20 –50 work-days ($3/work-day)	50	50	50	50	35	NA
Transplanting, Seed, nursery	15 work-days	100	100	100	100	100	130*
Weeding, Herbicide	5-7 work-days	50	50	50	50	35	50
Fertilizing	3 work-days	120	120	120	120	120	NA
Bird-scaring	30 - 40 work-days	50	50	50	50	50	50
Harvesting	20 - 30 work-days	60	60	60	60	60	40
**Harvester	3 - 5 work-days	100	100	100	100	100	NA
Threshing	15 - 20 work-days†	50	50	50	50	50	20
Sawah-based rice farming cost		650	750	700	750	800	250
Yield	4 - 5 t/ha	4.0	4.5	4.5	4.5	5.0	1.5
Gross income	$500/t paddy	2000	2250	2250	2250	2500	750
Net income		1350	1500	1550	1500	1700	460

† 1 work-day costs $1.5-3.5. In case of Non-'Sawah,' threshing day is less than half
*direct sowing and/ or dibbling = higher seed rate
** if harvester available we can save $10 (Harvester = Harvesting + threshing + winnowing) and get high quality market competitive grains
Once 'sawah' developed, power-tiller cost for rice farming will not be a major problem. Since farmers were well trained during the first year in difficult 'sawah' development, 'sawah'-based rice farming will be more sustainable than old-style ODA-based irrigation projects.

Table 4 Financial Analysis (US $) on 'Sawah' Eco-technology for Rice farming. (NB: Training Allowance Cost is not included.)

Items	Year 1	Year 2	Year 3	Year 4	Year 5
A. Revenue:					
4 t/ha @ US $500 per ton	2000	2000	2000	2000	2000
A. Cost of Production					
Development	1300	-	-	-	-
Operation	490	630	630	630	630
Total cost of production	1790	630	630	630	630
Gross profit/Loss (A-B)	210	1370	1370	1370	1370
Projected Cash flow					
Items	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue	2000	2000	2000	2000	2000
Total	2000	2000	2000	2000	2000
Funds application					
Cost of development	1300	-	-	-	-
Cost of operation	490	630	630	630	630
Replacement cost (Dep.)	-	-	-	-	-
Total	1790	630	630	630	630
Net cash flow	210	1370	1370	1370	1370
Cumulative cash flow	210	1580	2950	4320	5690

NPV @ 25%		Develop.	Operating	Receipt
	Year	Cost	Cost	210
	1	1300	490	1370
	2	-	630	1370
	3	-	630	1370
	4	-	630	1370
	5	-	630	1370

Summary data on past various irrigation projects in Sub-Saharan Africa funded by ODA through JICA and possibility of a dramatic reform under 'Sawah' Eco-technology

1. Lower Anambra, Nigeria: Total 22 billion Yen,≒ US $100million, 17 billion was Yen loan. Huge pump irrigation of 3850ha developed by Japanese companies, full mechanization during 1981-1989. JICA grant for technical cooperation,1989-1993. **High development cost of $30,000/ha,** Malfunction of both irrigation & mechanization since 1993. Both management and endogenous development are difficult

.2. Mwea, Kenya: 3000ha of new irrigation and 5860ha of rehabilitation during 2011-2016, 14 billion Yen loan, including planning consultancy cost of 0.7billion Yen in 1993-1996. Technical cooperation in 1989-1998 with 4billion Yen grant for rehabilitation of 5860ha. **High development cost of over $20,000/ha** and management. Difficult endogenous development.

3. JICA/MoFA Sustainable Development of Rain-fed Lowland Rice Production Project. Results so far only seem encouraging with yields of over 5t ha^{-1} recorded because it is on a micro-scale where demonstration sites are only micro-plots (0.1ha) with high cost. Net returns will therefore be very low and its economic impact negligible. Scaling up using 'sawah' eco-technology and effective collaboration in technology transfer is necessary to achieve the desired results

The target is the improvement of ODA projects by the application of 'Sawah' Technology (reduced cost and increased efficiency)

4. Proposal JICA 1billion Yen ≒ $15million, loan for 5000 ha of irrigation development within 5 years by 'Sawah' Eco-technology: 100-500 core sites, each 50-10ha 'sawah' development. Total 5,000ha, 20,000 ton of annual paddy production which is equivalent to US $10 million/year, within 5 years. 700 sets of power tillers at a cost of US $ 3million, 170 sets of small harvesters at a cost of US $ 2 million, Development logistics at a cost of $ 2.5 million, farmers training at a cost of US $ 2.5 million, Youth training at a cost of US $2.5 million, Vehicles and transport at a cost of US $ 1.5 million and Project management & consultancy at a cost of US $ 1 million.

Development cost is less than $3000/ha. Since the core sites attract 3-5 new sites, then new sites will be expand to 1500- 2500 sites. Thus endogenous development will expand at an accelerated rate.

5 Over 100,000ha of 'Sawah' development will take place from 2017-2026 through Africa wide dissemination.

6. Millions of ha of 'Sawah' development will then occur from 2027-2050 under the African wide rapid expansion and program and Realization of African Rice Green Revolution

Principles and Practices of
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