

Individual pump ownership and associated service providers in fadama irrigation in Northern Nigeria

La propriété individuelle de pompes et des fournisseurs de services dans l'irrigation fadama au Nigeria

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Abstract

A study was conducted in September 2001 to determine the impact of individual pump ownership and associated services in Northern Nigeria. The results showed that fadama farming was profitable and that individual ownership of water pumps impacted on the profit margin of the farmers. The gross margin for pump owners in the study area was by 13.7 percent higher than those of non-pump owners. The results showed that the major factors of success were pump ownership which had a correlation coefficient with gross margin ($r = 0.710$) and access to credit ($r = 0.785$). The other factors of success are the farmers' control over decisions on design and planning of irrigation infrastructure, and on crops grown. Access to inputs/spare parts and access to markets, although positively related to gross margin, had weak correlation coefficients of 0.388 and 0.335, respectively. The study concludes that individual ownership of pumps for fadama farming is profitable and sustainable and that the mode of pump acquisition could be replicated elsewhere. Ways of improving the effectiveness of the operations are suggested.

Résumé

Cet article communique les résultats d'une étude réalisée en septembre 2001 pour déterminer les impacts de la propriété individuelle de pompes dans le nord du Nigeria. On constate que l'agriculture de type fadama est profitable et que la possession de pompes influe sur la marge de profit des exploitants. La marge brute réalisée par les propriétaires de pompes dans la zone d'étude est 13,7 pourcent plus élevée que celle des exploitants qui ne possèdent pas de pompes. Les facteurs déterminants sont la propriété d'une pompe et l'accès au crédit qui sont corrélés à la marge brute, des coefficients de corrélation étant de $r = 0,710$ et de $r = 0,785$ respectivement. Le fait que les exploitants soient en plein contrôle des décisions relatives à la conception et la planification de l'infrastructure d'irrigation et aux pratiques culturales sont aussi des facteurs de réussite. L'accès aux pièces détachées et intrants, et l'accès aux marchés, bien que reliés positivement à la marge brute, n'affichent que les coefficients de corrélation faibles, de 0,388 et 0,335 respectivement. L'étude conclut que la possession de pompes conduit à une agriculture fadama profitable et durable, et que le mode d'acquisition des pompes est applicable ailleurs. Diverses suggestions en vue d'améliorer l'efficacité du fonctionnement sont enfin proposées.

1. Introduction

The development of irrigation dominated agricultural rural investment strategies in Nigeria in the 1970s and 1980s. The Government of Nigeria invested about US\$3 billion in irrigation development over a period of two decades, through the River Basin Development Authorities (RBDAs). This amount does not include the money expended on irrigation development through Agricultural Development Projects (ADPs) (Pradhan and Nwa 1993). Large, medium and small dams were constructed all over the country and these have impounded water capable of irrigating over 500,000 ha of farmland (Soribe 1993). The total irrigation potential is estimated as two million hectares. The expected returns from this investment were, however, not achieved.

The problems that were faced by the large-scale irrigation projects operated by the River Basin Development Authorities stemmed largely from the inadequate attention paid to user farmers in project formulation and implementation. This was also part of the reason why the large-scale approach to irrigation development had difficulties in making the expected impact. This led to the attention that is presently being paid to *fadama* development.

Fadama small-scale irrigation development started with the enclave ADP (Agricultural Development Project) of Bida in Niger State of Nigeria. Informal irrigation systems, based on controlled

flooding with farmers' participation were constructed. Water-control structures enabled irrigated cultivation of mainly rice and dry season vegetables. The technology also facilitated supplementary irrigation in the rainy season. Major characteristics of this method of irrigation infrastructure development, which make it popular among and acceptable by farmers, are (1) low cost, (2) farmers' involvement in development, and (3) ease of management, all of which require group activity.

Kano, Sokoto and Bauchi State ADPs started *fadama* irrigation with bunding and impounding of run-off and using residual moisture to produce a second crop. Farmers were also provided with 3-inch diesel pumps and hand pumps procured through farmer supply companies. These did not achieve the expected results. Subsequently, small portable petrol-driven pumps were introduced which could be owned and operated by individual farmers. These effectively replaced the existing *shadouf* and became popular with the farmers due to portability, convenience, ease of operation and maintenance. However, beyond 100 meters from the source of water, farmers began to encounter difficulties in conveying water. The need to explore more water sources or develop economical conveyance techniques arose.

The experts in these irrigation projects in the ADPs carried out an investigation in 1982 to ascertain the existence or otherwise of suitable shallow groundwater (aquifers) beneath these flood plains and establish appropriate technologies for exploiting them. Low cost technologies of drilling of tubewells using the same type and size of pump as owned by private *fadama* irrigation farmers were introduced. Shallow aquifer studies in the above states were then conducted to:

1. identify potentials in *fadama* for use of surface and shallow groundwater development;
2. delineate all *fadama* areas associated with surface and shallow groundwater resources in the state;
3. recommend suitable, simple and cost-effective drilling technologies for tubewell installations, along with abstraction of water.

The three ADPs have now developed substantial *fadama* lands through small-scale farmer-managed, cost-effective irrigation schemes with farmers' participation (Qamar and Tyem 1994).

1.1 Farmer-owned and farmer-operated irrigation farms using shallow wells

The irrigated area of this category of farmers is so small, often less than 0.25 ha, and is used for the cultivation of vegetable crops as against cereal crops, because of the lower value of the latter. The system is such that irrigated plots are usually very small, about 2m x 3m, and there is usually no shortage of water in the plots where crops are grown. The system is generally characterised by high conveyance losses and other wastages to which very little or no attention is paid by most farmers. More than 80,000 motorised pump-sets have been sold to farmers by ADPs alone, and it is believed that as many as that have again been sold by the private sector (FAO 1991).

The importance of the success of this type of farmer-owned and farmer-operated irrigation is that it demonstrates that farmers are prepared to make substantial capital investments (mostly without the assistance of official credit sources) to improve their farming operations when returns are high and the assets purchased are relatively easy to acquire. There appears to be no reason why farmers should not acquire larger pumping units, where situations require this, either as individuals or groups. The concept of farmers owning more permanent structures such as small headworks and canals and distribution systems would be a further step forward that justifies careful investigation and appropriate follow-up in the interest of accelerating irrigation development (FAO 1991).

Kolawole and Scoones (1994) identify land tenure system, population pressure, and environmental impact, as the factors threatening sustainability of use of *fadama* lands. Development intervention is also one such factor.

Falolu and Sangari (1994) reported that between 1983 and 1988 a total of 1,639 tubewells and 2,988 washbores were drilled and installed with fittings.

1.2 *Fadama land and irrigated agriculture development in Jigawa State*

In the area of *fadama* development about 8,000 tubewells have been constructed, out of which 6,000 have been provided with 2-inch (50 mm) petrol-driven pumps. This has facilitated the cultivation of over 5,000 hectares annually under irrigation. JARDA (Jigawa Agricultural and Rural Development Authority) had also constructed over 70 km of *fadama* access roads for ease of transportation of inputs and farm produce. The ADP had also gone into collaboration with Habib Nigeria Bank Ltd., to develop 120 hectares of *fadama* land using small-scale farmer-managed technologies. At present the state has the registration of 360 *Fadama* Users Association (FUAs), each association having at least 25 members.

2. The case study

This study was conducted to determine the impact of individual pump ownership and access to associated services on the *fadama* area.

2.1 *Methodology*

The study was conducted by taking a random sample of farmers in the study area. Each farmer gave his own individual response by answering some questions in a questionnaire. Thereafter, a checklist of questions were asked, for a collective response of members of FUAs, staff of the ADP and local mechanics.

2.2 *The study area*

Jigawa State was created in 1992 from part of the former Kano State. It lies between latitude 11°–13° north and longitude 8°–10°35' east. It covers a land area of about 24,410 km², with a human population of about 3,721,357 persons. Although most parts of the state lie within the Sudan savannah vegetation zone there are traces of guinea savannah on some parts of the southern borders of the state. The mean daily minimum and maximum temperatures are 19°C and 35°C, respectively. The rainy season lasts between June and September with an average of 644 mm rainfall per annum.

A total 70 percent of the land mass of Jigawa State is cultivated during the rainy season; bush fallows constitute about 10 percent, uncultivable land 5 percent, grazing reserves 10 percent and forest estates about 5 percent of the total. Prominent rainfed crops are millet, sorghum, cowpea, groundnuts, sesame, rice, bambara nuts, pepper, bitter melon and cotton. The State is blessed with floodplains popularly known as *fadama* lands. These floodplains are characterised by availability and accessibility to both open surface and underground water. The estimated land area under this category is about 15,000 hectares, 80 percent of which is cultivable under irrigation during the dry season between November and March.

Jigawa State has seven major irrigation schemes, one of which is the Hadejia Valley project, covering about 3,000 hectares. The major crops grown during the dry season are tomatoes, pepper, onions, wheat, lettuce, carrot, garden eggplant, maize, amaranthus and sugar cane.

2.3 *Analytical tools*

Both descriptive statistics and correlation analysis were employed in data analysis. Correlation analysis was used to study the relationship between success in use of the pumps and some variables. Success was measured by the profitability of the crops produced.

3. Results and discussion

3.1 *Socio-economic characteristics of respondents*

The socio-economic characteristics of respondents captured in this study include sex, age, level of education, membership of FUA, family size and farm size. These are presented in Table 1.

Table 1. Socio-economic characteristics of respondents.

	Variable	Frequency	Percentage
Gender	Male	34	100
	Female	0	0
Age	20 – 30	2	5.9
	31 – 40	12	35.3
	41 – 50	8	23.5
	51 – 60	8	23.5
	61 – 70	4	11.8
Level of education	Adult education	13	38.2
	Koranic	18	52.9
	Primary	1	2.9
	Secondary	1	2.9
	Tertiary	1	2.9
Family size	1 – 10	13	39.4
	11 – 20	15	45.5
	21 – 30	4	12.1
	> 30	1	3.0
Farm size	< 1 ha	13	38.2
	1 – 1.5 ha	8	23.5
	1.6 – 2 ha	9	26.5
	> 2 ha	4	11.8
Membership in FUA		34	100

From Table 1 it can be deduced that *fadama* farming is predominantly a male affair; among the sample of farmers none are female. When the age of farmers is considered, those within the age limit of 31–40 years predominate, being 35 percent of the total. This age group was then followed in equal proportion by those in the ranges of 41–50 and 51–60 years having 23.5 percent each. The younger farmers were the least involved, with just 5.9 percent, followed by those in the range of 61–70 who are 11.8 percent of the total.

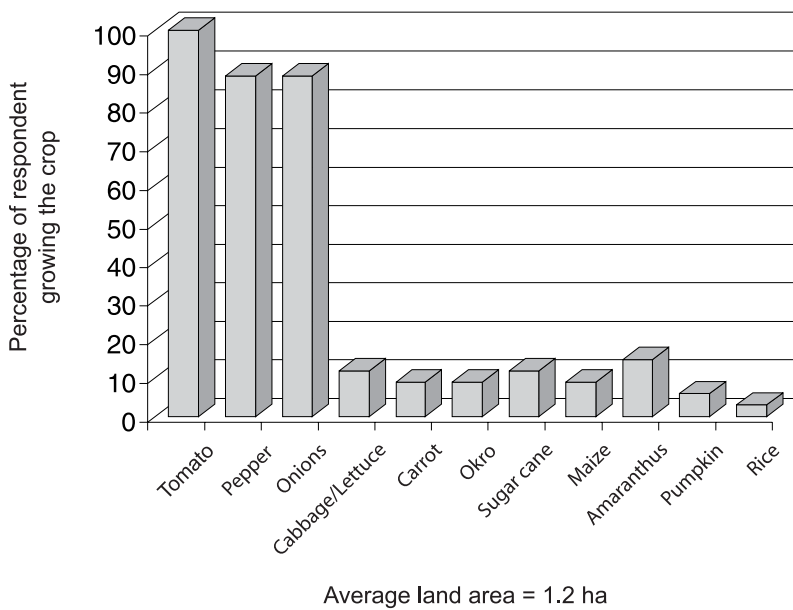
The educational levels of farmers studied was found to vary in the following order, koranic 52.9 percent, adult education 38.2 percent and primary school, secondary school and tertiary education having the least percentages of 2.9 percent each. All the farmers that responded were members of FUA, that is, 100 percent. When the family size is looked at, it was found that farmers having families with 11–20 members are the major group with about 45.5 percent, followed by those having 1–10 members, with 39.4 percent. Families that have members up to 21–30 and over 31 members were just 12.1 percent and 3.0 percent, respectively.

The farm sizes of the farmers also vary, farmers having less than one hectare predominate with 38.2 percent. This is followed by those having up to 2 hectares, 26.5 percent and those having 1–1.5 hectares, 23.5 percent. Only 11.8 percent of the farmers studied had over two hectares of *fadama* land under cultivation.

3.2 Crop production by farmers in the fadama area.

Figure 1 shows the crops that were cultivated by the farmers in the study area. All the farmers (100%) grew tomato. Other crops that are popular with the farmers are pepper and onions, grown by 88.25 percent. The fourth crop in terms of importance is amaranthus, grown by only 14.7 percent of the farmers. This was followed by sugar cane, cabbage/lettuce with 8.8 percent and 11.8 percent of farmers involved respectively. Carrot, okro and irrigated maize were cultivated by only 8.82 percent, while pumpkin and irrigated rice had the least frequency of cultivation, 5.9 percent and 2.9 percent, respectively.

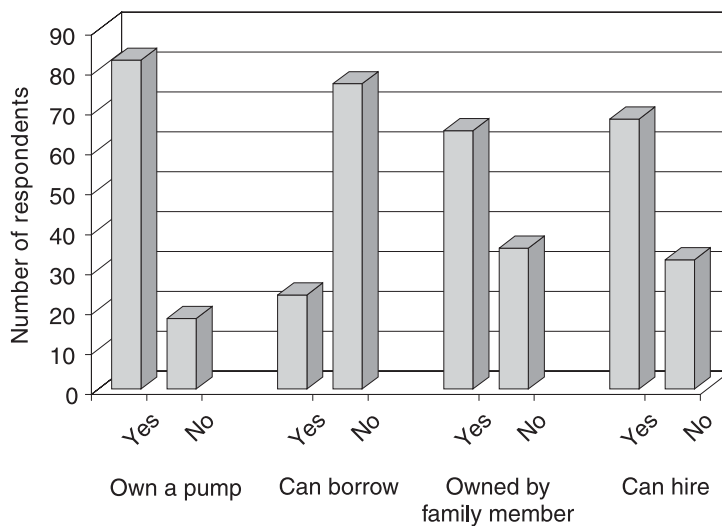
Figure 1. Crops grown under fadama cultivation in Chiyoko.



3.3 Access and ownership of individual pumps

Figure 2 describes ownership of individual pumps and access to pumps, that is, whether a farmer can easily borrow or hire a pump.

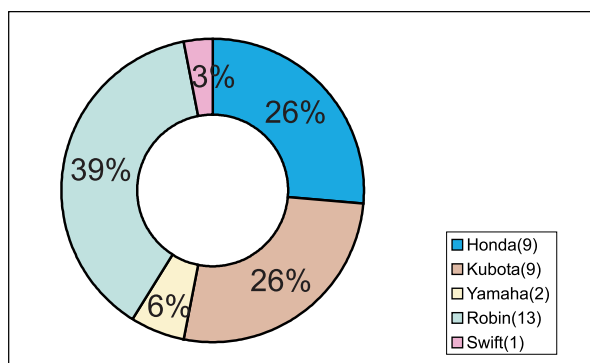
Figure 2. Access and ownership of individual pumps.



About 82.3 percent of the farmers sampled owned motorised pumps, while 17.7 percent did not. Among the farmers that owned pumps only 23.5 percent are willing to lend their pumps, while the majority, 76.5 percent do not want to lend their pumps to any body. It was also found that 67.6 percent of pump owners did not want to hire out their pumps; and only 32.4 percent was willing to hire out.

Sampled farmers in the study area use a variety of pumps for irrigating their farms (Figure 3). They are Robin, Honda, Kubota, Yamaha and Swift. Mechanics trained by ADP officials usually attend to pump problems that may arise.

Figure 3. Brands of pumps used by farmers.



3.4 Costs and returns of crop production in fadama lands

The cost and returns of *fadama* crops were computed. Two categories were studied: pump owners and non-owners. This is shown in Table 2.

Analysis of the cost and returns of the sampled farmers, for the 2000 /2001 cropping season, using the Gross margin analysis shows that the mean gross margin for pump owners was 110,586.00 Naira¹ (US\$968) while that of non-owners was N97,253.33 (US\$852). (Non-owners are farmers who do not own pumps personally, and who must therefore hire or borrow.) The level of profit of pump owners is higher than those of non-owners, thereby putting the former at a financial advantage over the latter. The income of non-owners is less, partly because the cost of hiring has to be considered; and partly because the hired or borrowed pump may not always be available when it is needed, which affects the productivity of the crops.

Most farmers indicated that *fadama* farming has enabled them to buy work bulls, pumps, or houses, while others have taken additional wives. Some have bought motorcycles and buses. A sizeable number had even gone on pilgrimage with the proceeds from the *fadama*. Further analysis shows a strong relationship between ownership of pump and gross margin ($r = 0.710$).

¹ In September 2001, US\$1 = 114.2 Naira at the bank exchange rate.

Table 2. Cost and returns (Naira/season) in Chiyoko fadama.

Cost / income item	Owners of pumps	Non-owners of pumps
Seed, fertilisers, pesticides	25,450	11,438
Farm operations	9,658	12,042
Total variable costs	35,160	22,063
Gross revenue	142,477	119,317
Gross margin	110,586	97,253

3.5 Profitability, sustainability and replicability

The data obtained and the assessment by farmers themselves indicated that the *fadama* farming is profitable. In addition, the ability of farmers to plan what to grow and the number of acres to cultivate, along with the guarantee of perennial streams in their locality and inputs availability for their production, appear to ensure sustainability of *fadama* cultivation in the area. It can also be asserted that this practice can be replicated in areas with similar *fadama* features.

3.6 Factors affecting success

3.6.1 Secure water supply

The presence of a perennial stream along the stretch of the entire *fadama* in Chiyoko (the study area) gave the assurance for a season-long secure water supply to the irrigated area. In addition, most farmers have either tubewells or washbores or even both in their farms. Table 3 gives the proportions of each.

Table 3. Proportion of tubewells and washbores among farmers studied.

	Frequency	%
Washbores	25	73.5
Tubewells	5	14.5
Open wells	4	11.8

3.6.2 Simplicity of technology

The technology of running individual pump-sets by farmers in the study area was quite simple and affordable. The operation and maintenance of the entire system is handled entirely by the farmers with ease. The farmers only sought the assistance of the local mechanic in a situation where some vital spare parts are to be replaced. Refuelling and change of engine oil at regular intervals are done by the farmers themselves.

3.6.3 Technology and crops offering high returns

Technology of crop production is being supplied mostly by extension agents of Jigawa State ADP (JARDA). The following crops were identified to offer high returns in order of priority: Tomato, pepper, onions, leafy vegetables, sugar cane, carrots and maize.

3.6.4 Control on planning, design and construction of irrigation infrastructure

The respondents participate in planning what their irrigation needs will be. The *Fadama* User Association (FUA) is the main group of farmers that liaise with the ADP for the planning and subsequently the construction of the irrigation wells on an individual farmer's field. Decisions on operation and maintenance of pumps are principally taken by the farmers themselves. They irrigate their farms using pump-sets. If problems arise with the use of pump-sets, they consult nearby local mechanics who attend to the maintenance or repair of these devices.

3.6.5 *Control on decisions affecting crop rotation, area cropped and planting date*

The farmers in the study area take decisions by themselves on the planting date, area cropped and crop rotation in line with the advice of extension staff of the ADP. Usually such decisions are guided by quality and quantity of land available to individual farmers, availability of enough capital for farming and the priorities of the farmers.

3.6.6 *Ability to size up the risks and benefits*

All the respondents in the study area indicated that they were prepared to make large capital investment to improve their farming operation. This shows that they have the ability to size up risk and benefits and can, therefore, count on themselves in order to improve on their financial position. Moreover, a large proportion of the farmers considered *fadama* farming worthwhile. Correlation analysis between ability to take risk and gross margin shows a positive but weak relationship ($r = 0.367$).

3.6.7 *Flexibility for continuously adapting their irrigation to changing situations and demand*

Most of the farmers now purchase their new pumps from the open market along with spare parts. Hitherto, farmers were supplied the pumps and spare parts by the ADP. Inputs were also purchased at the ADP. But now farmers source their inputs from the open market. This indicates the level of flexibility of farmers to changing situations and demand. Thus having realised the benefits from *fadama* farming they are willing to adapt themselves to new circumstances that prevail in order to continue cultivating their crops

3.6.8 *Availability of and timely access to credit*

Most respondents utilised the proceeds from their previous harvest as well as personal savings to finance their production. Some augment what they have with loans from friends. However, from the study carried out so far only one farmer got a loan from the Nigerian Agricultural and Co-operative Bank (NACB). Correlation analysis between access to credit and gross margin shows a positive and strong relationship ($r = 0.785$).

3.6.9 *Timely access to inputs and spare parts for maintenance*

The main problems identified with the pumps in the study area are piston and rings spoilage, valve spoilage, and frequent connecting-rod and plugs spoilage. A few of the farmers indicated problems of high fuel consumption of their pumps. All these problems are solved by mechanics located within the study area. The mechanics are trained by the ADP. The farmers indicated that the mechanics are efficient in the repair of their pumps and spare parts are usually bought in Kano by the mechanics on behalf of the farmers. Correlation analysis between availability of spare parts and gross margin shows a positive but weak relationship ($r = 0.388$).

3.6.10 *Ease of access to market*

Marketing of *fadama* crops by the farmers in the area constitutes little problem. With the exception of tomatoes all the crops are being bought on the farm or taken to nearby retail and wholesale markets. Correlation analysis between access to market and gross margin shows a positive but weak relationship ($r = 0.335$).

3.6.11 *Macro-economic and institutional environment*

The respondents indicated that the institutional arrangement for management of the *fadama* which gave them a say in decisions was more favourable to them than the previous arrangements. They were, however, unhappy that the government macro-economic policies have been counter-productive. They indicated, for instance, that they were unhappy with the removal of subsidy on inputs like fertilisers, which led to the high cost of fertilisers. The continued depreciation of the Naira and inflation have also not encouraged production.

4. Summary, conclusions and recommendations

The study indicated that 82 percent of the farmers that were interviewed are pump owners, and the acquisition of the pump had led to profitable *fadama* irrigation farming among them. Most of the people interviewed were content with what they had in terms of possession of houses, means of transportation, food reserve, etc. Some of the farmers mentioned that during peak periods of production, buyers come to the village from neighbouring states and some from faraway southern parts of the country to buy their produce. Pump ownership in the study area was initiated first by the ADP when a package was given to farmers in the form of loans, which included the construction of tubewells and washbore wells for the pump owners. Now individual farmers can buy their own pumps and maintain them. This has shown that pump ownership can be easily replicated in any *fadama* area.

Marketing of tomatoes constituted a problem to the farmers in the area. All the farmers had to contend with post-harvest loss due to poor market for their tomatoes at certain points in time during the season.

Results of correlation analysis showed strong relationships between gross margin and ownership of pump ($r = 0.710$), and between gross margin and access to credit ($r = 0.785$). Positive but weak correlation was found between gross margin and access to market ($r = 0.335$), availability of spare parts ($r = 0.388$), and ability to take risk ($r = 0.367$). This implies that pump ownership and access to credit are the most important factors that affect the profit margin, hence the success.

On sustainability of pump ownership, the study indicated that farmers can own and maintain their pumps without any difficulty. It is only in a situation where a major part is to be replaced that a local mechanic comes in. On the whole pump ownership has provided the farmer with a lot of freedom to take decisions on the design and planning of his irrigated farming activities. Such farmers find it easy to maintain their infrastructure and equipment on their own and, therefore, sustain their farming activities. In view of the fact that most pump owners find the farming business profitable, the experiences of the farmers in this study area may be replicated in other similar settings. It was also found that availability of spare parts was not a problem.

It can, therefore, be recommended that:

1. Credit facilities be made available to more *fadama* farmers so as to acquire pumps and finance their production activities with ease. The study did indicate that the majority of the farmers have little access to credit. The farmers may need the credit only at the initial stage.
2. The private sector be encouraged to establish cottage industries for fruits and vegetable processing. This will address the marketing problem of tomatoes in the area.
3. Government and the private sector endeavour to establish cold storage structures in areas of high production so as to reduce the huge post-harvest losses by farmers.
4. Government should evolve policies that will facilitate, for *fadama* farmers, the smooth flow of information, availability of production inputs including pumps, and easy access to markets where farmers can get favourable prices for their crops. This will enhance the replication of the success story in some of the *fadama* areas to other areas with similar settings and conditions.

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